NATURALIT

LIFE INTEGRUOTAS PROJEKTAS

NATURA 2000 TINKLO VALDYMO OPTIMIZAVIMAS LIETUVOJE

LIFE-IP-PAF-NATURALIT

LIFE16 IPE/LT/016

Natura 2000 teritorijų tvarkymo analizė

VYTAUTO DIDŽIOJO UNIVERSITETAS

MIŠKO BIOLOGIJOS IR MIŠKININKYSTĖS INSTITUTAS

VYTAUTO DIDŽIOJO UNIVERSITETO ŽEMĖS ŪKIO AKADEMIJA

Ataskaitą rengė:

prof. dr. G. Brazaitis, S. Šaudytė-Manton, prof. dr. V. Marozas, dr. Ž. Preikša

Sub-action A.4.2: Preparation of the methodical guidance and forest management planning standards on integration of nature conservation measures into forestry management planning process

Completed by 31.12.2020

NATURA 2000

Report on Analysis of Natura 2000 Site Management
Summary

The development of the methodological document "*Guidelines for the management of natural forest habitat types of EC importance*" is an important task towards ensuring the favourable conservation status of natural habitats and species of wild fauna and flora of Community interest. Work on applicable and appropriate recommendations required the integration of several important aspects and separate project activities. This **report consists of the following parts:**

Part I: Assessment of the parameters of natural forest habitat structure and anthropogenic impact to their conservation status was conducted determining most important structure parameters. More than 90 habitats have been analysed, including natural forest habitats overlapping with Woodland Key Habitats (WKH) to describe their structure, the degree of anthropogenic disturbance, and habitat conservation status. Statistical methods were used to calculate which habitat parameters are statistically significant and related to the condition of natural forest habitats, and to assess which values of isolated parameters are related to the unfavourable-bad, unfavourable-inadequate, or favourable conservation status of each habitat. Wood harvesting intensity and forest age component that impacts the condition of the natural forest habitat was also assessed.

Finally, multivariate GLMM models of factors influencing habitat conservation status were developed. The developed models are a good example of how the status of a natural forest habitats can be quantified and assessed in a faster and more efficient manner by evaluating fewer parameters. This work has shown that use of such models should be constructed separately for each natural habitat type, because of differences in the values of the components that make up their structure.

To evaluate the management outcomes for natural forest habitats, we reviewed the database of nature management measures performed in Lithuania and conducted field assessments.

Part II: Extensive analysis of scientific literature was performed to obtain and evaluate international scientific experience and knowledge on various forest habitat management methods, their achieved results, and recommendations. Experience gained in the Baltic Sea region and other countries containing habitat types found in Lithuania were summarized. We also systematized studies on the impact of forest fires on ecosystems and species as an introduction of low intensity controlled burning of certain forest habitats in Lithuania which is one of the proposed measures to ensure favourable conservation status for fire dependant ecosystems. The literature analysis serves as ground for Lithuanian forest habitat management recommendations that are currently being developed - "*Guidelines for the management of natural forest habitat types of EC importance*".

Part III: To summarize the experience and identify the application of forest habitat management abroad, an analysis of past and ongoing LIFE projects was conducted by briefly describing the objectives of these projects and their implementation progress. The project search tool of the project database and project publications provided by European Commission LIFE program were used. The collection of such information provides a better understanding to what scope and rate forest habitats are managed and what particular measures are applied and required for restoration of forest habitats. Forests often form an integral part of different protected areas, and the variety of forest habitats and the level of naturalness leads to specific site condition when actual measures are applied to improve the general state of habitats. Finally, nature management practices have been summarized through the creation of a database of projects in our biogeographical region and the natural forest habitat types managed by them. This database is attached as a MS Excel spreadsheet.

Attachment 1. Study visit report on "Experience of Natura 2000 forest management and conservation in Finland and Sweden". Key topics and issues covered during study visit:

Controlled fires as a mean of restoring forest habitat types 9010* and 9060; Restoration or improvement of the structure of forest habitats types 9020*, 9050, 9180*, 9080*, 91E0* through active conservation measures; Practical experience in managing Annex II species and Annex I species Habitats and Birds Directives; Legal basis for the practical management of habitats and species; The role of stakeholders in the practical management of habitats and species.

Attachment 2. Study visit report on "Experience of Natura 2000 forest management and conservation in Germany and Poland". Key topics and issues covered during the study visit: Identification, assessment, and monitoring of forest values; Valuation, maintenance, and enhancement of conservation value through nature management measures; A compromise of solutions between nature conservation and nature use and evaluation of the obtained results in establishing Natura 2000 protected areas in forests where economic activities were previously carried out.

Turinys

Įvadas

Natūralių miško buveinių tvarkymo metodinių rekomendacijų rengimas yra svarbus uždavinys, siekiant užtikrinti šių buveinių tinkamą apsaugos būklę. Siekiant parengti tinkamas rekomendacijas, jose turi būti integruota keletas svarbių aspektų:

Atliktas buveinių struktūros parametrų įvertinimas, nustatyta, kokie buveinių struktūros parametrai turi ženklią įtaką. Šiuo tikslu buvo atliktas daugiau nei 90 buveinių vertinimas, aprašant buveinės struktūrą, antropogeninį trikdymą bei ekspertiniu būdu įvertinta buveinės būklė. Statistiniais metodais buvo apskaičiuota, kokie buveinės parametrai yra statistiškai ženkliai susiję su natūralios miško buveinės būkle, bei įvertinta, kokios atskirtų parametrų vertės yra sietinos su bloga, patenkinama ar gera buveinės būkle. Taip pat buvo įvertintas miško kirtimų intensyvumo ir senumo poveikis natūralios miško buveinės būklei. Galiausiai, buvo sudaryti buveinių būklę įtakojančių veiksnių daugianariai GLMM modeliai. Mes taip pat atlikome natūralių miško buveinių struktūros įvertinimą palygindami buveines kurios turi ar neturi KMB (Kertinės miško buveinės) statusą. Ši analizės dalis yra pateikiama 1 ataskaitos dalyje;

Siekiant įvertinti natūralių miško buveinių gamtotvarkos rezultatus mes peržiūrėjome ir įvertinome Lietuvoje atliktų gamtotvarkos darbų duomenų bazę, atrinkome bei aplankėme Lietuvos miškuose esančias šių darbų vietas. Aprašomos veiklos rezultatai pateikti šios ataskaitos 1 dalyje;

Buvo atlikta plati mokslinių literatūros šaltinių analizė siekiant surinkti ir įvertinti įvairius buveinių tvarkymo būdus, pasiektus rezultatus bei teikiamas rekomendacijas. Antroje šios ataskaitos dalyje yra aprašyta Baltijos jūros regiono ir kitų šalių sukaupta patirtis tvarkant Lietuvoje aptinkamas natūralias miško buveines. Mes taip pat susisteminome miško gaisrų poveikio ekosistemoms tyrimus, nes jie yra labai svarbūs siekiant pradėti taikyti miško paklotės kontroliuojamą deginimą Lietuvoje.

Siekiant įvertinti buveinių tvarkymo patirtį užsienyje buvo atlikta vykusių ir vykdomų LIFE projektų analizė, trumpai aprašant šių projektų tikslus ir vykdymo eigą. Surinkta informacija pateikiama 3 šios ataskaitos dalyje. Galiausiai, gamtotvarkinės praktikos buvo apibendrintos sukuriant mūsų biogeografinėje zonoje vykdytų projektų ir jais tvarkytų natūralių miško

buveinių tipų duomenų bazę. Ši duomenų bazė yra pridedama MS Excel lentelėje, elektroninėje formoje.

I dalis. Natūralių buveinių struktūros parametrų ir antropogeninio poveikio įtaka jų būklei

Turinys

I.1 Įvadas

Miškas yra labiausiai paplitęs natūralus biotopas Europoje, kurio biologinė įvairovė palaipsniui formavosi pasitraukus ledynmečiui ir yra neatsiejama nuo žmogaus poveikio, todėl Europos miškų tipų klasifikacija apima ir natūralius, ir tradiciškai tvarkomus miško kraštovaizdžius (Barbati ir Marchetti 2005). Dabartinė ES politika reikalauja išlaikyti pakankamą kiekį skirtingų tipiškų augalijos rūšių buveinių formuojančių funkcionalius ekologinius tinklus (Angelstam et al. 2018). Užbaigus ES buveinių inventorizacijas bei įsteigus saugomas teritorijas sudarančias Natura 2000 teritorijų tinklą, yra svarbu jas tinkamai valdyti nepažeidžiant bei neprarandant buveinių (Evans 2012). Vienas iš LIFE integruotojo projekto „Natura 2000 tinklo valdymo optimizavimas Lietuvoje" veiklos tikslų yra parengti metodines rekomendacijas ir tvirtesnį pagrindimą remiantis empirinėmis žiniomis, tam kad miškų valdytojai galėtų imtis tinkamų apsaugos priemonių biologinei įvairovei palaikyti (Hernando et al. 2010).

Pirmiausia, kalbant apie miškų buveinių tvarkymą, bei norint pasiekti pusiausvyrą tarp miškininkystės, apsaugos ir buveinių tvarkymo, būtina suprasti skirtingų miško buveinių tiek natūralią tiek ir žmogaus veiklos įtakotą vystymosi dinamiką ir procesus. Deja, labai trūksta

mokslinių publikacijų apie medynų vystymosi tendencijas ir nėra paskelbtų mokslinių palyginamų duomenų apie medynų struktūrines charakteristikas Europos buveinių tipams (Palo ir Gimbutas 2015). Išskirtos Europinės svarbos buveinės ne visada turi teisinį saugomos teritorijos statusą. Dažnai tarptautiniu mastu pripažintos ir saugomos Natura 2000 miško buveinės yra prieinamos medienos pramonei dėl silpnų nacionalinių įstatymų (Miklín ir Čížek 2014). Kai kurių tipų buveinių ekonominis panaudojimas ir apsauga gali egzistuoti kartu taikant tvarumo principą. Net ir ūkiniuose miškuose naudojamų miškininkystės metodų įvairovės didinimas būtų naudingas miškų biologinei įvairovei (Mönkkönen et al. 2014). Miškininkai gali ir turi išmokti tvarkyti medynus pasižyminčius didele biologine įvairove ir išlaikančius svarbius gamtinius procesus, tačiau tokios pastangos bus sėkmingiausios, jei bus pagrįstos visapusišku natūralių miškų medynų struktūrų ir vystymosi procesų supratimu (Franklin et al. 2002). Reikėtų skatinti miškininkystę orientuotą į biologinę įvairovę, nes apie 80% borealinių miškų raudonosios knygos rūšių galima susieti su konkrečiomis medžių rūšimis ar miško savybėmis, o 60% jų - su negyva mediena (Tikkanen et al. 2006).

Mąstant apie klimato pokyčius bei statišką rūšių ir buveinių apsaugą konkrečioje vietoje, kur yra išskirtos Natura 2000 teritorijos, ateityje gali reikėti lankstesnio požiūrio į Natura 2000 įgyvendinimą, galbūt kuriant didelio masto dinaminę ir adaptyvių kraštovaizdžių valdymo strategiją (Bengtsson et al. 2003, de Koning et al., 2014). Taip pat, net ir išplėtus rezervatų sistemą, svarbu suprasti tai, kad visą miško žemę Europoje reikia nuolat tvarkyti palaikant tiek gamybą, tiek ir biologinę įvairovę, o atsižvelgiant į medyno lygmens trikdžių dinamiką, ją pakeisti skirtingais kirtimų tipais (Bengtsson et al. 2000, Shorohova et al. 2011).

Artima gamtai miškininkystė atsižvelgia į natūralius trikdžius, imituodama juos pagal mastą, pasikartojamumą bei intensyvumą (Kuuluvainen 2009, Woodcock et al. 2015, Schütz et al. 2016, Frelich et al. 2018, Jõgiste et al. 2018). Miško buveinių palanki apsaugos būklė labiausiai priklauso nuo miško struktūrų įvairovės susijusios su medžių rūšimis ir amžiumi, mikrobuveinėmis ir negyva mediena, tuo tarpu optimaliausias medienos ruošos sąlygas palaiko vienarūšiai vienodos struktūrinės sudėties medynai (Winkel et al., 2015). Ūkinės paskirties miškuose vienaamžiuose medynuose medžio mikrobuveinių aktyvus saugojimas yra svarbus, jei siekiama suformuoti struktūrinę įvairovę organizmams ir ekosistemų funkcijoms (Michel ir Winter 2009). Ūkiniai miškai, kuriems būdinga supaprastinta medynų struktūra, palyginti su natūraliais ar pusiau natūraliais miškais, pasižymi silpnesniais savireguliavimo mechanizmais

kalbant apie ligas bei kenkėjų antplūdžius (Grodzki 2016). Pagrindiniai neigiami miškams veiksniai yra sausinimas, struktūrinių elementų trūkumas, eliminavimas natūralių trikdžių režimų, tokių kaip gaisrai, miškininkystės intensyvinimas, invazinių augalų plitimas ir eutrofikacija (Latvian Nature Conservation Agency 2017).

Vykdomo LIFE integruotojo projekto rėmuose didelis dėmesys skiriamas gamtosauginei kontroliuojamo deginimo priemonei. Hemiborealiniuose pušies dominuojamuose miškuose gaisras yra esminis ekologinis veiksnys (Zackrisson 1977, Kuuluvainen 2002, Aponte et al. 2016, Seidl et al. 2020). Suomijoje Vakarų taigos atkūrimas deginant laikomas pačiu efektyviausiu būdu (Kuris ir Ruskule 2006). Vertinat kitų šalių patirtį bei gausų mokslinių publikacijų kiekį yra aktualu išbandyti ir galbūt taikyti šią priemonę Lietuvos Vakarų taigos bei Kerpiniuose pušynuose.

Bendruosius buveinių kokybės reikalavimus aprašė Palo ir Gimbutas 2015. Angelstam ir Kuuluvainen 2004, Walentowski et al. 2013 pateikia plačiai apibrėžtus miško dinamikos tipus, kuriais siūloma remtis kuriant praktinius biologinės įvairovės išsaugojimo metodus. Tačiau siūlant ir vertinant miško buveinių tvarkymo priemones reikalinga suprasti ekosistemų kompleksiškumą, skirtingų buveinių tipų vystymosi specifiką, kraštovaizdžio aspektą bei įvertinti esamą situaciją vietoje.

Šios darbo dalies tikslas yra įvertinti, kaip atlikti gamtotvarkos darbai siekiant pagerinti natūralių miško buveinių būklę ir atlikti natūralių miško buveinių būklės analizę priklausomai nuo jos struktūros bei vykdytų kirtimų, tarpusavyje palyginti natūralias miško buveines, kurios jau daugiau nei 10 metų turėjo kertinės miško buveinės statusą ir valstybiniuose miškuose buvo savanoriškai saugojamos su buveinėmis, kurioms toks statusas nebuvo suteiktas.

I.2 Metodika

I.2.1 Gamtotvarkos darbų vertinimas

Gamtotvarkos darbų vykdymas siekiant pagerinti natūralių miško buveinių būklę buvo įvertintas išanalizuojant gamtotvarkos darbų duomenų bazę, nustatant gamtotvarkos darbų apimtis Lietuvos miškuose bei įvertinant natūralių miško buveinių būklę šiuose sklypuose.

Gamtotvarkos priemonių efektyvumui įvertinti buvo naudojami įvairūs medyno struktūros parametrai - medyno įvairiaamžiškumas, ardiškumas, retmių gausa, negyvos

medienos tipai, jų kokybiniai ir kiekybiniai rodikliai, vykdytų ūkinių priemonių intensyvumas ir kiti. Buvo vertinama esama buveinės būklė ir vykdytų ūkinių priemonių įtaka buveinės geros būklės palaikymui.

I.2.2 Buveinių būklės vertinimas priklausomai nuo struktūros ir kirtimų intensyvumo

Natūralių miško buveinių būklės analizė priklausomai nuo jos struktūros ir atliktų kirtimų buvo atlikta sudarant buveinių būklės vertinimo kortelę (1 paveikslas). Pirmiausia nurodoma bendroji informacija: vertinimą atlikęs asmuo, data, kortelės numeris. Informacija apie vietovę: VMU regioninis padalinys, girininkija, kvartalo ir sklypo numeriai, buveinės centro koordinatės, taip pat nurodomas buveinės tipas ir jei vertinamos susijusios buveinės, nurodoma jų vertinimo kortelių numeriai.

Toliau apibūdinama medyno rūšinė sudėtis ir struktūra. Įvardinamos medžių rūšys, nurodant jų gausumą balais (1-10), atitinkamai pagal jų procentinę gausumo dalį medyne (kas 10%). Pažymimos pomiškio medelių rūšys, nenurodant jų gausumo. Įvertinamas medyno įvairiaamžiškumas (taip, ne), medyno glaudumas pagal intervalus: >0,9; 0,8-0,6; 0,5-0,3; <0,2; retmių gausa (nėra, pavienės, daug); ardiškumas (1 ar 2 ardai). Nurodoma ar yra išskirta kertinė miško buveinė.

Charakterizuojama negyva mediena (stiebo skersmuo >20 cm). Jos bendra gausa ir pagal tipus: sausuoliai, stuobriai, virtėliai (nėra, pavieniai, negausiai, vidutiniškai, gausiai). Negyvos medienos (D>20) irimo stadijos (1-šviežia. 5 - suirus) pagal 5 balų Waddell, 2002 skalę: 1 – vientisas, neseniai nukritęs, nepradėjęs pūti virtėlis; 2 – daugiau ar mažiau vientisas virtėlis, balana pradėjusi pūti, iš dalies minkšta, medienos negalima atskirti ranka; 3 – vidutiniškai supuvęs, dideli, kieti gabalai atskiriami ranka; 4 – šerdis supuvusi, rąstas nelaiko savo svorio, bet išlaiko formą; 5 – baigiantis pūti, rąstas neišlaiko formos, minkštas, miltiškas. Apibūdinama senų/stambių gyvų medžių gausa (200x50 m transektoje: 0-nėra, 1 - 1-2 vnt., 2 - 3-7 vnt., 3 - 8-20 vnt., 4 - >20 vnt. Lazdynų gausa įvertinta pagal Braun-Blanquet skalę.

Įvertinama ar augalų rūšys atitinka buveinės būdingąsias rūšis (visiškai, beveik, iš dalies); buveinės būklė (gera, patenkinama, bloga).

ES SVARBOS BUVEINĖS VERTINIMO KORTELĖ

Vertintojas ..... Data ..... Kortelės Nr. .....

VMU regioninis padalinys		Girininkija .....
Kvartalas	Sklypai	Buveinės koordinatės
		.....
Buveinės tipas		Susijusių kortelių Nr.

Medžių rūšys ir jų gausa medyne (100%=10 balų)	P	E	Ą	U	K	L	Sb	B	D	J	Bt	G	
Pomiškis (pažymėti kur yra)													

Įvairiaamžis medynas		Vid. medyno glaudumas				Retmių gausa			Ardiškumas	
Taip	Ne	>0,9	0,8-0,6	0,5-0,3	<0,2	Nėra	Pavienės	Daug	1 ardas	2 ardai

Negyvos medienos (D>20) gausa: →	Nėra	Pavieniai	Negausiai	Viduti-niškai	Gausiai	KMB	Taip	Ne

Negyvos medienos (D>20): irimo stadijos (1-šv. 5- suirus) ↓					Negyvos medienos (D>20) gausa pagal tipus*: (0 nėra, 1 pavieniai, 2 negausiai, 3 vidutiniškai, 4 gausiai): ↓					
1	2	3	4	5	Sausuolis:		Stuobrys:		Virtėlis:	

Senų/stambių gyvų medžių gausa**	0	1	2	3	4
Lazdynų gausa (pagal Braun-Blanquet skalę)	0	+, 1	2	3	4, 5

Augalų rūšys atitinka buveinės būdingąsias rūšis			Buveinės būklė (rūšių, struktūros ir procesų dermė)			
visiškai	beveik	Iš dalies	Gera	Patenkinama	Bloga	

Gaisro pažeidimai	Nėra	Yra	Bebrų veikla			Nėra	Yra
Sausinimo sistemos poveikio zona (iki 50m atstumu) (neveikianti priskiriama prie „nėra“)			Nėra	Yra už buveinės ribų		Yra pačioje buveinėje	
Invaziniai augalai (pagal Braun-Blanquet skalę)			0	+, 1	2	3	4, 5
Dirvožemio miškų ūkinės veiklos pažeidimai			Nėra	Pavieniai		Gausūs	
Dirvožemio neūkinės veiklos ir nat. pažeidimai			Nėra	Pavieniai		Gausūs	
Krūmų ir pomiškio šalinimas			Nėra	Pavieniai		Gausūs	
Medžių kirtimai (kelmai pagal supuvimo stadijas: 1-švieži, 2 – vidut. susiskaidę, 3- labai susiskaidę; Pagal gausą: A- Pavieniai; B-Negausūs; C-vidutiniškai gausūs; D- gausūs			Nėra	1		2	
				A	B	C	D

Buveinės tvarkymo reikalingumas:	Reikia	Nereikia
Pastabos:		

*Negyva mediena (200x50 m transektas): 0-nėra, 1- 1-2 vnt., 2- 3-7 vnt., 3- 8-20 vnt., 4- >20 vnt.
** Stambūs medžiai (200x50 m transektas): 0-nėra, 1- 1-2 vnt., 2- 3-7 vnt., 3- 8-20 vnt., 4- >20 vnt.
Puvimo stadija pagal 5 balų skalę (Waddell, 2002): 1 – vientisas, neseniai nukritęs, nepradėjęs pūti virtėlis; 2 – daugiau ar mažiau vientisas virtėlis, balana pradėjusi pūti, iš dalies minkšta, medienos negalima atskirti ranka; 3 – vidutiniškai supuvęs, dideli, kieti gabalai atskiriami ranka; 4 – šerdis supuvusi, rąstas nelaiko savo svorio, bet išlaiko formą; 5 – baigiantis pūti, rąstas neišlaiko formos, minkštas, miltiškas.

1 paveikslas. Buveinių būklės vertinimo kortelė

Įvertinami kiti veiksniai: Gaisro pažeidimai (nėra, yra); bebrų veikla (nėra, yra), sausinimo sistemos poveikio zona (iki 50 m) (nėra, yra už buveinės ribų, yra pačioje buveinėje; invazinių augalų gausumas pagal Braun-Blanquet skalę); dirvožemio miškų ūkinės veiklos pažeidimai (nėra, pavieniai, gausūs); dirvožemio neūkinės veiklos ir natūralūs pažeidimai (nėra, pavieniai, gausūs); krūmų ir pomiškio šalinimas (nėra, pavieniai, gausūs); medžių kirtimai pagal kelmus ir jų supuvimo stadijas (1-švieži, 2 – vidut. susiskaidę, 3- labai susiskaidę) (A - pavieniai; B - negausūs; C-vidutiniškai gausūs; D- gausūs).

Paskiausiai įvertinamas buveinės tvarkymo reikalingumas, jei yra papildomų pastebėjimų, jie nurodomi pastabų skirsnyje.

Kortelės buvo pildytos atlikus natūralios miško buveinės vizualinį vertinimą. Jos užpildytos neišėjus iš sklypo. Iš viso buvo atliktas vertinimas 93 sklypuose atstovaujančiuose 7 natūralių miško buveinių tipus.

Surinkti duomenys buvo analizuojami Apibendrintuoju mišriu tiesiniu statistiniu metodu (GLMM). Šis metodas yra optimalus siekiant atlikti reiškinių, turinčių dvinarį ir daugianarį pasiskirstymą analizę įtraukiant veiksnių, kurių įtaką siekiama eliminuoti grupę. Analizėje naudota Logit funkcija. Analizuojami veiksniai gali turėti tolygųjį ar diskretų pasiskirstymą. Gautos funkcijos vertintos pagal F kriterijaus patikimumą AIC koreguoto informacijos kriterijaus reikšmę. Buvo laikoma, jog veiksnys turi ženkliai patikimą įtaką, jeigu F kriterijaus patikimo reikšmė $p<0,05$. Esant $0,1>p>0,05$ buvo laikoma, jog kriterijus reikšmingumas yra artimas statistiškai ženkliam. AIC reikšmė pati savaime nieko nereiškia, bet naudotina, siekiant palyginti modelių reikšmingumą tarpusavyje. Šis kriterijus buvo papildantis F reikšmingumo vertinimą kompleksiškai vertinant abudu parametrus.

Pirmiausiai mes išanalizavome kokie aplinkos vertinti parametrai turi statistiškai ženklią įtaką natūralios buveinės būklei ir kokie parametrai turi ženklius skirtumus lyginant natūralias miško buveines KMB ir ne KMB teritorijose. Vėliau buvo sudaryti daugianariai statistiškai patikimi GLMM modeliai, kurie geriausiai reprezentuoja Buveinės būklę ir KMB statuso vertę. Sudarant daugianarius modelius buvo vykdoma žingsninė procedūra, pirmiausiai atrenkant labiausiai įtakojantį veiksnį, vėliau prie jo derinant antrąjį, kurių kombinacija yra esmingiausia ir t.t. Visa procedūra yra baigiama, kai nė vienas veiksnys nesukuria pridėtinės vertės kuriamam

modeliui. Veiksnių kolinearumas buvo vertinamas ir jo buvo siekiama išvengti vertinant sumažėjusias p ir AIC vertes tarp modelių.

Iš viso buvo išanalizuoti 93 natūralių miško buveinių vertinimai. Daugiausiai buvo 9010 buveinių (28 vnt.) ir 9020 buveinių (28 vnt.). 91D0 buveinių analizėn pateko 18 aprašymų. Daug mažesnį skaičių sudarė 9080 buveinės (10 vnt.), 9160 (5 vnt.) ir 91T0 (3 vnt.) buveinių. 91E0 buvo įvertinta 1 buveinė. Skirtumai tarp buveinių GLMM analizės metu buvo eliminuoti.

Analizei informacija buvo renkama 10 VMU padalinių. Dubravos (17 vnt.), Prienų ir Švenčionėlių (po 14 vnt.), Nemenčinės ir Veisiejų (po 10 vnt.), Trakų (8 vnt.), Varėnos (7 vnt.), Kretingos (5 vnt.), Anykščių ir Telšių (po 4 vnt.).

I.3 Rezultatai ir jų aptarimas

I.3.1 Lietuvoje atliktų gamtotvarkos darbų vertinimas

Įvertinant gamtotvarkos darbų mastą Lietuvoje, buvo analizuojama Gamtotvarkos duomenų bazė Biomon.lt, kurią administruoja Valstybinė saugomų teritorijų tarnyba. Analizuojamas laikotarpis nuo 2005 m. iki 2020 m. balandžio 1 d. Duomenų bazėje pateikiama informacija apie gamtotvarkos veiklas iš beveik 200 teritorijų. Absoliuti dauguma veiklų susiję su atvirų buveinių (pievų, šlapynių) tvarkymu. Miškuose vienokios ar kitokios veiklos pateikiamos iš 18 teritorijų (1 lentelė). Analizuojant gamtotvarkos veiklų miško ekosistemoje pasiskirstymą pagal tvarkymo tikslą, aiškiai dominuoja į Paukščių I priedą ar Buveinių direktyvos II priedą įtrauktų rūšių apsaugą orientuotos veiklos. Jos vykdytos 13 teritorijų (72 %). Dar dviejose teritorijose veiklos buvo orientuotos į invazinių augalų naikinimą (11 %) ir tik 3 teritorijose (17 %) numatytos veiklos, orientuotos į Buveinių direktyvos I priedo miško buveinių būklės pagerinimą. Reikia pabrėžti, kad šioje bazėje yra įtrauktos daugiausiai saugomų teritorijų direkcijų inicijuotos ar vykdytos veiklos. Pavyzdžiui, inkilų kėlimas, skruzdėlynų tvėrimas vykdomas daugelyje Lietuvos miškų, kuriuose darbus organizuoja ir atlieka girininkijų darbuotojai, stambiųjų paukščių lizdus kelia Lietuvos ornitologų draugijos nariai ar kiti gamtininkai, naudodami įvairių fondų/projektų lėšas. Taigi, esanti reali situacija apie paukščių apsaugai taikomų priemonių mastą ir intensyvumą nėra pilnai žinoma. Tenka pripažinti, kad iš Gamtotvarkos duomenų bazėje esančios lentelės kai kuriais atvejais yra sunku išskirti kokios priemonės kokiu tikslu ir kokiame plote buvo vykdomos, nes jos nėra išskaidytos į atskiras

eilutes, bet pateikiamos kaip vykdytos konkrečioje teritorijoje. Kaip matyti iš 1 lentelės, dauguma veiklų vykdytos 2012-2015 m. laikotarpiu.

Paukščių apsaugai buvo taikomos šios priemonės: lizdų plėšriesiems paukščiams ir juodajam gandrui kėlimas, inkilų uoksiniams paukščiams kėlimas, apsaugos priemonių nuo kiaunių uoksiniams paukščiams įrengimas, skruzdėlynų apsauga (kaip potencialus maistas meletoms), gastrolitų aikštelių vištiniams paukščiams įrengimas. Žinduolių apsaugai buvo taikomos priemonės - inkilų kėlimas šikšnosparniams ir miegapelėms. Niūriaspalviam auksavabaliui buvo taikomos priemonės, orientuotos į ąžuolynų atkūrimą sodinant ąžuoliukus bei kertami nepageidaujami medžiai ir trakas sukuriant atviresnes lajas apie stambius ąžuolus.

Efektyviausias būdas atkurti ir palaikyti ąžuolynus būtų kraštovaizdžio trikdžių imitavimas. Ąžuolai kolonizuoja atviras ar pusiau atviras buveines, bet miškuose dažnai reikalingas sodinimas (Bobiec et al. 2018). Gamtos tvarkymo planavime turėtų būti skiriamas didelis dėmesys atkurtų ir esamų buveinių erdviniam išdėstymui. Tyrimų rezultatai rodo, kad efektyviausia yra buveines atkurti netoliese esamų buveinių plotų (Lanta et al. 2020). Natūraliam miškui būdingų struktūrų gausinimo pagrindinės priemonės yra negyvos medienos gausinimas ir medyno lajos retmių formavimas. Įsigalint eglėms plačialapių miškuose buveinių struktūros gerinimui taikomos priemonės yra gausaus eglės pomiškio šalinimas, antro ardo medžių žiedinis nužievinimas, bei kirtimo atliekų pašalinimas (Ikauniece 2017, Lanta et al. 2020). Saugomų augalų tarpe priemonės vykdytos tik 2 rūšims - plačialapei klumpaitei ir vėjalandei šilagėlei. Klumpaitės atveju buvo retinamas medynas, pomiškis, valomas trakas, šienaujamos kvartalinės linijos jose praardant velėną. Įrodyta, kad atviros buveinės, kai medžių lajų susivėrimo indeksas yra mažesnis nei 65% yra palankesnės klumpaitės subrandinamų sėklų kiekiui ir jų produktyvumui (Kirillova ir Kirillov 2019). Ši rūšis teikia pirmenybę pusiau pavėsingoms vietoms su išsklaidyta šviesa ir yra jautri staigiam šviesos sąlygų pokyčiui. Spygliuočių miškuose užtikrinant tinkamas sąlygas plačialapei klumpaitei svarbų vaidmenį atlieka retmės medyne didinančios šviesos patekimą į žemuosius augalijos sluoksnius (Kļaviņa et al. 2011). Šilagėlei augimo sąlygos buvo gerinamos ardant miško paklotę. Gyvybingos šilagėlių populiacijos aptinkamos atvirose arba pusiau atvirose vietose, kuriose yra geras apšvietimas, šviesos sąlygos paprastai pagerėja po miško natūralių ar antropogeninio pobūdžio pažaidų tokių kaip ugnis, pažemio augmenijos pašalinimas, kirtimai, šienavimas, ganymas ir kt. (Pilt ir Kukk 2002). Manoma, kad beveik trečdalis nykstančių žolinės dangos rūšių priklauso nuo vidutinio

1 lentelė. Gamtotvarkos darbai saugomų teritorijų miškuose, vykdyti laikotarpiu nuo 2005 m.

Teritorijos pavadinimas	ST direkcija	Urėdija, Girninkija	Kvartalo nr., sklypo nr.	Vykdyti darbai	Tvarkymo metai	Tvarkymo tikslas
Gamtotvarkos darbai nukreipti į paukščių direktyvos rūšių buveinių tvarkymą						
Dainavos giria	Dzūkijos NP	Druskininkų MU Musteikos g-ja	359 kv., 19 skl., 360 kv., 7, 13, 14, 15, 16, 23, 26, 27, 28, 29 skl.	Iškirstos pušaitės 35,9 ha plote, įrengtos 5 gastrolitų aikštelės, pastatytas apžvalgos bokštas, stendas	2006	Tetervinas
Rūdninkų giria	Dieveniškių IRP	Šalčininkų MU Girios g-ja, Dainavos g-ja, Rūdninkų g-ja, Visinčios g-ja; Valkininkų MU Žygmantiškių g-ja		40 skruzdėlynų aptvėrimas ir aplink juos sumedėjusios augalijos pašalinimas, 37 žvyro-gastrolitų lesyklų įrengimas, 24 lizdų vapsvaėdžiams įrengimas, 20 lututėms inkilų įrengimas su apsaugomis nuo kiaunių, 5 informacinių stendų įrengimas.	2007-2013	Paukščiai: geniniai, vištiniai, vapsvaėdis, lututė
Taujėnų-Užulėnio miškai	Anykščių RP	Ukmergės MU Taujėnų g-ja, Balelių g-ja, Siesikų g-ja	214 kv. 7 skl., 244 kv. 6 skl., 230 kv. 6 skl., 120 kv. 1 skl., 11 kv. 3 skl., 24 kv. 2-7 skl., 67 kv. 16 skl., 62 kv. 4 skl., 102 kv. 3 skl., 103 kv. 5 skl., 245 kv. 9 skl.	10 lizdų, 2 informaciniai stendai	2012	Juodasis gandras
Žalioji gira	Krekenavos RP	Panevėžio MU, Pyvesos g-ja, Karsakiškio g-ja, Gegužinės g-ja	Pyvesos g-ja,- Vapsvaėdis: Kv. 4 skl.11;9-10;94-5;97-8;206-3;211-8;285-14,287-14, Juodasis gandras: Kv.229-7;232-15;256-19;286-3;278-8;Žvirblinė pelėda:61-6;62-5;100-6;252-2;253-1;276-12;284-13 .Gegužinės g-ja,- Vapsvaėdis:Kv.125-5;125-47;227-26;229-24;Juodasis gandras:Kv.168-9;Žvirblinė pelėda:181-15;200-16;201-54;213-2;214-36;229-19; Karsakiškio g-ja,- Vapsvaėdis Kv.129-34;150-8;191-75;209-14;241-8;241-13; Juodasis gandras:151-8;153-48;185-7;205-41;206-5; Žvirblinė pelėda: 172-42	Dirbtinių lizdų įrengimas: juodieji gandrai-11 vnt.; vapsvaėdžiai-18 vnt.; Inkilai žvirblinėms pelėdoms-14vnt.	2012	Juodasis gandras, vapsvaėdis, žvirblinė pelėda

Būdos - Pravieniškių miškai	Kauno marių RP	Kaišiadorių MU Pravieniškių g-ja, Būdos g-ja, Palomenės g-ja	58-69, 91-102, 110-122, 128-131, 133-145, 150-162, 168-177, 183-192, 197-205, 211-215, 218, 220-223, 225-245, 249-258, 264-269, 271-310, 379-385, 388-391, 426, 571, 575-577 kv.	Aptverta 60 skruzdėlynų ir iškirsta aplink juos sumedėjusi augalija, 11 informacinių lentų įrengimas, 24 lizdai vapsvaėdžiams, 20 inkilų iškėlimas, 1 informacinio stendo įrengimas.	2014	Paukščiai: geniniai, vapsvaėdis, pelėdiniai
Gamtotvarkos darbai nukreipti į invazinių rūšių šalinimą						
Ežerėlių kompleksas	Pavilnių Verkių RP	Vilniaus MU Verkių g-ja	35, 39, 40, 45, 46, 47, 48, 56, 57, 105, 443 kv.	Svetimkraščių ir invazinių rūšių naikinimas 181 ha plote	2018-2028	Invaziniai augalai
Skrebio miškas	Aukštadvario RP	Trakų MU Aukštadvario g-ja	38 kv. 2, 7, 8, 10. 13 skl., 39 kv. 19, 39 skl.	Invazinių medžių naikinimas 2,3 ha plote	Darbai pradėti 2014 m	Invaziniai medžiai
Gamtotvarkos darbai nukreipti į Buveinių direktyvos rūšių gyvenamosios aplinkos gerinimą						
Dūkštų ąžuolynas ir Dūkštos upės slėnis	Neries RP	Vilniaus MU, Dūkštų g-ja	3 kv., 4 kv., 5 kv., 6 kv., 8 kv., 9 kv. , 10 kv., 11 kv., 312 kv., 322 kv.	Sumedėjusios augalijos kirtimas ir pašalinimas, pievų šienavimas ir biomasės pašalinimas 58,16 ha plote. Šikšnosparniams 100 vnt inkilų iškėlimas, miegapėlėms 80 vnt. inkilų iškėlimas, 3 informaciniai stendai, ąžuoliukų sodinimas, biologiškai sujrančių apsaugų uždėjimas.	2007-2013	Šikšnosparniai, niūriaspalvis auksavabalis, miegapelės
Ančios upės slėnis	Pagramančio RP	Tauragės MU, Batakių g-ja		Medžių ir krūmų kirtimas bei pašalinimas. Miško buveinėse - retmių kirtimas gerinant buveinių kokybę, optimizuojant medynus 21,02 ha plote.	2010	Miško buveinės
Miškas prie Dilbinėlių	Žagarės RP	Joniškio MU Žagarės g-ja	68-4d;6d	Sumedėjusios augalijos kirtimas ir pašalinimas, atžalų šalinimas, 4,2 ha plote, kvartalinės paviršiaus praardymas, šienavimas 0,1 ha plote.	2012-2022	Plačialapė klumpaitė
Spindžiaus miškas	Aukštadvario RP	Trakų MU Aukštadvario g-ja	117 kv. 11, 13, 17, 19 skl., 118 kv. 17, 19, 20 skl., 120 kv. 1, 2, 10 skl., 126 kv. 6, 7, 9, 10 skl., 127 kv. 1-6 skl., 128 kv. 1-7 skl., 129	Sumedėjusios augalijos kirtimas ir pašalinimas 129 ha plote	2012	Vakarų taiga, pelkinės buveinės

			kv. 3, 6, 12, 14 skl., 137 kv. 7 skl., 138 kv. 2-6 skl., 142 kv. 12 skl.			
Žaliųjų ežerų apylinkių BAST	Pavilnių Verkių RP	Vilniaus MU, Verkių g-ja	32, 33 kv.	Jaunų eglaičių šalinimas, lazdynų retinimas, apsauginės tinklo tvoros įrengimas 20 ha plote	2013-2014	Plačialapė klumpaitė
Neries upės šlaitas ties Verkiais	Pavilnių Verkių RP	Vilniaus MU, Verkių g-ja	105 kv.	Menkaverčių medžių ir krūmų šalinimas, negyvos medienos kiekio didinimas, ąžuoliukų sodinimas ir jų ugdymas, senų drevėtų medžių tvarkymas ir priežiūra 10 ha plote	2013-2015	Niūriaspalvis auksavabalis
Galvydiškės kaimo apylinkės	Kurtuvėnų RP	Kuršėnų MU, Vainagių g-ja	35 kv. 32 d. skl., 63 kv. 12 d., 22 d. skl. d., 76 kv. 6 d., 9 d., 16 d., 17 skl., 77 kv. 13, 14 d., 29, 30, 38 d., 39 d., 45 d., 46 d., 47 d., 54 skl., 78 kv. 37 skl., 83 kv. 8 d. skl., 84 kv. 1 d. skl., 100 kv. 15, 28, 34 d. skl.	Sumedėjusios augalijos kirtimas ir pašalinimas 13,3 ha plote, 2 informacinių stendų įrengimas, miško paklotės praardymas, bulvių duobių rekultivavimas.	2014	Vėjalandė šilagėlė
Naudvario miškas	Krekenavos RP	Panevėžio MU Gustonių g-ja	103 kv.3, 4,7.; 104 kv. 5,9,8 skl.	Sumedėjusios augalijos kirtimas ir pašalinimas, atžalų šalinimas 4,83 ha plote, dirvos praardymas kvartalinės proskynoje.	2014	Plačialapė klumpaitė
Žagarės miškas	Žagarės RP	Joniškio MU Žagarės g-ja	49-17,19; 50-4d,5,6; 42-1,3; 15,28,27,29,30; 45-1,6,11,13d,15d,16d,18d,19d,20d,21d; 46-1d,2d,3d,5d,6d,7d,8d; 53-1d; 51-20d,22d,23d; 60-8d,9d; 64-22; 65-1,2d; 73-6,7,14d,15,19d; 84-11	Sumedėjusios augalijos, atžalų kirtimas ir šalinimas 29,7 ha plote kvartalinės šienavimas.	2017-2020	Plačialapė klumpaitė
Žaliųjų ežerų apylinkių BAST	Pavilnių Verkių RP	Vilniaus MU, Verkių g-ja	39, 31, 32, 34 kv.	Invazinių rūšių naikinimas visame BAST, periodiškas krūmų retinimas, jaunų eglaičių šalinimas plačialapės klumpaitės augavietėje.	2018-2028	Plačialapė klumpaitė
Šimšų miškas	Tytuvėnų RP	Tytuvėnų MU		Miško buveinių 22,46 ha tvarkymas	Planuojama pradėti	Miško buveinės

sunkumo miško trikdžių. Visoms šioms rūšims naudinga nedidelio masto medyno retmių formavimas pjaunant arba paliekant natūraliai išvirtusius medžius. Kelioms rūšims yra palankūs vidutinio sunkumo dirvožemio trikdžiai (takai, jodinėjimas žirgais ir kt.) bei trako išvalymas. Kai kurias rūšis palankiai veikia ganymas ar kontroliuojami deginimai (Reier et al. 2005)

Inkilų ar lizdų kėlimas, tiek kitos gamtotvarkinės priemonės rūšių apsaugai turi būti reguliariai stebimos ir, pagal poreikį, atnaujinamos/pakartojamos. Dalis lizdų, inkilų, iškeltų prieš 10 ar daugiau metų gali būti sunykę dėl įvairių priežasčių, iškirstas trakas ar pomiškis vėl ataugęs ir jau nėra veiksmingi esamu momentu.

Gamtotvarkos priemonės, orientuotos į Europos Bendrijos svarbos miško buveinių struktūros gerinimą vykdytos tik dviejose vietose - Spindžiaus miške Aukštadvario regioniniame parke bei Ančios upės slėnyje Pagramančio regioniniame parke ir dar planuojama artimiausiu metu pradėti darbus Šimšų miške Tytuvėnų regioniniame parke.

2020 m. Spindžiaus miške buvo įvertintos dvi 9010 Vakarų taigos buveinės, kuriose buvo vykdyti gamtotvarkos darbai. Vienoje buveinėje 128 kv. nebuvo aptikta jokių medžių kirtimo atvejų, tačiau buvo nustatytas trako ar pomiškio negausus šalinimas. Esanti medyno struktūra yra pakankamai gera, medynas įvairiaamžis, 2 ardų su pavienėmis retmėmis, tačiau visumoje buveinės būklė įvertinta bloga, nes pats medynas dar nėra labai senas ir negyvos medienos aptikta negausiai - pavieniai virtėliai ir keletas sausuolių. Gamtotvarkos priemonių efektyvumas nebuvo labai didelis, nes nebuvo tvarkomas pats medynas ir nebuvo priemonių negyvos medienos didinimui. Ateityje būtų galima padidinti aikštelių (retmių) skaičių arba vietomis taikyti kontroliuojamą paklotės deginimą.

Antroje buveinėje Spindžiaus miško 143 kv. buvo nustatyti neintensyvūs medžių kirtimai, vykdyti prieš daugiau nei 10 ar 20 metų. Greičiausiai tai buvo ne gamtotvarkiniais tikslais vykdomi, bet eiliniai atrankiniai kirtimai. Dabar esantis medynas yra įvertintas kaip geros būklės Vakarų taigos buveinė, nes medynas yra pakankamai senas, įvairiaamžis, dviardis, su pavienėmis retmėmis ir vidutinišku kiekiu įvairių puvimo stadijų negyvos medienos. Galima teigti, kad pavienių medžių kirtimas neigiamos įtakos buveinei neturėjo, kita vertus, galėjo pajvairinti medyno erdvinę struktūrą teigiama linkme. Artimiausiu metu šioje buveinėje intensyvesnių tvarkymo darbų nereikėtų vykdyti.

Atlikus gamtotvarkos darbų analizę paaiškėjo, jog objektų, kuriuos galima vertinti yra labai mažai ir tokia vertinimo apimtis neleis pasiekti iškeltų uždavinių. Dėl šios priežasties buvo nuspręsta daugiau pastangų dėti į žemiau aprašomą analizę.

I.3.2 Buveinių būklės vertinimas priklausomai nuo struktūros ir kirtimų intensyvumo

Miško ekosistemų būklės įvairiems buveinių tipams pagrindiniai vertinimo parametrai yra: negyvos medienos kiekis ir pobūdis, medyno lajų susivėrimas, geniniai paukščiai bei specifinės kerpės. Kiti senų miškų ar jiems būdingų trikdžių dinamikos rodikliai labiau susiję su miško buveinės tipo specifika, susijusia krūmų ir žolių ardo sudėtimi. Medynų tvarkymui taikant išplėstinę amžiaus rotaciją, jie gali būti struktūriškai panašūs į senuosius miškus (Liira et al. 2007). Šiame darbe buvo vertinama medyno struktūra, negyva mediena, miško kirtimai ir kiti įprastai vertinami buveinių inventorizacijoje parametrai. Kadangi šios analizės tikslas yra taikomojo pobūdžio geniniai paukščiai ir specifinės kerpės nebuvo vertinamos, dėl šių aspektų riboto pritaikomumo.

Vertinant visų natūralių miško buveinių būklę, bet eliminavus skirtumus tarp buveinių buvo atlikta GLMM analizė. Nustatyta, jog natūralios miško buveinės būklę tiek teigiamai tiek ir neigiamai statistiškai ženkliai įtakoja daug vertintų veiksnių (2 lent.).

Įvertinus medyno erdvinės struktūros parametrus nepriklausomai vienas nuo kito, dauguma vertintų veiksnių neturėjo ženklios įtakos buveinės būklei (medyno įvairiaamžiškumas, glaudumas, ardiškumas), artimas patikimam buvo nustatytas teigiamas ryšys tarp buveinės būklės ir medyno retmių ($p<0,07$). Tinkamiausia, kai medyno retmės yra pavienės, kiek mažiau tinkama, kai jų yra daugiau. Kertinių miško buveinių (toliau KMB) statusas buvo vienareikšmiškai teigiamai susijęs su gera buveinės būkle ($p<0,001$).

