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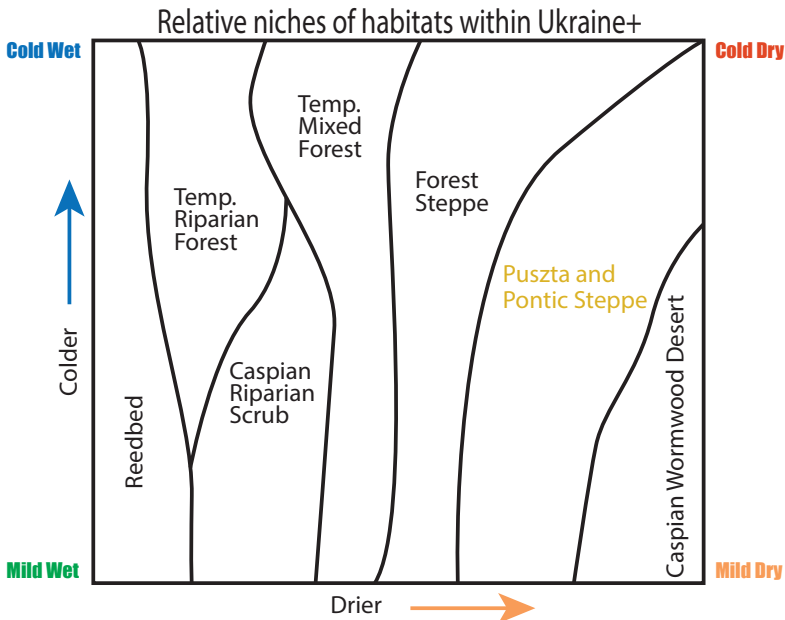
but the latitude and north–south aspect very significantly affect where the climate determines a transition to montane vegetation. The cooler montane zone has a warm-summer humid continental (Köppen **Dfb**) or subarctic (Köppen **Dfc**) climate, in which the winters are cold (av. -10 to -3°C / 14 – 27°F) and summers are cool (av. highs 15 – 20°C / 59 – 68°F). Precipitation of 600 – 1000 mm (24 – 40 in.), spread fairly evenly through the year, is ideal for **Eu1 EUROPEAN MONTANE SPRUCE-FIR FOREST** and **Eu3E EUROPEAN MONTANE MIXED FOREST**, interspersed with alpine meadows (see **Eu7B EUROPEAN TEMPERATE GRASSLAND AND SAVANNA**). Drier slopes develop extensive stands of **Eu1F EUROPEAN MONTANE PINE FOREST**. Nevertheless, the vast majority of these forests are heavily managed, and many are a far cry from natural forests.

The higher mountains above about 1800 – 2500 m (6000 – 8200 ft.) have a harsh alpine tundra climate (Köppen **ET**), in which the warmest month averages between 0 and 10°C (32 – 50°F). Summers are short and cool, and winters long and harsh with persistent snow cover and shearing winds. At these elevations, the vegetation is dominated by **Eu10F EUROPEAN ALPINE TUNDRA**. At even higher elevations, in the glacial zone, the vegetation transitions to **Eu10G EUROPEAN NIVAL ROCKY TUNDRA** with an ice cap climate (Köppen **EF**).

Conservation in the region is being led by the Nature and Biodiversity Conservation Union (NABU) (Germany), Polish Society for the Protection of Birds (OTOP), BirdLife Austria, Czech Society for Ornithology (CSO), and BirdLife Switzerland.

6 UKRAINE TO THE URALS

The vast area from w. Ukraine to the Urals and from Moscow to the Caspian Sea is a huge plain that, although under-visited by naturalists, has some very interesting habitats and is well worth exploring. Vast areas of former steppe are now Europe's wheat belt.





Rosy (Rose-coloured) Starling. © RALPH MARTIN, AGAMI

The most populous city in this vast region is Kyiv, at roughly the boundary between the forested zone of the north and the grasslands of the south. The region is predominantly a flat plain, maintained by a very long period of tectonic stability, in which there was very little uplift or erosion of the East European Craton. Most of this area was not glaciated, but it was, nevertheless, heavily influenced by the most recent glacial periods; strong, cold winds blew from the glaciers, moving silt and clay in clouds that resulted in large loess deposits, such as the Dnieper Upland near Kyiv. Soils formed on these deposits, but because the winds are relentless, they have been covered by loess deposits. A cross section through these deposits shows thin layers of palaeosols (preserved soil) dispersed between thick layers of fine silt.

The climate of the region's northern area is warm-summer humid continental (Köppen **Dfb**), with cold winter averages of -6 to -3°C (21 – 27°F), and a lot of snow is present for much of the winter. The summers are warm, with July average temperatures around 21°C (70°F) and some days exceeding 30°C (86°F). **Eu7E EUROPEAN FOREST STEPPE** develops in this zone, characterised by grasslands dotted with pockets of trees, which in the west tend to be deciduous groves, while to the east they become dominated by conifers. To the northwest of this region, the habitats are more closely associated with those of c. Europe (no. 5, above), with extensive stands of **Eu3D EUROPEAN TEMPERATE MIXED FOREST**, especially where Belarus borders Poland.

To the south and east of Kyiv, the Pontic-Caspian Plain extends from Romania, Moldova, and w. Ukraine all the way to the Ural Mountains in the east. It is hard to find a hill in this region. The climate in the west is humid subtropical (Köppen **Cfa**); winter temperatures average around freezing, and summer temperatures average 23°C (73°F). Precipitation is evenly spread throughout the year, totalling around 400 mm (16 in.). The climate in the east is humid continental (Köppen **Dfa**), with extremes in temperatures, from winter averages regularly below -10°C (14°F) to summer temperatures regularly topping 30°C (86°F). With the region's very low relief and extreme temperature gradient, there is little range for local climate variations, and hence the habitats are rather predictable. For most of the Pontic Plain, the main habitat is **Eu7C PUSZTA AND PONTIC STEPPE** with **Eu3H EUROPEAN TEMPERATE RIPARIAN FOREST** and **Eu11C EUROPEAN REEDBED** along the drainage lines. Despite trying times, the Ukrainian Society for the Protection of Birds (USPB) is working hard to try to protect birds and nature wherever possible.

The southeast of this region is where things get really interesting. The plain between the Black Sea and the Caspian Sea is flat, with a cold semi-arid climate (Köppen **Bsk**). Winters are cold and dry, with average January lows typically around -2°C (28°F). Snowfall is infrequent and does not accumulate. Summers, however, are blisteringly hot, with July averages exceeding 30°C (86°F) and temperatures occasionally topping 40°C (104°F). Most rain, which can be as low as 200 mm (8 in.) per year, occurs in the summer. The extreme climate results in the fascinating, shrubby **Eu2A CASPIAN WORMWOOD DESERT**, one of the three European desert types. Most thick vegetation is limited to ribbons of **Eu3J CASPIAN RIPARIAN SCRUB** snaking through the desert.

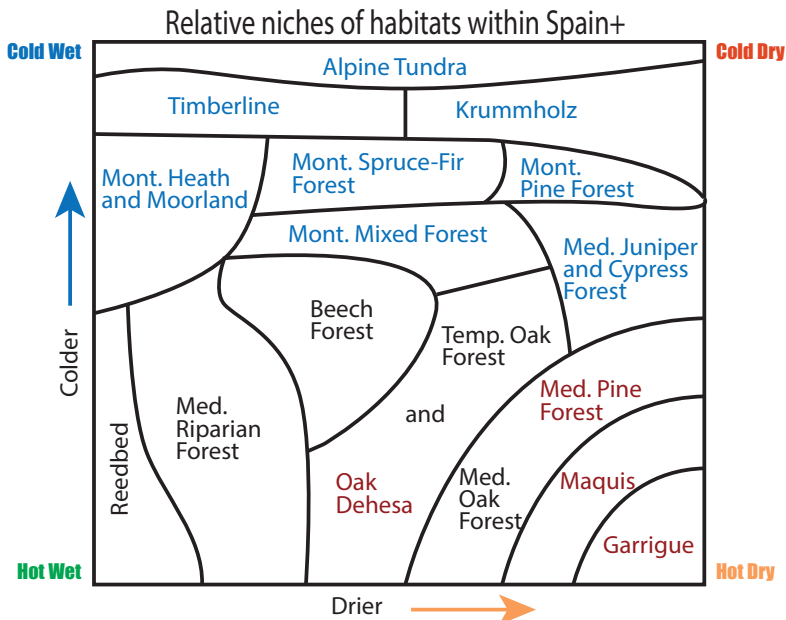
The far southeast borders on the Caucasus region along the Greater Caucasus Mountains. Lower elevations can have a warm-summer humid continental climate (Köppen **Dfb**), with mild summers, mild winters, and rainfall year-round. Conifer-dominated habitats such as **Eu1I EUROPEAN MONTANE SPRUCE-FIR FOREST** and broadleaf **Eu3A EUROPEAN TEMPERATE OAK FOREST** prevail. A fuller description of the Greater Caucasus Mountains is given in the Caucasus regional description (no. 10, below).

7 SPAIN AND PORTUGAL

The Iberian Peninsula is the first stop for many visitors taking a natural history vacation in Europe, and rightly so, because few areas combine superb birding with such delightful food, history, and cultural activities: **Eu8B EUROPEAN MAQUIS** in the morning, tapas for lunch, and **Eu6B OAK DEHESA** in the evening. The Iberian Peninsula is in the southwestern corner of Europe, comprising Spain and Portugal. It is geographically diverse, from the high Pyrenees mountains in the north through the rolling plains of the Meseta Central and down to magnificent coastal areas. The Mediterranean Sea lies to the east and south, the Atlantic Ocean to the west and north. A lesser-known mountain range in the southeast of the peninsula, the Sierra Nevada, has the highest peak in the region, at 3480 m (11,400 ft.). This geomorphological diversity significantly influences the climate and, consequently, the vegetation of the region.

The Iberian Peninsula is primarily underlain by ancient Precambrian and Palaeozoic rocks older than 250 million years. The mountains are much younger, formed when Africa crashed into Europe during the late Mesozoic–Cenozoic Alpine orogeny. Glaciation affected the highest parts of the Pyrenees and the Sierra Nevada during the Pleistocene (which ended only about 11,700 YA), leaving U-shaped valleys, moraines, and glacial cirques. Rock type has also affected topography; the limestone and dolomite formations in regions such as the Sierra Nevada are particularly susceptible to chemical weathering processes, forming karst, a terrain pocked with caves and sinkholes.

