

Article

Distribution of the Riparian *Salix* Communities in and around Romanian Carpathians

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Abstract: *Salix* riparian communities are particularly diverse and of extraordinary ecological importance. This study will analyze the diversity of *Salix* riparian communities (*S. alba*, *S. fragilis*, *S. purpurea* and *S. triandra*), their distribution, ecological importance, and conservation. There were 444 records for *S. alba*, 417 for *S. fragilis*, 457 for *S. purpurea*, and 375 for *S. triandra*, both from the literature and herbaria. Thus, it can be seen that the distribution of the four *Salix* species studied is very widespread throughout the territory where this study was carried out. According to EIVE (Ecological Indicator Values of Europe) but also to the national list values for niche positions and niche widths, they were noted to be very close for all ecological indicators: M (soil moisture), L (light), and T (temperature), but not for the ecological indicator of soil nitrogen (N) availability or R (soil reaction). Obviously, those riparian *Salix* communities are important for the functions they indicate, primarily for climate change mitigation, but also for regulating water flow, improving water quality, and providing habitats for wildlife. Conservation and management of these important ecosystems are necessary to maintain their biodiversity, and ecological services and strategies that can be used to protect and manage these communities are outlined.

Keywords: *Salix* communities; riparian communities; distribution of *Salix* ssp.; ecological indicators; ecological importance; conservation



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1. Introduction

Riparian communities are habitats that are located near bodies of water such as rivers, streams, ponds, lakes, and wetlands, and they are important habitats for many species of wildlife, providing shelter, food, and water sources [1–5]. They also act as buffers between land and water, filtering pollutants from the water and protecting the shoreline from erosion [6,7]. These communities' presence can help improve water quality and maintain biodiversity [8–10]. The composition of riparian communities varies greatly depending on the climate, soil type, and land use in the area [9,11]. In general, riparian communities tend to be more diverse in warmer climates and on soils with higher organic matter content [9]. In some cases, land use can have a major impact on the species composition of riparian communities, as activities such as logging, grazing, and urban development can change the vegetation structure and reduce the diversity of species [10,12]. Riparian areas contain a variety of vegetation and are important features in watersheds [3], but *Salix* species are a major component of riparian areas and provide multiple ecosystem services [6,10]. The diversity of *Salix* species is high, and about 450 species are found worldwide [4]. In many regions, multiple species coexist in riparian areas, and the composition of these communities can vary significantly between watersheds [6,7].

The genus *Salix* consists of species that occupy different ecological environments and can be broadly classified into two groups: those found near water bodies (riparian or alluvial) and those in wetland habitats [13]. The distribution of riparian *Salix* communities occur in temperate and boreal climates and are found throughout most of the northern hemisphere, where they are particularly abundant along riverbanks and streams [11]. In some areas, they

can also be found in wetlands and along lakeshores [5]. They are adapted to a wide range of soil and moisture conditions, including high water tables and seasonal flooding [2,11].

Changes in climate are predicted to have a significant impact on *Salix* communities [12], as shifts in temperature and precipitation can alter the species composition of *Salix* stands, their regeneration, and the ability of *Salix* communities to provide important ecosystem services [14,15]. As temperatures increase, the range of suitable habitats for many *Salix* species is expected to shift, with some species likely to become more dominant in northern regions and others in the southern regions [16]. Changes in precipitation are also likely to have an impact [17], as increased levels of precipitation in some areas can lead to decreased water availability in others [18,19], potentially reducing the suitability of certain habitat types for certain *Salix* species [20]. In addition, changes in fire regimes and other disturbances such as flooding, drought, and herbivory are likely to have an effect on willow communities [14,16].

Riparian habitats have received attention from researchers worldwide, including studies by Niman et al. [9], who emphasized their importance in preserving biodiversity, and by Poff et al. [6], who focused on their ecological integrity. Recent research has focused on the management and conservation of these habitats, which are considered unique and essential [8,10–12].

Recently, a study by Cannone et al. [14] found that changes in the European Alps ecosystem are taking place, with *Salix* shrubs spreading beyond their typical riparian and wetland habitats into subalpine and alpine shrublands, meadows, snowbeds, pioneer vegetation, and barren lands of the nival belt. Myklestad and Birks [21] analyzed the distribution of 65 native *Salix* species in Europe, finding a possible connection between certain habitats, altitudes, and species occurrences due to temperature tolerance. Previous studies in Romania have described *Salix* communities only in isolated areas. There is, however, a study of the distribution of the *Salix* genus nationwide [22], but the significant role of these riparian communities is overlooked in conservation and management efforts. An exception is a study that includes *Salix alba* communities together with *Populus alba* in the Natura 2000 site Muresul Mediociu-Cugir [23].

This study provides an overview of riparian *Salix* (*S. alba*, *S. fragilis*, *S. purpurea*, and *S. triandra*) communities in and around the Romanian Carpathians, including their diversity, distribution, ecological importance, and conservation. In the context of climatic changes, the role of these communities is vital for local and regional ecosystems.

2. Material and Methods

The Carpathian Mountains span across Romania and are an important mountain range in Eastern Europe. They form a natural border between Romania and its neighbors and are home to a number of unique flora and fauna [24]. The Romanian Carpathians are the source of most of Romania's rivers. The Romanian rivers network consists of a large number of rivers, including the Danube. These rivers flow through the country and form the backbone of Romania's hydrography [25].