Dauguma veiksnių iš negyvos medienos grupės turėjo statistiškai ženklų teigiamą poveikį. Geros būklės buveinėms buvo būdingas vidutinis ir gausus negyvos medienos kiekis ($p<0,001$), kuris reprezentavo visų keturių, 2-5 medienos suirimo stadijų, negyvą medieną. Tik 1 suirimo stadijos negyva mediena nebuvo statistiškai ženkliai nesusijusi su buveinės būkle. Geros būklės buveinėse buvo bent jau negausiai aptinkami sausuoliai ir virtėliai, o stuobriai – pavieniui arba dažniau.

2 lentelė. GLMM daugianariu logit modeliu atliktas natūralias miško buveines veikiančių veiksnių vertinimas. Veiksniai analizuoti nepriklausomai. Buveinės tipo įtaka eliminuota. Statistiškai ženklią įtaką darantys veiksniai pažymėti spalvomis: žalia spalva-teigiamai, raudona spalva-neigiamai.

Veiksnys	AIC kriterijus	F kriterijus		Veiksnių reikšmingiausias intervalas	< Bloga būklė	> Gera būklė	Vertinimo gradientas					
		F	p				0	1	2	3	4	5
Kontrolinis (buveinės būklė)	628											
Medyno įvairiaamžiškumas	630	0,67	0,42		-0,79	0,41	0	0,48				
Medyno glaudumas	627	0,61	0,44		-2,06	-0,86	K=-1,4 (tolygus kintamasis)					
Medyno retmės	643	2,77	0,07	Pavienės ar daugiau	0,14	1,4	0	1,6	1,44			
Medyno ardiškumas	630	0,09	0,77		-0,97	0,23	0	0,18	0,23			
Negyvos medienos gausa	792	9,28	0,001	Vidutiniškai ir gausiai	-0,73	1,42	0	-1,13	1,59	3,7	3,94	
KMB	818	37,49	0,001	Yra	-0,42	1,84	0	4,45				
Negyvos medienos suirimo stadijų skaičius	725	5,31	0,001	Bent 4	-0,58	1,18	0	-2,22	0,59	1,37	3,74	3,55
Negyvos medienos suirimo stadija 1	630	0,65	0,42		-0,64	0,56	0	0,51				
Negyvos medienos suirimo stadija 2	656	10,49	0,002	Yra	0,16	1,49	0	1,84				
Negyvos medienos suirimo stadija 3	688	16,47	0,001	Yra	-0,27	1,18	0	2,27				
Negyvos medienos suirimo stadija 4	687	17,1	0,001	Yra	-0,77	0,72	0	2,8				
Negyvos medienos suirimo stadija 5	644	5,61	0,02	Yra	-0,91	0,36	0	1,85				
Sausuolių gausa	757	9,51	0,001	Negausiai ir daugiau	0,17	1,98	0	1,27	3,1	5,41		
Stuobrių gausa	762	10,56	0,001	Pavieniai ir daugiau	-0,16	1,75	0	3,28	4,19	3,17		
Virtėlių gausa	803	8,98	0,001	Negausiai ir daugiau	-0,5	1,59	0	-0,32	3,09	3,96	4,83	
Biologiškai senų medžių gausa	767	8,04	0,001	Negausiai ir daugiau	0,15	2,12	0	-0,16	3,24	5,4	4,67	
Lazdynų gausa	661	2,24	0,07	Pavieniai	-0,42	0,92	0	2,75	1,21	1,18	0,78	
Žolinės augalijos tipiškumas	878	14,37	0,001	Beveik ir visiškai	12,78	14,71	0	12,75	15,7			
Miško gaisro požymiai	628	0,11	0,74		-1,1	0,09	0	-0,34				

Bebrų veiklos požymiai	639	0	0,99		-0,96	0,24	0	10,6		
Sausinimo sistemų poveikis	668	0,05	0,95		-1,14	0,07	0	-11,4	-0,2	
Invaziniai augalai	630	0,75	0,52		-1,04	0,18	0	1,67	-0,65	-0,65
Dirvožemio pažeidimai ūkinės veiklos metu	637	0,49	0,62		-1,32	-0,09	0	-0,5	-12	
Dirvožemio pažeidimai natūralūs	627	0,12	0,89		-1,05	0,14	0	0,1	-0,57	
Krūmų ir pomiškio šalinimas	631	1,84	0,18		-1,12	0,1	0	-1,46		
Kirtimų intensyvumas suma įvairaus senumo	653	8,17	0,005	Nėra ar 1 pavienis atvejis	-1,74	-0,44	K=-0,31 (tolygus kintamasis)			
Šviežių kirtimų intensyvumas	642	4,91	0,009	Nėra	-1,4	-0,08	0	-1,88	-2,17	
Vidutinio senumo kirtimų intensyvumas	669	3,67	0,008	p<Nėra ar pavieniai	-1,44	-0,01	0	1,45	-0,84	-1,83 -1,57
Senų kirtimų intensyvumas	669	3,14	0,02	Mažiau nei vidutiniškai	-1,35	0,08	0	0,96	0,52	-2,2 -12,9
Buveinės tvarkymo reikalingumas	637	3,14	0,08	Nereikia	-1,35	-0,11	0	-2,67		

Geros būklės buveinėms taip pat buvo būdinga negausus ar didesnis biologiškai senų medžių kiekis, pavieniui aptinkami lazdynai (p<0,07) bei svarbi tipiška ar beveik tipiška žolinės augalijos rūšių danga. Vertinant visus buveinių tipus kartu, bet kiekvieną veiksnį atskirai invaziniai augalai neturėjo ženklios įtakos natūralios miško buveinės būklei (p<0,52).

Iš buveinės pažeidimų didžiausią neigiamą poveikį turėjo medžių kirtimai. Geros būklės buveinėse nebuvo aptinkama šviežių kelmų (p<0,009), tačiau toleruotini pavieniai vidutinio suirimo stadijos kelmai (p<0,008) ir vidutiniškai gausūs seni kelmai (p<0,02). Bendras kirtimų intensyvumas vertinant visų suirimo stadijų kelmus taip pat turėjo statistiškai ženklią įtaką buveinės būklei. Geros būklės buveinėse buvo aptikti tik vienos suirimo stadijos pavieniai kelmai. Kiekvienos suirimo stadijos kelmų gausą vertinant 4 balų sistema, jų suma iki 5 balų buvo įvertinta, kaip lemianti patenkinamą natūralios buveinės būklę, o dar didesnė – apsprendė blogą

buveinės būklę. Nustatyta, kad borealiniuose taigos miškuose iškirtus apie 20% medynų tūrio, nebus pertrauktas negyvos medienos tęstinumas ateityje (Hekkala et al. 2016).

Nemaža dalis įvairių buveinės pažeidimų neturėjo ženklios statistinės įtakos natūralios buveinės statusui (miško gaisro požymiai, bebrų veiklos požymiai, sausinimo sistemų poveikis, natūralūs ir ūkinės veiklos metu atsiradę dirvožemio pažeidimai, krūmų ir pomiškio šalinimas), tačiau sudarant geriausiai įtakojančių veiksnių modelius dalis šių veiksnių pateko į ženklią pridėtinę vertę turinčių sąrašus.

Atliekant labiausiai natūralių buveinių būklę [BB] įtakojančių veiksnių modeliavimą buvo sudarytas modelis iš įvairaus intensyvumo kirtimų intensyvumo balų sumos [KI_{Sum}], negyvos medienos suirimo stadijų skaičiaus [NM_{st}], žolinės augalijos tipiškumo [ŽAT] ir invazinių augalų [IA]. Gautą modelį galima aprašyti taip:

$$BB= -0,61\times KI_{Sum} + NM_{st} + ŽAT + IA,$$

Į modelį įstatant KI_{Sum} vertinimo balų reikšmę (šviežių, vidutinio senumo ir senų kirtimų intensyvumas vertinamas 1-4 balas) ir kitų veiksnių reikšmes pagal 3 lentelės koeficientus. Pritaikius šį modelį ir gavus mažiau nei 1,21 balo, buveinės būklė laikytina bloga, tarp 1,21 ir 3,52 – patenkinama ir daugiau nei 3,52 – gera.

3 lentelė. Daugianaris GLMM modelis sudarytas siekiant apibūdinti natūralių miško buveinių būklę. Modelis sudarytas žingsniniu būdu, surenkant geriausiai įtakojančių veiksnių rinkinį.

Veiksnys	F	p	Geriausias intervalas	Vertinimo gradientas					
				0	1	2	3	4	5
Modelio korekcija	13,9	0,001							
Kirtimų intensyvumas suma įvairaus senumo	25,9	0,001	Nėra	K=-0,61 (dauginti iš balų sumos, SUM MAX=12)					
Negyvos medienos suirimo stadijų skaičius	15,6	0,001	4-5 stadijų	0	-2,7	1,84	2,3	3,41	4,55
Žolinės augalijos tipiškumas	18,5	0,001	Visiškai tipiška	0	0,95	4,13			
Invaziniai augalai	3,5	0,019	Nėra ar pavieniai	0	-0,16	-3,07	-2,53		

Šis modelis buvo sudarytas taikant žingsninę (*stepwise forward*) regresinio modelio sudarymo procedūrą, kai pradžioje visi veiksniai buvo analizuojami atskirai, vėliau atrinkus labiausiai įtakojantį veiksnį, prie jo buvo atrenkamas antrasis, kuris su jau atrinktu veiksniu sudarė geriausią modelį. Šis veiksmas buvo kartojamas iki tol, kol nė vienas papildomas veiksnys nesukūrė pridėtinės vertės modelyje.

Gautas modelis yra sudarytas iš 4 veiksnių. Neigiamą įtaką natūralios buveinės būklės vertinimui turi kirtimų intensyvumo balų suma, o teigiamą negyvos medienos suirimo stadijų skaičius. Negyvos medienos suirimo stadijų skaičius koreliavo su 20, o kirtimų intensyvumo suma su 15 veiksnių (4 lentelė). Šie du veiksniai yra tiesiogiai susiję su negyvos medienos kiekiu miško buveinėse, dėl to pastarasis veiksnys nepakliuvo į modelį, nors daugumos ekspertų vertinimu yra laikomas vienas iš pagrindinių apsprendžiančių natūralios buveinės būklę. Žolinės augalijos tipiškumas taip pat yra svarbi sąlyga, nesusijusi nei su negyvos medienos, nei su kirtimų vykdymu buveinėje. Šis veiksnys koreliavo su 9 analizuotais veiksniais. Galiausiai, invaziniai augalai turi neigiamą įtaką buveinės būklės vertinimui. Invazinių augalų gausa koreliavo su 8 analizuotais veiksniais (4 lentelė).

Peržiūrėjus sudarytą koreliacijos matricą (4 lent.) matome, jog absoliuti dauguma natūraliose buveinėse vertintų veiksnių koreliuoja su bent vienu modelį sudarančiu veiksniu. Tik medyno glaudumas, bebrų veiklos požymiai, krūmų ir pomiškio šalinimas nekoreliavo nė su vienu vertintu buveinių parametru. Tačiau medyno glaudumas yra susijęs su retmėmis ir įvairiaamžiškumu.

2002-2005m. buvo išskirtos KMB, kurios pradėtos laisvanoriškai saugoti dėl FSC sertifikavimo reikalavimų. Natūralios buveinės turinčios KMB statusą yra įdomios tuo, jog šiose buveinėse nebuvo vykdoma įprastinė ūkinė veikla mažiausiai 15 m., ko nebuvo kitose natūraliose miško buveinėse, kurios išskirtos apsaugai pastaraisiais metais. Dėl šios priežasties yra svarbu palyginti natūralias miško buveines, kurios buvo išskirtos medynuose turinčiuose ir be KMB statuso, nes tai leidžia įvertinti, kaip šios buveinės vystysis ir atrodys po 1-2 dešimtmečių.

4. lentelė. Sudaryto natūralių miško buveinių būklės modelio narių Spearmano koreliacijos koeficientai su vertintais veiksniais. Veiksnio stulpelyje žalia spalva pažymėti veiksniai, koreliuojantys su modelyje esančiais, raudona – į modelį patelkę veiksniai. Statistiškai patikimos koeficientų reikšmės pažymėtos raudonai, *p<0,05, **p<0,01

Veiksnys	Negyvos medienos suirimo stadijų skaičius	Žolinės augalijos tipiškumas	Invaziniai augalai	Kirtimų intensyvumas suma įvairaus senumo
Medyno įvairiaamžiškumas	0,406**	0,042	0,195	0,341**
Medyno glaudumas	-0,031	-0,003	-0,124	0,127
Medyno retmės	0,352**	0,039	0,302**	-0,016
Negyvos medienos gausa	0,873**	0,288**	0,277**	0,106
KMB	0,669**	0,381**	0,250*	-0,033
Negyvos medienos suirimo stadijų skaičius	1,000	0,195	0,170	0,342**
Negyvos medienos suirimo stadija 1	0,635**	-0,069	0,000	0,311**
Negyvos medienos suirimo stadija 2	0,771**	0,137	0,159	0,405**
Negyvos medienos suirimo stadija 3	0,879**	0,274**	0,108	0,304**
Negyvos medienos suirimo stadija 4	0,761**	0,200	0,158	0,105
Negyvos medienos suirimo stadija 5	0,591**	0,023	0,296**	0,026
Sausuolių gausa	0,758**	0,348**	0,221*	0,060
Stuobrių gausa	0,759**	0,359**	0,252*	0,071
Virtėlių gausa	0,858**	0,258*	0,203	0,223*
Biologiškai senų medžių gausa	0,609**	0,243*	0,365**	0,272**
Lazdynų gausa	0,580**	0,110	0,160	0,580**
Žolinės augalijos tipiškumas	0,195	1,000	-0,029	-0,087
Miško gaisro požymiai	-0,172	-0,143	0,103	-0,271**
Bebrų veiklos požymiai	0,160	0,087	-0,027	-0,108
Sausinimo sistemų poveikis	0,075	-0,094	-0,150	0,314**
Invaziniai augalai	0,170	-0,029	1,000	-0,128
Dirvožemio pažeidimai ūkinės veiklos metu	0,293**	-0,039	-0,164	0,783**
Dirvožemio pažeidimai natūralūs	0,250*	0,033	0,421**	0,342**
Krūmų ir pomiškio šalinimas	-0,058	-0,020	0,153	0,173
Kirtimų intensyvumas suma įvairaus senumo	0,342**	-0,087	-0,128	1,000
Šviežių kirtimų intensyvumas	-0,051	-0,213*	-0,124	0,574**
Vidutinio senumo kirtimų intensyvumas	0,281**	-0,113	-0,115	0,929**
Senų kirtimų intensyvumas	0,432**	-0,028	-0,177	0,918**
Buveinės tvarkymo reikalingumas	-0,230*	-0,324**	0,125	-0,195

Vertinant medyno erdvinės struktūros skirtumus tarp KMB ir ne KMB esančių natūralių miško buveinių nustatyta (4 lent.), jog natūraliose miško buveinėse esančiose KMB yra ženkliai didesnis įvairiaamžiškumas ($p<0,01$), medynui daug labiau būdingos išreikštos retmės ($p<0,06$) ir dviardė struktūra ($p<0,04$), tačiau medyno glaudumas ženkliai nesiskiria ($p>0,43$).

Negyva mediena esanti KMB miško buveinėse buvo reprezentuojama daug didesnio suirimo stadijų skaičiaus, KMB buvo būdingos 3-5 suirimo stadijų negyvos medienos, bet 1-2 suirimo stadijų negyva medienos pasiskirstymas nesiskyrė tarp buveinių esančių ir nesančių KMB natūralių miško buveinių. Apibendrinant, negyvos medienos suirimo stadijų skaičius aptinkamas KMB esančiose buveinėse buvo statistiškai ženkliai didesnis, tačiau bendras negyvos medienos kiekis tarp KMB ir ne KMB esančių buveinių patikimai nesiskyrė ($p<0,23$). Sausuolių, stuobrių ir virtuolių gausa buvo ženkliai didesnė KMB esančiose buveinėse. Įprastai KMB esančiose buveinėse sausuolių ir virtuolių buvo negausiai ar daugiau, o stuobrių – pavieniui ar daugiau.

KMB esančiose natūraliose miško buveinėse buvo registruota ženkliai daugiau biologiškai senų medžių)$p<0,001$), žolinė danga buvo visiškai tipiška ($p<0,001$), tačiau KMB esančiose buveinėse nebuvo būdingi lazdynai ar jų buvo labai retai ($p<0,07$).

Iš buveinės pažeidimų statistiškai ženklūs skirtumai tarp buveinių esančių ir nesančių KMB buvo nustatyti skirtumai vertinant šviežių kirtimų ($p<0,04$) intensyvumą, kurių neaptinkama KMB. Bendras kirtimų intensyvumas taip pat yra ženkliai mažesnis KMB ($p<0,003$), apskaičiuota, jog tipišku atveju kirtimų visiškai neregistruota. Vertinant vidutinio amžiaus ir senų kelmų gausą ženklių skirtumų nenustatyta, tačiau KMB buvo jų mažiau nei ne KMB. Galiausiai KMB nebuvo aptinkama dirvožemio pažeidimų padarytų ūkinės veiklos metu ($p<0,04$). Vertinant kitus veiksnius (miško gaisro požymiai, bebrų veiklos požymiai, sausinimo sistemų poveikis, natūralūs dirvožemio pažeidimai, krūmų ir pomiškio šalinimas) esminių skirtumų tarp buveinių esančių ir nesančių KMB nebuvo nustatyta.

4 lentelė. GLMM dvinariu logit metodu nustatyti buveinių struktūros elementų skirtumai tarp turinčių ir neturinčių KMB statusą natūralių miško buveinių. Kiekvienas veiksnys vertintas nepriklausomai. Buveinės tipo įtaka eliminuota. Statistiškai ženklią įtaką darantys veiksniai pažymėti spalvomis: žalia spalva – teigiamai, raudona spalva – neigiamai.

Veiksnys	AIC kritierijus	F kriterijus		Veiksnių reikšmingiausias intervalas	Reikšmės vertinimo gradiente (KMB nėra=0; KMB yra=1)					
		F	p		0	1	2	3	4	5
Kontrolinis (buveinės būklė)	413									
Medyno įvairiaamžiškumas	427	7,26	0,01	Įvairiaamžis	0,1	0,57				
Medyno glaudumas	411	0,63	0,43		Y=-1,63*X+0,64; X=0,3-1					
Medyno retmės	428	2,93	0,06	Su retmėmis	0,07	0,42	0,67			
Medyno ardiškumas	420	4,63	0,04	Dviardis	0,17	0,52				
Negyvos medienos gausa	1353	1,43	0,23		0	0	0,27	0,93	1	
Negyvos medienos suirimo stadijų skaičius	751	2,73	0,03	Yra bent 4 stadijų	0	0	0,27	0,42	0,92	0,94
Negyvos medienos suirimo stadija 1	572	0,001	0,99		0	0,44				
Negyvos medienos suirimo stadija 2	716	0,001	0,97		0	0,52				
Negyvos medienos suirimo stadija 3	443	16,86	0,001	Yra	0,12	0,67				
Negyvos medienos suirimo stadija 4	452	16,59	0,001	Yra	0,21	0,92				
Negyvos medienos suirimo stadija 5	426	7,36	0,008	Yra	0,31	0,9				
Sausuolių gausa	697	4,32	0,007	Negausūs ir daugiau	0,03	0,19	0,64	1		
Stuobrių gausa	470	13,14	0,001	Pavieniai ir daugiau	0,03	0,67	0,89	0,97		
Virtėlių gausa	470	9,13	0,001	Negausūs ir daugiau	0,03	0,09	0,53	0,82	0,97	
Biologiškai senų medžių gausa	481	5,82	0,001	Negausūs ir daugiau	0,04	0,19	0,59	0,96	0,96	
Lazdynų gausa	420	2,29	0,07	Nėra ar pavieniai	0,81	0,5	0,28	0,001		
Žolinės augalijos tipiškumas	436	7,67	0,001	Tipiška visiškai	0,14	0,11	0,56			

Miško gaisro požymiai	412	0,01	0,95		0,37	0,35			
Bebrų veiklos požymiai	409	0,04	0,84		0,35	0,999			
Sausinimo sistemų poveikis	425	2,19	0,12		0,45	0,01	0,16		
Invaziniai augalai	408	0,51	0,68		0,31	0,002	0,002		
Dirvožemio pažeidimai ūkinės veiklos metu	427	3,4	0,04	Nėra	0,55	0,18	0,001		
Dirvožemio pažeidimai natūralūs	413	0,48	0,62		0,66	0,53	0,001		
Krūmų ir pomiškio šalinimas	439	0,01	0,94		0,39	0,001			
Kirtimų intensyvumas suma įvairaus senumo	441	9,56	0,003	Nėra	Y=-0,417*X-0,28				
Šviežių kirtimų intensyvumas	468	3,32	0,04	nėra	0,44	0,04	0,001		
Vidutinio senumo kirtimų intensyvumas	547	1,52	0,2		0,42	0,76	0,26	0,001	0,28
Senų kirtimų intensyvumas	457	1,84	0,13		0,48	0,46	0,43	0,04	0,001
Buveinės tvarkymo reikalingumas	462	0,001	0,99		0,41	0,001			

Atliekant GLMM modeliavimą buvo siekiama sudaryti aplinkos veiksnių rinkinį, kuris labiausiai pabrėžtų skirtumus tarp natūralių miško buveinių esančių ir nesančių KMB (4 lent.). Į sudarytą modelį pateko negyvos medienos trečia suirimo stadija ([NM_3], žolinės dangos tipiškumas [ŽDT], kirtimų intensyvumas [KI], įvairaus senumo kategorijų dažnumo balas ir medyno įvairiaamžiškumas [IA]. KMB miško buveinėms buvo būdinga tai, jog medyne aptinkama 3 suirimo stadijos negyva mediena, tipiškas žolinės augalijos sluoksnis, nėra medžių kirtimų ženklų ir medynas yra įvairiaamžis. Formulė, kuri apibūdina sudarytą modelį atrodo taip:

$$BB_{KMB[0-1]} = NM_3 + ŽDT + KI + IA - 9,37$$

Į modelį reikia įstatyti 4 lent., esančias reikšmes priskirtas tam tikriems veiksnių kodams. Kirtimų intensyvumas skaičiavimui naudojama apskaičiuota balų suma. Pagal šią formulę apskaičiuota skaičių suma KMB bus artima arba didesnė nei 1, o ne KMB – artima arba mažesnė už 0.

4 lent. Daugianaris GLMM modelis siekiant įvertinti KMB statuso įtaką natūralioms miško buveinėms. Modelis sudarytas žingsniniu būdu, surenkant geriausiai įtakojančių veiksnių rinkinį.

Veiksnys	F	p	Geriausias intervalas	Reikšmės vertinimo gradiente (KMB nėra=0; KMB yra=1)					
				0	1	2	3	4	5
Modelio korekcija	2,44	0,04		Intercept=-9,37					
Negyvos medienos suirimo stadija 3	7,91	0,006	Yra	0	9,24				
Žolinės augalijos tipiškumas	4,51	0,014	Visiškai	0	-2,7	1,36			
Kirtimų intensyvumas suma įvairaus senumo	9,48	0,003	Nėra	K=-1,82 (dauginti iš balų sumos, SUM MAX=12)					
Medyno įvairiaamžiškumas	5,89	0,018	Įvairiaamžis	0	9,36				

Kertinėms miško buveinėms buvo būdinga 3 suirimo stadijos negyva mediena ir medyno įvairiaamžiškumas. Žolinės dangos tipiškumas turėjo daug mažesnę apsprendžiančių įtaką. Nedidelis kirtimų intensyvumas kertinėse miško buveinėse buvo galimas, ypač esant aukščiau aprašytiems teigiamai įtakojantiems veiksniams, bet didesnis įvairaus mažiaus kirtimų intensyvumas turėjo neigiamą apsprendžiančią įtaką.

Šis vertinimas buvo atliktas siekiant išsiaiškinti veiksnius, kurie turi įtaką gerai natūralios buveinės būklei. Sudaryti modeliai yra geras pavyzdys, kaip galima skaitinėmis reikšmėmis išreikšti ir įvertinti natūralios miško buveinės būklę ir kaip sudaryti modeliai gali padėti mums ateityje vertinant mažiau parametrų nustatyti natūralios buveinės būklę greičiau ir efektyviau. Vis dėl to sudarant šiuos modelius buvo eliminuota natūralios buveinės tipo įtaką, kas gali sudaryti šiek tiek keblumų, jeigu šis modelis bus naudojamas praktikoje. Šis darbas pademonstravo , jog tokie modeliai gali būti sudaromi, tačiau kiekvienam natūralios buveinės tipui, jie turėtų būti sudaromi atskirai, nes skiriasi jų struktūrą sudarančių komponentų vertės.

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Part II. Natura 2000 scientific literature review: Analysis of best practices from Europe

Contents

II.1 Introduction - understanding the concept of efficient forest protection in Natura 2000

One of the aims of this project activity is to develop methodological guidance and a stronger justification outlining the need of empirical knowledge to enable forest managers to take appropriate conservation measures to maintain biodiversity (Hernando et al. 2010). Forest being the most widespread natural ecosystem in Europe, is the reason why EU's policies require the maintenance of sufficient amounts of patches of different representative vegetation types, which then form ecological networks (Angelstam et al. 2018). European forest biodiversity resulted from both post-glacial recovery and human impact (Barbati and Marchetti 2005). Thus, the current classifications of European forest types include both natural and traditionally managed (e.g., wooded meadows) forest landscapes.

At the European level, the most important conservation instruments are the Bern and Bonn Conventions, and the Habitats and Birds Directives issued by the European Council to promote action towards the goals of the two conventions. Major tool or the most important practical means in the preservation of biodiversity and natural resources on the European level is the EU's Natura 2000 network of high conservation value areas which still needs to be strengthened (Müller and Maes 2015, Metsähallitus 2016, Salomaa et al. 2017). Completed habitat inventories and site designations in the EU forming Natura 2000 area network should be followed by appropriate site management to protect sites from loss and damage (Evans 2012). Overall comparable assessments on the effectiveness of European biogeographical habitat network are lacking due to differences in the quality and quantity of monitoring data of conservation status of habitat types and it is a great challenge for EU (Ellwanger et al. 2018).

This literature analysis is directed in four major parts. The first part covers the general concept of Natura 2000, its place in national protected area systems and tries to answer what

is an effective protected area network. Secondly, theoretical background scientific information on forest dynamics and structure elements that is essential for estimation of qualitative values on habitats and species of Community interest. Thirdly the focus is placed on countries that share same types of forest habitats as Lithuania which includes all boreal biogeographical regions and also countries like Poland, Germany and Czech Republic of continental biographical region. In addition, the part four will focus on analysis of particular forest types and their best management practises. This literature analysis serves as ground for Lithuanian forest habitat management recommendations which is currently being developed - "Guidelines for the management of natural forest habitat types of EC importance"

Several literature reviews on Natura 2000 network functionality and effectiveness were found and analysed (Davis et al. 2014, Popescu et al. 2014, Orlikowska et al. 2016). Many analysed studies adopted a 'gap analysis' approach when discussing the ecological effectiveness of Natura 2000 sites for given species and/or habitats. As defined by the Convention on Biological Diversity, a gap analysis within the conservation context is "an assessment of the extent to which a protected area system meets protection goals set by a nation or region to represent its biological diversity". In short, gap analyses determine ecological effectiveness based on whether the site or network of sites provide the necessary requirements or coverage of a species/habitat for achieving favourable conservation status in the long-term (Davis et al. 2014, Angelstam et al. 2017a).

In an Analysis on how European countries update and review their conservation objectives and how scientific discoveries are reported in regards of Natura 2000 network, Opermanis et al. (2014) recommended that national authorities responsible for nature conservation must implement regular monitoring of scientific literature on new species records.

All EU member states are required to produce Prioritized Action Frameworks (PAF) describing the needs for conservation actions in the Natura 2000 network. The PAFs can include descriptions of restoration actions, if the current conservation state in the Natura 2000 areas is unfavourable (Hagen et al. 2016). It is a strategic multiannual planning tool, aimed at providing a comprehensive overview of the measures that are needed to implement the EU-wide Natura 2000 network and its associated green infrastructure (e.g., European Commission 2013), specifying the financing needs for these measures and linking them to the corresponding EU funding programmes (Wales 2015, Unit 2019)

Identified habitats of European importance are not always located in legally protected area networks. Often internationally acknowledged and protected Natura 2000 forest habitats are accessible to logging due to weak national laws (Miklín and Čížek 2014). In some habitat types, economic utilization and protection can co-exist by applying a sustainability approach. Sustained wood production and biodiversity conservation are two major competing objectives of sustainable forest management policy. The pressure on the remaining functional habitat networks for biodiversity conservation is thus both increasing over time and expanding to new areas in the boreal forest biome. Research demonstrates that landscape history matters for the opportunities to satisfy wood production and biodiversity conservation objectives (Angelstam et al. 2011b). Comparison of five regions in the forest landscape history gradient in northern Europe's' West and East shows that when indicators for wood production perform well, the opportunities for biodiversity are poor (Angelstam et al. 2018, Naumov et al. 2018). Diversification of management regimes would benefit biodiversity while using forest for economic purposes (Mönkkönen et al. 2014).

Currently many of the existing protected areas in Europe have a poor relationship with bird species richness (Albuquerque et al. 2013). Thus, establishment of protected areas should aim to improve their representativeness by protecting and maintaining areas with high levels of species richness. As such, protecting forest habitat in Europe's east would deliver greater benefits as the overall geographic distribution of bird species richness increases in a west to east direction with countries such as Bulgaria (201 species), Poland (190 species), Lithuania (184 species) and the Czech Republic (181 species) showing the highest bird species richness (Albuquerque et al. 2013). This shows that extra efforts should be made to conserve the remaining high species richness areas in Europe rather than investing in restoration of very degraded habitats in Western Europe (Roberge and Angelstam 2006).

European level analysis showed that mainly due to differing patterns in species ranges, as wide-spread species are inevitably represented in many sites, but narrow ranged species are often covered only by a small number of sites in a particular area (Gruber et al. 2012).

Research on connectivity and connectedness of Natura 2000 areas across European borders displayed contrasting results. Cases of country boundaries situated along natural barriers, such as mountains or rivers were characterized with highest number of Natura 2000 areas on both sides of the borders for example Slovakia and the Czech Republic. In the Baltic

region (Estonia, Latvia, and Lithuania) the ratio between the Natura 2000 cover in the border region versus the interior was negative. A possible explanation for the smaller number of sites on the borders of the Baltic region is that these countries still host a high level of biological diversity throughout the region (Opermanis et al. 2012).

For European boreal forests, using the focal species approach (e.g., Lambeck 1997) is an appropriate approach for spatial planners to identify priority conservation areas in forest management units (Angelstam et al. 2003). Focal species have an umbrella function where the conservation of a more demanding species would protect a range of speces with lesser specialisation (Roberge and Angelstam 2006). Given the empirically well-defined requirements of species, habitat can be quantified using tree species and age classes (Manton et al. 2005). Therefore, the concept of umbrella species or focal species provides clear and measurable guidelines for the assessment of status, trends and for conservation planning (Roberge and Angelstam 2004).

Trochet and Schmeller (2013) showed that ≥ 90% of threatened species (e.g., mammals, birds and reptiles) occur within the current Natura 2000 network. However, the Atlantic, Boreal and Continental biogeographical regions were nominated as having poor threatened species coverage (31.48%, 26.67% and 14.71% respectively) (Trochet and Schmeller 2013).

In perfect world Natura 2000 territories should reflect eight criteria used to identify areas of biodiversity conservation, these criteria were derived from analysis of significant number of international environmental initiatives (Asaad et al. 2017):

(1) areas contain unique and rare habitats;

(2) areas include fragile and sensitive habitats;

(3) areas are important for ecological integrity;

(4) areas are representative of all habitats;

(5) the presence of species of conservation concern;

(6) the occurrence of restricted-range species;

(7) species richness;

(8) importance for life history stages.

Recent analysis indicates lack of consistency of international information on the conservation status assessment of the species and habitat types in the Natura 2000 reports. Assessments in most of the countries are mainly based on expert judgement, no consensus exists among the countries for monitoring methods or the indicators which should be used to assess the favourable conservation status of forest habitat types (Alberdi et al. 2019). Even though, there exists data about the state and quality of the Natura 2000 network in separate countries, but they do not allow for general conclusions at the EU level. Dynamics of changes in CORINE Land Cover classes in areas of the Natura 2000 ecological network showed minimal loss in environmental and landscape diversity on European level (Kubacka and Smaga 2019). Quality indicators are the backbone of conservation status monitoring and reporting. Currently selection and testing of existing indicators, those to be used for the assessment of all the components of the conservation status of forest habitats and forest habitat types is crucial (Kovač et al. 2016).

Bearing in mind climate change and static nature conservation of species and habitats at the place where they currently occur at established Natura 2000 areas, future consideration of more flexible implementation of Natura 2000 might be at stake (de Koning et al. 2014). Also it is important to consider that the whole forest land in Europe needs constant management for both production and biodiversity, even with an expanded reserve system (Bengtsson et al. 2000).

II.2 Estimation of qualitative values on habitat structure and functions of habitats and species of Community interest.

II.2.1 Stand structure, forest phases, disturbance regimes

The protected area network Natura 2000 aims to unify the EUs effort to protect nature and its diversity. Implementation of such wide European protected area network comprises of not only ecological and economic bus also of social issues. However an analysis on social aspects of the Natura 2000 network showed that the greatest challenges are low level of public participation, a negative public perception, a lack of flexibility by responsible authorities and insufficient consideration of the local situation (Blicharska et al. 2016). Traditional forest

managers eventually will need to adopt, understand and accept new ideas and regulations (Koivula and Vanha-Majamaa 2020). Even traditional forest management aims to the protection of soils and water resources, and the habitats of protected plants and animals.

Understanding forest development processes is essential to achieve a balance between forestry, conservation and habitat management globally. There is absolute lack of scientific publications on stand development trends and no published scientific comparable data about stand structural characteristics for European habitat types (Palo and Gimbutas 2015).

It is becoming increasingly accepted that reserves do not need to be static entities, but be part of large-scale dynamic and adaptive landscape management strategies (Bengtsson et al. 2003). Determining the proportion of areas that should be set aside in a landscape suggests three basic approaches 1) permanent protection areas 2) shifting mosaics in the matrix (Bengtsson et al. 2003, Angelstam et al. 2011a), and 3) the combinations of the two approaches, i.e. combinations of protection (reserves) and “managed old-growth”. For example, old forest patches could be maintained with fire suppression, whereas where old-growth is more abundant, silvicultural practices such as partial logging could be used to maintain the structure of managed stands surrounding conservation patches. Taking into account natural dynamics of forests in boreal region combined protection regimes like strict protection areas and “managed old-growth” areas should be combined considering stand-scale disturbance dynamics replaced by different felling types (Shorohova et al. 2011).

Foresters can and must learn to manage forest stands that sustain biological diversity and a range of essential processes, but they will be most successful if their efforts are based on a comprehensive understanding of the structures and developmental processes in natural forest stands (Franklin et al. 2002). Close to nature forestry takes into account natural disturbances by mimicking them in regard of size, frequency and severity (Woodcock et al. 2015, Schütz et al. 2016, Frelich et al. 2018, Jõgiste et al. 2018). Favourable conservation status depends largely on a diversity of forest structures (related to tree species and age, microhabitats, and deadwood), whereas optimum conditions for economic timber production are often rather uniform stands, particularly if high demands for biomass production are to be met (Winkel et al. 2015).

Natural disturbance regimes in forest ecosystems can be distinguished based on severity: stand-replacing and gap-forming regimes create the extremes of the gradient, with intermediate (partial) disturbances constituting the varying conditions in between. Despite anthropogenic influences on disturbance regimes in the Baltic States, these two extremes in natural disturbance regimes can be found (Kuuluvainen 2009).

For developing practical approaches to biodiversity conservation, it is useful to separate three broadly defined types of forest dynamics:

Succession, or rather stand development, after stand-replacing disturbances, caused by large-scale external disturbance such as severe high-intensity fire and wind throw, insects, fungal disease, beaver (best corresponds with clear cutting) from 0 to 28% of ageing and old-growth forest

Cohort dynamics related to partial disturbances or low-intensity disturbance with partial loss of trees - caused by low-intensity fire or wind throw, caused by large herbivores and insects (best corresponds with case by case cutting leaving last case) about 70% of ageing and old-growth forest

Gap dynamics caused by the death of individual trees or small groups caused by wind throw and self-thinning, caused by insects, fungal disease (best corresponds with partial and selective cutting) stable and moist micro climate, constant supply of deadwood of various decay stages, highest proportion 96% of ageing and old-growth forest (Angelstam and Kuuluvainen 2004)

Another similar approach showing forestry activities as acceptable part of forest dynamics and drivers of succession can be based on three types of disturbances:

Gap-driven ecosystems resulting from rare stand-initiating events. Most forest stands have a closed canopy at so called “optimal phase” of a natural succession. These are gap-driven ecosystems with regeneration taking place in small gaps created by the death of an individual tree.

Disturbance driven-ecosystems resulting from frequent stand-initiating events. Perfect examples are relatively unmodified alluvial sites belonging to Habitat Type 91E0* “Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicon albae*)”. Regular flooding is an essential disturbance to maintain this structure.

Managed ecosystems resulting from singular or frequent stand-maintaining events. Earlier succession stages exist from clear cuts. Pioneer species still contribute to the canopy cover (*Populus, Betula*). Only on smaller areas may one find old-growth stages and regeneration. In addition, there are the anthropogenic grasslands resulting from deforestations centuries ago. These require on-going maintenance of the current management system to prevent re-establishment of forest (Walentowski et al. 2013).

Natural disturbance dynamics must be analysed at the landscape level, taking in mind that most forestry planning happens on landscape level (Jonsson et al. 2011). Man caused disturbances like military training activities a good example is Adazi Natura 2000 site in Latvia, demonstrates benefits on the abundance of protected bird species and maintains habitat diversity (Aunins and Avotins 2018).

Structural attributes of forest stands are increasingly recognized as being of theoretical and practical importance in understanding and managing forest ecosystems because:

Structure is the attribute most often manipulated to achieve management objectives following establishment of a forest stand;

Structure is a readily measured surrogate for functions (e.g. productivity) or for organisms (e.g. cavity-dwelling animals) that are difficult to measure directly;

Structures have direct value as a product (e.g. wood) or in providing a service (e.g. in sequestering carbon or influencing hydrologic responses).

The index of forest structural diversity developed and based on traditional forest inventory data can be used for extracting important information about biodiversity relevant forest conditions and thus provides an evidence-base for forest management and planning (Storch et al. 2018).

Important operational directives proposed by (Hobson and Ibisch 2013) could be applied alongside the existing list for sustainable forestry:

- To maximise net biomass retention based on measures taken from appropriate old growth reference sites (retention of super-canopy trees, proportion of post-incremental trees, mounds, large snags and logs, and areas of undisturbed field vegetation, understory and soil).

- To maximise the water-retention capacity of forests through more careful consideration of stand structure, dead wood retention and soil conservation
- To promote connectedness through variable retention of environmental legacies, including native seed banks, vegetation and local geomorphological features
- To safeguard cross-scale processes by planning and managing at landscape scale
- Mimic natural gap dynamics and succession phases using “free-willed” forest as reference sites

General habitat quality requirements by (Palo and Gimbutas 2015)**:**

1. Forests with site-type-typical well-developed stand structure or stand structure recovering over next 30 years
2. Signs of earlier natural disturbances independent of tree age, or the stand age is higher the predefined forestry middle-aged class for dominant tree species
3. The habitat patch area is larger than 0.01 ha
4. No regular drainage areas, but some old and stabilized or not functioning ditches may exist

Some indicator species reveal the age of the habitat, its structural diversity and habitat longevity, and the environmental quality. The saproxylic beetle *Xestobium austriacum* indicates autochthonous *Abies* habitats. It is confined to very old trees with large stems. In Germany this beetle is classified as “relict of lost virgin forests” (Müller et al. 2005). *Bolitophagus reticulatus* is a beetle of montane forests associated with the fungus *Fomes fomentarius* on *Fagus* and *Betula*. Beatle species *Cucujus cinnaberinus* needs open spaces and prefers lowland areas with soft-wooded broadleaves. The adults and older stages of larvae hibernate under bark of wet coarse deadwood mainly of *Populus tremula*. The rare fungus *Polyporus squamosus* grows on coarse woody debris where it causes a white rot in the heartwood of living and dead hardwood trees, it has a widespread distribution. Lichen *Lobaria pulmonaria* indicates low air pollution and has almost been eliminated from central Europe. It is commonly known as lungwort or lung lichen due to declining population, *L. pulmonaria* is considered to be rare or threatened in many parts of the world, especially in lowland areas of Europe. In spruce forests the following taxonomic groups and species are indicators for habitat quality and intact environmental conditions: epiphytic lichen species, e.g. *Bryoria*, *Evernia*, *Pseudevernia*, *Hypogymnia* and

Usnea, require high air quality. The red rove beetle *Olisthaerus substriatus* is a typical indicator for older Norway spruce forests living predatorily under the bark of old *Picea* trees (Jonsson et al. 2011). This species lives in the boreal and the alpine region. In Germany this rove beetle (family *Staphylinidae*) is considered as relict of lost virgin forest (Müller et al. 2005). Indicators for pristine watercourses with intact hydrology, dynamics and water quality of the habitat type 91E0* include the species ostrich fern *Matteucia struthiopteris* which grows in moist soils of deciduous and mixed forest, wooded river bottoms, and swamps. This species is representative of intact alluvial forests that accompany and shelter selected indicator species of habitat and environmental quality (Walentowski et al. 2013).

Good example of landscape consideration is using the White backed woodpecker as an umbrella species for prioritisation in spatial conservation planning of broadleaved forest. The forest areas with high predicted numbers of breeding White-backed woodpeckers according to the demographic model and where the woodpeckers have been breeding could be regarded as having high conservation value, since they probably harbour natural forest attributes demanded by the White-backed woodpecker which are functional both at the levels of forest stands and landscapes. (Edman et al. 2011).

Near-natural stands are much more structured, more dead wood (10–20 times of the volume of managed forests) and are characterised by a much higher abundance of breeding birds, especially wood-inhabiting and beech forest indicator species, as well as some saproxylic fungi species (Winter et al. 2005) .

Study was carried out by comparing the composition of ancient forest cores, forest edges and overgrown wooded grasslands. From the comprehensive selection of stand indicators and taxonomic groups (73 characteristics plus indicator species) was found that only a few stand characteristics and ecological groups reflect the historical origin of deciduous stands and can be used to distinguish between recently overgrown semi-open woodlands and potentially valuable broad-leaved forest habitat patches. These indicators are herb layer richness, the functional composition of vascular plant richness, epiphytic indicator bryophytes mostly old-growth indicators, and composition of plant and moss species. Historical semi open woodland patches consisted of a greater richness of herbaceous layer species, and particularly more graminoids, perennial and apophytic species. Forest cores included more hemeradiaphoric plant species. (Palo et al. 2013).

The conservation status establishes where action is most needed and the vulnerability indicates the urgency of these actions. Managers can then implement suitable management and monitoring strategies for the recovery and/or conservation of biodiversity, according to the results of the environmental diagnosis. Proposed environmental assessment has three phases. In the first phase, the current conservation status of the habitats is assessed. This is based on the following criteria: the conservation of vital functions of the habitat - determined by how much of the habitat is damaged and the vitality of the habitat (e.g. the amount of foliage loss), richness of plants assessed by the percentage of plant species typical for that habitat actually found in the habitat, forest structure, area of the habitat in the protected zone at local and regional scales. Each of these criteria is 'scored' by experts according to conservation status. The statuses are: 'excellent', 'good', and 'intermediate to poor'. In the second phase of the diagnosis, the vulnerability of different habitats to environmental change is assessed. This improves understanding of how possible actions, plans or projects could affect the habitat and is based on four criteria: fire hazard, erosion hazard, the ability and speed of the habitat to recover after a man-made or natural disturbance and the habitat vulnerability to changes in vegetation. In the third phase, the first two assessments (conservation status and vulnerability) are combined to allow the territory to be divided into distinct management areas: unfavourable areas requiring urgent management action, intermediate areas with good conservation status but requiring further recovery measures and optimal areas having excellent conservation status with no need for intervention (Velázquez et al. 2010).

The actual spatial and temporal landscape properties strongly determine the effectiveness of a conservation measure, which is explained by the nonlinear trade-off curves. It was identified that compensation of increasing habitat destruction by increasing patch creation is only efficient for landscapes in which habitat destruction rate is still low (compared to the rate of local population extinction). This means that a conservation strategy which is effective in a landscape with presently low dynamics is not necessarily effective in a highly dynamic landscape or vice versa. Increasing patch destruction can be compensated to a certain extent by improvements in other spatial and⁄or temporal landscape attributes. Focusing on trade-offs between management options reveals two key factors essential for management decisions: First, the trade-offs are generally nonlinear irrespective of considering spatial or

temporal landscape attributes. Secondly, species can be grouped according to their response to particular management options (Johst et al. 2011).

The recent discussion about the relationships between biodiversity and ecosystem services also raises the question as to whether the argumentative basis for nature conservation can be strengthened by emphasizing the role of species and habitats in supporting ecosystem services. A literature survey shows that mainly socio-cultural and some regulating services are dependent on particular species, groups of species, or habitat types, while many other services, especially those related to provisioning, rely more heavily on vegetation structures and land cover. These findings are exemplified and discussed using a case study on Natura 2000 sites in the Ore Mountains in the German state of Saxony. Only a small portion of the species listed in the Annexes of the Habitats Directive is bound to particular Natura 2000 habitat types. Such species can be regarded as indicators both for these habitats and for the ecosystem services they provide, as well as for indicating changes in ecosystems and related services, which are caused by climate change and land use changes e.g. due to flood mitigation measures and the enhanced use of renewable energies (Bastian 2013).

II.2.2 Fire as forest disturbance

Nowadays, natural disturbances are recognized as important ecological factor affecting forest biodiversity (Johnson 1992, Engelmark 1993, Gromtsev 1996, Parviainen 1996, Angelstam 1998, Kuuluvainen 2002, Ryan 2002, Bergeron et al. 2004). Fire disturbance is a major factor affecting vegetation structure and composition in boreal and hemiboreal forest landscapes. In hemiboreal *Pinus*-dominated forests fire is essential ecological factor (Zackrisson 1977, Kuuluvainen 2002, Aponte et al. 2016, Seidl et al. 2020). In many areas foresters have removed fire from forest ecosystems (Gromtsev 1996, Parviainen 1996, Päätalo 1998, Tinner et al. 1999, Gromtsev 2002, Koivula and Vanha-Majamaa 2020). Nowadays, natural disturbances are recognized as important ecological factor affecting forest biodiversity (Angelstam 1998, Kuuluvainen 2002, Bergeron et al. 2004, Fernandes et al. 2013). Introduction of the use of controlled fire in forestry is now recognized (Granström 1996, Parviainen 1996, Khabarov et al. 2016). Importance of fire as a natural disturbance factor in Lithuania has not been well documented. Only sporadic observations were presented on fire impact to pine forest

ecosystems (Karazija 1988). Modern forest management should consider the impact of fire as increases in the frequency and intensity of natural and anthropogenic fire disturbances are expected to occur as a consequence of global climate changes (Päätalo 1998, Carcaillet et al. 2007). Fire occurrence depends on weather variations, the long-term trends in climate, the presence of fuels and human activity. Changes in temperature and precipitation are likely to alter disturbance regimes, the most important being fire (Clark 1989, Schröter et al. 2005, Thuiller et al. 2005, Carcaillet et al. 2007, Change 2007, Flannigan et al. 2009).

