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Requirements by the Great Spotted Woodpecker *Dendrocopos major* for a suburban life

LENNART HANSSON

Abstract

The Great Spotted Woodpecker *Dendrocopos major* has expanded its habitat range to include suburban areas in Sweden. This range expansion may affect entire communities of hole-nesters by proficient excavation of nest holes. Numbers, habitat and nest site selection were studied in a 3 km^2 suburban area in south-central Sweden during the years 1983-91 and in several forest landscapes without houses. Densities were much higher in various habitats within the suburban landscape but in such areas woodpeckers preferred to nest in woodland areas that were fairly distant from houses and in large trees. Nest heights and the number of nest holes per tree increased with distance from houses, while the proportion of Aspens among nest trees decreased with distance from houses. Aspens still dominated strongly among nest trees. The proportions of new nests and trees with single nests were lower in the suburban area than in remote forests. It is concluded that nest sites, and possibly breeding densities, are constrained by the few old or decaying trees left when new housing areas are built. Retainment of old trees and different-sized young Aspens would promote higher densities of woodpeckers and other hole-nesters and maintain a high diversity of hole-nesting species.

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Introduction

Most woodpeckers are specialized birds requiring old forests or other particular habitat features (Short 1982). However, the Great Spotted Woodpecker *Dendrocopos major* is a fairly generalized species that commonly occurs in modern managed forests (Haftorn 1971). It is often seen at bird-feeders at villages and in suburban areas during winter and has started to breed in such environments.

The Great Spotted Woodpecker is just one among a large number of bird species that recently have populated environments strongly affected by man. However, this species should be of special concern as it functions as a keystone species for many hole-nesting animals; it usually excavates a new nest hole each year and thus provides other species with a scarce and often limiting resource.

In order to understand its influence on the suburban animal community, its density there relative to those found in natural habitats should be known, as well as factors limiting its breeding numbers in the new habitat. Such factors may be human or human-related disturbance or amount of suitable habitat or nest trees. The frequency of new nests is also important for its role as a keystone species.

The objectives of this study were thus: 1) to compare numbers of Great Spotted Woodpeckers in a suburban area and those found in various types of more natural habitats, 2) to establish preferences (or tolerance) for habitats and tree species in the suburban environment and 3) to assess the proportions of new nests excavated in various suburban habitats.

Methods

The number of breeding Great Spotted Woodpeckers was censused each spring during the years 1983-91 in a 3 km^2 suburban area in the southern part of the city of Uppsala in south-central Sweden. This suburban area is located in a landscape with forests, wooded pastures and abandoned agricultural land. The human habitations include both small single-family houses with gardens and multi-storeyed blocks without gardens. Many houses in the study area were built during the 1970s.

Woodpecker densities in this suburban area were compared with densities in three other landscapes in the same region. Regular bird censuses (line transects) were performed in the springs of 1980-91 in a 5 km^2 forestry area with mature but fairly dry and poor pine-spruce forest and many clearcuts (Hansson 1983). Territory mapping of birds was performed in 1982-84 on four wooded 'islands' in agricultural land (Hansson 1986) and the total area surveyed, including similar-sized adjoining fields, was then c. 2 km^2. Finally, a landscape very similar to the suburban study area in size and habitat composition, but without houses and situated across a river valley, was examined for woodpeckers in 1988-90.

Nests were located from the begging-calls of the young at almost daily inspections from late May and throughout June. Habitat, nest tree species, tree diameter at breast height (DBH), age and height of nest hole and total number of nest holes were established at each discovery of an occupied nest. New nest holes could be easily distinguished from old ones by fresh wood-chips at the base of the nest trees. Nesting habitats were classified as (mainly coniferous) forest (more than 25 m from an edge or a house), forest edge, built-up area (maximally 25 m from a house) and wooded pasture. Nests were positioned on a map of the area and distances to the nearest building were estimated.

Using a coordinate system covering the whole study area, random locations for possible woodpecker nests were plotted on the same map from a table of random numbers. These locations were visited and habitat and tree composition were established. The woodpeckers did not breed in trees with a DBH less than .25 m, so all trees of at least this size were counted at the random points in 50 x 10 m areas, located in a north-south direction inside habitats but parallel to edges. For each year, the same number of actual and random nest sites were examined.

Results

The number of breeding pairs in the 3 km^2 suburban area varied between 5 and 11 (Fig. 1), i.e. by a factor of c. 2. There was no clear trend with time and the peak number was recorded in 1990, after an unusually mild winter. In addition, 1-2 breeding pairs of Green Woodpeckers *Picus viridis* were annually found within the study area.

No single breeding Great Spotted Woodpecker was found in the clearcut-dominated forestry area during the years 1980-91 and observations were also scarce in winter (cf. Hansson 1983). One Great Spotted Woodpecker nest was found in a forested 'island' in the agricultural landscape in 1983 but the density was still much lower than in the suburban area. No nest could be found in the equivalent landscape across the valley but one pair of anxious adults were observed in 1989 and 1990 and might have bred just outside the area censused. In summary, Great Spotted Woodpecker densities were much lower in managed forests than in the suburban area during the years 1983-91.

Table 1. Distribution of Great Spotted Woodpecker nests in various suburban habitats and the gross distribution of habitats according to a random nest distribution. See text for definitions of the habitats.

Fördelningen av större hackspettens bon på olika biotoper i och kring bostadsområden jämfört med en slumpartad fördelning. De olika biotoperna beskrivs i texten.

Habitat distribution *Biotop*	Actual nests *Verkliga bon*	Random *Slumpad fördelning*
Closed forest *Sluten skog*	27	12
Forest edges *Skogskanter*	19	12
Wooded pastures *(Skogs)betesmark*	4	6
Around houses *Vid hus*	16	36

The distribution of habitats used by the Great Spotted Woodpecker for nesting in the suburban area (Table 1) differed significantly ($G = 15.81$, $P < 0.001$) from the

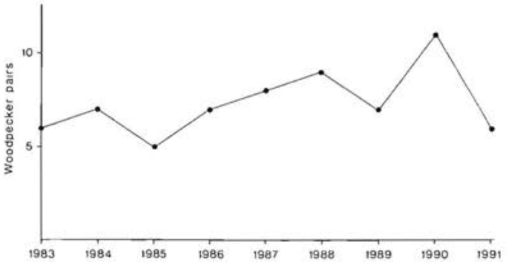

Fig. 1. Numbers of breeding Great Spotted Woodpeckers in 1983-91 in a 3 km^2 suburban area in southern Uppsala, south-central Sweden.

Antal häckande par av större hackspett under 1983-91 i ett 3 km^2 stort, delvis skogsbevuxet, område med bebyggelse i södra delen av Uppsala.

gross composition. There were comparatively more nests in forest and fewer in built-up areas.

Distances between nest and houses were compared between years by one-way analysis of variance. There was no year effect ($F = 1.15$, NS) so the different woodpecker densities did not affect the distributions of nest holes. The distances between houses and nest holes were significantly larger than between houses and the random points ($t = 4.61$, $P < 0.001$) so a close neighbourhood of houses was not attractive to the woodpeckers at breeding time. Woodpecker nests were, on average, located 139 m from the nearest house while the random points were, on average, 62 m from houses.

Nest height increased significantly with distance from houses ($r = 0.35$, $n = 65$, $P < 0.01$). This height was obviously related to the sizes of the trees as height of nests also increased with DBH ($r = 0.33$, $n = 52$, $P < 0.05$). However, DBH and distances were not correlated ($r = -0.07$). Thus, partial correlations between nest height and distance ($r = 0.40$, $n = 65$, $P < 0.001$) and DBH ($r = 0.35$, $n = 52$, $P < 0.05$) were both significant.

Aspen *Populus tremula* was the most common nest tree and contained more than half of the total number of the fresh nest holes (Table 2). However, the proportion of occupied nest holes in aspen and other tree species differed between the habitats ($G = 9.03$, $df = 2$ (forest edge and wooded pasture pooled), $P < 0.05$), with comparatively more other tree species being used in the forest. All nest trees were alive but pines and spruces used for hole excavation showed signs of weakness (decay level 2 on the scale by Hågvar et al. 1990).

The total density of trees with DBH > 25 cm did not differ significantly between the various habitats, probably to a large extent due to great differences within habitats (Table 3, $F = 0.95$). Within separate tree species, only Birch *Betula verrucosa* differed clearly in occurrence ($F = 4.59$, $P < 0.01$), with highest density in the pasture and the lowest around buildings. Spruce *Picea abies* also showed a tendency for habitat differences ($F = 2.24$, $P = 0.09$), with the highest density in closed forest. However, Aspen made up a very small proportion of the large-sized trees in all habitats (9 % as a mean) and the woodpeckers thus showed a very strong preference for Aspen, especially around houses.

Out of 46 nest holes examined with regard to age, 33 (72 %) were made during the present spring. A G-test of the distribution of new and old nest holes between habitats revealed no differences. The number of new and old nest holes in occupied trees varied between 1 and 15. Out of 60 nest trees, 31 (52 %) contained only one hole. There was no significant difference in the number of nest holes per tree between Aspen and the other tree species. The number of nest holes per occupied tree was weakly ($r = 0.25$, $n = 52$, $P = 0.07$) related to the distance to the nearest building.

Table 2. Distribution of nest trees in the various habitats.

Fördelningen av boträd på de olika biotoperna.

Tree species *Trädart*	Forest *Skog*	Edge *Kant*	Pasture *Beten*	Houses *Hus*
Populus tremula Aspen, *Asp*	13	16	2	14
Betula verrucosa Birch, *Vårtbjörk*	5	0	2	1
Picea abies Spruce, *Gran*	5	0	0	0
Salix caprea Sallow, *Sälg*	2	2	0	1
Pinus sylvestris Pine, *Tall*	2	0	0	0
Quercus robur Oak, *Ek*	0	1	0	0

Table 3. Mean number of trees per ha in the different habitats. Trees of all species with DBH > 0.25 m were censused in random 50 x 10 m quadrats.

Medeltäthet av träd per ha i de olika biotoperna. Träd av alla arter med en minsta diameter om 0.25 m i brösthöjd räknades i slumpmässiga ytor om 50 x 10 m.

Tree species *Trädart*	Forest *Skog*	Edge *Kant*	Pasture *Beten*	Houses *Hus*
Populus tremula Aspen, *Asp*	8	15	7	8
Betula verrucosa Birch, *Vårtbjörk*	20	33	47	9
Picea abies Spruce, *Gran*	42	7	27	18
Salix caprea Sallow, *Sälg*	1	13	17	2
Pinus sylvestris Pine, *Tall*	47	28	17	42
Other species *Övriga arter*	0	3	0	4

Discussion

Suburban habitats, including forests close to houses, had much higher woodpecker densities than forest areas uninfluenced by human habitations. There was no evidence of interactions between Man and woodpecker during the breeding period, or during the summer months of the year, so the attraction to a suburban area is probably only related to the winter feeding. Instead, woodpeckers evidently avoided the very close neighbourhood of humans (or their cats?) when selecting a nest site. Similar distributions have been observed in passerines relying on winter feeding by humans (Hansson 1986). Both cases can be considered as edge effects due to spatial restriction of resources for winter survival.

The suburban woodpeckers used trees with similar DBH as in close forests (Hågvar et al. 1990). The mean nest heights in the suburban forest (5.3 m) and at houses (4.3 m) were at the centre and lower end of values reported for Norwegian forests by Hågvar et al. (1990).

The woodpeckers preferred to nest high up in trees of considerable size, to some extent independently of tree species. They either chose from a wider variety of tree species far from houses or Aspens close to houses. Many bird species prefer to nest as high as possible in trees, presumably to avoid predators (Nilsson 1984). However, the fairly few woodpeckers that nested very close to houses evidently had to use soft-wooded Aspens. The reason seems to be that old, more or less decaying trees of various species had been removed when the houses were built, leaving healthy and rapidly growing trees, e.g. Aspens, which had, or soon attained, the DBH needed by the woodpeckers. However, the selection of fairly young, growing Aspens obviously meant that the Woodpeckers had to excavate their nest holes, on average, at a lower height.

These findings raise the question if Aspens were originally preferred to the same extent as they presently seem to be in strictly managed forests (Aulén 1988, Hågvar et al. 1990), and evidently also in suburban environments. Wesołowski & Tomiałojć (1986) found that only 30 % of the nests of the Great Spotted Woodpecker in a primeval Polish forest were in Aspens. Breeding densities were also higher in deciduous than coniferous parts of that forest, indicating that Swedish forests, under present day methods of management and lacking the successional late deciduous phase (Esseen et al. 1992), keep Great Spotted Woodpecker densities below their potential level, as also concluded by Nilsson (1979).

Of the suburban Great Spotted Woodpeckers 28% were breeding in old nest holes compared with 15 % in more remote forests (Aulén 1988). Also this observation may indicate that trees close to houses are less suitable than trees in more or less natural forests. Hågvar et al. (1990) found 71 % single nest cavities per tree in forests against 51 % in the present study. New and single nests generally seem to be preferred by hole-nesters in order to avoid predators that memorize earlier breeding locations (e.g. Sonerud 1985, Nilsson et al. 1991).

Use of the Great Spotted Woodpecker excavations by other species was not quantified, but breeding by Blue Tit *Parus caeruleus*, Nuthatch *Sitta europaea* and Starling *Sturnus vulgaris* was observed. The old softened trees make nest excavation fairly simple and many nest holes suitable for other species may successively be produced in such trees. It is unclear if a woodpecker pair only has a single nest hole or if, when suitable trees are available, they also excavate special holes for night or winter protection. Different holes in the same tree will probably be occupied by different species due to territorial limitations within species. Widely dispersed Aspen nest holes may instead all be occupied by individuals of one particular species that breeds early or is otherwise competitively superior to other hole-nesting species. Thus, nest construction in old trees may lead to greater community diversity than single holes in younger trees.

Both the density of Great Spotted Woodpeckers and the effects of this species as a keystone species appear to increase by suitable management. The single most important measure would be to retain old and decaying trees in built-up areas. Protection of fairly young Aspens may also cause a general increase of bird density, as new trees will be continuously made available for the Great Spotted Woodpecker.

Acknowledgement

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Sammanfattning

Större hackspettens Dendrocopos major *krav för att häcka i bostadsområden.*

Större hackspetten har under senare tid börjat uppträda i bostadsområden eller, med ett mera internationellt uttryck, i suburbana miljöer. Den ses där mest vintertid vid fågelborden men bon påträffas numera också nära hus. Den är inte ensam om detta nya biotopval bland fåglarna men denna art kan visa sig ekologiskt speciellt betydelsefull då den hackar upp bohål som senare kan användas av andra fågelarter och även av andra djur. Den kan därför betecknas som en nyckelart för trädhålsberoende djur.

Det är i detta sammanhang av speciellt intresse att jämföra häckningstätheterna i suburban miljö med de i mera ursprungliga biotoper, att se vilka krav arten har på häckningsmiljöer och häckningsträd i sådana områden och att fastställa proportionen nya bohål i de olika delbiotoperna kring bostäder och andra hus. Antalet häckande par fastställdes därför i ett bostadsområde om 3 km^2 i södra Uppsala, i ett 5 km^2 stort skogsbruksområden med omfattande kalhyggen utanför Uppsala, i ett 2 km^2 jordbruksområde med stora (10 - 25 ha) skogsklädda åkerholmar och slutligen i ett 2-3 km^2 måttligt utnyttjat skogs- och betesområde fritt från hus men f.ö. mycket likt Uppsala-stadsdelen. I det suburbana området urskiljdes fyra delbiotoper: sluten skog, skogskanter, delvis skogsbeväxt betsmark och områden högst 25 m från bebodda hus ('bebyggelse' i inskränkt mening). Bon spårades nästan dagligen under slutet av maj - juni genom att lokalisera de högljutt tiggande ungarna. Biotop, boträdsart, träddiameter i brösthöjd, bohålets ålder (nytt eller gammalt) och totalt antal bohål i det utnyttjade trädet noterades. Den verkliga fördelningen av nyttjade biotoper och trädarter jämfördes med den totala sammansättningen i undersökningsområdet. Den senare erhölls genom att inventera 50 x 10 m-ytor som utvaldes med slumptal ur ett koordinatsystem som täckte hela undersökningsområdet.

Antalet häckande större hackspettspar i det suburbana området varierade mellan 5 och 11 under undersökningsperioden 1983-91 (Fig. 1). Där förekom dessutom 1-2 par gröngölingar. Det häckade ingen större hackspett alls i det hårt utnyttjade skogsbruksområdet. Ett större hackspettpar häckade på en åkerholme under ett av de fyra undersökningsåren i jordbrukslandskapet. Skogslandskapet som liknade det suburbana området i struktur och skötsel höll högst ett par under de två undersökningsåren. Det suburbana området, som var skyddat mot skogsbruk, uppvisade alltså mycket högre tätheter än de flesta mer eller mindre hårt utnyttjade skogsmiljöerna.

I det suburbana området föredrog de större hackspettarna att häcka i sluten skog och undvek bebyggelsen (Tabell 1). Bona låg också längre från hus än slumpmässigt utvalda punkter. Bohöjden ökade med avståndet från hus och också med trädens diameter i brösthöjd. Aspen var det både absolut och relativt sett mest utnyttjade trädslaget (Tabell 2 och 3). Det nyttjades mera intensivt nära bebyggelse än i den slutna skogen. 72 % av alla bon hade tillverkats under häckningsvåren. Proportionen nya och gamla bohål och antal bon per träd varierade inte mellan trädslag eller biotoper. Antalet bohål per träd visade dock en tendens att öka med avstånd från hus.

