

Picking of Wild Edible Mushrooms in Finland in 1997–1999 and 2011

Marjut Turtiainen, Olli Saastamoinen, Kari Kangas and Matti Vaara

Turtiainen, M., Saastamoinen, O., Kangas, K. & Vaara, M. 2012. Picking of wild edible mushrooms in Finland in 1997–1999 and 2011. *Silva Fennica* 46(4): 569–581.

This study reports on national survey results concerning mushroom picking in Finland during four separate years: 1997–1999 and 2011. The material was collected by mailed questionnaire surveys amongst Finnish households. The sample size varied from 1858 (in 1998) to 6849 households (in 1997) and the response rates varied from 51% (in 2011) to 70% (in 1999). The results indicate that both the rate of participation in mushroom picking and estimates of the quantities collected varied greatly depending on whether the survey was conducted in a favourable or unfavourable year. In 1998, when the mushroom crop was abundant, a total of 47% of all households were engaged in picking and the total harvest was 16.1 million kg. In 1999, when the crop was poor, the estimates were the lowest (23% and 3.3 million kg, respectively) and in a year with a relatively abundant crop (2011), the estimates were 42% and 15.0 million kg, respectively. Mushrooms were collected mainly for home use, which accounted for 85–90% of the total harvest depending on the year. Only a small proportion of all households (0.3–1.3%) were engaged annually in commercial mushroom picking. In 1997–1999, milk caps formed the major part of the total amount picked (i.e. 37–53% depending on the year), whilst in 2011 their share was approximately one fifth of the total harvest. The results also indicate that the proportion of ceps in commercial picking has increased since the 1990s.

Keywords wild mushrooms, mushroom picking, household use, market use, milk caps, ceps

Addresses University of Eastern Finland, School of Forest Sciences, P.O. Box 111, FI-80101 Joensuu, Finland **E-mail** marjut.turtiainen@uef.fi

Received 5 June 2012 **Revised** 27 August 2012 **Accepted** 6 September 2012

Available at <http://www.metla.fi/silvafennica/full/sf46/sf464569.pdf>

1 Introduction

In Finland, as in many other European countries, there is a long tradition of picking wild edible mushrooms (e.g. Rautavaara 1947, Salo 1995, Sisak 1998, Paal and Saastamoinen 1998, Volkov et al. 2003, Seeland and Staniszewski 2006, 2007). This forest-related activity has maintained its popularity rather well and in some countries, even a growing interest in mushroom picking has been observed during the last decades (e.g. Palahi et al. 2009, Cai et al. 2011). A recent national survey of outdoor recreation indicates that 40% of the Finns picked mushrooms annually in the years 2009–2010 (Sievänen and Neuvonen 2011). For comparison, the corresponding rate of participation in berry picking was 58% (Sievänen and Neuvonen 2011). The generality of mushroom and berry picking in Finland, as well as in Sweden and Norway, is based on the so-called ‘everyman’s right’, the right of open access to all forested areas, which also includes the opportunity to collect wild foods from forests.

Finns have adopted two traditions for the inclusion of mushrooms in their diet; eastern and western. The latter, the old Roman tradition, came through France and Sweden to the educated people of southwest Finland and the eastern tradition came from Russia via Karelia, which was stronger because it was adopted by ordinary country folk (Härkönen 1998). The western tradition favoured chanterelles (*Cantharellus cibarius* Fr.) and ceps (*Boletus edulis* Bull.:Fr., *B. pinophilus* Pilat & Dermek), whereas the eastern tradition focused primarily on milk caps (woolly milk cap (*Lactarius torminosus* Schaeff.:Fr.), northern milk-cap (*L. trivialis* (Fr.:Fr.) Fr., *L. utilis* (Weinm.) Fr.) and other *Lactarius* species) (e.g. Rautavaara 1947, Härkönen 1998). The picking and use of wild mushrooms has always been and still is, more common in eastern Finland compared with other parts of the country (e.g. Rautavaara 1947, Sievänen et al. 2002). Nowadays the collection of mushrooms is no longer motivated by the demands of subsistence but has largely become a leisure-time activity combining benefit and recreation. However, tax-free earnings received from mushroom picking are an important source of extra income for many people, particularly in rural regions of eastern Finland (Cai et al. 2011).

Compared with studies on wild berries, Finnish

studies on picking wild mushrooms are relatively few and most of these studies are regional, i.e. concern either a certain municipality or district (Salo 1984, 1985, Jäppinen et al. 1985, Saastamoinen and Lohiniva 1989, Kujala et al. 1987, 1989, Sipola et al. 1994, Hyppönen et al. 2009, Cai et al. 2011). National studies have focused on the utilisation (consumption) of mushrooms rather than the picking of them, other than for a few exceptions (Pekkarinen et al. 1980, Sievänen et al. 2004). Pekkarinen et al. (1980) explored, among others, household involvement in mushroom picking and the average amounts picked during 1977 but did not provide any estimate of the total annual harvest. Sievänen et al. (2004) used data from the first national survey of outdoor activities conducted in 1998–2000, in order to examine mushroom picking skills, participation in picking and the frequency of picking occasions. Their focus on recreational participation meant that they too did not produce information about the quantities picked.

Despite the sparse research results, there are some useful statistics on mushroom picking. In particular, it must be noted that important statistics on the annual quantities of berries and mushrooms (by major species or groups of species) bought by organised trade and industry, have existed since 1977 (so-called MARS statistics). However, an “unorganised” trade, including the major part of the outdoor market trade and direct trade to kitchens and restaurants, is not represented in these statistics (Finnish Statistical... 2011, Maaseutuvirasto 2012).

An important source of information regarding the utilisation and picking of mushrooms and berries by Finnish households has been the periodical Household Budget Survey (see e.g. Ahlqvist and Ylitalo 2009), carried out approximately every five years since 1966 by Statistics Finland. This includes data on different household groups and regions regarding self-collected mushrooms for a household’s own consumption and purchased mushrooms. However, data on the amounts of food consumed, that was regularly provided as a part of the Household Budget Survey until 1998, is no longer available because Statistics Finland now only enquires about consumption expenditure (Viinisalo et al. 2008). In 2006, the amounts consumed were explored in co-operation with the

National Consumer Research Centre (Viinisalo et al. 2008). The results of Household Budget Surveys and trade and export statistics, among other sources, have also been used in making annual and historical estimates of the value of berries and mushrooms as a minor component of forestry value added in the National Accounts (Kunnas 1973, Saastamoinen 1978, Saastamoinen et al. 1998).

