Nature Conservation Efforts by Forest Owners – Intentions and Practice in a Swedish Case Study

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Before a forest operation Swedish forest owners need to fill in a registration form. Since 1994, when a new Swedish Forestry Act came into force, intended nature conservation measures can also be noted on the form. I evaluate 1) if the self-reported nature conservation intentions displayed any trends from 1995 to 2000, and 2) if the intentions were implemented. All forms from these years, in one municipality, were analysed and the stand structure retention was measured on 40 clear-cuts. The intentions, noted as check-marks on the form, showed an increasing trend during these years. However, the increase may be an artefact of changes the form during the time period. The number of check-marks on the forms and the stand structure items actually present on the 40 clear-cuts showed a positive relation. The clear-cuts with ≤3 check-marks on the form had lower amounts of the three most common items, than those with ≥4 check-marks. To conclude 1) a true increase in the self-reported intentions of the forest owners could not be established; 2) the intentions were generally followed by associated practices on the clear-cuts; 3) the amounts of stand structures retained were probably not enough to reach the biodiversity goal of the Forestry Act. The registration form could be improved to become less open for interpretation and contain quantified recommendations. Self-reported intentions of the forest owners could then possibly be used as indicators of real structural retention, which could facilitate planning and allow for making predictions about the future forests.

Keywords biodiversity assessment, boreal forest, forest conservation, forest policy, indicators, policy implementation
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1 Introduction

During the last decades it has become evident that intensive commercial forestry poses a threat to biodiversity in forests all over the world (Heywood 1995). As a consequence new forestry principles and recommendations for nature conservation have been developed, both at the levels above the national state, e.g., the National Forest Programmes by the UN and the European Union Forestry Strategy, and at the national level. Accordingly, political decision-making in many countries has put pressure onto forest owners to introduce new practices for forest management (e.g. Innes 1993; Johnston 1993; Ferlin et al. 1999; Lacaze 2000). Also Sweden, which is forested to about 55% with mainly coniferous, boreal forests (Skogsstyrelsen 2000), has adopted a new forest policy.

Policy-making of today is supposed to involve many different actors. However, as discussed by Hogl (2002), there may be pitfalls due to such multi-level governance. The involvement of many levels and arenas on which the legislation should be formulated and accepted, may affect the final result negatively. Thus, implementation gaps (Gilg and Kelly 1997), in this case a discrepancy between the legislation and the actual conservation measures taken, may occur. An example of this was given in Sweden when a report from the Swedish National Audit Office (Riksrevisionsverket 1999) strongly criticised the Swedish National Board of Forestry (NBF) on the achievements on reaching the biodiversity goal of the legislation.

Studies in the 1980s and early 1990s revealed a low level of conservation efforts in general in Sweden (Eckerberg 1988; Skogsstyrelsen 1991) and also that many forest species were red-listed due to habitat degradation (Berg et al. 1994). The conclusions drawn from these studies were that the current Forestry Act, where nature conservation first was introduced in 1975 and then strengthened in 1979 (Swedish Forestry Act 1948, 1979; Ekelund and Dahlin 1997), was insufficient to preserve forest biodiversity. The legislation had nevertheless some effect as the situation improved somewhat during this time period. In retrospect, NBF concluded that the nature conservation efforts had become better from 1989/91 to 1992/93 (Skogsstyrelsen 1997). However, they wrote that the improvements applied more to the fulfilment of the minimum standards of the Forestry Act of 1979, than to the actual requirements of the threatened forest species.

In 1994 there was a third change in the legislation concerning nature conservation. This time the goals for productivity and biodiversity became equally important. Following the legislation NBF presently formulates its task as to:

> 'Implement the forest policy which promotes the principles of sustainable management of forests and conservation of the biodiversity of forests. The new Swedish Forest Policy is giving the maintenance of biodiversity the same priority as efficient utilisation of forests and forest land for production of industrial wood as well as non-wood goods and services. Equal emphasis is thus being put on environment and production goals.'

The Swedish Environmental Protection Agency (SEPA) has in its vision of the future, 'Sweden the year 2021' (Naturvårdsverket 1997), briefly outlined the future of forestry:

> 'On the larger part of the forested area a commercial forestry which takes great consideration to the nature is conducted, while approximately 5% of the total area is protected. In this type of management, combined with nature care, the deciduous component is highly increased compared to its current state. Selective cutting and natural regeneration are the main methods used on a large scale.'

In some areas, however, intensive forest management will be the main management method in order to cover the need for forest products. In these areas more forest will be protected.

As the report from the Audit Office (Riksrevisionsverket 1999) expressed that NBF failed on reaching the biodiversity goal, it seems, however, that the intentions of NBF and SEPA were not communicated effectively to the actors in forest management. These are, mainly: forest companies, the Church, municipalities and non-industrial private forest (NIPF) owners (one-man/family enterprises). The former three owner categories often own more than 1000 ha of forest. The forest holdings of the about 200 000 NIPF owners have a mean size of only 50 ha, but these

owners have a large impact on the landscape, since they together own about 50% of the total forested area (Skogsstyrelsen 2000).

The report from the Audit Office (Riksrevisionsverket 1999) also mentioned as a problem that the law lacks possibilities to impose restrictions on the forest owners for the fulfilment of the biodiversity goal. This goal is supposed to be reached in a voluntary way and NBF can only provide information and counselling.