The southeast and central parts of the region mainly have Mediterranean climates with mild, wet winters and either warm (Köppen **Csb**) or hot (**Csa**) summers. There are even areas on the peninsula with a cold semi-arid climate (Köppen **Bsk**) of very hot summers and mild, dry winters; summer temperatures regularly exceed 35°C (95°F) in the Almería region of s. Spain, while less than 300 mm (12 in.) of rain falls annually. The south of the peninsula, with the cities of Málaga, Spain and Lisbon, Portugal, is dominated by Mediterranean habitats including the low **Eu8A EUROPEAN**





Eurasian Wryneck. © JACQUES VAN DER NEUT, AGAMI

GARRIGUE. This is the short, prickly, dry heathland you find in exposed locations and around many of the heavily visited archaeological sites. A very similar habitat in this region is **Eu8B EUROPEAN MAQUIS**, which generally grows on deeper, more fertile soils. Maquis vegetation, with small trees like Wild Olive, Tree Heath, and Strawberry Tree, is taller and denser.

There are many small conifer

groves in this southern region, with trees like Umbrella Pine in the **Eu1G MEDITERRANEAN PINE FOREST** and junipers in **Eu1H MEDITERRANEAN JUNIPER AND CYPRESS FOREST**. Many of these forests are managed, and the more extensive plantations can be ecological deserts devoid of all the species that make the pine forests so great for birding. Cork Oak grows naturally in communities of **Eu3F MEDITERRANEAN OAK FOREST**. To the north of this region, Madrid sits on the Meseta Central, a region offering phenomenal birding opportunities: the wide-open grasslands and

Andújar, Andalusia, Spain. © VINCENT LEGRAND, AGAMI



shrublands of **Eu7D IBERIAN STEPPE** occur in a matrix with the savannas dotted with scattered oak trees of the **Eu6B OAK DEHESA**. Iberian Steppe continues through the eastern plateau into the very dry regions of Almería. **Eu12E EUROPEAN SODA PAN AND INLAND SALT MARSH** habitat is sparsely scattered through the region, and rivers with ribbons of **Eu3I MEDITERRANEAN RIPARIAN FOREST** and **Eu11C EUROPEAN REEDBED** weave their way through the dry areas.

Eu12D EUROPEAN COASTAL SALT MARSH is found along many of the coasts behind **Eu12C EUROPEAN SANDY SHORE AND DUNE**, while a whole other world opens up offshore, with **Eu12F MEDITERRANEAN TO CASPIAN PELAGIC WATERS** in the warmer eastern waters and **Eu12G ARCTIC AND TEMPERATE PELAGIC WATERS** to the west and north.

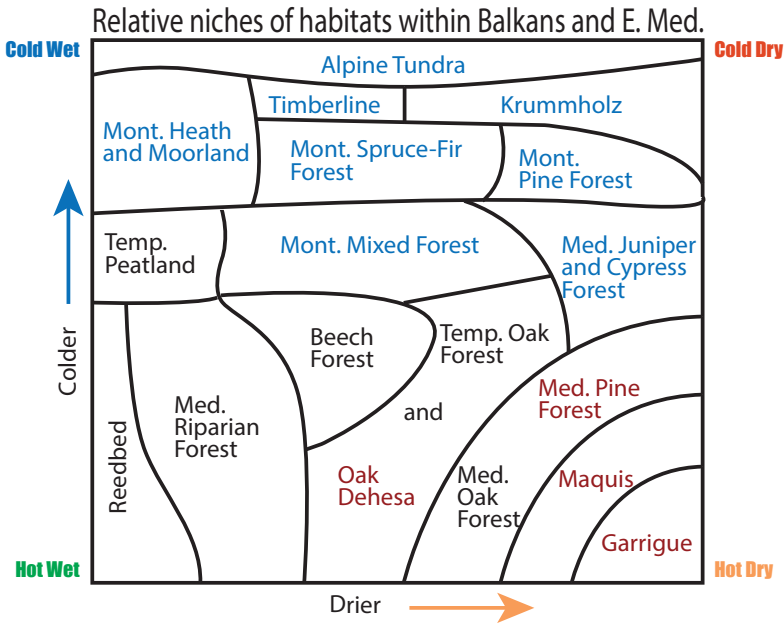
The northern and northwestern areas, like the Basque Country of Spain and n. Portugal, have **Eu12A EUROPEAN ARCTIC AND TEMPERATE ROCKY COASTLINE** and **Eu12C EUROPEAN SANDY SHORE AND DUNE**. The climate is primarily oceanic (**Cfb**), with cool summers, mild winters, and in excess of 1200 mm (50 in.) of rain per year. Temperate broadleaf woodlands grow here, especially **Eu3A EUROPEAN TEMPERATE OAK FOREST** and **Eu3B EUROPEAN BEECH FOREST**. In mid-elevation areas of the Pyrenees and the Sierra Nevada, the climate is humid continental (Köppen **Dfb**), with cold, snowy winters, cool summers, and rainfall sometimes exceeding 1500 mm (60 in.). The Sierra Nevada has both **Eu1F EUROPEAN MONTANE PINE FOREST** and **Eu1I EUROPEAN MONTANE SPRUCE-FIR FOREST**, while the Pyrenees are dominated mainly by the latter. The Pyrenees, however, do support multiple deciduous forest types such as **Eu3A EUROPEAN TEMPERATE OAK FOREST**, **Eu3B EUROPEAN BEECH FOREST**, and **Eu3E EUROPEAN MONTANE MIXED FOREST**, with **Eu7B EUROPEAN TEMPERATE GRASSLAND AND SAVANNA** in the areas between the forests. Somewhat higher elevations have a more extreme subarctic climate (Köppen **Dfc**), leading to the development of **Eu1B SUBALPINE TIMBERLINE WOODLAND**. A tundra climate (Köppen **ET**) is found even higher in the mountains, above about 2100–2300 m (6900–7500 ft.). Temperatures remain cold throughout the year, and winters have very heavy snowfalls. At these elevations, trees can no longer grow, and the landscape is dominated by the very low, shrubby or grassy **Eu10F EUROPEAN ALPINE TUNDRA**. The glacial **Eu10G EUROPEAN NIVAL ROCKY TUNDRA** develops above about 3000 m (10,000 ft.) in the ice cap climate (Köppen **EF**).

SEO/BirdLife Spain, the Portuguese Society for the Study of Birds (SPEA), and the Gibraltar Ornithological and Natural History Society are heavily involved in bird and broader environmental conservation in the region.

8 EASTERN MEDITERRANEAN AND THE BALKANS

Millions of tourists visit the incredible monuments of Italy every year, oblivious to the subtropical wonders available to be explored off the well-worn tourist paths. The mild climate of Italy and the Mediterranean region to its east offers the keen naturalist a whole suite of birds, amphibians, reptiles, and invertebrates not found in the temperate regions farther north in Europe. It can, however, be a place of heartbreaking extremes: in spring migration, thousands of birders visit places like Lesvos to marvel at the immense migration from Africa to Europe, whereas in nearby Malta, some locals take as much pleasure in killing those same birds for absolutely no purpose other than the thrill of murder itself.

While most of Italy juts into the Mediterranean, the Alps form the country's northern border and feature environments much more typical of the c. Europe region (no. 5, p.37). The Alps started forming with the collision of the African and Eurasian tectonic plates in the late Mesozoic (around 70 MYA) but only really got cranking in the Cenozoic. In the Pleistocene (2.6 MYA–11,700 YA), these mountains were covered in glaciers, which caused significant erosion and an immense weight on the land. Since the end of the last ice age, the mountains have continued to grow through the



convergence of the African and Eurasian tectonic plates as well as isostatic rebound, where the earth bulges because the weight of ice has been removed. What is also fascinating about the Alps is that they do not have volcanic activity, suggesting that they were formed purely by orogeny, in which rocks have been accreted (adhered) to the mountains and buckled, folded, and faulted rather than formed by oceanic basalts and sediments being subducted and melting below the surface. This uplift and subsequent glaciation have resulted in incredibly rugged, towering mountains with very deep valleys and a range of local climates. The mountains' lower elevations—for example, around Bolzano—have a warm-summer humid continental climate (Köppen **Dfb**), and remnants of **Eu3A EUROPEAN TEMPERATE OAK FOREST** are scattered through extensive **Eu13A EUROPEAN CROPLAND** and **Eu13B EUROPEAN URBAN ENVIRONMENTS**; and areas of **Eu3H EUROPEAN TEMPERATE RIPARIAN FOREST** and **Eu7A EUROPEAN WET GRASSLAND** can be a naturalist's delight, especially in the spring. The climate changes into the montane zone (Köppen **Dfb–Dfc**), where summers are cool, with temperatures averaging between 10 and 22°C (50–72°F), and winters are snowy and cold, with averages of –3 to 3°C (27–37°F). **Eu3B EUROPEAN MONTANE SPRUCE-FIR FOREST**, **Eu3E EUROPEAN MONTANE MIXED FOREST**, and **Eu1I EUROPEAN MONTANE SPRUCE-FIR FOREST** start to dominate at about 600 m (2000 ft.) above sea level, where they are chequered with the pastures and meadows of **Eu7B EUROPEAN TEMPERATE GRASSLAND AND SAVANNA**. The climate (Köppen **Dfc**, subarctic) turns colder with increasing elevation, and it becomes increasingly difficult for trees to grow. **Eu1B SUBALPINE TIMBERLINE WOODLAND** and **Eu1J SUBALPINE KRUMMHOLZ** establish the upper boundary above which trees are not able to grow effectively. Above this tree line, at about 1700 m (5600 ft.), the tundra climate (Köppen **ET**) allows only the shrubs and grasses of **Eu10F EUROPEAN ALPINE TUNDRA** to grow. **Eu10G EUROPEAN NIVAL ROCKY TUNDRA** is found at the most extreme of elevations and climates (Köppen **EF**, ice cap climate), typically above about 3000 m (10,000 ft.).