Due to the lack of comprehensive surveys, the available recent national estimates on the picking of mushrooms have largely been educated estimates based on the results of trade statistics, other non-systematic data and long-term knowledge in the field. For example, it had been estimated that the amount of edible mushrooms harvested annually has varied from 5 to 9 million kg during recent years (Salo 2011). According to an earlier estimation, the amount of mushrooms picked for household use ranges from 2.5 to 10 million kg and for sale from 0.5 to 1.5 million kg (Moisio 2006).

Although well-deliberated estimates are useful, it is evident that there is a lack of reliable national estimates of the extent to which mushrooms have been picked in more recent years by Finnish households, both for their own use and for sale. As the annual crops vary greatly, it would be necessary to form an overall picture of the picked amounts on the basis of data covering a period of several consecutive years (cf. Saastamoinen et al. 2000, Turtiainen et al. 2011).

Despite these gaps in statistics and research results, it may well be that the state of knowledge in Finland still exceeds that of most other countries, reflecting the general difficulties in monitoring the amount and value of a large variety of non-wood forest products (NWFPs) in Europe (Forest Europe... 2011, Turtiainen and Nuutinen 2012) and elsewhere (e.g. Vantomme 2003, Pierce and Bürgener 2010).

In other European countries, only a handful of estimates are available at national levels, for the total quantities of picked wild mushrooms. In Sweden, for example, Hultman (1983) estimated that 21.8 million litres (about 13.1 mill. kg) of mushrooms were collected for home consumption in 1977. Twenty years later, a similar questionnaire survey indicated that no significant change had occurred in the Swedes' picking behaviour, i.e. both participation in mushroom picking

(32%) and the volumes picked per person had remained unaltered (Lindhagen and Hörnsten 2000). Undoubtedly, the most thorough research on berry and mushroom picking besides Finland, has been conducted in the Czech Republic, where annual surveys have been carried out since 1994 (Sisak 2006, also L. Sisak, pers. comm.). During 1994–2005, the total amount of mushrooms picked varied from 13.5 to 29.7 million kg (Sisak 2006).

The purpose of the present paper is to report on the national results concerning mushroom picking by Finnish households during four separate years; 1997–1999 and 2011 (so far only a few preliminary estimates have been given for the years 1997 and 1998 in a popular article of Saastamoinen and Kangas 2001). In particular, the following results are presented for each of the study years: participation in picking (also in commercial picking), collected amounts (both for household consumption and sale) and distribution of the picked amounts according to the species. In this study, “mushrooms” includes only wild mushrooms, i.e. products from mushroom farms are not considered.

2 Materials and Methods

A sample of 6849 households was extracted from the Finnish National Population Register in 1997. In fact, the sample was drawn from amongst the inhabitants aged over 18 years but, in the case of each person included in the sample, the questionnaire sent concerned not only the person in question but the whole household. In 1997, the sampling frame included approximately 2 188 000 households. The sample was stratified according to the previous division of provinces in Finland so that provinces located on the mainland were considered (i.e. 11 provinces or strata) (Fig. 1). More resources were allocated to the strata where the gathering of wild berries and mushrooms was known to be popular, mainly on the basis of existing statistics on commercial collecting (Malin 1997). Maybe it is worth noting that Ahvenanmaa (i.e. province 12 in Fig. 1) was excluded from this study because it belongs to hemiboreal vegetation zone and, thus, differs from the other parts

of the country in many ways (see e.g. Kalliola 1973). After one call-back, the response rate for the mailed questionnaire sent out during the last quarter of 1997, stood at 60% (Saastamoinen et al. 2000).

For the 1998 and 1999 surveys, smaller samples of 1858 and 1913 households were extracted from the sampling frame of 1997 (i.e. from the list of 6849 households used in 1997) and questionnaires were mailed during the last quarter of those years. Samples were allocated into provinces according to the Neyman allocation (Cochran 1977) on the basis of the data from 1997. As a result of experience gained from the survey of 1997, people over 80 years old were excluded from the samples of the following years. In 1998 after one call-back, a response rate of 69% was obtained. In the following year, the response rate reached 70% when the number of households with out-dated addresses (71 households) was excluded.

In 2011, a new sample of 3700 households was taken from the Finnish National Population Register (the sampling frame included approximately 2 503 000 households). This sample was stratified using an equal allocation, i.e. Finland was divided into five areas (Fig. 1), each containing a random sample of equal size (740 households). Questionnaires were distributed in October–November 2011 and after a second mailing, the response rate stood at 51%.

The 1997 questionnaire form was rather comprehensive and included several questions concerning wild berries, wild mushrooms, as well as other NWFPs. In other years, the questionnaire form included only questions concerned with the quantities of wild berries and mushrooms collected. During the first three years of concern in this study, enquiries were made into the amount of mushrooms collected by the whole household for its own use and also for commercial purposes. The reporting of the distribution of collected mushrooms according to species was anticipated to be difficult and so this was addressed by a voluntary question. In 2011, respondents were asked to report separately not only the total amount picked for home use and for sale but also the amount by different mushroom species. However, the number of species or categories of species listed in the questionnaire form was lower compared with earlier years (for example, northern

