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Point count census using volunteers of terrestrial breeding birds in Norway, and its status after six years

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At present two monitoring programmes for terrestrial breeding birds are being undertaken in Norway. The Norwegian Directorate for Nature Management (DN) funds oneprogramme, which began in 1990, has paid fieldworkers. The other census programme, begun in 1995 and described here, is run by the Norwegian Ornithological Society in co-operation with Nord-Trondelag University College (HiNT). Its fieldwork involves unpaid volunteers who choose their own routes, each of 20 points. The number of participants has increased but slowly from the start so that in 2000 just 69 routes were investigated. These routes are unevenly distributed geographically, very few being in northern Norway. From the results, it is uncertain if the indices for the various bird species tell us only about changes in these routes, or if the data can be extrapolated to inform us about Norwegian populations. The paper discusses advantages and disadvantages of the census programme. The conclusion is that a new programme is needed and it is hoped to start in 2001. Because of the uneven distribution of volunteers and of the extremely difficult terrain, a semi-random approach will be applied. The country will be divided into regions, Of which five regions will be chosen and divided into 18km×18km squares. Within each chosen region 20 squares will be selected randomly. Each square will have 20 points determined according to a prescribed procedure. The information to be gathered at each point in the survey is discussed. This programme will be funded by DN, HiNT, and by companies sponsoring individual species. Participants in this new programme will have their expenses covered. Data on distribution and densities of Willow Warbler *Phylloscopus trochilus* and Chiffchaff *P. collybita* in Norway show exclusive competition between the species. The volunteer programme will continue.

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1. Introduction

The effect of human activity on environment has a great impact on living organisms. For example, it appears that since the 1950s, agricultural, forestry and construction has reduced the number of birds in wetlands, in forests or on farmlands throughout Europe (Tucker & Heath 1994). We modify the landscape and use increasing amounts and varieties of pesticides and other chemicals. Some of these chemicals may be very resistant to breakdown, thus staying in the food webs for a long time. Residues sometimes are still present in the food we eat. It is also known that some of the chemicals we release into the environment influence sexual development and can cause sterility. Pollution and large-scale landscape change may even be changing the climate. In general, increasing human populations and the scale of the application of technological developments have a massive and continuing negative impact on the environment. More than ever we need to monitor wildlife throughout Europe to see how natural populations are changing over time. The way populations change may give us important information about the health of our surroundings.

Birds are very well-suited as ecological indicators. They are relatively easy to study, and because many of the the public are knowledgeable about them, the work of amateurs can be harnessed in useful monitoring programmes. Because birds are relatively easy to identify, monitoring fieldwork methodology can be carried out with a high degree of confidence. Furthermore, birds have long been well-studied. Because species occupy a variety of niches throughout the food chain, some are likely to be particularly suitable for monitoring such as the accumulation of substances throughout that chain. Moreover, they may also be sensitive to some of the multiplicity of factors affecting the food chain. Those species with long life spans May well incorporate the effects of environmental stress over time, providing researchers with an opportunity to measure pollution over many years (Furness & Greenwood 1993).

Monitoring programmes must be effective and reliable. Well-defined objectives and a trustworthy methodology are necessary so that politicians and the public can accept the results and make the right decisions. The aims of the point count census programme of breeding birds in Norway, as designed by the Norwegian Ornithology Society, are to detect:

1. The impacts of pesticides and other pollutants on bird populations.
2. The effects of changing weather variables from year to year.
3. Still unknown threats to the environment.
4. The impact of human activity, especially land use, on bird populations.

To be able to do this, detailed information about population changes is needed.

To separate environmental factors from the masking effects of climatic changes, or to find any cause-effect relationships between birds and their environments, as many species as possible should be monitored (Koskimies & Väisänen 1991). It is also essential for a successful monitoring programme to be able to distinguish between natural and human-induced population changes, which may be difficult to do (Olsen *et al*. 1999). Because complete counts are out of the question for most bird species, careful selection of sampling design is essential. In the following I will present the methods used in the voluntary programme of point count census of terrestrial breeding birds in Norway, and discuss proposed methodological changes. Some findings are also presented.