NBF and SEPA thus have clear sets of intentions for the Swedish forestry. However, the problem with implementing these in reality is that the forests have many different owners, which have different opinions and values and for that reason do not act in concert (Kuuluvainen et al. 1996; Egan et al. 2001; Pregernig 2001). During the 1990s the large Swedish forest companies committed to environmental certification systems, e.g., the Forest Stewardship Council (FSC). The private forest owners associations were, however, negative towards the concept of certification (Elliott and Schlaepfer 2001). To gain acceptance for, and to implement, a conservation-focused policy, may hence be a slower process within the NIPF owner group (Ask 2002). Furthermore, the intentions of the forest owners concerning conservation are not well studied, especially not amongst the NIPF owners. Kuuluvainen et al. (1996) studied the harvesting behaviour of Finnish NIPF owners with different objectives and found that multiobjective owners, which valued both monetary and nonmonetary benefits of their forests, contrary to expectations harvested more than single-objective owners. According to Kangas and Niemelainen (1996), 'health and vitality' of the forest was the most important management objective to Finnish forest owners, and especially owners of large woodlots considered conservation as less important. An interview study by Götmark et al. (2000) on 33 Swedish NIPF owners concluded that these were weakly positive to conservation, but they were more supportive of the environment when the questions did not involve personal sacrifices. Since the legislation is not binding it is important to understand the forest owners' intentions about conservation measures, because these are decisive factors of what is finally set aside for conservation purposes during final fellings.

Intensive forestry has the capability to alter the landscape from one type to another (Elkie and Rempel 2001) and forest management have affected many forest species negatively (Gärdenfors 2000). Many of the presently threatened forest species have large area requirements and/or need habitats, which are not provided by an intensive forestry. Also, the slow dispersing species need a sufficient connectivity to be able to spread and survive (Mikusinski et al. 2001; Villard and Taylor 1994; Brunet and von Oheimb 1998; Dettki 1998; Bossuyt 1999; Michaels and Bornemissza 1999; Reunanen et al. 2000). As pointed out by Angelstam (1998) and Hunter (1999) preserving ecosystem integrity, i.e. the natural processes and dynamics in the ecosystem that provides an array of different habitats, is also important. The basis for biodiversity maintenance is thus strongly linked to the behaviour of the actors in the landscape. It would be useful to find methods, which with a high degree of probability can assess the intentions of the forest owners, and also predict the outcomes of measures of conservation undertaken by them. In this task it is of interest to critically examine any self-reported intentions of the forest owners.

On the Swedish registration form for planned harvesting activities it is since 1994 possible, however optional, to report planned conservation measures. It is thus possible to assess the forest owners' intentions concerning nature conservation measures, as these are stated by them. The first aim of this study was to evaluate whether or not the self-reported intentions of the forest owners on the registration forms showed any changes during the period after the form was revised to include the intentions. The rationale was that the new Forestry Act, information campaigns about forestry and conservation (Skogsstyrelsen 1990, 1999), and an increased awareness about the decline of biodiversity, as reported by NBF and SEPA (Skogsstyrelsen and Naturvårdsverket 1998), could have affected the intentions of the forest owners in a positive way during these years. If so, the intentions should show an increasing trend.

Attitudes and intentions are often assessed by the use of opinion surveys. The limitation of such methods is that they rarely can assess if the declared intention of a respondent is followed by a consistent behaviour. Estimated attitudes and

intentions are not necessarily good predictors of behaviour (Tarrant and Cordell 1997). The self-reported intentions on the forms provide a unique opportunity to test the relationship between these and the subsequent practises. To test the hypothesis that the self-reported conservation intentions were implemented in practice was thus the second aim of this study. Provided there is a positive correlation between the intentions on the form and the practice, i.e. what is actually left on the clear-cuts, this is an appealing approach for making predictions about the future conservation status of the forest. Finally, I draw some general conclusions concerning the nature conservation from the data collected from the regeneration forms and the results of the field study.

Table 1. The different forest owner categories in the municipality of Lindesberg and the size and proportion of their respective land holding. Also the agreement to follow the criteria of the Forest Stewardship Council (FSC) or the similar Swedish concept for small enterprises, Green forest-management plan (GFP), is shown.

Forest owners	ha	% of total area	FSC or GFP
Private (NIPF-owners incl.)	50000	52.1	
Forest company	36800	38.4	X
The Church	7000	7.3	X
The municipality	1600	1.7	X
'Common land'	500	0.5	
Total area of forest	95900	100.0	

2 Study Area

The study was performed within the municipality of Lindesberg, an area largely dominated by managed forests and located in the region of Bergslagen, south central Sweden. From the early mediaeval times until the late 19th century, the main industry here was the extraction of iron and other metals. This demanded huge amounts of firewood and charcoal, which took its toll from the forests, i.e. they were over-exploited during a long time (Wieslander 1936).

Today the forests of the region consist mainly of even-aged stands of conifers, nearly all of which are below 120 years of age. The single largest forest owner is the forest company AssiDomän (now Sveaskog), while the Church and the municipality of Lindesberg own relatively modest shares (Table 1). According to AssiDomän the productivity of their forests in this area ranges from 8–9 m^3 of yearly increment at the best sites in the southern part, to 3–4 m^3 at the sites with the lowest productivity in the north.

This area can be considered representative of Sweden because 1) it is situated on Limes Norrlandicus, the natural border between the hemi-boreal and the southern boreal forest and 2) it has roughly the same ownership distribution (Table 1) as the whole Swedish forest area, which is owned by small private enterprises at 51%, state and other commonly owned forests at 10%, and share holding companies at 39%. This means that the ownership is roughly 50/50 between large companies and NIPF owners (Skogsstyrelsen 2000).

The large forest owners are certified according to criteria of the FSC and concurrent with most Swedish municipalities (Hammar 1999), Lindesberg has made a Green Forest-Management Plan (GFP), which is an equivalent to FSC, but aimed at non-industrial owners (Table 1). A GFP is made individually for each owner. The Forestry Act requires that each forest owner should make a plan, which describes the forest and its natural and cultural values. This plan should be shown on demand from the NBF, but is otherwise not checked.

3 Methods

3.1 The Registration Form and Selection of Data

The forest owners in Sweden have to register all forest management activities, such as cutting or draining, affecting an area larger than 0.5 ha (Skogsstyrelsen 1993). This is made on a registration form, which should be sent to the Regional Forestry Board six weeks in advance. A permission to harvest within two years, with a possible

extension of one year, is then granted. For this study I collected data from all of the received forms (n = 1665) from the years 1995–2000 in the municipality of Lindesberg.

