3.4 Geology and Soils

(a) Geology and Soils Baseline Conditions

Geology, Hydrogeology and Hazardous Geomorphologic Processes

Ukrainian territory is situated in the south-eastern part of Eastern European platform, and the mountain structures of Carpathia and Crimea that surround the platform. Mountain structures are part of the Alpine folding geosyncline region. Rocks of Precambrian, Palaeozoic, Mesozoic, and Cenozoic age form three structural levels. A variety of underground resources are mined in Ukraine and, according to the inventory of natural resources, there are more than 8,500 deposits of 97 types of minerals in Ukraine.

Among the exogenous geological processes in Ukraine, landslides are the most important. Landslides are generally induced when the shear stress on the slope material exceeds the material's shear strength. The occurrence and reactivation of landslides is conditioned by a number of terrain and geo-environmental factors related to bedrock and soil properties, weathering conditions, jointing and structure, slope morphology, land cover/use, surface and groundwater flow, etc.

Landslides in Ukraine mainly occur on the coasts of the Black and Azov Seas, as well as in the Carpathian region. Fluctuations in groundwater level often cause groundwater flooding in some areas of Ukraine. High groundwater poses significant geotechnical risks to engineering structures and could impair local and regional economic development. Groundwater flooding typically occurs in industrial (Dnepropetrovsk and Krivyj-Rih) and agricultural (Odessa and Mikolayvska oblasts) areas of the country.

Exposed geological strata along a river through the Carpathian foothills

Carpathian Mountains; part of the Alpine folding geosyncline region

	
Ground-sloughing (landslip), Carpathians.	Gently rolling low hilly terrain of a likely karst origin

Soils and Soil Quality

Soils Distribution

The soil cover of Ukraine is diversified and tends to occur in latitudinal zones across the country (see Figure 3-13). The north-west has a wide belt of soddy (dern or dernovo)- podzolic soils with mainly light texture on sand-clay strata. These soils form approximately 70% of the total cover and are characterised by low humus content and increased acidity; they therefore need application of mineral fertilisers and organic manures, as well as lime to yield a rich harvest. Thirty percent of the territory is occupied with sod (dern), meadow, meadow-bog and peat-bog soils with slight soddy (dernor dernovo) sands on elevated pine-clad terraces. Over 600,000 hectares (60%) of Ukrainian peat lands are concentrated here.

A wide belt of grey forest soils, as well as podzol and typical chernozems with a 1.2-1.5 m thick humus bed, running from south-west to northeast, is located somewhat to the south. These soils are formed on loess strata. In addition to these, small areas are occupied with bog, meadow and meadow-chernozem soils, often of solonetz type.

Further to the south, encompassing a considerable part of the territory of Odessa, Kirovograd, Dnipropetrovsk, Zaporizhia, Donetsk and Lugansk regions, chernozems are located, with the thickness of their humus bed up to 80-90 cm and formed on moist-loamy strata.

The southern part of Prychernomorie lowlands contain dry southern chernozems, which are replaced along the coastlines of the Black Sea and the Sea of Azov with a rather narrow strip of dark-chestnut and then chestnut soils combined with solonetz and soloth.

Carbonatic chernozems and brown forest (often with gravel) soils prevail in the Crimean Mountains, while the Carpathians are characterised with short-profile

mountain-forest and sod-brown soils with low content of humus, leached and heavy acid soils (the pH of the solids is generally between 3.6 - 5).

Soil Types and Quality

Chernozems (Mollisols) are humus-rich grassland soils used extensively for growing cereals or for raising livestock, which are the most valuable soil type in Ukraine. Chernozems in Ukraine are represented by variations - podsolised, typical and ordinary – predominately formed on loess and loess-like deposits mainly in forst steppe and steppe zones. Their hydrophysical chareristics are favourable for cultivation. Southern chernozems are found in the dry steppe subzone along the Black Sea coast and southern areas of the Crimean plain. Solonetz chernozems, which have lower humus content and less favourable hydrophysical properties, will often form on saline clays. Chernozems in Ukraine account for approximately 8.9% of the world resources of Chernozems.

Sod-podsolic soils are typically found in sandr, moraine-sandr and alluvial plains, as well as in some parts of the forested terraces in the forest steppe and steppe zones. These soils can be subdivided into weak, medium and heavily podsolised, and further categorised by waster regime into automorphous, surface-gleyed and deeply-gleyed varieties. They produce an acid reaction of soil solution and are slightly saturated with basics. Sod-weakly podsolised sand and lamy sand soils are frequently encountered in northern Ukraine and sandy variations are associated with the eolian kuchugur uplands. With the use of suitable farming technology, these soils will support farily good yields of winter rye and potatoes. Medium and heavily podsolised gleyed sod soils are found in the uplands of Carpathia, where the abundance of precipitation requires regulation of the water regime, liming and application of fertilisers. Nutrient poor light-grey, grey and dark-grey podsolised soils can be found in the forest steppe, watershed plateaus, and in northern Ukraine's loess isles.

Other soil types in Ukraine include:

- dark-chestnut residual solonetz soils found mainly in the southern (dry) steppe subzone;
- sod-gleyey soils found in watersheds and terraced plains in the mixed forest and forest steppe zones;
- sod-skeletal soils in the zone of crystalline rock outcrop in the Ukrainian Shield (which require amelioration for agricultural use);
- sub-carbonate soils in the western mixed forest zone (most fertile soils in northern Ukraine);
- meadow chernozem soils found on terraces in the forest steppe and steppe zones;
- solonetz soils of low fertility in Crimea and along terraces of southern rivers such as the Dnipro;
- solodized soils unsuitable for farming in minor depressions of the steppe; and,

- peaty soils and bog-marsh that have developed in the floodplains and depressions experiencing poor drainage in northern Ukraine.

In the higher elevations, sod-podsolic and surface-gleyed soils, as well as podsolised brown forest soils are found on the piedmonts of the volcanic range, while mountain brown forest soils and sod-brown forest soils can be found in the mountainous aeras of the Carpathians. Mountain brown forest soils and sod-brown forest soils are also found in the higher altitudes of the Crimean forest zone, along with stony cinnamon mountain soils.

Soil Erosion and Degradation

Soil erosion is a significant problem in the country. Eroded soils cover 85% of total steppe and forest-steppe territories. About 100,000 hectares of fertile land is lost every year because of wind and water erosion. Erosion has largely resulted from excessive use of water resources for irrigation and poor soil management.

Soil degradation is an issue in Ukraine. Degradation has been caused by several factors; a) use of pesticides and fertilisers; b) soil and groundwater contamination due to storage of pesticides, and c) fertilisers or other hazardous chemicals. Virtually all regions of Ukraine have a significant level of soil pollution from pesticides. Significant proportions of air pollutants are also absorbed by soils within five km of pollution sources; which commonly include ferrous and non-ferrous metallurgy, light industry, and thermoelectric power stations. Open cast mining, processing and smelting enterprises are also major sources of soil pollutants in Ukraine.

As a consequence of the Chernobyl nuclear power plant accident in 1986, 8.4 million hectares of agricultural land were contaminated, principally by Caasium-137. This led to the abandonment of 180,000 hectares of arable land and 157,000 hectares of forest; and the designation of a 'Zone of Alienation' around the town of Prypiat, within which most activities are heavily restricted (the area of alienation is marked on Figure 3-14). A slow process of decontamination of the surface soil layers is underway, but the latest available published data for soil contamination (1998) indicates that areas of the north and central Ukraine still show signs of radioactive contamination (Ministry for Environmental Protection and Nuclear Safety of Ukraine).

Seismic conditions

The territory of Ukraine is situated in a seismic zone (see Figure 3-15). The highest risk zones are situated in Crimea, the western Black Sea coast, and the Carpathian Mountains. Previous earthquake intensities within the country have reached above seven on the Richter scale. Additionally, intensive mining operations can cause technogeneous earthquakes that are not as intense as natural events but, if in industrially developed areas, could lead to harmful and

destructive results.

Seismicity in Ukraine is most apparent in western, southwestern and southern areas, where two basic seismic regions - Carpathian and Crimean-Black Sea – are located.

Seismicity of the Carpathian region is defined by earthquakes in Zakarpattya, Carpathians, and Prykarpattya, with Zakarpattya being the most seismoactive. In western areas of Ukraine, earthquakes originate at relatively shallow depths (2-10 km) which cause local vibrations of soil surfaces with intensity of 7-7.5 magnitude on the Richter scale. Similar vibrations are felt in Zakarpattya from deeper and larger earthquakes originating in Romania approximately 60 km from the Ukrainian borders. In Prykarpattya, an earthquake of magnitude 5.3 on the Richter scale took place in 1875 near the region Velyki Mosty (in the L'viv region). A considerable part of the Ukrainian territory is under influence of the undercrust earthquakes, which take place in the Vranch zone in Romania (area of the joint between the eastern and southern Carpathians). Maximum magnitudes of earthquakes in this zone can reach 7.6 points on the Richter scale.

Seismicity of the Crimean-Black Sea region is defined by the epicentres of the earthquakes located in an offshore area of the Black sea, near the southern coast of Crimea with magnitudes up to 6.8 on the Richter scale. Onshore, Crimean earthquakes with magnitudes exceeding 2.0 on the Richter scale have occurred from the 1st century BC up to the present time. On the flat part of Crimea and the Sea of Azov, earthquakes with magnitudes over 1.0 on the Richter scale can occur.

In the central part of Ukraine, only a few earthquakes of shallow depths (5-10 km) and low magnitudes (up to 3 on the Richter scale) have been recorded. The strongest earthquake in the eastern part of Ukraine occurred in 1913 near Kupyansk (magnitude 3.5, local vibrations with the intensity up to 5-6 on the Richter scale). In the western part of Ukraine, near urban village Mykulynzi in the Ternopil region, an earthquake with magnitude of 4 on the Richter scale took place on January 3rd, 2002, with an intensity of 6 on the Richter scale in the epicentre with effects equivalent to 7 on the Richter scale on the weakened soils.

(b) Geology and Soils Future Trends in Baseline

Intensive mineral extraction activities in Ukraine – principally concentrated in Donetskiy, Krivirizhsko-Nikopolskyj (southeastern Ukraine), and Pricarpatskyj (southwestern Ukraine) industrial regions – caused essential changes in geology of the regions and have led to environment degradation, such as changes in groundwater hydrology of the territory, deformation of geological bands, soils pollution, and alkalinisation. This long-term trend is likely to continue, since no significant efforts have been undertaken to remedy the situation.