2. Present monitoring system of terrestrial breeding birds in Norway

At present, two monitoring programmess for terrestrial breeding birds are being undertaken in Norway. The Norwegian Directorate for Nature Management started the first, a ‘Monitoring Programme for Terrestrial Eco-systems’ (MTE) in 1990. In brief, this programme includes monitoring of precipitation, soils, plant communities, birds (Golden Eagle *Aquila chrysaetos*, Gyrfalcon *Falco rusticolus*, Willow Grouse *Lagopus lagopus* and passerines) and mammals (mountain (Arctic) fox *Vulpes*

(Alopex) lagopus, mountain hare *Lepus timidus* and rodents) in seven permanent monitoring areas. In the MTE, monitoring is concentrated in the northern boreal and alpine ecosystems, and bird censuses are undertaken in the sub-alpine birch forest and above the tree line. In each of the seven areas the census takes place along 10 routes, each with 20 points. Stratified randomisation determines the placement of the routes. All participants in the MTE are paid.

The Norwegian Ornithological Society in co-operation with Nord-Trondelag University College (HiNT) runs the census programme (HFT) described below. After a couple of years of planning in co-operation with leaders of the Swedish (Svensson) and the Finnish (Väisänen) programmes, the census started in 1995. Some details of the census methods are:

2.1. Selection of counting routes and points

There are 20 points on each route. The participants can choose their route and points freely. The distance between points may vary, provided that there is a minimum of 350m between points in open areas and of 250m in forests, to minimise double-counting of individuals. Exactly the same points must be used in subsequent years for the population indices to have any value. The census must be taken by the same person each year. There are no restrictions on how the participants move between points (*e.g.* on foot or by a vehicle of any kind).

2.3. Census periods

The 'best' period for census-taking in southern Norway is from 10 May to 10 June, in central Norway from 10 May to 20 June, and in northern Norway from 30 May to 30 June. Although these are the recommended dates, because each routes is counted at the same time every year, the results for each route are comparable, no matter what the overall census period. For any route, timing of a census in later years should not differ by more than seven days from that of the first year.

2.4. Time of day

The best time for census taking is between 0400 and 0900. Census work is not allowed after 1000. The start of a count should not differ by more than 30 minutes from that of the first year.

2.5. Weather

Calm weather without precipitation is ideal. Point counts should be avoided if the weather is rainy or cold, or if the wind is moderate to strong. The census can be stopped and rescheduled to continue another day if the weather gets too bad.

2.6. Field work

The enumerator should approach the point carefully. The census period at each point is exactly five minutes. The surroundings within a 50m radius of the point are described and assigned a habitat code according to a prescribed list. Any habitat change from one year to the next within this 50m area is described. For each species observed (seen or heard), the number of pairs within and beyond the 100m circle is noted in a species list. An observed pair is defined as:

1. A male heard or seen.
2. A pair.

3. A single female.
4. A party of fledglings.
5. A nest.

Overflying birds are included as 'beyond 50m'. Flocks beyond 50m are registered in parentheses, (F5) meaning a flock of five birds. The organizing committee calculates the number of pairs in such flocks by taking into account the species, geography and time of year (Husby 1998). All bird species are counted.

In the Norwegian Ornithological Society, an organizing committee of three members manages the census programme. There is one contact person in each of the 20 counties. The most important functions for the contact person are to provide information about the census programme at meetings and to recruit qualified volunteers. Enumerators send completed census forms directly to the organizing committee after each season.

Svein Haftorn, a knowned Norwegian ornithologist, originally recommended this bird census programme (Haftorn 1995). Information about the project was presented orally at the annual meetings of The Norwegian Ornithological Society in 1994 and 1995. Subsequently, both general information and some of the results have been published annually in the Society's magazine. Information is also published in regional magazines, and an annual report is sent to the volunteers and other interested persons. One arbitrarily-chosen participant was given a bird book in 2000, and the same will be done this year.