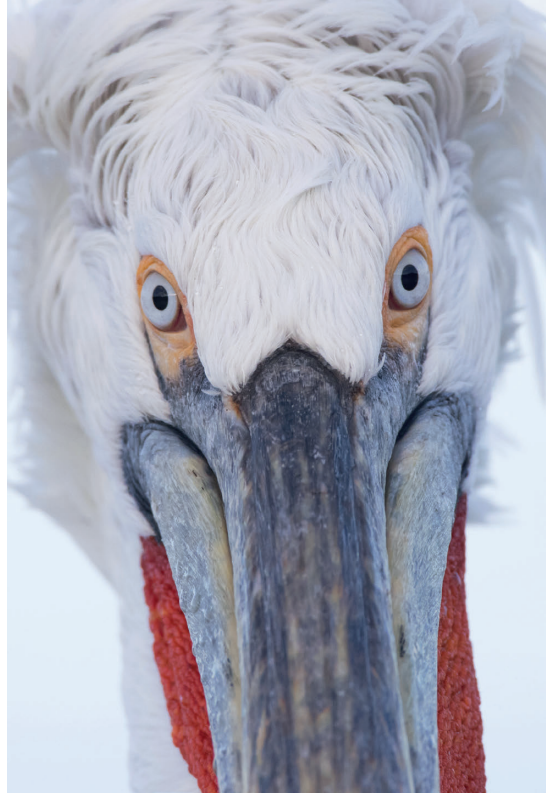
The Apennine Mountains run down the spine of Italy and are composed primarily of sedimentary rocks formed during the Mesozoic and Cenozoic eras, including limestone, marl, and sandstone.

Tectonic uplift from the collision of the African and Eurasian plates built this mountain range but also resulted in significant volcanism and the intrusion of magmas into the landscape. Active volcanoes like Mt. Etna and Mt. Vesuvius are very evident reminders of the geological forces at play in the region.

The mountains farther east, such as the Dinaric Alps of Slovenia to Albania, the Pindus Mountains of Greece, and the highlands of Cyprus, are made mainly of sedimentary rocks, such as shallow sea sandstone and limestones, but include deep-sea sediments such as flysch. All these Mesozoic rocks have been uplifted, folded, and faulted as Africa collides with Eurasia, resulting in a bit of the earth's mantle being smeared onto Europe (see Sidebar 1: Do You Want to See a Bit of the Mantle?, p.99).

The bases of these mountain ranges have Mediterranean climates, especially the hot-summer Mediterranean climate (Köppen **Csa**). Winters are mild and wet, while summers are dry and very hot, with temperatures soaring to 40°C (104°F) or above. Vegetation in these areas is very hardy, and **Eu8A EUROPEAN GARRIGUE** and the taller **Eu8B EUROPEAN MAQUIS** are both common. Conifer groves in the lowlands of the e. Mediterranean are **Eu1G MEDITERRANEAN PINE FOREST**, with trees like Umbrella Pine, or **Eu1H MEDITERRANEAN JUNIPER AND CYPRESS FOREST**. The waterlogged valleys and rivers of the region have swaths of **Eu3I MEDITERRANEAN RIPARIAN FOREST** and **Eu11C EUROPEAN REDBED** wetlands.

The slightly milder warm-summer Mediterranean climate (Köppen **Csb**) is found a bit higher in the landscape or on coasts with moderating winds. This environment supports habitats such as **Eu1G MEDITERRANEAN PINE FOREST** and **Eu3F MEDITERRANEAN OAK FOREST**. Low-lying seaboard can also have **Eu12D EUROPEAN COASTAL SALT MARSH**. Coastline habitats are **Eu12C EUROPEAN SANDY SHORE AND DUNE** or **Eu12B**



Above right: **Dalmatian Pelican.**
© MARC GUYT, AGAMI

Right: **Lesvos, Greece.**
© MARC GUYT, AGAMI



MEDITERRANEAN TO CASPIAN ROCKY COASTLINE, while extensive **Eu12F MEDITERRANEAN TO CASPIAN PELAGIC WATERS** are found offshore.

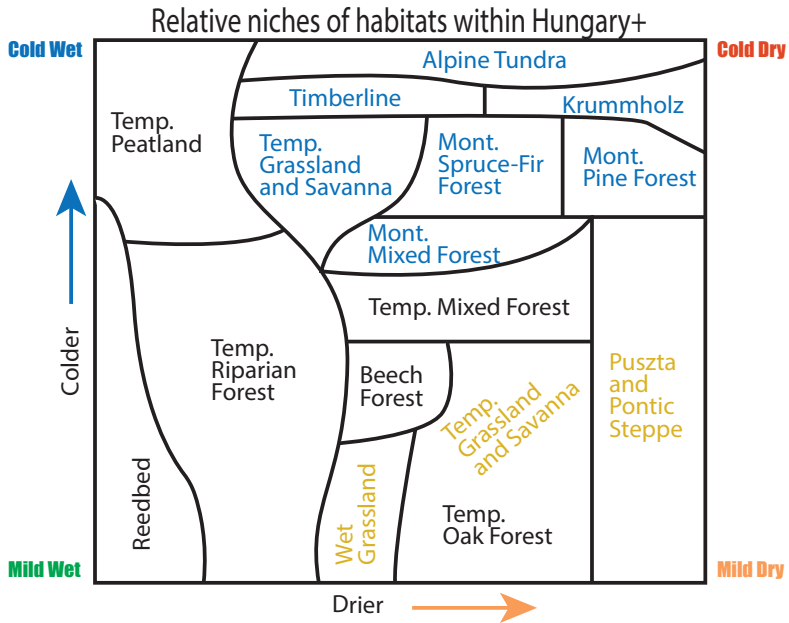
The bases of mountains in southern areas have a humid subtropical climate (Köppen **Cfa**), with hot, humid summers, mild to cool winters, and significant rainfall throughout the year. Deciduous forests such as **Eu3A EUROPEAN TEMPERATE OAK FOREST** and **Eu3B EUROPEAN BEECH FOREST** are common. Mountains in the Balkan Peninsula have a temperate oceanic climate (Köppen **Cfb**) between about 500 and 1500 m (1600–4900 ft.). The mild summers and cool, wet winters promote habitats such as the **Eu3E EUROPEAN MONTANE MIXED FOREST**. In the c. and n. Balkans, including much of Serbia and Bulgaria, the climate is warm-summer humid continental (Köppen **Dfb**), with cold, snowy winters, mild summers, and rainfall sometimes exceeding 1500 mm (60 in.). The forests are commonly coniferous, including **Eu1F EUROPEAN MONTANE PINE FOREST** and **Eu1I EUROPEAN MONTANE SPRUCE-FIR FOREST**. The higher Balkan Mountains have a subarctic climate (Köppen **Dfc**), with precipitation throughout the year and cold winters. These high slopes have **Eu1J SUBALPINE KRUMMHOLZ** interlaced with large open pastures and meadows of **Eu7B EUROPEAN TEMPERATE GRASSLAND AND SAVANNA** at somewhat lower elevations and **Eu10F EUROPEAN ALPINE TUNDRA** above the timberline. Eastern Bulgaria has a cold semi-arid climate (Köppen **Bsk**), with hot summers regularly topping 35°C (95°F) and mild, dry winters in which average January lows are typically around –2°C (28°F). Annual rainfall is typically less than 300 mm (12 in.). In addition to the Garrigue and Maquis described above, there are also extensive areas of **Eu7C PUSZTA AND PONTIC STEPPE**.

In most countries in the region, engaged and committed BirdLife International partners work tirelessly for the conservation of nature and birds, including the Lega Italiana Protezione Uccelli (LIPU) (Italy), BirdLife Slovenia (DOPPS), Association BIOM (Croatia), Centre for Protection and Research of Birds of Montenegro (CZIP), Bird Protection and Study Society of Serbia, Macedonian Ecological Society, Hellenic Ornithological Society (Greece), Protection and Preservation of Natural Environment in Albania, Bulgarian Society for the Protection of Birds, BirdLife Malta, and BirdLife Cyprus.

9 HUNGARY, SLOVAKIA, AND ROMANIA

When people visit this region, they usually spend their time in Bratislava, Slovakia; Budapest, Hungary; or Bucharest, Romania, all perched on the relatively flat plains of the Pannonian Basin, with hardly a mountain in sight. Yet this area is wrapped in the fascinating Carpathian Mountains and abutted by the captivating Transylvanian Plateau, which remain off the normal tourist or naturalist route.

The Carpathian Mountains are a prominent range that arcs through Slovakia and southeast through Romania then switchbacks to the east through s. Romania, resembling half a triangle. They are part of the Alpine–Himalayan orogenic belt, formed by the collision of the African and Eurasian tectonic plates from the late Cretaceous (~70 MYA) to the Miocene. The range comprises not only very acidic plutonic and metamorphic rocks, such as granite and gneiss, but also sedimentary rocks, such as limestone, sandstone, and shale. Adding to the complexity are significant intrusions of younger igneous rock and more recent metamorphism. During the Pleistocene, the mountains were subjected to significant glaciation and therefore have classic alpine landforms, such as cirques and steep valleys. The lower elevations and valleys of the Carpathians experience a warm-summer humid continental climate (Köppen **Dfb**), with cold winter temperatures ranging from –3°C (27°F) in the lower valleys to –15°C (5°F) in the higher valleys. The summers can be very warm and wet, seeing average temperatures reaching 20°C (68°F) and most of the annual 800–1500 mm (31–59 in.) of precipitation. The lower valleys are dominated by deciduous forests such as **Eu3A EUROPEAN TEMPERATE OAK FOREST**, **Eu3E EUROPEAN MONTANE MIXED FOREST**, and some smaller patches of **Eu3B EUROPEAN BEECH FOREST**.



Higher upslope from the valleys, above 1500 m (4900 ft.), the climate changes to subarctic (Köppen **Dfc**), with shorter growing seasons and colder winter temperatures. The summers are very mild, with temperatures rarely exceeding 20°C (68°F), even during the peak of the season. Winters can be extreme, with heavy snows and the average temperature plummeting

Eurasian Hamster. © BENCE MÁTÉ, AGAMI



to -20°C (-4°F). The harsher climatic conditions are not conducive to deciduous forests, so the mountainsides are dominated by **Eu1I EUROPEAN MONTANE SPRUCE-FIR FOREST** and mountain pastures and meadows (**Eu7B EUROPEAN TEMPERATE GRASSLAND AND SAVANNA**), though smaller pockets of **Eu1F EUROPEAN MONTANE PINE FOREST** occur. In the higher reaches, the spruce-fir forest is replaced with **Eu1B SUBALPINE TIMBERLINE WOODLAND** and **Eu1J SUBALPINE KRUMMHOLZ**. The tundra (Köppen **ET**) climate of the higher mountains is too cold for tree growth, and **Eu10F EUROPEAN ALPINE TUNDRA** is extensive in places.