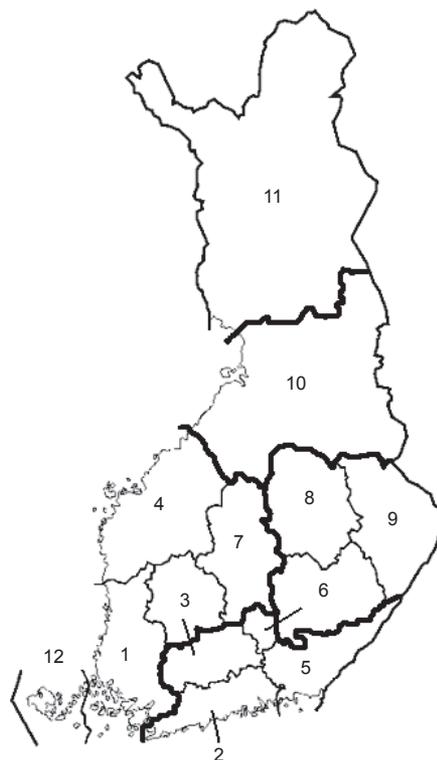


Fig. 1. Division of provinces in Finland in 1997 (thin lines) and division of five areas used as a basis of stratification in the 2011 survey (thick lines). Provinces 1–11 were applied as a basis of stratification in the 1997–1999 surveys. Two of the provinces (numbers 3 and 6) were split when areas for the 2011 survey were formed; otherwise the boundaries of five areas follow the boundaries of the previous provinces.

milk-caps were no longer separated from other milk caps), which was assumed to make it easier to answer. In all study years, the information on the amounts picked was requested as fresh and cleaned (in litres). For the purposes of this study, the litre estimates were subsequently converted into kilograms of fresh and cleaned mushrooms (1 kg = 2 litres).

In practice, almost all surveys suffer from non-response (Glynn et al. 1993). It has previously been found that people who are interested in a given topic and who are involved in the activities under study respond more frequently or promptly

than less interested people (Goyder 1987, Dillman 1991, Martin 1994). In this study, a decreasing trend was observed when the quantities collected and the level of involvement in mushroom picking in the 1997 data were compared between the successive batches of responses (i.e. between the responses before and after a call-back). This fact strengthened the suspicion of non-ignorable non-response.

To calculate an appropriate estimate with non-ignorable non-response, additional information (either direct or indirect) about the non-respondents is necessary (Glynn et al. 1993). A commonly used method to obtain direct information is to take a sample of non-respondents and generalise it to all of the non-respondents (e.g. Kanuk and Berenson 1975, Glynn et al. 1993). In the present study, this procedure was used for the 1997, 1999 and 2011 surveys. In 1997, a stratified random sample of 439 households was drawn from amongst the non-respondents and they were interviewed by telephone during the spring of 1998. In 1999, a sample of 187 non-respondents was interviewed during the latter part of the year. In 2011, the corresponding sample size was 176 and non-respondents included in the sample were interviewed during the first quarter of 2012. As the picking season had ended a relatively long time ago, only aggregate figures for commercial collection and for collection for home use were enquired into in the follow-ups.

To introduce the idea described above, the notation is presented here, mostly according to Glynn et al. (1993). In each stratum h ($h=1, \dots, L$; $L=11$ in 1997 and 1999, and $L=5$ in 2011), a random sample of n_h households is taken from a finite population of N_h households. Of n_h , n_{1h} are respondents and n_{0h} are non-respondents. A random sample of size n_{01h} is taken from the n_{0h} non-respondents, where \bar{y}_{01h} is the sample mean and s_{01h}^2 is the sample variance for the n_{01h} followed-up respondents. Consequently, the observed Y_h data in stratum h consists of $n_{1h}+n_{01h}$ values.

A double-sampling procedure is used in the estimation of population mean, \bar{Y} (Cochran 1977, Glynn et al. 1993). Respondents are considered as one sub-population and non-respondents as another sub-population in each stratum. Therefore, the estimate of \bar{Y} is

$$\hat{\bar{Y}} = \sum_{h=1}^L W_h [(n_{1h}\bar{y}_{1h} + n_{0h}\bar{y}_{01h}) / n_h] \quad (1)$$

and the associated variance is approximately

$$\begin{aligned} & \sum_{h=1}^L W_h^2 \left(\frac{1}{n_h} - \frac{1}{N_h} \right) \left(\frac{n_{1h}}{n_h} \right) s_{1h}^2 \\ & + \sum_{h=1}^L W_h^2 \left(\frac{n_{0h}}{n_h n_{01h}} - \frac{1}{N_h} \right) \left(\frac{n_{0h}}{n_h} \right) s_{01h}^2 \\ & + \sum_{h=1}^L W_h^2 \frac{N_h - n_h}{(N_h - 1)n_h} \left(\frac{n_{0h}n_{1h}}{n_h^2} \right) (\bar{y}_{01h} - \bar{y}_{1h})^2 \end{aligned} \quad (2)$$

In Eqs. 1 and 2, \bar{y}_{1h} is the sample mean for the n_{1h} respondents (and s_{1h}^2 is the associated sample variance) and W_h is the population weight (i.e. $N_h / \sum_{h=1}^L N_h$). It is worth noting that information

drawn from the follow-up data was incorporated not only into the estimates of the means (see Eq. 1) but also into the total estimates and rates of participation in mushroom picking. In each year (also in 1998), the total quantity estimated for the year in question, was divided amongst the mushroom species according to the distribution, calculated on the basis of the mail survey data of the year.

In 1998, no follow-up data amongst the non-respondents was collected. Instead, the results for 1997 were used in the analysis of 1998 results. In the samples of 1997 and 1998, it was found that 1011 households had reported the amount of mushrooms picked in both years. The changes that occurred in the quantities collected by these 1011 households were assumed to be representative of the whole sample. Consequently, the results for 1997, which were calculated using Eq. 1 and thus included the non-response adjustment, were multiplied by the ratios calculated. This calculation was done for each province. As a result of this procedure, the estimates of this study include the non-response adjustment also for 1998.

Variation in the estimates was expressed in terms of confidence intervals (Cochran 1977, and further Chojnacky 1998) so that the variance estimates were computed by means of Eq. 2. However, the confidence intervals for marketed mushrooms can be regarded only tentative because the number of observations concerning commercial pickers remained low. Confidence

intervals were not estimated for the 1998 results due to the computational process (i.e. due to the fact that variances could not be calculated using Eq. 2).

3 Results

In 1998, a total of 47% of all households engaged in mushroom picking (Table 1). During this particular year, the picked amounts, both average and total volumes, were also the highest when compared with the other study years (7.3 kg per household and 16.1 mill. kg, respectively). However in 2011, the total volume of mushrooms picked was almost at the same level (15.0 mill. kg) (Tables 2 and 3). In 1999, all these estimates were the lowest during the study period (23%, 1.5 kg per household and 3.3 mill. kg, respectively) (Tables 1–3).