All fieldwork is voluntary. The county contacts receive no remuneration. Members of the organizing committee do nearly all their work for free. The Directorate for Nature Management may provide future financial support for this monitoring programme, but that will depend on some methodological changes as explained below. Some economic support is received from Nord-Trondelag University College and The Norwegian Ornithological Society. From 2001, financial support will be provided by companies paying 5000 Nkr (almost 400 GBP) to sponsor individual species. So far of nine companies asked to sponsor species, the four that have agreed are; Norske Skog AS (Chiffchaff *Phylloscopus collybita*), Tronderenergi (Dipper *Cinclus cinclus*), Trondermat (Great Tit *Parus major*) and Aasen Sparebank (Magpie *Pica pica*).

Some results are presented, and an index is calculated for all bird species observed from a minimum of 20 routes. The index in the first year is set at 100, and the index the following years is calculated according to the formula:

$$\text{Index year } 2 = \frac{\text{Index year } 1 \times \text{Number of pairs observed year } 2}{\text{Number of pairs observed year } 1}$$

The routes have to be enumerated on two successive years by the same person before they are included in index calculations.

The collected data in the point count census can provide information to help determine relative densities in different parts of the country, habitat preferences and analyses of the competitive strength between different species. Chiffchaff and Willow Warbler *P. trochilus* are sympatric species in most of Norway, and they have a considerable overlap in both habitat and food selection (Saether 1983, Cramp 1992). Willow Warbler is the most common bird in the terrestrial bird monitoring programme in Norway, and in some parts there are also high densities of Chiffchaff. Is it possible that these two sibling species may competitively exclude one another at

Tab. 1. Indices for bird species observed on 20 routes or more. An index value of 100 is assigned to a species the first year the count exceeds threshold values. The sign indicates the significance level according to Spearman rank correlation between index values and the year, two-tailed test: * $P<0.05$, ** $P<0.01$ and *** $P<0.001$, and ns means not significant.

		1995	1996	1997	1998	1999	2000	Sign
Common Sandpiper	*Actitis hypoleucos*		100	100	109	152	118	ns
Common Gull	*Larus canus*		100	114	125	127	113	ns
Woodpigeon	*Columba palumbus*		100	90	112	123	99	ns
Cuckoo	*Cuculus canorus*		100	113	174	136	159	ns
Tree Pipit	*Anthus trvialis*		100	118	105	130	90,5	ns
Pied Wagtail	*Motacilla alba*		100	82.8	96.8	114	109	ns
Wren	*Troglodytes troglodytes*		100	77.7	121	151	145	ns
Dunnock	*Prunella modularis*		100	90.4	88.1	91.1	88.2	ns
Robin	*Erithacus rubecula*		100	77.8	75.2	116	109	ns
Blackbird	*Turdus merula*		100	98.6	109	118	96.7	ns
Fieldfare	*Turdus pilaris*	100	118	119	147	144	168	**
Song Thrush	*Turdus philomelos*		100	87.3	125	126	134	*
Redwing	*Turdus iliacus*	100	102	118	126	141	141	***
Garden Warbler	*Sylvia borin*		100	96.7	115	115	121	ns
Blackcap	*Sylvia atricapilla*		100	145	133	163	170	*
Chiffchaff	*Phylloscopus collybita*		100	116	119	99.2	100	ns
Willow Warbler	*Phylloscopus trochilus*	100	98.1	101	117	112	102	ns
Goldcrest	*Regulus regulus*		100	118	150	177	129	ns
Spotted Flycatcher	*Muscicapa striata*		100	116	123	137	140	***
Pied Flycatcher	*Ficedula hypoleuca*		100	120	111	103	87.5	ns
Willow Tit	*Parus montanus*		100	79	70.6	85.4	63.8	ns
Blue Tit	*Parus caeruleus*		100	72.4	91.3	99.7	70.1	ns
Great Tit	*Parus major*		100	97.1	99.1	95.4	85.2	*
Magpie	*Pica pica*		100	123	139	172	148	*
Carrion Crow	*Corvus corone*		100	126	141	146	143	*
Starling	*Sturnus vulgaris*		100	116	114	147	160	*
Chaffinch	*Fringilla coelebs*		100	95.3	94.1	92.5	92.4	***
Brambling	*Fringilla montifringilla*		100	117	90.2	113	97.8	ns
Greenfinch	*Carduelis choloris*		100	120	120	105	151	ns
Siskin	*Carduelis spinus*		100	129	114	97.3	115	ns
Redpoll	*Carduelis flammea*		100	69.6	81.2	95.3	50.3	ns
Yellowhammer	*Emberiza citrinella*		100	105	93.4	96	76.6	ns
Reed Bunting	*Emberiza schoeniclus*		100	107	98.5	74.8	84.6	ns