Forest fires are important in determining forest composition, energy fluxes and biogeochemical processes (Johnson 1992, Shugart et al. 1992, Engelmark 1993, Parviainen 1996, Ryan 2002, Wallenius et al. 2007, Summers et al. 2008, Aznar et al. 2016). Severe crown fires can change successional rates and alter vegetation species composition. Therefore, surface fires can promote an herbaceous flora, increase plant available nutrients in soil (Gromtsev 1996, Parviainen 1996, Gromtsev 2002, Bento-Gonçalves et al. 2012, Badía et al. 2014). Fires affect the species composition, stand characteristics, regeneration conditions (Zackrisson 1977, Mälkönen and Levula 1996, Päätalo 1998, Sedláková and Chytrý 1999, Granström 2001, Gromtsev 2002, Kauhanen 2002, Mallik 2003, Hille and Den Ouden 2004, Ryömä and Laaka-Lindberg 2005, Jayen et al. 2006, Marozas et al. 2007, Parro et al. 2009).

Fires can change belowground physical, chemical, microbial processes; eliminate aboveground biomass. Fire changes forest soils properties including increased bulk density and altered physical structure (Boyer and Miller 1994, Arocena and Opio 2003), increased soil cation stocks (Franklin et al. 2003, Liechty et al. 2005, Neff et al. 2005), and decreased carbon (C) and nitrogen (N) stocks in soils (Binkley et al. 1992, DeBano et al. 1998, Choromanska and DeLuca 2001, Carter and Foster 2004, MacKenzie et al. 2004, Certini 2005, Hosseini et al. 2017). The effect of fire on soil properties vary considerably among forest ecosystem types depends on fire severity and duration (Ice et al. 2004, Certini 2005, Boerner 2006).

The effects of surface fires on soils are generally relatively minor in many forest types (Richter et al. 1982, Binkley et al. 1992, Ferran et al. 2005, DeLuca and Sala 2006, Neill et al. 2007). Severe burns under drought conditions generally lead to significant changes to soil biogeochemical stocks (Smithwick et al. 2005).

Vegetation changes

The decline in the number of species immediately after the fire and the following increase after a few years was reported in earlier studies (Ilisson et al. 2006, Vanha-Majamaa et al. 2007, Parro et al. 2009). In addition, Nuzzo et al. (1996) reported significant increase in richness of herbaceous species after prescribed fire.

Surface fires, which remove existing ground vegetation, provide more favourable regeneration conditions for various species (Jonsson and Esseen 1998, Ilisson et al. 2006, Marozas et al. 2007). Other research has indicated that regeneration of *Pinus sylvestris* in some areas can be prevented by such species us *Calamagrostis epigeios*, an abundance of *Vaccinium* species or *Calluna* can also hamper seed germination (Päätalo 1998, Gromtsev 2002, Mallik 2003, Hancock et al. 2005).

Positive effect of fire on forest regeneration was reported in such studies (Gorshkov et al. 1996, Kruger and Reich 1997, Elliott et al. 1999, Kuuluvainen and Rouvinen 2000, Hille and Den Ouden 2004). More favourable conditions for seed germination and absence of vegetation competition were the reasons of the increased regeneration of pine seedlings. Johnstone et al. (2004) reported the highest regeneration rates of the dominant tree species in the boreal forest in North America in the first 5 years after fire.

Surface fires had considerable effect on vegetation coverage. Fire destroyed above-ground part of vegetation, but it can quite rapidly recover within 3-4 years. The recovery of moss layer is much slower and it takes more than 10 years (Marozas et al. 2007).

Skre et al. (1998) found that biomass of *Calluna vulgaris* L., *Polytrichum* spp. *Deschampsia flexuosa* (L.) Trin and *Pteridium aquilinum* (L.) Kuhn increased after the fire in pine forests of western Norway while regrowth of *Vaccinium myrtillus* L. and *Vaccinium vitis-idaea* L. was slower. In moss coverage in site a pioneer moss species with *Polytrichum juniperinum* appeared (Jonsson and Esseen 1998, Marozas et al. 2007, Parro et al. 2009). Other investigations also suggested Ryömä and Laaka-Lindberg (2005) that *Ceratodon*, *Funaria*, *Pohlia nutans*, *Polytricum* spp. appears quickly after the fire in boreal forest. Investigation of post fire recovery of species in Scots pine forest in the central part of the Kola Peninsula Gorshkov et al. (1996) showed that the dwarf shrub and herb layers recovered within 5-15 years after the fire while the mosses and lichens recovered within 90-140 years after the fire.

Nuzzo et al. (1996) also reported significant increase in richness of herbaceous species after prescribed fire. Skre et al. (1998) in pine forests of western Norway found that biomass of *Calluna vulgaris L., Polytrichum* spp. *Deschampsia flexuosa* (L.) Trin and *Pteridium aquilinum* (L.) Kuhn increased after fire while regrowth of *Vaccinium myrtillus* L. and *Vaccinium vitis-idaea* L. was slower.

The results of investigation of post fire recovery of species diversity in Scots pine forest in the central part of the Kola Peninsula Gorshkov and Bakkal (1996) showed that the dwarf shrub and herb layers recovered 5-15 years after fire while the mosses and lichens recovered 90-140 years after fire. Our results indicated that dwarf shrubs and herbs recovered 5-6 years after surface fire.

Positive effect of fire on forest regeneration was also reported in other studies (Gorshkov et al. 1996, Kruger and Reich 1997, Elliott et al. 1999, Kuuluvainen and Rouvinen 2000, Gorshkov and Stavrova 2002).

Soil properties

The effects of forest above-ground (surface and crown) fires on soil chemical properties strongly depend on fire severity. Severe high intensity fires could lead to significant chemical changes in the mineral soils (Smithwick et al. 2005, Hamman et al. 2007). The study of a short time change (one week after fire) in soil properties due to the fire was conducted in *Pinus densiflora* Sieb. et Zucc stands of the Kosung area in Kangwon Province in Korea (Kim et al. 1999). Some studies confirmed that forest fires increase soil cation stocks (Franklin et al. 2003, Liechty et al. 2005, Neff et al. 2005), but decrease carbon (C) and nitrogen (N) stocks in surface soils (Binkley et al. 1992, DeBano et al. 1998, Choromanska and DeLuca 2001, Carter and Foster 2004, MacKenzie et al. 2004, Certini 2005). Some information is available on the effects of prescribed fires. Monleon et al. (1997) studied the effects of low-intensity prescribed fires on soils in an eastern Oregon ponderosa pine forest. They found that 4 months after fire total C and inorganic N increased in surface (0–5 cm) layer of mineral soil. While the same study showed the decrease in C and N concentrations 5 years after fire, and by 12 years these variables returned to unburned levels. Neill et al. (2007) evaluated the effects of the prescribed burning on the soils in a Cape Cod oak-pine forest South Truro, Massachusetts, USA. The burning every year in summer increased pH of organic soil from 4.01 to 4.95 and of mineral soil from 4.20 to

4.79. Overall effects of burning on soil chemistry were minor. The burning had no significant effect on soil total C and N, C/N ratio, soil exchangeable Ca^{2+}, Mg^{2+}, K^{+} cations. Wagle and Kitchen Jr (1972) found no difference in extractable P among a 3 years and 14 years old burn and control in ponderosa pine forest in northern Arizona. Kraemer and Hermann (1979) observed no difference in P content in burned and controls areas 25 years after clear cut and broadcast fire on the west side of the Cascade Mountains. Baird (1998) studied the effects of a large wildfire in a ponderosa pine/Douglas-fir forest in the Cascade Mountains of Washington State. In soils within the low-severity burn areas total N decreased 1 year after the fire, while C/N was not significantly affected. In stands of ponderosa pine/Douglas-fir of the central, eastern Cascade Mountains of Washington State, Hatten et al. (2005) found very little difference in soil properties between sites burned by low-severity fires and those areas left unburned. In fact the soils appear to be unchanged in the face of low-severity forest fires.

Soil microbiota

Microorganisms are directly affected by fire induced changes in soil chemical composition, because their survival entirely depends on the soil environment. Understanding of fire effect on microorganisms abundance and composition contributes to an overall knowledge as whole ecosystem is affected by fire (Tateishi and Horikoshi 1995).

Mabuhay et al. (2003) found the highest microbial carbon biomass and microbial abundance in the unburned area, followed by the area burnt 2 years ago and lastly by the area studied immediately after fire. The study of microbial biomass carbon and abundance and diversity of soil microbiota immediately after the occurrence of fire in a Japanese red pine forest Mabuhay et al. (2006) showed that the microbial diversity was significantly lower in the burnt area. The unburnt control area had the highest biomass carbon, abundance, and diversity.

Hamman et al. (2007) study conducted in Hayman fire burned forest in central Colorado, USA showed no effect of low-severity burning on overall microbial biomass of either low- or high-severity burning. However, but the microbial community structure was different from the unburned areas.

II.3 Natura 2000 practices in other European Countries

II.3.1 Latvian experience

Latvia has the third lowest proportion 11.53% of Natura 2000 sites compared to its land area in the European Union which is considerably below the EU average level of 18% (European Commission 2015).

It is noticed lack of scientific literature of Latvian experience, even with high number of projects directly or indirectly related to species and habitat management. For example, since 2000, 25 projects of more than 35 million € within the LIFE and LIFE+ programmes have been carried out. Amounts of different materials like handbooks, brochures, presentations, reports still leaves a gap in scientific articles on habitat management, restoration and conservation in Latvia (Cinate et al. 2016).

Since 2008 with intensified forest management due to increased annual harvesting timber volume Latvia faces decrease of mature forest connectivity which is related to loss of specialist forest species (Rendenieks et al. 2015). Historically less intensive forest management and recent research shows clear relationship between amount of natural forest structures and bryophyte species richness (Madžule et al. 2012b).

Natura 2000 sites in Latvia for the first time have been consistently reviewed under the NATURA 2000 program 2013 - 2017 (National Program for Natura 2000 Sites in Latvia). A document has been prepared to assess the national priority level of all Natura 2000 sites, to draw up a list of actions to improve the status of each Natura 2000 site or to ensure an adequate protection regime. In Latvia, a significant part of Natura 2000 sites do not have nature management plans, so this program is the main and the only planning document for habitat assessment and selection (Latvian Nature Conservation Agency 2017). The conservation status of all 12 types of forest habitats in Latvia in 2007-2012 was bad and with a worsening trend. The main negative factors for forests are draining, the lack of structural elements, the elimination of natural disturbance regimes like fires, the intensification of forestry, the spread of invasive plants and eutrophication. Research topics specific to forest habitats should be targeted in the following areas to create an effective network of protected areas:

1. Quantity and variety of structural elements of important forest biodiversity and landscape

2. Impact of climate change on species composition and species distribution

3. The impact of forestry on biodiversity

4. Assessment of forest ecosystem services

5. Dispersive possibilities of forest species in fragmented landscape

Conservation measures in Latvia is understood as both active and passive nature conservation components and is more suitable term than the traditional term management which suggests only active performance (Cinate et al. 2016). Man caused disturbances like military training activities a good example is Adazi Natura 2000 site in Latvia, demonstrates benefits on the abundance of protected bird species and maintains habitat diversity (Aunins and Avotins 2018). Latvian Habitat Interpretation Manual describes four natural disturbance regimes in Latvian forests: rare disturbances of great intensity (fires, windfalls and massive insect damage), frequent disturbances of small intensity (cohort dynamic) after them the majority of the forest stand remains vital, gap dynamics, where individual trees or small groups of trees die due to such disturbances as windfalls, snow breakages or insect damage and Influence of herbivores(Aunins 2013). Analysis on history of a semi-natural pine dominated landscape of Northern Latvia State national parks shows frequent fires were the dominating disturbance feature over the past 250 years, shaping stand dynamics, structure and species distribution (Kitenberga et al. 2019). From 1998 to 2014, prescribed burning was carried out in around 289.7 ha of Latvian forest land, with an aim to conserve the natural values. Of the whole area, 288.5 ha were moorland and only 1.2 ha were forests (Cinate et al. 2016).

The presence of structural elements typical for natural, old-growth forests in a forest stand is a significant and sometimes decisive indicator of quality. The diversity of structural elements is also indicative of natural stand development in cases where a stand has been planted rather than regenerated naturally. The most significant structural elements of a natural forest are biologically old or large-dimension trees, stumps and snags, large logs, hollow trees, canopy gaps, uneven age structure and indicator and specific species of woodland key habitats (Ikauniece 2017). Epiphytic lichen species diversity research in Latvia of one of the rare habitat type, broad-leaved tree forests, shows importance of stand tree species diversity, past land-use and its continuation and presence of *Quercus robur*, *Tilia cordata* and also the pioneer species *Populus tremula* supporting highest lichen richness (Štikāne et al.).

While Latvia has quite effective process of initiation and establishment of small protected territories or micro reserves outside Natura 2000 for species and habitats is quite different situation for the expansion of the overall Natura 2000 network due to the lack of scientific information (Ikauniece 2011). Currently undergoing additional inventories in Latvia might broaden EU forest habitat distribution in Latvia.

II.3.2 Finish experience

Finland has established special protection areas for the conservation of species of the Birds Directive and sites of interest to communities of the Habitats Directive. In 2015, the Finnish Ministry of Environment established areas approved by the European Commission as special conservation areas SAC special areas of conservation. The Natura 2000 network of sites largely coincides with the existing network of protected areas, but extends to previously under-protected habitats. In Finland most of the protected areas are located on state-owned land resulting from the prevailing policy of buying the land on which protected areas are designated (National Audit Office 2007). In 2014, amendments to the Nature Conservation Act were adopted to control the negative impact on Natura 2000 sites. Most of the sites in the Finnish Natura 2000 network aim to preserve their naturalness, it means their preservation does not require active intervention measures (Metsähallitus 2016). However, biodiversity-oriented forestry should be more often considered because approximately 80% of red-listed boreal forest species could be linked to specific tree species or forest characteristics, and 60% of them were associated with dead wood (Tikkanen et al. 2006). An experiment on forest restoration in Finland aimed to introduce conditions favouring deciduous trees, which in Finland are mainly pioneer species specifically European aspen (*Populus tremula*) (Vanha-Majamaa et al. 2007). Multiscale management should focus for disturbances and structures at three operational scales, i.e. at landscape, stand, and patch/microhabitat (Kuuluvainen 2002). Development of plans and projects most likely having adverse effects on the sites of European ecological importance, Natura 2000 sites requires Appropriate Assessments. In Finland, however, there is need for more iterative planning practices in which the preparation of a plan or project with alternative options goes together with the impact assessment equipped with sufficient data (Söderman 2009).

Restoration prioritization working group of about 100 experts produced a report on options and costs of meeting the Aichi biodiversity target of restoring at least 15 percent of degraded ecosystems in Finland (Kotiaho et al. 2016). That demonstrates state`s serious consideration towards set restoration targets.

Scientists had published comprehensive analysis overlooking different aspects of maintaining biodiversity in Finnish forests including natural dynamics and natural disturbances of forests which is essential condition for many local species to survive (Virkkala and Toivonen 1999)

Also understanding high costs of optimal Natura 2000 network attempts on the prioritization of high conservation value habitats were carried out (Mikkonen and Moilanen 2013).

In Finland restoration by burning is considered to be the most effective way for Western taiga (Kuris and Ruskule 2006).

Finland has established a nationwide network of 50 fire continuum areas in order to maintain sufficient coverage of burned forest by continually implementing controlled burning according to a regional plan. The fire continuum plan is a regional (1–3,000 km²) long-term (20–50 years) plan with the objective of secure the continuity of fire habitats both in time and space. Continuous establishment of these ephemeral habitats is necessary for the long-term survival of several endangered fire-dependent species. Forest fires create habitats that are critical for numerous specialized species. A fire continuum area consists of a network of several Natura 2000 sites within a 20 km distance. The optimum period between consecutive fires inside a fire continuum area is 3–5 years. Fires at this interval are able to maintain populations of both fire-dependent and fire-favouring endangered species in the area (Hagen et al. 2016).

Summarised 20 years of practice restoring and managing forest habitats in protected areas in Finland focuses on the restoration of heathland forests, herb-rich forests, white-backed woodpecker habitats, nemoral broadleaved forests and sunlit habitats (Similä and Junninen 2012).

The team of NATURALIT experts visited Finish Natura 2000 areas with high variety and scale of nature management activities during June 2019 (Leisjarvi national park, Ormajärvi-Untulanharju and Sajaniemi Natura 2000). Conservative habitat management is often combined

with strict protection status. All forest management aimed to improve the status of protection values and if profit appears due to some wood production it dedicated for future protection needs. Our group visited ongoing prescribed burning area and familiarized with the technological issues. Aim of prescribe burning was to stop forest succession from pine to spruce dominated forests, increase the number of species affiliated with deadwood and old burnt areas. Smaller scale damages imitated by taking narrow strip of bark around tree stem. Such practise increases the volume of deadwood and prevents the spread of spruce. Such practise is decreasing due to enlarging prescribed burning. Bushes and undergrow trees might be felled aiming to improve light and temperature regime for critical species. Some rare herb species are propagated artificially and introduced in new typical habitats. Old drainage ditches are naturalised by making dams and stopping water flow. Finally, valuable deadwood are protected in high range of areas, even close to infrastructure areas, by leaving high stumps (4-6m). More about the results of study visit are presented in 1 appendix.

II.3.3 Swedish experience

In Sweden all Natura 2000 areas are protected with the support of the Environmental Code and classed as a national interest. In planned forest management activities, the forest owner needs permission from county administration to carry out activities in Natura 2000 areas. If the core values in the actual Natura 2000 area are threatened, the application for permission can be restricted or denied (Stjernström et al. 2017). Non-intervention management model is prevailing in southern Swedish coniferous forest national parks and nature reserves regardless of whether they were intended to represent earlier fire-disturbed pine/pioneer broadleaf forest types or more fire-sensitive, spruce-dominated forest types (Niklasson and Drakenberg 2001).

In Sweden the Natura 2000 areas are selected by county boards in the different counties after consultations with land owners and concerned authorities. Before the Government makes a decision about the selected areas it is checked by the National Environmental Protection Agency. When the areas are checked the Government proposes to the EU Commission which areas should be parts of the Natura 2000 network. Sweden is one of many countries that have been criticised for not presenting enough areas for certain landscapes and species (Wärneryd and Gomér 2009).

In Sweden major causes of biodiversity loss over the last century were changes in natural and traditional disturbance regimes such as abandonment of traditional management of semi-natural grasslands, the lack of natural forest fires has reduced biodiversity in the taiga, and the heavily changed hydrology of rivers and wetlands (Halme et al. 2013, Hagen et al. 2016).

Prioritised action framework (PAF) for Natura 2000 in Sweden (PAF 2013) presents an overall assessment of conservation status for forest habitats, an overview of pressures and threats to species and habitats and summary of strategy and priorities for period 2014-2020 also expected outcomes with particular focus on priority habitat types and species. The Swedish PAF highlights restoration priorities on a more general level, and simultaneously points out the habitat groups where restoration is of particular importance.

PAF for Natura 2000 in Sweden points out situation of declined species' ranges in particular of the invertebrates and mosses. For many species, this can be explained by loss of habitat, and fragmentation of certain forest types. Deficiencies in the forest quality is another explanation, the lack of dead wood and old trees, and the absence of fire and floods are some key reasons for this. The intensification of forestry makes the prospects seem dark for some of our coniferous and mixed forests, especially for nutritious spruce forest (9050) and taiga (9010), and the species that are associated to them. The main reason is the felling of forests with high conservation values, but clearing and thinning are also affecting the forest structure negatively. Other threats that may play a larger role in the future are forest fertilization and the spread of alien species. Due to the increased consideration of humid forest types in recent decades, the state of the wet woodland types 9080, 91E0 and 91D0 have improved. In southern Sweden, intensive land use and extensive drainage and ditching have however already largely eradicated these habitats. The nemoral forest types are largely dominated by different broadleaved tree species. The area of broadleaved woodland has not changed in any obvious way in the last century, but a major decline is likely to have occurred earlier. This combined with the lack of old trees and deadwood, competition with spruce and nitrogen deposition means that the situation is unfavourable for the broadleaved deciduous forests. Reduced deposition of sulphur and the ambitions to protect and restore broadleaved forests and streams with adjacent forest gives some hope for some forest types. Exploitation is an imminent threat for many broadleaved forests due to their proximity to populated areas. The mountain hare has been pushed back by the snow-free winters and clear cutting practices, which lead to increased predation and

competition with the introduced European hare, whose range is expanding. Several of the mosses have such a limited occurrence that they suffer a high risk of disappearing unless the places where they occur are protected. *Euphydryas maturna*, *Pulsatilla vulgaris* ssp *gotlandica* and *Pulsatilla patens*, are disadvantaged by the lack of small-scale disturbance and by the forests becoming denser. Due to the historically higher population pressure in southern Sweden, the situation is in many cases more difficult in the Continental region than in the Boreal. The situation in the south has been made worse by the high deposition of nitrogen and sulphur. In the Alpine region, the status and prospects are generally brighter.

Summary of strategy and priorities ensuring good functioning of Natura 2000 network in forest includes such measures as: improved consideration during harvesting and in the commercial forestry, prescribed forest fires, restoration of natural water regimes influencing wet forests along rivers and lakes, temporary protective fencing around important areas for deciduous regrowth/successions, grazing or re-introduction of grazing in forests with management-dependent values, recreation of forest borders with a high proportion of deciduous trees, conservation of veteran trees.

The following, main management regimes are recommended:

Maintenance and re-introduction of fire as a natural disturbance regime in boreal and boreonemoral forests (in order to achieve this, the preparation an implementation of regional plans is suggested, as well as competence building for managers). This measure is most relevant for 9010 and 9060

Maintenance and restoration of hydrological regimes, and restoration of drained areas (suggested actions to achieve this are mapping and prioritisation of the most important flooded forests, as well as a guidance document for the work. With this, the CABs, with the support of national authorities, can start the work to restore the natural hydrology of the prioritized objects). This measure is most relevant for 9080, 91D0, 91E0, 91F0 and 9010.

Maintenance and re-introduction of traditional management, particularly in meadow and pasture habits in the nemoral and boreonemoral region (suggested measures are the preparation of regional prioritisation plans, restoration of the most important objects, and continued management of all areas that are currently managed). This measure is mainly

relevant for 9070. The restoration of oak habitats in important areas for oak-dependant species has the highest priority on national level. See also priorities under grasslands.

Spontaneous development/non-intervention management is regarded as the most important management regime in all objects where the forest is to develop through natural dynamics. This management regime is relevant for all habitat types except 9070. In addition to the general management regimes above, the following measures can be prioritized in certain woodland objects in protected areas

Restriction/reduction of spruce growth in broadleaved forests, 9020, 9110, 9130, 9180, 9190 (this measure has high priority in the nemoral region, and is important in order to stop an unnaturally high level of spruce in natural broadleaved forests)

Restriction/reduction of spruce in other deciduous forest (suggested as a species conservation measure, in boreal deciduous forest generated after forest fires, or to avoid an unnaturally high spruce content in boreonemoral or nemoral deciduous forests)

Restriction/reduction of spruce growth in pine forests (this can be an additional measure substituting fire, particularly if it is necessary for pine-living insects in areas with a documented importance for them)

Removal of non-native tree species

Restoration of low-quality habitats, particularly habitats with an insufficient area, such as 9010 and 9130. This can also be an important measure for improved connectivity between core areas. The Species action plans for woodland species are an important source of knowledge for regional priorities, and should be taken into consideration when management actions are developed (PAF 2013).

The team of NATURALIT experts visited Swedish Natura 2000 areas with high variety and scale of nature management activities during June 2019 (Tivedens national park, Nedre Dalälven biosphere reserve, Kinnekulle, Högsböla, Melldala and Nolberget nature reserves). We were introduced with various nature management practises in protected areas. Valuable protected areas are established in the most valuable areas, and the state compensates any financial loss to current owners. The use of cattle for pasturing is common practise in semi-open habitats, such as wooded meadows, and it ensures survival of species demanding special management regime. We examined various practises of fencing in forest and open landscapes. Administration

pays high attention to visitors and provides infrastructure that protects existing rare species and facilitates visitors. In general, even common trees (pines) are protected against negative impact of visitors and building of infrastructure. Some de-barking practises are used for small scale tree species modifications. We visited extensive wetlands that were opened by felling all arboreal species that appeared due to lack of grazing during last decades. Finally, the white-backed woodpecker re-introduction program in national park was started by using temporal feeding attraction for birds.. More about the results of study visit are presented in 1 appendix.

II.3.4 Estonian experience

In Estonia 10% of total forest area is strictly protected forests and this number was reached by implementing Natura 2000 network. Rapid expansion of strictly protected forest areas in Estonia was also due to applying principle of protecting more rather less while information on values is insufficient with the future perspectives to allow adequate management of protected areas (Link 2010).

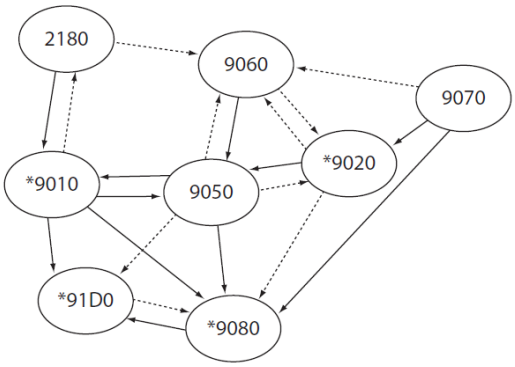
Estonian prioritised action framework PAF has more specific targets and goals for restoration than the Swedish PAF. These targets and goals will make it easier to use the PAF for planning specific actions, and also to evaluate and follow up on any achievements. (Hagen et al. 2016)

Main objective of forest nature conservation in Estonia is to protect natural processes and late successional or typical hemi-boreal species (Nature Conservation Act; Lõhmus *et al.*, 2004), the progressive natural changes in forest habitats is not a primary concern in nature conservation policy. Nevertheless, it might become a policy issue that the relative representation of some habitat types is changing.

Estonian (hemi)boreal late-successional or virgin forest landscape should be covered with mixed spruce-forests: which corresponds mostly to type Herb-rich spruce forest (9050) with pattern of Western taiga (*9010) and Broad-leaved forests (*9020). Late-successional peatlands may be also covered with various forest types such as Bog forests (*91D0), some Western taiga stands or Deciduous swamp forests (*9080). The main forest habitat types can be divided into subtypes on the basis of their landscape features and special forest qualities such as sparse noncultivated Dune forest (2180), fire-influenced species-rich Esker forest

(9060), landslips-containing shady and moist Slope forest (*9180) and flooded Alluvial or Riparian forest (*91E0 and 91F0) (Palo and Gimbutas 2013, Palo et al. 2013, Palo and Gimbutas 2015, 2017). High severity disturbance is linked mostly to fire on poor soils close to the Baltic Sea (Parro et al. 2015). Lowland forests and forests on fertile moraine or rendzina soils have a gap phase disturbance regime, driven by dynamics of wind, pathogens, and insects (Vodde et al. 2015). A conceptual model of forest stand development in Estonia shows possible more sustainable forestry considerations (Kangur et al. 2005).

Diagram below shows theoretical ways of succession of forest habitats, based on knowledge about the development of forest site types and communities. Continuous arrow – common natural succession; dashed arrow – rarely occurring succession or changes after natural disturbances (fire, windthrow, flooding) (Palo and Gimbutas 2013). This illustrates what types of habitats would increase with natural development and where succession needs to be stopped by applied management in order to maintain certain forest types.



Research on localities of *Lobaria pulmonaria* known as an indicator species of undisturbed old-growth forests ecosystems in Estonia, showed three major considerations of forest management: short rotation period of tree stands, species prefers rare forest types which often under strong economic pressure and it prefers host trees which have a restricted distribution in Estonia or are not favoured in forest management practice. Continuous and vast forest cover areas had highest density of localities of L. *pulmonaria* (Jüriado and Liira 2009).

II.3.5 German experience

The German federal government provides framework legislation and the sixteen federal states are responsible for the implementation of the federal laws, while retaining some degree of freedom on how to do this. This is also the case for the Natura 2000 network, resulting in a variety of different implementation approaches. Survey concluded that in Germany, less financial resources should have been spent on planning but more concentrated on actual management measures (Wätzold et al. 2010). In depth analysis of legal interpretations of appropriate assessments for projects and plans in accordance with Article 6(3) of the Habitats Directive 92/43/EEC shows wide range of aspects and complexity of evaluation affecting the conservation objectives of the site concerned (Möckel 2017).

In total about 17% of the German forest area was designated as “Special Areas of Conservation (SAC)”, which includes many beech forests that formerly were not subject to a special protection status and management plans, containing measures for the protection of SACs, are just being developed (Rosenkranz et al. 2014).

It was noted that in Germany rare habitats are overrepresented compared to common habitats when using the same quantitative proportional targets for all of them (Friedrichs et al. 2018).

The distribution of high-nature-value forest habitats can be determined using forest data on plant species distributions and occurrence only when indicator species that are closely associated to forest habitats and a specialised species are selected. Such method is highly dependent on the availability of high-quality species distribution data (Culmsee et al. 2014).

Tree microhabitat concept (Großmann et al. 2018, Larrieu et al. 2018) was developed and detailed under demonstration project ‘Establishing a European network of demonstration sites for the integration of biodiversity conservation into forest management’ supported by the German Federal Ministry of Food and Agriculture. It is a practical tool for accessing trees important for biodiversity and needs to be adopted on wider scale (Kraus et al. 2016). Microhabitats are inventoried before selective cutting operations in Schorfheide-Chorin Biosphere Reserve to demonstrate how sustainable forest management can consider biological values.

Tree microhabitat structures as indicators of biodiversity used due to high correlation with the abundance of forest species and ecosystem functions. Active management for microhabitats in wood production stands is important if the aim is to create structural complexity for a variety of organisms and ecosystem functions in even-aged stands. Most of the investigated microhabitats are indeed indicators of natural mature and natural old-growth stands, e.g., broken tree top, bayonet top, crack or scar, bark loss, hollow chamber, stem cavity with decay, bark pocket with and without decay, bark bowl, burl, heavy resinosis, and bark burst (Michel and Winter 2009). In beech forests, hollow trees not only promote the few specialists of hollow trees, but also play a superior role for species under pressure by current logging practices and as a keystone structure with high habitat diversity at one tree (Müller et al. 2014).

There are positive examples how variety of small scale management approaches and intensities, ranging from unmanaged and overaged coppice stands to spruce stands with small clear-cuts created a diverse habitat mosaic in the private woodlands in Germany (Molder 2016).

Examples of different management practises of pure Norway spruce stands towards re-establishing European beech ecosystems showed significantly increased number of macro fungal species and needs further to be considered for more climate adapted mixed stands (Goldmann et al. 2015, Heine et al. 2019).

Three EU forest habitat types *Tilio-Acerion* forests of slopes, screes, and ravines (9180*), Bog woodlands (91D0*) and Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (91E0*) in Bavaria, Germany were looked at in climate change perspective. In the study, bog woodlands are most threatened, followed by *Tilio-Acerion* forests of slopes, screes, and ravines. The alluvial forests with *A. glutinosa* and *F. excelsior* seem to be remarkably less exposed to climatic changes (Steinacker et al. 2019) .

The team of NATURALIT experts visited Natura 2000 areas in Germany during October 2018. Schorfheide-Chorin biosphere reserve close to Berlin was visited. Natural ground water level in biosphere reserve was restored. Natural forest habitats are managed aiming to harmonize conservation and production needs. Within stand multi age tree structure is created by selective cutting. There are felled microgroups every 4-5 yrs. by felling 70-80% of increased volume. Biodiversity protection effect is achieved by protecting trees with microhabitats. There

are comprehensive studies and monitoring for microhabitat values as well as management effect. More about the results of study visit are presented in 2nd appendix.

II.3.6 Polish experience

In spite of the generally favourable attitudes to nature which Polish people generally have, Natura 2000 is perceived as an unnecessary additional conservation tool. Both local authorities and communities residing in the Natura areas think that the programme is a hindrance, rather than a help in the economic development of municipalities or regions, as was initially supposed. This lack of acceptance results from many factors, mainly social, historic and economic. In the case of Poland the communication system between the representatives of the Polish Ministry of the Environment responsible for the Natura 2000 implementation and local governments was most severely criticized. In contrast, the local government's position was seen as consistent with that of their community.(Grodzinska-Jurczak and Cent 2011).

Although the Natura 2000 network is internationally accepted in the EU through policy, there are country specific production oriented bureaucracies. For example environmental NGOs and the EU Commission have limited access to decision-making procedures concerning the protection of biodiversity via NATURA 2000 in the Bialowieza Forest, Poland (Logmani et al. 2017). Second phase of the Natura 2000 network requires development of management plans for designated protected sites. Residents as well as other stakeholders do not demonstrate enough support for enforced regulations to maintain habitats requiring active protection in their proper condition due to the Natura 2000 network requirements (Grodzińska-Jurczak et al. 2012).

Survey on biodiversity economic values indicated that general public strongly prefer protection of natural ecological processes, at least for some environmentally valuable areas, and are willing to pay for passive protection regimes (Czajkowski et al. 2009).

It is important to consider the spatial distribution of deadwood and to increase its volume in areas focal for biodiversity such as in Natura 2000 sites and ecological corridors. However in the relatively short period from 2004 (the establishment of the Natura 2000 network in Poland), only slight increase of coarse woody debris volume has been recorded in managed forests covered by the Natura 2000 program (Banaś et al. 2014)..

In Poland, it was defined that Natura 2000 insufficiently protects the most endangered wolf population and thus suggested expansion of Natura 2000 to protect at least an additional 8% of wolf habitat in western Poland (Diserens et al. 2017).

The team of NATURALIT experts visited Polish Natura 2000 areas during October 2018. Natura 2000 area Puscha Notecka and nature reserve Swietlista Dabrova close to Poznan had been visited. Pine forests are felled by clearcutting. The felled areas width is 55m. Some areas for *Lululla arborea* are felled up to 6 ha. Mainly natural regeneration is aimed. Some sites are seeded mixing pine, oak and beech. In oak reserve gaps without oaks might be felled up to 0,5 ha. Wild horses are used for pasturing in forest habitat in neighbouring forest. More about the results of study visit are presented in 2nd appendix.

II.3.7 Slovenian experience

Slovenia is one of the most forested countries in Europe and the Natura 2000 network covers 36 % of the country with forest being the prevailing ecosystem type. In Slovenia, the ideas of forest planning and management are oriented towards the natural species composition and natural forest regeneration have an important place in sustainable forest management, high share of dead wood of different sizes must be kept in forest ecosystems. These close-to-nature forestry practices have been used in Slovenia for over 50 years to promote the conservation of nature and forests (Kutnar et al. 2011).

Study aimed to design a set of biodiversity and conservation status indicators and to evaluate their suitability in Slovenia's three largest forest habitat types. It is strongly suggested to divide heterogeneous forest habitat types into subtypes, because forest habitat subtypes differ in species composition and ecological conditions, their management will differ (Kovač et al. 2016).

II.4 Lithuanian forest habitat types

Lithuania is characterised by several environmental gradients like climatic, postglacial, base rock which in turn influences diversity and distribution of potential forest habitat types across the country.

One of the most important plant habitat lines in the territory of Lithuania is the northern boundary of the hornbeam (*Carpinus betulus*). The territory of the country lies in a transitional zone of coniferous forests and broadleaf forests, which contain elements of southern taiga and nemoral forest vegetation. Because of these reasons there is a large diversity of forest habitats in Lithuania, the internal structure of habitats is complicated and often not typical (Rašomavičius et al. 2012).

According to European Environmental Startification Lithuania belongs to nemoral environmental zone covering the southern part of Scandinavia, the Baltic States and Belarus. It is the environmental zone characterised by mixtures of Taiga forest and Deciduous broadleaved forests (Metzger 2018).

In Lithuania, 13 habitat types of Community importance are found in forests, of which 6 habitat types are priority (*) (Rašomavičius et al. 2012). The European Commission 2013 specifies that Forests are (Sub)natural woodland vegetation comprising native species forming forests of tall trees, with typical undergrowth, and meeting the following criteria: rare or residual, and / or hosting species of Community interest. Further subsections analyse in more detail the specifications of particular forest habitats. However, focus is concentrated on the seven most widely spread habitat types with dynamic management models mimicking natural forest disturbances currently being developed in the “Guidelines for the management of natural forest habitat types of EC importance in Lithuania”.

9010* Western Taiga

Natural old forests as well as those young forest stages naturally developing after fire. Natural old forests represent climax or late succession stages with slight human impact or without any human impact. Present natural old forests are only minor remnants of those originally occurring in Fennoscandia. With intensive forestry, which is carried out practically

throughout this region, the main features of natural old forests disappear, i.e. the considerable amount of dead and rotten wood, the great variation in tree age and length and species composition, the trees from previous generations, the more stable microclimate. Old natural forests are habitats of many threatened species, especially bryophytes, lichens, fungi, and invertebrates (mostly beetles). Some of the present old natural forests have human impact, but in spite of that they maintain many characteristics of the natural forests. Because of the important role of fire, burned forest areas, and their young succession stages, have been naturally common in the boreal region. Nowadays they are extremely rare because of efficient fire protection and forestry. Natural recently burned forest areas are very important habitats for many endangered species. Typical of natural burned areas is a great amount of dead burned wood and a varying density of living trees which greatly conditions the regeneration of the forest. The character of the forests varies with the different boreal zones (hemi-, southern, middle, and northern) and different site types. The following sub-types are distinguished, according to the main tree species and site type variation:

- natural old spruce forests
- natural old pine forests
- natural old mixed forests
- natural old deciduous forests
- recently burnt areas
- younger forests naturally developed after fire

Plants: Pine forests - Pinus sylvestris, Vaccinium vitis-idaea, Calluna vulgaris, Empetrum nigrum, Pleurozium *schreberi, Cladonia* spp.; Spruce and mixed forests - *Picea abies*, *Pinus sylvestris*, *Betula* spp., *Vaccinium myrtillus*, *Deschampsia flexuosa*, *Maianthenum bifolium*, *Oxalis acetosella*, *Trientalis europea*, *Dicranum* spp., *Pleurozum schreberi*, *Hylocomium splendens*; Deciduous forests - *Betula* spp., *Populus tremula*, *Deschampsia flexuosa*, *Vaccinium myrtillus*, *Agrostis capillaris*, *Equisetum sylvaticum*. Lichens - *Evernia divaricata*, *Lobaria pulmonaria*. Fungi - *Amylocystis lapponica*, *Gloiodon strigosum*, *Fomitopsis populicola*, *Skeletocutis odora*, *S. stellae*, *Phlebia centrifuga*, *Haploporus odorus*, *Aporpium cargae*, *Gelatoporia pannocincata*, *Phellinus populicola*. Animals: Mammals - **Pteromys volans*, *Myopus*

schisticolor, *Sorex minutus*; Birds - *Picoides tridactylus*, *Perisoreus infaustus*, *Dendrocopos leucotos*, *D. minor*; Beetles - *Tragosoma depsarium*, *Pytho kolwensis*, *P. abieticola, #Cucujus cinnaberinus*, *Peltis grossa*, **Osmoderma eremita*.

Originally natural old forests were found in the whole boreal and hemiboreal zones, except in the treeless zone. In Finland nowadays most of the natural old forests are found in eastern and northern parts, in southern and western parts of the country only remnants of these forests remain. In Sweden most of the old natural forests are in the north and only some of them in the south. The most important restoration measures in Swedish boreal forests for promoting biodiversity are to increase the number and quality of undisturbed forests, the amounts of coarse woody debris, the number of deciduous trees, and to introduce fire as an ecological process. (Fries et al. 1997). Prescribed burning initially negatively affects most species groups (apart from pyrophiles), but within 10–15 years post-fire sites begin to support many rare and threatened deadwood-dependent species. Only epiphytic lichens remain negatively affected (Koivula and Vanha-Majamaa 2020).

The main natural succession in Western taiga habitats is towards regional climax community which is mixed spruce and broad-leaved forests or alternatively towards forest paludification. Due to this transitional stands could be identified for particular habitat, like 9050, 9020*, 9080*, 91D0*(Palo and Gimbutas 2015).

Norway spruce stands in Europe are susceptible to *Ips typographus* outbreaks which related to growth dynamics or even the replacement of tree generations in the ecosystem. Managed forests compared to natural or close-to-nature forests characterized by simplified stand structure and in turn weaker regulation mechanisms (Grodzki 2016).

In Latvia necessary activities for this type is non-intervention. Management and restoration activities to improve the conservation status of Western taiga, restoration activities is planned to realize in three terms: short-term management measures to be implemented by 2015, mid-term management measures to be implemented by 2020, and long-term management measures to be implemented by 2050. Selected restoration activities include: controlled burning with preparation works to ensure safety and control over fire and measures to increase amounts of habitat's structures, especially, dead woods in different decaying stages and openings that aim to diversify the composition of tree stands in future (Latvian Fund for

Nature 2015). Gauja National Park in Latvia is one of the most significant Natura 2000 sites in Latvia for the protection of EU habitat 9010* Western taiga. The management under the project LIFE + project FOR-REST includes the development of openings for the diversification of the forest stand and promotion of the development of various types of dead wood. Planned controlled burning of the habitat due to the objections of the active group of people, which gained vast publicity, was cancelled (Lārmanis and Andrušaitis 2016).

Western taiga is found in the protected landscape area "Adazi" in Latvia. Existence and regeneration of this type of the pine forest is related to forest fires, which prevent formation of thick undergrowth, allow self-seeding of new pine trees and create different age tree stands. In the commercial forests clear-cuts can be partially likened to the impact of fires. Forests in the project site are currently not being used in forestry and only tactical military exercise, which does not create fires, takes place in them. Therefore, there is no natural forest regeneration. During the project controlled burning will be carried out to replace natural disturbance. It will contribute to the creation of mixed age pine stands in the long-term and provide better feeding conditions for the European Roller in the short term. The project will restore 20 hectares of old or natural Western taiga by a controlled burning of the undergrowth. These works will be performed in accordance with the specially developed plan of action. Burning will carried out by the National Armed Forces and the JSC "Latvian State Forests" in collaboration with specialists from the State Forest Service. Support for the air will be provided by the National Armed Forces helicopter, which will ensure surveillance and firefighting if necessary. (LIFE+project “Birds in Adazi”).

Low-severity fires typically release less carbon per fire event (although total emissions are dependent on area burned) at more frequent intervals than with stand-replacing regimes, and favour long-lived and fire-resistant (or tolerant) forest species that typically survive multiple fire events (Ritchie et al. 2007). In Finland restoration by burning is considered to be the most effective way for Western taiga (Kuris and Ruskule 2006). Examples of good practices of fire use as a management tool in Europe for nature conservation in protected areas, the management of habitats for hunting, landscape management, fire use in fuel reduction and fire suppression are presented in a report (Montiel and Kraus 2010).

In Estonia Western taiga habitats at present include more pine stands than are likely in the future, when spruce will become more dominant and frequent. Aging and low frequency of

birch trees in sub-canopy layer will, in the absence of disturbance, decrease the presence of birches in the stands for many years; whereas the frequency of broad-leaved trees will rise, especially maple and oak (Palo and Gimbutas 2013).

9020* Fennoscandian hemiboreal natural old broad-leaved deciduous forests (*Quercus*, *Tilia*, *Acer*, *Fraxinus* or *Ulmus*) rich in epiphytes

The hemiboreal natural old broad-leaved deciduous forest forms a transition between the Western Taiga and the nemoral forests. The most common tree species are *Quercus robur*, *Ulmus* spp., *Fraxinus excelsior*, *Tilia cordata* or *Acer platanoides*. There is typically a considerable amount of dead wood and a long continuity of woodland cover on the sites. The species-diversity of lichens, fungi, insects and soil-organisms is high. In many cases the forests have previously been used for grazing or mowing.

Plants: *Allium ursinum*, *Anemone nemorosa*, *Corylus avellana*, *Dentaria bulbifera*, *Hepatica nobilis*, *Lathyrus vernus*, *Mercurialis perennis*, *Milium effusum*, *Poa nemoralis*, *Polygonatum multiflorum*; Bryophytes- *Antitrichia curtipendula*, *Homalia trichomanoides*, *Orthotrichum* spp., *Porella platyphylla*, *Zygodon* spp.; Fungi- *Auricularia mesenterica*, *Ganoderma lipsiense*, *Eichomitus campestris*, *Mycena galericulata*, *Tricholoma album*, *T. sulphureum*; *LichensArthonia vinosa*, *Biatorella monasteriensis*, *Cliostomum corrugatum*, *Gyalecta flotowi*, *Lobaria pulmonaria*, *Phlyctis agelaea*

A necessary activity in Latvia for this type is non-intervention and is the best conservation approach for old broad-leaved deciduous forests. In Latvia it is a rare type of natural forest vegetation with an area of 8500 ha or 0.13% of Latvia (Aunins 2013). Passive restoration efforts by setting aside of deciduous woods for development by natural succession, together with active restoration by creation of dead wood, can lead to high biological value of the stands in nearest future (Madžule et al. 2012a).

Deciduous forest age structure of trees is uneven and young trees occur in groups. The canopy layer is usually composed of broad-leaved tree species: *Fraxinus excelsior*, *Tilia cordata*, *Quercus robur*, *Acer platanoides*, *Ulmus glabra* or *Ulmus laevis*. *Populus tremula* and *Betula* spp. can occur, particularly in stands after clearcutting or large-scale natural disturbances, such as wind-throws (Ikauniece 2013a). Gap-driven ecosystems results from rare stand-initiating

events. Most forest stands have a closed canopy at so called “optimal phase” of a natural succession. These are gap-driven ecosystems with regeneration taking place in small gaps created by the death of an individual tree. Deciduous forests could be recovered from overgrown former wooded meadows or pastures by partly cleaned from bush to support natural regeneration of broadleaves and by release of some old trees with high biodiversity value (Kuris and Ruskule 2006).

In natural broad-leaved forests the volume of dead wood is high, even exceeding 100 m3/ha (Bobiec 2002). Dead wood is an important structural element for many species. The aim of management in such forests can be to increase dead wood volume with a diameter greater than 25 cm to at least 20 m3/ha. The volume of both lying and standing dead wood can be increased by emulating natural disturbances. The applicable method depends on conditions of the site and the management objective. The most significant reason for why broad-leaved stands disappear is clearcutting. Selective felling to remove old, dead and damaged trees has an adverse impact on the quality of the habitat and reduces the volume of dead wood and number of existing or potential biologically old trees. Biologically old, large dimension trees with a diameter above 35 cm should not be selected for felling, as they have high biological value when living. If the cut trees are *Picea abies*, the branches should be removed from the stand immediately after felling to prevent soil acidification by needle litter, which is not desirable for this habitat.