In 1997–1999, milk caps were the most commonly picked mushroom species (Table 4). In 2011, category “others”, including e.g. false

Table 1. Participation in mushroom picking and in commercial mushroom picking by Finnish households in 1997–1999 and 2011.

Year	Proportion of all households (%)	
	Participation in picking	Participation in commercial picking
1997	38	0.6
1998	47	1.3
1999	23	0.3
2011	42	1.0

morels (*Gyromitra esculenta* (Pers.:Fr.) Fr.) and trumpet-shaped chanterelles (*Cantharellus tubaeformis* (Bull.:Fr.) Fr.), formed the largest part of the total quantity of mushrooms picked (40%). The shares of chanterelles and milk caps were approximately equal at 23% and 21%, respectively (Table 4).

In each year, mushrooms were collected mainly for home use, which accounted for 85–90% of the total harvest depending on the year (Tables 2 and 3). When considering collection for house-

Table 2. Wild mushrooms (kg per household) picked by Finnish households in 1997–1999 and 2011 (95% confidence intervals are given in parentheses). Proportions of the total picked for home use and for sale are presented in square brackets.

	1997	1998	1999	2011
For home use	3.5 [90 %] (2.7; 4.3)	6.2 [85 %]	1.3 [90 %] (1.1; 1.6)	5.2 [88 %] (3.8; 6.7)
For sale	0.4 [10 %] (0.0; 0.8)	1.1 [15 %]	0.2 [10 %] (0.0; 0.4)	0.7 [12 %] (0.0; 1.5)
Total	3.9 (3.0; 4.8)	7.3	1.5 (1.2; 1.8)	6.0 (4.3; 7.6)

Table 3. Total mushroom quantities picked (million kilograms) by Finnish households in 1997–1999 and 2011 (95% confidence intervals are given in parentheses).

	1997	1998	1999	2011
For home use	7.7 (5.9; 9.4)	13.7	3.0 (2.4; 3.6)	13.1 (9.6; 16.7)
For sale	0.9 (0.0; 1.8)	2.4	0.4 (0.0; 0.8)	1.8 (0.0; 3.7)
Total	8.6 (6.6; 10.5)	16.1	3.3 (2.6; 4.1)	15.0 (10.8; 19.1)

Table 4. Proportions of different species or categories of species from the total quantity of mushrooms picked in 1997–1999 and 2011. In the parentheses, the corresponding proportions from the amount of commercial picking are presented for the years 1997 and 2011.

Species	Proportion of total (%)			
	1997	1998	1999	2011
Milk caps	37 (39)	48	53	21 (37)
Northern milk-cap	20 (37)	33	28	
Other milk caps	17 (2)	15	25	
Chanterelles	11 (5)	22	15	23 (3)
Ceps	12 (9)	7	3	10 (23)
Other boletuses	7 (0)	3	3	4 (1)
Russulas	3 (0)	2	3	2 (0)
Others	30 (46)	18	22	40 (36)

hold use only, annual distributions of the picked amounts by different species were quite similar to those estimated for the total harvests (see Table 4) and, therefore, not separately presented in this study. In fact, it is quite obvious that these distributions resembled each other because most mushrooms were picked particularly for own use.

Only a small proportion of all households (0.3–1.3%) engaged annually in commercial mushroom picking, the highest figure being from 1998 (Table 1). The total quantities collected for sale varied from 0.4 mill. kg (in 1999) to 2.4 mill. kg (in 1998) and was 1.8 mill. kg in 2011 (Table 3). In 1997, mushrooms including the category “others” and milk caps, formed 85% of all mushrooms collected for sale, whilst the proportions of other species remained relatively low (Table 4). In 2011, milk caps and category “others” both constituted approximately one third of the amount of commercial picking. The share of ceps was almost one fourth (Table 4).

4 Discussion

This study is the first occasion when national survey results on the quantities of mushrooms picked by Finnish households have been reported for several years (for three consecutive years 1997–1999 and for the year 2011). Earlier, the corresponding results concerning wild berry picking in Finland in 1997–1999 have been presented

by Saastamoinen et al. (2000) and to a lesser extent, by Turtiainen et al. (2011). To ensure the comparability of results, the basic data for the 2011 survey were collected using the same form of questions as in the study of Saastamoinen et al. (2000) and Turtiainen et al. (2011) for the years 1997–1999.

Non-response bias can be regarded as one of the greatest limitations to validity in any survey (e.g. Dillman 1991, Connelly et al. 2003). In this study and also in the work of Saastamoinen et al. (2000), the non-response bias was reduced by collecting follow-up data from a sample of non-respondents and generalising them to all of the other non-respondents. In both of these studies, the estimates of the mean were derived using Eq. 1 which takes into account not only the non-response bias but also the effects of sample stratification. Saastamoinen et al. (2000) estimated the variances by applying a standard method subsequent to a single imputation. However, this method was later found to reduce the variance estimates and consequently produce confidence intervals that were too narrow (Kangas 2001). Therefore, the variance estimates for the present study were calculated using an improved method (i.e. Eq. 2), as suggested by Kangas (2001).

It has been stated that consideration of non-response bias is becoming increasingly important as response rates to all types of surveys have shown a declining trend over recent years (e.g. Connelly et al. 2003, Graefe et al. 2011). Also in this study, a decreasing trend over time

was observed when response rates of the 1997–1999 surveys (60–70%) were compared with the response rate of the 2011 survey (51%). Naturally there are also other explanations for the high variation in response rates obtained in this study. The most significant of these is undoubtedly the fact that in 1997 the questionnaire form was quite comprehensive and lengthy (11 pages), whilst for the other study years the length of the questionnaire varied from two to four pages. It is presumable that an increase in response rate by ten percentage units between the 1997 survey and 1998–1999 surveys was caused primarily by this fact (cf. Saastamoinen et al. 2000).