There is a large-scale program on prevention and mitigation of landslides and groundwater flooding of the most vulnerable areas in Ukraine. The program is executed and managed by the Ministry of Emergency Situations; however, it has not been very successful because these issues are not priorities for the Ministry. Soil erosion prevention has been a priority target for the sectoral Ministries (Ministry of Environment, Ministry of Agrarian Policy); however, the rate of soil erosion is not declining, and there are no changes proposed to drive any positive changes. Lack of knowledge and skills, along with an absence of governmental incentives, do not provide any immediate opportunities for improvements for the erosion issue.

The Ministry of Emergencies of Ukraine continues to supervise clean-up and restoration activities within the Zone of Alienation around Chernobyl (see Figure 3-14).

(c) Geology and Soils Data Sources

The following data sources were used in producing the baseline text for the geology and soils section:

- Ukraine in Maps, Institute of Geography, National Academy of Sciences of Ukraine, 2008;
- Food and Agriculture Organisation of the United Nations (FAO) Land & Water Development Division National Soil Degradation Map;
- FAO Country Pasture/Forage Resource Profiles - Ukraine, A.V. Bogovin;
- World Data Center for Geoinformatics and Sustainable Development, http://wdc.org.ua;
- Institute of Geophysics of NAS of Ukraine, S.I. Subbotina; and,
- European Commission Joint Research Centre, Institute for Environment and Sustainability, Land Management & Natural Hazards Unit.

(d) Geology and Soils Data Quality

Most of the available information on geology and soils is somewhat dated (largely dating from 1990s to mid 2000's). Nevertheless, bedrock geological features are likely to have remained largely unchanged in recent years. As a result, the quality of data available to characterise geology and soils is acceptable.

(e) Geology and Soils Data Gaps

There is limited oblast specific data on geology and soils, other than the information that can be identified from broad scale maps.

(f) Geology and Soils Constraints and Opportunities for Renewable Energy

The key constraints and opportunities for renewable energy in relation to geology and soils are summarised in Table 3-6.

Table 3-6: Constraints and opportunities in relation to geology and soils

Constraints	Opportunities
• High value of Chernozem soils might limit siting options for all renewable energy projects; • High level of soil pollution, including heavy metals could impose more constraints upon the construction of renewable energy projects; and, • Seismic activity and landslides could limit siting options for all renewable energy projects in seismically-sensitive areas.	• Possibility of siting for all renewable energy projects on land formerly used for minerals extraction or that is contaminated; • High soil productivity often relates to significant nearby biomass potential; and, • Increased demand for mineral resources could support a steady and increasing demand in electricity production for all renewable energy projects.

(g) Geology, Soils and Land Use Figures

The figures that follow have been referenced within Section 3.4 of this Topic Paper (the Geology, Soils and Land Use baseline and future baseline text):

Sod-podzolic soils on ancient alluvial and fluvioglacial deposits
- Sod-weakly podzolic sandy and clay sandy
- Sod-medium podzolic loamy sand

Sod-podzolic gleyed (gleyic and gley) soils on ancient alluvial and fluvioglacial deposits and moraines
- Sod-weakly podzolic gleyed
- Sod-medium podzolic gleyed
- Sod-, medium-, and strongly-podzolic surface-gleyed

Podzolized soils mainly on loess deposits
- Light grey and grey podzolized
- Dark grey podzolized
- Chernozems podzolized

Regraded soils mainly on loess deposits
- Dark grey regraded
- Chernozems regraded

Typical chernozems mainly on loess deposits
- Chernozems typical low-humus and weakly-humus
- Chernozems typical medium-humus

Ordinary chernozems on loess deposits
- Ordinary deep low- and medium-humus chernozems
- Ordinary medium-humus chernozems
- Ordinary low-humus chernozems
- Ordinary low-humus shallow chernozems

Southern chernozems on loess deposits
- Southern low-humus and weakly-humus chernozems

Chernozems on heavy clays
- Chernozems mainly alkaline on heavy clays

Chernozems and rubbly sod soils on the eluvium of dense rocks
- Chernozems and rubbly sod soils on the eluvium of dense non-carbonate rocks (sandstones and schists)
- Chernozems and sod-calcareous soils on the eluvium of carbonate rocks (marls, chalks, and limestones)

Chernozems residual-alkaline on loess deposits
- Chernozems typical and ordinary residual-solonetzic
- Chernozems southern residual-solonetzic

Meadow-chernozem soils mainly on loess deposits
- Meadow-chernozem
- Meadow-chernozem surface-alkaline
- Meadow-chernozem deep-alkaline

Chestnut soils on loess deposits
- Dark chestnut residual-alkaline
- Dark chestnut alkaline
- Chestnut solonetzic soils in the complex with alkaline

Meadow soils on deluvial and alluvial deposits
- Meadow
- Meadow solonetzic

Bog soils on alluvial, deluvial, and fluvioglacial deposits
- Meadow-boggy and bog
- Peatbog soils and peatlands

Solonetzes
- Mainly solonchak solonetzes

Solod soils
- Meadow-chernozem and sod-soloded gley soils and solods

Sod soils
- Sod mainly gleyed sandy, clay sandy and loamy sand soils in the complex with low-humus sands
- Sod sandy and clay sandy mainly ungleyed soils in the complex with low-humus sands, sometimes with hilly topography and chernozem sandy soils
- Sod podzolized loamy soils and their gleyed types

Brown-podzolic soils mainly on deluvial deposits
- Brown-podzolic soils and their surface-gleyed types

Brown mountain-forest soils
- Brown mountain-forest rubbly soils in the complex with their gleyed types

Sod-brown and mountain-meadow soils
- Sod-brown and mountain-meadow soils

Cinnamonic soils
- Cinnamonic mountain rubbly soils

Soil combinations and complexes
- Soil combinations
- Solonetz complexes

Texture of soils
- Sandy and clay sandy
- Loamy sand
- Light loamy
- Medium loamy
- Heavy loamy
- Clay
- Rubbly

Boundaries of soil contours of different texture

Soil salinization
- Sodium
- Chloride-sulphate-sodium
- Chloride-sulphate

Soil gleyization
- Gleyed (gley and gleyey)
- Surface-gleyed

Note. The gleyization sign in complexes and combinations of soils refers to the first figure.

Figure 3-13: Soils of Ukraine (After Kanash, O.P., Lationova, T.M., and Medvedev, V.V., 2010)

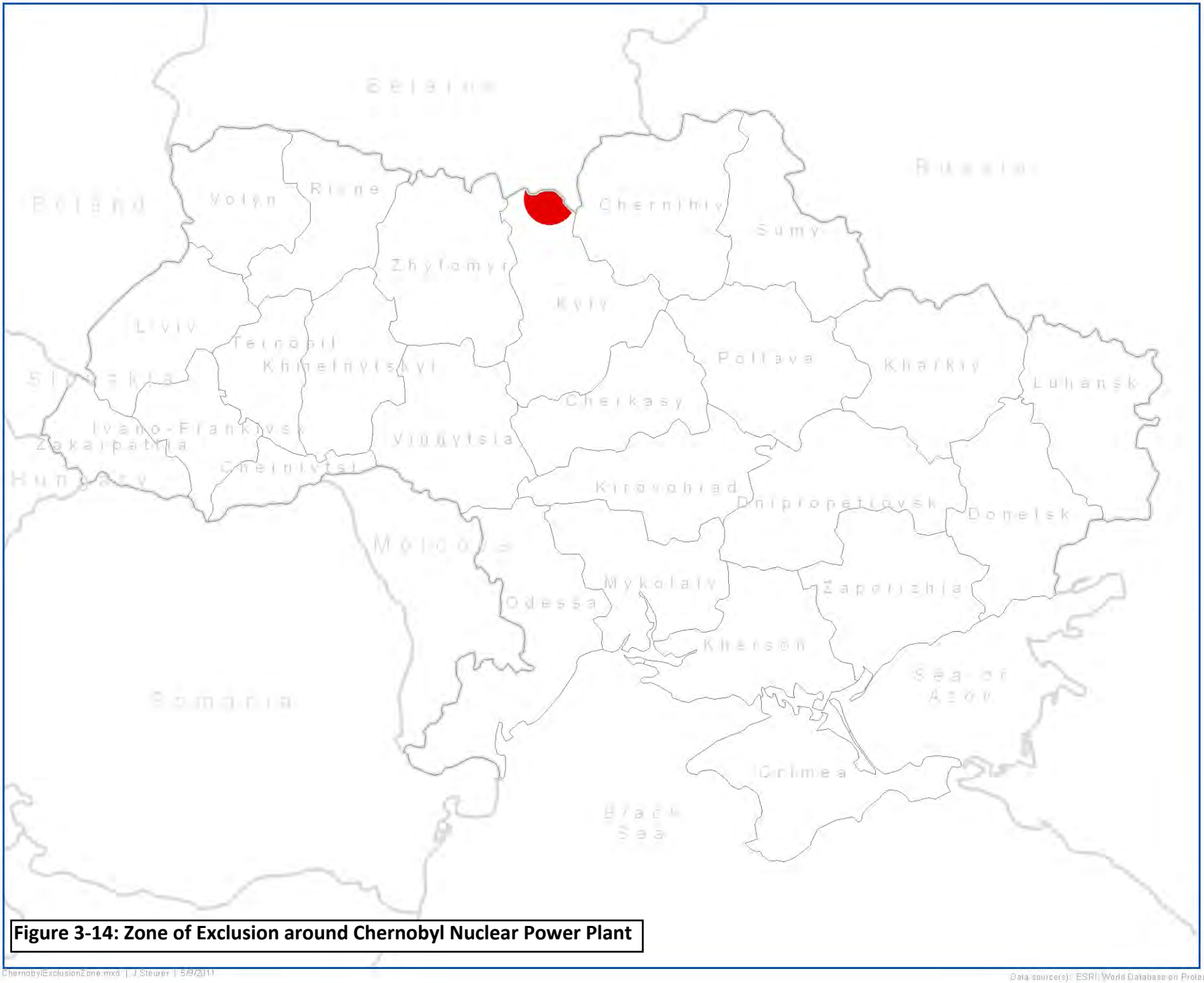


Figure 3-14: Zone of Exclusion around Chernobyl Nuclear Power Plant

Ukraine Sustainable Energy Lending Facility Strategic Environmental Review

Chernobyl Exclusion Zone

Legend

30 km Chernobyl Exclusion Zone

Data Sources: ArcWorld Supplement

N
W E
S

0 50 100
Kilometers

1 cm = 60 km

USELF
Ukraine Sustainable Energy Lending Facility

BLACK & VEATCH
Building a world of difference.