Non-intervention conservation and management of habitat provides passive protection. However, applying non-traditional forestry methods aimed at the creation and management of forest stands of a certain tree composition, ensuring the environmental requirements of the target species including protected species) includes the emulation of natural disturbances. Soil scarification should be avoided, because open mineral soils propagates pioneer species (Björse 2000).

Gap dynamics is a very characteristic disturbance in broad-leaved forests and is a process when individual trees or small groups of trees suffer mortality due to wind-throw, snow break, and insect infestation or naturally when the biological age of the tree is reached. Advance growth rapidly develops in gaps. Such small-scale disturbances, where other conditions remain stable, cause the development of an uneven-aged structure with standing and fallen trees in various stages of decay (Bottero et al. 2011). Stands must be allowed to transform freely into

terminal phase or gradually renew in small gaps. All the forestry management should be aimed at restoration of the natural mosaic pattern. Gap dynamics seems to be characteristic of communities in which the tree crown architecture prevents light from penetrating to the ground and inhibits continuous stand renewal beneath the canopy (Bobiec et al. 2000).

In low quality or potential future habitats, management can include creation of mosaic forest structures, gaps, and dead wood of various types, if it is necessary to improve the habitat conditions of a particular protected species dependent on dead wood or good light conditions in the forest. This type of management can generate diverse micro-climatic conditions – both well-lit areas and retained shaded patches with a shrub layer. Management can be expected to have a positive impact on populations of epiphytic mosses and lichen. For example, *Metzgeria furcata* prefers shaded stems of trees, while *Flavoparmelia caperata* requires improved light conditions (Ódor et al. 2014). Emulation of natural processes is not required in habitats of good and medium quality, except in specific cases where it is required for the conservation of a specific habitat of a protected species. In some cases, low-intensity improvement of forest stand structure can be performed in habitats of low quality. If a forest stand is left to natural processes, development of structures will occur naturally in the long run. It is recommended to mostly conduct management for the improvement of forest stand structure (diversification) in relatively young stands adjacent to Old broad-leaved deciduous forests, which will reduce habitat fragmentation and increase the continuous area of the habitat. In these cases the management occurs in areas around the habitat. In areas suitable for the development of the habitat, reconstructive felling can be used to increase the proportion of broad-leaved trees in the over storey and promote the development of vegetation characteristic of the habitat.

In old, natural broad-leaved forests the minimum volume of dead wood with a diameter > 25 cm is recommended to be at least 20 m3/ha. The volume of dead wood can be increased by creating lying and standing dead wood. The selected method depends on site characteristics and purpose. If the management aim is to increase the availability of habitat and substrate for fungi, bryophytes, and invertebrate species inhabiting dead wood, selected trees are felled and left on the ground.

In Estonian broad-leaved forests, the dominance of oak, aspen and birch clearly shows a decreasing trend. In the next generation, spruce is therefore likely become more frequent. The dominance of shade-tolerant broad-leaved species will also increase. Light-demanding pine

will totally disappear from the tree composition, as it is a relict tree species from overgrown Wooded pastures 9070. *Corylus avellana* dominated in shrub layer and it's frequency on plots was very high, it may even prevent the survival of shade-tolerant regrowth for a while (Palo and Gimbutas 2013). Positive shrub provided oak seedling protection against ungulate browsing was observed and assessed in southern Sweden (Jensen et al. 2012). Broadleaved forests are very common on areas that have been wooded meadows or pastures a century ago. Further natural development depending on soil type influences broadleaved communities' domination or shift towards more mixed forests with various amounts of spruces (Palo and Gimbutas 2017).

Historical perspective of current structure and dynamics of temperate lowland natural forest in the Bialowieza National Park in Poland illustrates the whole complexity of factors such as climatic (cold period 1790–1830), also local fires were typical phenomena in Bialowieza, but were successfully contained after 1800, the regeneration of *P. sylvestris* was quite abundant in post-fire periods and of course impact of ungulates (Miścicki 2012). Research shows that low-intensity fires (reduced conifer reproduction) in combination with canopy openings aids successful oak regeneration in temperate Europe (Bobiec et al. 2018, Petersson et al. 2020).

Study in Bialowieza National Park demonstrated that protective structures, mostly the spruce logs, facilitate the presence and growth of oak saplings and that this is most likely achieved through a browsing elimination effect created when logs surround a sapling (Smit et al. 2012). s. Most of the best quality grown-up oak saplings developed in the immediate neighbourhood of spruce logs (Bobiec et al. 2011). Stand gaps of various sizes supports regeneration of *Q. robu*r, even small gaps 500 m² (0.03–0.05 ha) shows successfull establishment of Oak. (Diaci et al. 2008). However for further successful growth, saplings require gaps of approximately 1000 m² or even more than 2000 m² (von Lüpke 1998, Diaci et al. 2008).

Understanding that current tree composition and structure was formed by applying 19th or 20th century land use practices and its current state protection shouldn't be the main aim rather letting forest areas on fertile soil be viewed as one unit with different patch level scenarios towards more natural state (Palo and Gimbutas 2017).

9050 Fennoscandian herb-rich forests with *Picea abies*

This type occurs in areas of brown forest soils with mull, often in low-lying areas, ravines and slopes with fine sediment and a favourable water regime. The succession of this vegetation type normally leads to the dominance of spruce in the tree layer, although the broad-leaved trees often comprise a significant element. Tall herbs and ferns dominate, but the species composition varies greatly between northern, southern and western Fennoscandia. The forests are characterized by distinct layers of vegetation. The bottom layer is covered unevenly by bryophytes, the field layer is dominated by herbs and grasses, the bush and tree layers are well developed including a variety of species. Several vegetation types have been described, the main groups being dry, mesic and moist grass-herb forests. Sometimes ground water is flowing near the ground surface, which give rise to a specific species rich ”wet-forest” flora and invertebrate fauna.

Plants: *Actaea spicata*, *A. erythrocarpa*, *Botrychium virginianum*, *Calypso bulbosa*, *Carex remota*, *Cicerbita alpina*, *Crepis paludosa*, # *Cypripedium calceolus*, *Diplazium sibiricum*, *Epipogium aphyllum*, *Geranium sylvaticum*, *Impatiens noli-tangere*, *Matteuccia struthiopteris*, *Melica nutans*, *Milium effusum*, *Paris quadrifolia*, *Viola selkirkii*; Mosses- *Brachythecium* spp., *Cirriphyllum piliferum*, *Eurhynchium* spp., *Plagiomnium* spp.

Habitat type Fennoscandian herb-rich forests with *Picea abies* 9050 is reported only in Finland, Sweden, Lithuania and Estonia. In Latvia Herb-rich spruce forests into 9010* in many cases was included in Western taiga forest habitat, assuming that they are a more fertile sub-type of boreal forests. By 2020 the implementation of mapping of EU habitats must be finished and 9050 Herb-rich forests with *Picea abies* must be separated from 9010* Western taiga. (Lārmanis and Andrušaitis 2016).

Assessment criteria and management considerations of the habitat type 9050 are still unclear in Estonia. Habitat type 9050 is mostly semi-natural in Estonia, thus continuation of traditional land-use to maintain the habitat in good condition is often required. Restriction of former management practices and strict protection of the habitat may lead to a thicker tree and bush canopy and disappearance of characteristic herb species (Korjus et al. 2016). In Estonia Herb-rich Spruce forests will lose pine trees from their composition and frequency of birch and aspen will decrease. The dominance of spruce will also decrease, but it will stay as a frequent

tree species. The stands will be mixed spruce-forests with many deciduous tree species in all layers and a species-rich shrub layer, where *Corylus avellana* is frequent and mostly dominant (Palo and Gimbutas 2013).

In boreal forest landscapes, herb-rich forests are viewed as biodiversity hotspots due to their rich flora and the associated biota. Herb-rich forests have the potential to host species-rich polypore assemblages if they have a sufficient amount of dead wood, not because of their fertility, study showed 101 polypore species found in herb-rich forests represent 40% of all polypore species in Finland. (Hämäläinen et al. 2018).

9060 Coniferous forests on, or connected to, glaciofluvial eskers

This type includes Fennoscandian conifer forests found on or close to eskers. The top of an esker is often characterized by *Pinus sylvestris* and the slopes sometimes by *Picea abies*, although deciduous species may occur. Eskers are glaciofluvial gravel and sand formations which consist of relatively sorted material, often forming ridges over 20 meters high. In terms of ecological site factors they are more variable than the surrounding forest on flatter ground. In particular the microclimate differs notably between shaded and sunny slopes. Thus aspect and slope inclination, which reflect the effects of solar radiation and soil and air temperatures are important ecological factors. As a result of ecological characteristics, vegetation on sunny esker slopes is often relatively rich in species and particularly contains many leguminous plants as well as some eastern steppe plant species.

Plants: *Antennaria dioeca*, *Anthyllis vulneraria* subsp. *fennica*, *Astragalus alpinus*, *Brachypodium pinnatum*, *Calamagrostis arundinacea*, *Carex ericetorum*, *C. pediformis*, *Dianthus arenarius*, *Fragaria vesca*, *Hierochloë australis*, *Hypochoeris maculata*, *Juniperus communis*, *Lathyrus niger*, *L. vernus*, *Melica nutans*, *Oxytropis campestris*, *Pinus sylvestris*, *Polygonatum odoratum*, *Pulsatilla patens*, *P. vernalis*, *Pteridium aquilinum*, *Rubus saxatilis*, *Silene nutans*, *Thymus serpyllum*, *Vaccinium vitis-idaea* and *Viola rupestris* subsp. *Rupestri.*

Within the LIFE project “National Conservation and Management Programme for Natura 2000 sites in Latvia”, in winter 2013 – 2014 restoration of two pine stands on an esker system was conducted in the Razna National Park. It was attempted to create the natural structure of this habitat by reducing shading for sun-loving plants by partial harvest of trees and creation of

patches of exposed mineral soil. However, for more successful results target species should be still present before restoration commencement, also more scarification of the O horizon is needed and artificial seeding could be considered (Brūmelis et al. 2019).

In Estonia, these forests locally persist as fragments of continuous primary forest, but usually they are situated on former slash-and-burn areas (bushlands) or reforested agricultural land and thus habitat shows considerable variation in species composition due to differences in the historical backgrounds of the stands (Paal et al. 2011).

Pulsatilla patens (L.) Mill. is a threatened plant which in Fennoscandia favours south-facing, warm slopes of pine dominated esker forests. Lack of cattle grazing, modern forestry practices, and especially efficient fire prevention have resulted in closure of undergrowth vegetation in these forests. Optimal sites for seedling recruitment and flowering are characterised by open or semi-open sites with low or moderate amounts of mosses and litter (Kalliovirta et al. 2006).

9070 Fennoscandian wooded pastures

A vegetation complex in which the tree layer varies from sparse forest to small copses of trees and shrubs and patches of open grassland. These habitats have a representative mosaic of copses of trees (usually deciduous trees) and grassland with a long continuity of grazing. The tree layer consists either of deciduous broad-leaved species such as *Quercus robur*, *Fraxinus excelsior*, *Tilia cordata*, *Betula* spp., *Alnus incana* or conifers (*Picea abies*, *Pinus sylvestris*). Particularly in Sweden there are pastures with old, large oaks. A rich assemblage of threatened lichens, fungi, and invertebrates are associated with the bark and dead or decaying wood. The type also includes (particularly in Finland) deciduous forests established after slash-and-burn cultivation, that was a characteristic feature of the former land use in Finland In Finland scattered in the whole of the country, mostly in Southern and Central Finland; very rare or extinct in northern boreal zone. In Sweden scattered over the whole country. Regional variation is considerable. Wooded pastures are usually dominated by birch, pine, alder (*Alnus incana*) or spruce (spruce-dominated are often degraded types); in hemiboreal zone there are also subtypes dominated by e.g. Quercus, Fraxinus and Corylus.

Plants: *Agrostis capillaris*, *Alnus incana*, *Antennaria dioica*, *Botrychium* spp., C*ampanula persicifolia*, *Coeloglossum viride*, *Fragaria vesca*, *Geranium sylvaticum*, *Melampyrum cristatum*, *Prunella vulgaris*, *Ranunculus polyanthemos*, *Succisa pratensis*, *Veronica chamaedrys*, *V. officinalis*.

Nevertheless, the habitat type 9070 Fennoscandian wooded pastures, clearly a type of wood-pasture, inconsistently has become a forest habitat type. In Europe 24 wood-pasture habitats distinguished based on the geobotanical criteria of region, structure, land-use and tree species composition. Many European wood-pastures suffer from regeneration failure and are over-mature, are abandoned, overgrazed or cleared. It is necessary to select stands to be restored towards natural woodland and others to be managed as wood-pasture (Bergmeier et al. 2010).

Wooded pastures assessed in western Estonia are social–ecological systems that depend strongly on active management to maintain their habitat value. Estonian wooded pastures turn out are a lot denser than wooded pastures in other parts of Europe, which naturally leads to a faster return to forest conditions, and thus an even greater threat of habitat loss through abandonment here than in other areas of Europe. (Roellig et al. 2016). Large structural gradient in European wood-pastures was defined (Roellig et al. 2018).

The loss of wooded pastures is one of the major causes for the loss of European roller (*Coracias garrulus*) from the Saaremaa, Estonia region (Roellig and Sammul 2014).

9080* Fennoscandian deciduous swamp woods

Deciduous swamps are under permanent influence of surface water and usually flooded annually. They are moist or wet, wooded wetlands with some peat formation, but the peat layer is usually Interpretation Manual - EUR28 Page 107 very thin. Ash (*Fraxinus excelsior*) in the hemiboreal zone and black alder (*Alnus glutinosa*) reaching the middle boreal zone are typical tree species. Gray alder (*Alnus incana*), silver birch (*Betula pubescens*) and willows (*Salix* spp.) are also common. A mosaic of patches with different water level and vegetation is typical for the type. Around the tree stems are small hummocks, but wet flooded surfaces are dominant. Deciduous swamp woods are most common in Finland in the southwestern archipelago and

other coastal areas. On the mainland they are rare. In Sweden they are common throughout the whole region.

Plants: *Carex caespitosa*, *C. diandra*, *C. disperma*, *C. elongata*, *C. loliacea*, *C. rhynchospora*, *C. tenuiflora*, *Calamagrostis canescens*, *C. chalybea*, *C. stricta*, *Calla palustris*, *Glyceria lithuanica*, *Iris pseudacorus*, *Lycopus europaeus*, *Lysimachia thyrsiflora*, *Lythrum salicaria*, *Solanum dulcamara*, *Thelypteris palustris*; Mosses- *Calliergon cordifolium*, *Helodium blandowii*, *Pseudobryum cinclidioides*, *Spagnum squarrosum*, *S. teres*, *S. fimbriatum*, *S. riparium*

Actual area of 9080 is in the range of 25-30 thousand ha. Currently stands above 80 years old make 10.6 % of all black alder sites (birch - 8.4% in all sites). Sites considered as 9080 should include significantly more mature woods (Kuris and Ruskule 2006).

Necessary activities in Latvia for this type are non-intervention, rewetting, removal of recently built beaver dams, limiting of beaver population.

Forbidden activities should include maintenance cuttings, restoration or maintenance of drainage system, soil damage and disturbance of water regime.

Activities allowed in order to diversify stand structure are thinning up to 20 % of the growing stock. Acceptable method in dense (density over 0.8) and uniform stands as this habitat naturally regenerates with the same community it has been previously. Cuttings can be done by groups (10-20 stems) and only in winter when soil is frozen. Under an alder stand, light levels are inadequate and herbaceous vegetation prevents the development of new seedlings. Claessens (2005) reported some successful regeneration after heavy shelterwood cuttings in Germany (basal area of 10 m^2 ha^{-1} after thinning) and after gap regeneration in Belgium (gaps of ~1000 m^2)

Distances between final crop trees should be 10–12 m (i.e. ~**70–100** final crop trees ha^{-1}) (Claessens et al. 2010).

Regulation of beaver population in drainage system is also possible. Restoration could be done by leaving drainage system without maintenance to restore natural water regime (Kuris and Ruskule 2006).

9160 Sub-Atlantic and medio-European oak or oak-hornbeam forests of the *Carpinion betuli*

Forests of *Quercus robur* (or *Quercus robur* and *Quercus petraea*) on hydromorphic soils or soils with high water table (bottoms of valleys, depressions or in the vicinity of riparian forests). The substrate corresponds to silts, clayey and silt-laden colluvions, as well as to silt-laden alterations or to siliceous rocks with a high degree of saturation. Forests of *Quercus robur* or natural mixed forests composed of *Quercus robur*, *Quercus petraea*, *Carpinus betulus* and *Tilia cordata*. Endymion non-scriptus is absent or rare.

Plants: *Quercus robur*, *Carpinus betulus*, *Acer campestre*, *Tilia cordata*, *Stellaria holostea*, *Carex brizoides*, *Poa chaixii*, *Potentilla sterilis*, *Dactylis polygama*, *Ranunculus nemorosus*, *Galium sylvaticum*.

The common hornbeam grows mostly in mixed stands dominated by deciduous oaks, forming oak-hornbeam forest communities. In mixed forests it can be a dangerous invader, regenerating better and faster than valuable timber species, such as oaks, ash or Scots pine (Sikkema et al. 2016).

Small stands of *Carpinus betulus* are only found in the southwest part of Latvia in the vicinity of Dunika and the River Sventāja valley on the border of the distribution home range of this species. Therefore, this habitat variant in Latvia has very high conservation value. Necessary activities in Latvia for this type: Non-intervention. However, succession is one of the main factors that in the long term can worsen the status of this habitat and affect the characteristic species composition and reduce the habitat area that conforms to the criteria of protected habitats. Thus, management of this habitat could include removal of spruces in advance growth and subcanopy (Ikauniece 2017).

One of the closest and most significant reference forests containing 9160 type of forest habitat is Bialowieza forest. Long term study of natural forest dynamics in Bialowieza National Park shows increase of late successional deciduous species *Tilia cordata*, *Carpinus betulus* and *Fraxinus excelsior*, however, this study suggests high compositional instability and lack of climax stage due to environmental change (Bernadzki et al. 1998).

High and increasing representation of *Carpinus, Corylus, Betula* and *Salix* species in the understory of forests are unwanted in sustained yield forestry, Kowalczyk et al. (2011) showed

that European bison (*Bison bonasus)* have a preference for browsing on *Carpinus, Corylus, Betula* and *Salix* species compared to pine and spruce. Thus, in terms of browsing damage to forestry, bison do not interfere with the aims of forestry. In general *Carpinus betulus* is considered as only species that is able to regenerate in the presence of herbivores. Research across Europe has demonstrated that recruitment of tree species can be limited by increased large herbivore densities (Kuijper et al. 2010, Angelstam et al. 2017b). However, the effects of climatic changes and changes in forest openness seem having less importance in effecting tree recruitment and species composition (Angelstam et al. 2017c). It also suggested that periodical significant declines in ungulate numbers, whether human-induced or caused by natural factors, may provide an opportunity for the regeneration of a range of tree species and influence more diverse and dynamic forest development (Kuijper et al. 2010).

9180 * *Tilio-Acerion* forests of slopes, screes and ravines

Mixed forests of secondary species (*Acer pseudoplatanus*, *Fraxinus excelsior*, *Ulmus glabra*, *Tilia cordata*) of coarse scree, abrupt rocky slopes or coarse colluvions of slopes, particularly on calcareous, but also on siliceous, substrates (*Tilio-Acerion* Klika 55). A distinction can be made between one grouping which is typical of cool and humid environments (hygroscopic and shade tolerant forests), generally dominated by the sycamore maple (*Acer pseudoplatanus*) - sub-alliance *Lunario-Acerenion*, and another which is typical of dry, warm screes (xerothermophile forests), generally dominated by limes (*Tilia cordata*, *T. platyphyllos*) - sub-alliance *Tilio-Acerenion*. The habitat types belonging to the *Carpinion* should not be included here.

Plants: *Lunario-Acerenion - Acer pseudoplatanus*, *Actaea spicata*, *Fraxinus excelsior*, *Helleborus viridis*, *Lunaria rediviva*, *Taxus baccata*, *Ulmus glabra*. *Tilio-Acerenion - Carpinus betulus*, *Corylus avellana*, *Quercus* sp., *Sesleria varia*, *Tilia cordata*, *T. platyphyllos*.

Necessary activities in Latvia for this type: Non-intervention

Management and future outlook of these vulnerable habitats especially needs to consider the competition by alien species, scenarios on forest management options, and the dispersal abilities of the habitat types' constituting species (Steinacker et al. 2019). Some mountainous countries manage this habitat combining forestry practice with habitat

requirement measures adapted to the needs of the habitats and species (Merce et al. 2013). Comparison of the forest stand structure in managed and unmanaged ravine forests in Poland showed that stand structure analysis is more sensible for the detection of forest management on ravine forests than the comparison of plant species composition (Baran et al. 2020).

9190 Old acidophilous oak woods with *Quercus robur* on sandy plains

Acidophilous forests of the Baltic-North Sea plain, composed of *Quercus robur*, *Betula pendula* and *Betula pubescens*, often mixed with *Sorbus aucuparia* and *Populus tremula*, on very oligotrophic, often sandy (or moraine) and podsolized or hydromorphic soils; the bush layer, poorly developed, includes *Frangula alnus*; the herb layer is formed by *Deschampsia flexuosa* and other grasses and herbs of acid soils (sometimes includes *Molinia caerulea*), and is often invaded by bracken. Forests of this type often prevail in the northern European plain and occupy more limited edaphic enclaves. Syntaxa: *Querco-Betuletum*, *Molino-Quercetum*, *Trientalo-Quercetim roboris*. 41.54 - Forests of *Quercus robur* and, sporadically *Quercus pyrenaica* or hybrids, on podzols, with a herb layer formed by the group of *Deschampsia flexuosa*, with *Molinia caerulea* and *Peucedanum gallicum*. Syntaxa: *Peucedano-Quercetum roboris.*

Plants: *Quercus robur*, *Betula pendula*, *B. pubescens*, *Sorbus aucuparia*, *Populus tremula*.

In general, forest habitats with oak faces natural regeneration limitations due to changed disturbance regimes across Europe. Since new stone age human activities such as vegetation burning by hunter-gatherers, slash-and-burn economy of early farmers, silvopastoralism, subsistence family farming provided suitable habitats steadily colonized by oaks in the landscape (Bobiec et al. 2018).

91D0* Bog woodland

Coniferous and broad-leaved forests on a humid to wet peaty substrate, with the water level permanently high and even higher than the surrounding water table. The water is always very poor in nutrients (raised bogs and acid fens). These communities are generally dominated by *Betula pubescens, Frangula alnus, Pinus sylvestris, Pinus rotundata and Picea abies*, with species specific to bogland or, more generally, to oligotrophic environments, such as Vaccinium

spp., Sphagnum spp., Interpretation Manual - EUR28 Page 114 *Carex spp*. [*Vaccinio-Piceetea: Piceo-Vaccinienion uliginosi (Betulion pubescentis, Ledo-Pinion*) i.a.]. In the Boreal region, also spruce swamp woods, which are minerotrophic mire sites along margins of different mire complexes, as well as in separate strips in valleys and along brooks. Sub-types: 44.A1 - Sphagnum birch woods 44.A2 - Scots pine mire woods 44.A3 - Mountain pine bog woods 44.A4 - Mire spruce woods

Plants: *Agrostis canina, Betula pubescens, B. carpatica, Carex canescens, C. echinata, C. nigra, C. rostrata, Eriophorum vaginatum, Frangula alnus, Juncus acutiflorus, Molinia caerulea, Trientalis europaea, Picea abies, Pinus rotundata, P. sylvestris, P. mugo, Sphagnum spp., Vaccinium oxycoccus, V. uliginosum, Viola palustris; in spruce swamp woods also: Carex disperma, C. tenuiflora, Diplazium sibiricum, Hylocomium umbratum and Rhytidiadelphus triquetrus*.

Necessary activities in Latvia for this type: Rewetting – in complex with mires, prescribed burning in complex with heaths and non-intervention.

Mire spruce woods are characterized by internal small-scale disturbance with old trees continuously fall to the ground provide the forest floor with suitable microrelief conditions for new tree establishment and P. abies regeneration (Hörnberg et al. 1997). Such spruce forests should be managed by mimicking natural dynamics which involves selective cutting to maintain tree continuity, natural regeneration and parts of selected stands should be left uncut, deadwood production by gridle, push over or feeling selected trees and leaving large mature retention trees for biological diversity, of which 15% of the large trees retained should be broad-leaved (Ohlson and Tryterud 1999).

91E0* Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)

Riparian forests of *Fraxinus excelsior* and *Alnus glutinosa*, of temperate and Boreal Europe lowland and hill watercourses (44.3: *Alno-Padion*); riparian woods of *Alnus incanae* of montane and sub-montane rivers of the Alps and the northern Apennines (44.2: *Alnion incanae*); arborescent galleries of tall *Salix alba*, *S. fragilis* and *Populus nigra*, along medio-European lowland, hill or sub-montane rivers (44.13: *Salicion albae*). All types occur on heavy

soils (generally rich in alluvial deposits) periodically inundated by the annual rise of the river (or brook) level, but otherwise well-drained and aerated during low-water. The herbaceous layer invariably includes many large species (*Filipendula ulmaria*, *Angelica sylvestris*, *Cardamine* spp., *Rumex sanguineus*, *Carex* spp., *Cirsium oleraceum*) and various vernal geophytes can occur, such as *Ranunculus ficaria*, *Anemone nemorosa*, *A. ranunculoides*, *Corydalis solida*.

This habitat includes several sub-types: ash-alder woods of springs and their rivers (44.31 - *Carici remotae-Fraxinetum*); ash-alder woods of fast-flowing rivers (44.32 - *Stellario-Alnetum glutinosae*); ash-alder woods of slow-flowing rivers (44.33 - *Pruno-Fraxinetum, Ulmo-Fraxinetum*); montane grey alder galleries (44.21 - *Calamagrosti variae-Alnetum incanae* Moor 58); sub-montane grey alder galleries (44.22 - *Equiseto hyemalis-Alnetum incanae* Moor 58); white willow gallery forests (44.13 - *Salicion albae*). The Spanish types belong to the alliance *Osmundo-Alnion* (Cantabric atlantic and southeast Iberia peninsula).

Plants: Tree layer - *Alnus glutinosa*, *Alnus incanae*, *Fraxinus excelsior*; *Populus nigra*, *Salix alba*, *S. fragilis*; *Betula pubescens*, *Ulmus glabra*; Herb layer - *Angelica sylvestris*, *Cardamine amara*, *C. pratensis*, *Carex acutiformis*, *C. pendula*, *C. remota*, *C. strigosa*, *C. sylvatica*, *Cirsium oleraceum*, *Equisetum telmateia*, *Equisetum* spp., *Filipendula ulmaria*, *Geranium sylvaticum*, *Geum rivale*, *Lycopus europaeus*, *Lysimachia nemorum*, *Rumex sanguineus*, *Stellaria nemorum*, *Urtica dioica*.

Necessary activities in Latvia for this type: Non-intervention

The main factors shaping the composition of Alluvial swamp forests are probably the impact of historical drainage, cutting and traditional agricultural land use on wooded mires. Therefore, the dominance and frequency of birch, aspen and willow decreases and that of spruce, lime and ash increases (Palo and Gimbutas 2013).

Climate change treats is a major issue for fulfilling Natura 2000 goals for Alluvial forests and other wetland habitats (O'Keeffe et al. 2019). Floodplain forests that are managed for forestry lack the diversity of successional patches present in a more natural floodplain forest and restoration management should include planting native species, felling and removing non-native trees and fencing to prevent access to grazing and browsing animals (Hughes et al. 2012).

91F0 Riparian mixed forests of *Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior* or *Fraxinus angustifolia*, along the great rivers (*Ulmenion minoris*)

Forests of hardwood trees of the major part of the river bed, liable to flooding during regular rising of water level or, of low areas liable to flooding following the raising of the water table. These forests develop on recent alluvial deposits. The soil may be well drained between inundations or remain wet. Following the hydric regime, the woody dominated species belong to *Fraxinus, Ulmus* or *Quercus* genus. The undergrowth is well developed.

Plants: *Quercus robur, Ulmus laevis, U. minor, U.glabra, Fraxinus excelsior, Fraxinus angustifolia, Populus nigra, P. canescens, P. tremula, Alnus glutinosa, Prunus padus, Humulus lupulus, Vitis vinifera ssp. sylvestris, Tamus communis, Hedera helix, Phalaris arundinacea, Corydalis solida, Gagea lutea, Ribes rubrum*.

Riparian forest and oak dominated communities are the main forest habitats under threat of invasive alien species in the Continental and Alpine biogeographical regions (Campagnaro et al. 2018). In the future, the highest risks of invasion for *Acer negundo*, *Prunus serotina*, *Quercus rubra*, and *Robinia pseudoacacia* species are predicted in Central and Northern Europe (Camenen et al. 2016).

Riparian mixed forests are associated with the middle and lower floodplains of the main arterial rivers in Europe, but otherwise occur in similar situations to alluvial forests (91E0), often occurring in mosaics with such stands. Over ten different tree species may comprise the canopy, and the ground flora is remarkably rich including not only species typical of other types of floodplain forest but also many plants more familiar from drier temperate forest types (Hughes et al. 2012).

In Estonia young age of trees and lack of continual stands can be detected in habitat type Riparian forests. Theoretically, their higher tree layer composition should show a variety of broad-leaved trees, but at present first successional phases with aspen and birch are dominant. Their dominance and frequency will greatly decrease in following generations, at the same time the percentage of spruce will increase. The lack of large dead wood and the lower age of trees are also common for places with historical, traditional land use (Palo and Gimbutas 2013).

91T0 Central European lichen Scots pine forests

Natural lichen-rich acidophilous *Pinus sylvestris* forests belonging to the alliance *Dicrano-Pinion* occurring on inland nutrient poor sands of the north-eastern plains and hills of Central Europe and of the nemoral belt of the middle and southern Sarmatic region. The trees are low growing as the soils are nutrient deficient and subject to drought stress

Plants: *Pinus sylvestris, Juniperus communis, Cladonia furcata, Cladonia gracilis, Cladonia silvatica, Ptilidium ciliare*

These forests are often a characteristic stage of natural succession on inland dunes, stands of plantation origin should not be included. Similar woodlands on coastal sand dunes should be regarded as 2180 Wooded dunes of the Atlantic, Continental and Boreal region.

Central European lichen Scots pine forests could be described as low-productivity stands on thin soil and is featured by higher lichen species richness than productive forests (Hämäläinen et al. 2020).

To ensure a stable presence of lichen forests in the Polish landscape scientists proposes the removal of litter and humus or optionally controlled surface fires. Well-known examples indicate that some factors contributing highly to the formation of the 91T0 habitat include surface fires as well as the removal of litter and decayed wood (Faliński, 1965; Heinkenet al., 2009; Matuszkiewicz, 2007). Limiting protective measures to the thinning of stands or to the removal of harvested wood mostly really affects younger stands in which the formation of lichen forests is most often a periodic occurrence resulting from earlier disruptions, such as logging, or the renewal or afforestation of poor farmland. These measures undoubtedly speed up the formation of lichen forests in younger stands. In older stands, only the radical depletion of the nutrient-rich top layers of soil is able to slow the displacement of lichens by grasses and shrubs. Measures that rely only on the removal of wood, while allowing for the contemporary deposit of nutrients that cause eutrophication in forest habitats or allowing for the their circulation throughout forest ecosystems, are not radical measures (Kołodziej et al. 2016).

Diversity loss of lichen pine forests is observed in Poland. Results indicate that the abundance of *Cladonia* species is limited by strong competitors, i.e., vascular plants and bryophytes, which may be explained by eutrophication and climate warming. Only pine forests with a minor abundance of lichens have chances to persist in the vegetation of Central Europe,

while the most valuable communities with high abundance of indicators will disappear. Though an assessment of the total decrease in the area of lichen pine forests is not possible with the available regional data, local observations indicate a large decline in the area of lichen pine forests in Central Europe. Their conservation seems to be a serious challenge, because it is difficult to provide optimal conditions for all indicators (Stefańska-Krzaczek et al. 2018). In Central Europe, the natural *Cladonio-Pinetum* is a rare and seriously endangered plant community dominated by Scots pine and cryptogams. This threat is increased by the human impact of forest management. The majority of European Scots pine forests are considered not to be natural. They are either intensively managed economic forests or mildly managed semi-natural forests (Dingova Kosuthova et al. 2013).

Lichen pine forest habitat is very sensitive to changes in environmental factors and is a very unstable community. The method of creating *Cladonio-Pinetum* is not clearly defined. They may be a natural variation of pine forests, or their formation could be anthropogenic and associated with the historical and traditional agricultural economy of the population in heavily forested areas (Grzesiak 2017).

In spite of already practiced removal of the whole wood after possible thinning, there are litter and moss raking and complete cessation of clearcuts in favour of the selection cutting management are necessary for Cladonia-Scots pine forest conservation. Not enough is known about the traditional, extensive use of pine forests. The low thickness of organic horizon and low tree canopy cover positively affected the occurrence of forest lichen species in the study area (Zaniewski et al. 2014). Canopy tree layer has the most significant influence on the diversity of lichens (Dingova Kosuthova et al. 2013).

The study shows that lichen-rich pine forests in Bavaria, Germany are severely retreating. The main reasons are the abandonment of the former litter collection dropped Nitrogen export and strong Nitrogen import via the atmosphere. Without adapted protection management also the last patches of this forest type will disappear soon, regardless of whether used by forestry or not. Re-introduction of litter raking (nutrient export) is the one. While in the past many lichens were growing around the cleared places and were able to recolonize such places soon, these lichens nowadays usually are rare or even missing. Therefore, on the litter raking places the remaining few lichens nowadays have to be collected before extraction procedure, dried, ground up and "seeded" on the newly open sandy places (Fischer et al. 2015).

The role of forestry practices in relation to the decline of lichen-abundant forest land in Sweden is debated. However, the key role that forestry can play to help improve conditions for ground lichens has become clearer. Results together with other studies suggest a number of ways in which active forest management can play a central role in reversing the trend of declining ground lichen-abundant forests. Removal of cutting residues can have a positive effect on lichen because of reduced shading and fertilizing effects of the residues Several studies point at the importance of undertaking careful soil scarification methods on clear cut areas to minimize the impact on the remaining lichens As an alternative, natural regeneration from seed-trees, continuous cover forestry, or other more careful final harvesting methods could be considered. Finally, carrying out more pre-commercial and commercial thinning may improve conditions for the growth of ground lichens (Jonsson Čabrajič et al. 2010, Korosuo et al. 2014). This is especially important as these young forest stands contain the majority of the remaining lichen-abundant forests. Further implementation of the forest management practices discussed above can be mediated by the fact that 47 % of the remaining lichen-abundant areas are on state-owned land (Sandstrom et al. 2016).

Habitat type “Central European lichen Scots pine forests” is very similar to pine–lichen forests of northernmost Fennoscandia and were common in the landscape until the early 1900s. Such forests were the result of a long-term use of fire to remove mosses and dwarf-shrubs to promote ground-lichens in winter-grazing grounds for semi-domesticated reindeer (Hörnberg et al. 2018).

The effect of site type on the lichen cover and biomass was expected: the poorer was the type, the higher were the lichen cover and biomass (Kumpula et al. 2014). This may be due to the fact that barren and xeric sites, especially if the soil is highly water permeable, are too poor and too dry for many vascular plants, and lichens can successfully compete with them (Akujärvi et al. 2014, Korosuo et al. 2014).

Figure 2. Some earlier project initiatives tried to contribute and produced some recommendations on management activities in forest habitats. (Kuris and Ruskule 2006). However this can serve as general guidance and understanding, but habitat management recommendations should be adopted by each country taking into consideration newest scientific data.

Habitat type	Activities forbidden	Activities allowed	Possibilities of recovering
9010* Western taiga	✓ Any kind of cutting ✓ Burning in alvar forests ✓ Taking away dead and decay wood ✓ Cleaning of windfall	✓ Natural wild fires ✓ Surroundings of recreational areas can be cleaned from dangerous 'hanging' trees	✓ Burning of cultivated stands and leaving to natural regeneration ✓ Diversifying of stand structure by cutting small gaps (up to 15 m of diameter) and leaving large scale laying wood ✓ Mineralization of surface to promote natural regeneration in site types with dense grass and moss layer
9020* Fennoscandian hemiboreal natural old broad-leaved deciduous forests (*Quercus, Tilia, Acer, Fraxinus or Ulmus*) rich in epiphytes	✓ Maintenance cutting ✓ Burning ✓ Taking away dead and decay wood	✓ Cutting of spruce to support regeneration of broadleaved ✓ Cutting of aspen and birch can be considered but the evaluation has to be done for each site separately ✓ Surroundings of recreational areas can be cleaned from dangerous 'hanging' trees	✓ Overgrown former wooded meadows or pastures can be partly cleaned from bush to support natural regeneration of broadleaves ✓ Some old trees with high biodiversity value can be released
9030* Natural forests of primary succession stages of landupheaval coast	✓ Taking away dead and decay wood	✓ Can be managed with small scale selective cutting securing continuous forest cover	
9050 Fennoscandian herb-rich forests with *Picea abies*	✓ Maintenance cuttings ✓ Burning ✓ Taking away dead and decay wood	✓ Can be managed in a way to secure existence of spruce stand, i.e. small scale selective gap fellings ✓ Surroundings of recreational areas can be cleaned from dangerous 'hanging' trees	✓ Diversifying of stand structure by cutting small gaps (up to 15 m of diameter) and leaving large scale laying wood
9060 Coniferous forests on, or connected to, glaciofluvial eskers	✓ Maintenance cuttings ✓ Taking away dead and decay wood	✓ Can be managed with small scale selective cutting to secure continuous forest cover ✓ Surroundings of recreational areas can be cleaned from dangerous 'hanging' trees ✓ Views can be opened if soil erosion is avoided ✓ Forest grazing can be continued in small scale, young undergrowth can be taken away in that case	✓ Diversifying of uniform stand structure by cutting small gaps (up to 15 m of diameter) or up to 30% from the total forest volume to promote co-dominant tree species ✓ Leaving large scale laying wood ✓ Mineralization of surface to promote natural regeneration
9070 Fennoscandian wooded pastures	✓ Leaving without management ✓ Cutting of tree layer ✓ Overgrazing ✓ Extra feeding at the site should be avoided	✓ Pasturing ✓ Careful sanitary cutting is allowed sometimes	✓ Cleaning from bush and restoration of previous pasturing methods
9080* Fennoscandian deciduous swamp woods	✓ Maintenance cuttings ✓ Restoration or maintenance of drainage system ✓ Soil damage and disturbance of water regime	✓ Can be managed by cutting out up to 20% of the growing stock; regenerates naturally with same tree species ✓ Cuttings can be done only with frozen surface. ✓ Regulation of beaver population in drainage system.	✓ Drainage system can be left without maintenance to restore natural water regime; water tams would be too radical restoration method having rather negative than positive effect on communities.
9160 Sub-Atlantic and medio-European oak or oak-hornbeam forests of the *Carpinion betuli*		✓ Cutting of spruce and aspen is seen as needed management for this type for protecting old oak trees.	✓ Cutting of spruce is necessary to restore this habitat type.

Habitat type	Activities forbidden	Activities allowed	Possibilities of recovering
9180* Tilio-Acerion forests of slopes, screens and ravines	✓ Any kind of forest management	✓ Views can be opened in exceptional cases	
9190 Old acidophilus oak woods with Quercus robur on sandy plains	✓ Maintenance cuttings ✓ Taking away dead and decay wood	✓ Careful sanitary cutting can be allowed sometimes	
91D0* Bog woodland	✓ All activities disturbing natural water regime ✓ Any kind of forest management	✓ Preservation of Capercallie playgrounds and habitats may require some cutting of spruce regeneration ✓ Directing visitors to specially prepared tracks	✓ Drainage system can be left without maintenance to restore natural water regime; water tams could be considered
91E0* Alluvial forests with Alnus glutinosa and Fraxinus excelsior (*Alno-Pandion, Alnion incanae, Salicion alvae*)	✓ All activities disturbing natural water regime, any kind of river floodplain engineering	✓ Small scale gap felling ✓ In Lithuania sometimes fight against certain pathogens coming from beetles is needed. ✓ Regulation of beaver population in drainage system.	✓ Sometimes it is necessary to stop drainage. Diversifying of stand structure by cutting out spruce and dominating birch and aspen, but leaving laying wood
91F0 Riparian mixed forests of Quercus robur, Umus laevis and Ulmus minor, Fraxinus excelsior or Fraxinus angustifolia, along great rivers (*Ulmenion minoris*)	✓ All activities disturbing natural water regime, any kind of river floodplain engineering	✓ Small scale gap felling ✓ In Lithuania sometimes fight against certain pathogens coming from beetles is needed. ✓ Regulation of beaver population in drainage system.	✓ Sometimes it is necessary to stop drainage. ✓ Diversifying of stand structure by cutting out spruce and dominating birch and aspen, but leaving laying wood
2180 Wooded dunes of the Atlantic, Continental and Boreal region	✓ Taking away large-scale dead and decay wood ✓ Cleaning of windfall	✓ Wild forest fires can be suppressed and left to natural regeneration ✓ Small scale selective or shelterwood cutting securing continuous forest cover ✓ Surroundings of recreational areas can be cleaned from dangerous 'hanging' trees ✓ Lush regeneration of spruce can be eliminated and views can be opened ✓ Directing visitors to specially prepared tracks	✓ Diversifying of stand structure by cutting 20…35% of standing trees and leaving at least 10 cmb of large scale laying wood

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Part III. Description of Life projects associated with forest habitat management

Contents

III.1 Life projects

This document serves as an overview of results or objectives of forest related LIFE projects in relevant biogeographic region neighbouring to Lithuania EU countries. Project search tool of project database and project publications provided by European Commission LIFE programme was used. The aim of collection of such information is better understanding to what scope and rate forest habitats are managed and what particular measures are applied for restoration of forest habitats. Forest often is integral part of different protected areas, and the variety of forest habitats and the level of naturalness leads to specific site condition when actual measures are applied in order to improve general state of habitats. However, there are possible to draw generalizations regionally on common problems in forest habitats related to over intensive forest cutting, changes of hydrological regimes, land abandonment and changed traditional management practices. Each below mentioned project concentrated on or included forest habitats and information from available layman's reports, final reports, project websites and project summaries where they exist have been extracted highlighting measures applied and possible outcomes.

III.2 Finland

Light & Fire LIFE Project 2014–2020

Pulsatilla patens grows on steep esker slopes and in the sunlit pine forests in their vicinity and is found only within a small area in the Kanta-Häme Region in the environs of the city of Hämeenlinna. Forest fires and forest grazing used to provide the habitats of *Pulsatilla patens* with enough light and sufficient gaps in the undergrowth.

Fire prevention, abandoned grazing and eutrophication caused by nitrogen loads have caused overgrowth in several habitats, while other areas are now covered by a thick layer of raw humus and forest litter. *P. patens* populations have been in alarming decline for decades and the species is now critically endangered.

The project covers seven Natura 2000 sites in which the species is still found. In 2016, excavators, hoes and metal rakes were used to clear habitats and their immediate surroundings

of shady trees and patches of surface peat. Some sites will also be burned to improve the growing conditions for *P. patens*.

Esker forests, coastal meadows, heathland and dunes and other sunlit environments have undergone major changes in recent decades. In esker forests tree stands are dense and structurally monotonous, allowing little light to reach the ground layer and due to the reduction in the number of forest fires a thick layer of forest litter and raw peat has accumulated. On heathlands and dunes, grazing by animals and prescribed burnings have ceased almost completely. Furthermore, the eutrophication and nitrogen load in the Baltic Sea have led to the rapid overgrowth of these habitats. Such changes now threaten these previously barren and extreme habitats and the plant and insect species living in them. Open landscapes have transformed into bushes and forests.

The Light & Fire LIFE Project will ensure the comprehensive maintenance of a range of habitats with special light and temperature characteristics located in 29 Natura 2000 sites from 2014 to 2020. The goal is to restore overgrown habitats to their original temperature, light and barrenness levels, thus restoring the conditions required by several narrow-niche species. Key measures include the removal of excess trees, bushes and surface peat by machine or hand. On some sites, small areas will be burned to remove surface peat, wild thyme (*Thymus serpyllum*) saplings will be planted to the benefit of several insect species, and lupin (*Lupinus polyphyllus*) and other alien species will be removed.

Fire plays an essential role in the natural life cycle of boreal forests. Forest fires kill some trees immediately and harm others, which die in a few years. Some trees continue growing, having sustained little or no damage. During the few years following the fire, decaying wood emerges at different stages of decomposition in the forest, while new trees grow among those that survived.

The forest undergrowth also changes as the flora closest to the ground burn to varying degrees. Forest fires are now rare and usually contained in small areas, due to efficient fire fighting and prevention.

As part of the Light & Fire LIFE Project, restoration fires that mimic natural forest fires will be lit in 2015–2020. Forests will be burned on 38 Natura 2000 areas. More decaying wood of various kinds and a large number of tree species need to be introduced to these sites, which

were used for forestry before becoming protected. This will also create habitats for insect and fungi species dependent on forest fires and decaying wood. Some species have become threatened due to fewer forest fires and efficient forestry.

More information: https://www.metsa.fi/en/project/light-fire-life/

Species-rich LIFE - Improving the Conservation Status of Species-rich Habitats 2011-2016

The Species-rich LIFE project reached or exceeded its objectives to restore the conservation status of 19 Annex I habitats of the Habitats Directive in 64 Natura 2000 sites in Finland. The project restored 1 126 ha of habitats (936 ha foreseen), and prepared 47 detailed restoration plans covering 915 ha. Three management plans were completed and approved by the Finnish Ministry of Environment within the project period. By improving the quality of the habitats, the project also improved the conservation status of the targeted species. Project actions benefitted Birds Directive Annex 1 species, especially white-backed woodpecker (*Dendrocopos leucotos*), and Habitats Directive Annex IV species, such as the clouded apollo (*Parnassius mnemosyne*) and marsh fritillary (*Euphydryas aurinia*) butterflies, a flat bark beetle species (*Cucujus cinnaberinus*), and lady's-slipper orchid (*Cypripedium calceolus*).

