

## Appendix 2.2: Nature’s contributions to people (NCP) from the perspective of indigenous and local knowledge (ILK)

Selected list of quotes derived from a content analysis of the ILK-dialogue in ECA (Roue & Molnar, 2016).

	NCP	NCP described through ILK	Trends of NCP - Decrease	Drivers
1	Habitat creation and maintenance	<ul style="list-style-type: none"> <li>• ‘Well yes, the owl also needs a place for hiding. / They say now that we have to leave something [deadwood] for the worms too.’ (<i>Local foresters</i>).</li> <li>• ‘If there were no herders here, the area wouldn’t be grazed properly. Nature would suffer. (...) Nobody would force them into the marsh, to clean the area up [from encroaching tall vegetation]. You need herders for that.’ (<i>herder</i>)</li> <li>• ‘My father and I started cutting down and clearing out the tall vegetation from the marsh. This made a good habitat for birds. In summer the water went away, and by September there was fresh grass for the livestock to graze on.’ (<i>herder</i>)</li> <li>• ‘You don’t have to have it munched down entirely, just leave the pasture in a condition where regrowth can be started. I have the area grazed in partitions, and by the time I get back there is regrowth again.’ (<i>herder</i>)</li> </ul>	<ul style="list-style-type: none"> <li>• ‘As a whole we can say that the naturalness of habitats decreased considerably in the last two decades. There is much less forest. Now there are a lot of clear-cuts. Here is not that bad, but they cut out almost completely the Rafajna forest.’ (<i>Local forester</i>)</li> <li>• ‘My twenty odd years of experience as a bird watcher shows me that many bird species disappeared from this country and many plant species disappear because these areas are encroached by taller plant species.’ (<i>herder</i>)</li> <li>• ‘It shrinks every day, the land shrinks every second. When you wake up in the morning the land is smaller than when you went to bed.’ (<i>reindeer herder</i>)</li> <li>• ‘We need all the forest types, but nowadays the big thing that is missing for us are the old pine forests that has almost disappeared because of forestry.’ (<i>reindeer herder</i>)</li> <li>• ‘We don’t have the natural migration roads anymore, they are destroyed, most of them (...) It’s quite large areas that must be restored to have functioning migration roads.’ (<i>reindeer herder</i>)</li> </ul>	<p>Climate change</p> <ul style="list-style-type: none"> <li>• ‘The trees are old and I can almost say that they are not fruiting. And until there was no such drought it was possible to collect acorns. But now, since there is this big drought, what the tree fruits falls down almost entirely wormy. Maple and ash have fruits, but the seeds of the other trees are worn out by this drought. This big warm during summers.’ (<i>Local forester</i>).</li> </ul> <p>Policies</p> <ul style="list-style-type: none"> <li>• ‘Bushes encroach and the wetlands are taken over by sedge. The simplest way to stop these plants is with fire: that kills the sedge and the bush too. But that’s illegal. Willow bushes [<i>Salix cinerea</i>] are protected by the National Park. They take up so much land, not just the meadows, but the pastures too, and they’ll never give it back. Because we aren’t even allowed to kill them.’ (<i>herder</i>)</li> </ul> <p>Markets</p> <ul style="list-style-type: none"> <li>• ‘We need all the forest types, but nowadays the big thing that is missing for us are the old pine forests that has almost disappeared because of forestry. (...) Nowadays it’s an industrial forest, I don’t call it a forest anymore because there’s only one kind of forest, everywhere, and even-aged. So in my view it’s</li> </ul>

