Preface

This Manual presents standard instructions for a large-scale bird monitoring programme for Finland which covers about 305 000 km^2 of the Boreal zone. Several thousand volunteers participate each year in collecting data for over ten different monitoring projects, many of which use internationally known field methods. The point count and the mapping censuses of breeding land birds represent techniques that have been slightly modified for the boreal conditions found in Finland. The development of projects that were originally created in North America or Britain, such as the winter bird census or nest recording, have created Finnish versions which differ markedly from the original ones. However, several monitoring methods originate from Finland, e.g. the census of breeding waterfowl pairs on inland lakes, the raptor grid scheme and the night-singing birds census.

To promote efficient computerization of the data and to advance integration between the projects, 31 recording forms have been designed. To illustrate the use of these forms, prefilled versions with real field data are included in this Manual.

The data gathered are used in ecological research as well as in environmental monitoring. The underlying subject of these studies is the relationship between bird populations and their habitats. Long-term changes in bird populations and their demographic processes may be used as indicators of broad-scale environmental changes caused by man and to identify the need for detailed applied studies on specific impacts.

The Manual was originally published in Finnish (Koskimies & Väisänen 1988). In producing this English version we want to promote international evaluation of the methods, before the accumulating databases are extensively used. We also hope that this presentation of the methodological development done in Finland will contribute to the integration of bird monitoring in Europe. There is clearly a need for a European bird monitoring manual. The main obstacle to the compilation of such a manual has been that national instructions have not been standardized for use over larger geographical areas.

In this edition of the Manual we have updated and translated the instructions. One should note, however, that where habitat types, census periods, species lists in the forms etc. are concerned, the instructions presented here have been designed to apply to Finnish conditions. If these methods are adopted in other countries, they will need to be modified according to national conditions.

Those colleagues who participated in developing the original Finnish versions (see Contents) also commented on the English text. Various chapters were also critically reviewed by Steve P. Carter (waterfowl point and round count), Humphrey Q.P. Crick (nest record scheme, raptor grid scheme, box-nesting birds scheme), Robert J. Fuller (point count, line transect and mapping census of breeding land birds, night-singing birds census, bird site register, register of faunistically valuable records, threatened birds register), John H. Marchant (point count, line transect and mapping census of breeding land birds), Will Peach (winter bird census, archipelago birds census), and Juha Tiainen (mapping census of breeding land birds). We are grateful for their valuable comments.

We thank also Sari Timonen and Suvi Raivio for help in translating, Marcus Walsh for revising the English, Esa Lammi, Barbro Elgert, Jari Korhonen, Jan Lindström, Hannu Pietiäinen and Pekka Routasuo for technical assistance, and Samuel Panelius for permission to use the computer facilities of the Finnish Zoological Publishing Board.

Electronic versions of the forms presented in this Manual are available without cost by sending a list of those needed and a 3.5" disc to RAV. For further editing of the forms one should have a Mac Plus or later Apple Macintosh microcomputer with a hard disc, MacDraw or some other graphics program for handling of pict-form files, and a PostScript laser printer. Data input and computer analyses, which may cause problems (see e.g. Digby & Kempton 1987: 176–186) are not treated here, but should be considered in an early phase of any monitoring scheme.

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Introduction: Bird Monitoring in Finland

The basic ideas of the Finnish bird monitoring programme are described in the following as an example of a national monitoring system within the Boreal zone. The programme is presented in more detail by Koskimies (1989a).

Birds as ecologigal indicators

Here, 'monitoring' means continuous and regular quantitative research using standardized methods, which reveals changes and causes of changes in the abundance and ecology of birds. Monitoring data can be used for ecological research and other purposes, e.g. conservation of birds.

Birds have been considered useful biological indicators because they are ecologically versatile and live in all kinds of habitats as herbivores, carnivores and omnivores. The ecology of birds is well known, and census and other study methods are well developed compared with those used for other biological taxa. Furthermore, bird monitoring is relatively inexpensive because voluntary birdwatchers can gather the field data.

Biological monitoring, e.g. using birds, has two main advantages compared with non-biological monitoring. Firstly, it is possible to detect environmental changes which cannot be observed or predicted by measuring a limited set of pre-selected physical or chemical parameters, and second, to detect and monitor biological, often cumulative and non-linear consequences of many environmental changes acting simultaneously.

There are also some problems with birds because they most often respond to secondary changes brought about by a primary cause, the response being one or more steps removed from the actual phenomenon (see especially Morrison 1986 and Temple & Wiens 1989). In addition, it is often difficult to confirm a cause-effect relationship between an environmental change and a population change, especially in migratory species which spend a major proportion of their annual life outside the monitored area.