The project restored 594 ha of herb-rich forests, by opening space for deciduous trees, shrubs and herbs; 82 ha of habitat for woodpeckers, by reducing shading and increasing the availability of dead and decaying wood; and 451 ha of semi-natural grasslands, by removing woody vegetation and reintroducing traditional mowing and grazing. Most restoration methods were existing best practices already used by Metsähallitus. However, in some cases, such as in habitats on calcareous rock and heaths, the project developed and tested new and more appropriate restoration methods. These have since been applied in other restoration sites in Finland, for example in the ongoing Light&Fire LIFE project (also coordinated by Metsähallitus). These restoration activities are likely to continue for many years to come, as the amount of degraded and not yet restored habitats is substantial in Finland. The methodology is also applicable in other areas of northern Europe. Striking improvements in the target habitats were already seen in many restored sites during the project, especially in some semi-natural grassland sites. In herb-rich forests, the recovery is generally slower, but in a few years the monitoring is

expected to reveal significant improvements. A major project achievement was rapidly transforming extensive areas of semi-natural grassland that were badly overgrown into semi-open pastures where sheep and/or cattle graze. They serve as excellent examples of the results that can be achieved through a combination of careful planning, successful professional restoration and well-functioning partnerships. The project established two trails in national parks to demonstrate restoration methods and their importance. Many of the other restored areas also serve as demonstration sites for habitat restoration.

Lady's slipper - Conservation of *Cypripedium calceolus* and *Saxifraga hirculus* in Northern Finland 2000-2005

Thanks to this project, a considerable amount of information on location and status of the two species is now available through inventories. Especially for Saxifrage hirculus this was the first time in Finland that systematic information on location, size and status of populations was gathered. The project produced two comprehensive status reports on the target species. These reports are important document to assess the favourable conservation status of these species and they propose measures to be taken to improve the conservation status. They were prepared using the most recent guidelines of the European Commission about favourable conservation status assessment. The reports cover the species over the whole of Finland (except the Aland Islands), which increases their value, facilitates the conservation work of the authorities and prioritizes protection needs. These species are currently one of the few FFH species in Finland for which there is so much information available. The beneficiary concludes that without the LIFE-Nature project similar work would have taken 20 years to complete. The project drew up a plan for an experiment to compare different forest management practices in the lady's slipper distribution area. These forests were state-owned, commercially-used forests outside pSCIs. Natura 2000 sites nearby were selected as control areas. The management work mainly consisted of removing spruce and other trees blocking out light and acidifying the soil. According to the beneficiary, the project could have experimented with even rougher measures, but these were considered too risky, because many sites contain other threatened species; like *Calypso bulbosa*. Based on the experience gained, the project produced forest exploitation recommendations which support the objectives of sustainable forestry and forest certification. After the LIFE project, the beneficiary continued promoting inclusion of the recommendations

as part of national forest management guidelines. The experimental forest management measures in economically used forests outside Natura 2000 areas yielded good foundations for future practices in forests containing lady's slipper. The direct involvement of forest professionals and forest owners in the project gave a good opportunity to train them to manage such forests correctly. The beneficiary trained forest owners and forestry professionals to take account of lady's slipper and yellow marsh saxifrage as part of forest management outside the Natura 2000 areas. Training courses and educational material were produced, both for private landowners and forest professionals. The landowners were also actively informed about the existence of these flagship species in their land. The project promoted actively the idea that forest centres conduct systematic lady's slipper and marsh saxifrage inventories in privately-owned forests. It drew up two restoration plans in co-operation with forest centres, which was a new activity for the forest centres. The Forest Centre of Northern Ostrobothnia created its own project to deal with lady's slipper and yellow marsh saxifrage, to complement the work done under the LIFE project. This project was funded by national forest improvement funds, and mapped the lady's slipper and yellow marsh saxifrage sites in privately-owned forested areas of Kuusamo, planning the required restoration work following the example of the LIFE-Nature project. This project included partners from both the nature conservation and forestry sectors. These participants had not previously worked closely together on species protection, but the 5 years LIFE project work together gave an excellent opportunity to share opinions, compare working routines, exchange information etc. The partners from the forestry sector concluded that building a network between nature conservation and forestry through the project was the most important result of the project for them. The project implemented a seed bank study for lady's slipper and saxifrage, to help plan management actions and possible restoration of extinct populations. The project duration was rather too short to gain substantial results, but the results for marsh saxifrage indicated that marsh saxifrage seems to have at least a short-term seed bank and thus restoration measures for recently extinct populations may be successful. During the project, it was agreed between Metsähallitus and the Ministry of Environment that Metsähallitus will have the monitoring responsibility for lady's slipper in northern Finland and for marsh saxifrage over the whole of Finland. The monitoring experience of the project should be useful in organizing national monitoring schemes for other FFH plant species as well. The monitoring guideline for marsh saxifrage has already proved to be useful in monitoring Primula nutans. The project's employment impact was 26 man months during 5 years. The project area

has a high unemployment rate, so the employment effect of the project can be considered significant. Two persons from the temporary project personnel were employed at Metsähallitus after project end. The forest workers who were involved in nature management work gained special experience which may help them to adjust to future needs in their sector, as the work description of forest workers may change in future more towards nature management.

Pohjois-Karjala - Herb-Rich Forests, Forests of *Dencrocopos leucotus* and Western Taigas in North Karelia 2001-2005

This project made a significant contribution to the conservation and management of the northern Karelian Natura 2000 areas. The main results are as follows:

- Management plans/restoration plans were made for all project sites and implemented during the project. Guidelines for forestry practice outside Natura 2000 areas (feeding areas for white-backed woodpeckers/ecological corridors for flying squirrel) have been linked to legally binding forest plans.
- Shading spruce was cut back and decayed wood increased in herb-rich forests (76 ha). • 46.8 ha of herb-rich forests, 32.4 ha of boreal forest and 30.7 ha white-backed woodpecker forest was either purchased, or compensation has been paid to landowners, in order to ensure their proper management.
- Trees were removed from too dense stands in white-backed woodpecker forest (78 ha).
- Restoration of alkaline fens and petrifying springs including Cypripedium calceolus distribution areas: in total 4.2 ha.
- Annual mowing of 0.5 ha lowland hay meadow.
- Mapping of important feeding areas of the white-backed woodpecker outside SPAs and preparation of guidelines for forest practices benefiting woodpeckers, over a total area of 2,200 ha.

The same actions were done in important ecological corridor areas for flying squirrels outside pSCIs (84 ha). The project formulated forest management guidelines for those flying squirrel and white-backed woodpecker areas outside the Natura 2000 areas which serve as feeding areas and/or ecological corridors between the nesting areas. In practise this meant that

the Forest Centre contacted forest owners. If the forest owner was willing, the forest management plans of the privately-owned forest was complemented with guidelines how to manage white-backed woodpecker habitats. Otherwise, the information on key habitats etc. was kept within the Forest Centre, to be taken on board when the forest owner starts managing his forest (he or she is obliged to inform the Forest Centre in advance). The project restoration work concentrated on prime habitats. By project end, already one new white-backed woodpecker couple inhabited a restoration area. This is promising because there are only approximately 50 nesting couples in all of Finland. The restored areas form a network of "stepping stones" to eastern populations of flying squirrel and white-backed woodpecker. The restoration of herb-rich forests safeguarded the future of many endangered plant species (e.g. *Diplazium sibiricum*, *Cinna latifolia* and *Cypripedium calceolus*). The project developed new monitoring methods for *Diplazium sibiricum* and *Cinna latifolia,* for which the beneficiary received extra funding from the Finnish Environment Institute. Besides the full-time coordinator hired via LIFE, the project provided work for numerous local people on the basis of ad hoc contracts. In total 81,000 euros was spent on restoration work done by local entrepreneurs. Working together with the local communities created a more positive atmosphere towards Natura 2000 and nature conservation in general. The project contacted over 100 landowners, and was able to get permission to do inventories on over 350 ha of private land. After these personal contacts, many landowners appreciated the conservation value of their estates in a new way. As a result, landowners participated in the restoration work and several private conservation areas were established. Encouraged by the LIFE-project, local stakeholders started a new project in 2005 for the herb-rich forests of central Karelia (Forest Centre in partnership with Regional Environment Centre). The main aim of this project is to create ecological corridors and stepping stones between conservation areas.

Pohjois-Savo - Deciduous Western Taigas and Herb-rich Forests in Pohjois-Savo 1999-2003

This project finished successfully. Land acquisition progressed smoothly, and 273 ha was acquired. The City of Kuopio protected an additional 290 ha, without compensation, parallel to the LIFE acquisitions. It protected 229.3 ha in subsite Kolmisoppi-Neulamäki (basically the whole subsite), 42 ha in subsite Puijo and 19.3 ha in subsite Halmejoki. A win-win outcome: The owner

of Turulanvaara site, Suomen Metsäosuus Oy, is part of a big Finnish forest industry company. It remained the owner of the forest, because the LIFE-Nature project only paid the value of timber which can not be used any more, and used the fact that a certain % of its forests was now nature conservation area for sustainability certification purposes. The project produced 6 restoration plans and 3 management plans. The implementation of all management plans started during the project; for restoration plans implementation was completed within the project. The only delay was the management plan for Puijo, which was not adopted until 21.6.2004. It took more time than foreseen, because of the site's complexity (popular recreation area for citizens of Kuopio, with ski facilities, lookout tower and a small hotel with a restaurant; covered by boreal forests, herb-rich forests and hosts 5 Annex II FFH species). Public consultation on Puijo continued after the project end and the beneficiary did the necessary adjustments before adopting the plan. However, the implementation of this plan already started within the project. The project removed spruce from 150 ha, increased decayed wood on 80 ha and restored 2 mires (7 ha in total). The biotope management measures were implemented in all 9 subsites as foreseen and most of them do not need further measures within the near future. Much experience was gained on the management of boreal forests and Fennoscandian herb-rich forests and the monitoring of these activities in the future should bring more new information. The success of the restoration measures is being monitored, but definitive results of the project biotope management measures can be better known only after several years. Conservation benefits for the Natura 2000 site and species/habitats targeted: The project area was 830 ha; all sites are pSCI and 3 are also SPA. The size of the sites ranged from 14 ha to 232 ha. The main target was conservation of *boreal forests and Fennoscandian herb-rich forests and species related to them, but also other habitat types benefited directly, like *bog woodlands and Fennoscandian lowland species-rich dry to mesic grasslands. Additionally, 5 other habitat types benefited indirectly. An Annex II species directly benefiting was the flying squirrel, *Pteromys volans*, from the restoration activities in overgrown herb-rich forests. Plant species which have benefited from project restoration actions were *Cypripedium calceolus*, *Cinna latifolia, Diplazium sibiricum, Plagiomnium drummondii* and *Herzogiella turfacea. Plagiomnium drummondii* exists only in Finland within the EU-15 and of the 40 Finnish occurrences, 25 % are in Puijo subsite. Herb-rich forest restoration in Huosiaisniemi, the best lady's slipper site in southern Finland, improved habitat conditions for Cypripedium calceolus. As for Annex I species of the Birds Directive, protection and management actions of the project

certainly improved the living conditions of several species. Conservation techniques: Using explosives to increase decayed wood was an innovative method in Finland and Fennoscandia. The beneficiary compared the expected results and costs between different methods for increasing decaying wood. Costs for using explosive were about 550-733 EURO/ha; pushing trees down with a machine 412 EURO/ha, but the two methods can not always replace each other. The monitoring of Kolmisoppi-Neulamäki included an interesting study on the risk of increasing bark beetles by increasing decayed wood, because this discussion cropped up during the implementation of the project actions. The results showed that "dangerous" bark beetles like *Ips typographus* and *Pityogenes chalcophragus* did not increase much, probably because 1) work was done in winter, 2) microclimate in small-scale openings is not favourable to *Ips typographus* and 3) natural enemies of bark beetles increased at the same time. This study gave good arguments to continue with this type of biotope management measure in other Natura 2000 areas as well. Project results were disseminated elsewhere, e.g. in Italy (LIFE-Nature seminar "Strategies for the Conservation and Restoration of European Forests", Parma, 7-9.6.2001), in Estonia (seminar about restoration possibilities to protect biodiversity in Estonia 4.12.2001) and at the Italian LIFE-Nature Bosco Fontanella project seminar in Mantova in May 2003 (Dead wood – a key element to biodiversity). The project coordinator, hired via LIFE on a temporary basis, got a permanent position at the Environment Centre of Pohjois-Savo at project end.

Taiga/Central Finland - Protection of Taiga and Freshwater Ecosystems in Central Finland 1999-2002

This project helped improve and maintain the conservation status of boreal forest in Central Finland in several different ways. Innovative about the project was the way it implemented Natura 2000 in forest habitats. Instead of declaring a site protected under the national Nature Conservation Act, as was usual practice in Finland, and imposing a 'nature management plan' under the Act (which does give the landowner automatic right to compensation for loss of use), the beneficiary decided to implement Natura 2000 through voluntary arrangements under the Forest Act. First, forest inventories were carried out. Landowners were asked if they were interested in jointly drawing up forest management plans on the basis of these inventories. Landowners who agreed, and then committed themselves to

implementing the plan, received compensation from LIFE and after the project from other sources (national sylvi-environment schemes). The negotiations were very time-consuming but it was important to invest the time so that the landowners understood the proposed management actions and committed themselves to apply them. In total the project succeeded in making forest management plans for 446 ha, more than foreseen. In Vaarunvuori subsite 6 plans covering 136 ha and in Iilinjärvi subsite 2 forest management plans covering 310 ha were drawn up. All these plans have a written commitment of the landowner to follow them for 10 years, managing the forest while taking nature values better into account. From the landowners' perspective, economic use of the forest will continue but in conformity with the Natura 2000 requirements - the advantage of the plans is that they make it clear for landowners what they can not and can do within their Natura 2000 areas. The Forestry Centre, which drew up the plans, received many contacts from other landowners in other Natura 2000 areas. In the forest management planning special attention was paid to the occurrence/potential of habitat types and species of the Habitats and Birds Directive. These plans were thus a first example of how to implement Natura 2000 in Finland on the basis of the Forest Act. The work also helped strengthen ties at local site level between the Regional Environment Centre and the Forest and Park Service. Four forest owners were compensated for concluding a 30 years contract not to do any forest management measures at all in certain forest habitats. Special management plans for deciduous forests with white-backed woodpecker were drawn up with the Forest and Park Service. These plans covered 120 ha. In total 381 ha forest was acquired during the project, including areas financed by national funds, within the pSCIs. One big forestry company did not want to sell, but wanted a compensation for reducing use because if it remained landowner and agreed to a forest management plan, it could profit from this in its forest certification. In some of this public land, forestry ended altogether after acquisition and the ecosystems were left to develop naturally. In other parts, active habitat restoration took place. The project improved the habitat quality of boreal forests and herb-rich forests by controlled burning, increasing decayed wood, removing shading spruces and exotic trees and ensuring good foraging forests for the white-backed woodpecker (more decayed wood). Work to convert coniferous to deciduous forest was carried out in Liukosaari-Korpisaari, Tarmola, Hipeli, Edessalo-Haukkasalo, Kuruvuori, Suonteen eteläosa and Onkisalo. Altogether 119.4 ha was been treated, well above the target of 75 ha. WWF-Finland organized a volunteer camp to clean the site Tarmola of branches – material costs for the camp were LIFE-financed. The main work was spruce cutting;

some spruces were killed by girdling. The purpose of the girdling is to increase the amount of decayed wood in the forests. For the same reason, some of the cut trees were left in the forest. Not all spruces were removed, because they are important for example for flying squirrels. The project used skilled forest workers to remove timber from the forest with horses, in order to reduce damage to the soil and herb layer. This was quite innovative and was broadcast by Finnish TV. Controlled burning was carried out over a total of 17 ha. In terms of information work, the project produced: • A brochure (2000 copies) describing the principal actions of the project and especially explaining the use of controlled burning; • A film, an A3 poster and photos. Target group was forest professionals and other stakeholders interested in forest management techniques for biodiversity (increasing decayed wood, controlled burning, using horses etc.).. The project distributed the material to forest professionals so that the "increasing biodiversity" forest management practices would also be used outside Natura 2000 sites. A seminar for 38 forestry professionals was held in Sept. 2000. A meeting with stakeholders was organized after the end of the project to present results and promote nature management methods also in sites outside Natura 2000 areas. The monitoring by the project showed that the management measures were successful. The monitoring results from the biotope management actions supported the views about the negative effects of spruce on characteristic features of deciduous tree-dominated forests. When there is too much shading spruce, this decreases the possibilities for species which are dependent on decayed wood or bright deciduous forests. One interesting result of the monitoring was that even though the project did not aim to increase the quantity of decaying wood from deciduous trees, the clearing and cutting of shading spruces uncovered decayed deciduous wood lying on the ground which until then was not hospitable for beetles owing to wrong temperature and light conditions. An Annex II species, Oxyporus mannerheimii, was found after the LIFE-financed management measures in the subsite Kuruvuori. It clearly had benefited from the biotope measures, because the area had been surveyed before the measures started without finding this invertebrate. A beetle species, *Hymenophorus doubieri*, which was considered extinct in Finland and very rare elsewhere in Europe, was found, as well as a bark beetle species, *Carphoborus cholodkowskyi*, was found for the first time in Finland. *Gavia arctica* benefited from the conservation of the shoreline forests; it is expected to have better nesting success. The project carried out inventories of white-backed woodpeckers to gather baseline data to gauge the long-term success of measures for this species. Without the support of LIFE-Nature this kind of project, gathering a large expert group

together, could not have been possible to carry out, the beneficiary reported. The project itself networked with two similar LIFE-Nature projects in Finland (Boreal groves in Pirkanmaa and Pohjois-Savo) and also in Estonia. It gave a presentation in May 2002 at the Latvian seminar on "Management of national protected areas and Natura 2000 sites".

Boreal groves - Conservation and management of boreal groves 1999-2003

The project covered 11 subsites located in Pirkanmaa. Most of these are small boreal herb-rich forests, but the largest site (Myllypuro) lies within the Nokia town limits and covers almost 90 hectares. In general, herb-rich forests are small in size in Finland and they cover only 1% of Finnish forests, because they have been heavily exploited by past farming use as their soil is richer. Typically herb-rich forests are now found on land more difficult to access, like steep slopes, rocky areas, river edges. The project tackled the most urgent management issues to improve herb-rich forest conservation status: shading trees were removed so that the ground flora could get more light, thereby increasing typical herb-rich forest vegetation, which includes trees and bushes like *Tilia* and *Corylus* as well. The long-term management of these forests was ensured through management plans which are valid for 10 years. In detail, the project produced: - An inventory concentrating on vascular plants, but also checking on mosses, lichens and mushrooms. The results were used in the management plans. - 15 management plans, covering 9 subsites, and determining the need for special care and the extent to which the sites can be used for recreational and educational purposes. The Pirkanmaa Environment Centre drew up these plans in close co-operation with land owners, which helped land owners to understand which kind of land use activities are allowed within Natura 2000 sites and which are not allowed. According to the plans, the landowners will no longer be permitted to engage in forestry operations, but they will be allowed to collect firewood for home use, for example. Since many of the areas concerned are privately owned, the landowners were employed, wherever possible, to carry out any measures to improve habitats, and they signed the management plans, committing themselves to continue to manage the forests after the project. The management plans are legally binding, once approved by the Regional Environment Centre, and they are all valid for 10 years (covering period 2001-2011, 2002-2012 or 2003-2013). The management plans are structured following a typical model of a management plan in Finland: - introduction - description of the area - methods - general principles of the biotope management actions - description of the subsites and their management actions - documentation of the work and

monitoring - literature The management plans include also an assessment under §65 of the Finnish Nature Conservation Act concerning possible significant deterioration for Natura 2000 values. The most urgent measures to improve conservation status of boreal herb-rich forests were done during the LIFE project by land owners, Metsähallitus and the city of Nokia. During the project, 89.8 ha in total was acquired, broken down by subsite as follows: Sasi 13.7 ha, Hepomäki 9.7, Alhonlahti 8.0, Vainoniemi 2.2, Mälkiäinen 2.4, Sydänniemi 14.5 ha; Valkeekivi 7.2, Kuohijo 12. 1 ha and Myllypuro 20 ha. Most landowners preferred to give up their rights (for example to practise commercial forestry) and receive a compensation for the ensuing loss, but keep the ownership of the land. Only a few hectares were purchased outright. A further 8 ha scattered over 4 subsites is under an expropriation process which continued after the LIFE project. Habitat improvement work was done gradually to avoid too drastic changes like too much increase of light, changes in microclimate etc. The tree felling and removal was done during winter (when the soil was frozen), because otherwise the work would damage the vegetation. Concretely, work consisted of thinning of bushes (understorey), cutting and removing young spruce, ring-barking aspen and poplar, removing shading trees to improve habitat conditions for *Acer, Tilia* and *Ulmus*; thinning trees around hazels; increasing decayed wood. One ditch was filled in to improve the hydrological conditions of a herb-rich forest. Lop and top was collected in piles so as not to increase soil acidity and sometimes burned, sometimes removed from the site. Where relevant, measures took account of white-backed woodpeckers and flying squirrel requirements. These biotope management measures have been carried out in 7 subsites out of 11. Area treated by subsite: Hepomäki-Kalkku 10.9 ha, Luodonsaari 31.4 ha, Mälkiäinen 3.3 ha, Sydänniemi 9.9 ha; Valkeekivi 3.9 ha, Kuohijoen-Kalkkilehdot 6 ha and Kauttakala 1 ha. In two subsites, Vainoniemi-Rauttunrahka and Alhonlahti, the land owner has committed himself to implement the biotope management measures defined in the management plan after the project, while in the last, Sasi, work will be carried out after the acquisition of the whole subsite is completed via expropriation. Some of the herb-rich forests are located near built-up areas (e.g. city of Nokia) and are threatened by erosion and littering caused by people. This problem was tackled by increasing public awareness about herb-rich forests, getting local people to participate in project actions to clear litter from Myllypuro and building a small bridge over a brook to decrease erosion by people using the hiking route crossing the brook. Information panels were erected in subsites Myllypuro, Mälkiäinen and Valkeekivi (10 in total). A nature trail with boardwalks was built in the subsite

of Mälkiäinen, which gives information about the ecology of boreal herb-rich forests and their species and Natura 2000. This trail is now being visited by school camps from all over Finland. A brochure about the project was produced for the general public. A 30-page report for professionals summarising all project results in one document was made. Because the management methods for the herb-rich forest habitat type are not standardised in Finland, there is little readily-available information how to implement biotope management concerning herb-rich forests. Knowledge is currently rather scattered in Finland, so this report is potentially useful to other boreal herb-rich forest managers. Moreover, large scale herb-rich biotope management has been limited so far, so that the project's biotope improvement actions, covering over 60 ha, are quite significant in terms of gaining experience on herb-rich forest management Monitoring of vegetation has started in each restoration area and in some sites the herb-rich forest vegetation has already started to recover, according to the project's final report. Continuation of the monitoring is included in the management plans. *Pteromys volans*, the flying squirrel, which occurs in the subsite Hepomäki-Kalkku, will benefit from the project actions, as removal of spruces will increase its food resources while increasing the proportion of large aspens will increase potential breeding places for the squirrel. Management planning took into account the requirement to leave enough big spruces and spruce thickets for flying squirrel shelter.

Quark - Quark Archipelago 1997-2002

The project was on target for management planning and biotope management, but land acquisition encountered a difficult situation. The local atmosphere was tense at the beginning of the project (as elsewhere in Finland, there was resistance against Natura 2000), but it improved during the project years thanks to the beneficiary's emphasis on dialogue and communication with the local community and stakeholders. A prolongation of 2 years was granted to this project and 54 % of the land acquisition took place in the prolongation years. By the end of the project in Dec. 2002, 660 ha of the 1,350 ha targeted was acquired or agreements with compensation payments had been made with private landowners. Notably acquisition of the commons land (500 ha) did not succeed. After collecting data about threatened species, the beneficiary began by informing the landowners concerned (either private persons owning small areas or commons associations owning large blocks) about the targets and the implementation

of the project. A framework plan for management (84 pages, covering valuable habitat types, biotope management and restoration, integrating nature conservation goals and recreational needs, monitoring and information) was drawn up. This plan was not legally binding but gave principles or guidelines on how to combine goals of nature conservation, recreation and traditional land use. It was also the basis for discussing management with landowners or identifying areas for acquisition as reserve. The elaboration of a framework plan before nature reserves under the national Nature Act were designated and binding reserve management plans with compensation schemes were drawn up, was different from the normal Finnish practice at the time. Landowners, local inhabitants and other stakeholders participated in the preparation of the plan. A draft was sent for comment to all landowners, who were also kept informed of on-going forest inventories on their land. This consultation process seemed to have helped in the negotiations with landowners about the implementation of the project and the long-term management. Because the plan gave a good deal of information on ecology, geology and cultural history, it helped local people to better understand the arguments for nature conservation. The planning of the whole area, where tourism is an important source of income, and the Natura 2000 targets became clearer, as well as the context for land acquisition by the state to create reserves. Legally binding nature management plans are drawn up in the context of land acquisition or compensation of the private owner under the Nature Act. During the project 131 ha were purchased and one-off compensation was paid for loss of use on another 530 ha (including for building rights) of the ecologically most valuable land. The land was mainly natural forest of the land upheaval coast (FFH code 9030) or bog woodland, plus some coastal meadows. Most of the landowners preferred compensations to land purchase, because they then remained owner. Although the owner's use of the compensated land was restricted, activities like hunting, grazing, and some use of trees could often continue (owners were even encouraged to cut down planted conifers for firewood in order to speed up the transition to more natural wood), unless the habitat types or species needed more restrictions. Of the total 1800 ha land area in the project site, 1118 ha had been acquired by the beneficiary at project end, including with other funds prior to LIFE. Controlled burning was used to restore heaths on the island of Sondasören. The action went smoothly, thanks to the participation of elderly locals with experience of burning (a common practice until the 1940s). Monitoring started immediately after the burning and showed that lingon berries and grasses benefited well and the usual pioneer plant, rosebay willow herb, did not take over. This burning is a form of long-

term biotope management – it will not need to be repeated until after 40-50 years. The LIFE project carried out the first forest restoration measure in Finland in forest of the land upheaval coast. On 50 ha public land planted pines were cut, to favour trees typical for the habitat. On 18.2 ha meadows and wooded pastures restoration work (mowing, clearing bushes, thinning overgrowth, especially junipers) took place in Klobbliden and Slåttskär. A work camp was organised by the beneficiary and Forest and Park Service in order to clear junipers. Grazing by sheep followed restoration. The framework plan included actions to promote grazing. At the end of the project, the whole wooded pasture and coastal meadow area (almost 1/3 of the total project site) was being grazed, so the project had been successful in achieving this target of the plan. More than 520 ha were being grazed by sheep (ca 200 animals) spread over 5 sites (Slåttskäret, Stora Segelsören, Grisselörsgrund, Sondasören and Vililiden in Lappören). The sheep farmers were encouraged to apply for agri-environment support, and received it. In addition, the LIFE project guided the grazing to the best places and financed fence material for 5 places on Slåttskär island with summer cottages. The cottage owners objected to having sheep around their cottages, so the project paid the fence material and the owners erected the fences. At project end there were plans to arrange camps for local young people to learn haymaking in the shore meadows which do not qualify for agri-environment, thereby passing on traditional work methods to the next generation. Most information work contributed towards promoting local people's awareness of the site and its possibilities for sustainable nature tourism. Several public meetings were held during the project and at the end of the project, in November 2002, there was a discussion and information meeting with villagers about the results of the project. • A project brochure in Finnish, Swedish and English was produced (8000 copies), describing Natura 2000, the LIFE-Nature project and habitats and species under the Habitats Directive and Birds Directive. The brochure was distributed to landowners, local entrepreneurs and tourist agencies. • A brochure was published in Swedish, Finnish, English and German about the nature and hiking routes of the area, distributed to visitors via local entrepreneurs and the Vaasa tourist agency. • A slide series ("kingdom of birds) was made by two professional nature photographers. 70 ha land at Kvicksund was purchased with ERDF funds before the start of the LIFE project. LIFE-Nature financed construction of visitor access infrastructure on this land, to foster nature-based tourism development. This included: - Three landing sites (jetties) for boats - Restoration of 2 roads (they were made narrower and better fitting to the landscape), and a barrier across another road to close it - A parking lot + an information panel - Service equipment

along a nature trail (hiking route): 6 signposts, 500 m boardwalks, storage for firewood, one fireplace, one resting place and two toilets. Part of the route was moved to a drier area and growth around the resting places and hiking route was cleared Numbers of visitors appeared to increase thanks to these better facilities and information by the LIFE-Nature project. A steering group was set up, with representatives from landowners, fishery, forestry, NGOs, the municipality concerned (Korsholm), Regional Council and the beneficiary. The LIFE-Nature co-operated with an Interreg II C project (Archibal: ARCHIpelago BALtic networking), which was developing tools for planning and management of tourism in the Baltic archipelagos, and with the Grön Bro II project which produced information for visitors.

Rahja - Rahja archipelago 1996-2002

The project encountered landowner opposition to Natura 2000 designation in its beginning, and had to be prolonged, but after the general socio-political context for Natura 2000 improved, also in the Rahja area thanks to the LIFE project's efforts, it was able to achieve most of its targets. During the project, the beneficiary succeeded in building up good working relations with the municipality of Kalajoki. The LIFE project steering group decided to continue working together after the project as a site management committee, inviting other stakeholders to take part. Surveys of vegetation, FFH habitats, land use, erosion, recreation and semi-natural grasslands were done and the results used for preparation of the management framework plan. A geomorphological study of river Siiponjoki was used to plan the nature trail and restoration. The management framework plan (Rahjan saariston Natura 2000-alueen runkosuunnitelma) prepared by the project had two parts: one focused on state-owned areas and the other on the private lands. The plan's objective was to reach consensus on the future use of the Rahja archipelago. It integrated the different interest sectors, tourism, hunting, fishing, farming and forestry, and set targets for managing nature, landscape, waste and tourism, besides defining areas which need to be free of disturbance and proposing ecological research. The plan is binding for public lands. For private land it is a guideline, but the measures it proposes can become legally binding through land use planning (shoreline plans). The project participated in 4 different land use plans, through which it was possible to a) move building rights outside pSCI, b) determine compensations for loss of building rights and c) determine location of building rights which could stay within pSCI. In this last case, the framework plan ensured building will

be conform to the conservation objectives. Altogether building of about 40 summer cottages inside the pSCI was prevented Ecologically valuable land defined by the framework management plan which the landowner did not want to sell to the state, could be protected under the Nature Conservation Act as privately-owned nature conservation area. Owners are then compensated for the loss of timber or other income and a legally binding document between the competent nature conservation authority and the landowner is drafted as to what the landowner can and can not do. The LIFE project thus acquired 433 ha valuable nature land, mainly coastal meadow (purchase of 78 ha and compensations for 384 ha), another 144 ha was in negotiation at project end. A second document prepared by the project was the biotope management plan (Rahjan saariston Natura 2000 –alueen luonnonhoitosuunnitelma). Like the framework plan, 500 copies were made and distributed to local stakeholders. It was used to determine where biotope management is needed, how urgent and what kind. The plan thus played an important role in establishing grazing management (see below). In the Siiponjoki area, the regional forest centre prepared special biotope management plans for owners of shoreline forest. These plans combine forest exploitation and nature protection, and served as case study and model in the publication “Principles of nature management planning” by the 1995 LIFE-Nature project White-backed woodpecker. Biotope management guidelines for private land were discussed with owners. The authorities can not oblige the landowner, even in an area under the Nature Conservation Act, to carry out active biotope management, so work might be done by own staff or contracted out. The LIFE project did not fully achieve all nature restoration targets because some landowners refused permission. The LIFE project: • undertook controlled burning and tree cutting to restore Annex I western taiga forest and attract invertebrates needing burned wood, on Pentti island and in Saarenkärki (total area 7 ha). Decaying wood was increased by girdling trees. • filled drainage ditches on the 11 ha coastal meadow of Kapelinranta, removed tree stumps and debris, then established grazing • opened an old weir on the river Siiponjoki to improve the natural status of the river delta. The LIFE-Nature project made it possible to test and find the right recurring management, transport and grazing methods for archipelago conditions (shallow water, rocky areas, new reefs and islets emerge from the sea every year because of 6-7 mm land upheaval per annum). The beneficiary approached local farmers to bring their animals to the meadows of the project area and so take care of grazing management. To encourage them, it invested in getting the conditions right. The project improved the landing sites of 3 islands with grazing management (Kurvonen, Hevoskari and Lepänen) to ease

transport of sheep. and bought equipment for biotope management and three boats for livestock transport and other tasks. Bushes and trees were cleared from 29.5 ha of overgrown coastal meadow. In turn, this encouraged farmers to commit themselves to long-term management of the archipelago meadows through agri-environment contracts. The project staff helped farmers draw up the working plans required as part of an agri-environment application form. Agri-environment contracts for 5 years covered 116 ha (97 ha with sheep and 19 ha with young cattle) at project end, and the target for recurring management by grazing was exceeded by over 50%. The annex I habitat types which benefited were boreal Baltic meadows, Fennoscandian wooded pastures and Fennoscandian lowland species-rich dry to mesic grasslands. A monitoring plan was drawn up, targeting the ecological effect of recreation and the nature management measures. A former fishing hut was renovated as wardening and monitoring base. Plant species monitoring concentrated on 5 species including Hippuris tetraphylla and Primula nutans, FFH species which benefited from the actions. Permanent plots were established to monitor these species. The project networked with 6 similar LIFE-Nature projects in Scandinavia The visitor management measures were based on the guidance plan for Rahja Archipelago (Rahjan saariston luonnonsuojelualueen opastussuunnitelma), completed in 1998, parallel to the LIFE project. They were: • A boating map (10,000 copies). • An aquatic nature trail for boats (8 km), better integrated to the natural values of the archipelago. • A terrestrial nature trail along the Siiponjoki river (8 km). • Information panels erected at landing sites and harbours (9 in total). • Observation tower with a small exhibition and an information centre, in Konikarvo harbour A parallel ERDF project included boating route dredging, route marking, building jetties for landing places, and camping facilities for nature tourists. The beneficiary of the LIFE project ensured that an appropriate assessment of the suitable sites for routes and landing sites was made before the decisions on individual ERDF actions. Therefore, the 5b programme did not conflict with the Natura 2000 area, but in fact strongly supported the LIFE project by laying the basis for eco-tourism. Public awareness measures: This project did opinion polls in the two municipalities it covered concerning the LIFE-Nature project and Natura 2000 issue. It produced: • Project introductory brochure • Brochure about the project results. • Publication ‘Birth and development of River Siiponjoki’ (Siiponjoen synty ja kehitys) - 300 copies • CD-rom with educational material for schools. • A nature film about land upheaval in the archipelago, produced by Soveri WildLIfe Oy • 3 articles about avifauna of the Archipelago, published in Ornis Botanica

Protection of old-growth forests in Kuusamo area 1996-1998

As the main objective was to preserve virgin boreal forest from economic exploitation, 90% of the project actions consisted of land acquisition. The biggest block (the sites Pajupuronsuo, Romevaara, Närängänvaara and Virmajoki) was owned by a cooperative association of owners. After several unsuccessful negotiations with the cooperative, the Ministry of Agriculture and Forestry decided to expropriate the block. An area of 13,780 ha was thus acquired, consisting for about half of old growth forest (western taiga), with extensive networks of mires, making up almost another half, in-between the forests. The block also contained dystrophic lakes and ponds and many geomorphological features (eskers, drumlins). It is one of the best boreal forests in Finland, dominated by Scots pine and spruce, with many trees 300-400 years old. In addition to this block, sections of ecologically valuable land owned by private individuals were acquired by land swaps (151.5 ha) or by direct purchase (6.4 ha). The acquired lands contain large populations of capercaillie (*Tetrao urugallo*), three-toed woodpecker (*Picoides tridactylus*) and Siberian jay (*Perisoreus infaustus*) as well as mammals like *Gulo gulo, Lynx lynx, Ursus arctos, Canis lupus, Pteromys volans,* Rangifer *tarandus fennicus*, and *Lutra lutra*. They are thus important core areas from which other, smaller and fragmented areas can replenish their populations. Six boreal forest inventories were made in adjoining Karelia. These inventories revealed plenty of information which had never been published before, and could contribute towards establishing national parks in Karelia. At the end of the LIFE project, at least five parks were being planned (Kalevala, Kostamuksha, Tolvajärvi, Koitajärvi, Tuulijärvi) and proposals for the boundaries of these parks were being made on the basis of the inventories. The Kostamuksha strict nature reserve exists already and in 2001 the government of the Russian Federation approved a list of national parks to be established by 2010; the Kalevala national park (74,400 ha) is one of them. The other areas have also been approved in principle. The LIFE-Nature project has thus helped and increased the cooperation between Russians and Finns concerning nature protection issues (transboundary forest areas), and this cooperation has remained intensive since then. In Karelia, its work was being followed up by projects submitted under TACIS and Interreg II. Because of the significant local opposition to conservation and the pressures in favour of intensive forestry, promoting public awareness of western taiga protection has been one of the main actions in the Kuusamo project after land

acquisition. This work covered different kinds of awareness-raising, from guided tours for local people to a website. It produced a slide series, a video (with help from the Finnish border guards, who provided a helicopter free of charge), two brochures, a CD-ROM and posters. An exhibition was held in the library of Kuusamo township, a school package with a forest game was made and information meetings were held. A manuscript for a play describing people's life in the Näränka wilderness (within the project area) was even produced. The LIFE-Nature project did indeed help decrease the resistance against taking forests out of economic use for nature conservation and by project end more local people saw positive sides to nature conservation than before. Also important was that the local community can still use the project area to hunt elk, black grouse and hares, which is very important for them. Some local people are involved in nature tourism and wanted to expand this activity into the land secured by LIFE. This would be good in terms of social acceptance of Natura 2000 but could bring risks – the point of the LIFE project was to create zones of undisturbed nature. For the Näräng̈änvaara section of the project area, which would become the focal point for appropriate nature tourism, a management and use plan was made, ensuring that the vulnerability of nature is taken into account in nature tourism. Local reindeer herders already began reindeer trips for tourists in the winter of 2000. The Ministry of the Environment bought an old estate in Näräng̈änvaara near the end of the project with plans to use it as visitor centre and for school camps. The centre would become the heart of a network of trails through this part of the project area which, it was hoped, would draw 20-30,000 visitors a year and create 10 jobs. Structural Fund assistance was sought and obtained after the end of the LIFE project to do the necessary investment. Since then, Näräng̈änvaara has been actively developed for sustainable tourism (the main building of the Näränkä farm estate has been restored and is rented to visitors, other parts of the farm have free access and a 14 km network of trails for hiking has been built).

III. 3 Sweden

LIFE BTG - Bridging the Spatial and Temporal Gaps in Threatened Oak Habitats 2016-2022

The LIFE BTG project will focus on 30 Natura 2000 network sites in south-eastern Sweden. It aims to reconnect the fragmented landscape of Fennoscandian wooded pastures, thus reducing the extinction rates of the local beetles that depend upon the wood for a habitat.

The specific project objectives are as follows:

- Initiate the process of recovery to a favourable conservation status of 1 405 ha of Fennoscandian wooded pastures and meadow habitats;
- Initiate the process of recovery to a favourable conservation status of the Annex II-listed hermit beetle, great capricorn beetle, stag beetle and the pseudoscorpion *A. stellae* in 30 Natura 2000 network sites;
- Initiate the creation of decaying wood habitats within these sites; and
- Increase and update the knowledge about the management of the targeted habitats and species among stakeholders, site managers and scientists by the dissemination of project experiences and results, in order to ensure transferability and replicability.

The following achievements will be considered as indicators of a successful recovery process:

- Clearing of overgrowth has resulted in reduced canopy cover benefiting the targeted habitats;
- Clearing of overgrowth and monitoring of ancient trees indicate an increased number of hollow trees that are sun exposed and thus indicate improved living conditions and potential for colonisation by tree-living insects, including by the target species;
- Planting of trees and bushes has been successful, i.e. by project end >80% survival of planted small trees and >90% survival of large oak trees, indicating that a process to bridge gaps between habitats has been initiated;
- The number of trees inhabited by the hermit beetle and *A. stellae* has increased, as indicated by monitoring using mould boxes;

- Wood-living beetles have begun colonising log piles;
- 'Veteranisation' (deliberate ageing) of trees has resulted in colonisation by the hermit beetle, A. stellae and other associated species, as indicated by monitoring using eclector traps; and
- The great capricorn beetle is re-established at two project sites, as indicated by monitoring exit holes of the species.

LifeTaiga - Reintroduction of burning in Boreal western taiga woodlands 2015-2020

The main objectives of LifeTaiga project include: transforming a significant proportion western taiga (9010) in Sweden from unfavourable to favourable conservation status; developing suitable methods for controlled burning, as well as training and encouraging authorities, companies, organisations and contractors associated with controlled burning; promoting a dialogue and delivering good quality, easy-to-understand information to landowners, local residents, visitors and the general public on the issue of controlled burning; and developing mutual collaboration with Finland in relation to the management of the target habitat.

Expected results:

- 120 controlled burning events on a total area of 2060 ha in 89 different Natura 2000 sites;
- Fencing, creation of bare soil, and targeted actions on 18 of these Natura 2000 sites;
- Large areas (more than 30 ha) burned at eight sites, intermediate sized areas burned (10-30 ha) in 65 projects sites, and smaller areas (in general less than 10 ha) burned at 16 sites;
- Production of a database, which will be used to refine methods of controlled burning;
- Development of information trails to highlight the ecology of controlled burning in specific Natura 2000 sites; and
- Implementation of awareness raising measures that facilitate the exchange of ideas among organisations and contractors, as well as reach new target groups via a mobile app, QR-coded information signs and an interactive website.

BushLIFE - Restoration of habitats rich in trees and shrubs 2014-2021

The main aim of the BushLIFE project is to restore a favourable conservation status for several semi-natural grassland habitat types and create optimal conditions for associated species in a total of 629 ha in 18 Natura 2000 sites in the county of Skåne. The project also aims to increase the habitat quality and conservation status of three species listed in Annex II of the Habitat Directive, one species in Annex IV and one bird listed in Annex I of the Birds Directive.

Expected results:

- 16 restorations plans produced for the project;
- Restoration of 325 ha thorough clearance of trees and bushes;
- Restoration of 15 ha by cutting woodland;
- Plantation of 254 ha with 20 190 trees, 2310 bushes, and 500 metres of hedge;
- Restoration of 31 ha through prescribed burning;
- Restoration of 290 trees through veteranisation (a technique aimed at increasing the speed of aging in trees);
- Improvement of habitat quality by creating 37 large stumps;
- Increased survival and reproduction rates for the dormouse (*Muscardinus avellanarius*) through the placement of 700 artificial nests in suitable bushes; and
- Production of 214 information signs, 15 leaflets, a book and a film.

LIFE Coast Benefit - Restoration of ancient agricultural landscape, natural forests and wetlands at the Baltic coast 2013-2019

The majority of the project areas are protected as nature reserves, or bird sanctuaries, as well as being Natura 2000 network sites. In recent years, the habitats have begun to deteriorate because of a lack of management. The grassland habitats and grazed forests have become overgrown with bushes and trees, following the ending of grazing and hay- making activities. The overgrowth has had a serious negative impact on the birdlife, plants, animals and fungi dependant on old semi-natural grasslands. Forestry plantations have created uniform

forests with insufficient clearings and decaying wood – necessary for biodiversity. Exotic tree species used in surrounding forestry areas have invaded the natural forest habitats. Species connected to the old, sun exposed *Pinus sylvestris* trees, or deciduous trees, forest fires and coarse woody debris are now rare and threatened in the project area, as elsewhere in Sweden. Drainage of wetlands is another problem, dramatically changing the habitats resulting in loss of biodiversity.

The project's overall aim is to improve the conservation status and habitats of the Natura 2000 network sites of the Western Baltic Archipelago. The main focus is the species and habitats favoured by traditional agricultural management, natural structures and disturbance regimes in forests and in shallow waters.

Specific objectives are (in order of importance):

To restore to a favourable conservation status the habitats and species of overgrown grassland habitats and grazed forests. This includes birds, plant, fungi and insects associated with grazed meadows, grassland bushes and forest edges, as well as wood-swelling beetles, fungi and lichens connected with wide-crowned old trees. The lifespan of pollarded and old trees will be prolonged through management;

To reduce predation of bird colonies by the invasive American mink (Mustela vison);

To carry out actions targeting commercial monoculture forest plantations to ensure they become more varied and to secure a more favourable status with more clearings and coarse woody debris. Species connected with the old, sun exposed trees, should benefit and numbers of invasive tree species will be reduced; and

To restore wetland habitats and associated flora and fauna.

Expected results:

Improved habitat quality for 1 411.9 ha of the following habitats: 1150, 1620, 1630*, 4030, 5130, 6270*, 6410, 6510, 6530*, 7140, 7230, 8230, 9010*, 9020*, 9070, 9080, 9160, 9190, 91D0. The measures will also target 117.4 ha of other areas of grassland and 434.3 ha of wooded habitat, likely to become valuable after restoration and over time; controlled burning

Habitat restoration benefits on 179.6 ha for *Philomachus pugnax, Limosa lapponica* and *Tringa glareola* through improved nesting and resting sites;

Habitat improvements and a reduction of mink predation across 155 ha of habitat favoured by targeted species of terns;

Improvements to 4.3 ha of *Botrychium* simplex habitats; and

Improvements to more than 50 ha of habitats favoured by *Lucanus cervus, Anthrenochernes stellae* and *Osmoderma eremita.*

SEPA: W-taiga/Bergslagen - Protection of western taiga in Bergslagen 1998-2002

The final result can be summarised: All four project sites were acquired and legally protected as nature reserves (with management plans annexed to the decisions). 97 % of the original objective was met; i.e. 1,332 ha acquired compared to 1,375 ha foreseen, the small difference being an effect of adjusted demarcation and revised size estimates of the sites. After acquisition, the sites were left to passive management, but with the possibility for future controlled burning in order to secure nature conservation qualities dependant on fire. The site Kindlahöjden (N2000 site SE0240039)merits special mention: The project activities at this site were co-ordinated with local and regional initiatives outside the project. Local and regional NGOs, as well as public bodies, had struggled for satisfactory protection of this site since the end of the 1980s, and the establishment of the nature reserve thanks to LIFE support was manifested with an inauguration in September 1999. 20,000-30,000 persons visit this site every year. The collective results from this project and the 11 others under LIFE II aimed for the protection of natural forest sites in Sweden should be evaluated in the perspective that although 65 % of the land surface of Sweden is covered by forests, and predominantly coniferous forests, most of this land is today characterised by commercial forestry. Less than 5 % of this land is judged to qualify as "natural forests" with reference to "key" characters such as the proportion of old trees, dead and decaying wood etc. Of the land benefiting from satisfactory legal protection, there was a geographical unbalance so far as most of it was located in the alpine region of Sweden previous to 1995. In this perspective, any contribution of western taiga and other natural forest habitats is a valuable input to the Natura 2000 network. The support from LIFE Nature to the various projects launched during LIFE II (1996-99) represented a total

additional contribution of 14 % on top of the expenditure from the national budget for the purchase of land for nature protection at that time.