MGRS (Military Grid Reference System) is a standardized grid system used to specify the location of points on the Earth's surface. The system divides the Earth's surface into a grid of squares, with each square identified by a unique combination of letters and numbers. The MGRS system is based on the Universal Transverse Mercator (UTM) coordinate system and is commonly used for navigation, mapping, and targeting. It provides a precise and globally consistent way of referencing locations, allowing users to quickly and accurately communicate the location of a target or objective [26]. The software that enabled these can visually present syntaxis chorology at a scale of 1:6,000,000; the map used shows the multi-year average temperature per year [27,28].

This paper gathers information from the national literature and the main herbaria from Romania [22].

Vegetation in the study area was analyzed using phytosociological methods from the Braun-Blanquet School (Zurich-Montpellier) [29]. The study focused on plant communities dominated by *Salix* species. The approach involves a systematic sampling of plant species

throughout the study area, using squares of 50 or 100 m². The squares are randomly placed in the study area, and the species encountered in each square are recorded, together with their frequency. Finally, the vegetation was classified according to EuroVegChecklist [30]. For a large number of surveys and to simplify the analysis, we use a synoptic table with constancy values coded in percentages. Using synoptic tables allows reusing published material presenting only simplified frequency class values, and we have recorded the categories as follows: V—90%, IV—70%, III—50%, II—30%, I—10%.

The research was carried out along the main watersheds of the mountain region of the Romanian Carpathians and in their surroundings. The angiosperms group taxonomy was performed according to the Euro + MedPlantBase [31] and The Plant List [32]. We used national literature as well [33].

Vegetation data were obtained from our own database but also from the literature [22].

Ellenberg has made significant contributions to the study of vegetation ecology, in particular through the Ellenberg Indicator Values [34]. However, the EIVE (Ecological Indicator Value System) is currently the most comprehensive ecological indicator system for European vascular plants. It uses consistent metric scales for niche position and width, allowing new opportunities for large-scale analysis of vegetation patterns. According to EIVE, for each of the *Salix* studied species, we considered the five dimensions: soil moisture (M), soil nitrogen (N), soil reaction (R), light (L), and temperature (T), and we calculated European values for niche position and niche width by combining values from individual EIV systems [35].

We used Microsoft Excel [36] to build and maintain our own database and Past [37] to create the graphs.

3. Results

By searching the literature in Romania, we have gathered 312 records for *Salix alba*, 269 records for *S. fragilis*, 305 records for *S. purpurea*, and 240 records for *S. triandra*. Additionally, another 132 records for *S. alba*, 102 for *S. fragilis*, 152 for *S. purpurea*, and 135 for *S. triandra* have been collected from herbaria (Figure 1).

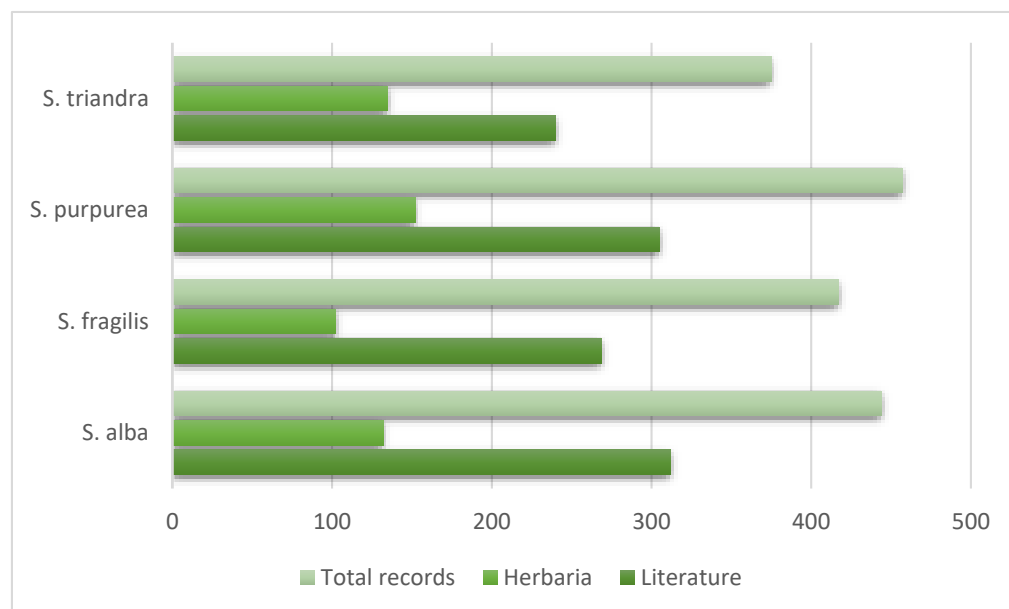


Figure 1. Number of *Salix* species records.

For a better understanding, we considered that a percentage diagram completes the overview of the distribution of studied *Salix* communities (Figure 2).