ChernobylExclusionZone.mxd | J.Steurer | 5/9/2011

Data source(s): ESRI, World Database on Protected Places, CIAT-CSI (http://srtm.csi.cgiar.org), PVGIS

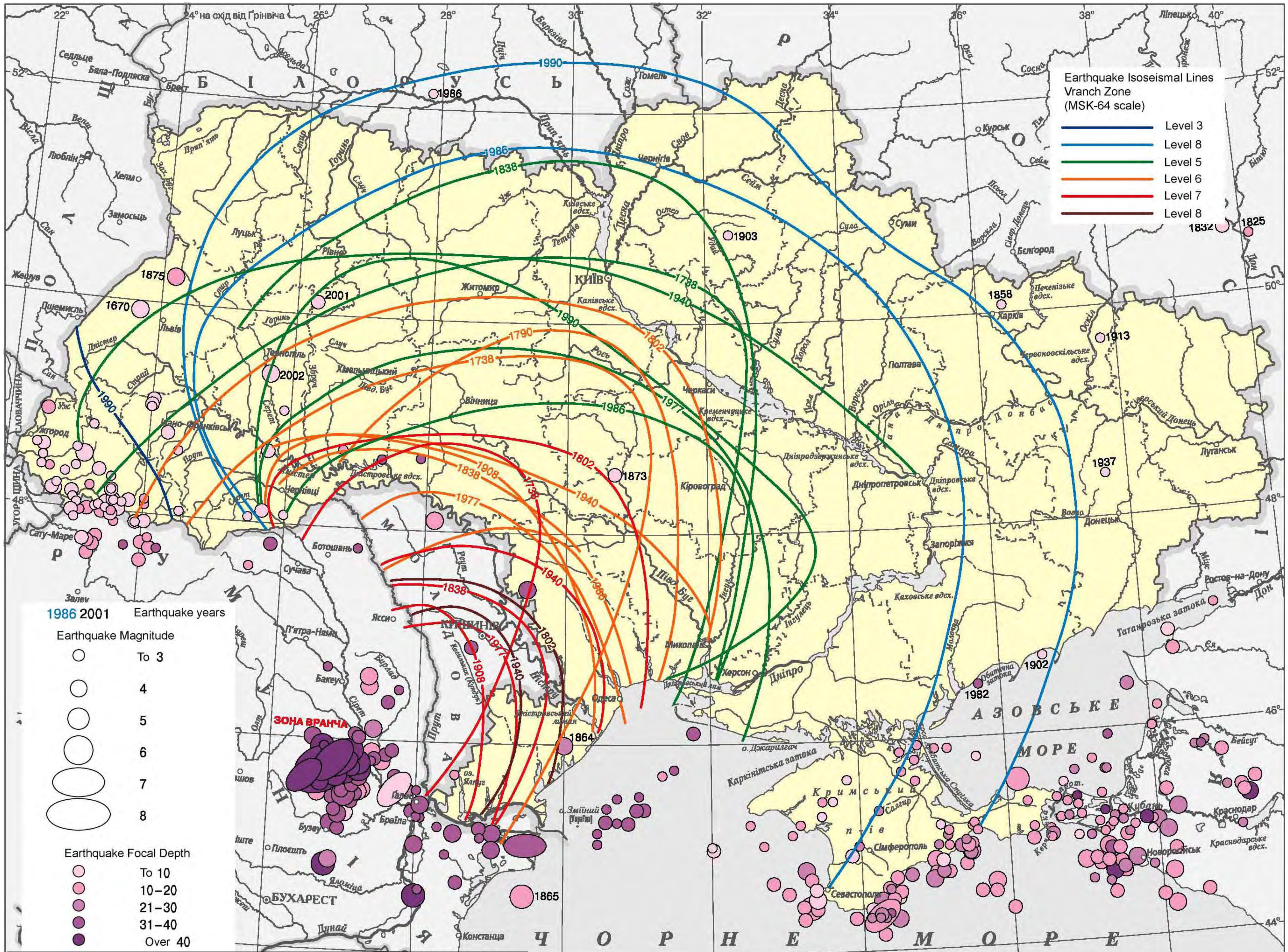


Figure 3-15: Seismicity Map (After Verbitsky, S.T., Kalitova, I.A., Kendzera, et al., 2010)

3.5 Landscape and Biodiversity

(a) Landscape and Biodiversity Summary of Existing Baseline

Topography and vegetation type

In general, the topography of Ukraine is characterised by flat lowlands and gently rolling uplands (generally referred to as plains or flatlands). The remaining 5% of the country is covered by mountainous and sub-mountainous regions, as shown in Figure 3-16. The western edge of Ukraine lies within the Carpathian mountain range (referred to as The Carpathian Zone), which stretches from the eastern boundary of the Czech Republic to the northern part of Romania. The highest mountain peak in the Ukrainian Carpathians is "Hoverla" with an elevation of 2,061m above mean sea level (amsl). Forested areas that are predominantly characterised by Fir (*Abies*) and beech (*Fagus*) tree species cover about half of the area occupied by mountain slopes, as shown in Figure 3-16.

Another distinctive topographic feature of Ukraine, the Crimean mountain range (referred to as the Crimean Zone), is located on the southeastern coast of the Crimean peninsula. This mountain range runs along the peninsula's seashore for about 250-300km in a northeastern direction from the southwestern tip of the peninsula. The highest point of the Crimean mountain range is the "Roman-Kosh" peak, at an elevation of 1,545m amsl. Approximately 60% of the hilly and mountainous terrain is covered by forest, consisting mainly of oak (*Quercus*), beech, hornbeam (*Carpinus*) and pine (*Pinus*).

The remainder of the country can be divided into four main geographic zones that can be described as roughly parallel 'east-west spread belts'. The most northern part of the country is predominantly covered by coniferous, mixed and deciduous forests (referred to as the Northern Mixed Forest Zone). Forest regions cover approximately 20% of the total area of the country. The elevation of the land varies mostly between 100 and 200m, but reaches some 400m in some places in the west. The forest-steppe and the western broadleaf forest (referred to as the Western Broadleaf Forest Zone and the Forest Steppe Zone) in the centre of Ukraine are predominantly agricultural and cover about 35% of the country. The topography ranges between 50 and 500m amsl with the higher regions being mainly to the west.

The remaining 40% of the country (the southern and eastern portions) lie within the predominantly arable steppe belt. The elevation varies between zero and 300m amsl with the higher regions being in the north and east of the zone. Most of the land in the forest-steppe and steppe zones (44% of the whole country) is covered by Chernozems (Mollisols) soils, a particularly fertile type of soil. Original (undisturbed) steppe ecosystem now is a decreasing rarity, with total areas less than 1% of the overall country territory. Figure 3-17 and Figure 3-18 describe the land cover and landscape character zones discussed in this section of the report.

Land Use

The land use pattern in Ukraine is characterised by significant use of land resources for agricultural purposes (see Figure 3-17). Agricultural land covers approximately 70% of the total territory of Ukraine including arable (37.1%), pasture (9.5%), hayland (4.4%), and perennial plants (1.5%).

Forests cover approximately 17.5% of the country, 4.1% is covered by buildings, 4% covered by water, and 3.4% is covered by miscellaneous categories of land.

There are 3.4 billion hectares of reclaimed areas in Ukraine that were formerly wetlands. Only 957,100 hectares of wetlands remain based on reported estimates. As previously discussed in Section 3.4a, activities within the Zone of Alienation around the Chernobyl nuclear site (see Figure 3-14) are restricted and under the jurisdiction of the Ministry of Emergencies of Ukraine.

Biodiversity

The biodiversity of Ukraine includes more than 72,000 species of flora, microbiota, and fauna. The biodiversity in most of Ukraine is associated with the East European Plain, which occupies 94% of the land area of the country, including the Polissja (northern forest), forest-steppe and steppe landscapes. The diverse geomorphology, climate, and topography of Ukraine account for much of the richness of flora and fauna. Ukraine is home to a high number of endemic and sub-endemic species, principally found in the Crimean Mountains, but also in the estuaries and marshes along the Black Sea and in the Carpathian Mountains; many of which are listed in the Red Book of Ukraine. Figures 19-37 show the Red Book Species distribution data for selected mammals (including bats); reptiles and amphibians; birds; and fish.

Aquatic Environment

Ukraine has several important aquatic ecosystems, including rivers, wetlands and seas. Many of the streams and rivers have been dammed for electricity, converted to fish ponds, or modified for irrigation. Wetlands associated with Ukraine's rivers cover about 5.3% of the country, and include coastal marshes, peat bogs, river plains, and forest swamps. The wetlands and marshes along Ukraine's Black Sea coast are among Europe's most important habitats for freshwater and marine fish. Ukraine's largest rivers (the Danube, the Dnieper, and the Southern Buh, as well as the Seversky Donetsk and Dneister Rivers in east and west Ukraine) include a variety of aquatic habitats that support a diverse assemblage of fish species.

Landscape and Biodiversity Zones

A review of available landscape, vegetation and biodiversity data and mapping has allowed for the definition of 16 landscape and biodiversity character zones

(see Figure 3-16); these zones are described in detail below. The distribution of notable and protected species of fauna is also summarised by zone; and Figure 3-18 shows within which zones the protected areas of Ukraine are located.

The Carpathian Zone

The mountainous Carpathian Zone can be sub-divided into the following landscape areas:

- Carpathian Western Uplands;
- Carpathian Foothills and Mountains; and,
- Carpathian Eastern Lowlands

The Carpathian Western Uplands comprises of dissected forest uplands of spruce (Picea)/beech, oak/beech, hornbeam/beech, pine/beech. Some areas are poorly drained with boggy soils, whilst drier areas contain meadows and oak forests. There are some pockets of grassland, cropland and transitional cropland and natural vegetation mosaics. The Carpathian Foothills and Mountains are a mosaic of forest fir/silver birch (*Betula pendula*), fir/beech, beech, oak/beech meadows and alpine meadows. There are areas of grassland, cropland, mosaics of cropland and natural vegetation, vineyards and gardens. The Carpathian Eastern Lowlands comprise flat lowlands, with swamps, meadows and oak forests, some areas of upland with beech/oak and fir/pine/beech forests. The majority of this area is covered in cropland, with cropland/natural vegetation mosaic and forest interspersed throughout.