SEPA: WT Svea+Götaland - Protection of western taiga in Svealand and Götaland 1998-2002

The final result can be summarised as follows: Six of the seven project sites were legally protected as nature reserves (with management plans annexed to the decisions) by the end of project. One project site (Vänersnäs) could not be done during the project due to change in ownership. With the cancellation of this site, 70% (1,262 ha) of the original objective (1,800 ha of forest) was acquired. After the project, the sites were left for passive management. The collective results from this project and the 11 others under LIFE II aimed for the protection of natural forest sites in Sweden should be evaluated in the perspective that although 65 % of the land surface of Sweden is covered by forests, and predominantly coniferous forests, most of this land is today characterised by commercial forestry. Less than 5 % of this land is judged to qualify as "natural forests" with reference to "key" characters such as the proportion of old trees, dead and decaying wood etc. Of the land benefiting from satisfactory legal protection, there was a geographical unbalance so far as most of it was located in the alpine region of Sweden previous to 1995. In this perspective, any contribution of western taiga and other natural forest habitats is a valuable input to the Natura 2000 network. The support from LIFE Nature to the various projects launched during LIFE II (1996-99) represented a total additional contribution of 14 % on top of the expenditure from the national budget for the purchase of land for nature protection at that time. Some of the participating county administrative boards in this project have experienced that it has contributed to raise the profile of this habitat as a nature conservation objective in general.

SEPA: Forests in N-Götaland - Protection of deciduous forests in northern Götaland 1998-2002

The final result, in terms of land acquired by end of project, was: 342 ha in nine sites, i.e. 53 % of the original project objective of 644 ha in 12 sites, was acquired during the LIFE project. Two sites were cancelled due to delayed negotiations (Älgön, Hulebo), and one site because of

an appeal against the nature reserve decision (Ålleberg). With reference to the nature conservation and Natura 2000 value, the final representation of priority habitats was 52 % of total area acquired, i.e. very close to the level of 51 % foreseen at project start. Basically, the sites have been left for passive management after end of project, although further removal of planted spruce trees and grazing will be done at some of them. Although around 65 % of the land surface of Sweden is covered by forests, the bulk is coniferous forests and most of it is characterised by commercial forestry. In south and central Sweden, during the 20th century much of the deciduous forests were transferred to coniferous forest plantations, while the remaining deciduous forests are to a large extent also characterised by commercial forestry. Estimates by SEPA indicates that less than 2% of the original distribution of deciduous forests are still intact, in terms of natural forest dynamics. In the perspective that deciduous forests with natural forest characteristics, such as high proportions of dead and decaying wood, hollow trees etc, have suffered from serious decline in most parts of Europe, any input of sites with high nature conservation value is a valuable contribution to the Natura 2000 network. Some of the project sites, such as Fårdala-Kleven, Västerplana Storäng and Gullmarsberg, are key sites for this kind of habitat, as well as for the bryophyte, fungi and lichen flora connected to them. Others, like Molla Bokskog, represents natural beech forests at the northern limit of the European distribution of Fagus sylvatica, considering that most of the beech forest found in more northern locations are plantations.

Protection of Western Taiga, Grossjöberget in Bollnäs 1997-1998

The objective, i.e. the purchase and legal protection of the site Grossjöberget, was successfully achieved. The size and demarcation of the site was slightly adjusted and expanded during the project, so the final volume of land acquired and protected became 432 ha. After the end of the project, the site was left to passive management. The nature conservation values of the site were identified during the 1960s, and in 1984 a voluntary deal was set up between the local nature conservation NGO and the landowners, not to start any clear-cuttings but to work towards raising the necessary funding for purchase and protection. During the implementation of the LIFE project, the local NGO played an important “shadow role” to increase motivation and understanding amongst the local community, within an informal network with the beneficiary and other “formal” project participants.

Forests & mires - Protection of forests and mires in Sweden 1997-2000

Between 1995 and 1999, a series of 12 LIFE-Nature projects with the primary objective to protect natural forest and mire habitats were launched in Sweden, with land purchase and legal protection as the main project actions. This particular project aimed at the acquisition of six sites dominated by western taiga and various mire habitats, 1,486 ha initially, later revised to 2,115 ha, located in central and northern Sweden. The final result can be summarised as follows: One of the six sites had to be cancelled due to complicated negotiations, and this resulted in a 5 % under delivery in terms of hectares; in total 2,014 of the revised target of 2,115 ha was achieved. After the project, the sites have been left to passive management. With the project, the protection of five sites important for the long-term conservation of natural forest and mire habitats (including priority habitats) was assured. With reference to the drastic loss of these kinds of habitat over the last 100-200 years, in combination with the remaining threat from commercial forestry, every contribution of protected sites was to be regarded as important at the time the project was selected. For one of the sites, Södra Åsmossen (Vargavidderna), the protection also benefited the re-establishment of a viable wolf population in southern Sweden.

Osmoderma eremita - Preservation of the beetle, Osmoderma eremita in Sweden 1997-2002

As regards land purchase and compensation, 994 ha was purchased/compensated in 24 sites. Satisfactory assurances for the long-term sustainability of the project's results were achieved for an additional nine sites of 1,256 ha; making a total of 2,250 ha in 33 sites where appropriate conservation management is guaranteed. This is in addition to the 13 sites that benefited from a national legal protection status already at project start. Actions were also foreseen for clearing scrub and for fencing areas in order to bring the land up to a standard where it could enter into long-term management agreements (agri-environment). The target for clearance was 668 ha on 40 sites; the project finally cleared 692 ha on 39 sites. The target for fencing was 50.4 km in 24 sites; fencing was finally done over 59.5 km in 32 sites. After clearing and fencing, followed up by temporary grazing contracts at some sites, agri-environmental agreements were signed covering 888 ha in 39 sites by the end of the project.

The area covered by these agreements would be further increased after the project. The information and dissemination activities included: A comprehensive conservation programme for the preservation of the species throughout Sweden. This was officially adopted by SEPA and formed the basis of conservation action in Sweden until the end of 2003. It was further backed up by individual management plans for at least 37 sites harbouring the species and protected, inter alia, through this project. An information brochure (in Swedish and English), with landowners and other stakeholders concerned by the management of Osmoderma habitats as the main target group. An international seminar, held 3-4 August 1999, with 30 participants from Sweden, Denmark, Germany, Latvia, UK and France. A report, in Swedish, entitled "The hermit beetle (*Osmoderma eremita*) in Sweden - status and distribution", based on the results of detailed field inventories to identify additional sites with Osmoderma. Another 50 sites were indeed found as a result of this survey – thereby substantially increasing the knowledge of the species in Sweden and in the EU. The inventory indicated that around 50 sites in Sweden can be judged to be of sufficiently satisfactory conservation status to assure the survival of the species at national level. Summing up, the project made a very significant contribution to the conservation of this priority species in Sweden through a variety of ways: Increased knowledge about the status, distribution and management needs of the species. 75% of the sites in Sweden where this species is present brought up to favourable conservation status. Long-term management of these sites guaranteed through land purchase, national legal protection or agri-environmental agreements. Awareness of this obscure beetle increased amongst general public and landowners alike. The project was thus a demonstration of LIFE-Nature supporting a short-term but work-intensive initiative bringing a specific species or habitat up to the level where the long-term maintenance of its conservation status can be assured, in this case at the national level. The project has also had some external influence, contributing to increased understanding and inspiration for the protection of broad-leaved forests and wooded pastures (habitats linked to *Osmoderma eremita*). In 2001 SEPA initiated a national survey of old and large deciduous trees, considering their biological values with reference to insects, bryophytes, lichens and fungi, to lead to the preparation of an action plan.

Western Taiga - Protection of Western Taiga in Sweden 1996-1998

During 1995-99, a series of 12 LIFE-Nature projects with the primary objective to protect natural forest and mire habitats were launched in Sweden, with land purchase and legal protection as the main project actions. This particular project targeted the acquisition of twelve sites dominated by western taiga, 8,796 ha in total, in central and northern Sweden. Twelve sites were indeed acquired but the final total area was reduced by 16 % to 5,609 ha. After the project, the sites were left to passive management. At the time the project was selected, protection of western taiga was prioritised with reference to the rapid loss of natural forest habitats. Although 65 % of the land surface of Sweden is covered by forests, and predominantly coniferous forests, most of this land is today characterised by commercial forestry. Land qualifying as "natural forests" with reference to key characteristics such as the proportion of old trees, dead and decaying wood etc., was judged to occur only over a small percentage (about 5 %) of its previous range. Thanks to the project, twelve nature reserves, important for the protection of western taiga and with sufficient restriction on commercial forestry, were established.

III.3 Poland

Grna Biebrza - Preservation of wetland habitats in the upper Biebrza Valley 2012-2019

The natural and semi-natural wetlands of the upper Biebrza Valley host a number of rare and endangered European habitat types listed in the annexes of EU Habitats Directive, such as the priority bog woodlands, as well as alkaline fens, transition mires and quaking bogs and Molinia meadows. These valuable natural and semi-natural wetland habitat types host many rare flora and fauna species highlighted for conservation in the annexes of the Habitats and Birds directives. Despite the high nature value of the area, however, comparison of land-use data has shown that over the past 30 years, forest cover has grown by nearly 95%. And over the same period, the area of non-forested ecosystems has diminished by 57%. The decline of the humid grasslands/meadows is attributed to the abandonment of traditional agricultural practices e.g. grazing and/or cutting regimes, as well as altered and simplified structures of the ecological landscape. The result has been a loss of valuable European plant communities, as well as a decline in important flora species and biotopes and associated fauna.

The project's overall objective is to increase the biodiversity of the upper Biebrza Valley through the restoration and maintenance of the mosaic of natural and semi natural wetland habitat types. The actions targeting the conservation of the habitats will also benefit a host of rare EU flora and fauna species.

Specific project objectives are:

- Restoration of the mosaic of non-forested wetland ecosystems;
- Improvement in the conservation status of associated wetland plant communities and especially of biotopes supporting rare bird species associated with the open grassland/ meadows;
- Improvement of the management efficiency of the project area of Natura 2000 network sites, 92% of which are privately-owned. Natura 2000 is currently viewed by local stakeholders, such as landowners and local and regional authorities, as a factor limiting economic development. A key aim, therefore, will be to demonstrate the economic benefits of land management in accordance with nature protection policies;
- Groundwater stabilisation of the targeted wetlands; and
- Integration of the project's nature protection objectives with the development of tourist activity.

Expected results:

- Stabilisation of the groundwater level of bog woodland (*91D0), alkaline fens (7230), transition mires and quaking bogs (7140) and Molinia meadows (6410), through liquidation of drainage system on some 35 km;
- Results of hydrological studies carried out over the course of the project will be used in the management of four Natura 2000 sites: "Dolina Biebrzy", "Ostoja Biebrzańska", "Puszcza Augustowska", and "Ostoja Augustowska";
- Sustainable land management will be achieved for the targeted habitats, as well as for the habitats of the aquatic warbler through land purchase, or long-term lease of private land;
- A mosaic of 460 ha of non-forested wetland habitats will be restored and its sustainable management guaranteed;

- Principles for forest use on some 1 200 ha of bog woodland (*91D0) will be established and a simplified forest inventory plan drawn up for privately-owned forests; Higher protection limits for forests growing on bog woodland (*91D0) will be established, following a ‘participating management model’ based on agreements between self-government bodies and key private stakeholder groups. Implementation of this model will take place through a coordinated strategy for the project area and exchange of information via the GIS platform; and
- Preservation of Natura 2000 habitats and species will be integrated with local development through small-scale tourist infrastructure.

Ostoja Wigierska - Endangered species and habitats protection of the Natura 2000 "Ostoja Wigierska" site 2012-2017

The "Ostoja Wigierska" project significantly contributed to the protection of a wide range of endangered species and habitat types in the Ostoja Wigierska Natura 2000 network site in north-east Poland. Further information on the project can be found in the project's layman report and After-LIFE Conservation Plan (see "Read more" section). This goal was achieved through the implementation of a series of diverse conservation and habitat restoration actions. The project team purchased 65 plots of land with a total area of 71 ha and designated them for nature protection purposes. Trees and shrubs were removed from over 24 ha, while excess herbaceous vegetation was removed from over 120 ha by mowing, resulting in the halting of succession processes and significant improvements in targeted habitat types in open ecosystems. The removal of Himalayan balsam (*Impatiens glandulifera*) was carried out for five consecutive years from an area of over 50 ha, resulting in up to 95 % reduction of this invasive plant species. The project team constructed two road-crossing systems (culverts) for amphibians, which contributed to a significant reduction in road mortality of migrating populations (including *Triturus cristatus* and *Bombina bombina*) in two localities. Two footbridges and one observation deck were built that prevented further degradation of valuable habitats due to trampling by visitors. The project team also changed the course of an educational trail to enable the recovery of sundew populations and the regeneration of priority peatbog habitat. Furthermore, the project team built four manure plates with a total area of 136 m2, and four liquid manure reservoirs with a total capacity of 117 m3. This significantly will

improve the quality of habitats for species, including dragonflies (e.g. *Ophiogomphus cecilia*) and the thick shelled river mussel (*Unio crassus*), by removing four sources of pollution from farms (for two rivers), thus contributing to an increase in their population sizes. Many environmental benefits arise from all the above-mentioned concrete conservation actions. The durable constructions built should continue to bring environmental benefits for many decades. Dissemination and public awareness-raising activities significantly increased knowledge and ecological awareness among the local community. The educational activities carried out not only made the local community aware of the need to conduct active conservation measures, but also showed how to undertake and contribute to such activities. This should be beneficial for nature conservation in the region in the long term. The project directly contributed to the implementation of the EU Habitats Directive and also contributed to EU policy goals relating to biodiversity, water quality, sustainable rural development, and invasive alien species. The socioeconomic benefits of the project occur through the enhancement of ecosystem services. The concrete conservation actions implemented particularly relate to biodiversity conservation, which brings diverse benefits including human interactions with nature in terms of health and well-being and the boosting of local ecotourism opportunities. The actions aimed at maintaining open habitats and the indigenous flora they support enabled the functions of these habitats to be maintained. Most of the activities carried out also increased the potential of the area of the Ostoja Wigierska Natura 2000 site to provide cultural services (e.g. recreational, aesthetic, scientific and educational).

ActiveKPN - Protection of natural resources of Kampinos Forest – Natura 2000 Site, through the renaturalisation of bought-up land 2011-2015

The overall objective of the ActiveKPN project (i.e. to conserve the target European habitats and species through concrete conservation activities) was successfully achieved through the planned renaturalisation actions carried out on purchased areas of land. These actions also helped mitigate threats such as habitat fragmentation and pressures from urbanisation.

All the specific project objectives were met. In total, thanks to the works, the conservation status of six habitat types and 11 species including mammals, birds, insects and plants are expected to show significant improvements in the long term. And, as well as these

individual outputs, the wider project goals were also achieved, for example, by increasing public awareness of the conservation measures within the Natura 2000 network site through the dissemination of information about the project.

A total of 200.56 ha of land was purchased under the project (i.e. a fraction over the planned land purchase). Eighteen farmsteads located on these newly purchased areas of land were demolished under the project. The initial stage of the project also included acquisition of all material necessary for the monitoring of the habitats and species and for carrying out the concrete renaturalisation actions which included afforestation, removal of shrubs, mowing and selective planting supporting natural succession. Initial estimates made under the project's application, were subsequently adjusted to reflect the actual conservation needs on the purchased land, established through monitoring.

Renaturalisation works were carried out on each of the purchased plots of land. However, due to different natural conditions, (for example, high water, or advanced stage of natural succession) it was found to be not always necessary, or even advisable, to perform these works across the entire area of the land plots. Indeed, in some cases these activities were conducted on only fragments of a given plot, according to nature expertise and the practical knowledge of park employees. Nevertheless, in order to strengthen the ecological impacts of the project, these works were also extended to other parts of the Puszcza Kampinoska Natura 2000 network site. In all, the works were carried out on 234 ha of land i.e. slightly more than initially forecast.

All of the information activities planned within the project were implemented. These included printed publications, construction of information boards and organisation of various educational activities both in education centres of the park and during special events, such as KPN Open Days or classes with students from universities in Warsaw. Monitoring of natural conditions on purchased land were also carried out. In total, the state of natural conditions was assessed on more than 200 ha of purchased land, as well as on adjacent areas. Botanical surveys also covered the monitoring of invasive species and identified the location of the various protected and valuable species on the purchased land.

Further information on the project can be found in the project's layman report and After-LIFE Conservation Plan (see "Read more" section).

III.4 Latvia

LIFE CoHaBit - Coastal Habitat Conservation in Nature Park 'Piejura' 2016-2020

The overall objectives of LIFE CoHaBit are to mitigate heavy anthropogenic pressures and to restore vulnerable coastal habitats of Piejūra Nature Park, a Natura 2000 network site. Conservation and restoration actions will be implemented and sustainable management introduced for 13 coastal habitat types (seven of which are priority) listed in the Annex I of the Habitats Directive.

Specific project objectives are to:

- Update the park's nature management plan;
- Implement concrete conservation and restoration actions;
- Control alien species invasion; and
- Involve the local community including landowners, local residents and other stakeholders in sustainable management of the park by implementing an effective awareness raising/educational campaign.

Expected results:

- An updated and approved site management plan;
- Restoration of 75 ha of coastal dune habitats (priority grey dunes, wooded dunes, embryonic shifting dunes and white dunes) in the Mangali area;
- Restoration of 5 ha of priority coastal lagoons in the Daugavgriva and Mangali areas;
- Restoration of 4.5 ha of priority Boreal Baltic coastal meadows and the surrounding complex of alluvial semi-natural grasslands in the Vakarbulli area;
- Significantly diminished deterioration of habitats of Community importance - allowing regeneration of natural vegetation on at least 800 ha in the Mangali, Garciems, Carnikava and Saulkrasti areas;
- Improved conservation status of bird species associated with the target habitats;
- Clearing of invasive species on an area of 175 ha; and
- Establishment of an information and education centre in the park.

LIFE Birds in Adazi - Improving of the conservation status of specially protected bird species in Natura 2000 site Adazi 2013-2018

The project's objectives are:

To restore in the Adazi Natura 2000 site, the breeding and/or foraging habitats of Birds Directive Annex I bird species and Habitats Directive listed heathland and bog habitat types;

To enhance conditions for the long-term sustainability of the Natura 2000 designated features within the site through comprehensive conservation and management planning, taking into account the needs and capacity of land owners and managers, and including awareness raising programmes for these owners and managers, as well as visitors to the site;

To promote cooperation and international networking with other managers of military Natura 2000 sites and institutions working with similar species and habitats.

Expected results:

- The restoration of 1100 ha of dry sand heaths, 500 ha of degraded bogs and 20 ha of Western taiga;
- Stable or increasing populations of *Tetrao tetrix*, *Caprimulgus europaeus, Coracias garrulus, Lullula arborea, Anthus campestris* and red-backed shrike (*Lanius collurio*) breeding and/or foraging in habitat 2320, and of *Tetrao tetrix, Grus grus, Tringa glareola* and *Caprimulgus europaeus* in the bog habitat;
- The erection of 60 nestboxes and 200 perching poles for *Coracias garrulus*. A webcam will also be set up at one nest of a specially protected bird species each year, beginning in 2015;
- A management plan for the project area will be developed and approved by statutory authorities;
- A study of the impact of military activity on species and habitats will be completed, to help inform future planning of military sites;
- An educational cycling trail (8 km) will be built; 40 notice boards and 30 information boards erected; visitors' days will be organised, with military personnel taking part; and

information materials will be prepared and distributed. Two educational films will also be made;

- An international conference will be help with at least 50 participants from 10 countries. In addition, study visits and exchanges will be organised.
- The project will restore 20 hectares of old or natural Western taiga by a controlled burning of the undergrowth. These works will be performed in accordance with the specially developed plan of action. Burning will carried out by the National Armed Forces and the JSC "Latvian State Forests" in collaboration with specialists from the State Forest Service. Support for the air will be provided by the National Armed Forces helicopter, which will ensure surveillance and firefighting if necessary.

Western taiga - a habitat protected in the European Union – is found in the protected landscape area "Adazi". Existence and regeneration of this type of the pine forest is related to forest fires, which prevent formation of thick undergrowth, allow self-seeding of new pine trees and create different age tree stands. In the commercial forests clear-cuts can be partially likened to the impact of fires. Forests in the project site are currently not being used in forestry and only tactical military exercise, which does not create fires, takes place in them. Therefore, there is no natural forest regeneration. During the project controlled burning will be carried out to replace natural disturbance. It will contribute to the creation of mixed age pine stands in the long-term and provide better feeding conditions for the European Roller in the short term.

More information: http://putniadazos.lv/sites/default/files/docs/putni_adazos_laymns_2018.pdf

HYDROPLAN - Restoring the hydrological regime of the Kemeri National Park 2011-2019

The project's main objective is to establish a hydrological restoration programme and and to carry out hydrology restoration measures within three different ecosystems:

- Bog woodland and swamp forest habitats - the peripheral forests at the western edge of the Kemeru tirelis raised bog;
- Raised bog habitats - the Zalais purvs raised bog; and
- Floodplain meadows - the floodplain of the river Skudrupite and the Melnragu meadows.

- Secondary objectives are:
- Creation of a hydrological restoration programme for priority areas within the national park, serving as an example for hydrological modelling in the region;
- Implementation of hydrology restoration measures to improve the conservation status of bog woodland and swamp forest habitats, raised bog habitats and riparian meadow habitats;
- Adaptation of airborne remote sensing data interpretation methods for hydrological modelling, habitat conservation status assessment and hydrology restoration planning, and distribution of know-how to other countries; and
- Awareness-raising to change the attitude of local people about hydrology restoration measures targeting habitats of EU importance.

Expected results:

- Inventory data on drainage systems and conservation status of the habitats of EU importance within raised bog Zaļais purvs and Skudrupite – Melnragu meadows and forests and the site's Natura 2000 data sheet updated;
- Creation of a hydrology restoration programme;
- Implementation of restoration activities on some 1 000 ha of bog woodland and swamp forest, some 550 ha of raised bog habitat and some 85 ha of floodplain meadows (restoring the meandering course of the river);
- The areas of hydrological restoration will be used as demonstration sites for nature conservation experts and other stakeholders; and
- Various dissemination activities will be carried out, including project leaflets and reports, exchange trips and a project website.

Habitat inventory and expected changes • During the Habitat Inventory, three protected forest habitats of EU importance were identified in the Zalais Bog: 1) 26.1 ha of Western taiga forests (9010*) forests, 2) Fonnoscandian deciduous swamp forests (9080*) - a total of 13.9 ha, and 3) Mire forests (91D0*) - total area of 39.1 ha. During the restoration of the hydrological regime, the areas of protected forest habitats are expected to increase by more than 90 hectares. Similarly, two protected wetland habitats of EU importance have been identified in

the area: 1) Active raised bogs (7110 *) - 47.7 ha and 2) Degraded raised bogs still capable of natural regeneration (7120) - 337.7 ha in total. By restoring the hydrological regime in the bog areas, optimal conditions will be created for the further development of the bog, the gradual disappearance of non-native bog species - the Labrador-tea, dense pine and birch stands, and the growth of the characteristic bog species - sphagnum and cloudberry. Five forest habitats were identified during the inventory of the western edge of the Great Kemeri Moorland: 1) Bog woodland (91D0 *) covering an area of 84 ha; 2) alluvial forests (91E0 *) covering 30 ha, 3) Fonnoscandian decidous swamp forests (9080 *) of 63 ha, 4) Western taiga forests (9010 *) covering 156 ha and 5) Fennoscandian hemiboreal natural old broad-leaved deciduous forests (9020 *) covering about 46 ha. As a result of the restoration of the hydrological regime, the area of protected forest habitats in this area is expected to increase by more than 400 hectares, and some forest habitats will be transformed into other forest habitats, or the habitat area will not change but its quality will improve.

FOR-REST - Forest Habitat Restoration within the Gauja National Park 2011-2015

The project's main objective is to establish a long-term forest habitat restoration and management programme for selected priority species and habitat types, to test and demonstrate innovative habitat inventory methods and implement the best practice habitat restoration measures in the Gauja NP Natura 2000 site.

Secondary objectives are:

- To draft a long-term forest habitat restoration and management programme for selected priority species and habitat types;
- To demonstrate and promote innovative habitat restoration and management measures aiming at improving the conservation status of forest habitats;
- To adapt airborne remote sensing technologies for forest habitat distribution evaluation and conservation status assessment as well as for restoration and management planning; and

- To increase the knowledge and awareness of nature conservation specialists, local municipalities and local residents on restoration and management measures for forest habitats of EU importance.

Expected results:

- Obtaining of inventory data on the distribution and conservation status of the selected priority forest habitats within the Gauja NP;
- Preparation of digital maps of the Gauja NP and updating of the Natura 2000 ste data sheet;
- Drafting of a long-term long-term restoration and management programme and habitat restoration and management plan for the target forest habitat;
- Implementation of the following restoration / management activities: hydrological restoration of 130-170 ha of bog woodland habitat; management of 280-300 ha of western taiga boreal forest; and management of 60-80 ha of broad-leaved forest;
- Use of the project areas as demonstration sites of efficient restoration and management measures for nature conservation experts, private land owners and other stakeholders; and
- Dissemination activities, including: project leaflets, a printed report on restoration, four short films, a website, and five seminars and experience exchange trips for nature conservation specialists, representatives from local municipalities and local people.

Management activities:

During the the project, a habitat type Western Taiga (9010*) with total area of 281 hectares was managed. The main purpose of management activities was to create openings in the forest stand by cutting the undergrowth of spruces and to increase the amount of lying and standing dead wood. To achieve it, there were several approx. 200m2 large, circular openings created in the forest stands throughout the whole territory. This was done in order to increase favourable light conditions in the forest stand and also for making extra space for development of new pine tree generation. Trees that were cut down while making the openings were left in the territory so lying dead wood was also created during this process. To create standing dead wood there were two methods used - making tree trunks and girdling the bark off of the tree. Trunks were created by cutting the tree at about 3m height from ground. Girdling, also called ring-barking is the complete removal of a strip of bark from around the entire circumference of

either a branch or trunk. This method was used to interrupt the water flow from roots to canopy, so the pine tree withers in a longer time period and the standing dead wood is created.

During the Project a series of management measures were carried out to restore and maintain the living habitats – forests of slopes, screes and ravines (9180*), old parks and alleys - of a protected beetle specie – Hermit beetle (Osmoderma barnabita). All activities were carried out according to previously developed habitat restoration, management and specie protection programme and the work was done in small patches in total area of 65 hectares. In most of the management sites works included removal of surrounding faster growing tree species and bushes around old oak trees and creation of large gaps for promoting oak regeneration, also the removal of first year tree offspring's and grinding of the stumps and roots that remain on the ground after management works.

More information: https://www.daba.gov.lv/upload/File/DOC/for_rest_laymans_report.pdf

Further information on Latvian forest habitat management is published in "Current management practices for specially protected habitats and species in Latvia: Forests" Editors: Kristine Cinate, Viesturs Larmanis, Inga Pikšena. Within is an article: "Restoration and management of Boreal zone forests: experience of similar foreign LIFE Nature projects" Kristine Cinate.

Raised Bogs - Restoration of Raised Bog Habitats in the Especially Protected Nature Areas of Latvia 2010-2013

The Raised Bogs project prepared management plans and regulatory documents for four protected areas of raised bog habitat in Latvia, in collaboration with local stakeholder groups. The management plans for all four project sites - Aizkraukle Mire and Forests, Aklais Mire, Melnais Lake Mire and Rozu Mire Nature Reserves - were approved by the Ministry of Environmental Protection and Regional Development. These management plans serve as guidelines for the implementation of restoration actions on these Natura 2000 sites and, as such, are a useful tool for helping the Nature Conservation Agency, Regional Environment protection boards and land owners/managers ensure sustainable conservation of the sites.

Hydrological studies of active raised bog were conducted before the concrete conservation activities, which included the building of dams on drainage ditches at all four

project sites using an excavator. The total restored habitat area was 488 ha (instead of the originally foreseen 290 ha). The positive effect of building the dams was clearly evident at all the project sites, with monitoring results showing that the water was raised to a new stable level and that typical raised bogs' vegetation was gradually regenerating. The blocking of drainage ditches should prevent further degradation and establish the conditions necessary for successful raised bog habitats regeneration. Eventually, sphagnum species should begin to dominate in the wetter areas, enabling active peat formation processes to be restored. There was an increase of sphagnum cover in the Melnais Lake Mire just six month after dam construction.

Public awareness on raised bogs conservation has been raised through various activities. Five project booklets (one general and four dedicated to each project site) and a layman's report were published and distributed. The beneficiary published a 244 page book, "Raised Bog Management for Biological Diversity Conservation in Latvia", in Latvian and English that included detailed information about the value of protecting raised bogs and recommendations for their management and monitoring, based on findings from all four project sites. A travelling exhibition "Secrets of Mires" was prepared and presented in 30 different locations, with 10 accompanying seminars addressing different stakeholder groups. A documentary film entitled "Mires Uncovered" was produced and shown in Latvian schools, nature education centres, universities, museums, libraries, and at international nature film festivals in Estonia and Portugal. It is also available on the project website (www.purvi.lv), along with detailed information on all the project's results and deliverables. The project's international conference "Sharing experience on Raised Bog Restoration" was attended by 50 participants from seven European countries. In addition, the project conducted a wide range of networking activities, including exchange contacts with LIFE projects in Wales and Germany, involving study tours, seminars, conferences and meetings.

The conservation actions on active raised bog should benefit up to eight priority habitats of the Habitats Directive, including degraded raised bogs still capable of natural regeneration, transition mires and quaking bogs, depressions on peat substrates of the Rhynchosporion, and natural dystrophic lakes and ponds, along with the many species these habitats support.

The project developed good practice in active raised bog habitat restoration in Latvia. The new experience obtained is applicable regionally, nationally and internationally, and using

the prepared management plans it could be put into practice in Natura 2000 sites in several other EU countries.

Further information on the project can be found in the project's layman report, After-LIFE Communication Plan and After-LIFE Conservation Plan (see "Read more" section).

More information:
https://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=file&fil=LIFE08_NAT_LV_000449_LAYMAN.pdf

ADAZI - Restoration of Biological Diversity in Military Training Area and Natura 2000 site "Adazi" 2006-2009

The project drew up a management plan for integrating nature conservation and military priorities for the site. The plan established a zoning system for the range of land use of the territory. The target was to get individual site rules approved by the cabinet of ministers and at least 30 individual site-users' agreements signed.

The management plan will also ensure co-ordinated management of the site, and the management capacity of the military personnel will be increased through two international conferences, other public events and education activities, daily training and the establishment of onsite education boards.

A hydrological study was carried out in order to implement measures that minimise the impact of hydrological changes on species and habitats. Such actions included the removal of beaver dams and restoration of natural flows of streams. Degradation of lakes was prevented by restrictions on recreation use and education of military personnel and general public.

Dune habitats were protected from damage through the zoning system established in the management plan and by educating military personnel. In addition, a total of 1075 ha of heath habitats and grasslands (habitats 4030, 4010, 2320, 6410 and 2330) were transformed to agricultural lands and their changed classification is being maintained. These areas include at least 1 000 ha of habitat 4030 European dry heath and 30 ha of habitat 2330 Inland dunes with open Corynephorus and Agrostis grasslands.

A total of 306 ha of mire habitats (7110 Active raised bog * and 7120 Degraded raised bog still capable of natural regeneration) were restored and oligotrophic Lake Mazuika is being maintained in good condition in the project site.

Forest habitats were also targeted. A total of 247 ha of priority forest habitats (Bog woodland (91D0*), Fennoscandian deciduous swamp woods (9080*) and Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (91E0*)) were restored and vehicle access to damaged areas were closed. The forest areas have also been cleared of rubbish.

Finally, five years after the end of the project, at least 1 600 ha had been cleared of unexploded ammunition.

Education and awareness activities aimed at the general public were conducted to prevent future damage to habitats. As a result of the project, the public is much more aware of Natura 2000 sites and its attitude towards their conservation is positive. Moreover, all military personnel of the National Armed Forces receives training on nature protection issues. The training programme created within the scope of the project is used in infantry schools and at the National Defence Academy.

Further information on the project can be found in the project's layman report and After-LIFE Conservation Plan (see "Read more" section).

IHM-VESTIENA - The improvement of habitats management in Natura 2000 site – Vestiena 2006-2011

The project achieved its main objectives: to develop the nature management plans (NMP) for three protected areas and to draft a site-specific regulation. NMPs were adopted according to the existing legislation.

It determined the general pressure limits for 13 types of habitats located in the project area and calculated the impacts on particular locations of habitats. The comprehensive GIS database in Latvia features some specially protected nature sites and includes the following information: topographic maps, land ownership, present land use, zoning of the territory, nature values (i.e. location of habitats and species of Community and national importance) sites with scenic views, areas important for landscape protection, recreational values and tourism

infrastructure, pressures on different areas and particularly on habitats of Community importance, and location of management activities.

The restoration of priority biotopes is ensured by the project on an area of 52.3 ha and the restoration of remaining 18 ha of grassland formations has been included in an After-LIFE Conservation plan. The activities carried out during the implementation of LIFE project established preconditions for the maintenance of 70 ha of land and these are planned to be continued after the end of the project. Around 600 ha are covered by agri-environmental programmes. The elimination of the invasive species, giant hogweed, has been completed according to the reduced target of 30 ha instead of the initial 245 ha. The project's activities also established preconditions for the control of 32.65 ha previously invaded with giant hogweed, which will also be continued after the end of the project. All the farmers whose properties are invaded with this alien species were invited to a special training session, and maintenance of cleaned sites from alien species has been included in the After-Life Conservation plan. In addition, a special volunteer monitoring sub-programme has been developed and introduced to monitor cleaned sites and to identify new ones.

In total five nature trails (instead of the planned six) were created with a total length of around 6.3 km including places for recreation – i.e. tables, benches and waste bins were established. Agreements for the maintenance of the trails have been concluded with the local landowners for 10 years. The establishment of the remaining sixth nature trail is included in the After-LIFE conservation plan.

The project has produced a number of information and educational materials, including booklets on forest, grassland and freshwater habitat management practices in Vestiena. The project also published short flyer-type leaflets containing practical information on how to eliminate step-to-step hogweed. A project website available in Latvian and English, and 15 seminars were organised on: grassland management and the limitations of pressures and loads on habitats; limitation of alien species; best practice of conservation and management of surface water habitats, and best practice of conservation and management of forest habitats. Finally three TV broadcasts were made on LTV 1 (a national channel) and one on regional TV; four information days were organised, and three round table discussions were held.

Further information on the project can be found in the project's layman report and After-LIFE Conservation Plan (see "Read more" section).

MIRES - Implementation of mire habitat management plan for Latvia 2004-2008

The project achieved very good results in all every aspect: management planning, direct habitat management and raising of public awareness of the target mire habitats of EU importance, project sites and Natura 2000 network.

The management plans prepared by the project and approved by the government's environment department for all four project sites (Cena Mire, Stikli Mires, Klani Mire and Veseta Floodplain Mire Nature Reserves) have set management goals and measures for these Natura 2000 sites for the next 10 years. Project management activities were very effective.

The greatest success of the project was bringing to an end the desiccation of the active raised bog habitats over an area of 320 ha by building dams on the drainage ditches in the project sites Cena Mire, Stikli Mires and Klani Mire. After raising the water level the degradation of the raised bog habitats was stopped. The results of the project monitoring activities show that the condition of the target priority habitats of EU importance – active raised bogs and bog woodland – has substantially improved and the typical raised bog species have started to re-establish themselves in the degraded areas.

Additionally, 4.9 ha of transition mires and quaking bogs and Fennoscandian mineral-rich springs and spring fens were restored in the project site Veseta Foodplain Mire, and 64.9 ha of Western taiga forests were managed in Stikli Mires and Klani Mire.

Dissemination activities included the production of materials in mostly Latvian and English: a general booklet about the project and four site booklets were published and distributed during different public events. The materials for the teachers and schoolchildren, including a field guide for mire excursions and colourful drawings, was also produced and distributed to the local schools. The guidelines on the conservation and management of mire habitats and species, 'Mire Conservation and Management in Especially Protected Nature Areas of Latvia', was another important output of the project; it serves as a very useful guidance tool for similar activities in the future. Finally, the project layman's report was produced and distributed to participants of the final seminars, project partners, stakeholders and other interested parties.

A nature trail and a watching tower were established at two project sites – the Cena Mire and the Stikli Mires complex. Along the nature trails attractive information boards and signs about the LIFE project and mire habitats and species were set up. Both trails are of a great interest for the visitors and have become a popular eco-tourism destination in all seasons.

Further information on the project can be found in the project's layman report (see "Read more" section).

III. 5 Estonia

LIFE-IP ForEst&FarmLand - Adaptive community based management of forest and farming landscapes to improve the conservation status of Natura 2000 habitats and species 2020-2029

The main objective of the LIFE-IP ForEst&FarmLand project is to implement the most critical part of the Estonian Prioritised Actions Framework (PAF) for Natura 2000 relating to forests and agricultural land. The management of Natura 2000 sites has so far been based on mostly bans and restrictions, which creates a negative image of nature conservation. One goal of this project will be to change the management of Natura 2000 sites towards more adaptive conservation measures/practices.

Expected results: The implementation of the LIFE-IP ForEst&FarmLand project is expected to result in the adoption and promotion of best practices for the management of the Natura 2000 network in Estonia, as well as the development and introduction of a versatile range of conservation tools and methods.

The main outcomes will include:

- developed action plans for different types of habitats and pollinator species;
- updated subsidy system for semi-natural habitats;
- implemented range of effective biodiversity-friendly measures + CAP support;
- training system developed 4 study trips organised for 40 people;
- participatory planning processes, including at least 30 farmers/farming companies;
- completed restoration projects for wet and dry forest habitats and for 20 coastal areas (restored forest habitats on 4 000 ha);

- restoration of 3 500 ha of wet forest habitats;
- improved forest structure and composition by cuttings and planting on 500 ha of dry forest habitats;
- restoration of 1 000 ha of semi-natural grasslands, including 20 pilot sites in coastal areas;
- restoration or creation of 100 small water bodies in agricultural landscapes;
- eradication of invasive alien species - *Fallopia* spp. in 12, *Solidago* spp. In eight, *Symphoricarpos albus* in 12 and *Sorbaria sorbifolia* in 12 pilot plots;
- at least 500 ha purchased and dedicated to conservation; and
- Estonian PAF for Natura 2000 prepared for the EU Multiannual Financial Framework (MFF) period 2028+.

LIFE Mires Estonia - Conservation and restoration of Mire Habitats 2015-2022

The priority habitat types – active raised bogs (7110), bog woodlands (91D0) and Fennoscandian deciduous swamp woods (9080) – have become very rare in the EU. This is mainly due to the negative impact of drainage. Based on overall biogeographical assessments of Estonia, the status of the habitat types targeted by the project is neither favourable nor secure.

The overall objective of the LIFE Mires Estonia project is to secure the favourable conservation status of wetlands, especially mires and priority habitats protected by the Habitats Directive: active raised bogs, bog woodland and Fennoscandian deciduous swamp woods.

Through the restoration of the hydrological regime and the abandoned peat mining areas, the project also aims to benefit fauna affected by drainage such as birds, amphibians, dragonflies and butterflies. The project will also raise awareness among the local population, present the project results nationally and internationally and develop a methodology and guidelines for the restoration of degraded mire habitats sites concurrently supporting western capercaillie (*Tetrao urogallus*), moor frog (*Rana arvalis*) and dragonfly (Leucorrhinia) populations.

The restoration and management activities will be carried out on six Natura 2000 areas and the hydrology improved on around 5800ha of which 3450 ha are Natura 2000 priority habitats.

Expected results:

- Significant and sustained improvement of conditions of the EU priority habitats active raised bog habitats (2447.2 ha restored), bog woodland (567.8 ha), Fennoscandian deciduous swamp woods (159 ha) and western taiga (276.2 ha);
- Conditions sustained for western capercaillie (*Tetrao urogallus*), willow ptarmigan (*Lagopus lagopus*), amphibian moor frog (*Rana arvalis*), and *Leucorrhinia* dragonfly populations;
- Spatial planning methodology developed for reducing the potential negative impacts to these species due to restoration activities, e.g. removal of trees or sudden closure of drainage ditches; and
- Public events to introduce restoration activities, study days for schoolchildren and teachers and the establishment of a LIFE trail.

EE Priority Forests - Protection of priority forest habitat types in Estonia 2001-2005

Although the project was not able to meet its land purchase targets - six private land units totalling 49 ha were purchased - it did succeed in establishing 20 forest protection areas and elaborating 19 management plans for securing the best available conservation status of these forest habitats. The project has strategic importance for the representation of several forest habitats in northern and eastern Europe within the Natura 2000 network. As part of the implementation efforts, over 200 ha of semi-natural grasslands, which had been previously abandoned, were restored and regularly mowed leading to clear changes in their species composition. To restore the natural state of drained forest communities, 22 draining ditches were closed in three sites. This provided valuable practical experience for the future about which type of blocking should be used in different conditions and forest communities. A first comprehensive strategy for the restoration of less valuable forest monoculture stands was developed, leading to forest restoration cuttings on 350 ha of such habitat. Special nets, made of coconut fibre, were used to fix 300 m² of eroded sandy soils in the habitat of wooded dunes

to help prevent further erosion and restore the eroded undergrowth and vegetation. This already produced signs of vegetative growth during the project. As part of its efforts to manage human impact on the forest whilst maintaining local interest in the sites, eight study trails and 17 camping places were established. Furthermore, 84 local forest roads were blocked to minimize the impact to sensitive habitats from the pressure of visitors. The locations of recreational infrastructure were very carefully designed in close cooperation with local community groups. The project established three nature study centres with nature education exposition and technical equipment in Puhatu, Muraka and Saarjõe nature reserves. It also produced a study film shown on national television, leaflets – in Estonian, English and even Russian - and information boards. It networked with other LIFE projects and participated in the Latvian LIFE-Nature Coop project "Experience exchange on habitat management among the Baltic LIFE-Nature projects".

More information:
https://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=file&fil=LIFE02_NAT_EE_008555_LAYMAN.pdf

III.6 Germany

LIFE Feuchtwälder - Conservation and restoration of alluvial forests and bog woodland in Brandenburg 2014-2022

The LIFE project is located in the north, north-west and south of Berlin and takes in 10 Natura 2000 sites located within three riverine systems. Bog woodlands are important stepping stones and hotspots of biodiversity habitats within the otherwise rather species-low environment. The limited occurrence of this habitat hinders its functionality and endangers its existence. During the last century the alluvial forests and bog woodlands in the valleys have been endangered by agriculture and commercial forestry activities. In addition, the modification of normal water flows has negatively influenced the natural hydrological dynamics and flood conditions in these alluvial habitats.

The project's main aims focus on securing and restoring floodplains that include habitats of bog woodlands and alluvial forests, in three riverine systems in Brandenburg.

As the moorlands of bog woodlands depend heavily upon the stabilisation and re-establishment of natural hydrologic conditions, the project seeks to re-establish a near-natural water regime within the alluvial areas and forests, as well as the associated waterways.

In order to improve the conservation status of these alluvial forests, the project also aims to stabilise and increase the interdependence between the watercourse and its floodplain. Ultimately this will cause the riverbed to rise and lead to a more natural frequency of flood overflows, which will better sustain the habitat's long-term integrity.

Expected results: Anticipated outcomes from the project will cover:

- Restoration, stabilisation and creation of 25 ha of bog woodlands and 130 ha of alluvial forests;
- Restoration of a near natural water regime within the floodplains of the riverine systems to develop alluvial forests;
- Stabilisation and restoration of natural hydrological conditions within the moorlands of bog woodlands;
- Establishment of a land use system that is sensitive to nature conservation on valuable open-land habitat types;
- Support to eco-tourism development in cooperation with parks and local communities (i.e. creation of nature trails for visitors, visitor guidance, and measures for boat users); and
- Awareness raising through the production of information material and information boards.

Measures in floodplain forests

In order to preserve and stabilize the floodplain forests, the interrelation between the river and its floodplain is to be improved. This is done by raising the base, remanufacturing or connecting old arms. The installation of dead wood, in the form of groynes or root stumps, initiates a dynamic river development. Forestry measures serve to improve the habitat structure in the floodplain forest. By illuminating existing floodplain forests, lying and standing dead wood is created and the lack of natural regeneration is stimulated. The removal of immigrant tree species or the conversion of incorrectly planted areas, but also the small-scale initial planting are further components of the range of measures.

Deactivating old, unused drainage systems in the floodplain meadows is necessary to restore near-natural water levels in the floodplain. Only native material is used to fill drainage ditches. The material is obtained by pushing the top surface flat in the immediate vicinity of the trenches. This creates raw soil locations that offer optimal site conditions for the natural rejuvenation of the floodplain forest.

Measures in bog forests

Moor forests in Brandenburg are often damaged by drainage measures. The main task in renaturation is therefore to stabilize the internal peat water levels. For this purpose, trenches are closed or floodable barrages are built. In addition, there are support measures in the catchment area of the forest bogs such as clearing of coniferous stands and forest conversion. In more disturbed locations, it is also necessary to remove immigrant, alien tree species such as spruce. The individual forest bogs are often scattered in large forest complexes. For this reason, it is necessary to actively reintroduce the formerly typical vegetation, especially at locations with poor species, after the water levels have been successfully stabilized.

More information: https://www.feuchtwaelder.de/

LIFE Forests-waterworlds - Ville Forests 2014-2020

Large proportions of Germany's oak or oak-hornbeam forests of the *Carpinion betuli* habitat are found in North-Rhine-Westphalia (NRW). This project covers one of the two main sites of this habitat type in NRW. Due to the large extension of this habitat type, the project site is of national and European value.

Changes in natural hydrology patterns remain a key threat for this forest type. Therefore, it is of crucial importance to optimise the site's hydrology through a closure of drainage ditches and raising of the water level. Such measures should also help to stabilise populations of several endangered amphibian species.

The project's main objective centres on conserving and developing oak-hornbeam forests, beech forests and lowland hay meadows in the targeted areas. The project also seeks to preserve and support woodland bird species (black, middle spotted and grey-headed woodpeckers) through the protection of dead wood and the management of suitable areas. The

improvement of valuable water and wet habitats in the areas is also planned, in order to preserve and support the existing populations of warty newt, midwife toad and agile frog.

Expected results: Expected results from the project include the following:

- Protection and restoration of the natural water balance in the targeted areas via controls on drainage ditches covering 350 ha. This will improve the conservation status of oak-hornbeam forests;
- Ecological succession is supported on 34 ha of Luzulo-Fagetum beech forests, eight ha of Asperulo-Fagetum beech forests, and 96 ha of oak-hornbeam forests. This will improve the connectivity between existing forests habitats;
- Introduction of coppice structures in combination with permanent protection and management of dead wood In 39 ha of oak-hornbeam forests. This will lead to an improved conservation status of woodpeckers;
- Acquisition of 123 private parcels of land (46 ha) with beech forests and oak hornbeam forest habitats;
- Restoration and connectivity of 20 patches of Nardus grasslands, Molinia meadows and Lowland hay meadows (7.5 ha); and
- Restoration and connectivity of 25 spawning basins in order to benefit targeted amphibians (warty newt, midwife toad and agile frog).