Except for personal data of the forest owner, and data on geographical position and size of the forest stand, the form requires data on the purpose of the management activity (i.e. regeneration cutting with nature consideration; extraction of forest fuel; draining; use of exotic tree species; and cutting for another purpose than wood production). The owner should also report planned activities at the clear-cut (i.e. scarification; removal of woody debris; and draining) and how the forest regeneration should be performed (i.e. planting; sowing; natural regeneration, or a combination of these methods). The form can be signed by either the forest owner or a representative of the owner, mostly the company that may harvest the stand. The forest owner is, however, responsible for the information on the form.

After the change of the law in 1994, the form was modified to allow voluntarily given descriptions of the intended nature conservation measures on the clear-cut. The form thus contains a section called 'Considerations to natural and cultural conservation values.' This is further divided into seven sub-sections: 1) low productive areas; 2) sensitive biotopes and cultural values; 3) plant and animal species; 4) protection zones; 5) trees, tree groups and dead trees; 6) damages to ground and water; and 7) other considerations, respectively.

I retrieved from the form data on: 1) Owner-category, divided into: 'Forest company,' 'NIPF,' 'the Church,' and 'Municipality/other company.' ('Forest company' was in this case only represented by AssiDomän and I merged 'Municipality' with 'other companies' because they represented few cases, 41 and 22 respectively, and both categories had other main occupations than forestry.); 2) Representative, divided into: 'large forest company,' 'forest owners association,' and 'private enterprise.' 3) Size of the stand (ha); 4) Regeneration mode; 5) Regeneration species (which was only required if natural regeneration was the planned regeneration method or if the regeneration species was exotic); 6) Sensitive biotopes and cultural values, which contained the 15 options: brook/ravine; well/small lake; island/cape; remains after pastures/meadows; stone piles or walls; rocky terrain/hillside; swamp forest; rocky forest; remains after mill or saw mill; old road/path; remains after virgin forest; island on bog; old house foundation; remains after charcoal stack or tar production; and other consideration; 7) Considerations to plant- and animal species, which contained the 4 options: growing site for threatened, rare or vulnerable species; nesting site for threatened, rare or vulnerable bird species; lekking site for capercaillie; and other consideration; 8) Protection zones; and, most important for this study, 9) number of check-marks in the section for 'Considerations to trees, tree groups and dead trees.' In this section it was possible to report the intended considerations concerning specified stand structures by check-marking nine specified types of tree elements. These are below referred to as 'stand structure items' and were constituted of: large deciduous trees; trees with cavities; dead standing or lying trees; uncommon tree species; trees with cultural marks; rowan/sallow; old trees; tall stumps; and other trees. In 1998 the form was revised and 2 items were added: large coniferous trees and tree groups. Also, the item 'tall stumps' was divided up into 'natural tall stumps' and 'created tall stumps.' All in all, this gave a total sum of 12 stand structure items on the revised form. The stand structure item section was of special interest since old trees and deciduous trees are very important for many species (Berg et al. 1994; Samuelsson et al. 1994; Esseen et al. 1996; Kuusinen 1996; Uliczka and Angelstam 1999, 2000). I counted the number of check-marks on each form and compared the numbers between years and different owner categories. In all analyses the program package StatView was used.

3.2 Field Study

I visited 40 clear-cuts that were reported during 1995–1999 and recorded the presence and the quantity of all retained stand structure items, in order to compare what was reported on the form with what was actually present in situ after the felling. To cover the whole range of possible number of check-marks on the forms, the clear-cuts were selected as a stratified random sample,

using ten registration forms within each of four groups. The groups were distinguished on the basis of the number of check-marks in the 'stand structure item' section: 0–1, 2–3, 4–5, and ≥6 check-marks. The sites were spaced out over the whole study area. Since the forms were chosen randomly on the basis of number of check-marks, they could not at the same time be chosen on the forest owner category. Thus, the analyses contain no division between owners. I also regarded the forest owner as ultimately responsible for the intentions on the form, as well as for the nature conservation measures on his/hers forestland. Hence, I did not make a division between forms signed by owners and forms signed by representatives.

On the clear-cuts I also counted the number of wind-throws. Further, I classified these as either left or removed, i.e. either the log was still intact or else the sawed of stump was noted as a removed wind-throw. When counting 'large deciduous trees' I only included those that had a diameter at breast height (DBH) ≥40 cm. Thinner trees, ≥10 cm DBH, were included in 'other trees.' The pines (*Pinus sylvestris*) that were left for seed production were not included, since they are normally taken away after some years. Dead wood was not included if smaller than 20 cm in diameter and neither were rowans (*Sorbus aucuparia*) or sallows (*Salix* spp.) thinner than 10 cm DBH.

4 Results

4.1 Owner Categories, Harvest Rates, Clear-Cut Sizes and Regeneration

The dominating owner category was 'NIPF', with 64% of all examined forms. The number of forms per owner category is shown in Table 2. During the six years 7086 ha, or 7.5%, of the total forested area within the border of the Lindesberg municipality (Table 2), were reported to be harvested, giving a mean harvest rate of 1.3% per year. The mean size of the clear-cuts was 4.3 ha when all owner types were combined. There was no statistical difference between the two categories 'Forest company' and 'the Church' and neither between 'NIPF' and 'Municipality/other companies' (Table 2). The mean clear-cut sizes of both of the former two were, however, larger than those for both of the latter two (Mann-Whitney, $p < 0.0001$)

Table 2. The number, the total reported area, and the mean size in hectares, of the registered clear-cuts, divided in the four different categories of ownership. The statistical difference in mean size is noted by the letters a and b in the table, different letters denote a statistically significant difference (Mann Whitney, $p < 0.0001$).