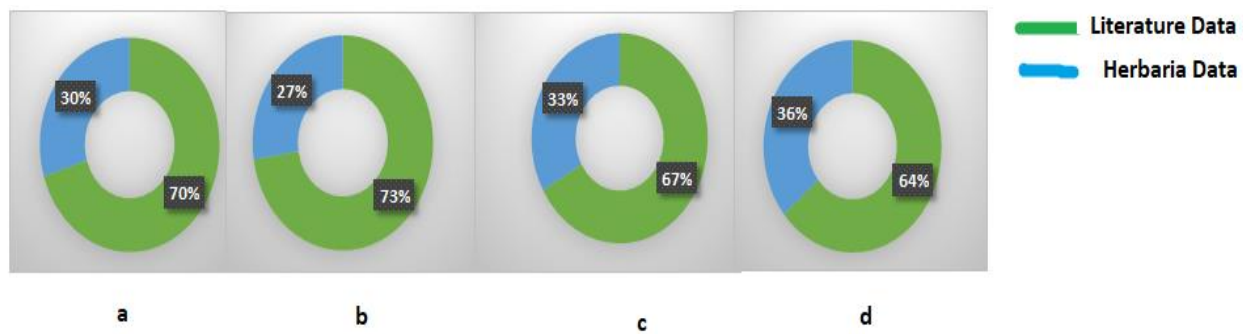


Figure 2. Data of *Salix* communities. (a) *S. alba*, (b) *S. fragilis*, (c) *S. purpurea*, (d) *S. triandra*.

Therefore, the number of records for all four species studied is much higher than the number of records in the literature (70.27% records for *S. alba*, 64.5 records for *S. fragilis*, 60.73 records for *S. purpurea*, and 64 records for *S. triandra*), and only 29.72% of the records for *S. alba*, 24.46 for *S. fragilis*, 33.26 for *S. purpurea*, and 36% for *S. triandra* were collected from herbaria.

Based on the MGRS code database collected from the literature and herbarium, we compiled distribution maps for each of the four *Salix* species studied (Figures 2–6). Our findings revealed a wide geographic range of locations where these willow species can be found. It is also observed that this wide distribution of the four *Salix* species connects different regions of the study area.

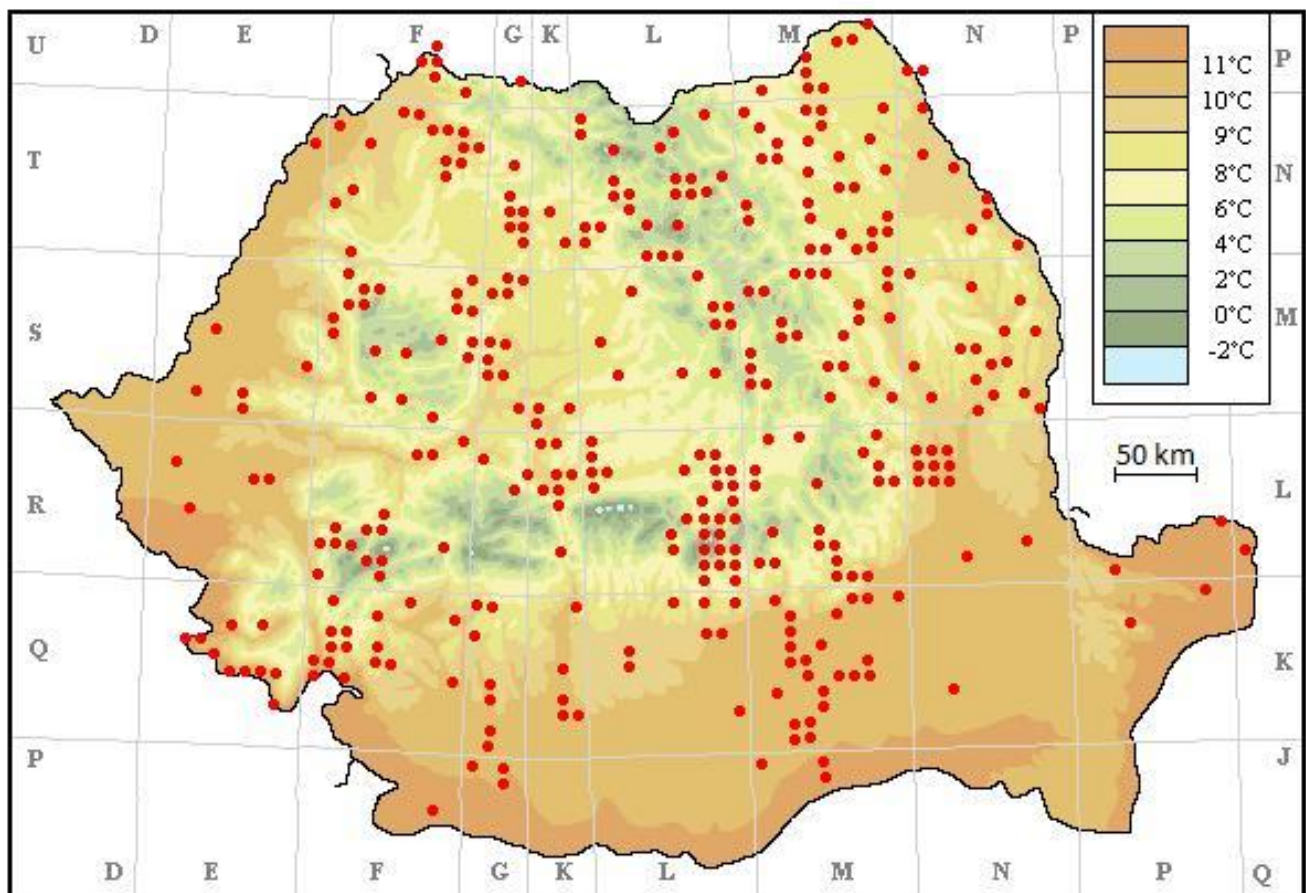


Figure 3. Distribution of ● *Salix alba* communities.