Thus far birds have been used most successfully to detect and monitor the effects of environmental contaminants (e.g. Morrison 1986). Bird data have been shown also to reflect broad-scale habitat changes over the long run, such as those due to agriculture and forestry (e.g. Järvinen & Väisänen 1979, see also Haila et al. 1989).

Aims and levels of monitoring

Weather and climatic oscillations are of major importance in regulating primary (birth rate, death rate, rate of dispersal) and secondary population parameters (density, population size, geographic range, habitat occupancy, age structure, sex ratio, proportion of birds that breed) of boreal birds. During the last ten years, for example, northern Europe has experienced two very warm summers and one very cold one, four very warm winters and two very cold ones. Weather conditions both during spring and autumn have also differed widely from year to year. Exceptional years have markedly affected the birth rate, death rate and immigration of birds in Finland. We are perhaps now facing a shifting phase of gross climate, indicated by extreme variability (cf. Pfister 1988). Anyhow, we cannot avoid a feeling that our recent reports (e.g., Väisänen et al. 1989, Väisänen & Koskimies 1989) have included more 'weather monitoring' than using birds as indicators for changes in Finnish habitats, for example.

To be able to separate environmental factors from the masking effects of climatic changes, or to find out cause-effect relationships between birds and their environments, as many species as possible should be monitored. Several studies have shown the limitations of using a low number of indicator species to monitor overall, long-term trends in a wildlife community (e.g. Wiens 1981, 1983, Wiens & Rotenberry 1981). Distribution between different geographical scales is also of utmost importance. The regional pattern is a result of complicated dynamics in a mosaic of local populations. On the scale of local communities, changes might not be linked with habitat changes. Even a broad habitat change can remain undetected, if monitoring does not cover most of the habitat range. Certain habitats may be more vulnerable to man-made activities than others.

Mere data on population sizes and densities provides no clue as to the causes of observed population changes. An attempt should be made to identify the particular population processes which are affected by environmental effects and which seem to be involved in the recorded change. Population ecology of breeding and wintering birds studied on different geographical scales, both regional and national, is the most suitable monitoring subject (see, e.g., O'Connor 1985, Tiainen 1985, Baillie 1990).

The monitoring of resident species is especially important because they are affected only by changes occurring in Finland and all of their population processes, at least in theory, can be directly studied throughout the year. Migratory species, however, must be included in the monitoring programme as well. They may indicate other types of environmental changes in their breeding areas compared to the year-round residents, and various environmental changes influencing bird populations in wintering areas and during migration.

Criteria for monitoring methods

The most important criteria when selecting monitoring methods are (1) suitability for the species and habitats monitored, (2) precision and accuracy independent of the habitat and bird density, (3) size of the change to be detected and (4) standardization of habitats, years and observers. A thorough discussion on the use of different methods for different purposes is included in Ralph & Scott (1981) and Møller (1983). Koskimies & Väisänen (1988) presented the first Finnish standard of monitoring methods.

There is no single method suitable for monitoring all bird species and habitats. One cannot avoid compromises between the accuracy of results and efficiency of work, but the results must be comparable from year to year. The influence of different errors on results should be known and standardized. Rapid one-visit census methods are often more suitable than time-consuming multi-visit methods, which voluntary bird watchers may find unattractive (e.g. Koskimies & Pöysä 1989). With rapid methods more representative samples from different areas and habitats can be gathered. In Finland over ten different methods to monitor population changes and different population processes are used. They are described in detail in this Manual.

In many countries, counts or trapping of migrants at bird stations have been used as a monitoring method. There are many uncontrolled biases in such data, however, and difficulties arise in interpreting the results. The main source of error is the great variation in migrant numbers, which may not at all indicate real population changes. Although it is perhaps true that counts of migrants reveal the most marked population changes in long-term data covering a few decades, relying on these does not fulfil the basic requirement of monitoring: the change must be identified early enough to prevent negative effects.

The integrated bird monitoring programme in Finland

The Finnish bird monitoring programme covers environment types and population ecology of various bird groups. A basic feature of the monitoring programme is that different projects are largely integrated to give maximal opportunity for data record linkage across the projects (Koskimies 1989a).

We have drawn a generalized picture of the Finnish bird monitoring projects in Fig. 1. The projects were classified into those bringing information either on primary or secondary population parameters of birds. In fact, several of them cover both types.