In addition to problems related to non-response, there are also many other problems in obtaining valid data from mail surveys (e.g. Dillman 1991). In this study, the questionnaires were distributed in late autumn when the picking season of most mushroom species was already over. False morels represent an extreme in this respect because they are picked in early spring. Thus, it is possible that there may have been memory failures, at least to some extent but it is difficult to say whether this bias is upward or downward. On the other hand, the picking season of some mushrooms, e.g. trumpet-shaped chanterelles, was still underway when the questionnaires were mailed (it continues up to the appearance of snow cover, the date of which varies greatly from year to year). This fact has most probably caused a downward bias in the estimates of this study but it is hard to conclude to what extent.

Respondents were asked to report the quantities picked as litres of fresh and cleaned mushrooms. In order to make answering as simple as possible, they were given an instruction specifying that one kilogram corresponds approximately to two litres of fresh and cleaned mushrooms. However, it is possible that some of the respondents found it difficult to provide the amounts as requested in the questionnaire (i.e. measurement error, see e.g. Dillman 1991). For example, a respondent may have recalled the collected volume before any treatment (i.e. before cleaning and other treatments) but was not able to convert it into cleaned and fresh mushrooms. Thus, in future questionnaires that concern mushroom picking, it should be seriously considered whether more instructions should be included in the questionnaire form

or alternatively, whether the respondents should be given an opportunity to report the amounts collected in the way they feel most comfortable (and leave any transformations needed to the researchers). Generally, experience gained from the 2011 survey, indicated that respondents had no problems in reporting the quantities picked according to the species or categories of species (cf. the 1997–1999 questionnaires). This fact is encouraging for employing similar species-specific questions in future surveys.

The results indicated that total annual harvests of mushrooms have varied more than presumed by the experts (cf. Moisio 2006, Salo 2011) during the last fifteen years. During two out of the four study years (1998 and 2011), the total quantities picked were considerably higher when compared with the upper limits of the estimates by both Moisio (2006) (i.e. 3–11.5 mill. kg) and Salo (2011) (i.e. 5–9 mill. kg). The total volume calculated for 1999 remained below the lower limit of the estimate of Salo (2011) but fell within the range of variation estimated by Moisio (2006). The total for 1998 (16.1 mill. kg) was almost as high as the record amount for the wartime year of 1943 (16.6 mill. kg), although in this comparison, it is important to keep in mind that the latter figure compiled for annual national accounting purposes is based on rather inaccurate data (Kunnas 1973). It is estimated that 2003 was a good crop year in which the total harvest of mushrooms reached 13.5 mill. kg (Salo 2011). This estimate for a single year, based on interviews with people working in mushroom companies and on expertise, is not so far from the results for 2011 reported in this study.

It was also found that both rates of participation in mushroom picking and estimates of quantities collected varied greatly depending on whether the survey hit a favourable or an unfavourable year (see also Sievänen et al. 2004). In Finland, there is no data on inter-annual variation in mushroom crops. However, it can be presumed that annual statistics on the quantities of wild mushrooms bought by organised trade and industry reflects, at least to some extent, also annual crop levels (cf. Turtiainen et al. 2011). In the present study, very different crop levels were represented by the survey years 1997–1999 and 2011. In 1998, there were abundant crops of all kinds of mushrooms

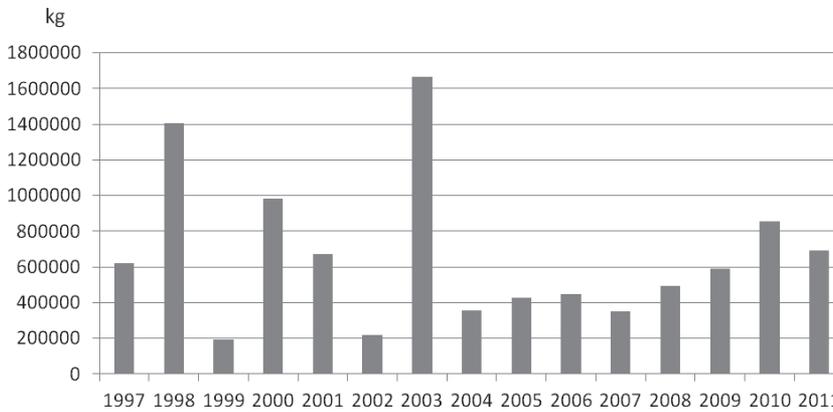


Fig. 2. Market supply of wild edible mushrooms in Finland in 1997–2011 (Maa- ja metsätalousministeriö 2007, Maaseutuvirasto 2012).

available for pickers, whilst in the following year the situation was totally different (Fig. 2; also information gained from newspapers and media releases of the Finnish Forest Research Institute). In 1997, the crop level was quite average. Therefore, it is presumable that the results concerning the years 1997–1999 provide an appropriate basis from which to form a picture of the picking intensity of the Finns, as well as fluctuations depending on the availability of mushrooms, at the end of the twentieth century. However, if one's aim is to examine any possible changes that may have occurred in the Finns' picking behaviour since the 1990's, it is a more difficult task on the basis of a single study year (2011). In 2011, the crop level was relatively abundant (Fig. 2; also information gained from various sources, e.g. from newspapers and media releases of the Finnish Forest Research Institute) and the rate of participation and picked amounts were not far from the corresponding estimates for 1998 but still, as comparisons between individual years are always more or less tentative in nature, any certain conclusions cannot be drawn on possible changes. For this purpose, a longer series of annual surveys is needed, including at least two other years with variations in crop abundance. In fact, two subsequent survey years (2012 and 2013) have already been planned. Naturally there is also a need to monitor annual mushroom crops by means of empirical measurements (cf. wild berry inventories, see e.g. Turtiainen et al. 2011).