The Carpathian zone supports populations of several large predators (carnivores and raptors) including several thousand brown bear (*Ursus arctos*), and more than 4000 wolves (*Canis lupus)*. Approximately 1000 lynxes (*Lynx lynx*) remain. The Carpathians are one of the last European refuges of the wild cat (*Felis sylvestris*), which are largely restricted to the beech forest in the west (see). The Carpathians provide a nesting site of the golden eagle (*Aquila chrysaetos*) (see Figure 3-28 through to Figure 3-32) and it is also the only mountain range in Europe with a free ranging population of European bison (*Bison bonasus*)[56]. The mix of meadow and forest also provides the unique habitat mosaic for the endemic Tatra vole (*Microtus tatricus*) (see Figure 3-19 through to Figure 3-21). Up to 21 species of bat were recorded in the Eastern Carpathian mountains in the late 1990's[57] all of which are reliant on suitable forest, woodland or scrub habitat, with at least five species presently listed at near threatened status or worse on

[56] World Wildlife Fund (Lead Author); C Michael Hogan PhD. (Contributing Author); Sidney Draggan (Topic Editor) *"Carpathian montane conifer forests"*. In: Encyclopedia of Earth. Eds. Cutler J. Cleveland (Washington, D.C.: Environmental Information Coalition, National Council for Science and the Environment). [First published in the Encyclopedia of Earth August 23, 2008; Last revised Date December 6, 2010; Retrieved March 23, 2011 <http://www.eoearth.org/article/Carpathian_montane_conifer_forests?topic=49597>

[57] Krochko and Kovtun (1998). *Changes in the bat fauna of Ukrainian Carpathians Mts. in the last 50 years*, Vespertilio 3: 51– 55.

the Ukraine IUCN Red List[58] (see Figure 3-22 through to Figure 3-25).

The herpatofauna of the Carpathians is largely represented by the fire salamander (*Salamandra salamandra*), Carpathian newt (*Triturus montadoni*), adder (V*ipera berus*), slow worm (*Anguis fragilis*), European pond turtle (*Emys orbicularis*) and the common lizard (*Lacerta vivipara*) (see Figure 3-26 and Figure 3-27).

The Crimean Zone

The Crimean Zone comprises steppe, mountains and a strip of sub Mediterranean landscape. The Yalia alpine meadows are a distinctive feature. The Crimean Zone can be subdivided into the following landscape areas;

- Crimean Steppe;
- Crimean Foothills and Mountains; and,
- Crimean Sub-Mediterranean Costal Slopes.

The rolling lowlands of the Crimean Steppe were previously covered with steppe vegetation. Today however the land cover is mainly cropland with areas of grassland. There are some areas of urban and built upland. There are pockets of cropland/natural vegetation mosaic and isolated areas of savannah and shrubland, with little tree cover. Crimean Foothills and Mountains are covered with forest (hornbeam, ash (*Fraxinus*), oak, Crimean pines (*Pinus nigra subsp. Pallasiana*), juniper (*Juniperus*), pine/beech groves), and meadows and yaila (alpine meadows). The forested areas are interspersed with significant areas of cropland and cropland/natural vegetation mosaic, grassland and isolated pockets of savannah. With the exception of Simferopol, Sevastopol and coastal towns there are few areas of urban or built up land. Crimean Sub-Mediterranean Coastal Slopes form steep slopes covered in subtropical vegetation, (pine/beech woodland, juniper, with some oriental hornbeam (*Carpinus orientalis*) and pine/oak woodland). Land cover is a patchwork of forest, cropland, cropland/natural vegetation mosaic, grassland, woody savannah and isolated patches of open savannah. There are permanent wetlands along the coastline.

		
View of eroded peak, forested slopes, and mountain steppe habitats of the central Crimean Mountains.	Rolling uplands of the Crimean steppe. This is a field planted with winter wheat.	Estuarine salt-marsh habitats of the Sevash region (located between Crimea and the southern coast of Ukraine mainland)

[58] IUCN Red List (2008) http://www.iucnredlist.org/

The fauna of the Crimea can be split between the wooded and grassland habitats of the mountains, foothills and steppe forest, and its Mediterranean southern coast. The mountain-forest fauna is most diverse on the northern slopes of the Yaila, where the endemic Crimean red deer (*Cervus elaphus sp.*), the Crimean chamois (*Rupicapra rupicapra sp.*), pine marten (*Martes martes*), stone marten (*Martes foina*) and fox (*Vulpes vulpes*) characterise the mammal ecosystem.Crimea supports around 20 of Ukraine's 26 bat species. The high diversity is associated with the availability of over 1000 known karst caves supporting large colonies of Greater Horseshoe Bat *(Rhinolophus ferrumequinum*) and, lesser mouse-eared myotis *(Myotis blythii)*[59] (see Figure 3-22 through to Figure 3-25).

Bird species include birds of prey such as the golden eagle, eastern imperial eagle (*Aquila heliaca*), short eared owl (*Asio flammeus*) and peregrine falcon (*Falco peregrinus*) wetland birds (see migratory birds) and passerines such as rock thrush (*Monticola saxatilis*) and black-headed bunting (*Emberiza melanocephala*) (see Figure 3-28 through to Figure 3-32).

The herpatofauna of the forests and meadows is represented by leopard snake (*Elaphe situala*), meadow viper (*Vipera renardi*) and Dice snake (*Natrix tessellate*). Among the reptiles found on the Crimean southern shore is the endemic Kotschy's gecko (*Cyrtopodion kotschyi*), and such lizards as the Crimean lizard (*Lacerta taurica*) and cliff lizard (*Lacerta saxicola*) (see Figure 3-26 and Figure 3-27).

The Northern Mixed Forest Zone

The Northern Mixed Forest Zone is a large area of uplands and lowlands, characterised by coniferous and broad leafed vegetation stretching across the north of the country and bordering with Poland to the west, Belarus to the north and Russia to the west. At one time this area would have been covered in forest but today the forest cover is less than 33%. Within this swath of land are significant areas of swamp, wetland and bogs. Vegetation consists of forest (oak/pine, coniferous alder, hornbeam) interspersed with cropland and cropland/natural vegetation mosaic which predominates in the east of the country. With the exception of the area around Kyiv, urban and built-up land is concentrated in the western part of this zone and is relatively sparse.

The remnant forest and wetland habitats within this zone contain relatively diverse fauna, providing a range for bison, and a variety of forest and woodland

mammals including lynx, elk (*Alces alces*), pine marten and roe deer (*Capreolus capreolus*) (see Figure 3-19 through to Figure 3-21). Woodland and meadow habitats provide suitable forage sites and summer roosts for a number of bat species, notably the pond myotis (*Myotis dasycneme)*, Natterer's bat (*Myotis nattereri),* the western barbastelle (*Barbastella barbastellus)* and the lesser noctule (*Nyctalus leisler)* (see Figure 3-22 through to Figure 3-25).

Bird species within the northern mixed forest zone include game birds such as black grouse (*Tetrao tetrix*) and Capercaillie (*T. urogallus*), woodland birds such as the grey-headed woodpecker (*Picus canus*) and great grey owl (*Strix nebulosa*), and migrant species such as the black stork (*Ciconia nigra)*, the latter species being particularly reliant on a habitat mosaic of forest and wetland for breeding territories. The protected (Ramsar) areas, known as Perebrody Peatlands and Polissia Mires, provide key nesting habitat within open water and boreal mire habitat mosaics for black stork, corncrake (*Grus grus)*, capercaillie, aquatic warbler (*Acrocephalus paludicola)*, and short-toed eagle (*Circaetus gallicus)* (see Figure 3-28 through to Figure 3-32).

Woodland, scrub and wetlands provide suitable habitats for a number of reptiles and amphibians, including the European pond turtle, slow worm, the Armenian rock lizard (*Darevskia armeniaca*), sand lizard (*Lacerta agilis*), smooth snake (*Coronella austriaca*) and adder (see Figure 3-26 and Figure 3-27).

The Western Broadleaf Forest Zone

The Western Broadleaf Forest Zone is a large area of uplands and lowlands in the west of the country, bordering with Poland to the east and characterised by broadleaf forest (hornbeam/oak, hornbeam/oak/beech, hornbeam/beech, beech, pine, oak/pine, hornbeam/pine, oak, and hornbeam). Today much of the area is cropland, with significant areas of mixed forest and cropland/natural vegetation mosaic. Urban and built up areas are scattered throughout the zone.

Mammals within this zone are represented by stoat (*Mustela ermine*), steppe polecat (*Mustela eversmanii*), mink (*Mustela lutreola*), badger (*Meles meles*) and otter (*Lutra lutra*); all of which are found throughout the wooded and riparian habitats in the majority of Ukraine. The open upland areas of this zone support populations of the European ground squirrel (*Spermophilus citellus*) (see Figure 3-19 through to Figure 3-21). The woods and wetland mosaics also support populations of pond myotis, Natterer's Bat, western barbastelle, lesser horseshoe bat (*Rhinolophus hipposideros*) and Bechstein's myotis (*Myotis bechsteinii)* which roost in the karst caves found in the northern part of the Podolia region (close to and east of the city of Ivano- Frankivsk) (see Figure 3-22 through to Figure 3-25).

Within the pockets of broadleaf wooded and meadow habitats that remain the herpatofauna of this zone is similar to that of the foothills of the Carpathian

Mountains, with the addition of the wall lizard (*Eremias arguta*), smooth snake, forest steppe adder (*Vipera nikolskii*) and the meadow viper (see Figure 3-26 and Figure 3-27).

The Forest Steppe Zone

The Forest Steppe in the centre of Ukraine is predominantly agricultural and covers about 35% of the country. Originally 25-33% of the Forest Steppe would have been forest, but today this figure is likely to be less than 11%. The topography ranges between 50 and 500m amsl with the higher regions being mainly to the west. The Forest Steppe can be sub-divided into the following landscape areas:

- Western Forest Steppe;
- Central Forest Steppe; and,
- Eastern Forest Steppe.

The uplands of the Western Forest Steppe are typically dissected with valleys, ravines and gullies. Land cover is mainly cropland, with a patch work of forest (oak/hornbeam, oak/pine, pine) and cropland/natural vegetation mosaic. Steppe meadow would have been present here but very little may remain. Small urban and built up areas are scattered throughout the zone. Some areas of the uplands are subject to landslides and are eroded by wind.

The uplands and lowlands of the Central Forest Steppe and the uplands of the Eastern Forest Steppe are typically undulating, occasionally hilly, and dissected by valleys and ravines. Land cover today is mostly cropland with some forest (oak, oak/pine, pine) and cropland/natural vegetation mosaic which are often associated with watercourses. Urban and built-up land is scattered throughout but is relatively sparse with the exception of the area around Harkov.

