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Changes in a Land Snail community (Gastropoda) in an open cut forest area

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This study was carried out in South Finland, in Hollola. The sample areas are situated in the middle of an open cut area. I took the samples in 1991 and 2009. Five species disappeared and five new species was observed. The species that increased the most are *Discus ruderatus*, *Vitrina pellucida* and *Columella edentula*. The variation in species of vascular plants has been noticeable. The moisture close to the soil surface is important to land snails, especially the remaining of ferns suffices for land snails.

The effects of open cutting forest on land snails have not been studied in Finland. There is some knowledge of the effects of slash and burn on land snails. There are also some studies on the effect of shrub and meadow maintenance (Routio 2008).

The leaf debris production of individual trees has been found to have a positive effect on the snail community (e.g. Bayer and Saari 1977, Strayer et al. 1986). The positive effect of aspen is particularly clear (Suominen et al. 2002). In contrast, the debris of birch and spruce can be seen as equally poor living environments for land snails (Uotila 1988).

Diversity increases in privately owned forest up to 700 m² of surface area. In smaller spots of forest, diversity decreases in relation to surface area (Suominen et al. 2002). Gastropods are significant to the forest ecosystem. Depending on the quality of forest, they perform 0,35–17% of the disintegration process (Gärdenfors 1986).

71 land snail species have been found in Finland, of which 50 occur in forest. The moist nemoral forests of south-western Finland and the Åland islands have the richest diversity.

This study was carried out in South Finland (EH), in Hollola (co-ord. 676:342). I counted the land snails twice on our chosen sample line in an open cut forest area. We made the first count two years after timber harvest and the second 20 years after the timber harvest.

Methods and study area

The sample areas are situated in the middle of an oblong 2.8 ha open cut area, which is almost square in shape, and on a 95 metre-long straight line. The four sample areas lie at regular intervals, 24 metres apart. The outer sample areas lie about 35 metres from mature forest. One sample consists of 15 litres of sifted surface soil and debris from a vertical depth of 0–5 cm. The radius of each sample area is 3 metres. The terrain is slightly sloping.

Fig. 1. The study area. The sample line in May, 1989. Study areas III and IV in May, 1989. Photos by Matti Valta.

Fig. 2. The sample line in August, 1996.

I took the samples in 1991 and 2009, in the third week of July, from the same places in one day. I screened one sample from the area in 2007. The results of that screening were very similar to the results obtained in 2009.

Before timber harvest, the study area was a lush, moist HeOT – PuViT type forest dominated by *Betula, Picea abies* and *Tilia cordata*. The harvest of the massive trees of the nemoral forest was carried out in the winter of 1988/89.

In the spring of 1991, the area was still open and the tracks of foresting machinery and the stumps of large spruce were to be seen (figure 1). The area had naturally grown under 0.5 m. tall saplings of *Acer platanoides, Alnus incana, Betula, Picea abies, Pinus sylvestris* and *Tilia cordata* and some thin *Sorbus aucuparia* that were left behind from the timber harvest. These were no more than 2 m in height. Some demanding species of the field layer were left, such as *Actaea spicata*, *Aegopodium podagraria, Lonicera xylosteum, Stachys sylvatica* and *Paris quadrifolia*. There were rich occurrences of *Equisetum sylvaticum, Geranium sylvaticum, Hepatica nobilis, Pulmonaria obscura* and *Ranunculus cassubicus*. There was also an abundance of grasses. The area

Fig. 3. The sample line in July, 2009.

was not ploughed, furrowed or sown with seedlings at any stage.

In 1996, the study area was an unthinned area of broadleaved saplings (Figure 2). In 2009, there was a Silver Birch dominated commercial forest being grown on the sample line, with a few Spruce among them (figure 3). The radius of the trees was about 15 cm. The few young Pine that had grown there in 1991 had been removed. The broad-leaved sapling growth had been thinned and some shrubbery removed between 1996 and 2007, so there were only a few maple and linden trees left in 2009. The mountain currant and blackcurrant, for example, had disappeared from the shrub layer as had the demanding nemoral species mentioned above. The large stumps had disintegrated. The soil pH readings obtained on the sample line were 5.55 and 5.52.

Results

21 land snail species were found in the study (Table 1). The range of species has changed by about a third in 18 years, the change being 31.2% (Table 2). 8 species have increased and 3 have declined. The number of individuals has risen by 39.7%. The species that have increased the most are *Discus ruderatus*, by 86,3 %, and *Vitrina pellucida*, by 83,2 %. Of the most abundant species on the sample line *Cochlicopa lubrica* increased 7,6 %, *Nesovitrea hammonis* 50,3 %, *Nesovitrea petronella* 45,4 %. *Euconulus fulvus*, decreased the most, by 29%.