	NCP	NCP described through ILK	Trends of NCP - Decrease	Drivers
				industrial sites produced by forestry. The old types, mixed, multi-storied, they don't exist anymore.' ( <i>reindeer herder</i> )
2	Pollination and dispersal of seeds	<ul style="list-style-type: none"> <li>'They (sheep) can bear seeds and scatter them.' (<i>herder</i>)</li> </ul>		
6	Regulation of freshwater quantity and location	<ul style="list-style-type: none"> <li>'Maybe it starts to snow in mid-November, so we get 10–20 cm of snow. Then comes a thaw weather that melts the snow cover so there's only water left. In the meantime, the ground has frozen by the end of October. So the ground doesn't let through the water anymore: it pools on the ground instead, especially in dry, lichen-rich pine forests. And soon it's icing [on top of the lichen]. It can be better where you have thicker humus where the ground lets through the water.' (<i>reindeer herder</i>)</li> </ul>		
8	Formation and protection of soils	<ul style="list-style-type: none"> <li>'Where the animals are roaming around, there is no decay, because the soil had a breath.' (<i>Local forester</i>)</li> <li>'Sandy soils can be particularly quickly overgrown if they are not grazed. Whether <i>parlagfú</i> (<i>Ambrosia artemisiifolia</i>), or <i>vaddohány</i> (<i>Asclepias syriaca</i>), when they propagate in it, they would dry out sand so much, it doesn't matter how much rain falls afterwards: it cannot be soaked again because it runs off.' (<i>herder</i>)</li> </ul>	<ul style="list-style-type: none"> <li>'Near the coast here, stump harvesting has become really interesting. When you harvest the stumps, there's only soil and stones left because you turn upside down the whole ground with all the root system. It's a huge impact, maybe 70-80% of the ground vegetation turned upside down.' (<i>reindeer herder</i>)</li> </ul>	<p>Over-exploitation</p> <ul style="list-style-type: none"> <li>'Too many livestock and overgrazing would overexploit the land, if it is not left to rest, it will not be able to regenerate.' (<i>herder</i>)</li> </ul> <p>Land-use change</p> <ul style="list-style-type: none"> <li>'Near the coast here, stump harvesting has become really interesting. When you harvest the stumps, there's only soil and stones left because you turn upside down the whole ground with all the root system. It's a huge impact, maybe 70-80% of the ground vegetation turned upside down.' (<i>reindeer herder</i>)</li> </ul>