Basic information on birth rates (Fig. 1: A) has been received from nest record cards since 1954 (v. Haartman 1969). These now total ca. 140 000 cards covering almost all Finnish species. The number obtained is nowadays about 6000 cards per year, and only in the most common species is it large enough for annual monitoring (Väisänen & Stjernberg 1989). Notable data are collected in the box-nesting birds scheme, and also in the raptor scheme (about 11 000 raptor nest record cards in eight years). Breeding success of waterfowl, archipelago birds and gallinaceous birds are also monitored in their respective projects, including, as far as possible, information on post-fledging mortality, which is an important gap in our knowledge of avian populations.

Information on mortality is difficult to obtain in general monitoring projects. Promising new methods for calculating annual survival rates have been developed using general bird ringing data (5.5 mill. birds ringed in Finland since 1913, or nowadays ca. 200 000 individuals per year, Saurola 1988; see also Dobson

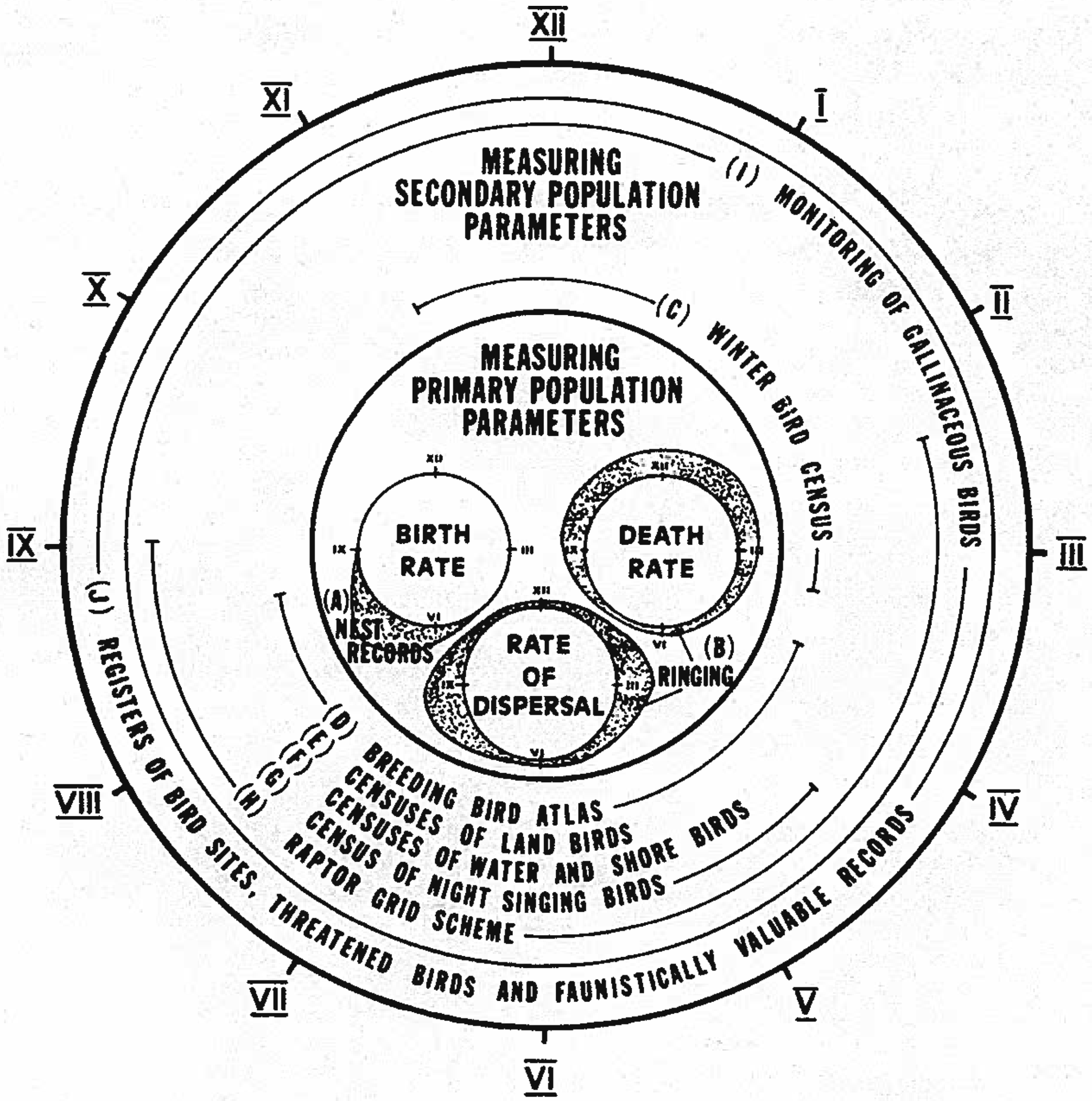

Fig. 1. Annual spread of bird monitoring efforts in Finland (Roman numbers denote months). Primary population parameters of boreal birds monitored include birth rate (A: nest record cards), death rate and rate of dispersal (B: ringing data). The other projects monitor annual variation in secondary population parameters (density, population size and structure, geographic range, habitat occupancy): early, mid- and late winter censuses of wintering birds (C), breeding bird atlas (D: repeated once in 10–15 years), point counts, line transects and mapping censuses of breeding land birds (E), censuses of breeding water-, sea and shore birds in inland lakes and in Baltic archipelagoes (F), night-singing birds scheme (G) and raptor scheme (H). Monitoring of gallinaceous birds (I) and collecting data for the registers of bird sites, threatened birds and faunistically valuable records (J) continue all year round.

1990) (Fig. 1: B). Comparisons of survival of sedentary birds between the winter bird censuses give crude estimates of annual death rates (e.g. Hildén 1989), as do the winter-time censuses of gallinaceous birds. The general ringing data contain useful information on dispersal rates in species which have been marked frequently. Ringing data can also be used to study causes of death, migration routes and wintering areas.

Standardized local studies based on intensive ringing of both adults and nestlings of as many species as possible are needed to improve the accuracy of mortality estimates. Thus far the most thorough data has been gathered on birds using nest-boxes. A special box-nesting birds scheme was started in 1987, covering about 20 study areas. In each of them, about 50–200 nest-boxes are checked frequently enough to monitor the laying date, clutch size, number of hatchlings and fledglings, and to ring parents and nestlings.

Information on secondary population parameters come from several projects:

Winter bird census (Fig. 1: C) was started in Finland in the winter of 1955/56 (e.g. Hildén 1988, Hildén et al. 1988, Väisänen & Koskimies 1989). The birds are counted along about 500 permanent routes of about 10 km each three times a winter to monitor changes in distribution and abundance of winter birds in various habitats, and changes in mortality during winter.

Atlas studies (Fig. 1: D) can be used in monitoring of changes in distribution, which for many species probably occur on a time scale of some decades. The first atlas was compiled in Finland in 1974–79 (Hyytiä et al. 1983, Koskimies 1989b), and the second one in 1986–89 with an improved methodology using a more quantitative basis than previously (Väisänen 1989). In total, about 300 000 records of breeding evidence were gathered from 3800 10-km squares in both atlas projects.

Population changes in about a hundred of the most common land birds (Fig. 1: E) have been monitored by line transects since 1979 and, in addition, by point counts since 1984. In the last few years about 30–50 transects (4–6 km each) and 70–100 routes with 20 points in each have been repeated in successive breeding seasons (e.g. Väisänen et al. 1989, Routasuo & Väisänen 1990). The interpretation of recent results will be enhanced by the long tradition of line transects since the 1940s (e.g. Järvinen & Väisänen 1978). The mapping method has so far been used for monitoring of breeding birds in a few virgin reference areas for comparison with man-altered environments (Koskimies 1988).

Archipelago bird populations have been monitored in a nation-wide project since 1984 (Fig. 1: F; Hildén 1987). Adult birds and their nests are counted and the contents of the nests recorded, preferably three times in a breeding season. There have been about 20 study areas containing hundreds of islands in total. Waterfowl and shore birds breeding on inland lakes and pools have been monitored in a nation-wide scale since 1986 (e.g. Lammi et al. 1990). The birds are counted twice in the beginning of the breeding season (over 700 counting sites a year). Broods and summer-time adult populations are also monitored in the project.

Night-singing birds (Fig. 1: G) are monitored separately because a special census method must be used (listening to nocturnally singing males). All observations (usually 5000–8000 singing males in total per year) made by bird watchers in Finland have been gathered since 1980 (e.g. Koskimies 1986). In addition, standardized route censuses were introduced in 1988 to improve the annual comparability. Each route (about 5–30 km long) is counted three times in early summer.

Population changes and breeding success of birds of prey (Fig. 1: H) have been monitored by searching all nests and territories of different raptor and owl species in 10-km squares since 1982 (e.g. Saurola 1986, Haapala & Saurola 1989, Haapala et al. 1990). About 120 squares have been monitored annually. Additional data on reproduction of pairs outside the study blocks have been gathered from ringers.