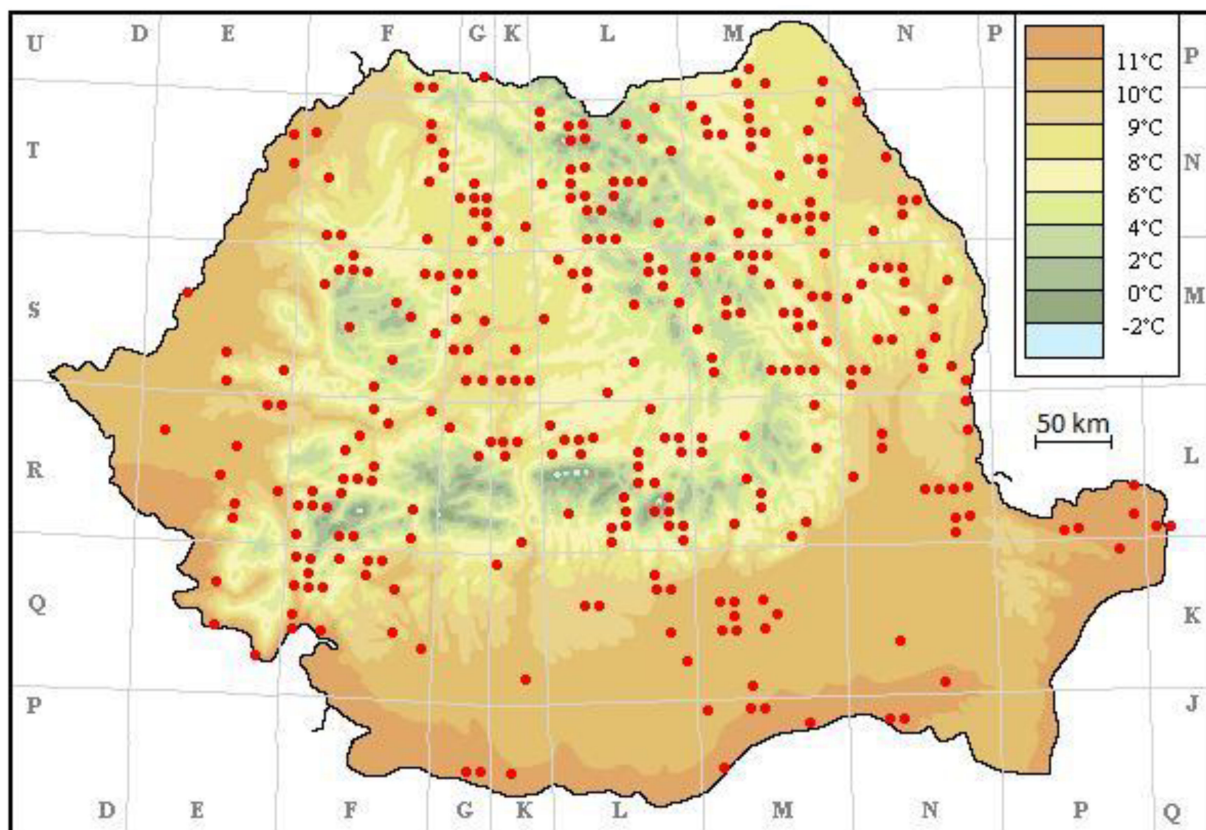


Figure 4. Distribution of *Salix fragilis* communities.