When the total estimates of this study concerning commercial collection (Table 3) are compared with the MARSİ statistics (Fig. 2), it can be observed that the estimates presented in Table 3 are systematically and considerably higher (49% in 1997, 72% in 1998, 87% in 1999 and 165% in 2011). In this comparison, it is important to keep in mind that the figures reported in MARSİ statistics are not all-inclusive as they ignore "unorganised" trade. However, the results of this study for commercial picking (especially those included in Table 4) cannot be regarded as reliable as the other results due to the relatively low number of commercial pickers in the data for each year. For this reason, the proportions of different species from the total amounts picked for sale were presented only as an example for two study years (1997 and 2011). Despite the limitations mentioned above and the differences in mushroom crops between these two years, it can be seen that the proportion of ceps in commercial picking has increased since the 1990's (Table 4). A similar observation can be made when examining the MARSİ statistics in the long term. These findings are in line with the fact that exports of ceps to the markets of southern Europe has increased significantly since the late 1990's. This is thanks to thousands of rural dwellers, particularly in eastern parts of the country, who have engaged in commercial harvesting of this species through the development of a well-organised export trade, mainly to Italy, by a single entrepreneur (e.g.

Richards and Saastamoinen 2010, Cai et al. 2011). For the first time in 2011, the share of foreign pickers (15% of all mushroom sales) was also reported (Maaseutuvirasto 2012).

The results of the present study can also be compared with the Household Budget Surveys. In 1998 and 2006, when the consumed amount of foods was last explored, the average quantities of mushrooms consumed by households were 3.0 and 1.9 kg/household, respectively (Viinisalo et al. 2008). As mentioned earlier, these figures include not only self-collected mushrooms but also those purchased from shops (both wild and cultivated mushrooms). However, the share of the latter component (i.e. purchased mushrooms) is much lower compared with the self-collected products (e.g. Pekkarinen et al. 1980, Kotimaiset Kasvikset ry 2006). In 2006, for example, the purchase of mushrooms was less than 0.6 kg/household (Kotimaiset Kasvikset ry 2006). The comparison indicates a high difference between the results of this study (Table 2) and the figures based on the Household Budget Surveys. Pekkarinen et al. (1980), who compared their study results with the corresponding national statistics, observed even higher differences and consequently, presented several potential explanations for the high differences in the figures. The most significant of these was related to the respondents' difficulties in providing the amounts in the way that was requested by the questionnaire form (as discussed also in this paper), which may have led, according to Pekkarinen et al. (1980), to overestimates. Other explanations included: 1) the fact that the survey method applied by Pekkarinen et al. (1980) differed from the method used in the Household Budget Surveys and 2) the fact that the surveys were conducted during different years (representing different crop levels). These explanations are applicable also for this study.

Several reasons can be found that support the conducting of long-term national studies on the collection of wild mushrooms, as well as other common NWFPs, in Finland and also other European countries. First, long-term national monitoring makes it possible to observe changes or trends that occur in the use of different NWFPs. This kind of knowledge can be utilised for various purposes, for example, when developing natural product sectors of a certain country. Second, it is

anticipated that with climate change there will also be further changes, e.g., in mushroom production by species and by forest types (e.g. Palahi et al. 2009). In Finland, as in any other country, these changes will presumably affect the utilisation of mushrooms so that, in a considerable long-term, some species will become more commonly picked and used, whilst some other species may lose their significance in the mushroom culture of a country. Finally, there are two data collection efforts related to pan-European reporting of NWFPs (the Global Forest Resources Assessment (FRA) and the State of Europe's Forests), which ask countries to provide information on various aspects of NWFPs. FRA requests information on total harvested quantities and values, whilst the State of Europe's Forests includes marketed products. It has been found that for the "State of Europe's Forests 2007" report (MCPFE/UNECE/FAO 2007), for example, many countries provided only rough estimates on the quantities and values of marketed mushrooms and berries, or did not provide any information, because of the absence of reliable national data (Turtiainen and Nuutinen 2012). In fact, Finland was one of the rare countries that could offer figures based on official statistics (i.e. MARS statistics) but, as mentioned above, even these figures were not all-inclusive. It is quite obvious that national NWFP surveys carried out by as many countries as possible, would also improve international statistics.

Acknowledgements

This study was initiated in 1997 as a part of a three-year research project titled "Between Subsistence and Global Markets: Grassroot Economies, Social Structures and National Policies in Sustaining Non-Wood Forest Products", funded by the Academy of Finland (Finnish Biodiversity Research Programme FIBRE). In 2011–2012, this study was supported by the strategic funding of the University of Eastern Finland (UEF) as a WP 4.3 of CABI-project. The School of Forest Sciences of UEF provided material support for the study.