Owner category	n	Total area (ha)	Mean size (ha) and stat. diff.	SD
Forest company	428	3061	7.2 a	4.9
The Church	102	674	6.6 a	4.6
NIPF owners	1072	3121	2.9 b	2.7
Municip. and other co.	63	230	3.6 b	2.7
Total	1665	7086	4.3	4.0

Of the 1665 areas, a total of 1355 were reported as only regeneration cutting, i.e. clear-cutting. On 22.4% of these forms either planting or sowing were to be used in the regeneration. A combination of planting or sowing and natural regeneration was found in 19.8% of the forms and the rest, 57.8%, were to be naturally regenerated.

Planned regeneration with exotic tree species never occurred. Natural regeneration was reported on 932 forms, however the species was only noted on 550 of these. In 56.5% of the 550 forms the regeneration species was pine. On 17.3% (5.7% of all forms) at least one of the regeneration species was deciduous. The proportions of the forest owner categories that were to be regenerating with deciduous trees were: 'Forest company' 54.7%, 'NIPF' 40.0%, 'Municipality/other companies' 4.2%, and 'the Church' 1.1%, respectively.

4.2 Natural and Cultural Values on the Form

In the form section 'Sensitive biotopes and cultural values' at least one item was marked in 606 forms. Separated by owner categories 49% of

these forms were from 'Forest company,' 42% from 'NIPF,' 5% from 'the Church,' and 4% from 'Municipality/other companies.'

The most common item marked in this section was 'remains after charcoal stack,' which occurred 327 times. One to three of the cultural remains, pastures, old house foundations, and stone piles or walls, were check-marked on 63 forms. Other items that were marked several times were: 'path or small road' 84 times, 'brook/ravine' 36 times, 'swamp forest' 20 times, and 'remains after mining' 9 times. All of the 15 items were marked at least once, though 'remains of virgin forest' and 'mill or saw mill' were only marked one time each.

The section 'Considerations to plant- and animal species' was used 8 times (0.5% of the forms) out of which three were unspecified. The specified notes used once each were: 'traces of three-toed woodpecker (*Picoides tridactylus*),' 'den,' 'rare trees and bushes,' 'ant-hill,' and 'habitat of the freshwater pearl mussel (*Margaritifera margaritifera*).'

4.3 Check-marks in the 'Stand Structure' Section

The year 1996 was significantly different from the years 1995, 1998, and 2000 (Mann-Whitney, $p=0.02$, 0.002, and <0.0001, respectively) in the mean number of check-marks. The last year, 2000, had the highest mean and was different from all other years (Mann-Whitney, $p<0.001$ for all tests) (Fig. 1). The other years were not statistically different from each other. The same data divided up into the different owner categories showed a more scattered picture (Fig. 2).

A linear regression of the total number of check-marks against time in years was significantly positive ($t=-6.3$, $SE=57.8$, $p<0.001$). When that regression was made for each of the owner categories, the categories 'Municipality/other companies' and 'the Church' showed significant negative relations with time, i.e. in these two owner categories the check-marks decreased from the first year to the last ($t=2.5$, $SE=273.2$, $p<0.01$ and $t=2.5$, $SE=247.1$, $p=0.02$). This result was the opposite for the other two owner categories, which showed significant positive relations with time ('Forest company,' $t=-6.6$, $SE=115.9$, $p<0.001$ and 'NIPF,' $t=-5.5$, $SE=69.4$, $p<0.001$). The total mean of check-marks for the 'the Church,' 4.3 (± 2.2), was significantly different from the other three owner categories (Mann-Whitney, $p<0.001$ for all tests) which all had means of 2.7–2.8 (± 2.0–2.1) and did not differ from each other.

For the 'NIPF' owners there was a significant positive relation between size of the stand and

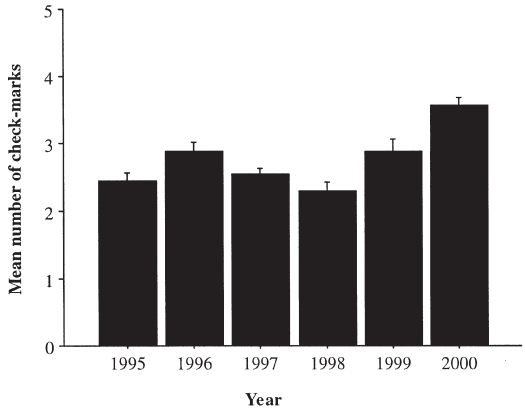

Fig. 1. Mean number of check-marked stand structure items on the registration form for each of the six years. The error bars indicate standard error.

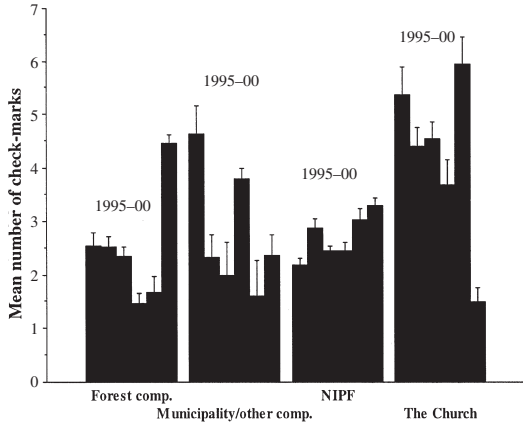

Fig. 2. Mean number of check-marked stand structure items per year in the years 1995–2000, in the different owner categories. The error bars indicate standard error.

the number of check-marks made on the form ($t = 8.0$, $SE = 0.02$, $p < 0.0001$). No such relation was found for the other owner categories. Also, the NIPF owners' check-marks were significantly different depending on which representative was presented on the form. The mean number of check-marks was highest for forms with the representative 'large forest company' (4.5 ± 3.3, $n = 95$), then came 'private enterprise' (3.2 ± 2.0, $n = 218$) and, lastly, 'forest owners association' (2.1 ± 1.1, $n = 185$). When no representative was presented the mean was 2.7 (± 1.9, $n = 574$). All of these differences were statistically significant (χ^2, $p < 0.005$ for all tests).