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9	Regulation of hazards and extreme events	<ul style="list-style-type: none"> <li>• ‘[All the forests] are important depending on the conditions. Some may have a shelter effect, for the wind that will harden the snow in the lichen-rich forest. This spruce forest, that has no lichen, has the function of stopping the wind.’ <i>(reindeer herder)</i></li> </ul>	<ul style="list-style-type: none"> <li>• ‘But nowadays there is no elm that is the problem. Before they were as big as the ash. Because of the many floods, it dried out. The young ones, it dries out too. I tell you, when I was a kid, there were this big.’ <i>(Local forester)</i></li> </ul>	<p>Climate change</p> <ul style="list-style-type: none"> <li>• ‘In the summer seasons weather conditions are usually quite extreme recently.’ <i>(herder)</i></li> </ul>
10	Removal of animal carcasses	<ul style="list-style-type: none"> <li>• ‘Even beasts are made by God and have a purpose, even the bad ones like wolves, they have their own role, they eat the corpses of dead animals, and they cleanse the landscape.’ <i>(herder)</i></li> <li>• ‘If you have the same area grazed all the time, it would be depleted and such plants that the sheep does not feed on will dominate.’ <i>(herder)</i></li> </ul>	<ul style="list-style-type: none"> <li>• ‘During the Russians [before 1991], there was a lot of deer. Everywhere we went, we saw them. Now, seldom a roebuck... That doesn’t count. Then there were quite many wild boars, when the kolkhoz [collectives] bowled out [1991]. But then came some sort of plague and they fell down.’ <i>(Local forester)</i></li> </ul>	<p>Land-use change</p> <ul style="list-style-type: none"> <li>• ‘Bushes encroach and the wetlands are taken over by sedge. The simplest way to stop these plants is with fire: that kills the sedge and the bush too. But that’s illegal. Willow bushes [<i>Salix cinerea</i>] are protected by the National Park. They take up so much land, not just the meadows, but the pastures too, and they’ll never give it back. Because we aren’t even allowed to kill them.’ <i>(herder)</i></li> </ul>
11	Energy	<ul style="list-style-type: none"> <li>• ‘There is need to have firewood, and something to build from (...) For firewood we went only here, on the Lapos. That was the closest, and there was thin, dry wood, which could be broken by hand.’ <i>(Local forester)</i></li> </ul>		
12	Food and feed	<ul style="list-style-type: none"> <li>• ‘There are many types of mushrooms here. But I don’t know. As we call them is not as it is in the sciences.’ <i>(Local forester)</i></li> <li>• ‘Acorns we could collect. That we could always. The pigs fatten on it.’ <i>(Local forester)</i></li> <li>• ‘[Arboreal lichen] is a fantastic food for reindeer under catastrophic grazing conditions. There is no such feedstuff to buy with money. Even for money I don’t think we would accept that they cut a forest full of arboreal lichen. There is no</li> </ul>	<ul style="list-style-type: none"> <li>• ‘In this rhythm, there will be no livestock left in the village.’ <i>(Local forester)</i></li> <li>• ‘People have got used to artificial food. People don’t realise that if herders go, tasty meat will go too.’ <i>(herder)</i></li> <li>• ‘After the end of communism, a lot of livestock was “killed off” in Hungary.’ <i>(herder)</i></li> </ul>	<p>Climate change</p> <ul style="list-style-type: none"> <li>• ‘Until there was no such drought it was possible to collect acorns. But now, since there is this big drought, what the tree fruits falls down almost entirely wormy.’ <i>(Local forester)</i></li> <li>• ‘If there is a drought-stricken period, sheep would not rut [get pregnant] and there will be less twins.’ <i>(herder)</i></li> </ul> <p>Markets</p> <ul style="list-style-type: none"> <li>• ‘In the market there are so many people selling their animals, they are quitting agriculture and animal husbandry because of the low prices, both for animals and products.’ <i>(herder)</i></li> </ul>

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		forage to place on level with arboreal lichen.’ ( <i>reindeer herder</i> )		<ul style="list-style-type: none"> <li>• ‘If we had a proper lamb market, then with Hungarian racka sheep I could get the same results as I do now, with these more sensitive breeds, with half the work and half the trouble.’ (<i>herder</i>)</li> </ul>
13	Materials and assistance	<ul style="list-style-type: none"> <li>• ‘People used to collect dry twigs with carts. They put them in piles. They had to put it in between four poles. They put it on the cart in this way and took it away.’ (<i>Local forester</i>)</li> <li>• ‘The “vassafa” (<i>Cornus sanguinea</i>) is the best skewer for bacon frying. It is firm enough.’ (<i>Local forester</i>)</li> <li>• ‘...the bark of the elm is a very good tying material. With this we tie up the dry wood on our back or on the bicycle.’ (<i>Local forester</i>)</li> <li>• ‘Sure beasts are a problem here, but for this problem you have dogs, you take some men with you, and you are safe from them.’ (<i>farmer</i>)</li> <li>• ‘No, the beasts are no real problem for us, we have our dogs and sticks, we are not afraid of wolves and bears.’ (<i>herder</i>)</li> </ul>	<ul style="list-style-type: none"> <li>• ‘Before the kolkhoz [before 1947] people went out less to steal. Then the village had its own forest and they could take wood from there. And the villagers did not steal from each other. Or they did not dare to go, because the forest had many owners then, and many eyes were watching (cf. Molnár et al. 2015). But in the kolkhoz period [1947–1991] the forest was owned by the state...’ (<i>Local forester</i>)</li> </ul>	<p>Policies and land tenure</p> <ul style="list-style-type: none"> <li>• ‘Before the kolkhoz [before 1947] people went out less to steal. Then the village had its own forest and they could take wood from there. And the villagers did not steal from each other. Or they did not dare to go, because the forest had many owners then, and many eyes were watching (cf. Molnár et al. 2015). But in the kolkhoz period [1947–1991] the forest was owned by the state...’ (<i>Local forester</i>)</li> <li>• ‘Nowadays we don’t even know where they are taking the wood. Everything goes for the state.’ (<i>Local forester</i>)</li> </ul>
14	Medicinal, biochemical and genetic resources	<ul style="list-style-type: none"> <li>• ‘We’re trying to cross-breed meat-producing sheep, so that our pastures can support them. That’s why they’re so spectacularly cross-bred. So they are productive in two types of weather, in dry weather, and in rainy years too.’ (<i>herder</i>)</li> </ul>		
15	Learning, artistic, scientific and technological inspiration	<ul style="list-style-type: none"> <li>• ‘We need to recognise each other’s knowledge. Then researchers have to try living together with a herder, to understand why we do the things we do, and to realise that it’s really a science. And</li> </ul>	<ul style="list-style-type: none"> <li>• ‘Herders don’t get enough recognition. It’s getting better, but it’s still not enough. People never thought about herders as knowledgeable people. (...) A lot of people don’t consider it real knowledge.’ (<i>herder</i>)</li> </ul>	<p>Inter-generational transmission:</p> <ul style="list-style-type: none"> <li>• ‘My grandfather was also forester in the Salánki (the Salánki forest). And my father here. And we were together all day long with that other forester (LF)./ My father-in-law’s</li> </ul>