References

- Ahlqvist, K. & Ylitalo, M. 2009. (eds.). Households' consumption 1985–2006. Statistics Finland, Income and consumption. 254 p. (In Finnish with English summary).
- Cai, M., Pettenella, D. & Vidale, E. 2011. Income generation from wild mushrooms in marginal rural areas. *Forest Policy and Economics* 13: 221–226.
- Chojnacky, D.C. 1998. Double sampling for stratification: a forest inventory application in the Interior West. USDA, Forest Service. Rocky Mountain Research Station, Research Paper, RMRS-RP-7. Available at: http://www.fs.fed.us/rm/pubs/rmrs_rp007.pdf. [Cited 24 Aug 2012].
- Cochran, W.G. 1977. Sampling techniques. 3rd edition. John Wiley & Sons, Inc., New York–Chichester–Brisbane–Singapore. 428 p.
- Connelly, N.A., Brown, T.L. & Decker, D.J. 2003. Factors affecting response rates to natural resource – focused mail surveys: empirical evidence for declining rates over time. *Society and Natural Resources* 16: 541–549.
- Dillman, D.A. 1991. The design and administration of mail surveys. *Annual Review of Sociology* 17: 225–249.
- Finnish Statistical Yearbook of Forestry. 2011. Finnish Forest Research Institute. 470 p. (In Finnish with English summary).
- Forest Europe, UNECE & FAO. 2011. State of Europe's forests 2011. Status and trends in sustainable forest management in Europe. 337 p.
- Glynn, R.J., Laird N.M. & Rubin, D.B. 1993. Multiple imputation in mixture models for nonignorable nonresponse with follow-ups. *Journal of the American Statistical Association* 88(423): 984–993.
- Goyder, J. 1987. The silent minority: nonrespondents on sample surveys. Polity Press, Cambridge. 232 p.
- Graefe, A., Mowen, A., Covelli, E. & Trauntvein, N. 2011. Recreation participation and conservation attitudes: differences between mail and online respondents in a mixed-mode survey. *Human Dimensions of Wildlife* 16: 183–199.
- Härkönen, M. 1998. Uses of mushrooms by Finns and Karelians. *International Journal of Circumpolar Health* 57(1): 40–55.
- Hultman, S-G. 1983. How much berries and mushrooms do we actually pick? *Vår Föda* 35: 284–297. (In Swedish with English summary).
- Hypönen, M., Hyvönen, J., Morri, P., Puoskari, J. & Hallikainen, V. 2009. Keräilyn, metsästyksen ja kalastuksen merkitys Ylä-Lapin kuntien kotitalouksille. [The significance of gathering, hunting and fishing to the households living in the communes of Upper Lapland]. *Metsätieteen aikakauskirja* 1/2010: 65–73. (In Finnish).
- Jäppinen, J-P., Kirsi, M. & Salo, K. 1985. Luonnonvaraisten sienten sadot ja kaupallinen poiminta Itä-Suomessa, ensisijaisesti Pohjois-Karjalan läänissä. [Crops and commercial picking of wild mushrooms in Eastern Finland, primarily in North Karelia]. *Metsäntutkimuslaitoksen tiedonantoja* 200. 103 p. (In Finnish).
- Kalliola, R. 1973. Suomen kasvimaantiede. [Botanic geography in Finland]. Werner Söderström Oy, Porvoo. 308 p. (In Finnish).
- Kangas, K. 2001. Wild berry utilisation and markets in Finland. University of Joensuu, Faculty of Forestry. Academic dissertation. 43 p. + 5 appendices.
- Kanuk, L. & Berenson, C. 1975. Mail surveys and response rates: a literature review. *Journal of Marketing Research* 12: 440–453.
- Kotimaiset Kasvikset ry. 2006. Kasvistase 2006. [Balance sheet on vegetables in 2006]. Available at: www.kasvikset.fi/Link.aspx?id=1047622. [Cited 16 Mar 2012]. (In Finnish).
- Kujala, M., Kynsilehto, K., Ohenoja, E., Saastamoinen, O. & Sepponen, P. 1987. Lapin läänin luonnonmarja- ja sienivarat, niiden satoarviot, hyödyntäminen ja sivuansiollinen merkitys. [Wild berry and mushroom resources in Lapland, their yield estimates, utilisation and significance as a source of extra income]. Pellervo-Seuran Markkinatutkimuslaitos. Polar-marsi 86 loppuraportti. 60 p. (In Finnish).
- , Malin, A., Ohenoja, E. & Sipola, K. 1989. Oulun läänin luonnonmarja- ja sienivarat, niiden satoarviot, hyödyntäminen ja sivuansiollinen merkitys (Ouka-projekti). [Wild berry and mushroom resources in Oulu region, their yield estimates, utilisation and significance as a source of extra income]. Pellervo-Seuran Markkinatutkimuslaitos, Raportteja ja artikkeleita 27. 74 p. (In Finnish).
- Kunnas, H.J. 1973. Forestry in Finland, 1860–1965. Studies on Finland's economic growth IV. Bank of Finland publications. Helsinki. 192 p. (In Finnish with English summary).
- Lindhagen, A. & Hörnsten, L. 2000. Forest recreation in 1977 and 1997 in Sweden: changes in

- public preferences and behaviour. *Forestry* 73(2): 143–153.
- Maa- ja metsätalousministeriö. 2007. Marjojen ja sienten kauppantulomäärät vuonna 2006. MARSİ 2006. [Market supply of berries and edible mushrooms in 2006]. Helsinki. Available at: http://www.mmm.fi/attachments/mmm/julkaisut/muutjulkaisut/5nIQT3MPv/MARSİ_2006_MMM_raportti.pdf. [Cited 23 Aug 2012]. (In Finnish).
- Maaseutuvirasto. 2012. Luonnonmarjojen ja -sienten kauppantulomäärät vuonna 2011. MARSİ 2011. [Market supply of wild berries and edible mushrooms in 2011]. Seinäjoki. Available at: http://www.mmm.fi/attachments/mmm/julkaisut/muutjulkaisut/66Y6ezH53/Korjattu_MARSİ_2011_MMM_final.pdf. [Cited 4 Apr 2012]. (In Finnish).
- Malin, A. 1997. Marjojen ja sienten kauppantulomäärät vuonna 1996. MARSİ 96. [Market supply of berries and edible mushrooms in 1996]. Elin- tarviketieto Oy, Food and Farm Facts Ltd. 21 p. + appendices. (In Finnish).
- Martin, C.L. 1994. The impact of topic interest on mail survey response behaviour. *Journal of the Market Research Society* 36: 327–338.
- MCPFE/UNECE/FAO. 2007. State of Europe's Forests 2007. The MCPFE report on sustainable forest management in Europe. Jointly prepared by the MCPFE Liaison Unit Warsaw, UNECE and FAO. 247 p.
- Moisio, S. 2006. Luonnontuotteiden talteenoton ja käytön edistämisohjelma 2007–2010. [Programme for promoting the picking and use of natural products in Finland during 2007–2010]. Arktiset Aromit ry, Arctic Flavours Association. 37 p. (In Finnish).
- Paal, T. & Saastamoinen, O. 1998. Non-wood plant products in Estonian forests. In: Lund, G., Pajari, B. & Korhonen, M. (eds.). Sustainable development of non-wood goods and benefits from boreal and cold temperate forests. *EFI Proceedings* 23. p. 109–117.
- Palahi, M., Pukkala, T., Bonet, J.A., Colinas, C., Fischer, C.R. & Martinez de Aragon, J.R. 2009. Effect of the inclusion of mushroom values on the optimal management of even-aged pine stands of Catalonia. *Forest Science* 55(6): 503–511.
- Pekkarinen, M., Poikela, M. & Koskinen, E.H. 1980. Sienten käyttö kotitalouksissa. [Use of mushrooms by the Finnish households]. Helsingin yliopisto, Elin- tarviketekemian ja -teknologian laitos. EKT-sarja 537. 159 p. (In Finnish).
- Pierce, A. & Bürgener, M. 2010. Laws and policies impacting trade in NTFPs. In: Laird, S.A., McLain, R.J. & Wynberg, R.P. (eds.). Wild product governance – finding policies that work for non-timber forest products. Earthscan, People and Plants International Conservation Series. p. 327–342.
- Rautavaara, T. 1947. Studies on the mushroom crop in Finland and its utilization. Werner Söderström Osakeyhtiö, Porvoo–Helsinki. 534 p. (In Finnish with English summary).
- Richards, R.T. & Saastamoinen, O. 2010. NTFP policy, access to markets and labour issues in Finland: impacts of regionalization and globalization on the wild berry industry. In: Laird, S.A., McLain, R.J. & Wynberg, R.P. (eds.). Wild product governance – finding policies that work for non-timber forest products. Earthscan, People and Plants International Conservation Series. p. 287–307.
- Saastamoinen, O. 1978. Havaintoja marjastuksen ja sienestyksen taloudesta. [Observations about the economy related to berry and mushroom picking]. Metsäntutkimuslaitos. Rovaniemen tutkimusase- man tiedonantoja 16. 21 p. (In Finnish).
- & Kangas, K. 2001. Miljoonia mätäneä metsiin. [Millions kilogrammes remain unpicked in the forests]. *Ostiensis* 4B: 28–29. (In Finnish).
- & Lohiniva, S. 1989. Picking of wild berries and edible mushrooms in the Rovaniemi region of Finnish Lapland. *Silva Fennica* 23(3): 253–258.
- , Kangas, J., Naskali, A. & Salo, K. 1998. Non-wood forest products in Finland: statistics, expert estimates and recent development. In: Lund, G., Pajari, B. & Korhonen, M. (eds.). Sustainable development of non-wood goods and benefits from boreal and cold temperate forests. *EFI Proceedings* No. 23. p. 131–146.
- , Kangas, K. & Aho, H. 2000. The picking of wild berries in Finland in 1997 and 1998. *Scandinavian Journal of Forest Research* 15: 645–650.
- Salo, K. 1984. The picking of wild berries and mushrooms by the inhabitants of Joensuu and Seinäjoki in 1982. *Folia Forestalia* 598. 21 p. (In Finnish with English summary).
- 1985. Wild-berry and edible-mushroom picking in Suomussalmi and in some North Karelian communes, Eastern Finland. *Folia Forestalia* 621. 30 p. (In Finnish with English summary).
- 1995. Non-timber forest products and their utilization. In: Hytönen, M. (ed.). Multiple-use forestry in