The Pannonian Basin covers much of Hungary and extends into parts of Slovakia and Romania. It can be regarded as a continuation of the Pontic Plains, which extend through Ukraine and into Russia. In the late Cretaceous, as the Carpathian Mountains were being uplifted and folding, a shallow sea was opening up through continental extension. This sea was filled with thick sequences of sedimentary rocks, primarily claystone, siltstones, and sandstones derived from the erosion of the Carpathians. Since then, while other European areas have been buckled and faulted, this region has remained very stable. Not much has happened since then. The region's geomorphology has been shaped by fluvial processes, generated particularly by the Danube River, creating extensive floodplains, alluvial plains, and low hills.

Much of the central part of the region (areas such as Budapest) has a humid subtropical climate (Köppen **Cfa**), with more extremes in weather than Bratislava in the western part of the region. The c. Pannonian Basin has mild winters, with temperatures averaging -2 to 0°C (28 – 32°F), and warm summers, with temperatures often exceeding 22°C (72°F). The area is considered semi-humid, with annual precipitation between 500 and 700 mm (20 – 28 in.). Conditions get significantly drier farther to the southeast, where there is a cold semi-arid climate (Köppen **Bsk**). In the hot summers, average temperatures can top 26°C (79°F), and in the cold winters, average temperatures are between -5 and -2°C (23 – 28°F). The precipitation is low, with most of the 300–500 mm (12 – 20 in.) falling in late spring and early summer.

The natural habitat of the wide-open plains is **Eu7C PUSZTA AND PONTIC STEPPE** peppered with **Eu12E EUROPEAN SODA PAN**. Nevertheless, much of the region has been turned over to agriculture, and **Eu13A EUROPEAN CROPLAND** abounds. Streams and rivers snake through the plains and are lined with **Eu3H EUROPEAN TEMPERATE RIPARIAN FOREST** as well as some fantastic, extensive **Eu11C EUROPEAN REEDBED** habitat. The hills rising in the salt-laden plains have deeper,

more nutrient-rich soils and are blanketed in **Eu3A EUROPEAN TEMPERATE OAK FOREST** and **Eu3B EUROPEAN BEECH FOREST**.

The Transylvanian Plateau had a similar history to the Pannonian Basin during the late Cretaceous and early Cenozoic, forming limestones, sandstones, and claystones, as well as freshwater lacustrine deposits. However, it differs



Small river snaking through the Hungarian steppe. © IAIN CAMPBELL, TROPICAL BIRDING

in that during the Miocene (23–5 MYA), this area experienced intraplate volcanism, a rare form of volcanic activity that occurs within a tectonic plate rather than at plate boundaries. Here, magmas intrude along older tectonic structures, such as fault lines, rather than forming a hotspot volcano (think Hawaii) or a volcano in a subduction zone (think Mt. Fuji). The resulting uplands are now a mixture of unfolded sedimentary rocks and volcanic rocks such as basalts and andesites, which form the bedrock of nutrient-rich soils.

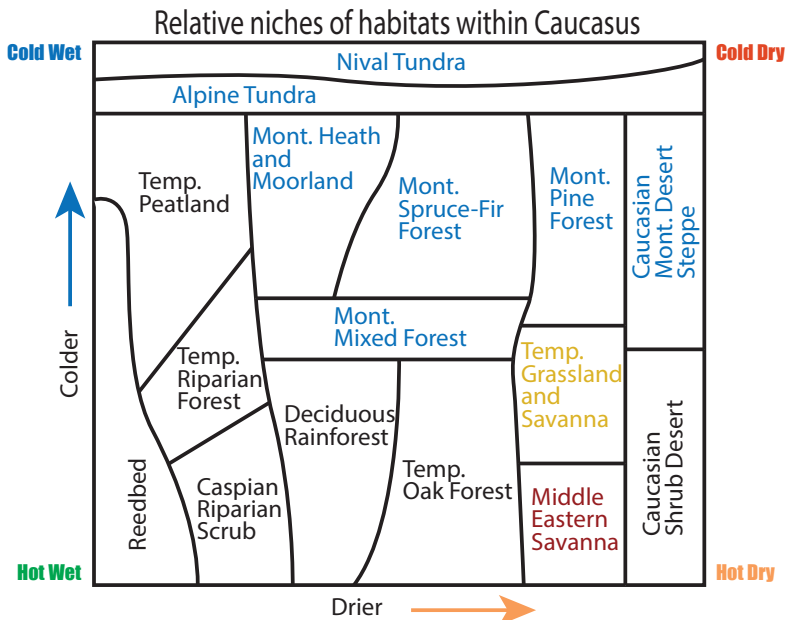
The climate at lower elevations on the Transylvanian Plateau is mainly temperate oceanic (Köppen **Cfb**), with mild summers and cool winters. Precipitation is evenly distributed throughout the year. This climate and the fertile soils promote **Eu3A EUROPEAN TEMPERATE OAK FOREST** and **Eu3B EUROPEAN BEECH FOREST** mixed with **Eu7B EUROPEAN TEMPERATE GRASSLAND AND SAVANNA** and **Eu7A EUROPEAN WET GRASSLAND**. At slightly higher elevations on the plateau, the forests of the warm-summer humid continental climate (Köppen **Dfb**) resemble those of the Carpathians, with extensive **Eu1 EUROPEAN MONTANE SPRUCE-FIR FOREST**, **Eu1F EUROPEAN MONTANE PINE FOREST**, and **Eu3E EUROPEAN MONTANE MIXED FOREST**.

Magyar Madártani és Természetvédelmi Egyesület (MME) (Hungary), BirdLife Romania (SOR), and BirdLife Slovakia (SOS) are some of the most important conservation organisations in the region.

10 THE CAUCASUS

The Caucasus region, encompassing Azerbaijan, Georgia, and Armenia, lies in the extreme southeast corner of Europe, where it is affected by many significant Asian elements and influences. The mélange of western and eastern habitats makes it one of the most intriguing regions in the world and a must-see for people with an interest in Eurasian biogeography.

Stretching between the Black and the Caspian Seas, this region is dominated by two parallel west–east mountain ranges: the Greater Caucasus and the Lesser Caucasus. The Greater Caucasus





Fire-fronted Serin.

© DAVID MONTICELLI, AGAMI

stretches from the Black Sea coast in Georgia to the Caspian Sea in Azerbaijan, forming a natural border with Russia. It has many of Europe's highest peaks, including Mounts Elbrus (5640 m/18,500 ft.) and Shkhara (5200 m/17,000 ft.). The Lesser Caucasus lies farther south, roughly aligning with the border between this region

and Türkiye and Iran. It is much lower than the Greater Caucasus, with only a few peaks over 3700 m (12,000 ft.). These mountains have created some wildly different climates within the small area of the region. The higher mountains have tundra and ice cap climates (Köppen **ET** and **EF**), with habitats such as **Eu10F EUROPEAN ALPINE TUNDRA** and **Eu10G EUROPEAN NIVAL ROCKY TUNDRA**. These are the areas where birders search for localised species such as the Caucasian Snowcock. **Eu1B SUBALPINE TIMBERLINE WOODLAND** grows at slightly lower elevations, but the climate is still subarctic (Köppen **Dfc**), with cold winters and precipitation throughout the year. As with the other mountain ranges of Europe, lower levels can have temperate climates, with mild summers and winters and year-round precipitation (Köppen **Dfb**). This montane zone is dominated by coniferous forests, especially **Eu1 EUROPEAN MONTANE SPRUCE-FIR FOREST**.

The (relative) lowlands between the two Caucasus ranges span from the Black Sea to the Caspian Sea. The lowlands of the Rioni River valley and the bases of the ranges along the Black Sea coast in w. Georgia are dominated by fertile plains, most of which have been cleared. Nevertheless, some areas of **Eu11C EUROPEAN REEDBED**, **Eu31 MEDITERRANEAN RIPARIAN FOREST**, and patches

Mud volcano, Azerbaijan. © IAIN CAMPBELL, TROPICAL BIRDING



of other forest types remain. At the base of the Caucasus ranges, particularly the Lesser Caucasus, there is a huge amount of orographic rainfall, derived from clouds formed above the Black Sea. The very wet oceanic climate (**Cfb**) has warm summers, cold winters, and a staggering 4500 mm (175 in.) of annual rainfall in places. These conditions allow for the formation of Colchic Forest, a type of **Eu3C EUROPEAN DECIDUOUS RAINFOREST**. These forests are reminiscent of an Andean cloudforest in summer, but winters are snowy, and the trees become largely leafless. The sister rainforest habitat—Hyrcanian Forest—occurs on the Azerbaijan–Iran border at the base of the Talish Mountains. The canopies of these two forests are similar, but they have different understoreys.

Towards the Caspian Sea, the Kura–Aras valley, in sharp contrast with the westerly sloping Rioni valley, is dominated in the uplands by arid habitats such as **Eu2C CAUCASIAN MONTANE DESERT STEPPE**, much of which has been turned over to agriculture. Nevertheless, farming practices are usually artisanal, so the boundaries between the original steppe and modified habitats are not as stark as in other parts of Europe, where the steppe has been obliterated. Most visitors will be amazed at how intact the habitats appear to be. Closer to the Caspian Sea is one of the two European lowland deserts, the **Eu2B CAUCASIAN SHRUB DESERT**. Visitors can see not only Goitred Gazelle here but also fantastic petroglyphs and amazing mud volcanoes. The lowlands of Azerbaijan also have **Eu3J CASPIAN RIPARIAN SCRUB**, a habitat that continues around the Caspian Sea and along the northern side of the Tian Shan mountains all the way to Mongolia.

The Society for Nature Conservation (SABUKO) (Georgia) and the Foundation for the Preservation of Wildlife and Cultural Assets (FPWC) (Armenia) are two of the most important conservation organisations in the region.