Population size and structure as well as birth rate of gallinaceous birds (Fig. 1: I) have been monitored along 800–900 routes (total length 20 000–30 000 km) once a season in late summer since 1964 (e.g. Lindén & Rajala 1981). From 1988 onwards the census has been done along hundreds of 12-km long triangular routes. These have been marked in the field and sample main habitats randomly.

Three monitoring projects have a clear conservation goal (Fig. 1: J):

- Faunistically valuable records of less numerous bird species have been gathered annually (e.g. Koskimies 1989c). These species often indicate threatened habitats, which remain poorly sampled in ordinary censuses due to their rarity.
- Data on breeding bird species and environmental conditions of important bird sites as well as probable threats have been recorded

for a bird site register since 1986 (Väisänen 1989).

- Information on each of the 38 threatened bird species listed in the Finnish Red Data Book (Rassi & Väisänen 1987) has been gathered from voluntary observers in a coordinated manner in order to monitor the size of the populations and their reproductive success (e.g. Koskimies 1989d). Many threatened species are intensively monitored in species-specific projects, including, for example, inventories of suitable habitats, nest sites, and effective ringing (e.g. Saurola 1990, Stjernberg et al. 1990, Virolainen & Rassi 1990, Wikman 1990).

The most important projects not described in this Manual include censuses of gallinaceous birds and intensive population ringing (see above), as well as standardized mist-netting (Constant Effort Sites Project) and the Euring Acroproject.

The aim of the Constant Effort Sites Project is to monitor breeding success and survival of passerines by standardized mist-netting. The method is similar to that used in Britain (Baillie et al. 1986): there are 12 10-day periods between 1 May and 31 August, and birds are netted in a standard way on one day per period. The habitat around the trapping sites (30–40 at present) should remain as constant as possible in order to eliminate the effect of local environmental changes on the results.

The Euring Acroproject has been running in Finland since the beginning of the 1980s. There are about 20 reed bed sites in southern Finland where Sedge Warblers and other reed bed passerines are trapped from July to September (e.g. Koskimies & Saurola 1985, 1988).

In addition to these annual projects covering the whole of Finland, there has been a separate study project of the breeding birds in agricultural habitats started as a nation-wide status inventory in 1984 (Tiainen et al. 1985). These mapping censuses have later included more local and intensive studies on the relationships between the breeding bird fauna and agricultural landscape.

Monitoring of pesticides in birds, which has so far been badly neglected in Finland, will be an important forthcoming project.

Most Finnish monitoring projects have been organized by the Zoological Museum, Finnish Museum of Natural History of the University of Helsinki, with the help of about 3000 voluntary birdwatchers, most of them having participated in the atlas projects. They form a permanent observer network. The Finnish Game and Fisheries Research Institute, Game Division, organizes the monitoring of gallinaceous birds. They also participate in organizing waterfowl monitoring together with the Zoological Museum.

Interpretation of monitored data

Interpretation of data is the most important part of monitoring (Koskimies 1989a). In environmental applications, interpretation means searching for cause and effect relationships to assess impacts of various human-caused changes on biological organisms. Field workers should, however, recognize when populations respond to something other than changes in their habitats. Weather and climate are probably the most important non-habitat factors which should be considered in bird monitoring work. Multivariate analyses are often needed (e.g. Digby & Kempton 1987).

There are many approaches to interpreting the data of bird monitoring studies. The basic goal of these is the separation of the influence of human-caused environmental changes from 'natural' changes. The control data base obtainable from virgin areas remains limited because virgin areas are scarce and not always comparable with existing habitats.

Suitable approaches to be further developed include (1) single indicator species, (2) grouping species with similar ecologies ('monitoring guild' approach), and (3) partitioning a change in population size to the different stages of the population processes ('population model' approach).

Birds with highly specialised life history traits may be used as indicators of special habitat needs and changes. There are many problems, however. Any single species can serve as an indicator for only a narrow range of ecological conditions within the habitat type. Some are even too rare to be of any help. Restriction to the indicator species of a priori known environmental changes diminishes the power of bird monitoring as a biological early warning system of complex and unexpected environmental changes.

Because many population changes have multiple causes, monitoring specific environmental changes is most rewarding if birds are grouped, for example, by habitat, by main strategy of migrating or feeding. The guild concept is most useful if species are arranged in guilds that accurately reflect their use of habitats and resources. To facilitate the grouping of Finnish birds into guilds, or groups of ecologically similar species, in various monitoring projects, a common species file has been created. In it the species have been classified according to size (classes based on average body weight), breeding habitat, food, wintering area, average clutch size etc.