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		<p>herders have to recognise the researchers' knowledge.' (<i>herder</i>)</p> <ul style="list-style-type: none"> <li>• 'I was born into it. I learnt everything I know about herding from my father, and I adopted what I needed from the older people. / Not from books, but from my father and grandfather. / I learnt it from my father. I didn't study this, I inherited it, I was born into it.' (<i>herders</i>)</li> <li>• 'I was there with the herd, to fatten them, that's why we can explain so much. (...) I only know what I lived through, I got wet and was cold many times. Several herders explicitly said that a good herder must learn directly from the animals: We were talking with them like I do with you now.' (<i>herder</i>)</li> <li>• 'We have the knowledge, how the land looks like, where the reindeer go. Now that I've been in this land for so long, it's much easier for me to manage reindeer in this area, compared to someone else who has never been here.' (<i>reindeer herder</i>)</li> </ul>	<ul style="list-style-type: none"> <li>• 'I would make better use of the reedy areas. There are some places that weren't used for grazing even 20 years ago. I would start to graze them heavily. There are about 200-300 hectares of reed beds here, which makes no sense, not even for the national park' (<i>herder</i>)</li> </ul>	<p>father was also a forester here. So as my brother-in-law.' (<i>Local foresters</i>)</p> <ul style="list-style-type: none"> <li>• 'I try to make it as I saw from my father. I held it a good solution and thinking back to it, it was indeed.' (<i>herder</i>)</li> <li>• 'Then my father told me so, it's clattering [dry steppe] in the morning and clapping [wetlands] in the afternoon. So we graze the dry one in the morning.' (<i>herder</i>)</li> </ul> <p>Hegemony of Western scientific knowledge</p> <ul style="list-style-type: none"> <li>• 'A researcher should get to know me and my family, and then he can ask his questions. Researchers should treat herders like humans. I don't think I'm less of a person than someone who went to university.' (<i>herder</i>)</li> </ul> <p>EU and national policies</p> <ul style="list-style-type: none"> <li>• 'The park favors traditional herding but with these regulations the steppe lifestyle will be killed off' (<i>herder</i>).</li> <li>• 'I think, at most, herders will be kept in the national parks, as an attraction. The kind of herding I do now will be killed off sooner or later, regardless of the subsidy structure' (<i>herder</i>)</li> <li>• 'Subsidies are very good because they help smallholders to develop, for example, by paying for proper winter fodder. The downside is that a lot of people are only keeping animals in order to qualify for the subsidies. That's bad for the herder community, because the large subsidies mean herders aren't needed. The livestock doesn't need to be productive, all that matters is the headcount' (<i>herder</i>)</li> </ul>