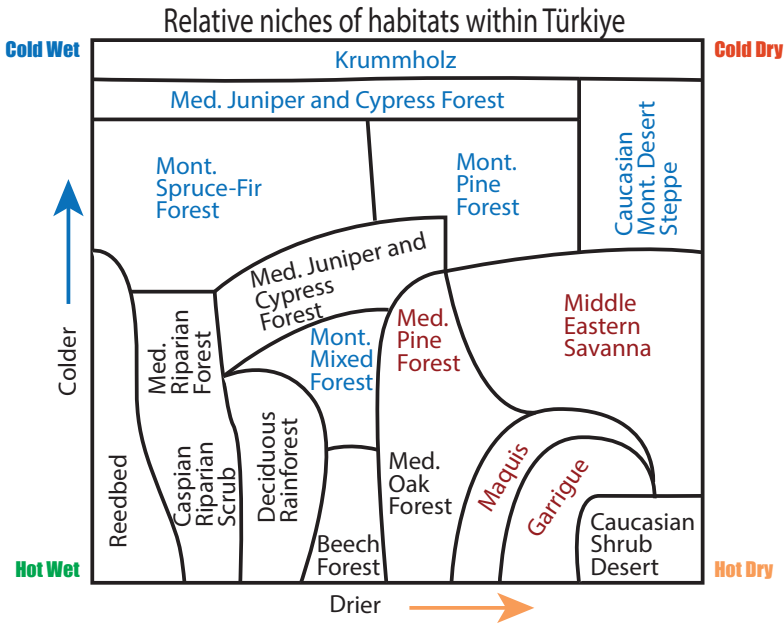
11 TÜRKIYE

Türkiye is a must-see country for naturalists, and it is a travesty that it is not much better known. A simple north–south trip in the east of the country will span many life zones, but most people, including nature lovers, do not see beyond Istanbul, the beaches of the southwest, and a quick visit to Cappadocia.

To even attempt to understand the habitats of Türkiye, we need to take a step back and consider the geology and geomorphology of the diverse region. Türkiye is said to be the crossroads of Europe and Asia, but even this is an artificial concept (see Sidebar 3: The Illusion of Europe, p.197). Türkiye is on the Anatolian microplate, which has been a firm part of a stable Eurasia since Europe and Asia became one around 420 MYA. The recent pounding from Africa has shaped Türkiye more.

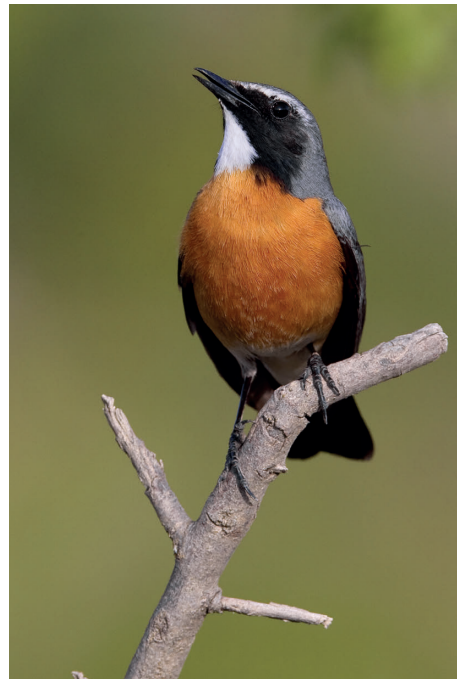
The Taurus Mountains in the south and the Pontic Mountains in the north are major orogenic belts, formed by collision and convergence as Africa crashes into Eurasia. The Taurus Mountains were uplifted mainly between the Palaeogene and Neogene (66 to ~2.6 MYA) but continue to lift today, albeit only 2.5 mm (0.1 in.) per year. As the Tethys Sea closed, the carbonate platforms were uplifted and folded, creating significant topographic relief in the south of Türkiye. At the same time, the subduction of the Tethys Sea under the Anatolian microplate pushed oceanic crust under Türkiye. This then melted, and volcanoes popped up into the Mesozoic–Cenozoic sedimentary rocks that had been accreted to (scraped onto) the Eurasian plate. This caused volcanic activity and the subsequent formation of the Pontic Mountains in n. Türkiye. The formation of the Pontic Mountains is more analogous to that of the South American Andes than Asia's Himalayas. Between the Taurus and Pontic ranges is a stable uplifted block called the Central Anatolian Plateau, a high-elevation region that is largely flat with low volcanoes.

The consequent diverse geomorphology has resulted in a variety of climates within Türkiye and a very wide range of habitats. The western parts of the country, especially around the Mediterranean



coastlines of Istanbul and Antalya, have a hot-summer Mediterranean climate (Köppen **Csa**). Summers are dry, with average temperatures exceeding 30°C (86°F). Winters are mild, usually 5–15°C (41–59°F), with annual rainfall around 1100 mm (43 in.). The widespread shrubby habitat typically encountered on the headlands and at archaeological sites is **Eu8A EUROPEAN GARRIGUE**, while the taller **Eu8B EUROPEAN MAQUIS** occurs on more protected sites. A little higher in the landscape, the climate changes to a warm-summer Mediterranean climate (Köppen **Csb**), which is similar to **Csa** but with milder summers; it tends to support habitats such as **Eu1G MEDITERRANEAN PINE FOREST** and **Eu3F MEDITERRANEAN OAK FOREST**. The Mediterranean areas are dissected by many rivers lined with **Eu3I MEDITERRANEAN RIPARIAN FOREST** and **Eu11C EUROPEAN REEDBED**.

The Pontic Mountains can receive a lot of moisture from the Black Sea, resulting in a humid subtropical climate (Köppen **Cfa**) on the coast and an oceanic climate (Köppen **Cfb**) a little higher in the mountains. Both areas have mild but very wet winters, with rainfall often



White-throated Robin. © DANIELE OCCHIATO, AGAMI

exceeding 2000 mm (80 in.), though the areas with a **Cfa** climate have hot summers, and those with **Cfb** climate have mild summers, with temperatures rarely topping 22°C (71°F). With these warm, wet climates, it is not surprising that **Eu3C EUROPEAN DECIDUOUS RAINFOREST** occurs here.

The mid-elevations of Türkiye's mountain ranges have a warm-summer humid continental climate (Köppen **Dfb**). Summers are mild, with average highs of 15–22°C (59–71.6°F), and winters snowy and cold, with temperatures regularly dropping below freezing. Farther upslope, the climate changes to subarctic (Köppen **Dfc**), with very cold winters and snow that stays for protracted periods. These regions are dominated by **Eu1I EUROPEAN MONTANE SPRUCE-FIR FOREST** and **Eu1F EUROPEAN MONTANE PINE FOREST**, although cleared areas can also have **Eu7B EUROPEAN TEMPERATE GRASSLAND AND SAVANNA**.

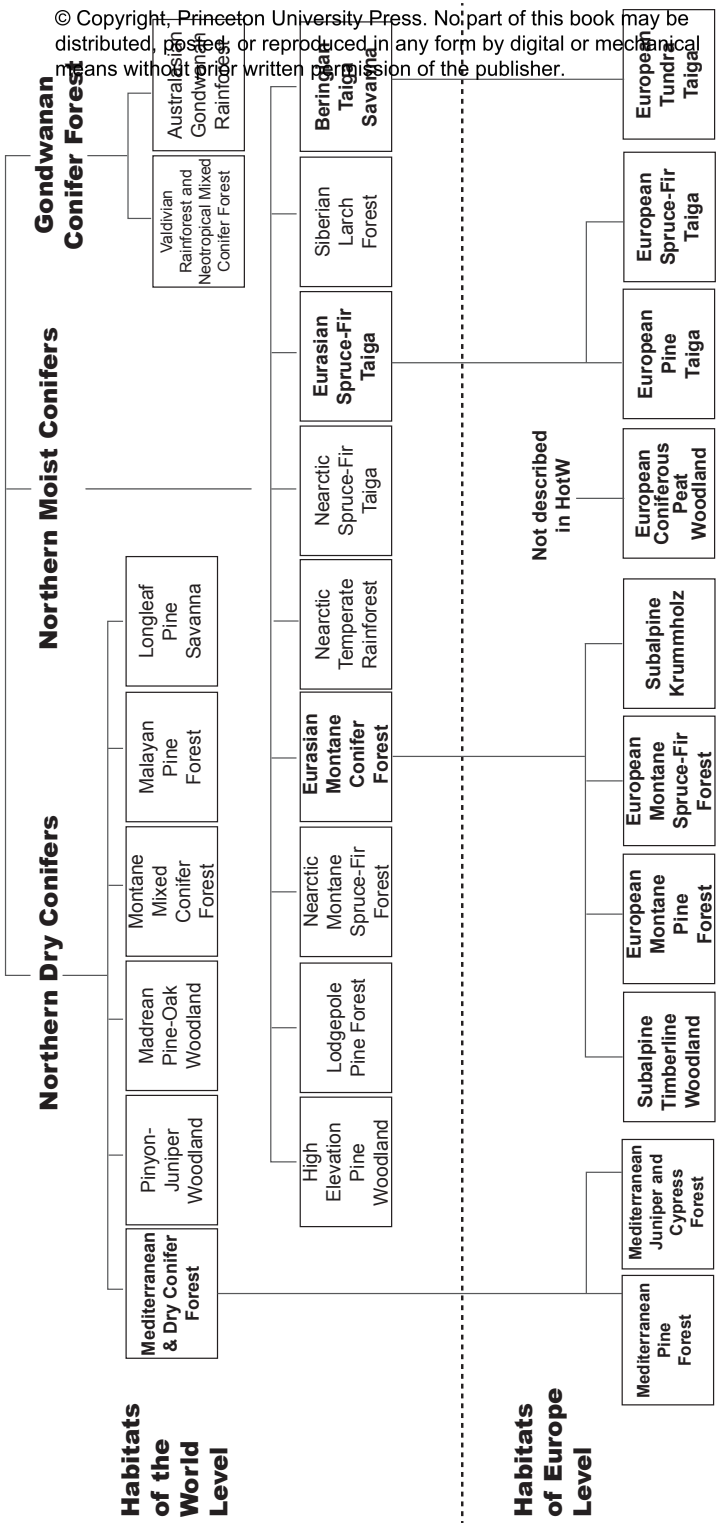
The vast central plains of Türkiye, including places such as Cappadocia, have a cold semi-arid climate (Köppen **Bsk**) featuring hot, dry summers and cold winters. The region gets around 300–400 mm (12–16 in.) of precipitation per year, and **Eu6A MIDDLE EASTERN SAVANNA** dominates. The climate generally gets more arid towards the east and southeast, where the drier deserts dominate: **Eu2B CAUCASIAN SHRUB DESERT** in the lowlands and **Eu2C CAUCASIAN MONTANE DESERT STEPPE** in the highlands. The arid lands are dissected by many rivers with **Eu3I MEDITERRANEAN RIPARIAN FOREST** and wetlands such as **Eu11C EUROPEAN REEDBED**.