the breeding grounds? The predictions are:

- If there is no competition between Chiffchaff and Willow Warbler, there will be low correlation values between the number of pairs of the two species in different parts of the country or in different habitats.
- If there is considerable competition between Chiffchaff and Willow Warbler, there will be a negative correlation between the number of pairs of the two species.

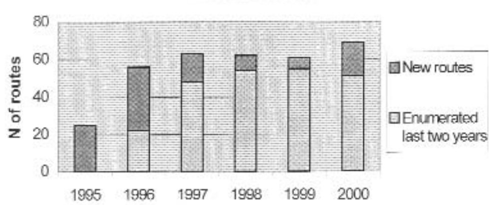

Fig. 1. Number of routes enumerated each year beginning in 1995.

3. Results

The number of participants in the bird census has increased slowly (the number of census routes is given in Fig. 1). In 2000,

Tab. 2. List of all habitat categories in which at least 20 points were enumerated. Habitat category numbers are the same as in Fig. 4.

Habitat category number	Habitat category	Number of census points
1	Spruce forest without shrubs (spruce as dominant tree)	49
2	Spruce forest with shrubs (shrubs < 2m high)	90
3	Pine forest without shrubs	54
4	Pine forest with shrubs	43
5	Deciduous forest without shrubs	21
6	Deciduous forest with shrubs	182
7	Mixed forest without shrubs	73
8	Mixed forest with shrubs	192
9	Scrub with deciduous bushes and trees	33
11	Clear-cut area	45
12	Pine mire (a peat bog with some pines)	29
13	Open mire	22
15	Arable land (including grassland)	82
17	Pasture, possibly with scattered bushes or trees, or both	37
18	Rural settlement (buildings, yards, gardens etc)	87
21	Mountain birch forest	36
25	Habitat category other than above	80
26	Mixed habitat, the mixture comprising two or more habitat categories as given above	136

57 different ornithologists enumerated the 69 routes. These routes are unevenly distributed throughout the country, as shown in Fig. 2. Most routes are enumerated well below the tree line, thus vertically separating this monitoring programme from the MTE programme.

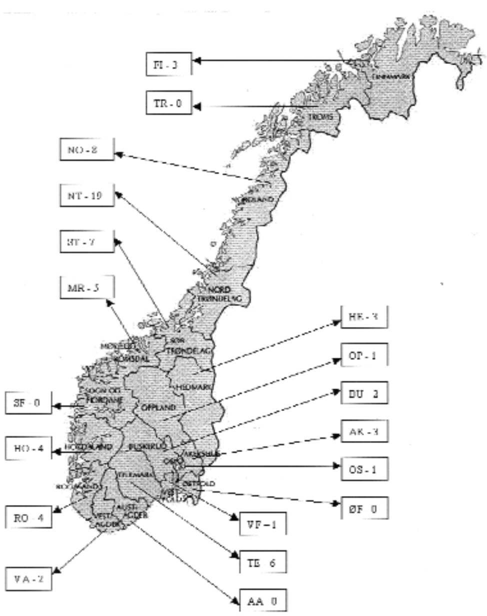

Fig. 2. Map of Norway showing the counties and the number of routes enumerated in each county in 2000.