Den höga hackpettstätheten i suburban miljö bör antagligen betraktas som en kanteffekt åstadkommen genom utfodringen vintertid. Hackspettarna syntes ointresserade av husens närmaste omgivning sommartid. Liknande observationer har gjorts på diverse övervintrande tättingar (Hansson 1986).

Även om boplatsvalet liknade det i allmän skogsmiljö (Hågvar m. fl. 1990) så föredrog spettarna att häcka högt och tämligen långt från husen. De valde antingen höga lägen från ett flertal trädarter långt från husen eller häckade lågt i stora aspar nära husen. De föredrar uppenbarligen hög bohöjd för att undvika rovdjur (se bl.a. Nilsson 1984) men har ofta inte denna valmöjlighet nära hus där gamla fallfärdiga träd har tagits bort i samband med husbyggandet. Likaledes häckade fler spettar i gamla bon i det suburbana området än i riktig skogsmiljö (se Aulén 1988) p.g.a. begränsat trädurval, något som också kan leda till ökad predation (Sonerud 1985, Nilsson m. fl. 1991).

Man kan fråga sig om aspen verkligen ursprungligen var ett så prefererat träd som synes framgå av undersökningar i väl skötta skogar och som här just intill bebyggelse. Uppenbarligen hålls större hackspetten vid en artificiellt låg nivå i många kulturskogar och även i välskötta fritidsområden, något som också påpekats av Nilsson (1979). Om gamla träd bevarades vid bebyggelse så skulle man troligen få många hackspettbon per träd. Möjligen tillverkar hackspettarna fler bon än för häckning, t.ex. för övernattning. Olika djurarter skulle utnyttja samma träd på grund av territorialitet mellan artfränder och bevarandet av sådana träd skulle leda till ökad diversitet. Bevarande av relativt unga aspar med stora inbördes avstånd kan också leda till ökad förekomst av hackspettar och av dem beroende hålhäckare men under sådana omständigheter skulle i stället främst vissa konkurrensstarka arter gynnas.

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Variation in wing length in relation to sex and age of Marsh Tits *Parus palustris*

JAN-ÅKE NILSSON

Abstract

Wing length of juvenile and adult Marsh Tits *Parus palustris* was measured during autumn and winter. Individuals later sexed during breeding were used to study a possible sexual dimorphism in wing length. Males of both juveniles and adults had significantly longer wings than females, the difference between the sexes being around 5.5 %. Using wing length as the only criterion, between 97.4 % and 88.6 % of juveniles and between 98.0 % and 93.4 % of adults can be unambiguously sexed during autumn/winter. Individuals measured during their second or later autumn/winter had significantly longer wings than those measured as juveniles. No evidence for selection against short-winged individuals was found. Each individual increased its wing length during the first complete moult. Hypotheses explaining an increase in wing length with age are discussed and I argue that the best explanation encompasses some sort of nutritional constraint during the nestling and/or early fledgling phase.

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Introduction

Many bird species are monochromatic, i.e. both sexes have more or less identical plumage. Although subtle plumage differences between the sexes have been noted in some of these species (e.g. Mosher & Lane 1972, Gosler & King 1989), other sex differences are often needed to sex these birds during autumn and winter. One such sex difference is the often observed sexual dimorphism in size (e.g. van Balen 1967). Wing length has been proposed to relate to overall size of an individual (van Balen 1967), thus this measure might be useful for sexing individuals of monochromatic species during the non-breeding season.

Another common feature of passerine wings is the increase in length with age, at least between juveniles and adults in their second winter or later. This increase in wing length may depend either on selection against short-winged juveniles, or on an increase in wing length of all surviving individuals during their first complete moult. Both processes will lead to a greater average wing length in adults than juveniles. Moreover, the shorter wing length of juveniles may be either a consequence of nutritional constraints on nestlings or fledglings (Slagsvold 1983) or an adaptive response to different wing length optima in juveniles and adults (Alatalo et al. 1984).

The aims of this study were (1) to outline a way to sex Marsh Tits *Parus palustris* during autumn and winter with the aid of wing length measurements, (2) to investigate the relation between wing length and age and, (3) to distinguish between some of the hypotheses explaining the commonly observed increase in wing length with age.

Methods

I have studied a population of Marsh Tits, 20 km east of Lund, southern Sweden since 1982. The Marsh Tit population bred in nestboxes within a 64 km^2 study area of small deciduous forests and groves interrupted by permanent pastures and agricultural fields.

During the breeding season all young from broods in the nestboxes and most of their parents were marked with an individual combination of colour-rings. During this time, I could easily sex the adults on the size and vascularization of the brood patch. In order to achieve reliable sex determination, only birds sexed during breeding entered the sex-specific analyses.

During the autumn and winters of 1982 - 1987, Marsh Tits were mistnetted, either using playback of song or feeding trays baited with sunflower seeds. I measured their wing length to the nearest 0.5 mm (using method (1) of Svensson 1984). All unbanded birds were colour-ringed for future identification.

The rectrices of juvenile Willow Tits *Parus montanus* and Crested Tits *P. cristatus* showed signs of feather wear from November and onwards (Laaksonen & Lehikoinen 1976). The degree of wear on rectrices and primaries are probably influenced by the amount of time and flying effort expended to meet the daily food requirements. Thus, factors such as quality of flock range and dominance status might result in differences between individuals in the degree and rate of feather wear. To avoid that this variation among individuals influence my measure of wing length, I restricted the analyses of wing lengths to individuals captured before 31 December each winter. Measures taken before 1 July, or on moulting adults, were omitted from the analyses since, before this date, the primaries of juvenile birds might still be growing.

Results

Sex differences: juveniles

Juveniles measured during their first autumn/winter showed a marked sexual dimorphism in wing length (Fig. 1). Males were the largest sex and had significantly longer wings ($\bar{x}$=65.73 mm; S.D.=1.06; N=35) than females ($\bar{x}$=62.36 mm; S.D.=1.08; N=43). Thus, males had 5.4% longer wing than females. In my study population, it seems reasonable to divide the sexes at a wing length of 64 mm (Fig. 1); individuals with a wing of 64 mm or shorter being females and those of 64.5 mm or longer being males. Only one male (2.9%) and one female (2.3%) had a wing length falling outside this dividing line.

Distributions of morphometric measures are often normally distributed. Therefore, knowing the mean and variance of the male and female distributions of wing lengths, respectively, it is possible to calculate the point on the x-axis where the two distributions intersect. I found this intersection point to be at a wing length of 64.1 mm. The proportions of the area under the male and female distribution curves that had x-values smaller or greater than 64.1 mm, respectively, was calculated to be 5.7% for both males and females. Thus, by fitting the data to a normal distribution, I found the division between the sexes to be at a wing length of 64.1 mm and that 88.6% of all individuals can unambiguously be assigned to the right sex on wing length alone.

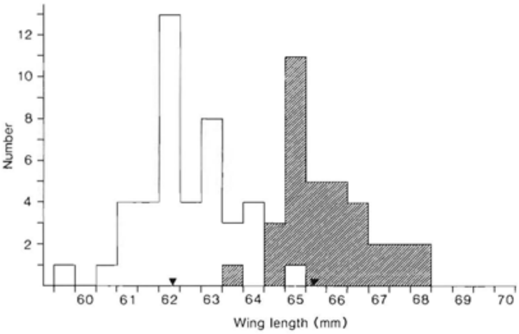

Fig. 1. Frequency distributions of male (hatched bars) and female (open bars) wing length in juvenile Marsh Tits. Males (N=35) and females (N=43) were measured during their first autumn or winter and subsequently sexed during breeding. Data from 1982 - 1987. The arrows indicate mean wing length for each sex. The difference between the sexes tested with t-test: t_{76}=13.85; P<0.001.

Fördelning av vinglängder hos hanar (fyllda staplar) och honor (ofyllda staplar) av entita. Hanar (N=35) och honor (N=43) mättes under deras första höst eller vinter och könsbestämdes vid efterföljande häckning. Data från 1982 - 1987. Pilarna anger medelvinglängden för varje kön. Skillnaden mellan könen testades med t-test. t_{76}=13.85; *P<0.001*

The sample above contained only juveniles that were found breeding the next breeding season and, thus, could be sexed on criteria other than wing length. Also when unsexed juveniles captured during autumn/winter were included, thereby greatly increasing sample size, the wing length distribution was clearly bimodal (Fig. 2).

To investigate whether the subsample of juveniles that succeeded in entering the breeding population constituted a random sample, with respect to wing lengths, of those juveniles alive during the preceding autumn/winter, I plotted the proportion of individuals in each wing length category in the two samples (Fig. 2). The two curves follow each other reasonably well and I conclude that the successful individuals were a random sample of those available with respect to wing length.

Sex differences: adults

A total of 50 individuals, sexed during breeding, were captured during their second autumn/winter or later. These adult birds also showed sexual dimorphism in wing length (Fig. 3). The wings of males ($\bar{x}$=66.55 mm; S.D.=1.21; N=30) were significantly longer (5.6%) than those of females ($\bar{x}$=63.00 mm; S.D.=0.73; N=20). Using a wing length of 64.5 mm as the division point between the sexes, all males and all but one female (95.0%) were correctly sexed.

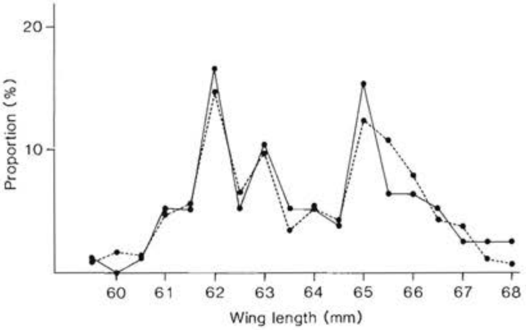

Fig. 2. Wing lengths of all juvenile Marsh Tits captured in autumn/winter (N=338; broken line) and of those that subsequently entered the breeding population (N=78; unbroken line). Data, expressed as percentages, from 1982 -1987.

Vinglängd hos alla ungfåglar som fångades under deras första höst eller vinter (N=338; streckad linje) och hos de som lyckades överleva till häckningssäsongen (N=78; heldragen linje). Data från 1982 - 1987.

By assuming normally distributed data and applying the same calculations as with juveniles, I found the division between the sexes to be at a wing length of 64.3 mm. Under the same assumptions, 96.6% of the males and 96.8% of the females had wing lengths that did not overlap with that of the other sex. Thus, 93.4% of all adults can be correctly sexed on wing length.

Age differences

Individuals measured during their second or later autumn/winter had longer wings than those measured as juveniles (Figs. 1 and 3). The mean increase among males was 0.82 mm (t-test: $t_{63}=2.92$; $P<0.01$) and among females 0.64 mm (t-test: $t_{61}=2.37$; $P<0.05$). This increase in average wing length in the population might be achieved in two different ways. Selection might act against short-winged individuals resulting in only the long-winged ones of each sex surviving to their second autumn/winter. Alternatively, each individual is able to grow longer primaries following its first complete moult.

In order to test the second hypothesis, I compared the wing lengths of the same individual during its first and second autumn/winter. Small sample sizes precluded a test on each sex separately, although males seemed to increase their wing length more than females (Fig. 4). The combined data showed, however, a significant increase in wing length by on average 0.65 mm between the first and second winter (paired t-test: $t_{16}=2.18$; $P=0.044$).

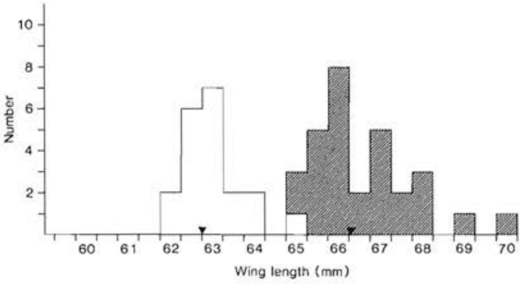

Fig. 3. Frequency distributions of male (hatched bars) and female (open bars) wing length in adult Marsh Tits. Males (N=30) and females (N=20) were measured during their second or later autumn/winter. Sex was determined during breeding. Data from 1982 - 1987. The arrows indicate mean wing length for each sex. The difference between the sexes tested with t-test: $t_{48}=11.80$; $P<0.001$.

Fördelning av vinglängder hos hanar (fyllda staplar) och honor (ofyllda staplar) av entita. Hanar (N=30) och honor (N=20) mättes under deras andra eller senare höst/vinter. Kön bestämdes vid deras häckningsförsök. Data från 1982 - 1987. Pilarna anger medelvinglängd för varje kön. Skillnaden mellan könen testades med t-test: $t_{48}=11.80$; $P<0.001$

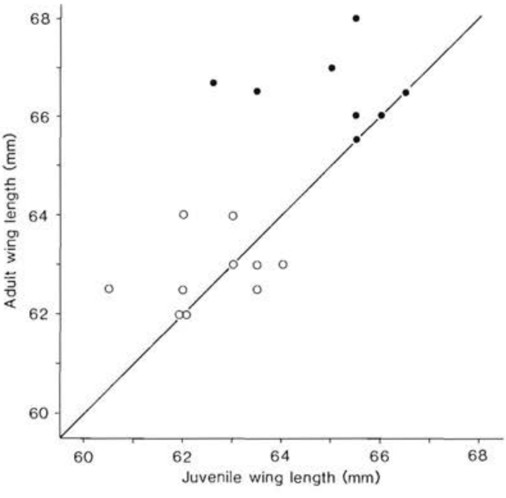

Fig. 4. Relationship between wing length of the same individual measured as a juvenile and as an adult, i.e. during its first and second autumn/winter, respectively. Data for 7 males (●) and 10 females (○). The line denotes unchanged wing length between the two times of measurements.

Samband mellan vinglängd hos samma individ, uppmätt dels som ungfågel dels som gammal fågel, dvs. under individens första respektive andra höst/vinter. Data från 7 hanar (●) och 10 honor (○). Den diagonala linjen visar oförändrad vinglängd mellan de två mättillfällena.

Discussion

Sexual dimorphism

Male Marsh Tits had significantly longer wings than females, a pattern that seems to be general among tits (Table 1). Many studies report a large degree of overlap between the sexes, making wing length of limited value as a method to sex individuals. As seen from Table 1, the best candidate for successful sex determination based on wing length, would be the Marsh Tit which has the largest sexual dimorphism. Also, the overlap between the sexes was relatively small and a large proportion of the Marsh Tits could be correctly sexed on wing length alone.

Variation with age

The smaller wings of juveniles compared with older birds found in this study also seems to be a general pattern among tits: Great Tit *Parus major* (van Balen 1967, Haftorn 1976, Winkel 1980, Alatalo et al. 1984), Blue Tit *P. caeruleus* (Stewart 1963, Winkel 1980), Willow Tit *P. montanus* (Haftorn 1982), Crested Tit *P. cristatus* (Laaksonen & Lehikoinen 1976) and Coal Tit *P. ater* (Winkel 1980, Alatalo et al. 1984). All of these studies report differences in the mean wing lengths of juvenile and adult birds. Thus, the increase in wing length with age might either be intra-individual, i.e. the wing of each individual increases during the first complete moult, or inter-individual, i.e. the short-winged juveniles in each sex die before they become adults. In the Marsh Tit there seems to be no such selection against short-winged juveniles. Increased wing length after the first complete moult, can explain most of the recorded difference between juveniles and adults at the population level. Furthermore, those juveniles that succeed in entering the breeding population seem to be a random sample of the winter population with respect to wing length. This is not surprising in the case of the Marsh Tit, since both establishment success and dominance has been shown to be unaffected by wing length (Nilsson & Smith 1988, Nilsson 1989a).

Why, then, do the wings become longer after the first complete moult? Either it may be adaptive for juveniles to have a shorter wing than adults (Alatalo et al. 1984) or the shorter wings of juveniles may be a consequence of nutritional constraints during the feather growth of nestlings or newly fledged young (van Balen 1967, Slagsvold 1983, Hogstad 1985).

The short wing of juveniles improve manoeuverability and as a consequence has been suggested to be important when it comes to predator avoidance (Alatalo et al. 1984). The longer wings of adults should instead minimize energy consumption during sustained flight. Although the interpretation of wing lengths in juveniles is reasonable, it is harder to understand why the adults of a sedentary species should have wings better designed for fast and sustained flight than those of juveniles. Since juveniles disperse during their first summer before becoming established in year-round territories (Marsh Tit, Nilsson 1989b) or may migrate (Great and Blue Tits, e.g. Ulfstrand 1962, Smith & Nilsson 1987), their need of adaptations for sustained flight ability should be greater than that of adults.

Therefore, among sedentary bird species, I think that the reason for shorter wings in juveniles than in adults is nutritional constraints during the growth of the wing. This may, for example, be due to a lowered growth priority of the wing feathers during their first summer compared to the time of their first complete moult when only feathers are grown (Hogstad 1985). The wing is also one of the last structures that attain adult or near adult size in juveniles (Slagsvold 1983). Thus, besides energy, time may also be limiting for the growth of the wing since selection for early independence and early dispersal, has been found among juveniles in many tit species (e.g. Nilsson 1989b, Perrins & McCleery 1989).

Table 1. Sex difference in mean wing length in some tit species, expressed as a percentage of the female wing length. The difference was calculated as the mean for age categories and sites within each study.