Doğa Derneği is a Turkish organisation involved in the monitoring and conservation of a wide range of wildlife species, managing the protection of 30 key biodiversity areas (KBAs), and running environmental education programmes.

See-see Partridge. © PETE MORRIS



CONIFER FORESTS



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CONIFER FORESTS

Eu1A EUROPEAN TUNDRA TAIGA

IN A NUTSHELL: This habitat, a spattering of conifers over various tundras, forms the northern tree line.

Global Habitat Affinities: **ASIAN TUNDRA TAIGA.**

Continental Habitat Affinities: Arctic equivalent of **SUBALPINE TIMBERLINE WOODLAND.** **Species**

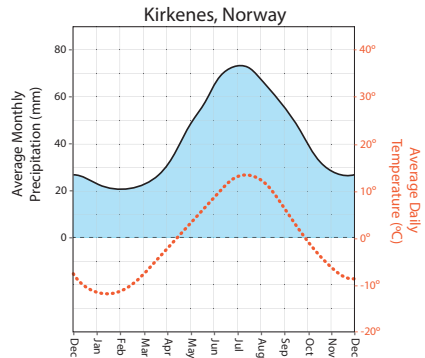
Overlap: **SPRUCE-FIR TAIGA; CONIFEROUS PEAT WOODLAND; SHRUBBY TUNDRA.**



DESCRIPTION: In some areas of Arctic and subarctic Europe, the transition from tundras to **PINE TAIGA** is rapid. But in other regions, the transition is nebulous—this is the Tundra Taiga, a habitat in the zone between the more typical tundra and the taiga forest proper, where the tundra starts to become dotted with stunted spruces, pines, and larches.

Norway Spruce (*Picea abies*) and Scots Pine (*Pinus sylvestris*) are the dominant tree species through most of this habitat. The Norway Spruce dominates in moderately well-drained podzol (or spodosol) soils (see appendix), while the Scots Pine, being very adaptable and tolerant of most environments, including well-drained and poorly drained soils, is therefore much more widespread. Although the conifers here are the same species as those in the extensive forests to the south, their structure is very different. Small clusters of closely spaced trees can form in the Tundra Taiga, but there is often 50 m (150 ft.) between individual trees or groves, and the trees are generally short (to only 15 m/50 ft.). This is in stark contrast to the dense forests that form in optimal conditions farther south, where the trees are two to three times taller. Besides the spruce and pine, Tundra Taiga has a peppering of European Larch (*Larix decidua*), along with Least Willow (*Salix herbacea*), Downy Willow (*Salix lapponum*), Dwarf Birch (*Betula nana*), Silver Birch (*Betula pendula*), and Downy Birch (*Betula pubescens*). There is a very low shrub cover, around 30 cm (1 ft.) tall, with another gymnosperm, the Common Juniper (*Juniperus communis*), and Marsh Labrador Tea (*Rhododendron tomentosum*). In boggy areas, the ground is often covered with Red-stemmed Feather Moss (*Pleurozium schreberi*).

The average temperature through the year is -5°C (23°F), with very short summers of 8 – 12°C (46 – 54°F) and very cold winters of -24.5 to -21.5°C (-12 to -7°F). The average midsummer temperatures can be warmer than the 10°C (50°F) limit for tundra, though it is still a harsh





An open pine-dominated Tundra Taiga with scattered birches in the background, possibly transitioning to Subarctic Riparian Woodland. © IAIN CAMPBELL, TROPICAL BIRDING

(Köppen **ET**) climate. With annual precipitation ranging from 200 to 400 mm (8–16 in.), some areas could be classified as arid terrain. Nevertheless, because evapotranspiration is so low, the landscape remains humid through much of the year. Permafrost is often present in these woodlands, but the habitat can form in regions without permafrost.

Covered in ice flow throughout the ice ages, this region was only recently exposed and is still rising from isostatic rebound (the earth buckling because of a release of pressure from the thick sheets of ice). The landscape is dotted with lakes, eskers, tills, and terminal moraines—evidence of the glacial scouring—combined with permafrost features such as pingos (mounds of earth formed through expanding ice over frozen permafrost). The drainage in these areas is often impeded and rarely dendritic (the normal branching drainage pattern typical of temperate regions). This creates the conditions for many small bogs, where large hummocks of sphagnum mosses grow, with marsh grasses in the channels between them. When the bogs become larger than 15 m (50 ft.) across, the habitat is better regarded as **BOGGY TUNDRA**.

WILDLIFE: Tundra Taiga is very important for breeding shorebirds, in particular a wide range of species that winter in Africa and India and come here to nest. They typically arrive in late May just as the snows are melting and starting to reveal the marshy habitat below. Wood Sandpipers are



Tundra Taiga is an open savanna-like mixture of scattered trees through tundra.

© IAIN CAMPBELL, TROPICAL BIRDING

particularly common in this habitat and nest both on the ground and in abandoned passerine nests in trees. Other common breeders include Spotted and Common Redshanks, Purple Sandpiper, and Black-tailed Godwit. Rough-legged Hawk (aka Rough-legged Buzzard) hunts over the open patches of the Tundra Taiga, along with White-tailed Eagle. Short-eared Owl and Northern Hawk Owl can be in the same small area, but the Northern Hawk Owl concentrates on hunting in the forested areas, whereas the Short-eared Owl hunts more in the open spaces. Willow Ptarmigan and a variety of passerines, such as Little Bunting, Bluethroat, and Tree Pipit, are also found in the extensive **SPRUCE-FIR TAIGA** to the south.

Wood Sandpipers can be quite common in the Tundra Taiga, often using conifers as song posts.

© MARKUS VARESVOO, AGAMI



Purple Sandpipers seem out of place when seen breeding in the Tundra Taiga, as most naturalists are more familiar with them in their rocky coastal non-breeding habitat. © MARKUS VARESVOO, AGAMI





Northern Hawk Owl is largely diurnal and likes to use prominent perches as lookouts in the Tundra Taiga. © MARKUS VARESVUO, AGAMI

The Tundra Taiga supports few mammals, but these include a number that most wildlife-watchers would love to see, such as Wolverine, Brown Bear, European Elk (Moose), and Reindeer (Caribou).

CONSERVATION: Few protection efforts are directed specifically at this habitat. With increasing world temperatures, it is migrating north into tundra habitats and, in its core range, is being replaced by thicker woodlands of the same tree species to its south, turning this very open woodland into **SPRUCE-FIR TAIGA**.

DISTRIBUTION: A belt of Tundra Taiga extends from Norway all the way across the top of Siberia and is wedged between the true tundra to its north and the taiga to the south. The width of the belt varies greatly, from just 5 km (3 mi.) wide in n. Finland to over 50 km (30 mi.) in c. Siberia. This habitat will likely become more widespread with global climate change as conifers and birches colonise areas dominated by **ROCKY** and **SHRUBBY TUNDRAS**.

WHERE TO SEE: Kirkenes, Norway.

The very special Wolverine is the holy grail for mammal-watchers exploring n. Europe.

© JARI PELTOMÄKI, AGAMI

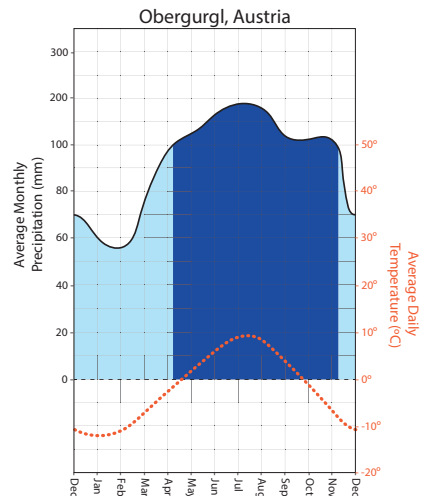


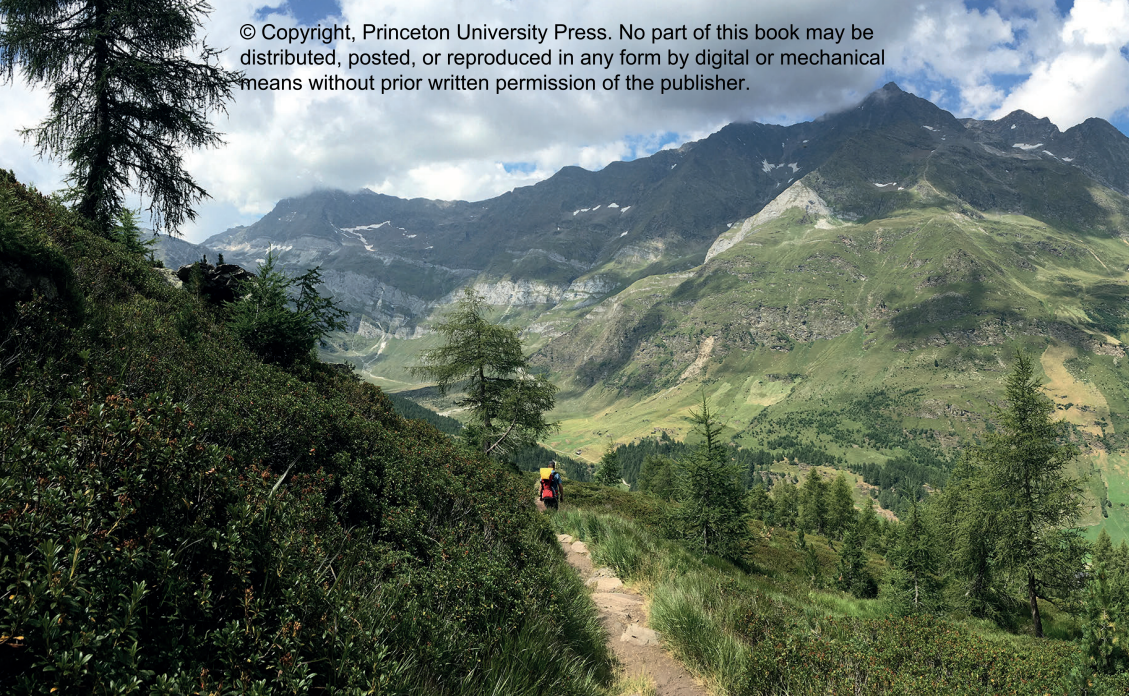
Eu1B SUBALPINE TIMBERLINE WOODLAND



IN A NUTSHELL: Open coniferous woodlands found above Europe's montane forests in the transition to the treeless **ALPINE TUNDRA**. **Global Habitat Affinities:** **NEARCTIC HIGH-ELEVATION PINE WOODLAND**; **AFROTROPICAL MONTANE DRY MIXED WOODLAND**; **SUBALPINE EUCALYPT WOODLAND**; **HIMALAYAN SUBALPINE WOODLAND**. **Continental Habitat Affinities:** **SUBALPINE KRUMMHOLZ**; **EUROPEAN SUBARCTIC RIPARIAN WOODLAND**. **Species Overlap:** **ALPINE TUNDRA**; **MONTANE SPRUCE-FIR FOREST**.