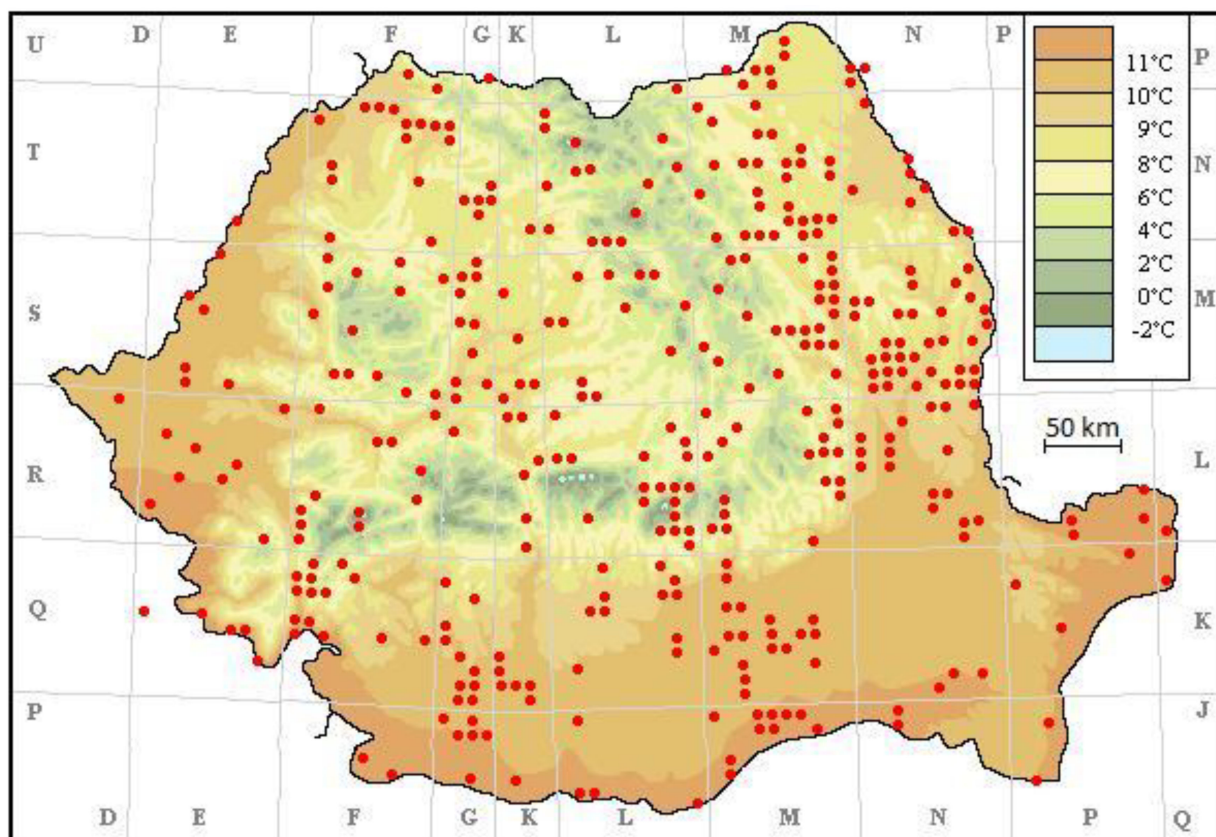


Figure 5. Distribution of *Salix purpurea* communities.

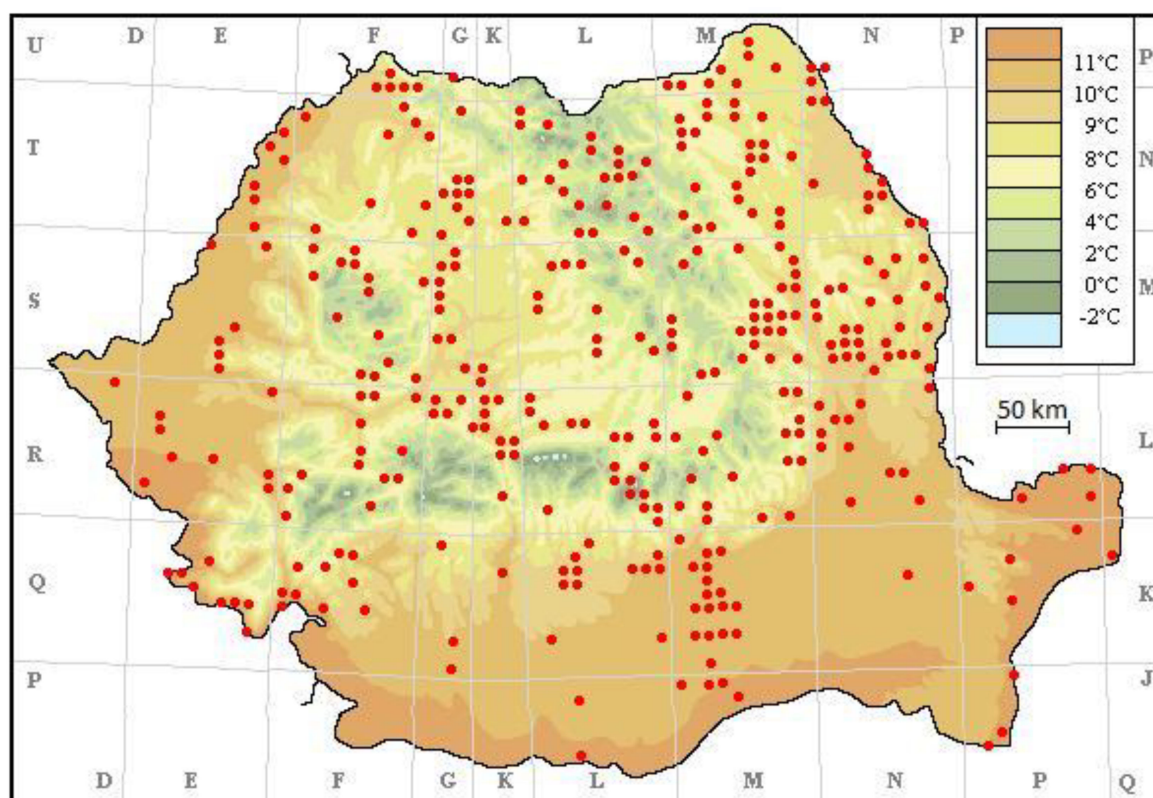


Figure 6. Distribution of ● *Salix triandra* communities.

Overall, the number of records was 444 for *S. alba* (Figure 3), 417 for *S. fragilis* (Figure 4), 457 for *S. purpurea* (Figure 5), and 375 for *S. triandra* (Figure 6).