The pockets of remnant woodland and riparian areas of the Forest Steppe provide forage habitat for stoat, steppe polecat through the zone, and rodents such as the lesser mole rat (*Nannospalax leucodon*) and Podolsk mole rat (*Spalax zemni*) in the west. The eastern Forest Steppe provides habitat for the southern range of the Russian desman (*Desmana moschata*) a semi aquatic rodent that burrows into the overgrown banks of ponds and slow moving streams (see Figure 3-19 through to Figure 3-21).

Pockets of deciduous forest, terraced plain forest meadows and wetlands support a variety of species of bat, whilst in the western part of the Forest Steppe zone in the Podolia region there are a number of karst caves which provide underground maternity roosts. Some of the species present within this zone include the Lesser Horseshoe Bat, Bechstein's myotis, Natterer's bat, Geoffroy's myotis (*Myotis emarginatus*) western barbastelle, lesser noctule, giant noctule (*Nyctalus lasiopterus*) and Kuhl's Pipistrelle (*Pipistrellus kuhlii*) (see Figure 3-22 through to

Figure 3-25). The herpatofauna of the forest steppe is very similar to that of the Western Broadleaf Zone (see Figure 3-26 and Figure 3-27).

The Steppe Zone

The Steppe (plains or flatlands) can be sub-divided into the following landscape areas:

- Northern Steppe;
- Central Steppe; and,
- Southern Steppe.

To the west the upland and lowlands of the Northern Steppe are typically dissected by ravines and wide gullies. Formerly steppe meadowlands but now land cover is mainly cropland, with few areas of cropland/natural vegetation mosaic or urban and built-up land. The central Northern Steppe comprises rolling uplands and lowlands, dominated by arable croplands, but often dissected by valleys, gullies and ravines with rugged scarps and gully oak forests. Urban and built up land is concentrated into compact units. A wider variety of vegetation cover is associated with cities and watercourses, consisting of forest and pockets of woody savannah, shrub land and cropland/natural vegetation mosaic are present. To the east, the Northern Steppe is typically dissected by ravines and gullies. Formerly steppe meadow, most of the land cover is now cropland, however there are some significant areas of urban and built up land particularly around Donetsk. The Donetsk Ridge is a prominent range of hills. Outcrops of rock can be observed and there are gully forests. Forest (mixed, pine and oak/pine, oak/pine/hornbeam,) is generally associated with watercourses and there are significant pockets of grassland and cropland/natural vegetation mosaic, the former often associated with urban and built up land.

Central Steppe lowlands are typically rolling, and occasionally flat, often dissected by ravines and gullies. Land cover is mainly cropland and areas of urban and built-up lands are relatively sparse. To the very southwest of this area a greater variety of vegetation can be observed with some grassland and isolated pockets of forest, savannah and cropland/natural vegetation mosaic. The Southern Steppe is a coastal lowland (Black Sea and Sea of Azov), occasionally rolling. The area was formerly steppe meadowlands but now land cover is mainly cropland. However significant areas of grassland, shrub land and woody savannah are present, particularly towards the coast. Around the estuary of the Dinipro River there is an area of forest (oak/birch and aspen/alder copses) and larger areas of grassland. There are significant areas of reclaimed saltmarsh; however some saltmarsh areas may remain. Urban and built-up land are concentrated around a small number of cities (including Odessa) otherwise such land is relatively sparse.

The mammal fauna of the steppe is similar to that of the forest steppe, supporting stoat, steppe polecat, badger, otter and southern birch mouse (*Sicista*

subtilis) in wooded areas and within river corridors (see Figure 3-19 through to Figure 3-21). Such habitat also supports populations of lesser noctule, giant noctule and Kuhl's pipistrelle (see Figure 3-22 through to Figure 3-25). Within the central and southern steppe, grassland and sparsely vegetated areas also support great jerboa (*Allactaga jaculus*) and thick-tailed three-toed jerboa (*Stylodipus telum*).

Herpatofauna is similar to the forest steppe zone providing limited but suitable wood, grassland and arid natural habitat types for wall and sand lizards, the Caspian whipsnake (*Coluber caspius*), four-lined rat-snake (*Elaphe sauromates*) grass snake and meadow viper (see Figure 3-26 and Figure 3-27).

The southern coast of the Steppe Zone supports large numbers of wetland birds; these are discussed within the section on migratory birds. Remnant areas of natural savannah vegetation support a range of bird species including the steppe eagle (*Aquila nipalensis*), pallid harrier (*Circus macrourus*), the great bustard (*Otis turda*) and the black-winger pratincole (*Glareola normandii*) (see Figure 3-28 through to Figure 3-32).

Protected Areas and Species

There are more than 55 species of fauna protected under the Bern Convention located in the territories of reserves, protected areas, and landscape parks all over Ukraine. The distributions of mammal, reptile, amphibian, fish and bird species listed in the Red Data Book of Ukraine (2009) are shown in Figure 3-19 through to Figure 3-37.

Ukraine has seven UNESCO Biosphere reserves and 33 sites listed as wetlands of international importance under the Ramsar Convention on Wetlands, locations and habitats of which are set out in Table 3-8. Protected areas in Ukraine are maintained under the natural reserve fund of Ukraine. The fund includes 7,346 protected areas that cover approximately 5% of total territory of the country. The structure of natural reserve fund includes 11 categories of territories and objects protected at national, regional, and local levels. Summary statistics for areas protected under the natural reserve fund at national, regional and state level and details of the relevant IUCN protected area management category[60] are provided in Table 3-7. Geographical distribution of reserve areas varies from region to region (as shown in Figure 3-18). Table 3-8 provides summary details of internationally designated sites by region and oblast. In many instances internationally designated sites overlap with reserves protected by the natural reserve fund.

[60] IUCN protected area management categories classify protected areas according to their management objectives. The categories are recognised by international bodies such as the United Nations and by many national governments as the global standard for defining and recording protected areas and as such are increasingly being incorporated into government legislation.

Table 3-7: Summary Statistics for Natural Reserve Fund Protected Areas

Category	Number	Area (ha)	Equivalent IUCN Category
National Biosphere Reserve	4	197,349	Ia - strictly protected areas set aside to protect biodiversity or geological/geomorphical features
Nature Reserve	15	159,656	
State Nature Reserve	1	4,540	
National Nature Park	1	49,400	II - large natural or near natural areas set aside to protect large-scale ecological processes, species and ecosystems characteristic of the area
National Park	7	470,968	
Protected Tract	149	34,053	III – protection provided to a specific natural monument, which can be a landform, sea mount, submarine cavern, geological feature
Regional Nature Monument	27	3,829	
State Nature Monument	29	1,680	
Regional Nature Preserve	799	401,722	IV - protected areas that aim to protect particular species or habitats
State Nature Preserve	208	388,928	
Regional Landscape Park	19	322,757	V - protected areas where the interaction of people and nature over time has produced an area of distinct character with significant ecological, biological, cultural and scenic value

Table 3-8: Internationally Protected Areas by Region

Location	Designations (Number)	Habitat
Western Region		
Carpathian Zone		
Zakarpattia/L'viv	UNESCO Biosphere (2)	M, BF
	Ramsar (1)	L, CF
Northern Mixed Forest Zone		
Rivne	Ramsar (1)	L, FW
Volyn	UNESCO Biosphere (1) Ramsar (3)	BF, L R, L, FW, TG
Northern Region		
Forest Steppe Zone		
Sumy	UNESCO Biosphere (1) Ramsar (1)	R, L, FW
Central Region		
Northern Mixed Forest Zone		
Zhytomyr	Ramsar (1)	FW, R
Southern Region		
Southern & Central Steppe		
Kherson (& Mykolaiv)	UNESCO Biosphere (3) Ramsar (7)	TG, SG, FW, R, L, SW
Odessa (& Mykolaiv)	UNESCO Biosphere (1) Ramsar (8)	SW, FW, R, L
South Western Region		
Western Broadleaf Zone		
Khmelnytska	Ramsar (2)	FW, R, L
Donbass Region		
Forest Steppe / Northern Steppe Zone		
Donetsk	Ramsar (2)	SW
Dnipro Region		
Northern Steppe Zone		
Dnipropetrovsk	Ramsar (1)	R, L, FW
Zaporizhia	Ramsar (3)	SW
Crimea Region and Zone		
Crimea	Ramsar (3)	SW

Key: Habitats: M – Mountain; BF – Broadleaf Forest/woodland; CF - Coniferous Forest SW – Saline and Coastal Wetlands; FW - Freshwater Wetlands; R – Rivers; L – Lakes; TG - Temperate Grasslands; SG - Steppe Grasslands

Migratory birds

The Atlas of Ukraine identifies within country, inter-country and intercontinental bird migration routes which pass through Ukraine (see Figure 3-38). The main Mediterranean/Black Sea/Scandinavian Flyway is one of world's largest bird migration systems bisecting Ukraine north-south. Birds within the flyway seek refuge and food in the open water and wetland habitats on the southern coast and various interior wetland sites and corridors. Ukraine provides refuge on the flyway to the critically endangered, slender billed curlew (*Numenius tenuirostis),* and the endangered red-breasted goose (*Rufibrenta ruficollis*). In general, the large populations of birds which fly north in the spring to their arctic or temperate breeding grounds, and south in the autumn to warmer wintering grounds are vulnerable to loss of habitat.

Resident bird populations also migrate between regions, notably east–west, between habitats on the Azov and Black Sea coasts, and in the north between the different wooded zones. Both resident and flyway populations of larger birds with relatively lower manoeuvrability (such as swans, geese, storks, pelicans and cranes) are at greater risk of collision with manmade structures, such as power lines, within the migratory corridors. Resident and migratory raptor populations may also be vulnerable to such structures, due to their large hunting range.

The coastal wetlands in the south host large populations of migratory birds. The coastal wetlands bordering the Black Sea/River Danube delta in the west, the coastal limans (lagoons) of the Kershon and Crimean coastal flats, and the sand and shingle spits and limans that characterise the northern shores of the Azov Sea provide ideal staging posts for hundreds of thousands of waterbirds.

A notable wintering resident of these coastal habitats is the endemic red breasted goose which, since the 1960's, winters in the Azov and Black Seas from October to March, before returning to its breeding grounds in the north and west of central Siberia. Other notable species dependent on these areas for their life cycles are Dalmatian pelican (*Pelecanus crispus),* great white pelican *(Pelecanus onocrotalus),* slender billed curlew and ferruginous duck (*Aythya nyroc)* - the latter forming part of an assemblage of wetland birds nesting in their hundreds of thousands at Tendrivska Bay on the Black Sea coast[61].