4.4 The Visited Clear-Cuts

Of the 40 visited clear-cuts, 13 were found better than what the owner reported on the form (i.e. having higher number of different stand structures on the clear-cut than checks-marks on the form), 16 were worse and 11 in accordance with the check-marks of the form. Overall, the sum of marks reported on the 40 forms was higher than the sum of presences of stand structures (154 vs. 128, respectively). The sum of reported marks in the stand structure section with the corresponding stand structure found at the site was 72, which means that 47% of the made marks were correct.

The highest number of different stand structure items found at a clear-cut was six, which was the case at three sites. The highest number found of the same structures that were check-marked on the form was five, which was found at two sites. The number of present items most often found, at 14 sites, was three. The three items most commonly registered on the form were dead trees, tall stumps, and large deciduous trees (Table 3). Except for large deciduous trees, these were also the items that were most often found. Most commonly found stand structure was 'other trees', mainly birch (*Betula* spp.). More than 10 such trees/ha were found at 6 sites. Rowan/sallow only reached a mean of 0.2 trees/ha (Table 4). With the exception of tree groups and old coniferous trees, which both were only possible to check-mark on four of the 40 forms, the items least often registered on the form, trees with cultural marks and

Table 3. Reported stand structure items, i.e. marked with a check-mark on the registration form, for the 40 visited forest regeneration areas. The table shows the actual stand structures found and the number and proportion that were wrongly reported, i.e. either not reported on the form but found on the regeneration area, or vice versa.

Stand structure item	Actually found on no. of sites	Reported on form for no. of sites	Wrongly reported on no. of forms	Wrongly reported on % of forms
Other trees [a)]	34	10	24	60.0
Tall stumps (natural and created) [b)]	32	25	14	35.0
Dead standing or lying trees	25	31	12	30.0
Tree groups [c)]	16	2	1	25.0
Rowan/sallow	12	18	15	37.5
Large deciduous trees [d)]	8	24	18	45.0
Large coniferous trees [e)]	1	3	3	75.0
Old trees [f)]	1	11	10	25.0
Trees with cavities	0	20	20	50.0
Trees with cultural marks	0	4	4	10.0
Uncommon tree species	0	2	2	5.0

[a)] 'Other trees' were mainly birch and aspen trees, which could not be categorised as large, old or uncommon tree species.
[b)] In the new form of 1998, which was used only in four out of the 40 cases, the item tall stumps was separated into 'natural' tall stumps and 'created' tall stumps. However this separation was left out in this table since these items were marked separately only in three cases and the two types were thus counted in the same way in the vast majority of the clear-cuts.
[c)] This item was only possible to report on the new form of 1998, hence the percentage was calculated on the four cases this was used.
[d)] Only trees ≥40 cm diameter at breast height were included in the count.
[e)] This item was only possible to report on the new form of 1998, hence the percentage was calculated on the four cases this was used.
[f)] Coniferous trees left for seed production were not included in, since they usually are taken away after some years.

Table 4. Mean amounts of the found stand structure items per hectare in the four groups of regeneration areas. The groups were defined by the different number of reported check-marks in the registration form section as: 0–1, 2–3, etc. Also, the mean numbers of check-marks in the groups are shown, together with the means of the recorded number of check-marks (one check-mark = that item was present at the clear-cut). Lastly, the number of corresponding check-marks made in the field, i.e. the specific item was both marked on the form and actually found at that site, are shown.

Stand structure item	Groups								
	0–1 x		2–3 x		4–5 x		6–12 x		All
	Mean amount ± SD	N:o of sites n = 10	Mean amount ± SD	N:o ofs site n = 10	Mean amount ± SD	N:o of sites n = 10	Mean amount ± SD	N:o of sites n = 10	Total mean amount ± SD
Other trees	4.6±8.6	7	3.3±4.6	8	5.5±4.3	10	6.6±6.9	10	5.0±6.2
Tall stumps	2.1±3.4	6	1.0±1.1	7	2.2±1.5	8	2.8±2.6	9	2.0±2.4
Dead trees	0.5±1.3	2	0.8±1.1	6	0.8±0.6	8	1.5±1.4	9	1.0±1.2
Tree groups (% of area)	0.4±0.7	4	0.1±0.2	1	0.3±0.3	6	0.2±0.3	5	0.2±0.4
Rowan/Sallow	0.1±0.3	1	0.3±0.5	4	0.2±0.2	6	0.04±0.1	2	0.2±0.3
Large deciduous trees	0	0	0.2±0.5	1	0.1±0.1	5	0.1±0.1	2	0.1±0.3
Large coniferous trees	0	0	0	0	0.02±0.1	1	0	0	0.004±0.0
Old trees	0	0	0	0	0.02±0.1	1	0	0	0.004±0.0
Trees with cavities	0	0	0	0	0	0	0	0	0
Uncommon tree spec.	0	0	0	0	0	0	0	0	0
Trees with cult. marks	0	0	0	0	0	0	0	0	0
Check-marks									
No. on forms	0.6±0.5		2.5±0.5		4.7±0.5		7.5±2.1		3.8±2.8
No. found	1.9±1.5		2.6±1.0		4.4±1.0		3.8±1.4		3.2±1.5
No. of corresponding	0		1.1±0.7		3.1±1.2		3.0±1.3		1.8±1.6

uncommon tree species, were not found at all.

The correspondence between intention and practice, i.e. the stand structure items registered on the form compared to found stand structures in the field, was better in some items than other (Table 3). For example, tall stumps, dead wood, and tree groups were correctly marked in 65–75% of the cases, while no trees with cavities were ever detected, even though this item was marked on 50% of the forms.

There was a statistically significant relation between the number of check-marked stand structure items on the form and number of items of any kind, found in the field ($df = 39$, $r^2 = 0.326$, $p < 0.005$). The regression for the specified check-marked items against the same items found in the field was also significant ($df = 39$, $r^2 = 0.645$, $p < 0.005$) (Fig. 3).