The values for niche position and niche width by combining the values from the individual EIV systems were noted (Table 1):

Table 1. Values for niche position and niche width.

a							
<i>S. alba</i>		<i>S. fragilis</i>		<i>S. purpurea</i>		<i>S. triandra</i>	
np	nw	np	nw	np	nw	np	nw
6.5	3.1	6.7	2.5	6	4.7	6.7	2.8
7.2	4.3	6.4	2.9	5.1	5.9	5.1	5
7.9	3.9	-	-	7.9	3.5	7.5	3.2
5.8	5.8	4.5	2.8	7.8	4.3	7.5	4.4
4.8	3.7	-	-	4	3.6	3.9	3.6
b							
<i>Salix</i>	<i>S. alba</i>	<i>S. fragilis</i>	<i>S. purpurea</i>	<i>S. triandra</i>			
M	5	5	5	5			
T	3	3	3	3			
R	4	4	3.5	0			

M = ecological indicator for soil moisture; N = ecological indicator for soil nitrogen availability; R = ecological indicator for soil reaction; L = ecological indicator for light; T = ecological indicator for temperature according to a. EIVE b. national list. np = niche position indicator, nw = niche width indicator.

In analyzing the four communities, there are 419 surveys, and we have extracted the most common species found in each community from the data we hold. The analysis was performed on 150 surveys where we found *S. alba* and *S. fragilis* as the co-dominant species, 123 surveys where we found *S. purpurea* as the dominant, and 146 surveys where we found *S. triandra* as the dominant. We listed a synoptic table in Table S1. We found 189 unique species in those four communities.

4. Discussion

In our research, the diversity of riparian communities is exemplified by the presence of four species of willow shrubs belonging to the genus *Salix* (*S. alba*, *S. fragilis*, *S. purpurea*, and *S. triandra*). Phytosociologically, the communities they define belong to *Salicetea purpureae* Moor 1958 [30]. These species can be found in a wide range of ecosystems, demonstrating the versatility and adaptability of these riparian willow communities. Our study highlights the importance of these communities that can have an influential role in maintaining biodiversity and ecological balance in various habitats. Information on the geographical distribution of species is essential to understand their evolutionary history and classification within the taxonomic system. Maps of 125 *Salix* species from the North American area were produced by Argus [38] and included herbarium data. Similar to our study, it is based on thousands of verified specimens deposited in herbaria.

We found them as did many other authors, in wetland ecosystems, such as bogs, marshes, and fens, as well as along streams, rivers, and lakes [5]. *Salix* species vary in size, shape, and growth form, and they can range from shrubby and mat-forming to taller and more upright [7]. These species possess a close approximation of environmental requirements, and as a result, it is not uncommon for them to be found together in a shared habitat. This can be observed through the presence of overlapping locations on the map, which indicates that these species can occur in the same area.

Salix community distribution maps provide mean annual temperature information as shown in Figures 3–6. The purpose of including this ecological indicator was to obtain information on the temperature preferences of *Salix* species. Analyzing these maps, it is evident that these species usually live in communities that fall within the average temperature range (also evident from the list of ecological indicator values, Table 1). This suggests that temperature plays a crucial role in shaping the distribution and abundance of these communities, as observed in previous research [1]. Consequently, the decision to use mean annual temperature as an indicator for distribution maps was based on the idea that it is an important factor in understanding the distribution of *Salix* communities.

Information about the geographical distribution of species is crucial in comprehending their evolutionary history and classification within the taxonomic system. The four *Salix* species can be found in a wide range of locations within the study region, a pattern that is consistent with previous studies [39,40].

As claimed by other authors, *Salix alba* is found from Europe to Western Asia, and in the area surveyed on the riverbanks of hilly rivers [41].

Plant species commonly found in *Salix alba* communities include other willow species (*S. fragilis* [42] which can sometimes be codominant or subdominant), *Alnus incana*, *Angelica sylvestris*, *Cardamine pratensis*, *Cruciata laevipes*, *Populus alba*, *Rumex obtusifolius* (Table S1) in the study area, as mentioned by other authors [43,44]. It is also a common component of disturbed sites [45,46].

Salix fragilis is a species of willow native to North America and Europe [47]. Like many authors, we found it in moist habitats, such as wetlands, riparian areas, and meadows [48]. It is a deciduous shrub, growing to a height of up to 6 m [49].

Salix purpurea is a species of willow that is found in a variety of wetland habitats (Figure 3), including wet meadows, marshes, fens, and swamps [50,51]. It is often found in wetlands that have been disturbed by human activities, such as agricultural drainage and the construction of dams and roads [51]. *S. purpurea* communities are typically composed of a mixture of other willow species, such as *S. alba* and *S. fragilis* [52,53]. It is a fast-growing, short-lived tree that is capable of colonizing disturbed areas and forming dense thickets. The other species are *Aegopodium podagraria*, *Alnus incana*, *Calamagrostis pseudophragmites*, *Myricaria germanica*, *Salix caprea*, *S. elaeagnos*, *S. viminalis*.

Salix triandrae communities are found in a variety of habitats ranging from river banks and wetlands to alpine meadows and open forests (Figure 4) [53]. These communities are dominated by the small, deciduous willow shrub, *S. triandrae*, which often forms dense stands along streambanks and in wet meadows [54]. In addition to *S. triandrae*, these

communities contain a variety of other plant species as *Echinocystis lobata*, *Galeopsis speciosa*, *Helianthus decapetalus*, *Heracleum sphondylium*, *Morus alba*, *Populus nigra* (Table S1).