The measurements of various population processes (breeding success, mortality and emigration/immigration) should be as thorough as possible. It is then possible to divide the total change into its components and evaluate the importance of each of them, as well as probable cause-effect relationships. Breeding success, for example, responds more rapidly and directly to environmental changes than population size, but on the other hand, it also varies more due to weather and other non-habitat factors. Of course, this 'natural' variation should be measured in order to separate it from a trend caused man.

Reporting of the results

The results of the various monitoring projects are reported annually in the Finnish field ornithological journal 'Lintumies' (articles contain longish summaries in English). These reports serve as feedback to voluntary observers. A summarizing report is necessary once or twice a decade in order to more thoroughly analyse year-to-year and long-term changes as well as to interpret results for both researchers and administrators.

International co-operation and development of bird monitoring

The main aim in the increasing international co-operation should be ensuring the comparability of results by standardizing the methods of field work and data analysis. With a larger geographical scale it is possible to estimate the extent of environmental changes and their total effect on bird populations and other biological systems. Finland has co-operated especially with Estonia and Latvia and with other Nordic countries (Koskimies 1989e). European-wide co-operation in the field of bird monitoring will probably increase in the near future (Hustings & Saris 1989). At least the following European countries in addition to Finland run monitoring projects and integrated programmes which have been applied to the respective habitats and bird faunas (see also Hustings 1988): Estonia (e.g. Lilleleht 1987), Latvia (e.g. Peterhofs & Priednieks 1989), Sweden (e.g. Statens naturvårdsverk 1978, Svensson 1987), Denmark (e.g. Braae & Woolhead 1986, Nohr & Braae 1986), Germany (e.g. Berthold et al. 1986, Gnielka 1990), The Netherlands (e.g. van Dijk 1985, 1989), United Kingdom (e.g. O'Connor 1985, Baillie 1990, Marchant et al. 1990) and Czechoslovakia (e.g. Janda & Stastny 1987). Several others are beginning new comprehensive studies (e.g. in Austria, Landman et al. 1990). In North America some monitoring projects have been in operation even longer than in Europe (e.g. Robbins 1985, see also the comprehensive manual by Cooperrider et al. 1986).

Interpretation of monitoring results is a seriously neglected field of research so far. To develop interpretation we need both extensive and intensive monitoring projects. Most of the present studies belong to the former group and they monitor broad-scale changes. Intensive population studies should be activated to search for cause-effect relationships and reasons for population changes. Monitoring of virgin reference areas should be more active than at present. More precise information on habitats and other environmental parameters should also be collected within bird monitoring projects (see also Temple & Wiens 1989).

References

Baillie, S.R. 1990: Integrated population monitoring of breeding birds in Britain and Ireland. – Ibis 132:151–166.

Baillie, S.R., Green, R.E., Boddy, M. & Buckland, S.T. 1986: An evaluation of the Constant Effort Sites Scheme. – Report of the Constant Effort Sites Review Group to the Ringing Committee of British Trust for Ornithology, Tring.

Berthold, P., Fliege, G., Querner, U. & Winkler, H. 1986: Die Bestandsentwicklung von Kleinvögeln in Mitteleuropa: Analyse von Fangzahlen. – J. Orn. 127:397–437.

Braae, L. & Woolhead, J. 1986: Dansk ornitologisk forenings fugleovervågning – status og fremtidige program (in Danish). – Dansk Ornitologisk Forening, Copenhagen.

Cooperrider, A.Y., Boyd, R.J. & Hanson, R.S. (eds.) 1986: Inventory and monitoring of wildlife habitat. – US Dept. Inter., Bur. Land Manage. Service Center, Denver.

Digby, P.G.N. & Kempton, R.A. 1987: Multivariate analysis of ecological communities. – Chapman and Hall, London and New York.

Dobson, A. 1990: Survival rates and their relationship to life history traits in some common British Birds. – Current Orn. 7:115–146.

van Dijk, A.J. 1985: Broedvogel–Monitoring-Project. – Limosa 58:167–172.

van Dijk, A.J. 1989: Broedvogel-Monitoringsproject. Handleiding. – SOVON, Beek.

Gnielka, R. 1990: Anleitung zur Brutvogelkartierung (in German). – Apus 7:145–239.

Haapala, J. & Saurola, P. 1989: Breeding and population trends of common raptors and owls in Finland in 1988 (in Finnish with English summary). – Lintumies 24:27–36.