Only one item showed a statistically significant difference in the comparison between the amounts found in the four groups. This was the amount of dead wood, which was higher in the

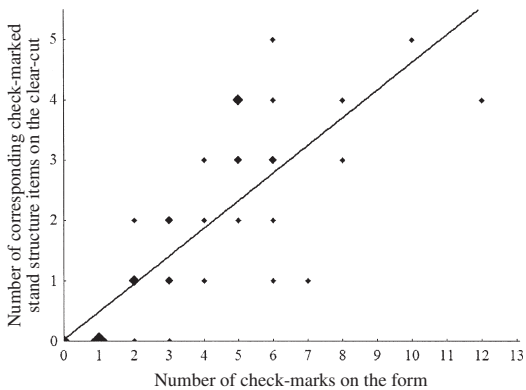

Fig. 3. Number of check-marked stand structure items on the form in relation to the number of the same items found at that clear-cut. The sizes of the points indicate the number of sites, i.e. the smallest points denote one site and larger points include two or more sites.

last group than in the first (Table 4, Mann-Whitney, p=0.016). However, if the 40 clear-cuts were divided into only two groups, the first group (n=20) encompassing the forms with 0–3 check-marks and the second group (n=20), the forms with ≥4 check-marks, the Mann-Whitney showed statistical significant differences between these groups in the amounts of the three items other trees (p=0.03), tall stumps (p=0.03), and dead wood (p=0.02).

There was a total mean of 2.4 (SE=0.37) newly fallen wind-throws/ha. The mean amount of wind-throws with removed trunks was 1.7 (SE=0.30) trees/ha. There were no significant differences between the four groups of selected clear-cuts in the numbers of newly fallen trees, either left of removed. The size of the 40 clear-cuts ranged from 1 ha to 8 ha but there was no significant relation between the amount of any stand structure and the size of the clear-cut.

5 Discussion

5.1 Harvest Rates, Clear-cut Sizes and Regeneration

Since 1980 the yearly harvested rate in Sweden has been about 0.9% (Skogsstyrelsen 2000, 2002). The total mean in this study was 1.3% of the area harvested per year. This gives a mean rotation cycle of about 83 years; slightly higher than the mean for the whole country. Short rotation cycles have implications for many of the slow dispersing threatened species. Some forest species, for example certain lichens, have habitat requirements that include old trees (Rose 1992; Kuusinen 1995; Uliczka and Angelstam 1999). In a previous study in this area Uliczka and Angelstam (1999) showed that several lichen species were not found, or found in very small amounts, on trees that were younger than 100 years. Dettki and Esseen (2003) modelled future biomass of pendulous lichens and their results suggested that a normal rotation (110 years) only can support a low amount of pendulous lichens and that shorter rotation was detrimental to epiphyte communities. Thus, the short rotation time in this study suggest that trees above that age, and their associated lichens, will be rare also in the future.

The mean size of a clear-cut in the county of Örebro, where Lindesberg is situated, was 3.9 ha in 1999. The mean size of all clear-cuts in this study was 4.3 ha, which came closer to the mean for the whole of Sweden, 4.7 ha. The forest company made larger clear-cuts than the NIPF owners did. This pattern was the same in the whole country in 1999. According to the forest statistics (Skogsstyrelsen 2000) both categories cut larger areas in northern, than in southern Sweden. However, what can not be seen in the statistics is that the same NIPF owner often registers several areas for cutting in a short time period. When going through the forms this was very clear. For example, one owner reported regeneration cutting on 34 ha separated on eight forms. Since the forest stands owned by NIPF owners usually forms contiguous areas, it may be misleading to state that NIPF owners generally cut much smaller areas than do large companies, with holdings that are scattered in the landscape. NIPF owners can, within a few years, cut several adjacent small stands. Thus, the result on a local scale may from a conservation viewpoint well be the same in both cases, since there was no difference in the number of stand structures left on the small and the large clear-cuts in this study.

The vast majority of the clear-cuts were regenerated with only coniferous tree species, contrary to the vision of SEPA. Only about 6% of all forms planned for a deliberate regeneration of deciduous trees. During the last 2000 years, much of the forests in southern Sweden have been transformed from rich, mixed deciduous, into species-poor coniferous-dominated forest types and the major controlling factor has been land-use (Björse and Bradshaw 1998). Thus, deciduous tree species already exist in reduced densities in this landscape (Swenson and Angelstam 1993; Enoksson et al. 1995; Uliczka and Angelstam 1999). This area already lost some species, for example the white-backed woodpecker (*Dendrocopos leucotus*) (SOF 1990; Angelstam and Mikusinski 1994; Uliczka and Angelstam 2000), a deciduous specialist (Hågvar et al. 1990; Carlsson 2000). For the re-colonisation and maintenance of such species the forestry has to provide habitats with deciduous trees in much larger proportions than today. The results of this study implies, however, that

the scenario of SEPA for 2021 (Naturvårdsverket 1997), concerning the highly increased deciduous component, is not likely to come true in this study area. However, if the naturally regenerated areas will be allowed to produce more than the intended tree species, which most often was pine, the vision of SEPA will be easier to realise.

5.2 Natural and Cultural Values on the Form

The forest company showed a higher propensity to mark items in the section 'Sensitive biotopes and cultural values' than the NIPF owners did. This suggests that the forest company has a more detailed knowledge of their forest land and/or that they consider the criteria of FSC. The latter suggestion is supported by the NBF, which found that the large forest companies both complied in a higher degree to the standards of the Forestry Act, and more often exceeded the standards, than did the NIPF owners (Skogsstyrelsen 2002). This result was the opposite to that of Eckerberg (1988), who found that large private forest companies exhibited the least regard for environmental protection. This was suggested to be due to the high degree of mechanisation of the large companies and to the fact that manual harvesting and processing were at that time used to a higher extent by the NIPF owners. Today all forest owners have access to mechanised harvesting methods, by leasing or sales of standing timber, which may have evened out these differences. The main explanation for a reversed result may thus be differences in the levels of deliberate conservation efforts.