As *S. triandra* grows in dense stands, it can create an environment that is not suitable for other trees to survive in [54]. The values for niche position and niche width are very close for all ecological indicators: M (soil moisture), R (soil reaction), L (light), and T (temperature) but not for the ecological indicator for soil nitrogen availability (N) [34]. Therefore, the four *Salix* species are found in separate communities within the same riparian habitat because of their distinct ecological needs. Although most *Salix* species are able to thrive in low oxygen conditions, some may have a preference for soil with more minerals than organic matter [13].

According to the national list of ecological indicators [33], it is evident that all *Salix* riparian species in the study have the same high M and T values because they are hydrophytic and also mesothermophilic species. The value of R is different and even more different for *Salix triandra*: it prefers very acidic soils unlike *S. alba* and *S. fragilis* which are found on weakly acid-neutrophilic soils. The use of ecological indicator values of plants to indicate environmental variables such as humidity, temperature, or pH is a powerful tool for research in plant ecology. This approach can be used to detect early changes in vegetation concluded by Saatkamp et al. [55]. Temperature and moisture were the main factors influencing the composition of the sites studied using Ellenberg indicator values [56]. They are interacting factors and not independent variables [57].

To better appreciate the distribution of these *Salix* species, we have displayed the synoptic table for each community studied (Table S1).

Hence, there are common species for each of the two *Salix* communities. For example, the common species of *S. purpurea* and *S. alba* together with *S. fragilis* are *Ranunculus repens*, *Geranium robertianum*, *Solanum dulcamara*, *Glechoma hederacea*, *Crataegus monogyna* and *Acer campestre*. Similarly, common species of *S. alba* communities together with *S. fragilis* and *S. triandra*: *Cucubalus baccifer*, *Lycopus europaeus*, *Stellaria aquatica*, *Oenothera biennis*, *Sambucus nigra* and the common species of *S. purpurea* and *S. triandra* are *Petasites hybridus*, *Cirsium oleraceum*, *Agropyron caninum*, *Phalaris arundinacea*, *Veronica beccabunga*, *Epilobium hirsutum*, *Polygonum minus*.

From our studies species characteristic of the Salicetalia alliance are found in all four communities (*Populus alba*, *P. nigra*, *Calystegia sepium*, *Eupatorium cannabinum*, *Humulus lupulus*, *Rubus caesius*, *Urtica dioica*, *Lysimachia vulgaris*, *Saponaria officinalis*, *Polygonum hydropiper*). In order to fully understand the dynamics of these *Salix* communities, further research is necessary in the future.

4.1. Ecological Importance

Below, we assess the status of the analyzed communities based on their ecological significance. The more widespread *Salix* riparian communities are, the more beneficial they are for providing important ecological functions and services. The distribution maps indicate that all four species analyzed have a wide distribution throughout the area under consideration [58]. One of riparian *Salix* communities' most important ecological functions is their ability to stabilize streambanks and prevent erosion [59]. The deep roots of willow trees and shrubs help to anchor the soil and keep it in place, reducing the risk of landslides and sediment runoff [60]. This is especially important in areas where human activities, such as agriculture and urban development, have increased the risk of erosion [61].

Riparian *Salix* communities also play a critical role in maintaining water quality [56]. The leaves and branches of willow trees and shrubs act as natural filters, trapping sediment and pollutants before they can enter rivers and streams [59,62]. Moreover, the root system of these plants helps absorb and break down pollutants, reducing the risk of contamination.

In this regard, distribution maps clearly demonstrate a wide range of locations where willow species are found. This species diversity in riparian habitats provides a rich range of resources and environments for many different plant and animal species. This includes birds, mammals, amphibians, and insects. The presence of these diverse species enhances

the biodiversity and ecological richness of these habitats, which are considered important for maintaining a balanced and healthy ecosystem [63].

Climate change is significantly impacting riparian *Salix* communities [64]. For a long time, researchers have focused on clarifying the principles that govern how temperature influences the distribution of species and vegetation [55]. Rising temperatures due to climate change can lead to increased evapotranspiration, which is the loss of water from plants and the surrounding air, stressing *Salix* communities and making them more vulnerable to disease and insect invasion [65]. Furthermore, changes in precipitation patterns, such as decreasing snow cover and earlier snowmelt, can alter the timing and availability of water for willows [66], which can lead to reduced growth and survival. These impacts emphasize the need for effective management strategies to preserve these communities and their important roles in stabilizing river banks and providing habitats for a diversity of species [23,65].

4.2. Conservation

The maps display the distribution of four *Salix* in the Romanian Carpathians. It may show areas where willows are more or less abundant, as well as any patterns or trends in their distribution [67]. The map could be useful for researchers studying the ecology of the region, or for conservationists interested in preserving important habitats for willows and the species that depend on them [68].

According to the synoptic table (Table S1), there are 189 unique species in our studied communities. The Salicetalia alliance, which includes a diverse group of plant species adapted to moist and wet habitats, was found to be present in varying abundances across all the communities studied.