Haapala, J., Korhonen, J. & Saurola, P. 1990: Breeding of raptors and owls in Finland in 1989 (in Finnish with English summary). – Lintumies 25:2–10.

v. Haartman, L. 1969: The nesting habits of Finnish birds. I. Passeriformes. – Comm. Biol. Soc. Sci. Fenn. 32:1–187.

Haila, Y., Järvinen, O. & Koskimies, P. (eds.) 1989: Monitoring bird populations in varying environments. – Ann. Zool. Fennici 26:149–330.

Hildén, O. 1987: A new seabird monitoring scheme in Finland (in Finnish with English summary). – Lintumies 22:62–67.

Hildén, O. 1988: Thirty years of Finnish winter bird censuses. – Sitta 2:21–57.

Hildén, O. 1989: The effects of severe winters on the bird fauna of Finland. – Memoranda Soc. Fauna Flora Fennica 65:59–66.

Hustings, F. 1988: European monitoring studies on breeding birds. – SOVON, Beek.

Hustings, F. & Saris, F. 1989: How to develop international co-operation in bird monitoring? A reaction. – Bird Census News 2, 2:5–7.

Hyytiä, K., Kellomäki, E. & Koistinen, J. (eds.) 1983: Finnish bird atlas (in Finnish). – SLY:n Lintutieto, Helsinki.

Janda, J. & Stastny, K. 1987: Monitoring of czechoslovak breeding birds by point count method. – Acta Oecol./Oecol. Gen. 8:303–304.

Järvinen, O. & Väisänen, R.A. 1978: Long-term changes of the most abundant south Finnish forest birds during the past 50 years. – J. Orn. 119:441–449.

Järvinen, O. & Väisänen, R.A. 1979: Changes in bird populations as criteria of environmental changes. – Holarctic Ecol. 2:75–80.

Koskimies, P. 1986: The occurrence of nightsingers in Finland in 1985 (in Finnish with English summary). – Lintumies 21:146–150.

Koskimies, P. 1988: Mapping censuses of the breeding bird fauna in the areas of integrated monitoring in 1987 (in Finnish with Swedish sum- mary). – Publ. Ministry Environment, Ser. D 45: 1–38.

Koskimies, P. 1989a: Birds as a tool in environmental monitoring. – Ann. Zool. Fennici 26:153–166.

Koskimies, P. 1989b: Distribution and numbers of Finnish breeding birds. – SLY:n Lintutieto, Helsinki.

Koskimies, P. 1989c: Faunistical report 1987 (in Finnish with English summary). – Lintumies 24:12–20.

Koskimies, P. 1989d: The occurrence of threatened bird species in Finland in 1987 (in Finnish with English summary). – Lintumies 24:81–87.

Koskimies, P. 1989e: How to develop international co-operation in bird monitoring? Experiences from Finland. – Bird Census News 2, 1:10–17.

Koskimies, P. & Pöysä, H. 1989: Waterfowl censusing in environmental monitoring: a comparison between point and round counts. – Ann. Zool. Fennici 26:201–206.

Koskimies, P. & Saurola, P. 1985: Autumn migration strategies of the Sedge Warbler Acrocephalus schoenobaenus in Finland: a preliminary report. – Ornis Fennica 62:145–152.

Koskimies, P. & Saurola, P. 1988: The EURING Acroproject in Finland in 1987 (in Finnish with English summary). – Lintumies 23:171–175.

Koskimies, P. & Väisänen, R.A. 1988: Monitoring bird populations in Finland: a manual (in Finnish with English summary). – Zoological Museum, University of Helsinki, Helsinki.

Lammi, E., Pöysä, H. & Väisänen, R.A. 1990: Monitoring breeding populations of the Finnish waterfowl in 1986–89 (in Finnish with English summary). – Lintumies 25:25–32.

Landman, A., Grüll, A., Sackl, P. & Ranner, A. 1990: Importance and application of census techniques in field ornithology: objectives, chances, problems and state of use in Austria. – Egretta 33:11–50.

Lilleleht, V. 1987: Bird monitoring in Estonia: aims and results. – Ornis Fennica 64:21.

Lindén, H. & Rajala, P. 1981: Fluctuations and long–term trends in the relative densities of tetraonid populations in Finland 1964–77. – Finnish Game Res. 39:13–34.

Marchant, J.H., Hudson, R., Carter, S.P. & Whittington, P. 1990: Population trends in British breeding birds. – British Trust for Ornithology, Tring.

Morrison, M.L. 1986: Bird populations as indicators of environmental change. – Current Orn. 3:429–451.