During the last five or six years, there has been a significant increase in index values for birds that leave Norway and spend their winters in Europe (all species combined), especially Thrushes *Turdus spp*, Blackcaps *Sylvia atricapilla* and Starlings *Sturnus vulgaris*, but Chaffinches *Fringilla coelebs* have declined (Tab. 1). Index values for birds migrating to Africa were more variable, but the number of observations of Spotted Flycatcher *Muscicapa striata* has increased every year since 1996. Birds that winter in Norway also show variable trends: Tits *Parus spp* have declined, Corvids have increased, and finches vary with the seed production of various trees.

The relative densities of Chiffchaff and Willow Warbler in different counties in Norway are given in Fig. 3. The relative densities are given as the mean number of pairs observed in each route (20 points) in the various counties. The mean values are

Tab. 3. Spearman rank correlations between the number of pairs of Chiffchaff and the number of pairs of Willow Warbler in the two most popular habitats common to both species in 2000. Only points (n) where at least one of the species was observed are included.

County	Deciduous forest with shrubs			Mixed forest with shrubs			Both habitats		
	r	p	n	r	p	n	r	p	n
MR	-0.32	>0.1	19	-0.76	<0.05	8	-0.35	<0.1	27
ST	-0.57	<0.1	10	-1.0	<0.001	9	-0.73	<0.001	19
NT	-0.47	<0.1	15	-0.63	<0.001	39	-0.59	<0.001	54
MR-NT	-0.45	<0.01	44	-0.66	<0.001	56	-0.56	<0.001	100

calculated for all counties with more than one route in the period 1996-2000. The eight counties in eastern Norway had significantly lower densities of both Chiffchaff (Mann-Whitney U-test, two-tailed: Z=-3.02, *P*<0.01) and Willow Warblers (Mann-Whitney U-test: Z=-2.31, *P*<0.005) than in the other eight counties.

The mean number of pairs of the two species at each point in different habitats is shown in Fig. 4. Naturally, the various habitats differ in importance for Chiffchaff and Willow Warbler. Mires and mountain birch forest hosted only Willow Warblers at significant densities. There is a weak positive correlation in the number of pairs of Chiffchaff and Willow Warbler observed in different habitats, though not significantly so (Spearman rank correlation: r=0.42, *P*=0.08). This means that both species have a tendency to prefer the same habitats, which increases the possibility of competition between them.

Looking at the eight counties in southern Norway and further northwards along the coastline, where the densities of both species were highest (Fig. 2), there were fewer Willow Warblers in areas where the densities of Chiffchaff were highest. This correlation was statistically significant (Spearman rank correlation: r=-0.83, *P*=0.010). To take a closer look at the competition between the species, I picked out the five habitats with the highest den-