The Crimean coastal wetlands support millions of waterbirds at various stages in their life cycles, notably populations of ruddy shelduck (*Tadorna ferruginea*), great cormorant (*Phalacrocorax carbo*), gull-billed tern (*Gelochelidon nilotica*) and slender-billed gull (*Larus genei*); white-fronted goose (*Anser albifrons*), mallard (*Anas platyrhynchos*), and garganey (*Anas querquedula*). To the east, a string of saline lagoons and sand spits protruding from the Azov Sea coast provide

[61] http://www.grid.unep.ch/bsein/redbook/txt/rufibren.htm?%20AVES

important habitat for tens of thousands of breeding ducks and wintering water fowl. The main river deltas in Ukraine also provide important migratory staging posts and seasonal residencies for vast numbers of water birds. The coastal river delta of the Dniester River and floodplain supports over 50,000 wintering birds and internationally important numbers of great white egret (*Egretta alba*) and glossy ibis (*Plegadis falcinellis*).

The Danube River delta is important for migrating, breeding (25,000 pairs), and moulting birds, and supports internationally important numbers of nesting pygmy cormorant (*Phalacocrax pygmeus*). Of the 140 bird species occurring at the site, 32 are nationally rare. The Dnipro River delta also supports internationally important numbers of breeding great white egret. In addition, large populations of numerous species of waterbirds moult at the site

A number of large freshwater wetlands provide staging posts for bird populations migrating between the Siberian tundra breeding grounds in the north and wintering grounds in temperate or tropical zones adjacent to or via the Black Sea. Inland, the Dneister reservoir, Bakotska Bay, on the northern Moldovan border supports various waterbird species like mallard, and great egret for long periods during their spring and autumn migrations. The Volyn wetlands in the Prypiat River and Stokhid River floodplains, and at Shatsk Lakes, lie on a migratory crossroads of two main flyways. These sites provide important habitat for numerous species of large numbers of breeding, staging, and moulting waterbirds.

Within Ukraine, the migratory corridor within the river floodplain of the Dneiper River (Dnipro) provides an important North-South migratory route for the white tailed eagle (*Haliaeetus albicilla*). Within this corridor the Dnipro Oril floodplains provide an important nesting place for oystercatcher (*Haematopus ostralegus)*, corncrake, black stork and night heron (*Nycticorax nycticorax*) and represents a key point of the Dnipro bird migration route. Large flocks of mallard, garganey, coot (*Fulica atra*) and white-fronted goose stop over during their autumn migrations.

Ukraine Fish Communities

Approximately 170 species and subspecies of fish occur in Ukraine and in the portion of the Black Sea shelf belonging to Ukraine. Table 3-9 lists the number of freshwater fish species of concern that occur in Ukraine as determined by the government of Ukraine and Figure 3-33 through to Figure 3-37 shows the distribution of selected Red Book fish species within Ukraine.

Table 3-9: Distribution of Listed Fish Species in Ukraine by river Basin

River Basin	No of Fish Species of Red Book of Ukraine (1992) and their Status*[62]				
	Endangered	Vulnerable	Rare	Missing	Undefined
Dneister	6	7	2	1	1
Danube	8	8	3	1	1
Southern Buh	5	2	0	0	0
Dneiper	8	3	0	1	1
Seversky Donetsk	7	4	0	0	0

Source: Ministry of Ecology and Natural Resources of Ukraine (1992), Red Data Book of Ukraine - Animal World

Migratory Fish

With its coastal marine environment, Ukraine supports several migratory fish, including the following six native species of sturgeon:

- Russian sturgeon (*Acipenser guldenstaedtii*);
- Ship sturgeon (*A. nudiventris*);
- Sterlet (*A. ruthenus*);
- Stellate sturgeon (*A. stellatus*);
- Atlantic sturgeon (*A. sturio*); and,
- Great sturgeon (*Huso huso*).

Except for sterlet, which is entirely a freshwater species, all of the above species are anadromous (i.e., live in the Black Sea and enter the freshwater rivers to spawn) and are afforded protection due to their inclusion within the Red Book of Ukraine. Their distribution is shown in Figure 3-33 through to Figure 3-37.

Other migratory species and the major basins in which they occur include the following:

- European eel (*Anguilla anguilla*) – Dneister, Serversky Donets, Southern Bug;
- Common whitefish (*Coregonus lavaretus*), broad whitefish (*C. nasus*), and northern whitefish (*C. peled*) – Lower Dnieper, Dneister, Southern Bug;
- Pontic shad (*Alosa immaculata*) – Danube; Dneiper;
- Caspian shad (*A. caspia caspia*) – Tributaries of the Black Sea;
- Bleak (*Alburnus sarmaticus*) – South Bug, Dneiper, and Danube;

[62] Status Missing: Species which have not been recorded in the wild in recent history. Endangered: Species whose populations are very small and unlikely to survive under additional stress. Vulnerable: Species that may be designated as "endangered" if populations continue to decline. Rare: Species whose populations are small and at risk but not to the point where they are considered "endangered" or "vulnerable." Undefined: Species for which adequate information to assign a "rare," "vulnerable," or "endangered" designation is not available.

- Huchen (*Hucho hucho*) – Danube;
- European river lamprey (Lampetra fluviatilis) – Danube;
- Roach (Rutilus rutilus) – Danube; Dneiper; Dneister; Seversky Donets; Southern Bug; and,
- Black Sea salmon (Salmo labrax).

The degree of upstream movement by migratory fish is in many cases affected by the presence of dams and other natural or man-made obstructions on rivers in Ukraine that impede migration.

Introduced Fish Species

The estimated number of exotic fish species that have been introduced to Ukraine waters varies depending on the information source that is reviewed. USAID[63] reported that since the early 1900's, 41 species have been imported for various reasons and through various means. A total of 34% of these species have been brought in for use in aquaculture applications, whereas the remaining 66% entered the Black Sea as larvae in ballast waters and/or attached to ship hulls. The number of introduced fish species in Ukraine has steadily risen from seven during the period from 1926 to 1950, to 11 from 1951 to 1975, and to 17 from 1976 to 2000. Such trends can have significant impacts on freshwater and marine ecosystems as non-native species affect endemic species through predation, competition for food and habitat, the destruction or alteration of habitat, and other factors.

Commercial Fisheries

Commercial fishing has historically been an important industry in Ukraine, and remains a key source of employment and income, particularly for people living along the Black Sea and in the country's major river drainages. Overfishing in the 1900s affected fish populations such that certain species have declined or been extirpated in portions of their natural range. Examples of these include sturgeon *(Acipenseridae spp.)*, mackerel (*Scombridae spp.*) and bonito (*Sarda spp.*) in the Black Sea, and pike (*Esox spp.*), perch (*Perca spp.*), roach (*Rutilus spp.*) and bream (*Abramis spp.*) in the Sea of Azov. In recent years, however, fish stocks have been reported as recovering, apparently due to reductions in water pollution and eutrophication of both marine and fresh water bodies. In 2003, Ukrainian catch amounted to 45,000 and 19,000 tons of fish/sea products in the Black Sea and Sea of Azov, respectively. Major commercial taxa in the Azov-Black Sea basin include fish species such as European sprat (*Sprattus sprattus*), Azov tyulka (*Clupeonella cultriventris*), anchovy (*Engraulidae spp.*), pike-perch (*Sander spp.*), grey mullet (*Mugil cephalus*), whiting (*Merlangius spp.*), dogfish (*Squalidae spp.*), and brill (*Scophthalmus rhombus*), and various species of mussels and clams. Table 3-10

[63] US Agency for International Development (2007) *Ukraine FAA 119 Biodiversity Analysis.*

includes the important commercial fish species in Ukraine's major river basins.

Table 3-10 Key Commercial Fish Species in Major Ukraine Drainages

Species		Dneiper	Dneister	Seversky Donetsk	Southern Buh
Common bream	*Abramis brama*	✓	✓	✓	✓
Roach	*Rutilus rutilus rutilus*	✓	✓	✓	✓
Vimba	*Vimba vimba*	✓	✓	✓	✓
Common carp	*Cyprinus carpio*	✓			
Wels catfish	*Silurus glanis*	✓	✓	✓	
European pike perch	*Lucioperca lucioperca*	✓	✓	✓	✓
Northern pike	*Esox lucius*	✓		✓	
Kutum	*Rutilus frizii*	✓	✓	✓	✓
European eel	*Anguilla anguilla*	✓	✓	✓	
Black Sea salmon	*Salmo trutta labrax*	✓			
Burbot	*Lota lota*	✓	✓		✓
Sterlet	*Acipenser ruthenus*	✓	✓		
Caspian shemaya	*Chalcalburnus chalcoides*	✓		✓	
Barbel	*Barbus barbus borysthenicus*				✓

Sources: Institute of Geography, National Academy of Sciences of Ukraine (2008) Ukraine in Maps; Food and Agriculture Organisation of the United Nations, Fisheries and Aquaculture Department (Undated) Fishery and Aquaculture Country Profiles: Ukraine.

Invertebrates

Approximately 44,000 species of invertebrates are believed to occur in Ukraine, most of which (~35,000) are insects. There are 299 species of invertebrates, including 226 species of insect, that have protected status in the Red Book of the Ukraine. However, many invertebrates remain undescribed and their distribution unknown due to limited survey capacity. Despite little available information it is considered that the greatest diversity and abundance of invertebrates is associated with remnant natural habitats and ecosystems, with a particularly rich fauna associated with the relict mountain, forest and wetland habitats in Crimea, Carpathian and coastal and estuarine zones of the Black Sea and Sea of Azov.

In general, limited information is available regarding the aquatic invertebrate communities of Ukraine's freshwater streams. However, it is known that the Dnieper River has a diverse community of aquatic flora and fauna, particularly in its upper reaches. Planktonic communities consist largely of various species of diatoms, rotifers, and algae. Plankton abundance decreases sharply in the Dnieper River's lower reaches due to the influence of reservoirs. Benthic communities consist of a variety of mollusc, aquatic insects, and other organisms. It is likely that other rivers in Ukraine support similar invertebrate populations.

(b) Landscape and Biodiversity Future Trends in Baseline

Although the government is planning a substantial expansion of the nature reserve fund of Ukraine (compared to current 2,990ha) by 2015, landscapes and biodiversity in Ukraine are under constant threat of uncontrolled land use for economic purposes (extraction of fossil fuels, residential development, and recreational facilities). Biodiversity in large parts of Ukraine was systematically adversely impacted during the Soviet era, largely to make way for agriculture. Steppe and wetland ecosystems (meadows and marshes) suffered the most. Land conversion activities and dams have seriously impacted biodiversity of rivers, the Black Sea, and the Sea of Azov. A few large reserves are well managed, while many small reserves have no management at all. Poorly regulated hunting activities and uncontrolled collecting of wild plants pose serious threats to declining populations of native species. Conservation programmes at the local level are energised and dynamic, but suffer from inadequate management of natural resources. The non-governmental organisation (NGO) community does not often have the influence to be an effective partner with government and industry to address biodiversity and natural resources issues.