Skillnader i medelvinglängd mellan hanar och honor, uttryckt som procent av honans vinglängd, för några olika mesarter. Skillnaderna är uträknade som medel för ålderskategorier och olika områden inom en studie

	Difference *Skillnad*	N	Source *Källa*
Marsh Tit *Parus palustris*	5.5 %	128	This study
	5.3 %	11	Gosler & King (1989)
Willow Tit *P. montanus*	4.4 %	117	Haftorn (1982)
Great Tit *P. major*	4.4 %	535	Haftorn (1976)
	4.3 %	130	Alatalo et al. (1984)
	4.3 %	2773	van Balen (1967)
	3.7 %	493	Winkel (1980)
Blue Tit *P. caeruleus*	4.0 %	200	Winkel (1980)
Black-capped Chickadee *P. atricapillus*	3.3 %	94	Gochfeld (1977)
Coal Tit *P. ater*	3.3 %	321	Winkel (1980)
	3.2 %	35	Gosler & King (1989)

Acknowledgement

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Sammanfattning

Variation i vinglängd i relation till kön och ålder hos entita Parus palustris

Många fågelarter uppvisar inga eller mycket små skillnader i dräktkaraktärer mellan könen. I ett försök att definiera vinglängdsgränser för hanar och honor som med någorlunda säkerhet kan användas för könsbestämning, fångade jag entitor under höst och vinter, 1982 - 1987. Jag analyserade sedan vinglängder för fåglar som fångades mellan 1 juli och 31 december.

Hanar fångade under sin första vinter hade signifikant längre vinge (medel=67.73 mm) än lika gamla honor (medel=62.36 mm). Detta betyder att hanarnas vinge var 5.4 % längre än honornas. Från figur 1 verkar det rimligt att påstå att individer med en vinglängd av 64 mm eller kortare är honor och de som har en vinge på 64.5 mm eller mer är hanar. Används detta värde som gräns mellan könen, kommer endast en hane (2.9 %) och en hona (2.3 %) på fel sida om skiljelinjen.

Storleksmått är oftast normalfördelade. Förutsätter man detta kan man räkna ut ett teoretiskt värde på överlappet mellan hanens respektive honans vinglängdsfördelningar. Med denna metod fann jag att 88.6 % av alla ungfåglar fångade under hösten/vintern kan könsbestämmas korrekt med hjälp av vinglängden.

Vid en analys av entitor som fångades under sin andra eller senare höst/vinter, fann jag likaså en signifikant längre vinge hos hanar (medel=66.55 mm) än hos honor (medel=63.00 mm). Skillnaden mellan könen uppgick i detta fall till 5.6 %. Använder man 64.5 mm som gränsvärde mellan könen fann jag att inga hanar och endast en hona (5.0 %) skulle ha bestämts till fel kön på vinglängden. Det teoretiskt uträknade överlappsvärdet mellan hanens och honans fördelningar blir i detta fall 6.6 %.

Individer som mättes under sin andra eller senare höst/vinter hade signifikant längre vinge än ungfåglar som mättes under deras första höst/vinter. Hanarnas vinglängd ökade med 0.82 mm och honornas med 0.64 mm. Denna ökning i vinglängd med åldern kan bero på två saker: antingen dör kortvingade individer i större utsträckning än långvingade eller också tillväxer vingen på varje individ under den första kompletta ruggningen. För att testa den andra av dessa förklaringar analyserade jag förändringar i vinglängd för 17 individer som var mätta både under sin första och andra höst/vinter. Dessa individer ökade i genomsnitt sin vinglängd med 0.65 mm från sin första till sin andra höst/vinter. Detta betyder att nästan hela ökningen i populationens vinglängd kan förklaras med att alla överlevande individer, under sin första kompletta ruggning, växer ut pennor som är längre än ungfågelpennorna.

Den individuella ökningen av vinglängden med åldern kan antingen bero på att unga och gamla fåglar har olika vinglängds optima, och att skillnaden mellan ålderskategorier alltså är adaptiv, eller på en näringsmässig begränsning under botiden eller familjeflockstiden. Jag finner det föga troligt att unga och gamla individer hos en stannfågel skulle ha olika optimala vinglängder. Med tanke på att unga entitor är tidspressade för att lyckas etablera sig och att vingen är en av de sista strukturerna som blir färdigväxt, kan man istället tänka sig att ungfåglarna prioriterar andra aktiviteter än att låta vingen växa ut till full längd.

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Population trends and fluctuations in Swedish woodpeckers

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Abstract

This is a quantitative study of population changes in four non-migratory woodpeckers in Sweden. Data were collected during five periods from late autumn to spring and during the breeding season, mainly using point counts. Most analyses are based on the proportion of the routes (each with 20 points) with observation of the species in each year. From 1975 to 1991 there were no population trends in the Great Spotted and Black Woodpeckers, but decreases in the Green and Lesser Spotted Woodpeckers. The mean annual decrease was about 2 % in the Green and 4 % in the Lesser Spotted Woodpecker. There was no trend in winter weather over this period, and only for the Black Woodpecker we found associations between mild winters and numbers recorded. The Great Spotted Woodpecker population increased in years with a high spruce seed supply. In southernmost Sweden frequency of observation was higher for the Green and, in winter, for the Black Woodpecker than further north, while the reverse was true for the Great Spotted Woodpecker. No regional difference was found for the Lesser Spotted Woodpecker.

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Introduction

Woodpeckers are most common in old, unmanaged forests where, in Europe, up to eight species can occur in the same forest (e.g. Tomiałojć et al. 1984). Thus, woodpeckers are often considered to be indicators of management impact (e.g. Scherzinger 1990, Spitznagel 1990).

In many managed forests in Sweden, only the Black Woodpecker *Dryocopus martius* and the Great Spotted Woodpecker *Dendrocopos major* occur (e.g. Nilsson 1979). The Middle Spotted Woodpecker *Dendrocopos medius*, dependent on old, open oak-dominated forests in Sweden, decreased over the last hundred years and finally disappeared in 1982 (Pettersson 1985). The White-backed Woodpecker *Dendrocopos leucotos* requires extensive forests with many old deciduous trees and snags (Aulén 1985). It has also contracted considerably from its former breeding range (Aulén 1986). In 1988, its population was estimated at 80 - 110 pairs (Aulén et al. 1989).

In a recent survey of population trends among 40 common bird species and their response to modern forestry (Svensson *in press*) four woodpecker species were included. Population indices for Black and Great Spotted Woodpecker showed no change, while the Green Woodpecker *Picus viridis* and the Wryneck *Jynx torquilla* decreased. It was suggested that the decline of the Green Woodpecker was an effect of the decrease of deciduous trees.

For the other three Swedish woodpecker species, however, there are no published data on long term population changes, except for some local reports. Ornithologists have suggested that the Lesser Spotted Woodpecker *Dendrocopos minor* and the Three-toed Woodpecker *Picoides tridactylus* have decreased, while the Grey-headed Woodpecker *Picus canus* may have increased somewhat along the southern border of its range (SOF 1990).

Here we report on the population trends and fluctuations in the Green, Black, Great Spotted and Lesser Spotted Woodpeckers in different seasons and regions in Sweden.

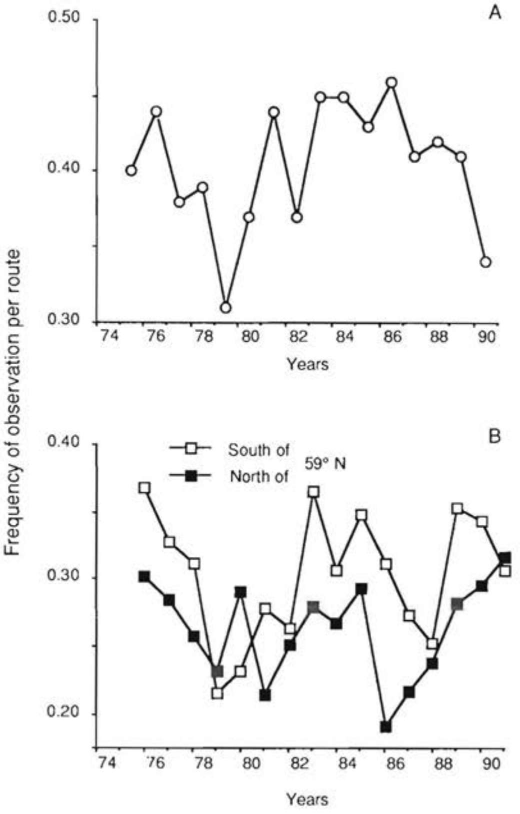

Fig. 1. The frequency of observation (proportion of point count routes with observations) of the Black Woodpecker in (A) May - June and (B) October - March. The material for the winter period is separated in two groups, north and south of 59°N.

Andelen punkttaxeringar med observation av spillkråka under (A) maj - juni och (B) oktober - mars. Materialet från vinterperioden är uppdelat i två grupper (söder resp. norr om Strömstad-Hallsberg-Katrineholm).

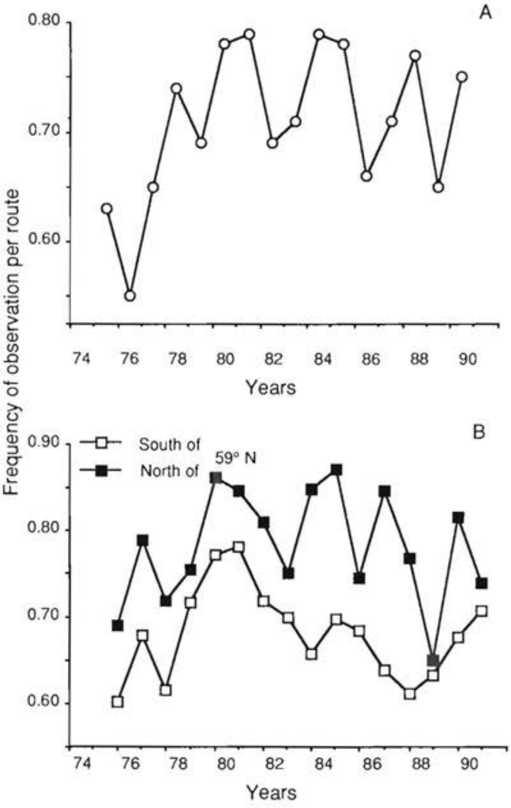

Fig. 2. Same as in Fig. 1 for Great Spotted Woodpecker.

Samma som i Fig. 1 för större hackspett.

Methods

The census data were extracted from the Swedish Winter Bird Count (1975/76 to 1990/91) and the Swedish Breeding Bird Census (1975-1990). The main method is a point count technique where volunteer participants establish routes with 20 points. At each point all individual birds, heard or seen, are counted during five minutes. In winter, counts are made in five periods from October through early March. In the breeding season one count is made in May-June. For a detailed description of field methods see e.g. Källander et al. (1977) and Svensson (1991). Between 646 and 1579 routes were censused each year in the Winter Bird Count and between 83 and 208 in the Breeding Bird Census. In order to increase the sample size for the Lesser Spotted Woodpecker we also included data from territory mapping plots in the breeding season, using all plots with at least one occupied territory in 1975-90 (10-18 plots per year).

We used two kinds of population data. The first was simply the proportion of routes with observation of the species in each year (termed frequency of observation), separating winter and breeding season. The second was based on the change of the number of individuals on routes that were common between two adjacent years.

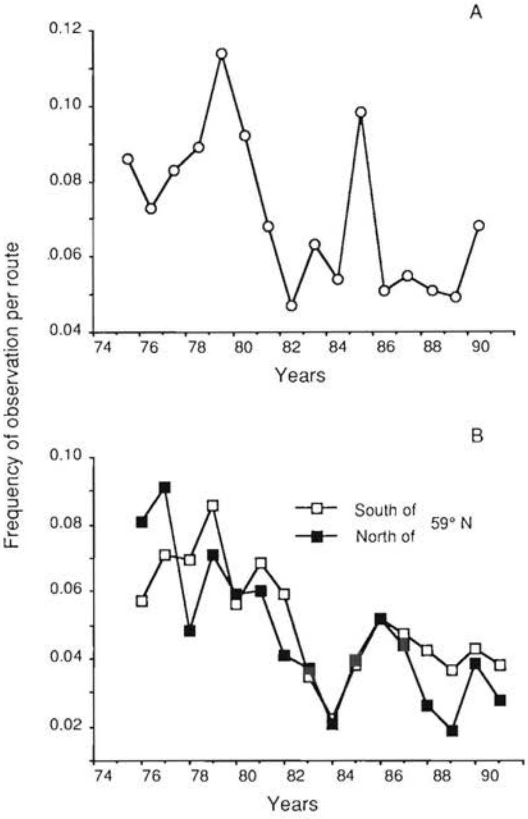

Fig. 3. Same as in Fig. 1 for Lesser Spotted Woodpecker.
Samma som i Fig. 1 för mindre hackspett

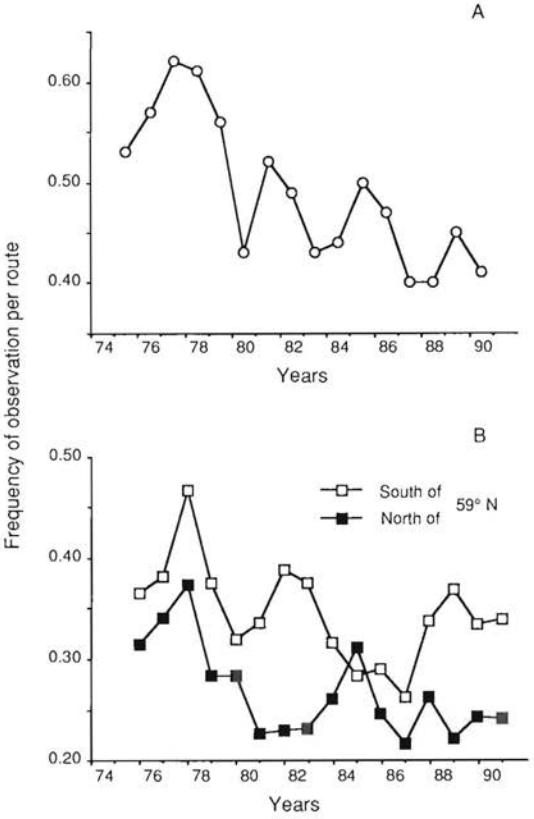

Fig. 4. Same as in Fig. 1 for Green Woodpecker.
Samma som i Fig. 1 för gröngöling.

These estimates of change were concatenated to form a series of annual indices with the mean index for 1975 to 1984 equal to 100 (see Svensson 1991 for methods of calculation).

We used the frequency of observation in most of the analyses, arcsinus transforming it for normalization before using it in analysis of variance. The advantage of using the frequency of observation is that double counts of individual birds from adjacent points are excluded and values from different years are independent from each other. The disadvantage is that it is less sensitive to changes in numbers than is an index based on totals of individual birds. Hence, in the analyses of effects of winter temperatures and winter food we have used the population indices instead.

We divided the material into two geographical groups with about an equal number of routes in each. The division was at approximately 59° N, leaving one fourth of the country in a southern region and the rest in a northern. Most of the routes in the latter region were however located in south central Sweden (south of about 62°N) and very few in the northern half (see map in Svensson 1991). The geographical distribution of routes has been stable over the years (Svensson unpubl.).

Mean winter temperature was calculated from the mean monthly temperatures in December-February for two cities in south and central Sweden (Växjö and Örebro). Mean temperature is closely correlated with mean minimum and mean maximum temperature and also with mean snow thickness (Nilsson 1987).

Table 1. Frequency of observation of four woodpecker species on point count routes, and the slopes of the population trends in 1975/76 - 1990/91 (winter) and 1975 - 1990 (breeding season).

Andel av punkttaxeringsrutterna med någon observation av fyra hackspettsarter samt förändringstakten i observationsfrekvens 1975/76 - 1990/91 (vinter) och 1975 - 1990 (häckningstid).

	Frequency *Andel*		Slope *Förändringstakt*	
	winter *vinter*	breeding season *häckningstid*	winter *vinter*	breeding season *häckningstid*
Green Woodpecker *Gröngöling*				
South of 59° N	0.346	0.518	-0.0051	-0.0091
North of 59° N	0.268	0.443	-0.0064	-0.0172
All routes	0.310	0.482	-0.0059	-0.0121
Black Woodpecker *Spillkråka*				
South of 59° N	0.303	0.392	0.0011	0.0028
North of 59° N	0.263	0.410	0.0003	-0.0009
All routes	0.284	0.401	0.0006	0.0012
Great Spotted Woodpecker *Större hackspett*				
South of 59° N	0.680	0.692	-0.0011	0.0036
North of 59° N	0.782	0.731	0.0002	0.0085
All routes	0.727	0.711	-0.0003	0.0058
Lesser Spotted Woodpecker *Mindre hackspett*				
South of 59° N	0.051	0.057	-0.0024	-0.0020
North of 59° N	0.047	0.047	-0.0035	-0.0024
All routes	0.049	0.052	-0.0029	-0.0025

Table 2. Analysis of variance of observation frequencies of four woodpecker species over 16 years (continuous variable), winter / breeding season (Period) and south / north of 59° N (Region). Only interactions that remained significant ($P<0.05$) after backward elimination are reported. The covariate, Year, tests for a trend over time whereas the two categorical variables tests for differences in frequencies between the two periods and regions respectively.

*Variansanalys av observationsfrekvenserna (andel av punktrutterna med observation) för fyra hackspettsarter under 16 år (kontinuerlig variabel) period (uppdelat på vinter och häckningssäsong) och region. Att år är en kontinuerlig variabel innebär att trender över tiden testas för sig ("Year"), eller att trenden skiljer sig mellan vinter och häckningstid ("Year*Period") eller regioner ("Year*Region"). För period och region testas skillnaderna mellan de två kategorierna samt eventuella interaktioner. Icke signifikanta interaktioner eliminerades successivt tills endast signifikanta ($P<0.05$) återstod.*

	df	F-ratio	P
Green Woodpecker *Gröngöling*			
Year	1	36.7	<0.001
Period	1	11.5	0.001
Region	1	25.6	<0.001
Year*Period	1	7.3	0.009
Black Woodpecker *Spillkråka*			
Year	1	0.3	0.612
Period	1	82.7	<0.001
Region	1	0.6	0.438
Period*Region	1	5.0	0.029
Great Spotted Woodpecker *Större hackspett*			
Year	1	1.7	0.192
Period	1	1.1	0.290
Region	1	16.5	<0.001
Lesser Spotted Woodpecker *Mindre hackspett*			
Year	1	14.1	<0.001
Period	1	0.2	0.690
Region	1	1.0	0.320

Results

Population trends

Data from different seasons and regions were consistent in indicating no trend in populations of the Black and the Great Spotted Woodpeckers (Fig. 1 and 2). Analysis of covariance of frequency of observation for these two species indicated no trend over time (Table 1 and 2).