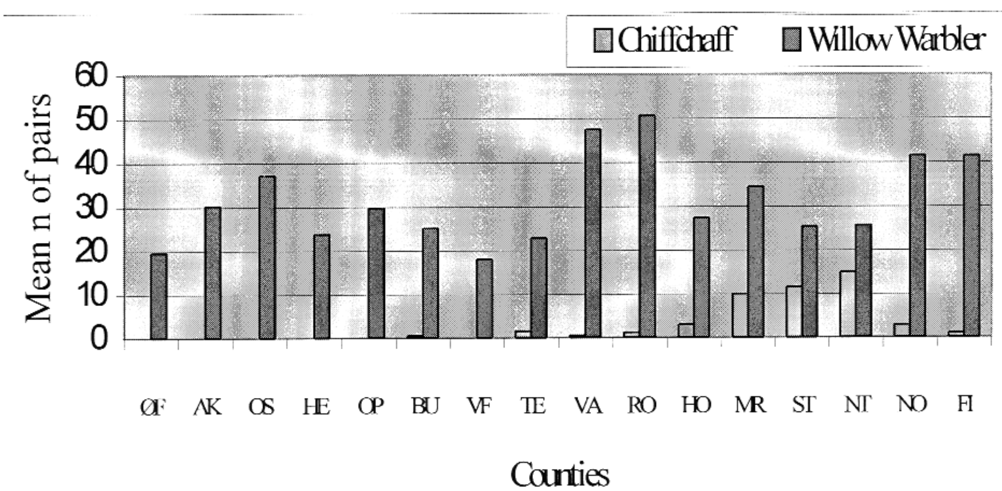

Fig. 3. Mean number of pairs of Chiffchaff and Willow Warbler registered at each point in the period 1996-2000. (Fig. 2 shows the location of the counties.)

sities of Chiffchaff, and the five habitats with the highest densities of Willow Warbler. Two of these habitats were common: a deciduous forest with shrubs (No 6 in Tab. 2 and Fig. 4) and a mixed forest with shrubs (No 8). The number of pairs of these two species were analysed to see if the number of pairs of one of the species was dependent or independent of the number of pairs of the other species. The analysis included only data collected within 50m of the census point, and only those points where at least one of the species was present. The three counties with the highest densities of Chiffchaff were included. The statistical tests are summarised in Tab. 3, and all three counties combined showed a strong negative correlation in each of the two habitats. The negative correlation was strongest in the two counties with the highest densities of Chiffchaff, and also in the habitat that contained most Chiffchaffs. The correlation became more negative by including only points with at least two pairs observed ($r=-0.79$, $P<0.001$, $n=34$) or at least three pairs observed ($r=-0.86$, $P<0.01$, $n=9$).

4. Discussion

According to Koskimies (1992), a national bird-monitoring programme must fulfil at least the following criteria. It must:

1. Be continual.
2. Be done in the same study areas from year to year.
3. Use comparable methods.
4. Cover as many species as possible.
5. Cover the whole country.
6. Cover all habitats, both optimal and marginal.
7. Detect both short-term and long-term population changes.
8. Be scientifically valid.
9. Have high efficiency.

Monitoring as many species as possible, as stressed by Koskimies & Väisänen (1991), allows us to separate the effects of some environmental factors from the masking effects of climatic changes, and to find any cause-effect relationships between birds and their environments. Both resident and migratory species must be included, because they experience different selection pressures during different seasons.

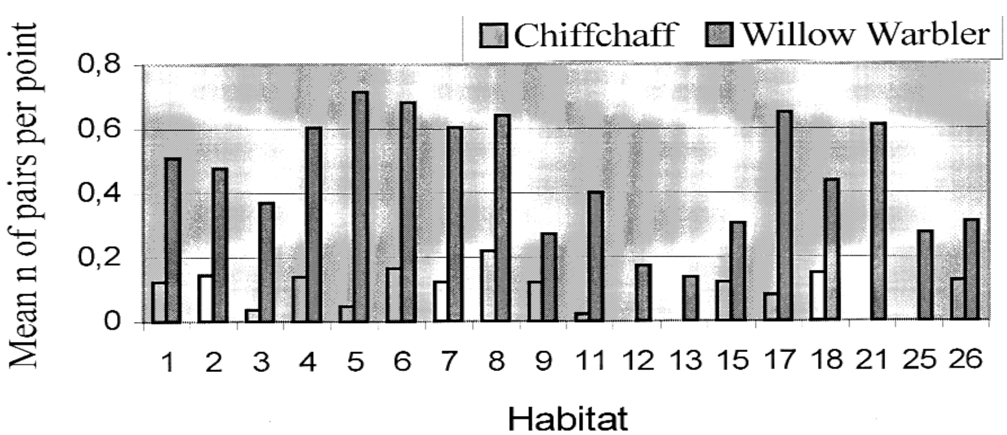

Fig. 4. Mean number of pairs of Chiffchaff and Willow Warbler observed in 2000 within 50m of each point in the various habitat categories. (Tab. 2 lists the habitat categories. Only those habitats in which at least 20 points were enumerated are included.)