DESCRIPTION: Europe's montane forests get progressively thinner upslope as the growing conditions get tougher. Extreme cold, long periods of snow cover, high winds, high solar radiation, and a short growing season all limit plant growth. Approaching the timberline, the conditions are so harsh that forests can no longer establish and are replaced by open woodlands and species better adapted to the extreme environment (Köppen Dfc, subarctic). The elevation of the timberline varies from location to location and is affected by aspect, latitude, soils, local climate, wind-shearing, avalanche activity, and land management. As such, Subalpine Timberline Woodlands form a band, 50–200 m (150–650 ft.) wide, around mountains, wedged in between the lower montane forests and the higher tundras. These woodlands are higher on warmer south-facing slopes and lower on north-facing slopes where snow remains longer into spring, shortening the effective growing season. The upper limit of the Subalpine Timberline Woodland (i.e., tree line) is as high as 2500 m (8200 ft.) in some undisturbed, warmer sites in the Pyrenees, Alps, and s. Carpathians, but it is more often at about 1800 m (6000 ft.). That said, the current tree line in many European mountain areas can be much lower than the ecological tree line, with trees having been cleared either for wood or to extend pastureland, and it can be as low as 1200 m (3900 ft.) or lower in disturbed n. Carpathian locations. The slow tree growth rate means that recovery of the ecological timberline can take centuries at best and millennia if major soil erosion and degradation of the humus layer have occurred.





Above: Open Subalpine Timberline Woodlands establish at the very limit of where trees can grow. This hiking trail weaves through scattered larches and dense Rusty-leaved Alpenrose. © DALE FORBES

Below: The magnificent Swiss Pine is restricted to Subalpine Timberline Woodlands, here growing alongside various grasses, Mountain Juniper, Bog Bilberry, and Dwarf Mountain Pine. © DALE FORBES



A very short growing season means that decomposition is very slow. This leads to the development of rich humus-filled, acidic soils, with a thick peat-like layer on north-facing slopes (humo-ferric podzols) and a humic upper layer on the slightly warmer and drier south-facing slopes (brown podzols).

The open pine woodlands of the Subalpine Timberline Woodland form one of Europe's most beautiful landscapes. Conifers 25 m (80 ft.) tall are interspersed every 10–100 m (30–300 ft.) through a carpet of small shrubs and grasses, invariably with a breathtaking backdrop of mountain peaks. Despite the tough growing conditions, the magnificent Swiss Pine (*Pinus cembra*) is restricted to this environment. It is revered in the Alps for the schnapps made with its cones and for its beautifully scented wood, which many find pleasantly soothing. The cones and rock-hard seeds also form the basis of a fascinating relationship with the Northern Nutcracker. A single nutcracker



collects 50,000–100,000 seeds every year, hiding them in thousands of locations—often in little rocky nooks and crannies. Many hidden seeds are not eaten, and these semi-protected spaces are perfect for saplings to establish. This explains why many adult trees are found embracing large boulders. The Swiss Pine's deep roots reach below the upper soil layers, which freeze in winter, allowing the tree to counter the extreme transpiration by accessing groundwater all year round.

The deciduous European Larch (*Larix decidua*) deals with the extreme solar radiation in winter by dropping its needles,

which first change colour, making for beautiful, blazing orange autumn landscapes. This pioneer tree species has benefitted from livestock grazing in the timberline zone, where trampling hooves expose the soil, opening it up for its saplings to establish. Treefalls, landslides, and avalanche damage can additionally open spots for European Larches to establish.

In the Alps, Subalpine Timberline Woodlands are typically at about 1700 m (5500 ft.) elevation and characterised by very open grasslands with scattered taller trees. Beneath the classic trees of this zone (Swiss Pine and European Larch) are grasses and a short shrub layer including species like Rusty-leaved Alpenrose (*Rhododendron ferrugineum*) on acid soils, Hairy Alpenrose (*Rhododendron hirsutum*) on carbonate-rich soils, Bog Bilberry (*Vaccinium uliginosum*), Lingonberry (*Vaccinium vitis-idaea*), Common Bilberry (*Vaccinium myrtillus*), and Mountain Juniper (*Juniperus communis* var. *saxatilis*). Birches (*Betula* spp.) and European Mountain Ash (*Sorbus aucuparia*) are infrequent but widespread. Subalpine Timberline Woodland will often be found in a mosaic with **SUBALPINE KRUMMHOLZ**, where mats of Dwarf Mountain Pine (*Pinus mugo*) come to dominate avalanche-prone and steep, calcareous slopes.

An open Swiss Pine woodland with a ground cover of Rusty-leaved Alpenrose. © DALE FORBES





Black Grouse has spectacular display grounds, known as leks, often choosing snowfields at the timberline. Many males gather to fight against each other and attempt to attract a female. © MARKUS VARESVUO, AGAMI

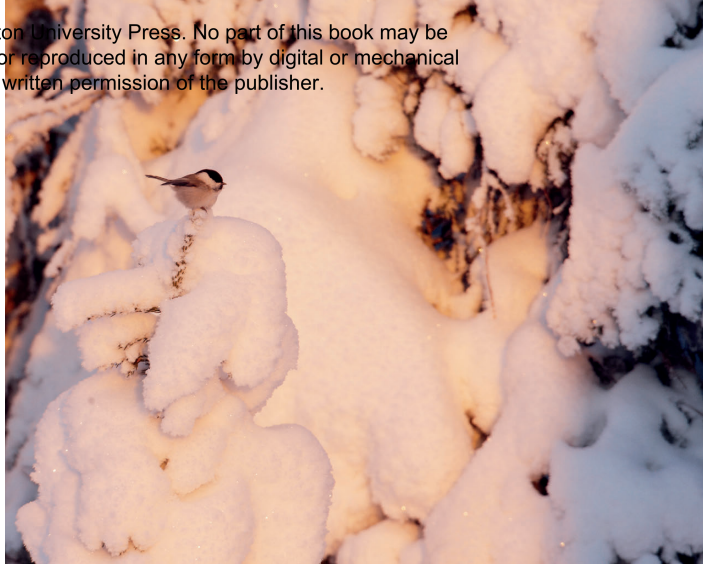
By contrast, European Larch and Swiss Pine are notably absent in the Pyrenees, where the tall-growing Pyrenean Mountain Pine (*Pinus uncinata*) occupies this niche. Rusty-leaved Alpenrose, Mountain Juniper, Common Bilberry, Bog Bilberry, and various grasses fill the gaps between the taller trees on cooler, moister slopes. Warmer limestone slopes tend to develop very little soil and vegetation, but some hardy species, like the beautiful Yellow Hedgehog Broom (*Echinospartum horridum*), Bearberry (*Arctostaphylos uva-ursi*), junipers (*Juniperus* spp.), and Common Lavender (*Lavandula angustifolia*), can establish and thrive.



In the Carpathians, timberline areas are often dominated by Subalpine Krummholz, but the occasional Subalpine Timberline Woodland can be found, with a varying mixture of European Larch, Norway Spruce (*Picea abies*), and Swiss Pine. These open woodlands are dominated by grasses where grazing pressure is high, with

Citril Finch prefers open forest and forest edge right up towards the tree line. © RALPH MARTIN, AGAMI

The hardy Willow Tit occupies a variety of woodlands but is particularly obvious and easiest to find at the timberline. Unusually for a tit, it excavates its own nest hole. © MARKUS VARESVUO, AGAMI



scattered bushes of Mountain Juniper and Myrtle-leaf Rhododendron (*Rhododendron myrtifolium*)—the Carpathian equivalent of the alpenroses. Farther south, Macedonian Pine (*Pinus peuce*) and Bosnian Pine (*Pinus heldreichii*) are found at the tree line.

Deciduous trees are commonly found in the subalpine zone in the Caucasus, where elfin forests of birch but also European Mountain Ash, European Beech (*Fagus sylvatica*), and oaks (*Quercus* spp.) grow in lower areas. In addition, Caucasian Pine (*Pinus sylvestris hamata*) can also reach into the subalpine zone. Grasses, Georgian Snow Rose (*Rhododendron caucasicum*), Common Bilberry, Lingonberry, and other small shrubs make up the understorey.

Subalpine Timberline Woodland does not appear to be present in the Apennines, where beech typically forms a relatively clean timberline below the grass-dominated, treeless subalpine zone.

WILDLIFE: Early on a spring morning, as the sky starts to turn blue, the Eurasian Pygmy-Owl and Boreal (Tengmalm's) Owl are still tooting as the lekking Black Grouse begin to display. Song Thrushes, Ring Ouzels, and Dunnocks sing as beautiful little Redpolls, Citril Finches, and Red Crossbills zip back and forth, and chunky Willow Tits start to look for breakfast. A reclusive Eurasian Three-toed Woodpecker works on a horizontal line in a conifer to milk the phloem sap (a third of their feeding in spring is spent on sap). But the real highlight of the morning—an icon of the Subalpine Timberline Woodland—is the Northern Nutcracker flying actively back and forth between the Swiss Pines. If you can see Northern Nutcrackers and Willow Tits, you are likely in this habitat.

If you are in the Caucasus, you are unlikely to have Northern Nutcrackers about, but you might well be treated to Mountain Chiffchaff, Fire-fronted Serin, or Caucasian Grouse.