However, the Lesser Spotted Woodpecker decreased significantly ($P < 0.001$) with the same rate in southern as in central Sweden (Table 2). We have little data from the breeding season for this species, but they are consistent with the result from the winter (Fig. 3). Combining all data the mean annual rate of decrease was -4.3% (95% confidence limits, -2.3% - -6.2%). For the Green Woodpecker the result was similar, indicating a decrease both in winter and summer (ANCOVA, $p<0.001$; Table 2, Fig.4). The annual rate of decrease did differ between seasons (Table 2) but the effect is very weak ($r^2 = 0.052$).

We examined frequency of observation for the late autumn (October, November), midwinter (December, January) and late winter (February, March) periods separately. Trends were consistent for different periods except in the Green Woodpecker. For this species the data indicated a decrease in late autumn ($P < 0.001$), while no significant trends were detected for the two winter periods (slopes = -0.001 and -0.004 with $P=0.84$ and 0.28, respectively).

Table 3. Correlation over 16 years between mean winter (December - February) temperatures and population indices in the same winters and subsequent breeding seasons.

Korrelationer mellan medeltemperaturen för december - februari (medel mellan Växjö och Örebro) och populationsindex samt mellan vintertemperaturen och efterföljande vårs häckfågelindex.

	r	P
Green Woodpecker *Gröngöling*		
Winter index	0.481	0.059
Breeding index	-0.337	0.22
Black Woodpecker *Spillkråka*		
Winter index	0.567	0.022
Breeding index	0.071	0.80
Great Spotted Woodpecker *Större hackspett*		
Winter index	-0.114	0.68
Breeding index	-0.124	0.66
Lesser Spotted Woodpecker *Mindre hackspett*		
Winter index	-0.238	0.38
Breeding index	0.079	0.78

Table 4. Spearman rank correlations between spruce seed supply[1] versus population indices and rate of population change in the Great Spotted Woodpecker.

Spearman rangkorrelation för mängden grankottar[1] mot populationsindex och årliga förändringstakten för större hackspett.

	r_s	N	P
Winter population index *Vinterindex*	0.602	15	<0.03
Breeding population index *Häckningsindex*	0.205	15	0.44
Rate of population change between winters *Förändring mellan vintrar*	0.610	14	<0.03
Rate of population change between breeding seasons	0.563	14	<0.05
Förändring mellan häck-*ningssäsonger*			

[1] Spruce seed production recorded in five semi quantitative classes at Stenbrohult, southern Småland in 1975-90 were: 0, 4, 0, 4, 0, 4, 0, 0, 5, 0, ?, 0, 4, 0, 5, 3.

[1] Granens kottproduktion registrerades i fem semikvantitativa klasser i Stenbrohult, södra Småland 1975-90: 0, 4, 0, 4, 0, 4, 0, 0, 5, 0, ?, 0, 4, 0, 5, 3.

Population fluctuations

We found no significant associations between indices of woodpecker abundance and mean winter temperatures except in the Black Woodpecker (Table 3). However, for this species the correlation was positive only with the winter index, not with the summer index. Over the years studied mean winter temperatures had no trend (r=0.376, N=16, P=0.15).

In resident passerines at high latitudes, winter food is also an important determinant of population fluctuations (e.g. van Balen 1980, Nilsson 1987). For the woodpeckers we have data on winter food only for the Great Spotted Woodpecker, which mainly feeds on coniferous seeds when available (Glutz von Blotzheim & Bauer 1980, Cramp 1985). The analysis indicates a positive effect of spruce seed supply on the size and rate of change of the Great Spotted Woodpecker population (Table 4).

Regional population densities

The Green and the Black Woodpeckers were more common in southern Sweden than further north, while the reverse was true for the Great Spotted Woodpecker (Table 1 and 2). The same patterns were found in both winter and breeding season, except in the Black Woodpecker for which there was no significant difference in the breeding season (Table 1 and 2). The Lesser Spotted Woodpecker was equally common in both regions (Table 2).

Discussion

Black and Great Spotted Woodpecker – species with no trend

The Black and Great Spotted Woodpeckers are the most common woodpeckers in Sweden since they can occur in managed forests without deciduous trees (e.g. Nilsson 1979). Since such forests are becoming more common in Sweden (Svensson *in press*) it is logical that the populations of these two species do not decrease. However, it is perhaps surprising that our data do not indicate increasing populations. It is possible that the area with new coniferous forests is not properly represented in the data set. Another reason could be that the expansion of the coniferous forest area occurs simultaneously with a concomitant decrease in the average quality of the forest for woodpeckers.

Both species prefer old unmanaged forests (Nilsson 1979, Tomiałojć et al. 1984). The species that depend on such forests decline rapidly (see introduction and below), and it is therefore not farfetched to assume that whatever factors are constraining them may also, to some extent, influence the Black and Great Spotted Woodpeckers. The Black Woodpecker also needs big trees for hole excavation. Young forests lack such trees and have a low density of Black Woodpeckers (Wahlström 1982). The average clear-cut area is much larger in north than in south Sweden. Hence it is possible that these species may have declined in the north. However, we lack counts there to be able to judge.

Lesser Spotted Woodpecker

The suggestion that the Lesser Spotted Woodpecker is decreasing in Sweden (SOF 1990) was confirmed by this study. It has decreased by about 50 % over a period of about ten years (Fig. 3), a rate similar to that of the endangered White-backed Woodpecker in both Sweden and Finland (Tiainen 1985, Aulén 1986). Also in Finland, the Lesser Spotted Woodpecker has decreased continuously since monitoring began more than 30 years ago (Tiainen 1985, Väisänen & Koskimies 1989). It mainly feeds on wood-living insects from autumn to late spring (Glutz von Blotzheim & Bauer 1980, Cramp 1985), and prefers old unmanaged deciduous forests (Spitznagel 1990, Olsson et al. *in press*, Pettersson & Fiskesjö *in press*). Its territory in an optimal habitat is about 20 ha (Ahlén & Nilsson 1982, Wesołowski & Tomiałojć 1986, Spitznagel 1990), but larger in managed forests (Wiktander et al. *in press*).

Swedish forest statistics is not suitable for an evaluation of the forest qualities in relation to the requirements of woodpeckers mainly dependent on dead deciduous wood. We know that the area of nemoral deciduous forest decreased with about 1 % yearly in 1960-1980 (Naturvårdsverket 1982). Since such forests are important habitats for the Lesser Spotted Woodpecker (Olsson et al. *in press*, Wiktander et al. *in press*) the decrease of the species could be due to decreasing amounts of suitable habitat. To evaluate this hypothesis there is a need for more appropriate forest statistics. However the decrease of the woodpecker is much faster than is the decrease of deciduous forest. One reason could be increasingly denser forests. Most wood beetles dependent on deciduous trees are favoured by sun-exposure of trees (Nilsson & Ericson 1991). Thus, it is possible that the food density has decreased in dead branches due to the denser forests. Another reason could be the inherent non-linearity predicted by models of extinction processes (e.g. Lande 1987). When a suitable habitat decreases, the dependent populations are expected to decrease even more.

Another possible explanation of the decline of the Lesser Spotted Woodpecker, also related to changes in forest composition, is competition with the Great Spotted Woodpecker. When the amount of spruce increases in relation to the amount of deciduous trees in the forests, as is the case in southern Sweden, the Great Spotted Woodpecker can increase in spruce mast years (Table 4). When the seed crop of spruce fails the Great Spotted Woodpecker is forced to forage on wood dwelling insects (own observations), perhaps reducing the amount of food for the Lesser Spotted Woodpecker. In such years, the Great Spotted Woodpecker may concentrate its foraging to the successively decreasing proportion of deciduous forests intensifying the assumed competition between the two woodpecker species. If this hypothesis is correct the smaller species could decline even if the deciduous forest area is unchanged when the coniferous area increases. We point out the high population level of the Great Spotted Woodpecker around 1980 (Fig. 2), coinciding with the strongest decline of the Lesser Spotted Woodpecker (Fig. 3). However, we found no significant correlation between the population index of the Great Spotted Woodpecker and the rate of change in the index for the Lesser Spotted Woodpecker.

Green Woodpecker

The decrease of the Green Woodpecker population has not been recorded by ornithologists in Sweden (SOF 1990), probably because the decline was only 20 - 30 % over a period of about ten years (Fig. 4). This species, as well as the migratory Wryneck, which is also declining (Svensson *in press*), feeds mainly on ants (Glutz von Blotzheim & Bauer 1980, Cramp 1985), often on pastures with scattered trees. Such habitats have decreased continuously in area during more than 50 years in Sweden (Anonymous 1984). Further, Svensson (*in press*) suggested that the decline of the Green Woodpecker was due to the selective removal of deciduous trees in mixed coniferous/deciduous stands. The habitat requirements of the Wryneck and the Green Woodpecker ought to be examined in detail.

Population fluctuations

Several resident passerines in northern Europe fluctuate according to mean winter temperatures (e.g. Källander & Karlsson 1981, Svensson 1981, Nilsson 1986, 1987). Among passerine populations, small species are more strongly affected by cold winters than are larger species (Graber & Graber 1979, Cawthorne & Marchant 1980). This is partly because the surface/volume ratio decreases with increasing body size. Thus, we would also expect smaller woodpeckers to be most depressed by cold weather. However, we found the opposite tendency.

The population sizes of Lesser and Great Spotted Woodpeckers, as well as the Green Woodpecker, seem to be unaffected by cold winters. On the other hand, the Black Woodpecker was recorded in lower numbers in cold winters. It is possible that the correlation we found is because we performed eight analyses and found one significant correlation by chance. Another possibility is that the correlation is valid and that in cold winters the activity and hence detectability is depressed in this species and perhaps also in the Green Woodpecker (Table 3). The lack of correlation between winter weather and the subsequent breeding population index supports this explanation. However, it is also possible that foraging of the Black and the Green Woodpecker is more difficult during cold winters with much snow, since they forage more on the ground than the two smaller species. The higher frequency of the Black and the Green Woodpecker in southernmost Sweden (Table 1) in contrast to frequencies for the Lesser and Great Spotted Woodpeckers is consistent with such an explanation. Censuses in large plots have revealed a higher density of Black Woodpeckers in southern compared to central Sweden (Tjernberg, Johnsson & Nilsson *in prep.*).

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Sammanfattning

Beståndstrender och fluktuationer hos svenska hackspettar

Hackspettarna omfattar flera hotade arter. Den i vårt land ekberoende mellanspetten har försvunnit helt. Vitryggiga hackspetten, som behöver stora arealer med gamla lövträd, har minskat kraftigt. Nyligen har nedgång befarats för den mindre och den tretåiga hackspetten (SOF 1990). Genom sin generella preferens för äldre naturskog betraktas hackspettarna som goda indikatorer på hur hårt skogen har exploaterats.

Sexton års data, huvudsakligen från punkttaxeringar från Svenska vinterfågelräkningen 1975/76-1990/91 och Svenska häckfågeltaxeringen 1975-1990, behandlas för spillkråka, gröngöling, större hackspett och mindre hackspett. Andelen av punkttaxeringsrutterna med observation av respektive art (observationsfrekvens) analyseras med variansanalys. Materialet regionindelas i en sydlig och en nordlig del med gränsen dragen mellan ruta 9 och 10 i rikets nät, ungefär motsvarande en linje dragen genom Strömstad, Hallsberg och Katrineholm. Denna delning ger två likstora delar av materialet. Rutterna från den norra regionen härrör huvudsakligen från Svealand

Resultaten (Tabell 1 och 2) visar att populationstrenderna är lika för olika regioner och perioder inom en art. Ett undantag är gröngölingen där data från häckningstiden visar på en kraftigare nedgång (-2.1% per år) än under vintern (-1.7% per år). Data från hösten visar på samma nedgångstakt som under häckningstiden medan det för december-mars endast finns en svag icke signifikant nedgång.

Trots att vi har jämförelsevis få observationer av mindre hackspett visar den en genomgående och mycket stark tillbakagång (-4% per år). Minskningstakten är lika hög som för vitryggig hackspett i både Sverige och Finland. För större hackspett och spillkråka finner vi inga populationstrender (jfr Svensson i tryck).

Större hackspetten och spillkråkan är de två arter som påverkas minst av dagens skogsbruk eftersom de kan leva även i intensivt skötta skogar, förutsatt att det finns lämpliga boträd. Följdriktigt visar de inga beståndstrender under 1975-1991, en period under vilken vintertemperaturen inte heller hade någon trend.

Hackspettar som tycks föredra naturbetesmarker för sitt födosök minskar, liksom denna naturtyp. Gröngölingens minskning har inte tidigare uppmärksammats av ornitologer, kanske beroende på att minskningen endast är 20-30% på tio år. Göktytans snabba minskning (Svensson i tryck) har dock uppmärksammats (SOF 1990). Dessa två arters biotopkrav borde analyseras närmare.

Mindre hackspettens snabba minskningstakt är inte så lätt att förklara som det kanske anses bland ornitologer. Arten har minskat mycket snabbare än mängden lövträd. Vi föreslår tre tänkbara förklaringar:

1. Ädellövskog är en föredragen biotop (Olsson m.fl. i tryck, Wiktander m.fl. i tryck) som har minskat med ca 1% per år 1960-1980. Kanske är ädellövskogarna nyckelbiotoper i landskapet för mindre hackspetten. Bland skötta lövskogar är det endast ädellövskogarna som tillåts bli gamla (se t.ex. Olsson m.fl. i tryck). Att mindre hackspetten minskar betydligt snabbare än lövskogen kan bero på det generella faktum att när lämplig biotop minskar går de därav beroende arterna tillbaka snabbare än biotopytan (se t.ex. Lande 1987). Statistiken från riksskogstaxeringen är dock inte tillräckligt detaljerad för att beräkna minskningstakten för speciella skogstyper.

2. Skogarna har blivit tätare vilket missgynnar många vedlevande lövträdsskalbaggar (Nilsson & Ericson 1991). Kanske har födomängden per döende och död lövträdsgren minskat p.g.a. att beskuggningen på grenarna ökat.

3. Större hackspetten ökar vid riklig tillgång på kottar (se nedan). Vintrar då det saknas kottar lever arten främst på vedlevande skalbaggar i likhet med mindre hackspetten (egna observationer). Om skogen ändras så att andelen barrträd ökar, vilket sker i dagens svenska skogar, gynnas större hackspetten under år med riklig tillgång på kottar. Detta innebär att mängden

större hackspettar som söker föda i den mindre artens huvudbiotop, lövskogar, ökar vid utebliven kottsättning. Vi tror att detta kan påverka den mindre hackspetten negativt genom lägre överlevnad. Åren kring 1980 sammanfaller en hög täthet av större hackspetten med en särskilt snabb minskning av mindre hackspetten (Fig. 2 och 3).

Beståndsindex för de fyra hackspettarterna jämfördes med medeltemperaturen för december-februari (medel för Växjö och Örebro). Endast vinterindex för spillkråka var signifikant korrelerat med temperaturen (Tabell 3). Det är möjligt att spillkråkan, och eventuellt gröngölingen, påverkas negativt av kalla vintrar, men också att aktiviteten och därmed observerbarheten minskar vid kallt väder. Beståndsindex för större hackspett och förändringshastigheten för beståndsindex visar positiva samband med mängden grankottar (grankottedata från södra Småland). Det är känt att grankotteproduktionen samvarierar över större områden.

Observationsfrekvenserna varierar regionalt för tre arter. Gröngöling och spillkråka vintertid visar högre frekvens i den sydliga regionen än i den norra. Större hackspetten visar det omvända mönstret. Mindre hackspetten visar samma frekvens i båda regionerna. Det nordliga materialet domineras dock helt av Svealand, tyvärr finns få rutter från Norrland.

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The age of young Willow Warblers *Phylloscopus trochilus* estimated from different stages of post-juvenile moult

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Abstract

A scale for estimating the progression of post-juvenile moult in Willow Warblers is described. The scale was used on birds caught at Ammarnäs, Swedish Lapland in 1984-1991. Two data sets were used to determine the average age (days since hatching) of birds in different stages of moult. First, 91 Willow Warblers with known hatching date were later retrapped and examined for state of moult. Most of these birds were caught in the earlier stages of moult. Second, birds first caught in one stage of moult were retrapped in later stages and this enabled an estimate to be made of the average age of juvenile Willow Warblers in the later stages of moult. The moult of juveniles commences at an age of 26 days, just after the outermost primaries reach full length. Few birds with completed moult were registered but data suggest that moult ends around 60 days of age. The scale is also applicable to juveniles of many other passerine species, but there are exceptions.

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Introduction

In studies on birds it is often important to determine the age of individuals in the population. Differences in age usually explains much of the interindividual variation in behaviour, e.g. in relation to reproduction (Pianka & Parker 1975, Partridge 1989) and migration (Alerstam 1982). For passerines, excellent reference works are available for separating adults from first-year birds (Svensson 1984). Recent studies have shown that adults of many species can be separated into further age classes (Karlsson et al. 1985, 1986). However, methods for determining the more precise age of juvenile birds during their first months of life are also desirable.