Møller, A.P. 1983: Metoder til overvågning af fuglelivet i de nordiske lande (in Danish with English summary). – Nordisk Ministerråd, Miljø rapport 1983, 1:1–185.

Nohr, H. & Braae, L. 1986: The Danish breeding bird censuses 1976–1983. – Vår Fågelv., Suppl. 11:165–170.

O'Connor, R.J. 1985: Long-term monitoring of British bird populations. – Ornis Fennica 62:73–79.

Pfister, C. 1988: Variations in the spring-summer climate of Central Europe from the High Middle Ages to 1850. – *In* Wanner, H. & Siegenthaler, U. (eds.): Long and short term variability of climate, pp. 57–88. Lecture Notes in Earth Sciences 16, Springer.

Peterhofs, E. & Priednieks, J. 1989: Problems of applying the line-transect method without repeated counts when the breeding season is long. – Ann. Zool. Fennici 26:181–184.

Ralph, C.J. & Scott, J.M. 1981: Estimating numbers of terrestrial birds. – Stud. Avian Biol. 6:1–630.

Rassi, P. & Väisänen, R. (eds.) 1987: Threatened animals and plants in Finland. – Committee Report 1985, 43:1-82.

Robbins, C.S. 1985: Summary of bird censusing and atlasing in North America. – *In* Taylor, K., Fuller, R.J. & Lack, P. (eds.): Bird census and atlas studies. British Trust for Ornithology, Tring.

Routasuo, P. & Väisänen, R.A. 1990: Population monitoring of Finnish land birds in 1988–89 (in Finnish with English summary). – Lintumies 25:76–79.

Saurola, P. 1986: The raptor grid: an attempt to monitor Finnish raptors and owls. – Vår Fågelv., Suppl. 11:187–190.

Saurola, P. 1988: Bird ringing in Finland 1913–1987 (in Finnish with English summary). – Lintumies 23:234–248.

Saurola, P. 1990: The Osprey – symbol of bird protection and monitoring (in Finnish with English summary). – Lintumies 25:80–86.

Statens Naturvårdsverk 1978: BIN Fåglar. Biologiska inventeringsnormer (in Swedish with English abstract). – Liber, Stockholm.

Stjernberg, T., Koivusaari, J. & Nuuja, I. 1990: Population trends and nesting success of the White-tailed Eagle in Finland in 1970–89 (in Finnish with English summary). – Lintumies 25:65–75.

Svensson, S. 1987: Fågeltaxering i PMK:s referensområden. Rapport från verksamheten 1986 (in Swedish). – Statens naturvårdsverk, Solna.

Temple, S.A. & Wiens, J.A. 1989: Bird populations and environmental changes: can birds be bioindicators. – American Birds 43:260–270.

Tiainen, J. 1985: Monitoring bird populations in Finland. – Ornis Fennica 62:80–89.

Tiainen, J., Pakkala, T., Piiroinen, J. & Ylimaunu, J. 1985: Changes and status of avifauna of farmland in Finland: background and general methods (in Finnish with English summary). – Lintumies 20:23–29.

Virolainen, E. & Rassi, P. 1990: Population trends of Finnish Golden Eagles in 1970–89 (in Finnish with English summary). – Lintumies 25:59–64.

Väisänen, R.A. 1989: Renewal of methodology in the second bird atlas of Finland. – Ann. Zool. Fennici 26:167–172.

Väisänen, R.A., Hildén, O. & Pulliainen, E. 1989: Monitoring of Finnish land bird populations in 1979–88. (in Finnish with English summary). – Lintumies 24:60–67.

Väisänen, R.A. & Koskimies, P. 1989: Winter birds in Finland in 1988/89, their long-term trends and densities in different habitats (in Finnish with English summary). – Lintumies 24:190–203.

Väisänen, R.A. & Stjernberg, T. 1989: Finnish nest record scheme in 1986–88 – a progress report (in Finnish with English summary). – Lintumies 24:142–149.

Wiens, J.A. 1981: Scale problems in avian censusing. – Stud. Avian Biol. 6:513–521.

Wiens, J.A. 1983: Avian community ecology: an iconoclastic view. – *In* Brush, A.H. & Clark, G.A. (eds.): Perspectives in ornithology, pp. 355–403. Cambridge Univ. Press, Cambridge.

Wiens, J.A. & Rotenberry, J.T. 1981: Censusing and the evaluation of avian habitat occupancy. – Stud. Avian Biol. 6:522–532.

Wikman, M. 1990: The Peregrine Falcon in Finland 1980–89 (in Finnish with English summary). – Lintumies 25:54–58.