- the Nordic countries. The Finnish Forest Research Institute. p. 117–155.
- 2011. Collectable forest produce. In: Rantala, S. (ed.). Finnish forestry, practice and management. Metsäkustannus Oy, Keuruu. p. 215–228.
- Seeland, K. & Staniszewski, P. 2006. Indicators for an European cross-country assessment of non-timber forest products & services. In: Niskanen, A. (ed.). Issues affecting enterprise development in the forest sector in Europe. University of Joensuu, Faculty of Forestry. Research Notes 169. p. 299–320.
- & Staniszewski, P. 2007. Indicators for a European cross-country state-of-the-art assessment of non-timber forest products and services. *Small-scale Forestry* 6: 411–422.
- Sievänen, T. & Neuvonen, M. 2011. Luonnon virkistyskäytön kysyntä 2010 ja kysynnän muutos. [Demand for outdoor recreation in 2010 and changes in the demand]. In: Sievänen, T. & Neuvonen, M. (eds.). Luonnon virkistyskäyttö 2010. [Outdoor recreation 2010]. Metlan työraportteja 212. p. 37–79. (In Finnish).
- , Pouta, E. & Neuvonen, M. 2002. Luonnon virkistyskäyttö maakunnittain. [Outdoor recreation by counties]. Metsäntutkimuslaitoksen tiedonantoja 885. 32 p. (In Finnish).
- , Pouta, E. & Neuvonen, M. 2004. Participation in mushroom picking in Finland. In: Ito, T. & Tanaka, N. (eds.). Social roles of forests for urban population – forest recreation, landscape, nature conservation, economic evaluation and urban forestry. Japan Society of Forest Planning Press. p. 122–137.
- Sipola, K., Tuokkola, P., Soppela, K., Tervonen, J. & Hirvijärvi, E. 1994. Marja- ja sienisadot ja niiden hyödyntäminen. Vuotoksen suunnitellun allasalueen luonnon tutkimukset, osa H. [Crops and utilisation of berries and mushrooms. Natural studies concerning the area of the planned reservoir in Vuotos, part H]. University of Oulu. 66 p. + appendices. (In Finnish).
- Sisak, L. 1998. Importance of main non-wood forest products in the Czech Republic. In: Lund, G., Pajari, B. & Korhonen, M. (eds.). Sustainable development of non-wood goods and benefits from boreal and cold temperate forests. EFI Proceedings No. 23. p. 79–85.
- 2006. Importance of non-wood forest product collection and use for inhabitants in the Czech Republic. *Journal of Forest Science* 52(9): 417–426.
- Turtiainen, M. & Nuutinen, T. 2012. Evaluation of information on wild berry and mushroom markets in European countries. *Small-scale Forestry* 11(1): 131–145.
- , Salo, K. & Saastamoinen, O. 2011. Variations of yield and utilisation of bilberries (*Vaccinium myrtillus* L.) and cowberries (*V. vitis-idaea* L.) in Finland. *Silva Fennica* 45(2): 237–251.
- Vantomme, P. 2003. Compiling statistics on non-wood forest products as policy and decision-making tools at the national level. *International Forestry Review* 5(2): 156–160.
- Viinisalo, M., Nikkilä, M. & Varjonen, J. 2008. Changes in the consumption of foods in households during the years 1966–2006. National Consumer Research Centre, Publications 7. 34 p. + appendices. (In Finnish with English summary).
- Volkov, A.D., Krutov, V.I., Kozlov, A.F. & Šiškin, A.I. 2003. (eds.). Lesnye resursy, lesnoe hozjajstvo i lesopromyšlennyj kompleks Karelii na rubeže XXI veka. [Forest resources, forestry and forest industries in Karelia in the turn of the 21st century]. Karel'skij naučnyj centr RAN. Petrozavodsk. 146 p. (In Russian).

Total of 57 references