More information: https://www.villewaelder.de/en/the-project/measures

The conversion of the non-native spruce and pine forests into oak-hornbeam forests is a long term task. A lot of conifer forests have large gaps in consequence of windthrows or attacks of pests like bark beetles. Since 2015 we have planted 260.000 oaks, hornbeams, limes and beeches into these gaps. Mountain ash, birch, wild cherry and willow will join without planting, so that a species-rich and multi-layered mixed oak forest will grow up.

In the winter 2015 to 2017 we mapped the habitat trees in all oak and beech forests of the project area. We marked trees with cavities and horsts, standing and lying deadwood and old-growth trees with microhabitats like lightning cracks, branch demolitions and dead branches. In cooperation with the local forest officers we selected single trees, groups of trees

and set aside areas excluded from timber production. These trees will remain in the Ville Forests as a habitat for woodpeckers, bats or saproxylic beetles.

Objective: Preservation and advancement of a permanent and exemplarily high amount of habitat trees (more than 10 trees per hectare) in all oak and beech forests older than 100 years by preserving individual trees and groups of trees.

Eichenwlder bei Wesel - Acidophilous oak woods with bogs and heaths 2012-2018

The aim of the proposed LIFE+ project is to improve the conservation status of habitats listed in Annex I of the Habitats Directive in North-Rhine Westphalia. Actions will take place across six Natura 2000 sites with a total area of 1,762 ha. The main threatened habitat is 'old acidophilous oak woods with *Quercus robur* on sandy plains,' which covers small areas.

The project aims to restore the old oak woods habitat to a favourable conservation status by removing the invasive black cherry (*Prunus serotina*) and to improve the conservation status of heath moors within the oak forests by restoring the habitat 'degraded raised bogs' that are capable of regeneration. The original hydrological level of bogs and mires habitats will be restored and buffer zones created around the bogs. At the Natura 2000 site 'Schwarzes Wasser', one of the only two natural dystrophic lakes in North-Rhine Westphalia, actions are planned to prevent the loss of local pond Littorelletea habitats. The project will also aim to restore dry sand heaths with Calluna and Genista, inland dunes with open Corynephrus and Agrostis grasslands and European dry heaths. It will also create additional North Atlantic wet heaths with Erica tetralix in the boundary areas of the bogs. The management and restoration of existing habitats and the creation of new habitats provide an opportunity for the conservation of existing species included in the Habitats Directive – for each habitat at least one key species has been defined. These are the stag beetle (*Lucanus cervus*), moor frog (*Rana arvalis*), yellow-spotted whiteface (*Leucorrhinia pectoralis*) and floating water-plantain (*Luronium natans*). A further aim of the project is to involve as many local people as possible in the project actions.

Expected results:

- Development of new habitats within 'Old acidophilous oak woods with *Quercus robur* on sandy plains', including the conversion of 25 ha of non-indigenous coniferous forests to oak

woods habitat; conversion of up to 70 ha of coniferous forest to habitat 9190; and planting of up to 2.5 ha of oak forest as a compensation for the conversion of pine forests to heaths;

- Development of 1.6 ha of bog woodland, including measures to combat invasion by black cherry (*Prunus serotina*);
- Improvement in the state of preservation of peatland habitats 7120, 7140 and 7150, including a reduction in the height of trees on 14.5 ha of bog boundary areas; the removal of trees on bushes on 6 ha of bog; and an increase in the yellow-spotted whiteface population through improvements to breeding places for larvae;
- Development of two new dystrophic ponds with a surface area of approximately 0.3 ha as spawning waters for moor frog (*Rana arvalis*);
- Prevention of the extinction of *Luronium natans* at the site "Schwarzes Wasser";
- Development of an additional 3 ha of wet heaths with *Erica tetralix*;
- Development of an additional 3 ha of European dry heaths on historical places;
- Restoration of 22 ha of dry heaths, dry sand heaths and inland dunes with open grasslands and installation of a 4.6 km-long fence to enable grazing by sheep on these areas; and
- Purchase of approximately 150 ha of land to implement measures in areas not owned by the project partners.

Acidophilous oak woods

At the end of the last ice age the departing glaciers left behind inland dunes consisting of sand and chalk. These were poor in nutrients, allowing the growth of a kind of sparse woodland, which is known by the technical term "acidophilic oak wood on sand". Its trees, common oaks first and foremost, grow much more slowly on the sand than on ordinary soil. Also, logging has in the past been limited to an extent that permits a large portion of old trees and deadwood to remain standing, giving the forest a high ecological value: the tears, hollows, cracks and dead trunks of the ageing trees are a habitat which many species of animals, mosses, fungi and lichen are closely dependant on. The rare stag beetle is a prime example. Its females lay their eggs into rotting oak stumps and roots. Semi-natural oak forests have declined in many places. The replacement of deciduous by coniferous forests is one of the reasons. The project supported acidophilous oak woods in two ways: on the one hand, 75 hectares of non-endemic

conifer woods were thinned out. In addition, 20 hectares of conifer monocultures were felled completely. The clearings were planted with young oaks which are expected eventually to grow into an oak forest. Moor birches were added to the mix on 3 hectares to encourage the development of moist to wet oak woods.

More information: http://www.bskw.de/downloads/Laienbericht_Eichenwaelder_en.pdf

1 priedas. Mokomojo vizito „NATURA 2000 miškų tvarkymo ir apsaugos patirtis Suomijoje ir Švedijoje“ ataskaita

MOKYMŲ ATASKAITA

2019-07-22

Vilnius

Mokomojo vizito pavadinimas: NATURA 2000 miškų tvarkymo ir apsaugos patirtis Suomijoje ir Švedijoje

Mokomojo vizito datos ir trukmė: 2019 m. birželio 12-20 d., trukmė 9 dienos

Saugoma teritorja, valstybė:

Leisjarvi Nacionalinis parkas, Suomija;

Ormajärvi-Untulanharju ir Sajaniemi Natura 2000 teritorijos, Suomija;

Högsböla (SE0540097), Melldala (SE0540106) ir Nolberget (SE0540100) gamtos draustiniai, Švedija;

Kinnekulle rezervatas, Švedija;

Tiveden nacionalinis parkas, Švedija;

Nedre Dalälven biosferos rezervatas, Švedija.

Finansavimo šaltinis: Projekto ,,Natura 2000 tinklo valdymo optimizavimas Lietuvoje'' (LIFE-IP PAF-NATURALIT) Nr. LIFE16 IPE/LT/016 lėšos.

Mokomojo vizito tikslas:

Mokslinės pažintinės išvykos metu „NATURA 2000 miškų tvarkymo ir apsaugos patirtis Suomijoje ir Švedijoje“ buvo siekiama geriau suprasti miškų apsaugos Šiaurinėje Europoje problemas ir sužinoti jų sprendimo būdus. Taip pat buvo siekiama pasimokyti iš gerosios praktikos pavyzdžių, įvertinti ir patvirtinti taikytų gamtosaugos priemonių efektyvumą, pasidalinti ir galimai perimti gamtosaugos priemonių taikymo miškuose patirtimi, sužinoti apie žemės naudojimo apribojimus bei ūkininkavimo rėžimus taikomus miško savininkams bei valdytojams.

Išvyka suteikė žinių, reikalingų įgyvendinant projekto Nr. LIFE16 IPE/LT/016 „Natura 2000 tinklo valdymo optimizavimas Lietuvoje” (LIFE-IP PAF NATURALIT) A.4.2 poveiklę.

Dalyviai:

VDU ŽŪA: Gediminas Brazaitis, Žydrūnas Preikša, Vitas Marozas.

VSTT MAC: Vytautas Uselis, Gintarė Grašytė.

VMU: Aleksas Žebrauskas.

DNP: Evaldas Klimavičius, Vaidas Vyšniauskas.

Pagrindinės temos ir klausimai:

1. Kontroliuojami gaisrai kaip priemonė EB svarbos 9010 ir 9060 tipo miško buveinių, vėjalandės šilagėlės buveinių atkūrimui;
2. EB svarbos 9020, 9050, 9180, 9080, 91E0 tipo miško buveinių atkūrimas ar buveinių struktūros gerinimas taikant aktyvias apsaugos priemones;
3. Pasidalinimas praktinio teritorijų turinčių Buveinių direktyvos II priedo ir Paukščių buveinių I priedo rūšis valdymo patirtimi;
4. Teisinis pagrindas praktiniam buveinių ir rūšių valdymui;
5. Interesų grupių vaidmuo praktiniame buveinių ir rūšių valdymo procese.

MOKOMOJO VIZITO REZULTATAI:

Leisjarvi Nacionalinis parkas, Suomija; 2019-06-13, (aprašė V. Vyšniauskas)

Pirmoje dienos pusėje lankėmės Liesjarvi nacionaliniame parke, kur išklausėme p. Ari Lahtinen pranešimą apie Suomijos saugomų teritorijų sistemą ir taikomus gamtotvarkos bei buveinių atkūrimo darbus.

Metsahallitus – tai valstybinė Suomijos įmonė valdanti visą valstybinę žemę ir vandenis. Pagrindinės veiklos sritys yra: miškininkystė, sėklų produkcijos gamyba, saugomų teritorijų tvarkymas, rekreacija, o taip pat ir miško valdų pardavimas. Visa administracinė veikla yra vykdoma „Parks and Wildlife Finland“ (R&WF) padalinio pagalba. Metsahalllitus yra atsakinga už daugiau kaip 12 milijonų hektarų valstybinės žemės ir vandenų, kas sudaro vieną trečdalį Suomijos bendro ploto. „Parks and Wildlife Finland“ yra atsakinga už viešąjį administravimą bei teritorijų priežiūrą t.y. gamtos apsaugą ir rekreacinę infrastruktūrą. Ši institucija valdo saugomas teritorijas bei suteikia galimybę nemokamai naudotis vieša lauko rekreacine infrastruktūra, o taip pat atsako už tvarų žuvų ir medžiojamųjų gyvūnų išteklių naudojimą, įskaitant leidimų platinimą. Be gamtinių vertybių, kurios sudaro 3.9 milijono hektarų – 40 nacionalinių parkų, 19 gamtos rezervatų, 5 nacionalinės žygiavimo trasos, 5 laukinės gamtos rezervatai Laplandijoje ir daugiau kaip 3000 tūkstančiai kitų saugomų teritorijų „Parks and Wildlife Finland“ yra atsakinga ir už ypač vertingą kultūrinį paveldą: 350 saugomų pastatų ir 2000 archeologinių objektų.

NATURA 2000 tinklą Suomijoje sudaro 1800 teritorijų, o tai yra 53.650 kvadratinių kilometrų. Metsahallitus valdomos žemės sudaro 80 procentų visos NATURA 2000 tinklo šalies

teritorijos. Pagal buveinių direktyvą yra išskirta 14%, o pagal paukščių direktyvą 9% teritorijos nuo bendro šalies ploto.

Didžioji dalis saugomų teritorijų, kurių žemė priklauso valstybei yra įsikūrusios šiaurinėje ir rytinėje Suomijos dalyse. Tai gana nederlingos teritorijos. Be abejo valstybės nuosavybės teise valdomoje žemėje yra paprasčiau įsteigti saugomas teritorijas kas paskutiniaisiais metais ir yra daroma. Suomiai teigia, jog buveinių direktyva nėra optimaliai įgyvendinta. Saugomų teritorijų įsteigtų privačioje žemėje yra gana daug, tačiau jų plotas nėra didelis.

Miškų buveinės daugiausiai dominuoja pietinėje ir šiaurinėje Suomijos dalyse. Šiaurinėje dalyje vyrauja skurdesnė, o pietinėje dalyje - rūšių įvairove turtingesnė augmenija. 2019 metų duomenimis 11.9 % rūšių gresia išnykimas, o jų didesnioji dalis aptinkamos pietinėje dalyje. Pagrindinė priežastis, dėl kurios rūšys nyksta yra trūnijančios ir negyvos medienos bei brandžių medynų trūkumas. Bendra aplinkosauginė situacija yra nebloga šiaurinėje dalyje, bet prastesnė pietuose, kur didelį nykstančių rūšių skaičių lemia intensyvi žemėnauda bei mažas saugomų teritorijų pasiskirstymas.

Metso – tai yra programa skirta miškų bioįvairovei didinti. Pagrindinės kryptys yra: pinigai skirti saugomoms teritorijoms privačiose valdose (miškų, pelkių, šlapžemių), gamtotvarkai ir bioįvairovės tyrimams.

Buveinių ir rūšių atkūrimui yra naudojami keli skirtingi gamtotvarkos būdai. Atkūrimo – tikslas yra pradėti sukcesiją iš naujo. Ši priemonė taikoma tik kartą. Gamtotvarkos – tikslas yra kovoti su sukcesija. Priemonė yra kartojama (pvz. ganymas). Pirmieji bandymai taikyti atkūrimą buvo pradėti 1989, o intensyviau 2003. Jau yra atkurta 17000 hektarų valstybinėje žemėje. Privačiose valdose taikoma tik gamtotvarka. Standartizuotas darbų planavimas parengiamas GIS programa ir vyksta dviem etapais: pirmajame etape gaunami leidimai planavimui, aptariama kaip numatomos vykdyti priemonės taikymas įtakos buveinių ir rūšių būklę. Antrajame etape duodami nurodymai darbuotojams, kada ir kaip priemonė turi būti atlikta.

Miško atkūrimo priemonių tikslai:

padidinti negyvos ir yrančios medienos kiekį – tam yra naudojamas galingas traktorius išverčiant medžius ar jų grupes su šaknimis;

atvirų miško plotų sukūrimas – atliekamas nužievinant medžio kamieną aplink. Taip medis palaipsniui išdžiūva, tampa stuobriu, o vėliau virtuoliu;

Negyvos ir yrančios medienos kiekio didinimas yra vykdomas ten, kur natūraliai jis gali nutrūkti, bei teritorijose kur yra nedidelis trūkumas su šalia įsikūrusiomis vertingomis rūšimis.

Tas yra atliekama keliais būdais: pašalinant žievę ant medžio aplink kamieną, išverčiant ar nulaužiant medžius, ekskavatoriaus pagalba atveriamas mineralinis derlingas dirvožemis, kad sodinukams būtų lengviau sudygti.

Nedidelių plynų plotelių sukūrimas yra vykdomas miškuose, kuriuose vyrauja jauni ir monotoniški medynai. Tokių plotelių gali būti 2-4 hektare. Tas yra daroma norint sudaryti sąlygas lapuočių miškų „atėjimui“, sukurti medžių rūšinę ir amžiaus įvairovę.

Deginimas – priemonė taikoma sausose ar vidutiniškai sausose teritorijose. Tas yra reikalinga, nes atsiranda apdegusios, įvairių puvimo stadijų medienos, medžių rūšinė sudėtis paprastai padidėja, medžiai auga grupelėmis kartais atskirai ar pavieniui skirtingais atstumais vienas nuo kito, medynas tampa įvairiaamžis, nes per gaisrą dalis medžių išgyvena. Miškų deginimas - pagrindinė priemonė taikoma miškų atkūrimui Suomijoje. Vidutiniškas gaisravietės plotas apie 2-4 hektarai. Ši priemonė vykdoma atsižvelgiant į orų prognozes, paprastai prieš ateinant stipresniam lietui, esant optimaliam vėjui, oro ir dirvožemio drėgnumui.

Gamtotvarkos darbai plačialapiuose miškuose vykdomi kaip ir kitose tvarkomose teritorijose, tačiau dar papildomai atveriant aikšteles, išariant vagas ir tikintis lapuočių medžių savaiminio atsikūrimo. Kadangi eglės medynai dominuojantys Suomijoje, trūksta šviesamėgių rūšių lapuočių, senų medžių, negyvos medienos, todėl tokioms rūšims, kaip ąžuolas, uosis, lazdynas ar liepa gresia išnykimas. Parenkant tvarkymo priemones taikomas pušų ir eglių medžių dalinis šalinimas paliekant negyvą medieną. Užtvenkiami grioviai ar kanalai, sodinamos liepos, ąžuolai, guobos, šalinamos invazinės rūšys.

Trečdalis Suomijos teritorijos buvo padengta pelkėmis, tačiau dėl aktyvios miškininkystės dalis jų buvo nusausintos, ypač pietinėje šalies dalyje. Gamtotvarkos priemonės taikomos priklausomai nuo aplinkos sąlygų. Kanalai ar grioviai yra užtvenkiami lygiose teritorijose, kur ekskavatoriui privažiuoti sudėtinga ir nepakanka durpių grioviui užpildyti. Norint sumažinti drėgmės garinimą yra kertami medžiai, tačiau atžalos tampa kita problema. Pagal orto foto nuotraukas yra parenkamos teritorijos, kuriose yra reikalingas medžių prakirtimas. Tvarkomose teritorijose atliekamas vizualinis patikrinimas atsižvelgiant į atžalų kiekį, užtvankų būklę ir vandens prasiskverbimą pro jas. Taip pat vykdomas rūšių monitoringas bendradarbiaujant su universitetais ir mokslo institucijomis.

Po pranešimo vykome į teritoriją, kurioje vyko miško deginimo paruošiamieji darbai ir šalia apžiūrėjome prieš dvi savaites išdegintą 4 hektarų plotą. Ruošiantis miško deginimo darbams dalis medžių buvo iškirsta, siekiant kad gaisras nepereitų į viršūninį. Deginamas plotas

parinktas taip, jog dalis jo ribojasi su pelke, dalis su keliu, o likusioje atkarpoje buvo iškirsta 3-4 metrų pločio apsauginė juosta bei ekskavatoriaus pagalba buvo nuimta miško paklotė. Visu perimetru buvo išvedžiotos priešgaisrinės žarnos su šakotuvais ir papildomai pajungta kita žarna, prie kurios buvo po asmenį apie 50 metrų nutolusį vienas nuo kito. Deginamo ploto kampuose buvo išdėstytos 1000 l talpos vandens talpyklos ir kibirai, jei nutruktų vandens tiekimas. Vanduo buvo tiekiamas iš pelkės, panaudojant motopompas su pastovaus slėgio palaikymu. Ugnies uždegime dalyvavo 2 asmenys. Panaudojant specialią įrangą t. y. ant pečių nešiojamą suskystintų dujų balioną, su degikliu padegama miško paklotė. Padegimai buvo atliekami taip, jog artėjant ugniai būdavo sukuriama priešpriešinė ugnis siekiant numalšinti ateinančią. Ugniai artėjant prie apsauginės linijos asmuo stovintis prie priešgaisrinės žarnos su šakotuvu liedavo vandenį ant apsauginės linijos taip neleisdamas ugniai plisti toliau. Deginimo darbuose dalyvavo 12 asmenų, tarp kurių buvo vienas koordinatorius nurodymus teikiantis radio ryšiu. Deginimo darbai vyko be jokių nesklandumų. Deginimo darbus stengiamasi vykdyti prieš lietų, pasibaigus deginimui dar vieną parą yra budima gaisravietėje, kad neatsinaujintų ugnies židiniai.

Pasibaigus deginimo darbams, mums buvo parodyta, kaip atrodo prieš ketverius metus degintas miškas. Matėsi daug stovinčių išdžiūvusių pušų, dalis buvo jau išvirtusios ir apie trečdalį vis dar žaliavo atlaikiusios deginimą. Aikštelėmis gausiai žėlė pušies savaiminiai medeliai.

Vėliau vykome į Liesjarven Kansallispuisto vietovę, kur apžiūrėjome atkuriamą pelkę. Ji atkuriama atstatant hidrologinį rėžimą. Senuose grioviuose iš medienos padarytos užtvankos ir grioviai užpilti durpėmis. Darbai atlikti daugiau nei prieš dvidešimt metų, jau yra susiformavusi kiminų danga.

Be gamtinių vertybių mums buvo pristatytas ir kultūrinis paveldas. Lankėmės Korteniemen ūkyje, kuris įkurtas 1700 metais, 1878 -aisias išpirktas valstybės ir nuo 1996 metų, Metsahallitus dėka, paverstas veikiančiu ūkiu. Jame galima pamatyti naminių gyvūnų, žemės ūkio pasėlių, tradicinius pastatus ir buities įrankius bei susipažinti su senovinėmis tradicijomis įvairių edukacijų metu.

Ormajärvi-Untulanharju ir Sajaniemi Natura 2000 teritorijos, Suomija; 2019-06-14 (aprašė Gintarė Grašytė, Vytautas Uselis)

Pirmoje dienos pusėje lankėmės Sattula ir Ilveskallio vietovėse, kur p. Teijo Heinänen mums aprodė Žolių turtingų eglynų (9050) buveines. Šie miško plotai atitinka EB svarbos buveines ir yra valstybiniuose miškuose, tačiau neturinčiuose specialaus apsaugos statuso. Atrinkti plotai yra tvarkomi pagal „Žolių turtingų eglynų apsaugos programą“ (Herb-rich Forest Conservation Programme), juose anksčiau buvo aptinkama (Sattula vietovė) ar šiuo metu išlikusi (Ilveskallio vietovė) reta, į Buveinių direktyvos II priedą įrašyta paparčių rūšis - *Diplazium sibiricum.* Sattula vietovėje siekiant išlaikyti gerą buveinės būklę ir sudaryti sąlygas augti minėtai paparčių rūšiai vykdomi labai neintensyvūs darbai – kertamos jaunos eglaitės (tankiai suaugusios jos keičia apšvietimo ir dirvožemio sąlygas, čia nebeauga žolės ir lapuočiai medžiai), atveriamos nedidelės aikštelės, siekiant paskatinti lapuočių medžių įsikūrimą bei padidinti jų dalį medynę. Brandžios eglės paliekamos. Ilveskallio vietovėje iki šiol išlikusi apie 100 individų *Diplazium sibiricum* populiacija. Jų augavietėje nevykdomi gamtotvarkos darbai, tačiau aplinkiniuose jaunesniuose eglynuose siekiama padidinti negyvos medienos kiekį bei sumažinti medyno tankumą, kad susidarytų palankesnės apšvietimo sąlygos. Tai atliekama dviem būdais – dalis eglių nukertama ir paliekama gulėti, dalis apžievinama ir paliekamos nudžiūti. Čia aptikome augantį Lietuvoje itin retą grybą – kiškinį skylenį (*Inonotus leporinus*). Eglynuose taip pat apžiūrėjome natūralius šaltinius bei indikatorinius jų augalus.

Be tikslinio šio tipo buveinių ir jų tvarkymo apžiūros, taip pat domėjomės ir sužinojome apie ganymą miškuose. Suomijoje jis leidžiamas, leidžiama ganyti valstybiniuose miškuose, tai yra populiaru. Ganymą miškuose gamtotvarkos tikslais vykdo ir pats Metsahalitus. Šiuose darbuose (rūpinimasis gyvuliais, jų priežiūra) labai noriai talkina savanoriai (kurie dar ir susimoka už galimybę prisidėti, gauti apgyvendinimą miške), tai yra taip populiaru, kad norinčių savanoriauti daugiau nei galimybių juos priimti. Savanoriai taip pat aktyviai prisideda vykdant paprastesnius monitoringus, sudėtingesni monitoringai dažnai daromi bendradarbiaujant su universitetais.

Po pietų lankėmės Ahvenistonharju vietovėje, kuri yra nacionaliniu mastu svarbi Natura2000 teritorija – spygliuočių miškai ant ozų (9060),- tvarkoma pagal Life projektą (Lifth&Fire Life, LIFE13 NAT/FI/000099). Čia siekiama atkurti vėjalandės šilagėlės populiaciją, kuri sparčiai nyksta dėl nepakankamo trikdymo teritorijai užaugant eglaitėmis ir krūmais, susiveriant žolinei dangai, kaupiantis humuso sluoksniui. Teritorijos išskirtinumas yra tas, kad ji yra praktiškai mieste, didesnė dalis žemės priklauso miesto savivaldai, teritorija gausiai lankoma, šalimais įrengtos įvairios slidinėjimo (nebeveikia) ir motociklų trasos. Teritorijoje atlikti įvairūs

darbai: iškirsta dalis eglių, kad sumažėtų užpavėsinimas; vietomis praardyta samanų ir humusingo dirvožemio danga; vėjalandės šilagėlės populiacija atkuriama sodinant pačius augalus (translokacija iš kitos vietos) ir sėjant sėklas. Vėjalandės šilagėlės populiacija kruopščiai stebima, suregistruojami ir suskaičiuojami bei pažymimi visi pasodinti ar iš sėklų išdygę augalai. Šilagėlės perkėlimas ir monitoringas vykdomas pagal specialiai 2015 metais parengtą planą. Taip pat apžiūrėjome tolimesnę ozo dalį, kur išlikusios buveinės pakankamai geros būklės, tvarkymo darbai nevykdomi, apžvelgėme tipingas šios buveinės rūšis - pievinę kreisvę (*Crepis praemorsa*), dėmėtąją džiugūnę (*Hypochaeris maculata*), plunksninę strugę (*Brachypodium pinnatum*), drugišių (*Oxytropis campestris*) (dalis jų Lietuvoje neaptinkamos).

Vakare taip pat apsilankėme Aulanko gamtos draustinyje, kuris patenka į Natura 2000 teritoriją „Aulangon alue“. Šis draustinis yra angliško stiliaus miško parkas, pradėtas formuoti XIX a. pabaigoje. Parke pasodinta daugiau kaip 140 skirtingų rūšių medžiai ir krūmai, yra kultūros paveldo statinių, tarp jų ir akmeninis apžvalgos bokštas. Nors tai žmogaus kūrinys, tačiau parkas suformuotas kaip miškas, čia gausu negyvos medienos, saugomi stuobriai (pavojingi medžiai nupjaunami, tačiau ne prie kelmo, o paliekant kelių metrų stuobrį), pažeisti medžiai. Dėl to parke gyvena paukščių direktyvos saugomos rūšys – tripirštis genys, uralinė pelėda.

Högsböla, Melldala ir Nolberget gamtos draustiniai, Švedija; 2019-06-16, (aprašė Žydrūnas Preikša)

Aplankėme 3 gamtos draustinius. Gidu buvo vienas geriausių ekologų Europoje, puikiai rūšis pažįstantis dr. Leif Andersson.

Högsböla draustinio dabartinis paviršius susiformavęs paskutinio ledynmečio įtakoje, tačiau geologinė uolienų sandara formavosi milijonus metų ir yra gana įvairi – galima aptikti smiltainio, alumo skalūnų, kalkakmenio, molio intarpų ir diabazo uolienų. Högsböla draustinis yra paskelbtas Natura 2000 teritorija (SE0540097) kaip Buveinių apsaugai svarbi teritorija. Teritorijos plotas – 32,2 ha. Daugiausiai ploto užima 9070 Medžiais apaugusių ganyklų buveinė (12,9 ha), toliau seka 6270 Rūšių turtingų smilgynų buveinė (8,1 ha). Dar teritorijoje aptinkamos 6210 Šienaujamų mezofitų pievų, 6530 Miškapievių ir 91E0 Aliuvinių miškų buveinės, kurių plotai žymiai mažesni. Teritorijoje yra išlikusi gyvybinga guobų populiacija, sutinkama senų ąžuolų, uosių. Jie yra ypač vertingi retoms epifitinėms kerpėms, pvz. *Gyalecta ulmi, Calicium adspersum*, vabalams, pvz. *Liocola marmurata* ir kt. Krūmų ardas taip pat gerai išreikštas, jame

dominuoja erškėčiai ir kadagiai. Jie formuojami augti nedidelėmis grupelėmis ar pavieniais individais. Teritorijoje susiformavę senos buveinių tvarkymo tradicijos ganant gyvulius ir genint didžiąją dalį medžių nupjaunant viršutines šakas ir formuojant žemą, neplačią lają (angl. pollarding). Toks genėjimas leidžia įsikurti šviesamėgėms rūšims, šakos pasitarnauja kaip pašaras gyvuliams žiemos metu. Ganymas yra būtinas palaikant pusiau atviras buveines. Ganymui naudojami mėsiniai Hereford veislės galvijai. Visa susidaranti negyva medieną yra paliekama vietoje iki pilno suirimo. Teritorija yra privati. Regioninė valdyba yra sudariusi apsaugos sutartis su vietos ūkininkais dėl palankaus gamtai ūkininkavimo. Teritorijoje tvarkymas yra vykdomas pagal patvirtintą gamtotvarkos planą. Teritorijos kontrolę vykdo ir ūkininkus konsultuoja Regioninės valdybos specialistai.

Melldala gamtos draustinis išsidėstęs vakarinės ekspozicijos šlaite ant kalkakmenio, smiltainio ir alumo skalūnų pagrindo. Teritorijoje gausiai veržiasi šaltiniai. Šaltiniai pasižymi ypač dideliu kalcio karbonato kiekiu, stipria srove, kuri neleidžia jiems išdžiūti sausuoju periodu ir užšalti net šaltą žiemą. Teritorija ypač vertinga botaniniu požiūriu. Ji paskelbta Natura 2000 teritorija (SE0540106) kaip Buveinių apsaugai svarbi teritorija. Plotas – 12,5 ha. Didžiausią dalį užima 9020 Plačialapių ir mišrūs miškai (6,8 ha). 9050 Žolių turtingi eglynai, 9070 Medžiais apaugę ganyklos, 6410 Melvenynai ir 7220 Šaltiniai su besiformuojančiais tufais užima žymiai mažesnius plotus. Rečiausia ir vertingiausia yra tufų buveinė, kurioje auga daugybė retų augalų rūšių, įskaitant musinį ofrį (*Ophrys insectifeta*), paprastąją tuklę (*Pinguicula vulgaris*), riestąjį ktenidį (*Ctenidium molluscum*) ir kt. Miške vyrauja plačialapiai medžiai – guobos, ąžuolai, klevai, uosiai. Žemė padengta beveik ištisine reto meškinio česnako (*Allium ursinum*) danga. Teritorija taip pat yra svarbi kūdriniam pelėausiui (*Myotis dasycneme*). Pagrindinė veikla šioje teritorijoje yra ekstensyvus ganymas tiek miške tiek ir atvirose buveinėse. Galvijai nėra leidžiami tik tufų teritorijoje, kad nepažeistų jų susidariusios struktūros. Ūkininkaujama yra pagal sudarytas apsaugos sutartis. Miške komerciniai kirtimai nėra vykdomi. Visa negyva mediena yra paliekama savaiminiam suirimui.

Nolberget gamtos draustinis išsidėstęs šiaurės vakarinėje Billingeno diabazo uolienų lygumoje. Teritorijos reljefą sudaro statūs šlaitai, apaugę vešliu plačialapių mišku. Žolių dangoje vyrauja meškinio česnako sąžalynai. Ši teritorija yra viena svarbiausių šalyje samanoms ir kerpėms, augančioms ant diabazo riedulių ir senų medžių. Teritorija taip pat labai svarbi retoms grybų rūšims. Pavasarį, prieš įsigalint meškiniam česnakui, žydi daugybė plačialapiams miškams būdingų žolių. Teritorijai suteiktas Natura 2000 statusas (SE0540100) kaip Buveinių apsaugai

svarbiai teritorijai. Teritorijos plotas – 26,2 ha. Teritorijoje dominuoja miško buveinės – 9020 Plačialapių ir mišrūs miškai, 9180 Griovų ir šlaitų miškai bei 9080 Pelkėti lapuočių miškai. Ankščiau teritorijoje buvo genimi medžiai, ganomi galvijai. Paskutinius kelis dešimtmečius ūkininkavimas nebuvo vykdomas ir susiformavo miško aplinka. Vietos gamtininkai rodo iniciatyvas ganymą vėl atkurti. Komercinė ūkinė veikla teritorijoje nevykdoma. Visa negyva mediena paliekama savaiminiam suirimui.

Kinnekulle gamtos rezervatas, Švedija; 2019-06-17 (aprašė Vitas Marozas, Žydrūnas Preikša)

Dienos gidu buvo p. Ulf Wiktander iš Regioninės apskrities valdybos.

Kinnekulle yra paskelbta Natura 2000 teritorija (SE0540063), kaip Buveinių apsaugai svarbi teritorija. Ji išsidėsčiusi kalvotame kraštovaizdyje 307 m virš jūros lygio. Pagrindiniai uolienų sluoksniai vyraujantys draustinyje yra smiltainis, alumo skalūnai, kalkakmenis, diabazas, paįvairinami molio intarpais. Dabartinį Kinnekulle kraštovaizdį suformavo paskutinis ledynas. Dėka geologinių teritorijos ypatumų susiformavo didelė ekosistemų bei rūšių įvairovė.

Teritorijoje yra keletas gamtos draustinių. Vienas jų - Österplana hed och vall (viržynų ir ganyklų) draustinis – yra didžiausias gamtos draustinis Kinnekulle ir yra išsidėstęs rytinėje dalyje. Draustinyje didžiausią plotą užima ganyklos ant kalkingo dirvožemio. Istoriškai minėti plotai buvo nuolatos ganomi ar šienaujami, taip suformuojant atviras buveines. Taip pat teritorijai būdingi pavieniai dideli medžiai (guobos, ąžuolai, uosiai, liepos). Ankščiau jie buvo genėjami, šakas ir lapus panaudojant gyvulių šėrimui. Šiuo metu siekiant išlaikyti atviras buveines, jos yra ganomos, krūmai, kurių galvijai neėda, šalinami. Šalinant nepageidaujamus medžius ir krūmus, paliekami jų stuobriai. Stuobriai įpjaunami, kad greičiau atsirastų negyvos medienos rūšių. Šiose buveinėse tarpsta daug retų rūšių. Endeminė rūšis – *Arenaria gothica*, daug orchidinių augalų ir kt. rūšių. Teritorijoje sumedėjusią augmeniją kerta Regioninės apskrities valdybos darbininkai. Ganymas vykdomas pagal apsaugos sutartis su vietos ūkininkais.

Munkängarna gamtos draustinyje apžiūrėjome plačialapių lapuočių miškus, kuriuose dominuoja seni ąžuolo ir liepos medžiai. Tarp žolinių augalų dominuoja *Alium ursinum*. Buveinėje gausu retų rūšių. Tvarkant šias buveines atliekami nedidelio ploto kirtimai, formuojant įvairaus dydžio aikšteles, siekiant sudaryti įvairesnes apšvietimo sąlygas. Pevieniai stambesni medžiai nupjaunami kelių metrų aukštyje paliekant aukštus stuobrius. Tokiu būdu siekama praturtinti uoksinių paukščių fauną. Taip pat apie stambius ąžuolus, anksčiau augusius atvirose vietose ir dabar stelbiamus gretimai augančių jaunų medžių, vykdomi ekstensyvus

kirtimai išvalant stelbiančius medžius. Kirtimai vykdomi keliais etapais, kas keli metai iškertant po nedidelę dalį medžių ir leidžiant ąžuolui kaskart adaptuotis prie pasikeitusios aplinkos.

Salen gamtos rezervate apžiūrėjome mišrius lapuočių miškus, kurie formuojasi vakarinės bei pietinės ekspozicijos šlaituose. Diskutavome apie šios buveinės tvarkymą, kurioje buvo pasodintos eglės. Buvo nuspręsta eglių nepašalinti. Švedų mokslininkai nustatė didelę mikorizinių grybų įvairovę, kuri jų manymu susidarė dėl eglės įtakos kalkingame dirvožemyje. Auga retos grybų rūšys: *Cortinarius percomis, Inocybe tricolor, Clitocybe vermicularis*.

Såten gamtos rezervate ankščiau taip pat buvo pasodintos eglės monokultūros, tačiau dėl mikorizinių grybų įvairovės nuspręsta jų neiškirsti. Šioje buveinėje apžiūrėjome plačialapės klumpaitės augavietę.

Tivedens nacionalinis parkas, Švedija; 2019-06-18 (aprašė Gintarė Grašytė, Vytautas Uselis)

Tivedens yra vienas iš Švedijos nacionalinių parkų, kuris išsiskiria savo miškingu, uolėtu, ežeringu kraštovaizdžiu. Jis taip pat yra ir Natura 2000 teritorija. Kaip vienas svarbiausių dalykų pristatant parką lankytojams akcentuojami miško gaisrai, kaip būtinas geros miško būklės elementas. Prie pagrindinio įėjimo į parką (lankytojų centro) pasitiko Daniel Gustafsson ir dr. Leif Andersson, kurie pristatė ne tik šio parko išskirtines vertybes, bet ir bendrus Švedijos nacionalinių parkų ir gamtos draustinių valdymo principus. Švedijoje iš viso yra 30 nacionalinių parkų, tai didžiulės teritorijos, kurios išsiskiria laukine gamta, čia nėra privačių žemių, paprastai nebūna visai jokių gyvenviečių ir pastatų (su retomis išimtimis seniausiuose įsteigtuose nacionaliniuose parkuose), nevykdoma jokia ūkinė veikla, tik gamtotvarkos darbai. Visur nacionaliniuose parkuose leidžiama lankytis turistams, tačiau jiems rekomenduojama laikytis pažymėtų trasų, įrengta stovyklavimo infrastruktūra. Tivedens nacionalinis parkas prieš porą metų buvo išplėstas, padidinta jo teritorija, parengtas tvarkymo planas. Nacionaliniai parkai visoje Švedijoje turi vieningą žymėjimą, infrastruktūrą, yra valdomi vienos agentūros, tačiau administruojami vietinių regionų administracijų, kuriose dirbantys žmonės yra atsakingi už biologinę įvairovę ir jos apsaugą (viename regione būna iki 15 darbuotojų, iš kurių pora dirba konkrečiame nacionaliniame parke; į šį skaičių neskaičiuojami lankytojų centrų gidai, kurie samdomi turizmo sezonui). Be nacionalinių parkų, šalyje gausu gamtos draustiniu. Šie paprastai yra mažesnio ploto, gali būti tiek valstybiniai, tiek privačiose žemėse, steigiami konkrečiu išsaugojimo tikslu. Įdomu, kad šiuo metu Švedijoje šių draustinių tinklas aktyviai plečiamas, vien

Örebro regione įsteigiama apie 10 naujų draustinių per metus. Privatūs asmenys, jei jų žemės patenka į draustinius, gauna kompensacijas už veiklos apribojimus, priklausomai nuo to, kiek ir kokių vertybių ten yra, todėl nėra vienos fiksuotos kompensacijų sumos.

Kaip minėta, viena pagrindinių parko išskirtinių verčių yra miško gaisrai. Visgi iki naujo tvarkymo plano patvirtinimo 2017 metais, natūralūs miško gaisrai turėjo būti gesinami, o kontroliuojami gaisrai nacionaliniuose parkuose nebuvo vykdomi (tačiau vykdyti kitose teritorijose pagal Life Taiga projektą). Dabar kontroliuojami gaisrai yra numatyti parko tvarkymo plane (abstrakčios teritorijos, kur būtų reikalinga, konkretus planavimas vyksta ruošiantis deginimui, planuojamas pasirengti detalus planas, kuriame jau numatomos visos detalės – vieta, orų sąlygos, lankytojai ir t.t.). Tvarkymo plane suplanuota deginti ne didelės gamtinės vertės miškus, o tuos miškus, kurie anksčiau buvo ūkininkaujami. Dėl ypatingo reljefo ir gausių lankytojų deginimui pasirenkami nuošalesni plotai, stengiamasi surasti plotus, kurie natūraliai atriboti gamtinių barjerų (pelkių, ežerų), nes dėl reljefo neįmanoma mineralizuoti ribų. Dėl šių priežasčių, skirtingai nei Suomijoje, čia kontroliuojami gaisrai paprastai būna didesnio ploto (apie 20 ha vienas deginimas, maksimaliai iki 40-50 ha, priklausomai nuo aplinkos sąlygų), tiek padegimas, tiek ribų priežiūra ir gesinimas paprastai vykdomi iš sraigtasparnio (iki šiol šiame nacionaliniame parke kontroliuojamas deginimas dar nedarytas, patirtis pristatoma remiantis Life Taiga projekto patirtimi).

Nedre Dalälven biosferos rezervatas, Švedija; 2019-06-19 (aprašė Aleksas Žebrauskas)

Ryte prie „Naturum Gysinge" ekspozicijų centro susitikome su p. Peter Ståhl, kuris papasakojo apie Färnebofjärdens nacionalinį parką. Visoje parko teritorijoje vyrauja valstybinė žemė. Parke skatinama bebrų medžioklė, nes norima išsaugoti drebules. Parkas įkurtas 1998 m., lankytojų centras pastatytas 2005 m. Stovyklauti galima tik tam skirtose vietose, žvejoti su specialiais leidimais. Parke aptinkami reti žinduoliai, paukščiai, žuvys, bestuburiai, samanos:

Ūdra *Lutra lutra*;

Sopraninis šikšniukas *Pipistrellus pygmaeus*;

Uralinė pelėda *Strix uralensis*, vandeninis strazdas *Cinclus cinclus*, jūrinis erelis *Haliaeetus albicilla*, žuvininkas *Pandion haliaetus*, upinė žuvėdra *Sterna hirundo*, tripirštis genys *Picoides tridactylus*, mažasis margasis genys *Dendrocopus minor*, baltnugaris genys *Dendrocopos leucotos*, pilkoji meleta *Picus canus*, žalioji meleta *Picus viridis*, juodoji meleta *Drycopus martius*, kurtinys *Tetrao urogallus*, margasparnė musinukė *Ficedula hypoleuca*;

Kiršlys *Thymallus thymallus*, upėtakis *Salmo trutta*, starkis *Sander lucioperca*;

Kelminis dulkiagraužis *Prionychus ater*, *Grammoptera ustulata*, ąžuolinis skaptukas *Xestobium rufovillosum*, dešimtdėmis drebulenis *Saperda perforata*, šiaurinis elniavabalis *Ceruchus chrysomelinus*, rausvasis šakalindis *Alosterna tabacicolor*;

Ąžuolinis zefyras *Favonius quercus*;

Upinis gleivytis *Leptogium rivulare*, helerio pilelė *Anastrophyllum hellerianum*, karališkasis trapiadyglis *Hericium coralloides*, plačioji platužė *Lobaria pulmonaria*, *Cliostomum corrugatum*.

Pirmiausia vykome į šlapias pievas, kurios prieš 10 metų buvo pradėtos tvarkyti (šalino krūmus ir medžius). Pirmus dvejus metus sumedėjusios augalijos kelmus frezavo, kad nebūtų atžalų. Vėliau užtenka tik šienavimo (negano). Šienavimas vykdomas po liepos 15 d.. Nušienauta žole šeriami mėsiniai galvijai ir avys. Visa 17 ha pieva šienaujama su smulkia rankomis valdoma technika, o žolė pašalinama rankiniu būdu. Iš Latvijos atsivežė baltnugarius genius (*Dendrocopos leucotos*) ir dedamos didelės pastangos, jog jie pasiliktų parko teritorijoje ir pradėtų veistis (po ilgamečių pastangų buvo nustatytas vienas perėjimo atvejis).

Parke aplink senus ąžuolus iškertami ąžuolus stelbiantys, ar jų lajai įtaką darantys medžiai. Kad nesukeltų ąžuolams streso medžiai kertami periodiškai, pirmiausia iškertami prie pat ąžuolų augantys medžiai ir krūmai, po kelių metų spindulys didinamas.

Vėliau vykome į aliuvinius miškus (91E0). Juose vykdoma neintensyvi gamtotvarka. Mažas egles iškerta ir palieka, dideles egles 70 cm aukštyje apžievina. Apžievintos eglės nudžiūna per 3 ir daugiau metų. Kadangi, džiūvimas nevienodas, pasiekiamas ir teigiamas rezultatas - negyvos medienos atsinaujinimas, jos atsiranda palaipsniui, o ne vienu metu daug. Pasiteiravus ar nebijo žievėgraužio tipografo (*Ips typographus* L.**)** židinių, paaiškino, kad pastebėję stipriai užpultas egles, jas pašalina (išveža) iš teritorijos, o kitas, mažiau užpultas, palieka pūti. Šalia aliuvinių miškų užliejamose pievose, auga seni karklai. Daugumą senų karklų paliekami, nes seni karklai plinta lėtai, bei ant jų auga retos samanų ir kerpių rūšys.

IŠVADOS:

1. Aktyvūs gamtotvarkos darbai yra yra plačiai taikomi Suomijos ir Švedijos saugomose teritorijose ir dažnai kombinuojami su šių teritorijų griežtu konservaciniu statusu. Visi miško kirtimai saugomose teritorijose (tame tarpe nacionaliniuose parkuose) atliekami siekiant

gerinti teritorijos gamtosauginę būklę. Pelno nėra siekiama, o jeigu jis susidaro – visas skiriamas konkrečios teritorijos gamtotvarkos darbams vykdyti.

2. Kontroliuojami gaisrai yra populiari ir vis plačiau taikoma gamtotvarkos priemonė Skandinavijoje. Taikant šią priemonę atgal pasukame miško sukcesiją, sumažinama pušynų kaitos į eglynus galimybė bei padidinama negyvą medieną mėgstančių rūšių gausa ir įvairovė. Kontroliuojami gaisrai yra gyvybiškai svarbūs visai eilei pirmųjų miško sukcesijos stadijų rūšių. Ši gamtotvarkos priemonė yra santykinai pigi, efektyvi, Lietuvoje pritaikoma daugeliu atvejų atskirose vietose siekiant skirtingų gamtotvarkos tikslų, bei pakeičianti brangesnes ir tuo pačiu ne tokias efektyvias priemones (pvz. miško paklotės išgrėbimas, negyvos medienos kiekio didinimas)
3. Siekiant lokaliai padidinti negyvos medienos kiekį, grupėmis nužievinami medžiai krūtinės aukštyje. Suomijoje ši praktika mažėja, nes didėja kontroliuojamų gaisrų mąstai.
4. Naminių gyvulių ganymas gali būti paprasta, bet efektyvi priemonė retų miško buveinių ir rūšių būklei pagerinti. Ganymas užtikrina retų ir pažeidžiamų pusiau atvirų buveinių su specifinėmis rūšimis išlikimą.
5. Siekiant pagerinti miško šviesiamėgių žolinių rūšių būklę, jų radimvietėse aikštelėmis yra iškertami krūmai, pomiškis ir II ardas, paliekant retokai augančius pagrindinio medyno medžius.
6. Retų rūšių būklė gali būti sėkmingai pagerinta sodinimo vietose paruošus tinkamas sąlygas ir pasodinant iš surinktų sėklų išaugintus retus augalus ar atkuriant jų populiaciją perkėlimo iš kitos teritorijos būdu.
7. Medžiais apaugusiose ganyklose yra formuojamas pusiau atviras kraštovaizdis, kontroliuojant gyvūnų nemėgstamų ėsti augalų gausą (pvz. erškėčių). Krūmų šalinimo darbai dažnai yra būtini netgi jei yra ganomi galvijai. Kombinuojant gamtotvarkos priemones geriau pasiekiami gamtotvarkos tikslai.
8. Gamtiniai draustiniai (Nature reserves) tiek privačiuose tiek ir valstybiniuose miškuose įkuriami išskirtinai biologinės įvairovės apsaugai. Šias teritorijas valstybė stengiasi išpirkti, bet to nepavykus – už patiriamus nuostolius miško sąvininkams kompensuojama. Lyginant su Lietuva, mūsų saugomose teritorijose yra nepalyginamai didesni miško ūkinės veiklos mąstai, vykdant šią veiklą yra siekiama pelno, o nustatyti apsaugos rėžimai orientuoti ne į optimalaus rėžimo sudarymą bet ūkinių priemonių laikiną suspendavimą – dažniausiai tai pakankamai gerai neužtikrina ilgalaikio vertybių išlikimo. Saugomose teritorijose *visi* miško

kirtimai (ir visa kita veikla) turėtų prisidėti prie šių teritorijų gamtosauginių tikslų siekimo, būklės gerinimo, o ne būtų planingai atliekami kai sueina medyno „brandos“ amžius (pagrindiniai kirtimai) ar net nepasiekus jo (atrankiniai, sanitariniai kirtimai).