The hatching date of young birds has a direct bearing on the reproductive success of the parent birds (see Price et al. 1988) and also in the survival of young once independence is attained. For example in Marsh Tits *Parus palustris*, early hatched young reach independence earlier than later hatched conspecifics and are therefore more successful in entering a winter flock (Nilsson & Smith 1988). Thus, knowledge of hatching date of juveniles caught after fledging may help to explain observed variation in many traits and behaviours.

In this paper we present a method for estimating the age (days since hatching) of first year Willow Warblers *Phylloscopus trochilus*, using the progress of post-juvenile moult. The scale presented has been used e.g. in a nation-wide Swedish project studying the migration of Willow Warblers (Hedenström et al. 1989). However, the age of birds in different stages of moult has not yet been determined.

Methods

Study area and material

The study was carried out near Ammarnäs (65°58'N, 16° 07'E) in Swedish Lapland, as a part of the LUVRE project (see Enemar et al. 1984). Daily ringing, using 20 to 22 mist nets, was carried out in a subalpine birch forest near Lake Tjulträsk (520 m a.s.l.) from approximately 15 July to 20 August during the years 1983-1991. In most years (1984-1991), non-systematic mist netting was also carried out in a study area situated less than 2 km north of Lake Tjulträsk. The breeding biology of Willow Warblers was studied there during several years up to 1985 (Arvidsson & Nilsson 1983, Arvidsson 1984, Arvidsson et al. 1985). During that study, all nestlings were ringed with aluminium rings and several of these birds were later caught by us. In addition we retrapped a few Willow Warblers ringed as nestlings by our own ringing group. Juvenile Willow Warblers remain in their nest for 12 days (Arvidsson & Nilsson 1983) and normally gain independence from parental control when 25 days old (own observations).

All juvenile Willow Warblers were ringed and the extent of post-juvenile moult noted (see below). Moult profiles were also taken on all birds retrapped later in the same season.

Assessing post-juvenile moult

In 1983 we developed a method for classifying the progress of post-juvenile moult in Bluethroats *Luscinia svecica* using a scale with seven categories (Lindström et al. 1985). This method served as a base for the scale we developed for Willow Warblers and is shown in Table 1 and Fig. 1. When devising this scale we chose

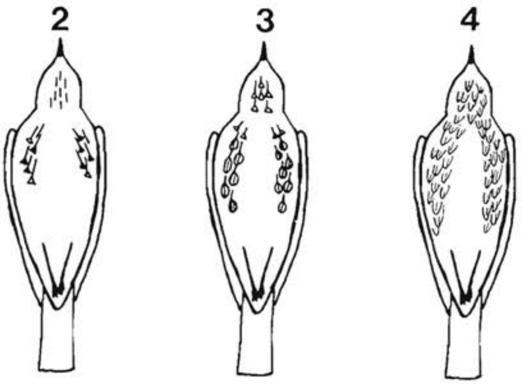

Fig. 1. Extent of post-juvenile moult on the underparts of Willow Warblers in moult stages 2, 3 and 4 (see Table 1). Dark areas refer to juvenile feather growth which is yellow, clearly contrasting with the greyish-white natal set of feathers.

Utbredningen av nya fjädrar (mörka partier) hos unga lövsångare i ruggstadium 2, 3 respektive 4. I verkligheten är de nya fjädrarna gula, ofta i skarp kontrast mot de gråvita fjädrar som är kvar sedan tiden i boet.

Table 1. Criteria for scoring post-juvenile moult in Willow Warblers. Only the underparts (throat, breast, flanks and belly) are considered.

Kriterier för klassning av ungfågelruggningen hos lövsångare. Endast undersidans fjädrar (strupe, bröst, flanker och buk) används vid klassningen.

Moult stage *Ruggningsstadium*	Moult criteria	*Ruggningskriterier*
1	Growth of primaries not yet complete, waxy sheats present on outer primaries.	*Handpennor ej helt utvuxna, de yttre har spolrester.*
2	Wing growth complete. New feathers growing on sides of breast with throat feathers still in pin.	*Vingpennor färdigvuxna. Ruggar fjädrar på strupe och flanker men strupfjädrarna har ännu inte brutit ut ur spolarna ("spikar").*
3	Growing feathers on throat and sides of breast (three moulting areas distinguishable). Some throat feathers have now emerged from the sheaths.	*Ruggar fjädrar på strupe och på bröstets sidor (tre urskiljbara ruggningscentra). Strupfjädrarna har brutit ut ur spolarna ("flaggor").*
4	The three moulting areas have merged. There is an uninterupted band of new feathers from the throat along each side of the breast and flanks.	*De tre ruggningscentra har vuxit ihop. Det går att följa ett sammanhängande stråk med nya fjädrar från strupen ner längs vardera kroppssida.*
5	New feathers only, but waxy sheaths still present on belly feathers.	*Enbart nya fjädrar. Spolrester på bukfjädrarna.*
6	Post-juvenile moult complete.	*Helt färdigruggad. Första höstdräkt.*

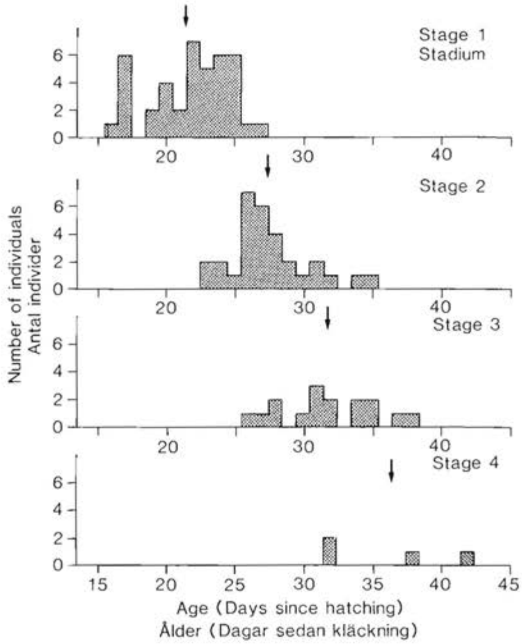

Fig. 2. Days since hatching of juvenile Willow Warblers ringed as nestlings and later retrapped and classified to stage of moult according to Table 1. Arrows indicate mean age of birds for each stage of moult.

Ålder hos bomärkta lövsångare som senare återfångats och klassificerats till olika ruggstadier enligt Tabell 1. Pilar anger medelåldern för fåglar i respektive ruggningsstadium.

Table 2. Mean number of days (± s.d.) between ringing and recapture for juvenile Willow Warblers ringed when in moult stage 2, 3 and 4, and recaptured in later stages of moult (see Table 1).

Det genomsnittliga antalet dagar (± s.d.) mellan första fångst och återfångst av unga lövsångare märkta i ruggstadium 2, 3 eller 4, och återfångade i senare ruggstadium (se Tabell 1).

Moult stage when ringed *Ruggstadium vid märk-tillfället*	Moult stage when recaptured *Ruggstadium vid kontrolltillfället*			
	3	4	5	6
2	4.5±2.5 (150)	9.1±3.2 (23)	18.0±3.4 (4)	(-)
3		6.4±3.5 (93)	11.2±2.1 (4)	24 (1)
4			5.0±2.9 (13)	(-)

criteria on the birds' underparts because they were easy to observe and examination of moult in other body feather tracts would have increased the processing of each bird. Since the moult of these feather tracts closely follow the moult of the underparts (Norman 1981), we decided to consider the underparts only. The scale has been in use by our ringing group since 1984.

Results

We captured and classified the extent of post-juvenile moult on the underparts of 91 Willow Warblers with known hatching date (Fig. 2). The median and mean age of juveniles in each stage of moult did not differ by more than one day, therefore only mean values are presented. The mean age of birds retrapped in moult stage 1 was 21 days. By an age of 26 days 95% had completed primary growth. The average age of birds in stage 2 was 27 days, and 32 days for moult stage 3. Unfortunately, only four individuals with known hatching day were caught when in moult stage 4 (mean: 36 days), and none when in stages 5 or 6.

However, an estimate of the average age of birds in later stages of moult (4-6) can be made using birds of unknown hatching date. We assume that the average age of individuals in moult stage 2 is 27.5 days, and then analyse birds ringed in stage 2 and recaptured in later stages of moult. In Table 2 we present the average number of days between ringing and recapture for birds ringed in moult stage 2, 3 and 4, respectively, and recaptured in later stages of moult. From this we can calculate the age of birds in stage 3 as 32 days (27.5+4.5), which is similar to known aged birds shown in Fig. 2. The age of birds retrapped in moult stage 4 can be calculated for birds initially caught in moult stage 2 as 37 days, or 38 days for birds ringed in moult stage 3. These estimates are similar to the 36 days shown by the four birds in Fig. 2. The average of the three estimates for birds in moult stage 4 is 37 days. Similarly, for birds in moult stage 5, the average age is 44 days. Table 3 shows the average ages of juvenile Willow Warblers in the different stages of post-juvenile moult.

Only one bird was recaptured in moult stage 6 (estimated age of 56 days) and we are therefore unable to give an age estimate on moult completion. However, according to Norman (1981), post-juvenile moult in Willow Warblers finishes around 60 days of age. In a study of hand-raised juvenile Willow Warblers, Gwinner (1969) found that the post-juvenile moult ended at an age of 60-70 days.

Table 3. The average age (days since hatching) of juvenile Willow Warblers in moult stages 1-5. These figures are derived from data of retrapped birds of known age (Fig. 2), and from retraps of birds caught in different moult stages (Table 2).

Genomsnittlig ålder (dagar sedan kläckning) hos unga lövsångare i ruggstadium 1-5. Åldersuppskattningarna är härledda dels från återfångster av fåglar med känd ålder (Fig. 2) och dels från återfångster av fåglar som fångats i olika ruggningstadier (Tabell 2).

Moult stage *Ruggstadium*	Age *Ålder*
1	21
2	27
3	32
4	37
5	44

Discussion

The criteria used in this study for estimating the progression of post-juvenile moult were chosen in order to obtain a standard method. However, there might be other good and easy criteria to use for estimating the progression of post-juvenile moult. For instance, Norman (1981) points out that the moult of the tail-coverts starts at an age of 37-39 days. Thus, a bird which had commenced tail-covert moult would conform to our stage 4.

Norman (1990) has already developed a method for ageing juvenile Willow Warblers. However, it is not directly compatible with the method presented here. Our method has been extensively used since 1984 at Ammarnäs, and at the bird observatories of Kvismaren and Ottenby, as well as in the Swedish Willow Warbler Project (Hedenström et al. 1989). Therefore, a detailed description of our scoring system would enable data sets collected with any of the two methods comparable. This is now possible because Norman (1990) gives the estimated age of birds in different moult categories. For instance, Willow Warblers in Norman's moult stage 3 are 26-30 days old, thus corresponding to our moult stage 2. Baggott (1975) classified post-juvenile moult in Willow Warblers in a similar way, but did not present age estimates for birds in different moult categories.

Fig. 2 shows that there is either individual variation in a birds' progress of moult, or the criteria used for classification is difficult to interpret by workers, or a combination of both. Ten ringers were involved collecting most of the data in this study and although we regularly checked the criteria between ringers, the number of people involved almost certainly increased the observed variation. Thus, the variation in the age of birds and the extent of moult is probably smaller than the data suggests. It is worth noting that the relationship between age and stage of moult is almost linear up to moult stage 5. However, the further the moult has progressed the more inaccurate the estimated age would be.

With minor adjustments, it is possible to apply this method also to other passerines. In many species, similar to the Willow Warbler, the natal feather growth has just finished (normally ending when the primaries are fully grown) when post-juvenile moult begins, e.g. in the Reed Warbler *Acrocephalus scirpaceus* (Norman 1981), the Wood Warbler *Phylloscopus sibilatrix* (Gwinner 1969), the Bluethroat *Luscinia svecica* (Lindström et al. 1985) and the Brambling *Fringilla montifringilla* (own observations). Other species show a dormant period between the end of natal feather growth and the onset of post-juvenile moult. Birds in this condition would comply with moult stage 2 (Table 1) and may remain so for about three weeks in the Chiffchaff *Phylloscopus collybita* (Gwinner 1969, Norman 1991) and probably more than a month in Blue tits *Parus caruleus* (own observations).

In a small number of species the post-juvenile moult seems to start before young birds gain independence from parental control. Thus, by the time the primaries are full-grown, the majority of feathers included in the moult are already shed and the new feathers are growing. These birds should be classified as stage 5 birds when they leave stage 1, thus skipping the intermediate stages. The Sedge Warbler *Acrocephalus schoenobaenus*, the Marsh Warbler *A. palustris*, the Great Reed Warbler *A. arundinaceus*, as well as the Red-backed Shrike *Lanius collurio* all seem to fit into this group (own observation). However, the post-juvenile moult in these species seems not to include all body feathers as in the the Willow Warbler, and may in fact be limited to the filling in of bare areas on the body, rather than replacement of feathers.

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Sammanfattning

Ålder hos unga lövsångare Phylloscopus trochilus *i olika stadier av ungfågelruggningen*

Vid många studier av fåglar är det ofta viktigt att rätt kunna åldersbestämma individer. Framför allt för tättingar så är kunskapen idag ganska god om hur man skiljer adulta fåglar från årsungar (Svensson 1984). Däremot saknas god kunskap om hur man mer exakt åldersbestämmer ungfåglar under deras första månader i livet. I den här uppsatsen presenterar vi en metod att bestämma åldern (i dagar efter kläckning) hos unga lövsångare *Phylloscopus trochilus* baserad på hur långt de kommit i sin ungfågelruggning.

Metoder

Studien utfördes nära sjön Tjulträsk, Ammarnäs (65°58'N,16°07'E) i svenska Lappland, som en del i det så kallade LUVRE-projektet (se Enemar et al. 1984). Under åren 1984-1991 fångades fåglar dagligen i 20-22 slöjnät, under perioden 15 juli till 20 augusti. De flesta av dessa år utfördes också oregelbunden fångst i ett undersökningsområde cirka 2 km norr om Tjulträsk. I det senare området studerades lövsångarens häckningsbiologi intensivt under åtskilliga år fram till 1985 (Arvidsson & Nilsson 1983, Arvidsson 1984, Arvidsson et al. 1985) och alla boungar ringmärktes. Flera av dessa återfångades senare av oss. Bouppgifter, inklusive kläckningsdag, för dessa fåglar ställdes välvilligt till vårt förfogande av B.E. Arvidson och R. Neergaard. Vid några tillfällen fångade vi också fåglar som var ringmärkta som boungar av oss själva.

Alla unga lövsångare som fångades klassificerades efter hur långt de kommit i ungfågelruggningen (ungfåglarna byter kroppsfjädrarna och en del vingtäckare strax efter att de blivit självständiga). Skalan som användes presenteras i Tabell 1 och Fig.1. Denna skala har under lång tid även använts vid Ottenby och Kvismare fågelstationer, samt i det landsomfattande Lövsångarprojektet (Hedenström et al. 1989).

Resultat

Totalt fångades 91 unga lövsångare med känd ålder. Deras fördelning över olika ruggningstadier framgår av Fig. 2. Medelvärdena och medianvärdena för fåglarnas ålder i de olika stadierna skilde sig aldrig åt med mer än en dag. Därför redovisas i fortsättningen endast medelvärden. Medelåldern i ruggstadium 1 var 21 dagar. Vid 26 dagars ålder hade 95 % av fåglarna färdigvuxna handpennor. Medelåldern i ruggstadierna 2 och 3 var 27 respektive 32 dagar. Vi fångade endast fyra fåglar i stadium 4 (vars kläckdag var känd) och de var i genomsnitt 36 dagar gamla. Vi fångade inga fåglar i stadierna 5 eller 6 med känt kläckdatum.

Vi använde också en annan metod för att kunna bestämma åldern på fåglar i de högre ruggningsstadierna. Till det utnyttjade vi data från de fåglar som märkts i nätfångsten och senare återfångats när de befunnits vara i ett längre framskridet stadium av ruggningen (Tabell 2). Medelåldern i stadium 2 är 27,5 dagar. Om vi därtill lägger de (i genomsnitt) 4,5 dagar det tagit för unga lövsångare att gå från stadium 2 till 3, ger detta en medelålder på 32 dagar för fåglar i stadium 3. Detta är samma åldersuppskattning som vi erhöll från de bomärkta ungarna (Fig. 2). På liknande sätt uppskattade vi åldern på fåglar i stadium 4: 37 dagar om vi börjar från stadium 2 och 38 dagar från stadium 3, vilket är mycket nära de 36 dagar som data i Fig. 2 indikerar. Den genomsnittliga åldern för fåglar i ruggstadium 5 blir på samma sätt 44 dagar. Bara en fågel återfångades i stadium 6 (uppskattad ålder 56 dagar). Enligt Gwinner (1969) och Norman (1990) avslutas ungfågelruggningen vid en ålder av 60 respektive 60-70 dagar. Vi föreslår att värdena i Tabell 3 används vid åldersklassning av unga lövsångare.

Diskussion

Kriterierna i den här presenterade skalan valdes för att de verkade lätta att observera. Det kan dock mycket väl finnas andra kriterier som är bra att använda. Till exempel så anger Norman (1981) att ruggningen av de övre stjärttäckarna börjar vid en ålder av 37-39 dagar (vilket skulle motsvara vårt ruggningsstadium 4).

En liknande skala har presenterats av Norman (1990) men de två metoderna är inte direkt jämförbara. Vår skala har använts på många platser ända sedan 1984. Vi ansåg det därför angeläget att presentera denna så att resultaten från studier där olika metoder använts kan jämföras. Detta är möjligt då också Norman (1990) ger åldersuppskattningar för fåglar i olika ruggningskategorier. Till exempel så är en lövsångare i Norman's stadium 3 26-30 dagar gammal, vilket skulle motsvara vårt stadium 2.