The changes in the land snail community give no indication of its ecological direction. Some *Vertigo* species that were few in number in 1991 were no longer found in 2009. *Carychium tridentatum,* which is typical of moist nemoral forest, newly appeared on the sample line, as did the sizeable *Fruticicola fruticum* and *Macrogastra plicatula*, which climbs tree trunks. In 1991, the most abundant species was *Cochlicopa lubrica* (119 individuals), and in 2009, *Nesovitrea hammonis* (155 individuals).

The variation in species of vascular plants has been noticeable (Table 2). Plants that are typical of open cut areas have decreased in particular (–56%). Examples of species that have disappeared completely are *Alchemilla* spp*., Alope-*

Table 1. The number of individual land snails and their per cent change in the four sample areas of the sample line: 21 species, n = 1258. Unidentified snails are young and/or broken individuals. The lower rows indicate the number of vascular plant species in each sample area.

	-91	-09	-91	-09	-91	-09	-91	-09	1991	2009	%	
Carychium tridentatum				6		1			-	7	+	7
C. lubrica	68	28	16	16	11	39	24	45	119	128	+7,6	236
C. lubricella				3					-	3	+	3
C. edentula	1	1		2	3	4		12	4	19	+79,0	23
C. aspera	7	4				1	3	2	10	7	-30,0	17
Vertigo pusilla	1					1		1	1	2	+50,0	3
V substriata	1	5	1	7	4	8	21	8	27	28	+3,6	55
V ronnebyensis							1		1	-	-	1
V lilljeborgi	1								1	-	-	v1
V geyeri							1		1	-	-	1
P pygmaeum	21	6	3	5	15	6	4	20	43	37	-14,0	80
Discus ruderatus	1	7	1	4	9	38	3	53	14	104	+86,3	116
Vitrina pellucida	3	22	1	33	9	17	4	29	17	101	+83,2	118
Nesovitrea hammonis	18	26	16	25	17	34	26	70	77	155	+50,3	232
N. petronella	12	24	6	26	14	40	39	40	71	130	+45,4	201
Zonitoides nitidus							4		4	-	-	4
Euconulus fulvus	13	4	6	4	20		30	41	69	49	-29,0	118
Cochlodina laminata								1	-	1	+	1
Macrogastra plicatula						1		2	-	3	+	3
Clausilia cruciata					1				1	-	+	5
Fruticola fruticum		2		2				1	-	5	-	1
Carychium sp				1		1			-	2		2
Columella sp		1						3	-	4		4
Vertigo sp	2	7					16	2	18	9		27
tot. individuals	149	136	50	134	92	190	176	330	478	792	+39,7	1258
tot. species	12	11	8	12	10	12	12	14	16	16		21
tot. plants	31	28	38	26	35	26	44	33				
forest plants	21	25	27	22	23	25	27	28				
open area plants	10	3	11	4	12	1	17	5				

Table 2. Changes in the land snail community and plant growth in the sample areas of the sample line.

	1991	2009	change %
land snail species	16	16	+-0
new		5	+31,2
disappeared		5	-31,2
tot. land snail individuals	478	792	+39,7
alive	71,1%	62,7%	-12,2
dead	28,9%	37,3%	+22,5
trees and shrubs	11	9	-18,8
ferns	8	8	+-0
plant species of the forest biotope	50	44	-12,0
plant species of an open biotope	25	11	-56,0
tot. vascular plants	75	54	-26,7
new		9	+12,0
disappeared		29	-38,7

curus pratensis, Deschampsia flexuosa, Carduus crispus, Epilobium angustifolium, Galeopsis bifida, Lathyrus pratensis. Ranunculus polyanthemus and *Stellaria longifolia*.

Only 12 % of forest plant species disappeared. Examples of these are *Actaea spicata, Aegopodium podagraria, Carex pallescens, Geum rivale, Linnea borealis, Melampyrum pratense, M. sylvaticum, Mycelis muralis* and *Stachys sylvatica.* Of the nine new species that have spread over the sample areas, seven are typical forest plants, so the change in the number of forest plant species remained small.

It is worthy of note that the number of fern species (eight species) remained the same between 1991 and 2009. The coverage of large ferns such as *Dryopteris expansa* and *Athyrium filix-femina* had clearly increased (Figure 3). The whole study area has changed in the direction of a fern dominated nemoral forest (AthOT).

To be noted

Many land snail species forage for food on tree trunks but climbing higher on bushes or trees is not necessary for them. Micro-climate, moisture and nutrition, on the other hand, are important. The forest surrounding a small opening shadows it from the sun early in the morning and late in the evening, so the dew forms earlier and remains longer. Land snails are typically nocturnal. It seems that in addition to the dew, the moisture close to the soil surface, under the grassy vascular plants and especially under the ferns of the field layer, suffices for land snails. Demanding nemoral forest plant species don't seem to be of significance to land snails due to being few in number.

The species diversity of land snails in the study area has remained unchanged. A small, 2.8 ha open cut area in a lush nemoral forest does not necessarily destroy or decline the land snails in the area. The common land snail species of South Häme have mostly increased.

The changes in land snail community would probably be different if the open cut area were ploughed or furrowed or if it were larger than the one studied here.

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