Does the point count census programme of terrestrial breeding birds run by the Norwegian Ornithological Society in Norway fulfil these criteria? Fig. 2 shows the distribution of enumerated routes by volunteers in different counties, and this uneven distribution will always be a problem. We will not be able to enumerate the whole country (criterion 5 above) in a satisfactory way. Experience indicates that we will have the same distribution problem in the future.

Another weak point is that volunteers choose their routes and their points non-randomly. This is probably not justifiable. Thus the results probably cannot be generalised to infer what is happening to the population as a whole. It is important to be aware of what has been sampled and how it might relate to the whole population in relation to such factors as geographical distribution and habitat coverage (Bibby *et al*. 1992). Preliminary calculations in Sweden indicate that routes chosen non-randomly by volunteers contain more birds than randomly selected standard routes (Svensson *pers comm*). This implies that volunteers choose bird-rich habitats that are not representative for the whole country. As far as I know, no test of the relationship between index changes from volunteer non-random routes and random standard routes has been published, but both Britain and Sweden have used both systems for a few years and soon will be able to present correlations between the population indices derived from those systems. The results of these analyses will give some indication about the reliability of our method.

Whatever the results of these analyses, we will start selecting routes more randomly, and standardise the way to choose points along these routes. Not all details are clear at the moment, but a few alternatives suggest themselves.

The LUCAS grid system, of 18×18km squares, is applicable to the whole of Europe. A fully random choice of grids in Norway to enumerate will still be problematic because:

- It is a large country with few qualified inhabitants able to enumerate a representative number of routes in all regions (Its area is *c*324 000km^2, its population *c*4.5 million). Southern routes are liable to be well covered relative northern routes, where residents and participants are few.
- Much of Norway's terrain is unsuitable for bird census work, and so an arbitrarily chosen 20-point may include features such as large lakes, fast-flowing rivers, vast fjords and mountains that are both high and steep.

The plan is therefore to find a semi-random approach, which entails:

- The selection of about five regions in different parts of Norway and the collection of sufficient data from them to identify bird population and distribution trends.
- Each region, being 20 000-30 000km^2 in area, will include many LUCAS grids.
- All grids unsuitable for bird census work will be excluded.
- Among the remaining grids, at least 20 will be randomly chosen in each region.
- Participants will have their expenses covered and perhaps be paid wages, which is probably necessary if more than 100 routes in these five regions are to be enumerated.
- In each grid the census has to follow a

detailed standardised method. There are two possible methods discussed so far:

- Combine line transect and point counts along the 2×2km square centred on the grid centre. Every kilometer a point count will be undertaken, to a total of eight points. The line transect connecting the points will be enumerated. Each km should take between 30 and 40 minutes to complete.
- Make point counts all the way around the 2×2km square centred on the grid centre, with 400m between each point, making 20 points altogether.

The first of these two approaches is used in Sweden. Preliminary calculations show slightly more observations per hour using line transect than using point count censuses, but the difference is small (Svensson, pers comm). Using point counts exclusively, the field method and treatment of the data will be uniform and similar to the existing programme.

- The current programme with volunteers choosing own routes will continue concurrently with the new proposed programme.

An essential aspect of any bird census is to discover reasons for changing bird populations. Therefore it is important to collect much information about the different factors affecting the birds. The Norwegian Institution of Land Inventory, The Norwegian Institute of Nature Research and other organizations are gathering various data in various regions, including data linked to the grid. Data will be collected on: pollution (local or remote in origin), precipitation, temperature, vegetation described by field investigation and by aerial photographic interpretation, other vegetation parameters (*e.g.* seed production, rate of growth), and some animal parameters (rodent population sizes, hare population changes). The bird population studies will be a part of an integrated study.

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