Som framgår av Fig. 2 så är antingen variationen i ruggningshastighet mellan individer stor, eller så ger metoden utrymme för icke-konsekventa bedömningar. I vår studie gjordes de flesta klassningarna av totalt 10 olika ringmärkare. Trots att vi regelbundet kalibrerar våra bedömningar så har det stora antalet inblandade personer säkerligen ökat variationen. Troligen är alltså den sanna spridningen i ålder mindre för respektive ruggningsstadium än vad som framgår av Fig. 2.

Efter små modifikationer är den här presenterade skalan användbar även för andra tättingarter. Hos arter som t.ex. rörsångare *Acrocephalus scirpaceus* (Norman 1981), grönsångare *Phylloscopus sibilatrix* (Gwinner 1969), blåhake *Luscinia svecica* (Lindström et al. 1985) och bergfink *Fringilla montifringilla* har ruggningen ett liknande förlopp. Andra arter kan dröja kvar flera veckor i stadium 2, t.ex. gransångare *Phylloscopus collybita* (Gwinner 1969, Norman 1981) och blåmes *Parus caruleus* (egna observationer). Hos ett fåtal arter startar ungfågelruggningen långt före det att fåglarna blivit självständiga. När handpennorna är färdigvuxna är också de flesta kroppsfjädrar klara eller nästan klara. Dessa fåglar går alltså, enligt vår skala, direkt från stadium 1 till stadium 5. Några arter som verkar höra till denna grupp är sävsångare *Acrocephalus schoenobaenus*, kärrsångare *A. palustris*, trastsångare *A. arundinaceus* och törnskata *Lanius collurio* (egna observationer). Dessa arter verkar dock inte byta alla kroppsfjädrar som t. ex. lövsångarna gör, utan ruggningen kan eventuellt vara begränsad till att nya fjädrar växer ut för att täcka nakna partier som inte täcks av fjäderskruden som anlades i boet.

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Levels of mercury in eggs of Red-throated Diver *Gavia stellata* and Black-throated Diver *G. arctica* in Southwest Sweden

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Abstract

In connection with surveys of breeding populations of *Gavia stellata* and *G. arctica* in Southwest Sweden 1978-91, unhatched eggs in abandoned nests were collected and analysed for mercury. In the investigated area, divers of both species primarily fish in oligotrophic lakes, many of them affected by air-borne acidifying pollutants. The level of mercury in *G. stellata* eggs was extremely high; in a sample of seven eggs from four breeding sites the mean concentration was 9.5 ppm dry weight with a range of 6.2-14.2 ppm, which is among the highest levels recorded for any bird species in Sweden. The concentrations in *G. arctica* eggs were lower: 1.0-2.4 ppm dry weight in samples from four breeding sites at circumneutral lakes, and on average 4.0 ppm (range 1.8-5.9 ppm) in a sample from four breeding sites at lakes affected by acidification. For *G. stellata*, all eggs contained mercury at levels where reproductive impairment is to be expected, and also single *G. arctica* eggs were so heavily contaminated that the risk of impairment must be considered. Fish samples from seven lakes indicated that potential prey fish (*Rutilus rutilus* and *Coregonus albula*, <20 cm) for *G. stellata* feeding chicks contained higher concentrations of mercury in lakes affected by acidification. In one lake, fish contained levels about twice those reported to be associated with behavioural and reproductive disturbances in fish-eating birds. Also, single fish in two other lakes contained high concentrations of mercury. The results indicate that especially *G. stellata*, but also *G. arctica* in their breeding grounds in Southwest Sweden are exposed to levels of dietary mercury, sufficiently high for reproductive impairment to be expected, and that a connection exists to high levels of mercury in prey fish from freshwaters affected by acidification.

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Introduction

The Red-throated Diver *Gavia stellata* and the Black-throated Diver *G. arctica* are fish-eating bird species that have attracted attention in the national conservation work in the Nordic countries due to a combination of factors, including declining of fish populations in acidified lakes, disturbance from out-door recreational activities, and water level regulations (e. g. Andersson et al. 1980, Haga 1980a, 1980b, Pakarinen & Järvinen 1984, Götmark et al. 1989, Eriksson 1992).

The two species forage primarily in oligotrophic waters which often have a low natural alkalinity and are thus susceptible to acidification by air-borne pollutants. In addition to the strain of dealing with a reduced food supply in acidic lakes, predators on fish risk exposure to increased levels of toxic metals through their food. Normally the exposure to cadmium, lead and aluminium is too low for any damage to occur, but the risk of exposure to mercury must not be neglected (Scheuhammer 1991). In the present paper we report high levels of mercury in eggs of Red-throated Diver and Black-throated Diver, as well as in potential prey fish, in an area with oligotrophic and acidic lakes in Southwest Sweden.

Study area

The study area covers the southern part of the county of Älvsborg (approx. 57°30'N, 12°45'E), Southwest

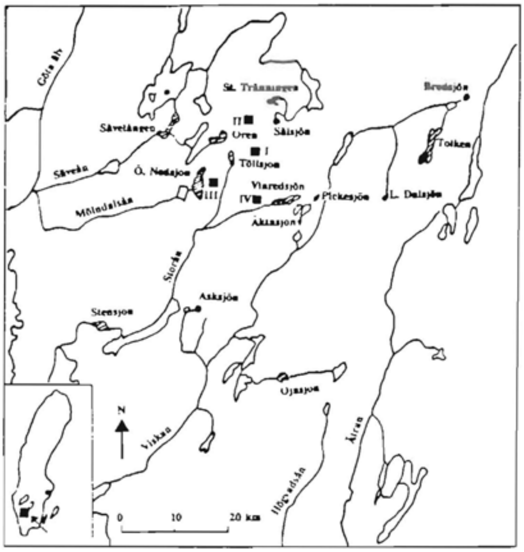

Figure 1. The study area in the southern part of the county of Älvsborg. Lakes mentioned in the text or tables are indicated. I-IV = sampling sites for Red-throated Diver eggs.

Undersökningsområdet i södra Älvsborgs län. Sjöar omnämnda i texten eller tabeller är markerade. I-IV = insamlingsplatser för smålomsägg.

Sweden, where surveys of the breeding populations of the two species of divers have been done since the 1970's (e. g. Ahlgren et al. 1991, Johansson 1991). The area is dominated by coniferous forests with *Picea abies* and *Pinus silvestris*, and forestry is the most wide-spread land-use actitivity. Most lakes are oligotrophic and circumneutral, if not acidified. The whole area is affected by acidifying pollutants, and field surveys during the early 1970's indicated that acidification of lakes, with pH-values regularly below 5.5, was already wide-spread more than 20 years ago (Almer 1972, Almer & Hanson 1980). Extensive liming programmes in order to restore fish stocks were initiated around 1980 and are still in progress (e. g. Brodin 1989).

In the study area, Red-throated Divers breed in small tarns (0.008-0.1 km^2), often naturally devoid of fish, and the chicks are fed with fish caught in larger freshwater lakes up to a maximal distance of 7.7 km from the breeding site (Eriksson et al. 1990). The population consists of 15-20 breeding pairs and an additional number of non-breeding adults. Since the 1930's, the breeding population has been reduced by almost 50 %, and this decline has been related to habitat changes, such as drainage (for forestry) or overgrowth of *Sphagnum* mosses in the breeding tarns, and decline of fish stocks in adjacent fishing lakes (Eriksson et al. 1988).

Black-throated Divers breed in comparatively large lakes (0.1-12.1 km) in the study area (Eriksson 1987, Ahlgren et al. 1991), and food for the young is normally caught in the breeding lake. The population size is approximately 200 pairs (deduced from Arvidsson 1984). During 1968-1985 there was no significant change in the breeding success (Eriksson 1987), but there are indications of a decline in recent years (Ahlgren et al. 1991). The average reproduction was 0.40 halfgrown to fledged young per pair and year during 1968-1985. This rate is the same as in other areas in South Sweden (Andersson et al. 1980) and in Finland (Pakarinen 1989), and close to the minimum of 0.4-0.5 young per pair which Nilsson (1977) estimated to be necessary for the maintenance of a stable population.

Methods

Eggs

During the surveys of the breeding populations, unhatched eggs in nests abandoned after desertion or hatching were collected. Therefore, eggs not hatched due to high concentration of any harmful element may be overrepresented, and our sample does not necessarily reflect the average exposure of all eggs. The concentrations of mercury were investigated by neutron activation analysis according to methods described by Odsjö & Sondell (1982). For breeding sites from which more than one egg were analysed, we used the mean concentration in our calculations. The sampling sites are shown in Fig. 1.

Fish

From seven lakes, known to be used by foraging Red-throated Divers (according to Eriksson et al. 1988), samples of Roach *Rutilus rutilus*, and from two lakes also Vendace *Coregonus albula*, were taken during May-September 1991. For both species, only fish smaller than 20 cm were collected. The fish species and sizes were chosen in order to reflect the diet given by Red-throated Divers feeding chicks in the study area (Eriksson et al. 1990). For the analyses of mercury, axial muscle tissue was used. The sampling lakes are shown in Fig. 1.

Lakes

The lakes included in our study have been subjected to measurements of different parameters of water quality since the early 1970's. Lakes where declines in pH below 5.5 have been recorded were classified as "affected by acidification".

Table 1. Concentrations of mercury and organochlorines in eggs of Red-throated Diver, collected 1986-1991, in Southwest Sweden. Sampling sites are shown in Fig. 1.

Halterna av kvicksilver och klorerade kolväten i smålomsägg, insamlade 1986-1991, i sydvästra Sverige. Provtagningsplatserna är markerade i Fig. 1.

Sampling site *Provtagnings-plats*	Year *År*	Hg, ppm dry weight *torrvikt*	Note *Anmärkning*
I	1986-91	7.4	Mean of 3 eggs (6.2, 6.6, 9.4 ppm). *Medelvärde för 3 ägg.*
II	1991	6.8	
III	1991	14.2	
IV	1991	9.5	Mean of 2 eggs (8.5, 10.4 ppm). *Medelvärde för 2 ägg.*
Mean ± S.E. *Medelvärde ± S.E.*		9.5 ± 1.8	

Results and discussion

Eggs

For Red-throated Diver, the number of analysed eggs is small: a total of seven eggs from four breeding sites. The levels of mercury were remarkably high, on average 9.5 ppm dry weight (Table 1). In a study of Common Loon *Gavia immer* in a mercury-contamined area in Canada, Barr (1986) concluded that disturbances in behaviour and reproduction were associated with mercury levels of 2-3 ppm wet weight in the eggs, and recorded a reduced breeding success at sites with an average concentration of 1.4 ppm wet weight. If these results apply also for Red-throated Diver, impairment in the reproduction cannot be excluded. (We used a conversion factor of 7 for comparisons with figures based on dry weight, see Lindberg et al. (1983) for Peregrine Falcon *Falco peregrinus*)

For Black-throated Diver, a total of 11 eggs from eight breeding sites were analysed. The average concentrations of mercury (1.5 and 4.0 ppm dry weight in non-acidic and acidic waters, respectively) were lower than for Red-throated Divers and comparable to those recorded by Barr (1986) for Common Loon outside highly contaminated areas in Canada. The average concentration of mercury was more than 2.5 times higher in samples collected at lakes affected by acidification (Table 2; P=0.10, two-tailed Mann-Whitney U test for comparison between circumneutral lakes and lakes affected by acidification). Single eggs contained mercury at such a high level that possible reproductive impairment cannot be excluded.

Table 2. Concentrations of mercury and organochlorines in eggs of Black-throated Diver, collected 1978-1991, in Southwest Sweden. Sampling sites are shown in Fig. 1.

Halterna av kvicksilver och klorerade kolväten i storlomsägg, insamlade 1978-1991, i sydvästra Sverige. Provtagningsplatserna är markerade i Fig. 1.

Sampling site *Provtagnings-plats*	Year *År*	Hg, ppm dry weight *torrvikt*	Note *Anmärkning*
A. Not acidic, circumneutral lakes (not lime-treated) *Ej sura, okalkade sjöar*			
Lake Bredsjön	1985	1.0	
Lake Lilla Dalsjön	1984	1.4	
Lake Tolken	1987	1.2	
Lake Sälsjön	1987-91	2.4	Mean of 3 eggs (2.3, 2.4, 2.4 ppm). *Medelvärde för 3 ägg.*
Mean ± S.E. *Medelvärde ± S.E.*		1.5 ± 0.3	
B. Lakes affected by acidification[a]. *Sjöar påverkade av försurning[a].*			
Lake Äktasjön	1984	3.5	
Lake Asksjön	1988	5.9	
Lake Pickesjön	1978	4.9	Means of 2 eggs (4.3, 5.4 ppm). *Medelvärden för 2 ägg.*
Lake Stora Tränningen	1978	1.8	
Mean ± S.E. *Medelvärde ± S.E.*		4.0 ± 0.9	

[a] Lakes with pH regularly below pH 5.5, at least before lime-treatment. All lakes except Stora Tränningen were limed when the egg samples were collected. *Sjöar med pH regelbundet under 5,5, åtminstone före kalkning. Alla sjöar utom Stora Tränningen var kalkade när ägg samlades in.*

Fish

There was a tendency for higher concentrations of mercury in fish collected in lakes affected by acidification than in non-acidic lakes (Table 3; P=0.10, two-tailed Mann-Whitney U test for comparison between circumneutral lakes and lakes affected by acidification). In one lake, Ören, the concentrations were much above the level of 0.3-0.4 ppm wet weight in prey, which Barr (1986) found to be associated with disturbances in behaviour and reproduction in the Common Loon. In two other lakes, Töllsjön and Öjasjön, single fish contained mercury above this level.

Differences between species

The concentrations of mercury in eggs of the Red-throated Diver were on average 3 times those in Black-throated Diver eggs. In the study area, the two species differ in their selection of fishing lakes (Eriksson & Sundberg 1991). If this difference also reflects preferences for different prey species, the Red-throated Diver presumably tend to forage on cyprinid and salmonid fish (such as Roach and Vendace, respectively), while Black-throated Diver to a large extent feeds on Perch *Perca fluviatilis*. Thus, the higher levels of mercury in eggs of Red-throated Divers is somewhat surprising: Meili (1991) found, in a comparison between Perch and Roach of 15-20 cm length in two Swedish lakes, higher concentrations of mercury in Perch.

For both species, the levels of mercury in eggs were higher than those reported for fish-eating raptors in Sweden. For Osprey *Pandion haliaetus*, which to some extent forage in the same kind of lakes as the two species of divers, the mean level of mercury was only 1.0 ppm dry weight in a sample of 167 eggs collected during 1962-73 at different sites in Sweden (Odsjö & Sondell 1982). Similar levels were found in a sample of 55 Osprey eggs collected in Southwest Sweden 1974-82 (Ahlgren & Eriksson 1984). In a highly contaminated population of White-tailed Sea Eagle *Haliaeetus albicilla* in the Baltic Sea, the mean level was 4.6 ppm dry weight in a sample of 75 eggs collected during 1965-78 (Helander et al. 1982). It is also worthwhile to consider, that for Peregrine Falcons, the mean level of mercury was 2.7 ppm dry weight in a sample of 15 eggs collected in northern Sweden during 1972-81 and 2.5 ppm dry weight for 24 eggs from southern Sweden during the same period (Lindberg et al. 1983). Thus, the mercury levels in eggs of Red-throated Divers are among the highest recorded for any bird species in Sweden, and the concentrations in eggs of Black-throated Divers were at the same level as those recorded in Peregrine eggs during 1972-81. A comparison of the mercury content in muscle and liver samples from adult birds at Lake Päijänne, Finland, during 1972-74 indicated that the Black-throated Diver is more susceptible to mercury exposure than other bird species, such as Great Crested Grebe *Podiceps cristatus*, Goldeneye *Bucephala clangula*, Red-breasted Merganser *Mergus serrator* and five Laridae species (Särkkä et al. 1978a, 1978b).

Differences between lakes

The number of lakes included in the study is small. Nevertheless, our results, indicating elevated levels of mercury in fish and Black-throated Diver eggs from lakes affected by acidification conform with the general knowledge that mercury levels in fish increase in acidified lakes (e. g. Håkanson 1980, Johansson 1980, Björklund et al. 1984) and that predators on fish are expected to be susceptible (e. g. Wiener 1987, Scheuhammer 1991).

Liming of lakes

Lime treatment has proved effective, not only in restoring fish stocks in acidified lakes (e. g. Bengtsson et al. 1980, Eriksson et al. 1983, Nyberg et al. 1986, Eriksson & Tengelin 1987), but also in reducing the concentrations of mercury in fish (e. g. Björklund et al. 1984, Håkansson et al. 1990). From this perspective, it is remarkable that the highest concentrations of mercury in potential prey fish for divers were recorded in limed lakes (Table 3 B), although we lack information to conclude whether concentrations should be even higher if the lakes concerned had not been treated. Improved liming techniques in order to reduce the exposure to toxic metals may be in conflict with other nature conservation goals, however, especially if liming of wetland habitats proves necessary.

Final comments

Our results can be summarized as follows: (1) Eggs of Red-throated Diver from Southwest Sweden contain mercury at very high levels, and reproductive impairment is probable, (2) the average level of mercury in eggs of Black-throated Diver is considerably lower, but individual eggs have high concentrations, and (3) in some lakes in Southwest Sweden, fish of species and size delivered to chicks of Red-throated Divers contain mercury at levels which have been associated with behavioural and reproductive disturbances in the Common Loon in Canada.