Northern Chamois is relatively common in these woodlands, and Red Deer will gladly use them in quieter areas. Red Fox is common,



Red Fox tracks are commonly seen threading through the snow in this habitat. © ALAIN GHIGNONE, AGAMI



The Northern Nutcracker is a keystone species of Subalpine Timberline Woodland with a tight association with the Swiss Pine. © MARKUS VARESVUO, AGAMI

while Brown Bear and Grey Wolf are sporadic. The Giant Deer (aka Irish Elk) was unlikely ever to have been particularly abundant, but had it not been driven to extinction, its preference for open spruce and pine woodlands would likely have made the Subalpine Timberline Woodland its favoured habitat in c. Europe.

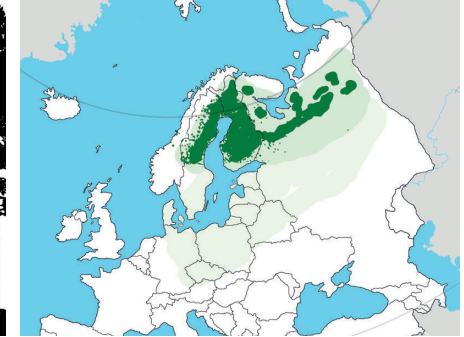
Reptiles are uncommon, but the Adder (*Vipera berus*) is found throughout Subalpine Timberline Woodland, while the Caucasus Subalpine Viper (*Vipera dinniki*) is a habitat specialist in the Caucasus Mountains. A wonderful diversity of interesting butterflies is found in Subalpine Timberline Woodland, including the Alpine Grayling (*Oeneis glacialis*); Eriphyle, De Prunner's, Large, and Mountain Ringlets (*Erebia eriphyle*, *E. triarius*, *E. euryale*, and *E. epiphron*); and the rare Asian Fritillary (*Euphydryas intermedia*) and Rätzer's Ringlet (*Erebia christi*).

CONSERVATION: The tough growing conditions mean that it can take centuries for the woodlands to recover once the trees have been removed at the timberline. Non-sustainable harvesting of Swiss Pine and other subalpine trees for timber, firewood, or to open up pastureland can depress the timberline dramatically. Similarly, clearing and disturbance by ski resorts and other sports venues can dramatically affect the health of this ecosystem.

DISTRIBUTION: Subalpine Timberline Woodland occurs in the subalpine zone of Europe's mountain ranges, most notably in the Pyrenees, Alps, Carpathians, and Caucasus.

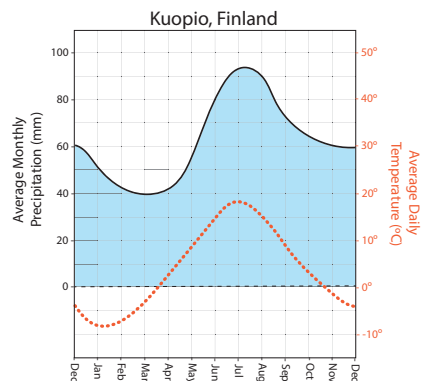
WHERE TO SEE: Hohe Tauern National Park, Austria; Aigüestortes i Estany de Sant Maurici National Park, Catalonia, Spain; Stepantsminda, Mtskheta-Mtianeti, Georgia.

Eu1C EUROPEAN CONIFEROUS PEAT WOODLAND



IN A NUTSHELL: These are the boggy conifer woodlands and forests of temperate and subarctic Europe: wet underfoot and extremely difficult to walk through. **Global Habitat Affinities:** NEARCTIC BOREAL CONIFER FOREST. **Continental Habitat Affinities:** SPRUCE-FIR TAIGA; TEMPERATE PEATLAND. **Species Overlap:** SPRUCE-FIR TAIGA.

DESCRIPTION: Coniferous Peat Woodlands are azonal, being found over a variety of climatic zones from the subarctic cold, wet climate of far n. Norway (Köppen Dfc) to the continental wet cold-winter, warm-summer climate of s. Germany (Dfb) and even to alpine areas in Greece. These woodlands grow in wet conditions on acidic peat soils (histosols; see appendix), often at the edges of treeless mires (TEMPERATE PEATLAND), but also forming large tracts of forest in the boreal zone without open mires. Peat-forming mosses require a near permanently wet environment to grow. Precipitation is not high, but the cool temperatures and low evaporation mean that water builds up quickly. This is especially true in the boreal zone, where glacial deposits block drainage and create a myriad of complex landforms and an abundance of lakes and mires.



Coniferous Peat Woodlands are invariably soggy, wet places with scattered trees and an open canopy.

© IAIN CAMPBELL, TROPICAL BIRDING





A Coniferous Peat Woodland dominated by Scots Pine with a diverse ground cover including bilberries, willows, and sphagnum mosses. © IAIN CAMPBELL, TROPICAL BIRDING

Coniferous Peat Woodlands also develop farther south, in the temperate zone, but here they generally form at the ecotone with **TEMPERATE MIXED FOREST** or where the natural hydrology of a raised bog (or other mires) has been disturbed. The draining of mires for peat extraction has allowed many of these Temperate Peatlands to become wooded and develop into Coniferous Peat Woodlands.

Although the ground plants of this habitat are similar to those of the **BOGGY TUNDRA** and open Temperate Peatland, the canopy cover means that the bird and other wildlife assemblages have far more in common with **SPRUCE-FIR TAIGA**, **PINE TAIGA**, and **TEMPERATE RIPARIAN FOREST** than they do with the tundra and other open habitats. Taiga forests typically have very uniform canopy heights, but the variety of microenvironments caused by the undulating and boggy nature of the ground surface in Coniferous Peat Woodlands means that these woodlands have very uneven canopies and forest structure. Trees are of many ages and growth forms, and even trees of the same species and age can have vastly different sizes.

Coniferous Peat Woodlands often have an open canopy but can also be closed-canopy forests. Scots Pine (*Pinus sylvestris*) or Norway Spruce (*Picea abies*) will often form a monospecific canopy when the bog water accumulates through precipitation (ombrotrophically) but rarely form uniform stands. Coniferous Peat Woodlands fed by groundwater (minerotrophically) are richer in minerals and nutrients. The tree assemblage has a greater mixture of species, but Norway Spruce, Downy Birch (*Betula pubescens*), and Alder Buckthorn (*Frangula alnus*) are invariably the most abundant in the wettest areas. By contrast, Norway Spruce and Dwarf Mountain Pine (*Pinus mugo*) are more common in the slightly drier areas.

The understory plant assemblage varies substantially between pine-dominated and spruce-dominated peatlands. Nevertheless, the low shrub community is similar to that of **TEMPERATE PEATLAND**, containing Bog Bilberry (*Vaccinium uliginosum*), Bog Cranberry (*Vaccinium oxycoccos*), Marsh Labrador Tea (*Rhododendron tomentosum*), Leatherleaf (*Chamaedaphne calyculata*), Common Heather (*Calluna vulgaris*), Black Crowberry (*Empetrum nigrum*), Wild Rosemary (*Andromeda polifolia*), Twinflower (*Linnaea borealis*), and the fascinating, carnivorous Round-leaved Sundew (*Drosera rotundifolia*).

Much of the ground cover is dominated by peat-forming sphagnum mosses such as Girgensohn's Peatmoss (*Sphagnum girgensohnii*), Northern Peatmoss (*Sphagnum capillifolium*), Prairie Peatmoss (*Sphagnum palustre*), and Flat-top Bogmoss (*Sphagnum fallax*). Non-sphagnum bryophytes commonly encountered include the cosmopolitan Common Haircap Moss (*Polytrichum commune*), Bog Haircap Moss (*Polytrichum strictum*), and Ribbed Bogmoss (*Aulacomnium palustre*). Sedges include Tussock Cottongrass (*Eriophorum vaginatum*), and forbs include Arctic Starflower (*Lysimachia europaea*). The fungi include the Lichen Agaric (*Lichenomphalia* spp.).

Peat soils (histosols) have more than 30 cm (12 in.) of organic soil material in the upper 90 cm (36 in.). This has accumulated from plant remains in which excess moisture, anaerobic conditions, and acidity slowed down the decomposition process, leading to the buildup of organic matter. As with the tundras to the north, the rock type or parent material sitting below the peat deposits is unimportant to the development of peat soils, because they start developing with bryophytes (mosses and similar plants) that do not depend on roots for the uptake of nutrients from the inorganic parent material. The pioneer vascular plants that establish later, such as trees and shrubs, have root systems that use the nutrients from the breakdown of the mosses, algae, lichens, and fungi rather than nutrients from the soil below the peat.

WILDLIFE: This habitat can be seen as an ecotone between **TEMPERATE PEATLAND** and **SPRUCE-FIR TAIGA** or **PINE TAIGA**, and this is reflected in the bird assemblage. However, the one bird that epitomises this environment is the Eurasian Woodcock (although it is also found elsewhere). This chunky, attractive, but goofy-looking snipe spends the day hidden on the forest floor with its amazingly camouflaged plumage. During spring and early summer, males emerge at dusk to perform a unique aerial display, known as 'roding', in which they perform a linear patrolling flight just above the level of the canopy, emitting a series of nasal calls interspersed with short, high-pitched calls as they go. They also flash their white tail tips, which are brighter than any other known feather—perfect for attracting the attention of a mate in the dim light.

In the more open areas in and around boreal Coniferous Peat Woodlands, you may see migratory ground species such as the European Golden-Plover, Common Greenshank, Jack Snipe, Common Snipe, Wood Sandpiper, and Common Gull. Within the woodlands,

The cryptic Jack Snipe is usually very secretive but has an amazing aerial display. © PETE MORRIS





Above: Willow Ptarmigan does not migrate but assumes white plumage in the winter to allow it to hide from predators in its snowy environment.

© MARKUS VARESVUO, AGAMI

Below: Interestingly, male Bramblings acquire their attractive summer dress through abrasion rather than moult, as the pale-tipped winter feathers wear darker. © MARKUS VARESVUO, AGAMI



(continued)

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Habitats are worded **in full** in the index beginning with the word European, where relevant. The word 'European' has been dropped from references to habitats within the *actual* text, e.g., 'Montane Spruce-Fir Forest' refers to *European* Montane Spruce-Fir Forest (see *page 10*).

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