While Salicetalia vegetation plays an important ecological role, it is not considered to be a highly diverse plant community, and there are typically no endemic species associated with it [69]. However, one major challenge facing these communities is the presence of invasive plant species. Invasive plants can quickly outcompete native vegetation and disrupt the balance of the ecosystem, leading to negative impacts on water quality, wildlife habitat, and other ecological processes [69]. Some of the most invasive species in our studied communities but also in Southeast Europe [70] are *Amorpha fruticosa* and *Rudbeckia laciniata* (Table S1). *A. fruticosa* was introduced for ornament and land protection but has quickly spread, invading natural *Populus* and *Salix* forests, outcompeting native species, and reducing floodplain carrying capacity [71]. Interestingly, this species has been noticed to form an *amorphosum fruticosae* subassociation (Borza 1954 n.n.) Coste 1975 (Syn.: *Amorphetum fruticosae* Borza 1954 n.n.), within the association *Salicetum triandrae*, as well as in that of *Salicetum albae amorphosum fruticosae* Morariu et Danciu 1970 [72]. Similarly, *R. laciniata* is found in riparian habitats, forms dense clusters, and can outcompete native plants [71]. The presence of these invasive species can have serious implications for ecological health, and it's crucial to monitor and control their spread to protect biodiversity [7,67]. The study also highlights the decline in biodiversity data quality and the need for more resources for biodiversity research and conservation.

Salix riparian communities are vital habitats for biodiversity and ecological balance, but they are threatened by human activities, such as canalization, plant invasion, and climate change. This results in a decline in their quality and biodiversity [63]. Protecting and conserving these areas is crucial for the survival and prosperity of different species, especially *Salix alba* [70,73]. In recognition of their ecological significance, *Salix alba* and *Populus alba* galleries are part of the protected habitat in the N2000 network, which is a network of protected areas established in accordance with the EU Habitats Directive [74]. This network plays a crucial role in safeguarding the biodiversity of Europe and preserving its unique habitats and species.

According to distribution maps, there is a significant opportunity to apply the concept of creating connected riparian community corridors and enhancing habitat connectivity in the study area [75]. This will help to improve the overall health and functioning of the riparian ecosystem and enhance the resilience of these habitats to the impacts of human

activities and environmental changes [76,77]. By implementing these measures, it will be possible to conserve these vital habitats and maintain their ecological significance for future generations [3,78].

Conservation status of *S. alba* communities: Emerald: G1.11—Riverine *Salix* woodland; Table S1: *91E0 Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*); 92A0 *Salix alba* and *Populus alba* galleries.

Conservation status of *S. triandra* communities: EUNIS: F9.121: Almond willow-osier scrub MAES-2: Heathland and shrub IUCN: Temperate shrubland.

Conservation status of *S. purpurea* communities: Emerald: F9.1 Temperate and boreal riparian scrub, Table S1 of the Habitats Directive: 3230 Alpine rivers and their ligneous vegetation with *Myricaria germanica*; 3240 Alpine rivers and their ligneous vegetation with *Salix elaeagnos*.

5. Conclusions

Salix riparian communities are vegetation communities found in riparian areas [13,67] and are characterized by the growth of several species of willow, shrubs, and herbaceous plants [15]. The distribution of four *Salix* species and the communities in which they are found were analyzed. Depending on the environmental conditions, the species in a *Salix* riparian community may include one or more of the species studied (*S. alba*, *S. fragilis*, *S. purpurea*, and *S. triandra*) as well as other trees and shrubs such as *Populus alba*, *Alnus glutinosa*, *Humulus lupulus*, *Rubus caesius* [16]. In these communities, herbaceous plants such as *Urtica dioica*, *Galium aparine*, *Stellaria aquatica*, *Agrostis stolonifera*, *Ranunculus repens*, *Poa trivialis*, *Solanum dulcamara*, *Lysimachia nummularia* can also be found. [16,17].

The analyzed species have a widespread distribution in riparian habitats from studied areas and provide important ecological functions such as stabilizing streambanks and preventing erosion, maintaining water quality, and enhancing biodiversity [61]. The four *Salix* species found in a riparian habitat have different ecological needs, primarily due to differences in soil nitrogen availability (N). Despite having similar values for other indicators such as soil moisture (M), temperature (T), and light (L), they are found in separate communities. All *Salix* species are hydrophytic and mesothermophilic, with varying preferences for soil reaction (R), with *Salix triandra* preferring very acidic soils and others preferring weakly acidic to neutral soils.

Salix riparian communities are important habitats for biodiversity and ecological balance [3]. Effective management strategies are necessary to preserve these communities and their ecological roles [61]. The N2000 network, established under the EU Habitats Directive, protects these habitats and plays a major role in biodiversity conservation in Europe. Several strategies can be used to conserve these habitats, such as maintaining existing populations, restoring degraded habitats, carrying out research and monitoring, and promoting education and outreach activities. The conservation status of *S. alba*, *S. fragilis*, *S. triandra*, and *S. purpurea* communities varies and are recognized as important habitats for conservation.

Further in-depth investigations are needed to gain a comprehensive understanding of riparian habitats and the species that occupy these environments. In addition, future research efforts should also focus on other important tree and shrub species found in these habitats to expand our knowledge and improve our understanding of these important ecosystems.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/d15030397/s1>, Table S1: Synoptic table of *Salix* communities.

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