Eriksson (1992) concluded that the Red-throated Diver is more susceptible than the Black-throated Diver to the ecological changes in acidified lakes. Red-throated Divers rely, to a higher degree than Black-throated Divers, on fish susceptible to low pH-values. Black-throated Diver may also benefit from the increased abundance of aquatic insects in lakes with reduced predation from fish and may make use of the increased water transparency in acidified waters. The present results indicate that higher concentrations of mercury in eggs of Red-throated Diver may also be contributing to a higher susceptibility in this species.

Temporal or geographical coincidence between decreased population size or breeding success in birds and exposure by acidifying pollutants have been primarily attributed to indirect effects of pH or metals on the quantity or quality of food, sometimes in combination with habitat changes, while toxic effects of metals on

Table 3. Concentrations of mercury (ppm wet weight) in axial muscle tissue from fish, <20 cm, collected during May-September 1991 in South-west Sweden. Sampling sites are shown in Fig. 1.

Halterna av kvicksilver (ppm våtvikt) i ryggmuskelprover från fisk, <20 cm, insamlade i maj-september 1991 i sydvästra Sverige. Provtagingsplatserna är markerade i Fig. 1.

	Roach *Mört*			Vendace *Siklöja*		
Sampling site *Provtagningsplats*	Mean ± S.E. *Medelv.±S.E.*	Range *Intervall*	n	Mean ± S.E. *Medelv.±S.E.*	Range *Intervall*	n
A. Not acidic, circumneutral lakes[a] *Ej sura sjöar[a]*						
Lake Stensjön	0.13 ± 0.02	<0.10-0.18	5	–	–	–
Lake Sävelången	0.21 ± 0.02	0.14-0.28	5	0.18 ± 0.03	0.12-0.28	5
Lake Viaredssjön	0.11 ± 0.01	<0.10-0.16	5	–	–	–
Lake Öjasjön	0.17 ± 0.02	0.11-0.23	5	0.25 ± 0.04	0.15-0.37	5
Lake Östra Nedsjön	0.14 ± 0.01	0.12-0.17	5	–	–	–
Mean ± S.E. *Medelvärde ± S.E.*	0.15 ± 0.02			0.22 ± 0.04		
B. Lakes affected by acidification[b]. *Sjöar påverkade av försurning[b]*						
Lake Töllsjön	0.23 ± 0.06	0.12-0.43	5	–	–	–
Lake Ören	0.80 ± 0.07	0.55-0.97	5	–	–	–
Mean ± S.E. *Medelvärde ± S.E.*	0.52 ± 0.23			–		

[a] Lakes Öjasjön and Östra Nedsjön are lime-treated. *Öjasjön och Östra Nedsjön är kalkade.*

[b] Lakes with pH regularly below pH 5.5, at least before lime-treatment (both lakes are limed). *Sjöar med pH regelbundet under 5,5, åtminstone före kalkning (båda sjöarna är kalkade).*

reproductive success or survival have been regarded as less important (e. g. Schreiber & Newman 1988, Eriksson 1991). The present indications that foraging in lakes affected of acidification, through the consumption of fish contaminated with high levels of mercury, might have contributed to a decreased population size. It is doubtful that liming cannot be a final strategy in order to solve the problems treated in the present paper, a reduction of the emissions of acidifying pollutants is the only long-term solution.

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Sammanfattning

Kvicksilvernivåer i ägg av smålom Gavia stellata *och storlom* Gavia arctica *i sydvästra Sverige.*

Både smålommen och storlommen har uppmärksammats i det svenska fågelskyddsarbetet. Latenta hotfaktorer är bl. a. minskad tillgång på fisk i försurade vatten, störningar och olämplig reglering av vattenståndet (t. ex. Andersson m. fl. 1980, Haga 1980a, 1980b, Pakarinen & Järvinen 1984, Götmark m. fl.

1989, Eriksson 1992). Båda arterna fiskar till stor del i näringsfattiga sjöar som ofta har en naturligt låg buffertförmåga och därför är sårbara för försurning. Förutom ett minskat födounderlag riskerar predatorer på fisk i sura sjöar att utsättas för en ökad exponering av giftiga metaller, inkl. kvicksilver (t. ex. Scheuhammer 1991).

Undersökningsområde och metoder

I samband med inventeringar, utförda på frivillig och ideell basis, av de häckande bestånden av smålom och storlom i södra delen av Älvsborgs län har okläckta ägg, som lämnats kvar i övergivna eller kläckta bon, insamlats och analyserats med avseende på deras kvicksilverinnehåll. I undersökningsområdet (Fig. 1) häckar smålommen i småsjöar och tjärnar (0,008-0,1 km^2), som ofta är naturligt fisktomma, och ungarna matas med bytesfisk (i huvudsak mörtartad och laxartad fisk upptill 20 cm längd) från större sjöar belägna upptill 7,7 km från häckningsplatsen (Eriksson m. fl. 1990). Det häckande smålomsbeståndet består av 15-20 par plus ett antal icke häckande, adulta fåglar. Beståndets storlek har i det närmaste halverats sedan 1930-talet (Eriksson m. fl. 1988). Storlommen häckar i större sjöar (0,1-12,1 km^2; Eriksson 1987, Ahlgren m. fl. 1991) och föda till ungarna hämtas normalt i häckningssjön. Beståndet uppgår till ungefär 200 par (baseras på uppgifter från Arvidsson 1984), och under perioden 1968-85 låg den genomsnittliga ungproduktionen på 0,40 halvstora-flygga ungar per par och år (Eriksson 1987), eller nära den nivå på 0,4-0,5 ungar per par som Nilsson (1977) beräknat vara ett minimum för att vidmakthålla en oförändrad storlek av beståndet. Sedan mitten av 1980-talet har ungproduktionen gått ner i området (Ahlgren m. fl. 1991).

Från sju sjöar, som används av fiskande smålommar, insamlades under perioden maj-september 1991 mört, och från två av sjöarna även siklöja, av högst 20 cm längd. För analyserna av kvicksilver användes ryggmuskelprover.

Resultat och diskussion

I smålomsäggen (totalt sju ägg från fyra olika häckningsplatser) uppmättes extremt höga halter av kvicksilver (medelvärde: 9,5 ppm torrvikt, Tabell 1). I kanadensiska undersökningar noterades en minskad häckningsframgång hos islom vid ett kvicksilverinnehåll i äggen på ungefär samma nivå (Barr 1986). I storlomsäggen (elva ägg från åtta häckningsplatser) var kvicksilverhalterna lägre och på ungefär samma nivå som Barr (1986) rapporterade för islom häckande i områden med låg påverkan av kvicksilver i Canada. Den genomsnittliga nivån var 1,5 ppm torrvikt i prover från fyra icke försurade sjöar, jämfört med i medeltal 4,0 ppm torrvikt i ägg insamlade vid fyra sjöar påverkade av försurning (Tabell 2, P=0,10, tvåsidigt Mann-Whitney U-test för jämförelse mellan icke sura och försurningspåverkade sjöar). Enstaka ägg innehöll så höga koncentrationer av kvicksilver att man inte bör utesluta risken för fortplantningsstörningar.

Som jämförelse kan nämnas att för fiskätande rovfåglar var genomsnittsvärdet bara 1,0 ppm torrvikt i fiskgjuseägg insamlade på skilda platser i Sverige 1962-73 (Odsjö & Sondell 1982) och liknande värden har uppmätts i fiskgjuseägg insamlade i sydvästra Sverige 1974-82 (Ahlgren & Eriksson 1984). I det av kvicksilver och klorerade kolväten kraftigt exponerade beståndet av havsörn vid Östersjön var medelvärdet 4,6 ppm torrvikt i ägg insamlade 1965-78 (Helander m. fl. 1982). Det genomsnittliga innehållet av kvicksilver i ägg från pilgrimsfalk var ungefär 2,5 ppm torrvikt under perioden 1972-81 (Lindberg m. fl. 1983). Kvicksilvernivåerna i smålomsägg är således bland de högsta som uppmätts i svenska fågelägg, och i storlomsägg ligger halterna på ungefär samma nivå som för pilgrimsfalk under 1970-talet. I en undersökning av bl. a. kvicksilverhalterna i muskel- eller leverprover från olika fåglar vid sjön Päijänne, Finland, var storlommen kraftigt belastad jämfört med andra arter, såsom skäggdopping, knipa, småskrake, fisktärna och fyra måsarter (Särkkä 1978a, 1978b).

En tendens till högre halter av kvicksilver i fisk från försurningspåverkade sjöar noterades (Tabell 3, P=0,10, tvåsidigt Mann-Whitney U-test för jämförelse mellan icke sura och försurningspåverkade sjöar). I sjön Ören låg koncentrationerna väsentligt över den nivå på 0,3-0,4 ppm våtvikt, där man kan påräkna störningar i beteende och fortplantning hos islom (Barr 1986). I två andra sjöar, Töllsjön och Öjasjön, innehöll enstaka fiskar höga halter av kvicksilver.

Även om antalet sjöar i undersökningen är litet, indikerar analyserna av såväl storlomsägg som fisk att belastningen av kvicksilver är högre i försurningspåverkade sjöar. Tidigare undersökningar, sammanfattade av Eriksson (1992), antyder att smålommen är mer sårbar än storlommen för de ekologiska förändringarna i sura sjöar. Smålommen är mer beroende av försurningskänsliga fiskar, och storlommen torde i viss mån kunna tillgodgöra sig fördelarna med den ökade tillgången på vattenlevande insekter i sjöar med en minskad predation från fisk och det ökade siktdjupet i sura vatten. I allmänna översikter av hur fåglar och däggdjur påverkas av försurning har man i regel ansett att det i första hand är indirekta effekter på t ex födotillgång eller födans kvalitet som är viktiga, medan toxiska effekter av metaller bedömts vara av mindre betydelse (t. ex. Schreiber & Newman 1988, Eriksson 1991). I den här studien finns indikationer på att en kraftig exponering av kvicksilver, genom födointag i försurningspåverkade sjöar, kan ha medverkat till en tillbakagång i det häckande beståndets storlek av smålom i sydvästra Sverige.

Kalkning används inte bara för att höja pH-värdet, för att därigenom återskapa betingelser för livskraftiga fiskbestånd, utan också för att minska belastning av kvicksilver i fisk (t. ex. Björklund m. fl. 1984, Håkansson m. fl. 1990). Det är därför anmärkningsvärt att de högsta koncentrationerna av kvicksilver noterats i kalkade sjöar (Tabell 3 B), låt vara att man inte vet hur höga koncentrationerna skulle ha varit om sjöarna inte kalkats. Förbättrade kalkningsmetoder torde emellertid enbart ge kortsiktiga vinster, och kan dessutom komma i konflikt med andra naturvårdssträvanden, speciellt om kalkning på land i s. k. utströmningsområden blir aktuell. Minskade utsläpp av försurande ämnen är den enda långsiktiga lösningen på den typ av problem som vi behandlat.

Short Communications Korta rapporter

Reproductive success of the Shore Lark *Eremophila alpestris* in southern Lapland

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Decline of the Shore Lark population

Evidence from many sources shows that the Shore Lark *Eremophila alpestris* population of northern Fenno-Scandia has declined much during this century and also in recent decades. The decline in Finland has been summarized by Hildén (1987). The Shore Lark was common both in northern Finland and on migration in southern Finland around the turn of the century, but a rapid decline occurred already about 1910. Numbers were then rather stable until about 1950 when a new decline began and continued through the 1960s and 1970s. Merikallio (1958) estimated the Finnish population at about 10,000 pairs from line transects in 1941-1956. Although the estimate was based on a rather small sample (only 12 records along about 240 km of line transects), it contrasts drastically with the most recent information obtained in the 1980s on many hundreds of kilometres censused in suitable habitats, producing only five records. Hildén (1987) estimated that the present Finnish population was at most only some tens of pairs.

Less is known about the Swedish population. No comprehensive survey has yet been made. Good data are available only from the Ammarnäs area of southern Lapland (Svensson 1990). In a one square kilometre plot of suitable habitat, censused since 1963, about two pairs bred every year until 1976. After that year the Shore Lark has bred only once, in 1978, in that plot. Extensive line transects have been made around Ammarnäs since 1972. In 1972-1977 an average of 6 and a maximum of 9 birds were recorded annually, whereas only one observation has been made in 1978-1991.

The decline has been recorded also on migration and in the winter quarters. Autumn migration data from Ottenby bird observatory (Edelstam 1972, and excerpt from the observatory diary by Jan Pettersson) and Falsterbo bird station (Rudebeck 1950, Ulfstrand et al. 1974, Roos 1991) have partly been summarized in Svensson (1990). In North Jutland, where careful records have been kept since 1974 (Anon. 1990), 1400 birds were reported in 1974. The numbers declined rapidly to an average number of about 100 in 1982-1988. However, starting in 1988, there has been some increase, with 318 in 1989 and 801 in 1990 (Anon. 1991). Also at Falsterbo and Ottenby more birds than previously have been observed after 1989. Such fluctuations may, however, be quite temporary and only reflect, for example, improved survival during the unusually mild recent winters. This suggestion is supported by the Ottenby data. Two autumns with deviatingly high numbers, 1973 (135 birds) and 1975 (136 birds), happen to coincide with a series of very mild winters. The mean number of larks in 1963-1978 (1973 and 1975 excluded) was 37 and the maximum number was 67. For 1979-1989 the figures were 7 and 18, respectively.

The aim of this study was to document if low breeding success could explain the decline of the Shore Lark population in Sweden. We chose the Ammarnäs area because we knew that a few pairs still remained on the mountains north of Ammarnäs.

Two of us (O.B. and J.T.) carried out most of the field work in 1990, between 10 June and 10 July. In 1991 we worked from 7 June to 4 August, O.B., Å.E., M.H., P.N. and J.T. from 7 June to 5 July, Å.B. and T.J. from 30 June to 31 July, and S.S. from 25 June to 3 August. Thus we covered most of the breeding season, though missing the early phase of arrival and territory establishment and the late phases of post-fledging events of the young. The missing of the late phase means that we were not able to follow the broods long enough after fledging to determine the final breeding success.

In 1990 we searched an area of about 10 square kilometres on Björkfjället northeast of Ammarnäs. In 1991 we searched a larger area, about 25 square kilometres on the same mountain, including the area of 1990 (the centre of the study area is at approx. 66° 05' N, 16° 20' E). The Shore Larks bred on or near the peaks

Table 1. Laying date, clutch size, and fledging success in the Shore Lark at Ammarnäs in 1990 and 1991. The letters in the 1st egg column indicate method of date calculation: H = from known hatching date, A = from age of young, E = from age of embryos in deserted nest, L = laying date known exactly, O = nest found with sitting female, depredated at next visit; the possible range given.

Läggningsdatum, kullstorlek och häckningsframgång för berglärka i Ammarnäs 1990 och 1991. Bokstäverna i kolumnen för 1:a ägg anger metoden för beräkning av datum: H = från känt kläckningsdatum, A = från ungars ålder, E = från embryons ålder i övergivna ägg, L = exakt läggningsdatum känt, O = bo funnet med ruvande hona, rövat vid nästa besök; möjligt intervall givet. Typ av kull: replacement = omläggning, late first = sen förstakull, true second = genuine andrakull.

Year *År*	Site *Plats*	Type of clutch *Typ av kull*	1st egg June date *1:a ägg Juni datum*	Clutch size *Kull-storlek*	No. of hatchlings *Antal kläckta*	No. of fledglings *Antal flygga*
1990	ÅB		7 H	4	3	2
	MI		1 A	4	4	3
	LI		1 A	4	4	3
1991	ÅB		10-15 E	5	0	0
	ÅB	replacement	28 L	5	5	5
	LI		6 H	4	3	3
	JN	late first?	27 H	3	3	2
	DÖ		12 H	5	5	5
	DV		3 A	3	2	2
	DV	genuine second	29 H	3	3	3
	BÅ		11 H	5	3	3
	LA		4-14 O	5	0	0
Mean per nest	*Medeltal per bo*			4.2	2.9	2.6
Mean per pair	*Medeltal per par*				3.5	3.1

at elevations between 900 and 1100 m. The forest line runs at about 760 m and the highest peaks reach just above 1100 m.

All but one of the mountain peaks where we found Shore Larks but no nests were searched at least twice and most often many times in order to make it likely that no birds bred. When we had located a nest it was monitored by repeated visits to determine final clutch size, number of hatchlings, and number of fledglings. We also tried to find the fledglings after they had left the nest, but this proved difficult.

Results

In 1990 we located 5 pairs and three nests. One pair may not have bred, whereas a second pair certainly did, although the nest was not found. In 1991 we located 7 breeding pairs and 9 nests, two pairs laying twice. A number of single, most likely non-breeding birds, most of them males, were located in both years.

The breeding data of the Ammarnäs Shore Larks are given in Table 1. The only clutch sizes recorded were 3, 4, and 5 eggs with a mean of 4.2 (s.d. 0.83) eggs. Two females laid more than one clutch. In one case it was a replacement clutch after depredation of the first clutch at the incubation stage. In the other case it was a second clutch following a successfully raised first brood. Both females laid the same number of eggs in their first and second clutches.