The section for 'Considerations to plant- and animal species' was used only eight times, i.e. on 0.5% of the forms. In the National Forest Inventory (Skogsstyrelsen 2002), 5% of all regeneration areas contained species for which this section would be appropriate to use. An expected result in this study would thus be about 80 forms. That the section was used ten times less than that may be due to the absence of sensitive species or key-habitats on the study sites. This explanation is supported by the fact that this region has a long history of intensive forestry and may for that reason be species poor, at least locally (e.g. Uliczka and Angelstam 2000). However, several small 'key-habitats', or hot-spot areas for red listed species, were found within the study area during a nation-wide inventory (Skogsstyrelsen 1994) in the early nineties. The areas were not protected at that time, but it is possible that the owners avoid cutting them, hence the low number of marks in this section. However, it is also possible that the forest owners have no knowledge of the key-habitats, or the species these contain, or that they ignore them for economic reasons.

5.3. Check-marks in the 'Stand Structure' Section

That there was an increase during the study period in the mean number of check-marks (Fig. 1) may simply be an effect of the addition in 1998 of three items in this form section, i.e. the increase from 9 to 12 items. The new form was only to a small extent used in 1998. It became more widely used in 1999 and in the year 2000 it had more or less replaced the old one. As 'tall stumps' was an often check-marked item, the division of this into 'natural' and 'created' tall stumps will render it two check-marks, instead of one, on the new form. Tall stumps are probably often check-marked, and also retained at the clear-cuts, since they are easy to create and the explanations for their preservation are easily understood; birds of prey use them as perches when hunting small mammals and they provide habitat for species using dead wood. Thus, the raise of the mean number of marks may not indicate increased conservation intentions among the forest owners.

The owner category that was most homogenous among years was the NIPF owners. The larger differences within the other owner groups can be the result of that the large companies have a few employees who fill in most of the forms and make more or less the same amount of check-marks every time. It may thus be that different people routinely make the same number of marks, regardless of the properties of the forest stand. This, in turn, may also mean that they did not perform a proper inventory, or that they did not understand that they were supposed to check-mark only stand structures that existed at the site. If this is the case, it implies that the system with a complicated registration form does not work

unless proper instructions are given.

The group of NIPF owners is thus the most interesting to examine in this study. The lack of a clear increase in check-marks may imply that there was no increase in intentions of taking conservation measures during these years for this owner group. If so, the fulfilment of the biodiversity goal is still not to be reached in a voluntary way. It may also be that they are influenced by the opinions of others, i.e. harvesting enterprises and timber buyers, as suggested by the differences in check-marks depending on the origin of the representative. That the forest owner associations have been negative, and the large forest companies positive, to the certification process, may be reflected in the different mean numbers that showed on the forms where they were the representatives. This explanation is circumstantial but, nevertheless, it is in line with the results of Pregernig (2001), that individual consultants which displayed values concerning management methods could influence the forest owners.

5.4 The Visited Clear-Cuts

It seemed that when the forest owners made few check-marks in the stand structure section, they managed to do a little better than intended, as the observed mean of present items was higher at the sites than on the forms. However, when there were many check-marks in the section that result was reversed, i.e. no clear-cut had more than six present stand structures of different kinds, regardless of the number of check-marks.

When the four groups of clear-cuts were pooled into two groups the most commonly occurring items, i.e. other trees, tall stumps, and dead wood, showed higher densities in the group with ≥4 check-marks than in the group with ≤3 check-marks. This suggests that the check-marks made actually mean something to the forest owner in terms of commitment. Additionally, the number of clear-cuts at which the three most commonly found stand structures were present, was higher in the last of the four groups (10, 9, and 9, respectively) than in the former groups (Table 4), which could support the reliability of the positive relation between made check-marks and found stand structures (Fig. 3).

A remarkable result, however, is that only 47% of the check-marks were represented by a corresponding stand structure in the field. For example, while 20 owners check-marked 'trees with cavities' no such trees were detected. Generally, cavity trees are old and large; Sandström (1992) found them to have an average age of 120 years. Some cavities may be difficult to see, and may hence have been missed in a few instances. However, at several sites it seemed clear that trees with cavities had not been present at the cutting, since all remaining trees were too thin and there were no stumps of larger trees or aspens. Evidently, the owners sometimes check-marked stand structures that they would like to protect if they were found at the site. Thus, this result also supports the idea that in many cases the forest owners do not perform an inventory for conservation items prior to the cutting. Since it is voluntary it is also not expressed on the form that they should do so.

The ambitions of the forest owners to set aside tall stumps, dead wood, and deciduous trees were, however, mostly followed by proper practices. When check-marking 'large deciduous trees' they may have meant the birch and aspen trees that were defined as 'other trees' in this study. There is thus a possibility that the forest owners actually tried to preserve the existing stand structures of any conservation value. Since deciduous trees formerly were removed and recently dead or damaged coniferous trees should, according to the Forestry Act (Skogsstyrelsen 1993), if the amount exceeds 5 m^3 within an area of one hectare, be removed or treated against forest insect pests, there may have been few of these stand structures left to retain at the clear-cuts. For example, the initial densities of rowan and sallow would have been low due to the forest management methods of the past, which may explain the low densities of these trees on clear-cuts of today.

Even though the number of stand structure items found was positively correlated with the number of check-marks on the form, the found items generally had low mean amounts from a biodiversity conservation viewpoint. For example, the mean amount of dead wood was 1.0 dead tree per hectare and, furthermore, 70% of the trees thrown over by the wind after the felling were removed. According to the Swedish FSC-criteria (Forest Stewardship Council 2000) the owner should leave 'some'

dead trees per ha. Not even the clear-cut group with most check-marks, with a mean of 1.5 dead trees/ha (Table 4), reached that amount.