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				<p>Markets</p> <ul style="list-style-type: none"> <li>• ‘Nowadays pastures are being fenced off by the big companies and small entrepreneurs too. That’s changing the nature of herding. They don’t need us any more, because the cattle is kept in place by the electric fences’ (<i>herder</i>)</li> </ul>
16	Physical and psychological experiences	<ul style="list-style-type: none"> <li>• ‘I cannot wait for the weekend, just to have a walk in the forest.’ (<i>Local forester</i>)</li> <li>• ‘If spring comes and the nights are warm enough, we stay out the whole night fishing.’ (<i>Local forester</i>)</li> <li>• ‘In springtime when you go out and smell the fresh air, it cannot be told, the feeling of how wonderful it is.’ (<i>herder</i>)</li> <li>• ‘I went bird watching since I was 12. I have always lived close to nature.’ (<i>herder</i>)</li> <li>• ‘For me, it’s like recreation when I’m out. Nature is like settling for me. I feel good in it, be it grassland or forest’ (<i>herder</i>)</li> <li>• ‘For me, this means relaxation. I have time to watch the wildlife, game and birds.’ (<i>herder</i>)</li> <li>• ‘For me, it’s like recreation when I’m out. Nature is like settling for me. I feel good in it, be it grassland or forest.’ (<i>herder</i>)</li> </ul>	<p>‘In southeastern Siberia, nomads and villagers have complained that the returns from sable hunting have diminished.’ (Lavrillier et al. 2016)</p>	
17	Supporting identities	<ul style="list-style-type: none"> <li>• ‘Then people respected the forest somehow better. Perhaps because they knew that they were living out of it.’ (<i>Local forester</i>)</li> <li>• ‘This is like home, you can’t tell it. It has to be felt.’ (<i>herder</i>)</li> <li>• ‘I lived in a farmstead since I was a kid, livestock and nature for me are one and the same.’ (<i>herder</i>)</li> </ul>	<ul style="list-style-type: none"> <li>• ‘The young ones don’t want this anymore.’ (<i>Local forester</i>)</li> <li>• ‘Young people should be taught to love nature. Young people today don’t like it.’ (<i>herder</i>)</li> <li>• ‘All plants and animals which are now gone or rare were common for my grandfather. Now you have to protect the gopher, all kinds of plants and animals.’</li> </ul>	

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		<ul style="list-style-type: none"> <li>• ‘when the cuckoo sings we are rejoicing as well’ (<i>farmer</i>)</li> <li>• ‘Everyone knows a proverb saying that ‘every seventh [one] is Khidyr.’ This proverb reflects folk wisdom that all beings in this world have their representatives with special capacities. For example, we may roughly say that six poplars may be just regular poplars but the seventh one would be ‘special’, i.e., sacred. And it applies to everything – to trees, springs, animals, and people.’ (Siezdbek Moldo, a guardian of Kochkor-Ata sacred site)</li> </ul>	<p>(...). The world of my father, of my grandfather, in that world you did not have to protect, conserve. Now you have to conserve and define the value of it, so that it could be conserved. (...) Well, I think there were a lot more birds, a lot more livestock.’ (<i>herder</i>)</p>	
18	Maintenance of options	<ul style="list-style-type: none"> <li>• ‘We just borrow the reindeer from our children, and grandchildren and so on. I manage them just for the future, and the same with nature.’ (<i>reindeer herder</i>)</li> </ul>		<p>Policies</p> <ul style="list-style-type: none"> <li>• ‘When they came here every ten years, and they are also coming nowadays to control the forest and to plan cuttings, hoeing, planting, then they planned for us for ten years ahead what can be cut.’ (<i>Local forester</i>)</li> </ul>