Ataskaitos priedai ir naudingos nuorodos:

1.1 Priedas. Kelionės dalykinės nuotraukos.

Ataskaitą parengė kelionėje dalyvavę ekspertai

Leisjarvi Nacionalinis parkas, Suomija; 2019-06-13

Paveikslas Nr. 1. Informacija apie planuojamas/vykdomas gamtosaugines priemones yra pateikiama ant atspausdinto lapo, trumpai aprašant vykdomus darbus, bei pateikiant vietovės planelį. Siekiant kontroliuoti planuojamą gaisrą buvo iškirstas siauras medyno ruožas prie miško keliuko.

Paveikslas Nr. 2. Vaizdas po atlikto kontroliuojamo miško gaisro. Dalis eglių buvo iškirstos siekiant riboti ugnies galimybes pereiti į viršūninį gaisrą.

Paveikslas Nr. 3. Vaizdas po konroliuojamo miško gaisro. Tvarkomas plotas buvo padalintas į dalis iškertant spindžius. Šiais spindžiais vykdoma gaisro kontrolė, juda žmonės bei naudojama gaisro gesinimo technika.

Paveikslas Nr. 4. Kontroliuojamo gaisro perimetras buvo apsaugotas su ekskavatoriumi pašalinant miško paklotę. Ekskavatorius naudojamas dėl didelio akmenų kiekio.

Paveikslas Nr. 5. Vandens tiekimui naudojamas mobilus vandens siurblys.

Paveikslas Nr. 6. Greta tvarkomo ugnimi ploto buvo keletas vandens talpų. Vandens tiekimas žarnomis iš mobilaus vandens siurblio buvo organizuotas visu tvarkomo ploto perimetru, kas 20-40 m. prie magistralinės šlangos prijungiant laistymo elementus.

Paveikslas Nr.7. Planuojamo kontroliuojamo gaisro vietoje yra labai svarbi informacija apie iškritusius kritulius. Krituliai sekami spec. matuokliais.

Paveikslas Nr. 8. Kontroliuojamas gaisras pradedamas taip, kad ugnis plistų prieš vėją. Ugnies vietose budi žmonės, kurie lieja vandenį ant ribinių linijų, kad ugnis „nepabėgtų“ iš kontroliuojamos teritorijos. Kartais vanduo pilamas iš į gaisravietės plotą siekiant sumažinti ugnį.

Paveikslas Nr. 9. Kontroliuojamas gaisras yra puikiai kontroliuojamas ir nesukelia streso čia dirbantiems žmonėms...

Paveikslas Nr. 10. ... belieka tik laiku sudrėkinti pie kontroliuojamo gaisro plotą esančią juostą. Toliau esanti jau sudegusi zona nereikalauja tiek dėmesio.

Paveikslas Nr. 11. Miškas padeginėjamas spec. įranga su suspaustomis dujomis.

Paveikslas Nr. 12. Bene didžiausia ugnis matyta kontroliuojamo gaisro metu.

Paveikslas Nr. 13. Plotas po kontroliuojamo gaisro.

Paveikslas Nr. 14. Dėl pakartotino gaisro rizikos, kontroliuojamo gaisro plote budima dar keletą dienų, paprastai iki pirmo didesnio lietaus.

Paveikslas Nr. 15. Plotas, kuriame kontroliuojamas gaisras buvo atliktas prieš 4 metus. Didžioji dalis medyno išliko, bet jis tapo šviesesnis, padidėjo negyvos medienos.

Paveikslas Nr. 16. Siekiant padidinti negyvos medienos kiekį nedidelėse aikštelėse pušys apžievinamos ir pamažu išdžiūsta.

Paveikslas Nr. 17. Atlikta gamtotvarkos priemonė miško sausinimo kanalėlis buvo užtvenktas bei atkurta pelkėto miško aplinka.

Ormajärvi-Untulanharju ir Sajaniemi Natura 2000 teritorijos, Suomija; 2019-06-14

Paveikslas Nr. 18. Medžių apžievinimas – gan dažnai anksčiau taikyta gamtotvarkos priemonė, siekiant padidinti negyvos medienos kiekį.

Paveikslas Nr. 19. Ozo šlaituose prakertamos mažos aikštelės pašalinant nedidelių eglių pomiškį ir traką. Šiose vietose tikimasi retų šviesiamėgių žolinių augalų plitimo.

Paveikslas Nr. 20. Vėjalandės šilagėlės *Pulsatilla patensplatinama* dauginama pasodinant po keletą išaugintų iš sėklų augalų. Tokias grupes skiria 3-5 metrų atstumai.

Paveikslas Nr. 21. Keliantys grėsmę medžiai nupjaunami paliekant didelę pagrindinio kamieno dalį, - tai bus puiki buveinė dar daugelį metų retoms grybų, kerpių ir paukščių rūšims. Gan įprasta praktika vakarų valstybėse, padedanti sumažinti tokių medžių keliamą grėsmę, išsaugojant gamtosauginį potencialą.

Högsböla, Melldala ir Nolberget gamtos draustiniai, Švedija; 2019-06-16

Paveikslas Nr. 1. Aplankytos saugomos teritorijos informaciniai stendai. Informacija pateikiama švedų kalba bet yra trumpas tekstas ir angliškai.

Paveikslas Nr. 2. Nuostabus gidas Dr. Leif Anderson supažindina su dirvodaros procesais bei uolienų sluoksniais Švedijoje, kas turi didelę įtaką augalų rūšių pasiskirstymui.

Paveikslas Nr. 3. Senoms ganykloms yra būdingi seni medžiai, ant kurių žievės yra daug retų kerpių bei samanų rūšių.

Paveikslas Nr. 4. Ganyklose formuojamas pusiau atviras kraštovaizdis, saugojant senus medžius, ir iškertant dalį nepageidaujamų krūmų, kurių negali kontroliuoti čia ganomi galvijai.

Paveikslas Nr. 5. Neseniai nugenėta guoba. Guobų šakos bei lapai ilgą laiką buvo naudojami naminių gyvūnų maistui. Taip susiformuodavo stori keletos metrų aukštyje nuolat genimi medžiai. Tokio medžio kamienas yra tikras retų rūšių „lobynas“, o guobų maras greičiausiai šių guobų neįveikė dėl to, jog jaunos neturėjo vidutinio storumo šakų bei kamienų.

Paveikslas Nr. 6. Seniai nugenėtos guobos vaizdas.

Paveikslas Nr. 7. Ganomos ganyklos vaizdas, kurioje vykdomas nepageidaujamų krūmų šalinimas.

Paveikslas Nr. 8. Šioje saugomoje teritorijoje buvo atlikta detali senų medžių ir su jais susijusių vertybių inventorizacija.

Paveikslas Nr. 9. Galvijai šioje ganykloje yra būtini saugomoms vertybėms išsaugoti.

Paveikslas Nr. 10. Skruzdėlės gali prisidėti prie greitesnės medžio žūties...

Paveikslas Nr. 11. Ypač reta epifitinių kerpių rūšis – *Gyalecta ulmi*, sutinkama tik ant senų medžių.

Paveikslas Nr. 12. Visa negyva mediena yra saugoma.

Paveikslas Nr. 13. Saugomos teritorijos Melldala aprašymas.

Paveikslas Nr. 14. Plačialapių miške žolinę dangą sudaro ištisiniai meškinio česnako sąžalynai. Dalis teritorijos aptverta pritaikant ganymui. Praėjimui įrengti spec. varteliai.

Paveikslas Nr. 15. Labai sena guoba, gali būti jog jos amžius siekia 400m.

Paveikslas Nr. 16. Saugoma teritorija yra ant šlaito ir šlaito apačioje fromuojasi karbonatingi tufai. Aplankytas tufas buvo didžiausias Švedijoje ir pasižymėjo unikaliu retų rūšių rinkiniu.

Paveikslas Nr. 17. Nolberget rezervato informacinis stendas.

Paveikslas Nr. 18. Patekti į rezervatą galima pro šį įėjimą.

Paveikslas Nr. 19. Saugomo plačialapių lapuočių miško vaizdas.

Paveikslas Nr. 20. Šlaitų apačioje kaupiasi organika ir sudaro sąlygas derlingas sąlygas mėgstantiems lapuočiams atsirasti.

Kinnekulle gamtos rezervatas, Švedija; 2019-06-17

Paveikslas Nr. 21. Saugomos teritorijos informaciniai stendai.

Paveikslas Nr. 22. Savaime užsidarantys vartai į saugomą teritoriją.

Paveikslas Nr. 23. Bendras saugomos teritorijos vaizdas.

Paveikslas Nr. 24. Atviros ganyklų vietos pasižymi didele retų augalų įvairove. Belieka juos surasti.

Paveikslas Nr. 25. Retas augalas Vienalapė driežlielė *Ophioglossum vulgatum.*

Paveikslas Nr. 26. *Arenaria gothica* – endeminė rūšis.

Paveikslas Nr. 27. Musinis orfis *Ophrys insectifera*.

Paveikslas Nr. 28. Saten saugomos teritorijos informacinis stendas.

Paveikslas Nr. 29. Såten gamtos rezervate ankščiau taip pat buvo pasodintos eglės monokultūros, tačiau dėl mikorizinių grybų įvairovės nuspręsta jų neiškirsti. Šioje buveinėje apžiūrėjome plačialapės klumpaitės augavietę.

Paveikslas Nr. 30. Plačialapės klumpaitės radimvietė yra lankoma žmonių. Pavyzdys kaip gamtinės vertybės yra parodomos visuomenei, nors kartais nuo to augalai nukenčia.

Tivedens nacionalinis parkas, Švedija; 2019-06-18

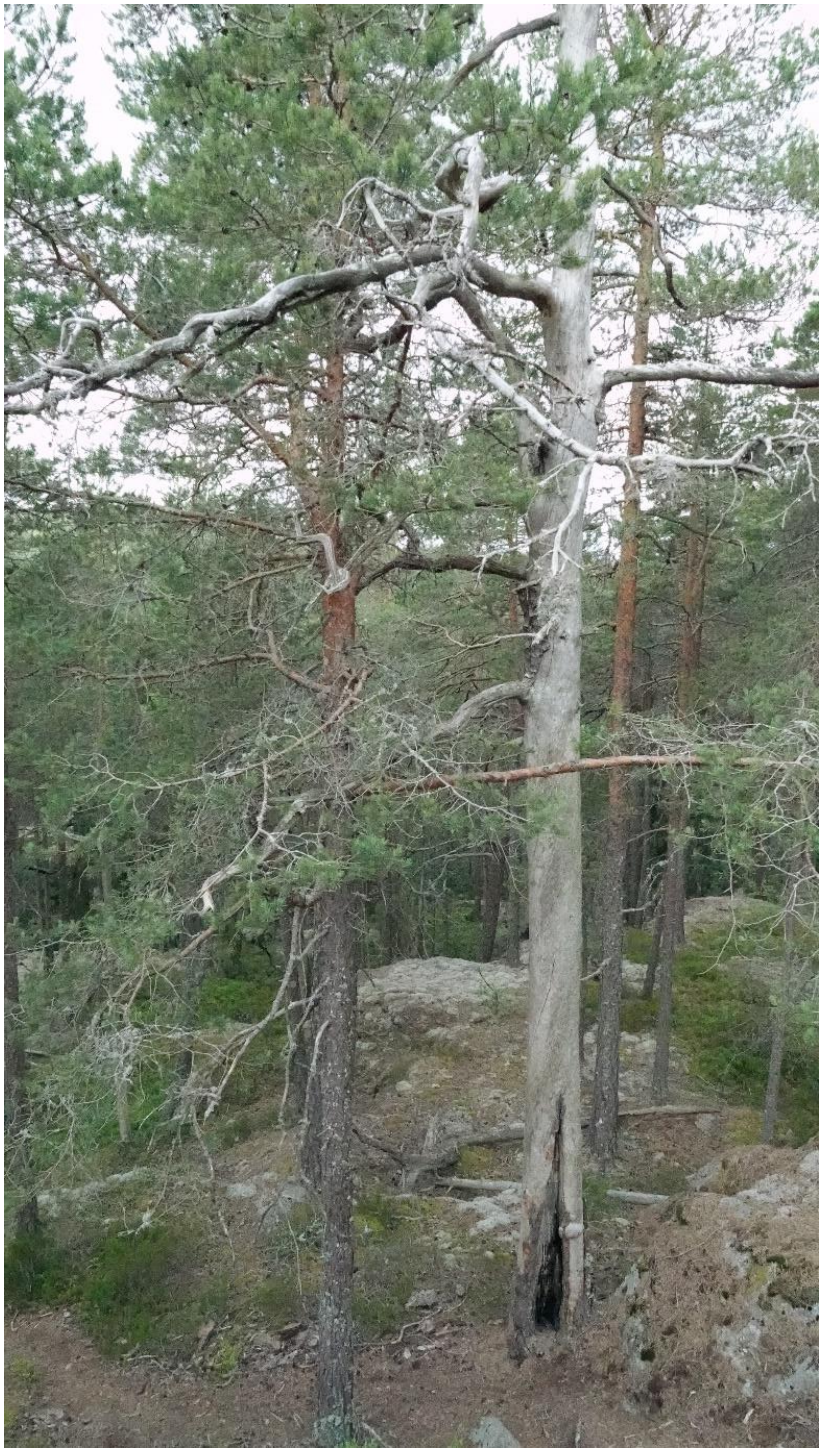
Paveikslas Nr. 31. Tividens nacionalinio parko informacinė erdvė.

Paveikslas Nr. 32. ... kurioje po atviru dangumi yra pateikiama daug informacijos.

Paveikslas Nr. 33. Prie neseniai įrengtos informacinės erdvės įrengtos automobilių stovėjimo vietos. Medžiai išsaugoti įrengiant juos apsaugančius medinius šulinėlius. Šio šulinėlio gylis – apie 2 metrus.

Paveikslas Nr. 34. Nacionaliniame parke gausu vietinių ir užsienio lankytojų, kuriems įrengta daug pažintinių takų. Pažintiniai takai pažymėti medžiaginėmis juostomis ant medžių. Kiekviena trasa turi savo spalvinį ženklinimą.

Paveikslas Nr. 35. Nacionaliniame parke vyrauja konservacinio pobūdžio biologinės įvairovės išsaugojimas.



Paveikslas Nr. 36. Seniai gaisro pažeista išdžiūvusi pušis prie pažintinio tako.

Paveikslas Nr. 37. Plotas, kuriame prieš keletą metų nacionaliniame parke įsiplieskė natūralus gaisras.

Nedre Dalälven biosferos rezervatas, Švedija

Paveikslas Nr. 38. Nacionaliniame parke esančio gamtos rezervato informacinė erdvė.

Paveikslas Nr. 39. Seni ąžuolai saugomi apie juos lajos perimetru pašalinant augančius konkuruojančius augalus.

Paveikslas Nr. 40. Siekiant kontroliuoti eglių plitimą plačialapiuose miškuose eglės yra nužievinamos.

Paveikslas Nr. 41. Visas šis plotas užliejamos pievos buvo atstatytas ilgu ir tikslingu darbu. Pievos yra kasmet šienaujamos, daugiausiai taikomas brangus rankinis darbas. Šios pievos buvo šienaujamos ilgą laiką ir apleistos XXa viduryje, kas nulėmė jų apaugimą mišku.

Paveikslas Nr. 42. Vietinis gamtininkas džiaugiasi retų augalų gausa atstatytoje buveinėje.

Paveikslas Nr. 43. Nacionaliniame parke vyko baltnugarių genių populiacijos atkūrimo projektas, kurio metu paukščiai atvežti iš Latvijos ir paleisti. Siekiant, kad jie nepaliktų nacionalinio parko teritorijos jie papildomai maitinami žiemą.

2 priedas. Mokomojo vizito „NATURA 2000 miškų tvarkymo ir apsaugos patirtis Vokietijoje ir Lenkijoje“ ataskaita.

MOKYMŲ ATASKAITA

2018-10-29

Vilnius

Mokomojo vizito pavadinimas: NATURA 2000 miškų tvarkymo ir apsaugos patirtis Vokietijoje ir Lenkijoje

Mokomojo vizito datos ir trukmė: 2018.10.21-25, trukmė 5 dienos

Valstybė, miestas:

Chorino biosferos rezervatas (Schorfheide-Chorin Biosphere Reserve), Vokietija;

Oborniki miškų urėdiją (Nadleśnictwo Oborniki), Lenkija.

Finansavimo šaltinis: Projekto „Natura 2000 tinklo valdymo optimizavimas Lietuvoje" (LIFE-IP PAF-NATURALIT) Nr. LIFE16 IPE/LT/016 lėšos.

Mokomojo vizito tikslas:

Išvyka buvo siekiama įgyti žinių, reikalingų įgyvendinant projekto Nr. LIFE16 IPE/LT/016 „Natura 2000 tinklo valdymo optimizavimas Lietuvoje” (LIFE-IP PAF NATURALIT) A.4.2 poveiklę bei geriau suprasti vidurio Europos miškų apsaugos problemas, jų sprendimo būdus. Apsilankymo metu taip pat buvo siekiama pasisemti šalių gerosios praktikos, įvertinti ir įsitikinti taikytų gamtotvarkos priemonių efektyvumu, pasidalinti ir galbūt perimti gamtosauginių sprendinių įgyvendinimo patirtį apribojant ūkininkavimo rėžimus miško savininkams bei valdytojams.

Dalyviai:

Aleksandro Stulginskio universitetas: Gediminas Brazaitis, Žydrūnas Preikša, Vitas Marozas, Silvija Šaudytė-Manton.

Valstybinės saugomų teritorijų direkcijos Metodinis analitinis centras: Vytautas Uselis, Gintarė Grašytė, Nerijus Žitkevičius.

Valstybinių miškų urėdija: Gerda Jucevičiūtė, Eduardas Mickevičius.

Pagrindinės temos ir klausimai:

Miško vertybių identifikavimas, vertinimas bei stebėsena.

Vertės nustatymas bei jos palaikymas ir didinimas taikant gamtotvarkos priemones.

Taikoma apsaugos bei saugomų vertybių būklės gerinimo praktika bei jos palyginimas su analogiškomis veiklomis Lietuvoje.

Kompromisinių sprendinių paieškos tarp gamtosaugos ir gamtonaudos patirtis bei gautų rezultatų vertinimas steigiant NATURA 2000 saugomas teritorijas miškuose, kuriuose anksčiau buvo vykdoma ūkinė veikla.

Mokomojo vizito rezultatai:

Schorfheide-Chorino biosferos reservatas, Vokietija

Vokietijos Schorfheide-Chorin biosferos rezervato pristatymas. Šios saugomos teritorijos direktorius Martin Flade pristatė rezervatą, vykdomus projektus. Tai viena didžiausių saugomų teritorijų Vokietijoje, įsteigtų 1990 m., 129,161 ha ploto, su 240 ežerų. Nuo 2011 m. tai ir UNESCO teritorija, nes čia saugomi išlikę senieji lygumų bukų miškai. Tai žemumų bukų miškai, kurių išlikę mažiau nei augančių aukštumose. 70 proc. miškų yra valstybiniai. 2013-2014 m. teritorijoje buvo įgyvendinti hidrologinio režimo atstatymo darbai (iš viso apie 830 ha teritorijoje). Įdomu ir tai kad medžioklė draudžiama, išskyrus 2 kartus per metus, kada medžiojama tam tikrus gyvūnus visoje teritorijoje. Saugomos teritorijos didžioji dalis ūkių vykdo ekologinį ūkininkavimą. Sudaromos sutartys su privačių sklypų savininkais. Administracijos darbuotojai patys vykdo monitoringą, tyrimus.

Apsilankėme Lankytojų centre, kurį įkūrė vietos gyventojų bendruomenė savo lėšomis. Tai labai pasiteisino, nes bendruomenei suteikiama informacija, efektyvesnis bendradarbiavimas. Apžiūrėjus lankytojų centro ekspoziciją, aplankėme bukų mišką, esantį draustinyje, kur auga virš 100 metų bukai. Šioje teritorijoje uždrausta vykdyti kirtimus prieš 30 metų, galimi tik biologinės įvairovės kirtimai. Teritorijoje dirbantis miškininkas paminėjo, kad jis turi specialų leidimą lydėti grupes ir tik su gidu galima nueiti nuo tako. Kitiems lankytis galima, bet tik einant pažymėtais takais (galima pasirinkti vieną iš 3 maršrutų). Takai specialiais ženklais pažymėti ant kai kurių medžių užpurškiant lapo formos ženklą. Pažymėtina, kad įrengta tik labai minimali infrastruktūra - 1 stendas draustinio pakraštyje ir griežtesnės apsaugos teritorijos riboženkliai. Šie ženklai yra vienintelė lankymąsi ribojanti priemonė, lankytojų kontrolė faktiškai nevykdoma. Miškininkas paminėjo, kad visgi žmonės turi nuo seno pamėgtus takus, kuriais kartais vaikšto, nors ta nėra leidžiama. Dalis draustinyje esančių miškų yra privatūs, jų savininkai tiesiog kartais eina į juos, nors jokia veikla ten ir nėra leidžiama.

Toliau mus lydėjo biosferos rezervato direktorius kartu su atstovu iš miškų administracijos . Aplankėme bukų sengirę, kur vyrauja 200-250 metų bukai, o atskiri medžiai siekia apie 300 m. Tiesa, medynas gana retas, aikštelėse gausiai atželia jaunesni medžiai, tačiau gausu negyvos medienos. Sengirės plotas nedidelis - apie 90 ha, ji apribota kelio ir geležinkelio. Čia galima lankytis tik su lydinčiu miškininku arba rezervato darbuotoju, takas pažymėtas iš abiejų pusių virvėmis, už kurių eiti negalima. Ne tik apžiūrėjome sengirę, jos struktūrą, tačiau ir aptarėme ūkininkavimą miškuose. Kolegos iš Vokietijos pabrėžė, kad nekyla konfliktų tarp gamtininkų ir valstybinių miškininkų, nes jie visuomet atstovauja tą pačią pusę, ekonominis interesas nėra aukščiau aplinkosauginio. Regiono mastu yra patvirtinta miškų strategija, kur

aplinkosauginiai aspektai iškelti į pirmą vietą, vykdomas tik neintensyvus ūkininkavimas, iškertant pavienius medžius ar nedideles aikšteles, samdomi rangovai, atitinkantys specialius reikalavimus. Padaliniuose dirba specialistai, kurie patys įvertina, kiek ir kuriuos medžius galima iškirsti, pažymi juos.

Toliau vykstame į bukų miškus, saugomas Natura 2000 buveines, kuriose vykdoma neintensyvi ūkinė veikla. Miškininkas pristato ūkininkavimo principus, kurių vienas pagrindinių - sukurti kuo įvairesnę erdvinę struktūrą. Vienaamžiai medynai kertami neintensyviai, įterpiant nedideles aikšteles, kuriose savaiminiu būdu atsikuria bukų medynai. Pabrėžtina, kad dėl leidžiamų medžioklių šie miškai nepatiria žvėrių poveikio, jaunuolynų nereikia tverti. Be to, atrenkant medžius kirtimui, įvertinama kiekvieno būklė, atrenkami medžiai turintys mikrobuveinių (pažaidų, drevių ir pan.), siekiant tokius išsaugoti. Toks ūkininkavimo modelis sukurtas vykdant projektą, šiame miške ir yra vienas iš plotų, kur sužymėti visi medžiai ir galima išbandyti pristatytą marteleskopo duomenų sistemą. Bukai sunumeruoti natūroje, skaičiai atitinka ir duomenų bazėje esančią informaciją, galima įvertinti, o po to peržiūrėti, ar tas medis atitinka kriterijus kaip medis su mikrobuveinėmis (kiekvienas medis pagal tai įvertintas balų sistema). Saugomos teritorijos specialistai ir miškininkai sutaria dėl bendrų principų, gamtotvarka ir miškotvarka vyksta susiderinus visus veiksmus (su rezervato direkcija derina visas ūkines veiklas, gamtotvarkos priemonės įtraukiamos į miškininkų planus). Biosferos rezervatui rengiamas vienas bendras tvarkymo planas, o kiekvienai mažesnei Natura 2000 teritorijai rengiamas detalesnis gamtotvarkos planas.

Oborniki miškų urėdija, Lenkija

Atvykus į miškų urėdiją buvo pristatyta urėdijos vykdoma miškininkystės veikla bei tvarus miškų naudojimas. Urėdija taip pat dalyvavo Modelinių miškų (Oborniki Model Forest) projekte (Baltic landscapes projekto rėmuose https://www.skogsstyrelsen.se/en/baltic-landscape/) bei miško anglies fermų projekte (Forest carbon farms). Oborniki miškų urėdija priklauso Poznanės valstybinių miškų padaliniui ir yra rytinėje Notecka girios, užimančios 137 tūkst. ha nederlingų pušynų masyvo dalyje. Didžiąją dalį ploto užima pušynai (90 proc.). Vidutinis medynų amžius 60m., tūris 269m3. Iš viso per metus iškertama 110 tūkst. m3 medienos, tame tarpe 57 proc. pagrindiniais kirtimais. Kasmet apie 190 ha iškertama plynai, 29 ha – atvejiniais kirtimais. Biologinė įvairovė saugoma taikant priemones numatytas miškotvarkos plane, specialioje biologinės įvairovės apsaugos programoje bei regioninio direktorato atliktame strateginiame Miškų ūkinės veiklos poveikio aplinkai vertinime. Natura 2000 teritorijoms yra

rengiamas Natura 2000 apsaugos tikslų planas (10 m. periodui) ir Gamtos apsaugos planas (20 m. periodui). Nukrypimai nuo šių planų negalimi.

2012-2014m. urėdija dalyvavo Modelinių miškų projekte. Šiame projekte buvo siekiama išbandyti naują Natura 2000 miškų integruotą planavimo ir tvarkymo modelį. Buvo siekiama kraštovaizdžio lygmeniu subalansuoti suinteresuotų grupių interesus, bei itin didelis dėmesys skiriamas upelių ir upių tinklo apsaugai. Oborniki miškų urėdijos specialistai ėmėsi lyderystės šiame projekte ir jie prie apskrito stalo sukvietė virš 20 suinteresuotų organizacijų atstovų atvirai diskusijai. Buvo keliamos problemos ir ieškoma jų sprendimo būdų. Projekto pabaigoje gauti rezultatai buvo apibendrinti ataskaitoje „Analysis of the barriers to implementation and management of Natura 2000 network and implementation of the European Landscape convention in Poland“ (https://www.skogsstyrelsen.se/globalassets/projektwebbplatser/baltic-landscape/reports/report-no-04-wp4-dr-a-m-jagodzinski-july-23-2013-analysis-of-barriers-to-implemementation-and-management-of-the-natura-2000-network-and....pdf). Šeimininkai pateikė Welna walley (Natura 2000 teritorija) apsaugos problematiką dėl žemdirbystės, sausinimo bei užtvankų statymo.

Urėdija šiuo metu dalyvauja valstybinių miškų inicijuotame Carbon farms projekte. Šiame projekte siekiama padidinti anglies fiksavimą miškuose. Projektą iniciavo ir koordinuoja valstybinių miškų direkcija.

Po pristatymo su urėdijos specialistais išvykome į Noteckos girią, kurioje buvo parodytos vykdomos tipinės ūkinės priemonės.

Urėdijoje vyrauja pušynai, todėl miškininkaujama naudojant plynų kirtimų sistemą. Pušynų kirtimo amžius yra 90 metų, tačiau siekiant subalansuoti medynų paskirstymą pagal amžiaus klases tam tikrą medynų kiekį galima kirsti nuo 80 metų. Kertama juostinėmis biržėmis, kurių plotis apie 55 m, o ilgis paprastai tęsiasi per visą kvartalą. Taip siekiama, kad pušis savaime užsisėtų nuo gretimo medyno. Kirtavietės plotas apie 3 ha. Įdomu, kad dėl didesnių erdvių atvėrimo paukščiams (pvz. ligutei) pagal gamtotvarkos planus galima kirsti didesnius plotus - iki 6 ha. Kirtavietėse 5 proc. nuo ploto paliekama paprastai viena didelė medžių grupė biologinei įvairovei. Miškas daugiausia atkuriamas siekiant savaiminio žėlimo. Siekiant didinti lapuočių kiekį medynuose bei priešgaisriniais tikslais apie kirtavietes formuojama beržų juosta. Taip pat miškas atkuriamas ir vadinamuoju Sobieckio metodu, kai kartu sėjama pušis su ąžuolais ar bukais, derinat taip kad pušis augtų pirmajame arde, o lapuočiai antrajame.

Po pietų lankėme „Swietlista Dabrova“ gamtinį rezervatą, kuris taip pat yra paskelbtas ir Natura 2000 teritorija. Pagrindinė vertybė – Europos bendrijos svarbos buveinė – termofiliniai acidofiliniai ąžuolynai *Potentillo albae Quercetum.* Buveinė besiformuoja esant padidintam

šviesos režimui miške. Jos netvarkant, pradeda augti nebūdingos, unksmę mėgstančios rūšys, suveši trakas ir pomiškis. Todėl, patvirtinus Gamtos apsaugos planą šiai teritorijai, buvo pradėti medyno formavimo kirtimai, iškertant dalį nebūdingų medžių rūšių (ypač pušį, liepą, skroblą) bei pravalant traką. Vietose, kur ypač sutankėję medžiai ir neauga ąžuolas, yra plynai iškertamos iki 0,5 ha dydžio aikštelės, kuriose bus įveisiami ąžuolai. Šiuos visus darbus organizuoja ir prižiūri urėdijos darbuotojai. Pagal patvirtintą Gamtotvarkos planą, termofilinių ąžuolynų buveinėje numatytas ganymas. Tačiau kol kas jis prieštarauja anksčiau parengtam Gamtos apsaugos planui ir ganymas buveinėje yra neleistinas. Tačiau ganymą, kaip gamtotvarkos priemonę, urėdijos darbuotojai išbando kitoje gretimoje, nesaugomoje teritorijoje. Ganymui naudojami lenkiški arkliukai (Polski konik). Kol kas demonstracinis plotas siekia apie 10 ha teritoriją, kurioje ganosi 5 arkliai, tačiau teritoriją žada ateityje plėsti. Arkliams trūkstant maisto, jie yra papildomai šeriami ir girdomi. Kol kas urėdijos darbuotojai neturi plano, kaip reikėtų paleisti arklius ganytis dideliuose plotuose (dėl arklių saugumo užtikrinimo bei jų ganymo plotų kontroliavimo).

Paskutinis aplankytas objektas Lenkijoje Poznanės pakraštyje buvo "Morasko Meteorito" draustinis (The "Morasko Meteorite" Reserve). Šioje vietoje saugoma grupė t.y. septyni smūgio metu atsiradę krateriai Morasko kalno šlaite. 55 ha teritorija draustiniu paskelbta 1976 metais. Draustinyje saugoma ne tik kraštovaizdis su meteorito krateriais, bet ir anksčiau plačiai paplitę ir buvę būdingi Wielkopolska regione ąžuolo bei skroblo medynai (*Galio sylvatici - Carpinetum*). Praėjome draustinyje įrengtu pažintiniu taku su informaciniais stendais. Tai puikus pavyzdys saugomos teritorijos, esančios miesto ribose ir skirtos gamtai išsaugoti bei žmogui naudoti rekreacinėms ir edukacinėms reikmėms.

IŠVADOS:

1. Natura 2000 saugomuose senuose unksminių rūšių medynuose galima suderinti gamtosauginius bei ūkinius visuomenės interesus siekiant įvairiaamžės medyno struktūros ir kirtimus vykdant atrankinių kirtimų metodu. Ekonominis efektyvumas pasiekiamas senuose medynuose iškertant ekonomiškai vertingiausius medžius (kertama mikrogrupėmis kas 4-5m. apie 70-80% priaugančio medyno tūrio), gamtosauginis efektas pasiekiamas saugant senus medžius su mikrobuveinėmis.
2. Pastaraisiais metais senuose saugomuose bukynuose išvystyta medžių mikrobuveinių apsaugos koncepcija po papildomo adaptavimo gali būti taikoma Lietuvos sąlygomis bei tapti svarbiu gamtosauginiu įrankiu tiek Natura 2000 buveinių tiek ir ūkiniuose miškuose.

3. Viena iš alternatyvų siekiant išlaikyti reikiamą *termofilinių acidofilinių ąžuolynų* struktūrą yra pomiškio bei trako naikinimas pasitelkiant naminius gyvūnus. Archajiškų arklių veislių naudojimas yra tinkama priemonė stabdyti prieš tai iškirstų medelių ir krūmų pakartotinį žėlimą.
4. Saugant ES paukščių direktyvos rūšis (pvz. ligutė, lėlys) gyvenančias atvirose miško vietose Lenkijoje yra leidžiama kirsti didesnes plynas kirtavietes nei ūkiniuose miškuose.

Ataskaitos priedai ir naudingos nuorodos:

2.1 priedas. Kelionės dalykinės nuotraukos

Ataskaitą parengė:

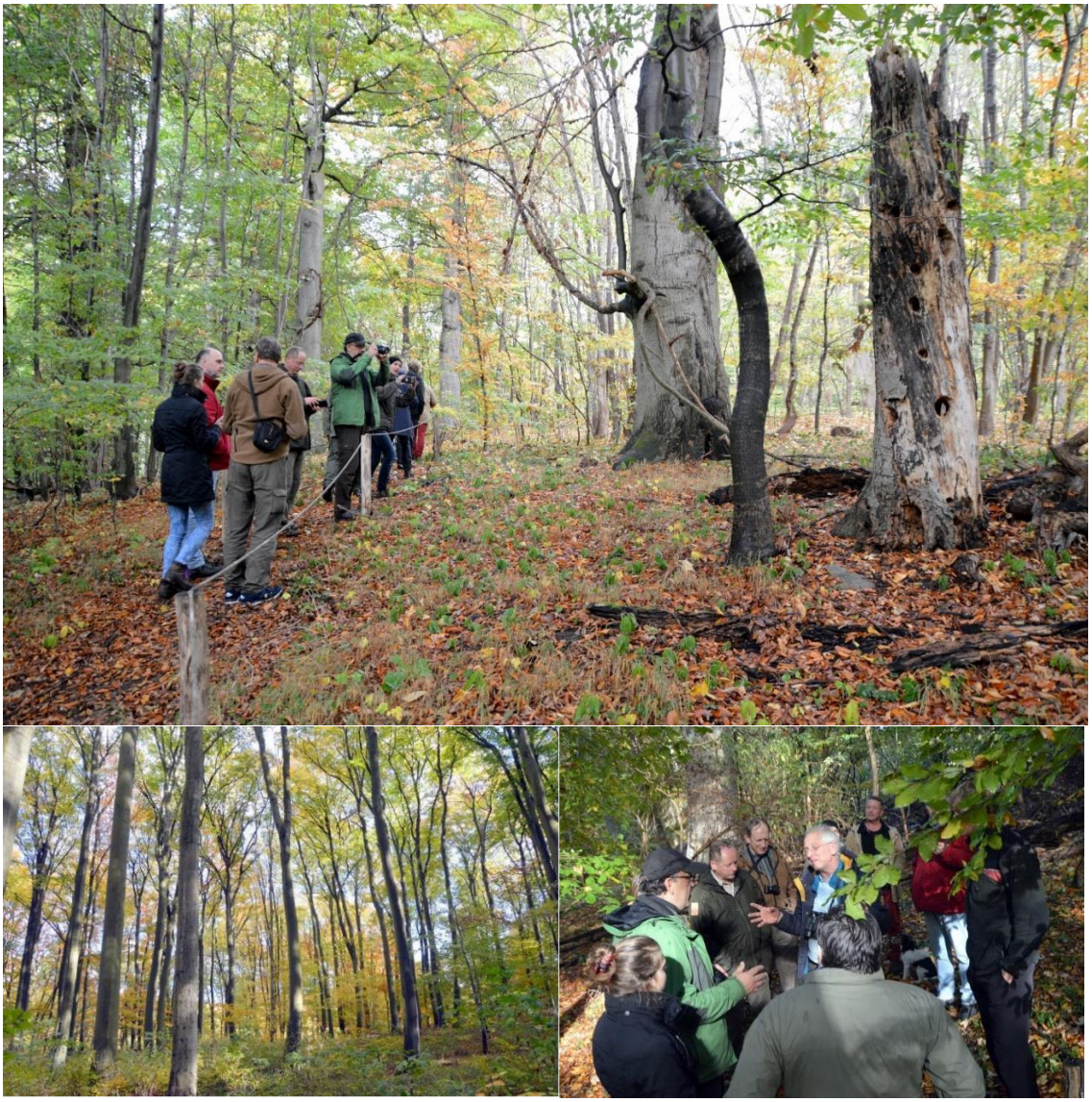
ASU ir VSTT MAC kelionėje dalyvavę ekspertai

Kelionės dalykinės nuotraukos

1 pav. Schorfheide-Chorin biosferos rezervato administracijoje

2, 3 pav. Schorfheide-Chorin biosferos rezervato lankytojų centre

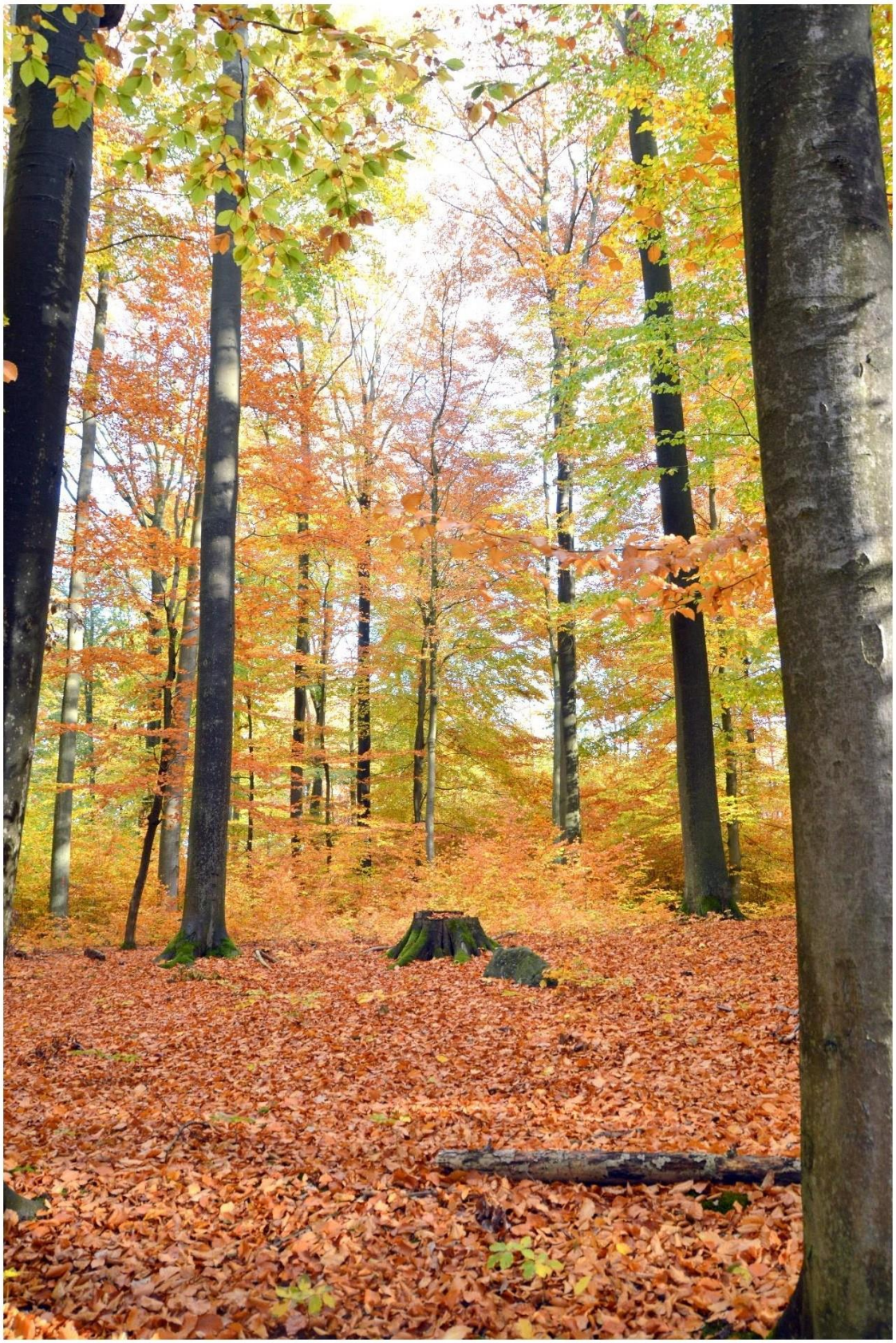
4-9 pav. Lankymasis Schorfheide-Chorin biosferos rezervato bukų miške (medžių amžius - apie 100 m.)



10-12 pav. Lankymasis Schorfheide-Chorin biosferos rezervato bukų miške (kai kurių medžių amžius - apie 300 m.)

13 pav. Metodinio-analitinio centro ekspertas V. Uselis apžiūri Lietuvoje retai randamą korališkąjį trapiadyglį *Hericium coralloides* (Schorfheide-Chorin biosferos rezervatas)

14, 15 pav. Schorfheide-Chorin biosferos rezervato direktorius dr. M. Flade pristato parengtą mikrobuveinių inventorizavimo rezultatą – duomenų bazę, kuria galima naudotis gamtoje



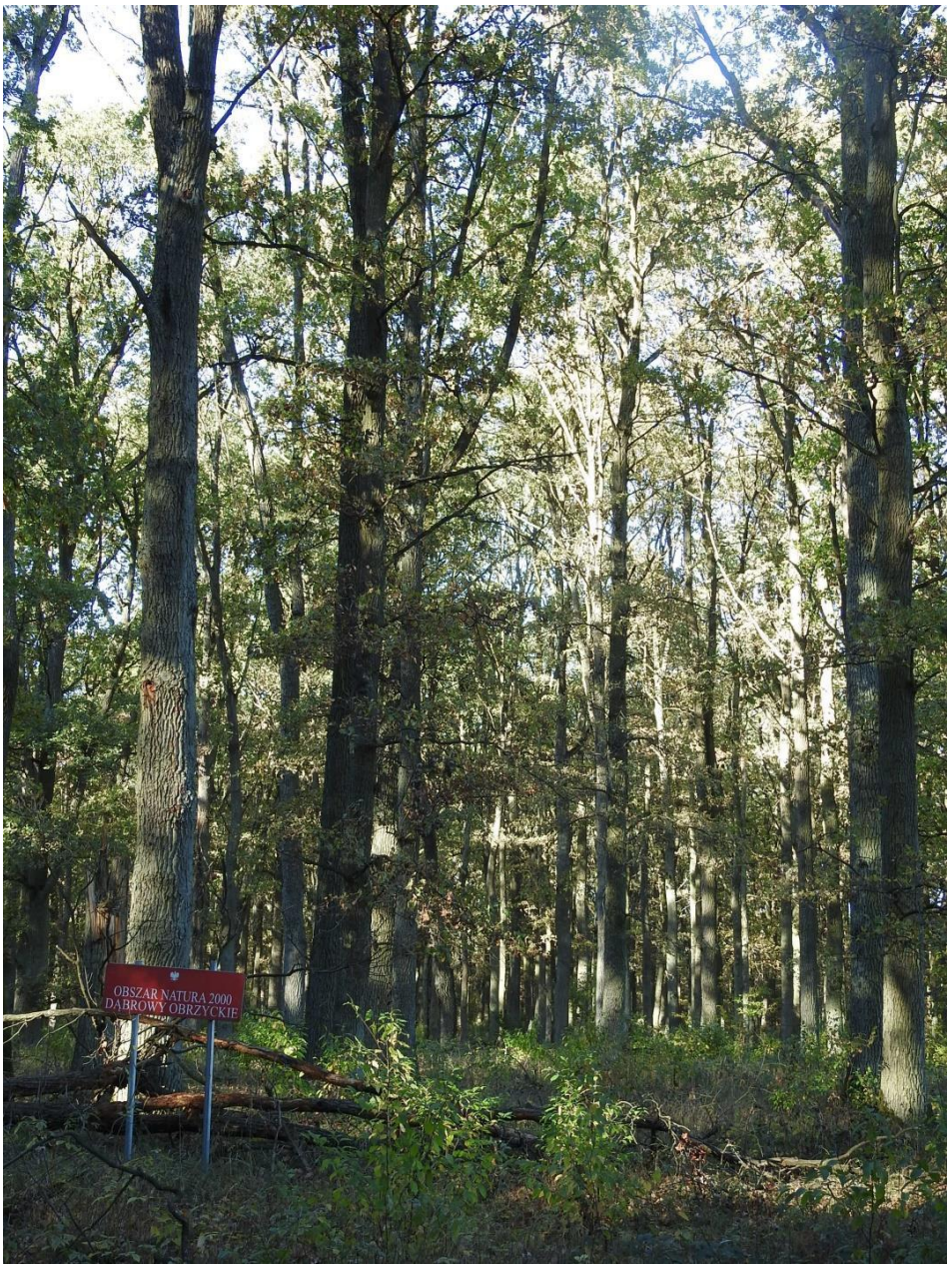
16 pav. Bukų miškas po atrankinių kirtimų (Schorfheide-Chorin biosferos rezervatas)

17 pav. Tipiška plyna kirtavietė pušyne. Dešiniau esantis medynas bus išretintas ir paliktas

18 pav. Pagrindinių kirtimų metu yra siekiama išsaugoti 5 proc. medyno tūrio. Medžiai paliekami didelėmis biogrupėmis

19 pav. Miško atkūrimas sėjant Sobeckio metodu. Sėjama pušis, bukas ir ąžuolas tuo pačiu metu, kaip ir paruošiama žemė

20 pav. Geros būklės termofilinis ąžuolynas po atliktų atrankinių kirtimų



21 pav. Natura 2000 teritorija, gamtinis rezervatas „Swietlista Dabrowa“

22 pav. Informacinis stendas apie gamtinį rezervatą „Swietlista Dabrowa“

23 pav. Diskusijos apie ąžuolynų tvarkymą

24 pav. Grupiniai plynieji kirtimai atveriant aikšteles, kuriose bus atkuriami ąžuolynai

25 pav. Lenkiškas arkliukas (Polski konik) Noteckos girios demonstraciniame plote