Low amounts of dead wood at forested sites with a long history of logging or high management intensity, have been found in many countries, e.g. in Norway, Poland and the UK (Storaunet et al. 2000; Kirby et al. 1991; Green and Peterken 1997). In old-growth temperate and boreal forests the amount of standing dead wood has been estimated to 10% (which was 20–40% of all dead wood) of the total basal area of all standing trees, irrespective of volume of the forest (Nilsson et al. 2002). The average volume of dead wood on managed productive forestland in Sweden has been estimated to an average of 6.1 m^3/ha, with the highest average volume in spruce forests in northern Sweden (12.8 m^3/ha), but only 3.5–4.0 m^3/ha in these parts of Sweden (Fridman and Walheim 2000). Additionally, there may be qualitative differences in dead wood of different types. Jonsell et al. (1998) suggested that leaving dead wood on clear-cuts could increase the amount of breeding substrate for invertebrate species that prefer sun-exposed substrate. However, other species are dependent on shaded sites and cannot utilise the dead trees on clear-cuts. In this study the amounts of dead wood found on the clear-cuts were probably not enough to secure the existence of sensitive species depending on dead wood, since the amounts found were even lower than those found by Fridman and Walheim (2000), and according to Gärdenfors (2000) many species are currently threatened by the low amounts of dead wood in Swedish managed forests.

Also, the mean amount of 'other trees', 5 trees/ha, was low compared to the FSC-criteria of 10 trees (Forest Stewardship Council 2000). A mean of 7.3 trees/ha, that were left on clear-cuts for conservation purposes, was found in the latest National Forest Inventory (NFI) (Skogsstyrelsen 2002). The explanation for the difference in these figures may be that in the national inventory were included, for example, coniferous trees, old deciduous trees, and rowans/sallows. In my study these trees were noted as specific stand structure items and hence not included in 'other trees.' However, NFI found less than 5 trees/ha on 64% of the investigated areas, which was in line with the result of this study.

5.5 Registration Forms as a Tool in Policy Implementation

Concerning the use of the registration form for reporting nature conservation efforts, I suggest that this specific form did not constitute a constructive tool. It seemed to be unclear to the forest owners and open for various interpretations. A possible use of the check-marks as indicators of real conservation efforts could be facilitated by making registration forms easily understandable and more adapted to such a purpose. This study must, however, be considered as preliminary, more research is necessary to evaluate the usefulness of self-reported conservation intentions – or how to make them useful. If the importance of the form is strengthened it may in the future become a useful tool to discern trends in forest owners' attitudes towards conservation, as well as effects of new conservation related policy instruments. Also, the conservation objectives of the separate owner groups and the representatives, i.e. different harvesting enterprises, should be further investigated.

Different kinds of forms for intended forest management activities are used in several other countries, e.g., Finland, UK and Norway. For these and other countries, which use or are planning to use, registration forms, and are considering the logic and usefulness of these, it may be wise to be careful when the form is developed. The Swedish registration form is directly derived from the prescriptions of the Forestry Act. However, an improved form must be designed with interdisciplinary input. For example, there are several ways that respondents can give less than optimal replies in inquiries and questionnaires (Krosnic 1999). If this should be avoided psychological knowledge is probably necessary in the development of registration forms.

Improvements of the form could, for example, be that it was clearly stated that it is desirable that the owner makes an inventory before filling in the form. The form could also give clear quantitative recommendations for how much of a few, well defined and easily recognisable stand structures should be left on a clear-cut if the owner wishes to enhance biodiversity by retaining at least minimum amounts of such structures. These should be of documented importance to biodiversity

and could, for example, consist of dead trees >20 cm DBH, deciduous trees, old trees, edge zones, and tall stumps. The number of items could be reduced to include only these. Also, the cultural considerations should be separated from the nature conservation section of the form, since the management recommendations differ.

At present the forest owners are probably aware of that the given conservation intentions on the form are not registered or used in any way by either the NBF or others. If the owners instead knew that their reported intentions were properly registered and used as information, their interest in filling in the form carefully, as well as taking the intended measures afterwards, would probably increase. This could, in turn, increase the predictive value of the intentions. If shown to be good predictors, the intentions given by the forest owner concerning the amounts of specific stand structures, could be registered in a database. This would facilitate an overview of the nature conservation status in the forest landscape. The increased knowledge that could be drawn from such a database would be useful in an ecological landscape planning process. Also, the change of the political paradigm, i.e., that forest policy-making should turn from a top-down hierarchical process, into an interaction between the policy-makers, authorities, different organisations and the actors involved in forest management (Dykstra and Heinrich 1996; Appelstrand 2002; Schanz 2002), could be facilitated by the use of the registration form in a new way. For example, with properly given feedback to the forest owners, the registration form could become useful as a tool for communication between these and the authorities. Furthermore, commitments made on the form could become coupled with the use of economic compensations, e.g., intended conservation efforts could be tax-deductible and the Regional Forestry Board, or their equivalents in other countries, could have a control function of this. Such changes could strengthen the incentive for the forest owners to perform conservation efforts, and also to fill in the form correctly. I thus suggest that a thoughtful and considerate way of using registration forms could be a passable way to reach the biodiversity goal without legislating against the right of self-determination for the forest owners.

6 Conclusions

The hypothesis that the forest owners' intentions declared on the registration form, concerning retention of stand structures during harvesting, should be related to the presence of such stand structures on the clear-cuts, could not be rejected. This suggests that self-reported conservation intentions might be valid indicators of actual conservation efforts. If carefully designed, a self-reported declaration form may provide information that allows for making general assumptions about the level of acceptance within different owner groups for the forest policy itself, as well as for predictions about the future forest composition. However, to make an evaluation of the usefulness of this method, more research is needed.

It could not be shown that the intentions of the forest owners to retain stand structures for conservation purposes had increased during the years after the change of the Forestry Act. The observed increase may instead be due to the addition of items on the form. It was, however, evident that the retention of different stand structures in several cases was less diverse and showed lower amounts, than recommended in Swedish policies. Consequently there is an implementation gap between the forest policy and the practical management. The proactive ecological management, which could reverse the down-going trend for the red-listed forest species, is still neither intended nor applied by all forest owners.

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