There are; however, certain positive tendencies in land use. There are trends towards increasing the areas under conservation status (on average 400 hectares per year), expansion of forest areas, as well as towards the reduction of non-vegetated areas and radioactively polluted lands.

(c) Landscape and Biodiversity Data Sources

- The following data sources were used in producing the baseline text for the landscape and biodiversity section:
- Protected Area and Key Biodiversity Area data was downloaded from the Integrated Biodiversity Assessment Tool (IBAT) (http://www.ibatforbusiness.org). Provided by BirdLife International, Conservation International, IUCN and UNEP-WCMC (contact ibat@birdlife.org for further information);
- “Ukraine FAA 119 Biodiversity Analysis” (US Agency for International Development: February 2007);
- “Red Data Book of Ukraine” (IA Akimova (editor) - K.: Hlobalkonsaltynh (Edited), 2009). Wildlife / Natural Science, 2009.- 600 p;
- “Biodiversity Assessment for Ukraine” (Chemonics International Inc. and Environment International Ltd.: August 2001);
- “Lower Danube – The Last Refuge for Surviving of Sturgeon Fishes in the Black Sea Region” (M. Vassilev, Institute of Zoology, BAS, Sofia, Bulgaria);
- Biodiversity and Protected Areas – Ukraine (Earthtrends 2003 [www.earthtrends.wri.org]);
- “National Atlas of Ukraine”;

- "Fishery and Aquaculture Country Profiles: Ukraine" (Food and Agriculture Organisation of the United Nations, Fisheries and Aquaculture Department; www.fao.org/fishery/countrysector: undated);
- Dnieper River (www.history.com/topics/dnieper-river;
- Freshwater Ecoregions of the World: 425: Dnieper – South Bug (www.feow.org);
- Earth's Endangered Creatures – various fish species (www.earthsendangered.com);
- Information on various fish species (www.fishbase.org);
- Information on various fish species (www.iucnredlist.org);
- Information on various fish species (data.gbif.org);
- List of freshwater fishes for Ukraine (www.mongabay.com);
- Information on the Dniester River (www.dniester.org);
- United Nations Environment Programme - Black Sea Environmental Internet Node (http://www.grid.unep.ch/bsein/redbook/txt/rufibren.htm?%20AVES);
- WWF http://www.eoearth.org/article/Carpathian_montane_conifer_forests?topic=49597; Atlas of Ukraine.);
- Land Cover http://webmap.ornl.gov/wcsdown/dataset.jsp?ds_id=10004;
- Ukraine in Maps;
- National Atlas of Ukraine, ed. by L.G. Rudenko. Available from National Academy of Sciences of Ukraine Institute of Geography, 01034 Kyiv;
- Guidelines for Landscape and Visual Impact Assessment Second Edition, Spons Press;
- Krochko and Kovtun, 1998. Changes in the bat fauna of Ukrainian Carpathians Mts. in the last 50 years, Vespertilio 3: 51– 55;
- Ramsar Wetlands http://ramsar.wetlands.org/Database/Searchforsites/tabid/765/language/en-US/Default.aspx;
- UNESCO Biosphere Directory http://www.unesco.org/mabdb/br/brdir/directory/contact.asp?code=UKR ;and,
- Red Book of Ukraine. Wildlife / Natural Science. IA Akimova - K.: Hlobalkonsaltynh, 2009 .- 600 p.

(d) Landscape and Biodiversity Data Quality

Landscape and biodiversity data quality varies widely, with the majority of distributional data is based on a national resolution. In most cases readily available data on ecology and habitat association are general and focussed on internationally and nationally protected areas and species. Data related to a particular drainage, region or site is very limited. General statements regarding resources are made but not backed by specific data.

(e) Landscape and Biodiversity Data Gaps

Data collation and or primary collection is required to address landscape and biodiversity data gaps associated with:

- Species and habitat associated records and distribution at Unitary Authority/local/project level;
- Up-to-date, drainage-specific data on fish populations;
- Data on aquatic invertebrates;
- Information on aquatic habitats in major drainages; and,
- Information on existing landscape character.

(f) Landscape and Biodiversity Constraints and Opportunities for Renewable Energy

The key constraints and opportunities for renewable energy in relation to landscape and biodiversity are summarised in Table 3-11.

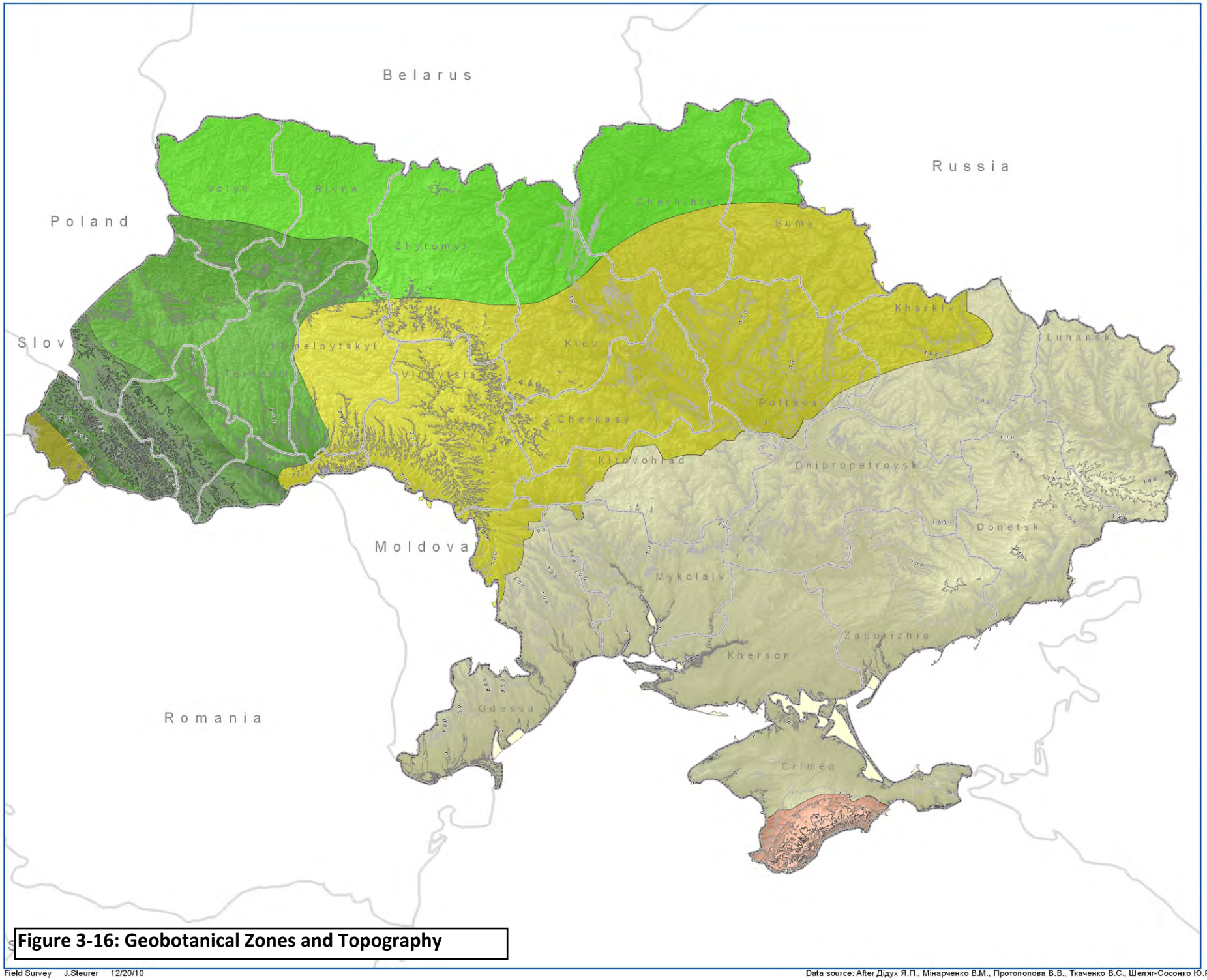
Table 3-11: constraints and opportunities in relation to landscape and biodiversity

Constraints	Opportunities
• The presence of protected areas, and any expansion to protected areas, may reduce the amount of land available for all renewable energy projects; • High density of existing protected areas are located in the most promising for renewable energy project areas (Carpathian region (hydropower), Crimea (wind, solar)); • Low productivity and land degradation in certain areas of the country could prevent development of biomass and biogas projects; • Small hydro: minimum flow requirements to protect biodiversity; • Bird migration corridors, important breeding grounds for large birds, or areas favourable for bats (wind, mainly); • Presence of protected fish or terrestrial species;	• Degraded lands could be used for wind or solar renewable energy projects; • If feasible, underground transmission lines in highly sensitive areas would limit effects on landscape and visual amenity; • New ancillary structures (pylons) can be aligned to other existing liner structures within the landscape (such as roads or railways) to limit impacts; • Sensitive siting of new structures in relation to landform can limit obtrusive views; • Improvements to local roads as part of project development; • Sensitive design of new structures to allow them to blend in with the local landscape character; and, • Opportunity to create 'landmark features' of new infrastructure buildings/facilities where appropriate.

Constraints	Opportunities
• The construction of infrastructure and ancillary development (buildings, pylons) associated with renewable energy projects and wind farms in particular are likely to impact negatively on visual amenity and landscape character; • The requirement to construct new transmission corridors may lead to further fragmentation of wildlife corridors and migratory routes (birds, bats, mammals; e.g. bison, wolf); and, • Construction of transmission lines and towers present an obstacle to birds and bats.	