We do not know what predator was responsible for the two complete losses. The LA nest was empty without any trace of eggs and with the nest material torn out and scattered around. No larks were seen on the next visit although the area was searched carefully so it is unlikely that a replacement clutch was laid. In the ÅB nest there was one cold egg left with egg shell fragments around the nest. Small tooth marks on the remaining egg suggested a weasel to have been responsible. In all other cases the losses were either eggs that did not hatch or one nestling that died. In the ten clutches that did hatch, 5 out of 40 eggs did not hatch (12.5 %), and of 35 hatchlings 4 (11.4 %) died before they left the nest. Thus the total loss was 22.5 % of all eggs laid, the two depredated clutches not included. If we include the pair LA that probably did not lay a replacement clutch, the loss was 14 out of 45 or 31 %. We do not know why some eggs did not hatch. We examined all the five eggs and found embryos in four of them and one that apparently was unfertilized. Using Mayfield's (1975) method, survival probability during the incubation period (2 nest losses, 49 exposure days, incubation period 11 days) was 63.2 %. Combining the three survival probabilities of incubation, hatching (87.5 %), and fledging (88.6 %) the total survival probability from onset of incubation to fledging was 49 %.

We do not yet have sufficient information about mortality to compare it with the production of young. Both of two females ringed in 1990 returned in 1991 as well as two of eight ringed young. We have also recieved reports about two of the young of 1990 in the wintering area, one seen in north Jutland in April 1991 and one on the Swedish west coast in the autumn of 1991. Both these birds and both young that returned to Ammarnäs came from the same brood of three. Since these young were identically colour-ringed we cannot tell whether the records represent two or three different birds (the two birds that returned to Ammarnäs were almost certainly different because one was raising young several kilometres away from where we saw the other one).

Discussion

Mean clutch size was the same as given in the handbooks (e. g. Haftorn 1971, Glutz von Blotzheim 1985, Pätzold 1987) for the *flava* subspecies (3-5, mostly 4). Judged from this, clutch size has not declined recently, and consequently this is an unlikely cause of the population decline. Different subspecies have different typical clutch sizes, so comparisons with the more extensive data from other geographical areas cannot be used to judge if present clutch size has declined. The Shore Lark may lay larger clutches late than early in the season (Cannings & Threlfall 1981), but our data set is yet too small to show much in this respect.

Other workers have found much lower proportions of unhatched eggs than we did: 1 of 24 eggs, 4.2 % (6 nests; Sutton & Parmelee 1955), 2 of 44 eggs, 4.5 % (14 nests; Verbeek (1967), and 1 of 86 eggs, 1.2 % (26 nests; Cannings & Threlfall 1981). This gives a total of 4 of 154 eggs or 2.6 %. Our figure, 12.5 %, is significantly larger ($p = 0.004$, Mann-Whitney $U = 153.0$, $N = 10, 46$; the data from the three other studies were pooled).

As with clutch size the number of fledged young cannot be compared with that of other populations because there are basic differences between subspecies. Here we make a comparison only with the results of three studies from North America where the conditions seem to be fairly similar to those of the Ammarnäs area, and we compare only the rate of fledging success, namely the proportion of hatchlings that fledged. Sutton & Parmelee (1955) obtained data from six nests. Including one destroyed nest but excluding one nest which was not checked later than three days after hatching the average number of fledged young in 5 nests was 2.4 (66 % of hatchlings). Verbeek (1967) obtained a fledging rate of 61 % of the hatchlings (15 nests). The data given by Cannings & Threlfall (1981) cannot be used for a comparable calculation but they give the figure 59 % of the eggs giving rise to fledged young, which is very similar to our 62 % if we include the two depredated nests.

From Scandinavia we have only the data given by Spjøtvoll (1970) who found ten fledged broods rather late in the season. The average number of juveniles was 3.1, which is identical with the average number of young fledged per pair at Ammarnäs. However, the two figures are not comparable since Spjøtvoll recorded his broods well after fledging and additional mortality may have occurred among our birds soon after they fledged. It is also likely that Spjøtvoll's pairs produced more young per pair since at least some of the females were probably incubating a second clutch. In our area we had no indication of any other second clutches than the one we found.

In summary, the two years of our study indicate that present clutch size is the same as the one expected from litterature data and that it is not evident that the number of young leaving the nests is impaired. We know yet too little about the frequency of true second clutches and survival between seasons for an estimation of the balance between production of young and mortality. We must also learn more about the survival of the young after fledging. The only possible indication of breeding impairment is the rather high proportion of eggs that did not hatch in otherwise successful nests. However, the sample size is small and we cannot yet evaluate the significance of this observation.

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Sammanfattning

Häckningsframgång hos berglärka i södra Lappland

Berglärkan har minskat kraftigt i norra Fenno-Skandia (Hildén 1987, Svensson 1990). För att studera häckningsframgång och dödlighet startade vi studier av berglärka i trakten av Ammarnäs sommaren 1990. Vi har bestämt kullstorlek, antal kläckta ungar och antal flygga ungar för tre bon 1990 och sju bon 1991. Av bona 1991 var ett en omläggning efter predation och ett annat en äkta andrakull efter en framgångsrik första häckning.

Resultaten framgår av Tabell 1. De två honorna som lade mer än en kull hade samma äggantal i båda. Medelkullen för samtliga bon var 4,2 ägg. Två bon förlorades helt genom predation, båda på äggstadiet. Av de 40 ägg som fanns i bon där ungar kläcktes var det 5 som inte kläcktes (12,5 %). Av 35 kläckta ungar dog 4 innan de skulle ha lämnat boet (11,4 %). Totalförlusterna var således 22,5 % i de sju bon som inte spolierades. Om även det prederade boet LA, där det sannolikt inte skedde någon omläggning, inräknas blir totalförlusterna 31 %.

Den observerade medelkullstorleken stämmer med vad som anges i handböckerna. Antalet flygga ungar per par synes inte vara speciellt lågt, men vi har tyvärr inte mycket att jämföra med. Medeltalet ungar i tio flygga kullar i Norge (Spjötvoll 1970) var också 3,1. Denna siffra är dock svår att tolka eftersom observationerna dels gjordes en tid efter utflygningen och dels avsåg förstakullar från par vars honor troligen delvis låg på andrakullar. Förlusterna i våra bon är inte uppseendeväckande stora i jämförelse med nordamerikanska studier. Det enda som är signifikant högre är antalet icke kläckta ägg. I tre nordamerikanska studier var det bara 4 av 154 ägg (2,6 %) som inte kläcktes. Vi vet inte vad som orsakade att en del ägg inte kläcktes, men vi noterade att det fanns embryon i fyra av dem och att ett var obefruktat.

Vi har ännu inte tillräckligt med data om dödligheten för att ställa den mot produktionen av ungar. Båda av två 1990 märkta honor återkom 1991 och av åtta märkta ungar återkom två. Dessutom har vi fått rapporter om ytterligare två ungfåglar mellan häckningsä-songerna, en har setts nära Skagen i april 1991 och en nära Varberg hösten 1991. Tyvärr märkte vi inte ungarna individuellt 1990 så vi vet bara att båda är ur samma kull. Detta tyder på god överlevnad, men materialet är för litet för några slutsatser.

Sammanfattningsvis finns det ännu inget som tyder på försämrat häckningsresultat och som alltså skulle kunna förklara artens tillbakagång. De okläckta äggen är möjligen en varningssignal och vi vet ännu inget om huruvida andelen andrakullar kan vara lägre i dag än förr. Vi lyckades konstatera en säker andrakull och är ganska säkra på att det inte fanns några fler. Undersökningen fortsätter 1992 varvid vi både kommer att få ett större material rörande häckningen och möjlighet att bättre bestämma dödligheten genom att identifiera återkommande fåglar av de 37 som vi nu har märkta.

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Upprop - döda skrattmåsar

1991 hittades under en begränsad tid på senvåren ett större antal döda och döende adulta skrattmåsar, dels vid Kvismaren i Närke, dels på ett par platser i Skåne. Orsaken till denna onormala dödlighet är okänd.

Inom ett nyligen igångsatt WWF-projekt, vilket syftar till att förstå orsakerna bakom den dramatiska tillbakagång av den svenska skrattmåsstammen, som skett de senaste två decennierna, är vi intresserade av alla uppgifter om mera omfattande dödlighet hos adulta skrattmåsar under häckningstid.

Att enstaka gamla måsar dör under häckningstid är normalt, men skulle Du lägga märke till vad Du bedömer vara onormalt många döda (eller döende) måsar vore vi mycket tacksamma om Du noterade *datum, plats, antal döda måsar och yttre omständigheter* (exempelvis om måsarnas hittats i, vid eller långt ifrån en koloni) samt om det finns något Du kan sätta måsarnas död i samband med.

Eventuellt kan vi komma att vara intresserade av att analysera döda måsar (sjukdomssymptom, giftrester). Har Du funnit ett större antal döda måsar och har möjlighet, placera därför några (nydöda) måsar i plastpåsar tillsammans med fynduppgifter och lägg dem i en frysbox.

Rapportera Dina iakttagelser till:
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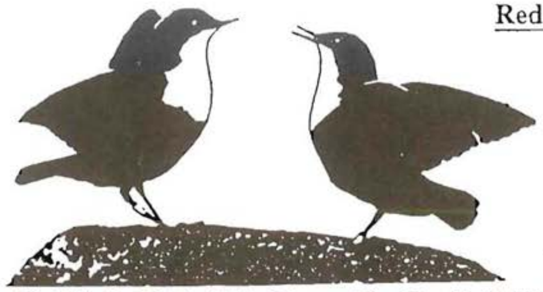

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Strömstareåret i redovisningarna räknas per den 1 augusti. *Manusstopp är den 1 september.* Manuset bör vara maskinskrivet eller, ännu hellre för den som har tillgång till dator, insänt på diskett; 3,5" (eller 5 1/4"), MS DOS (en ren ascii-fil) och en utskrift. Allt material sändes till någon av redaktörerna ovan.

Ny tidskrift !

Colour-ringed Broad-billed Sandpipers from the Sea of Azov

Färgmärkta myrsnäppor från Azovska sjön

A request for observations *Efterlysning av observationer*

This spring the Azov Sea Wader project 1992 will carry out a study of Broad-billed Sandpipers in the Bay of Sivash on the Crimea. It is a joint project between the Foundation Working Group International Wader and Waterfowl Research (WIWO) and the Black Sea/Azov Sea Ornithological Station in Melitopol, Ukraine. It is partly funded by the conservation fund of the Swedish Ornithological Society.

One of the main aims of the project is to help Ukrainian ornithologists to gather more data on the numbers of migrating waders and waterfowl in order to establish a large Sivash National Park for adequate conservation. It is already known that he area is important for at least one million waders in spring and autumn, as well as for thousands of wintering and staging Great Bustards and Red-breasted Geese.

A pilot study revealed that, considering the small population size in the Western Palearctic, relatively large numbers of Broad-billed Sandpipaers are present in spring and autumn in the extensive lagoon systems of the northern Crimea. They possibly comprise the largest concentrations of this species in Europe. Lack of telescopes and ornithologists in this area were the reason that these concentrations remained unknown for such a long time. Recently, recoveries showed that many of these Broad-billed Sandpipers might winter in the Persian Gulf. In 1991 ornithologists of the Black Sea/Azov Sea Ornithological Station retrapped Broad-bills: one from Ottenby, Sweden, one from Central Anatolia, Turkey (where two birds were ringed by a WIWO project), and one from Dubai (ringed by an English expedition).

This spring the ecology of Broad-bills in their last staging area before the breeding grounds (largely in Scandinavia) will be studied intensively. For these local studies as well as for long-range recoveries Broad-bills will be individually colour-ringed with three colour-rings (red, yellow, light green, light blue, black and white) and one metal ring above tarsus. Different combinations will also be used from August onwards in Jubail, Persian Gulf, Saudi Arabia, where long-term wader studies will be initiated. Ottenby Ringing Station will also mark Broad-bills individually with colour-rings.

It is hoped that these combined efforts with the Ukrainian ornithologists will safeguard the future of the Broad-billed Sandpiper and reveal more of its peculiar migration ecology. Every bird watcher in Scandinavia is invited to watch Broad-bills even more carefully this spring and autumn. All observations can be send to:

Azov Sea Wader Project 1992
Foundation WIWO
c/o Vogelbescherming
Driebergseweg 16c
3708 JB Zeist
The Netherlands

COLOUR-RINGING OF MEDITERRANEAN GULLS (*Larus melanocephalus*) in THE NETHERLANDS & FRANCE

We hereby inform you on the following colour-ringing projects of Mediterranean Gulls (*Larus melanocephalus*) carried out in the SW Netherlands and Northern France.

Since spring 1989 Mediterranean Gulls have been marked in the breeding colonies in the SW Netherlands, where both adults and chicks have been ringed. Since autumn 1991 Mediterranean Gulls have also been ringed on the coasts of Northern France (during the non-breeding season).

In **The Netherlands** birds are ringed with a single **white PVC ring** engraved with a combination of 3 black characters; up to now 2 digits followed by 1 letter on the tarsus (either left or right).

In **Northern France** birds are marked with a single **green PVC ring** engraved with a combination of 3 white characters; up to now 1 letter followed by 2 digits on the tarsus (either left or right).

In both countries, birds are also ringed with a normal metal ring (on opposite tibia).

These colour-ringing programs have been officially approved by the national ringing schemes (Vogeltrekstation ARNHEM & C.R.B.P.O. Paris) and EURING.

CONTACTS:
Details of sightings (even partial data: e.g.only the colour of the ring) will be welcomed at the following addresses.
The Netherlands:
Peter L. MEININGER, RWS-DGW, Afd. Biologie, Postbus 8039, 4330 AK MIDDELBURG, The Netherlands. FAX: 31/1180/16500 - TEL.: 31/1180/-11851 (prof.) - 31/1180-36593 (private).
France:
Pascal RAEVEL, Résidence du fief, Route d'Hazebrouck, 59270 BAILLEUL, FRANCE. FAX: 33/20.43.67.32 - TEL.: 33 / 20.43.65.79 - 33/28.48.71.01 (private).

COLOUR-RINGING PROGRAMMES OF THE VOORNE BIRD OBSERVATORY (THE NETHERLANDS)

LESSER BLACK-BACKED GULLS (*Larus fuscus*), **COMMON GULLS** (*Larus canus*) and **AVOCETS** (*Recurvirostra avosetta*) have been marked with colour-rings during the breeding season since 1990 at the Voorne Bird Observatory (SW Netherlands) (both adults and chicks).

LESSER BLACK-BACKED GULLS have been marked with either a single white or green engraved PVC ring or a combination of two rings (one on each tarsus).
COMMON GULLS have been marked with a single green or balck engraved PVC ring (only in 1991).
AVOCETS have been ringed with a single white engraved PVC ring.
N.B.: Some rings may have become stained as a result of which they are now rusty coloured.

All these projects use engraved rings with a combination of 3 characters.

CONTACT: Details can be sent to the following address.
Norman D. van SWELM, ORNITHOLOGISCH STATION VOORNE, Schepenenweg 26, 3233 CL OOSTVOORNE, THE NETHERLANDS

In the future these projects may be repeated with different colours.

As individuals of these species are likely to visit your region/country, we request to announce these projects among your colleagues, members and/or into your periodical(s).

Instruktioner till författarna
Instruktions to authors

Allmänt gäller att bidrag skall vara avfattade enligt den modell som finns i tidigare häften av tidskriften. Titeln skall vara kort, beskrivande och innehålla ord som kan användas vid indexering och informationssökning. Uppsatser, men ej andra bidrag, skall inledas med en Abstract på engelska om högst 175 ord. Texten bör uppdelas med underrubriker på högst två nivåer. Huvudindelningen bör lämpligen vara inledning, metoder/studieområde, resultat, diskussion, tack och litteratur. Texten får vara på svenska eller engelska och uppsatsen skall avslutas med en fyllig sammanfattning på det andra språket. Tabell- och figurtexter skall förses med översättning till det andra språket. Tabeller, figurer och figurtexter skall finnas på separata blad. Det skall finnas minst 4 cm marginal till vänster om texten som skall vara maskinskriven med minst dubbelt radavstånd. Manus skall insändas i tre kopior inklusive tabeller och figurer. Originalfigurer skall insändas endast efter uppmaning.

Andra bidrag än uppsatser bör ej överstiga 2000 ord (eller motsvarande om det ingår tabeller och figurer). De skall inte ha någon inledande Abstract men däremot en kort sammanfattning på det andra språket.

Författarna erhåller korrektur som skall granskas omgående och återsändas. Tillsammans med korrektur erhålls också beställningsblankett för särtryck. Av uppsatser, men ej övrigt, erhåller författaren 50 särtryck gratis.

Referenser skall i texten anges med namn och årtal samt bokstäver (a, b etc) om det förekommer referenser till samma författare och år mer än en gång. För litteraturlistans utformning se nedan.

Contributions should be written in accordance with previous issues of the journal. The title should be short, informative and contain words useful in indexing and information retrieval. Full length papers, but not other contributions, should start with an Abstract in English not exceeding 170 words. The text should be divided by no more than two levels of subheadings. The following primary subheadings are recommended: Introduction, Methods/Study areas, Results, Discussion, Acknowledgements, and References. The text may be in English or Swedish and the paper should end with a comprehensive summary in the other language. Table and Figure legends should be in both languages. Table and Figure legends must be on separate sheets of paper. Manuscripts should be submitted in three copies with at least 4 cm margin to the left, typewritten with at least double line spacing. Do not send original Figures until requested.

Contributions other than full length papers should not exceed 2 000 words (correspondingly less if they contain Tables or Figures). There should be no Abstract but a brief summary in the other language.

Authors will receive proofs that must be corrected and returned promptly. They will also receive a form for ordering reprints. Fifty reprints of full length papers, but not of other contributions, will be free of charge.

References in the text should be given using name and year, and if there is more than one reference to the same author and year also letters (a, b, etc). How to write the reference list, see below.

Referenser *References*

I texten *In the text:* Andersson (1985), Bond (1913a, 1913b), Carlsson & Dennis (1956), Eriksson et al (1989), (Andersson 1985), etc.

I referenslistan *In the reference list:*

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