(g) Landscape and Biodiversity Figures

The figures that follow have been referenced within Section 3.5 of this Topic Paper (the Landscape and Biodiversity baseline and future baseline text):



Ukraine Sustainable Energy Lending Facility Strategic Environmental Review

Geobotanical Zones and Topography

LEGEND

- Index Contour
- Contour
- Supplemental Contour

European Broadleaf Forest Region

- Alpine-Carpathian Mountain Province of Forests and Alpine Vegetation
- Central European Province of Broadleaf Forests
- Eastern European (Sarmatian) Province of Coniferous-Deciduous and Broadleaf Forests

Eurasian Steppe Region

- Pannonsla Province of Heliophilous and Nemoral Forests, Meadows and Ostepnene Meadow Steppes
- Eastern European Forest-Steppe Province of Oak Forests, Ostepnene Meadows and Steppes Meadows
- Pontychna Steppe Province

Mediterranean Sclerophyllous Forests Region

- Sub-Mediterranean Sub-Provinces of Deciduous Forests

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0 50 100
Kilometers

1 cm = 60km

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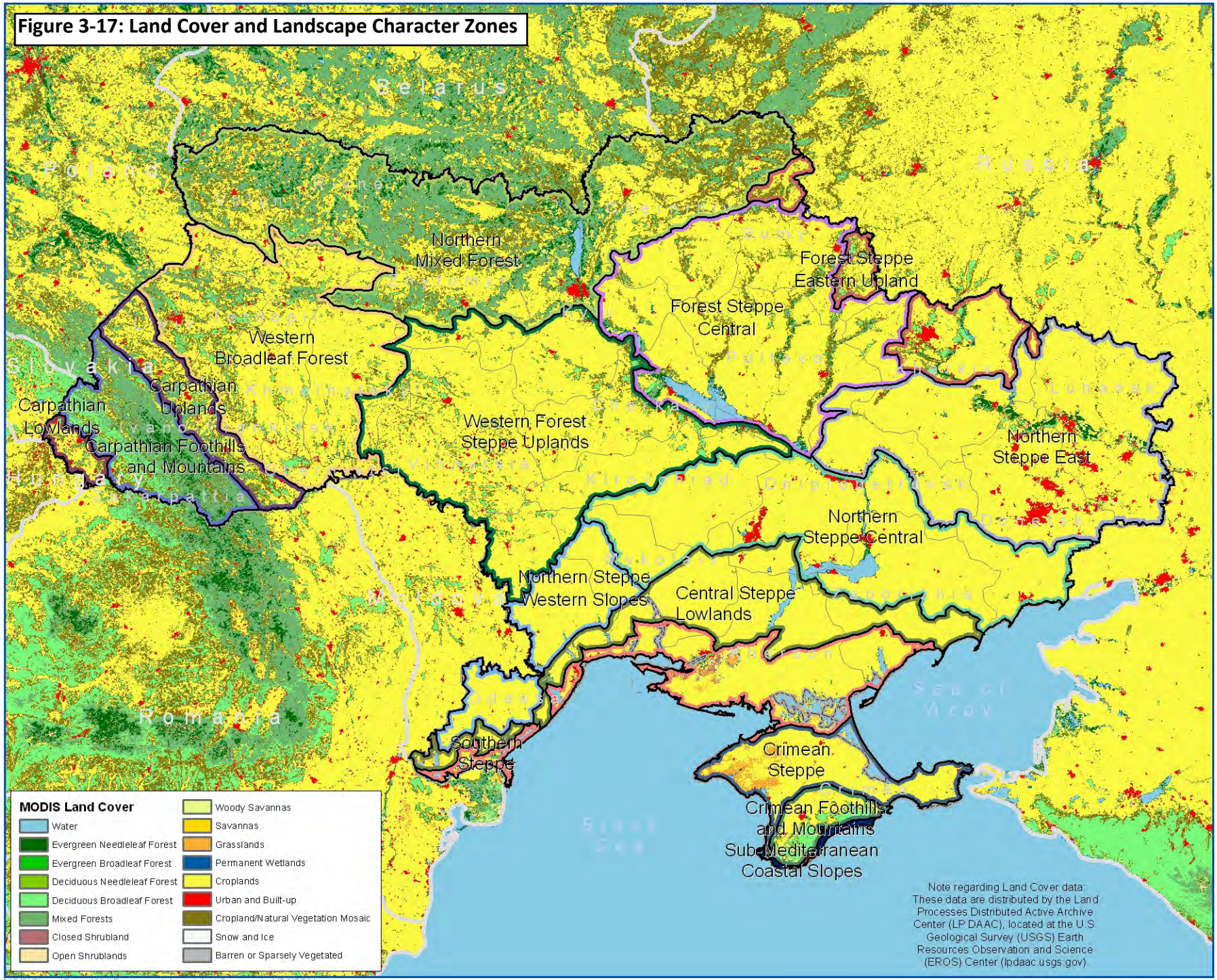
Figure 3-16: Geobotanical Zones and Topography

Field Survey J.Steurer 12/20/10

Data source: After Дідух Я.П., Мінарченко В.М., Протополова В.В., Ткаченко В.С., Шеляг-Сосонко Ю.Р., National Atlas of Ukraine; ESRI; Black & Veatch

Figure 3-17: Land Cover and Landscape Character Zones



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Land Cover with Landscape Character Zones

Legend

Landscape Character Zones

- Carpathian Foothills and Mountains
- Carpathian Uplands
- Carpathian Lowlands
- Central Steppe Lowlands
- Crimean Foothills and Mountains
- Crimean Steppe
- Forest Steppe Central
- Forest Steppe Eastern Upland
- Northern Mixed Forest
- Northern Steppe Central
- Northern Steppe Western Slopes
- Northern Steppe East
- Southern Steppe
- Western Broadleaf Forest
- Western Forest Steppe Uplands
- Sub-Mediterranean Coastal Slopes

Data Sources: MODIS MOD1201v5 Land Cover; National Atlas of Ukraine; ArcWorld Supplement; DeLorme; ESRI

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0 50 100
Kilometers

1 cm = 60 km

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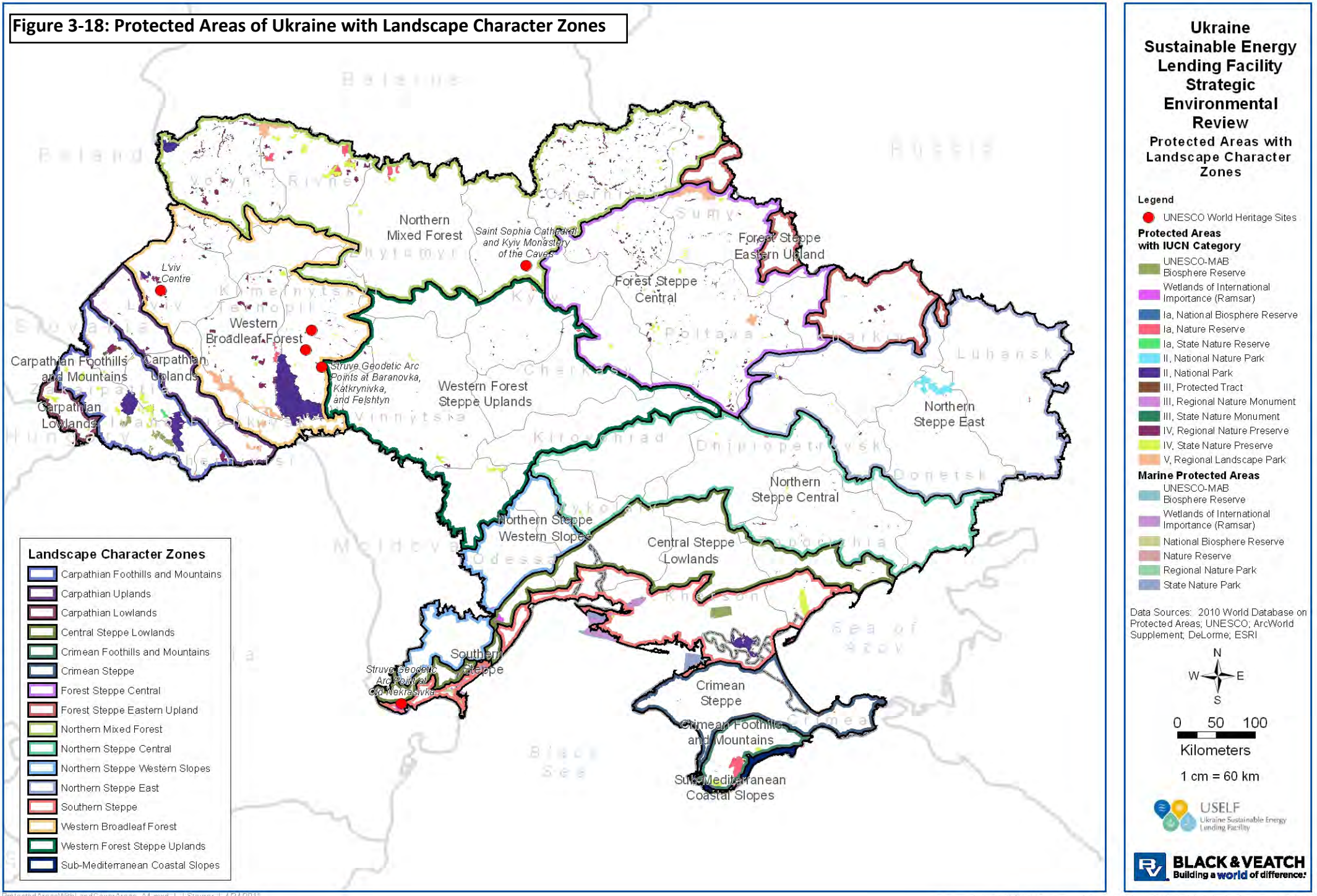
MODISLandCoverWithRegions_A4.mxd | J.Steurer | 4/24/2011

Data source(s): ESRI; World Database on Protected Places; CIAT-CSI (http://srtm.csi.cgiar.org); PVGIS

Figure 3-18: Protected Areas of Ukraine with Landscape Character Zones



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Protected Areas with Landscape Character Zones

Legend

- UNESCO World Heritage Sites

Protected Areas with IUCN Category

- UNESCO-MAB Biosphere Reserve
- Wetlands of International Importance (Ramsar)
- Ia, National Biosphere Reserve
- Ia, Nature Reserve
- Ia, State Nature Reserve
- II, National Nature Park
- II, National Park
- III, Protected Tract
- III, Regional Nature Monument
- III, State Nature Monument
- IV, Regional Nature Preserve
- IV, State Nature Preserve
- V, Regional Landscape Park

Marine Protected Areas

- UNESCO-MAB Biosphere Reserve
- Wetlands of International Importance (Ramsar)
- National Biosphere Reserve
- Nature Reserve
- Regional Nature Park
- State Nature Park

Data Sources: 2010 World Database on Protected Areas; UNESCO; ArcWorld Supplement; DeLorme; ESRI

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0 50 100
Kilometers

1 cm = 60 km

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ProtectedAreasWithLandCoverAreas_A4.mxd | J. Steurer | 4/24/2011

Data source(s): ESRI; World Database on Protected Places; CIAT-CSI (http://srtm.csi.cgiar.org); DMSIS