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AN EVALUATION OF THE CONSTANT EFFORT SITES SCHEME

Published in February 1993 by the British Trust for Ornithology
The Nunnery, Thetford, Norfolk IP24 2PU, U.K.

ISBN 0-903793-31-8

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Report of the Constant Effort Sites Review Group to the Ringing Committee of the British Trust for Ornithology

May 1986

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SUMMARY

1. Habitat-specific data on changes in population size, productivity and annual survival rates can be obtained from programmes of constant effort mist-netting at selected study sites. Such data would complement those provided by existing BTO schemes and would provide information which is essential for the modelling of populations at a national level.

2. A trial constant effort sites scheme has been in operation since 1981. The number of study sites increased from 17 in 1981 to 47 in 1984.

3. Most sites are in wetland or scrub habitats. The scheme should concentrate on these habitats and on deciduous woodland. Conifer plantations should be excluded due to the rapid changes in bird populations caused by succession.

4. Thirty three species were caught in sufficient numbers to provide worthwhile information. Of these the warblers are of particular interest from both a conservation and a scientific viewpoint.

5. Detailed analyses of the 1983 and 1984 pilot data for Blackcap, Willow Warbler, Wren, Blackbird and Bullfinch were carried out.

6. Capture patterns of adults were similar in both years as were those of juveniles. Thus it is unlikely that comparisons of capture totals will be affected by behavioural changes between years.

7. Totals of adults captured declined through the season due to a combination of trap-shyness and behavioural factors. By the end of the season over 50% of captures were of birds which had already been handled during that summer. Thus a high proportion of the adults regularly using a site appear to be captured each year.

8. Numbers of juveniles captured increased rapidly after fledging and then remained relatively constant for the rest of the season. Numbers of juvenile Willow Warblers declined in late August due to migration while the late appearance of juvenile Bullfinches reflected the late breeding season of this species. By the end of the season the percentage of juveniles which were ringed was lower than for adults. This is probably because juveniles move through the study sites more than adults.

9. It is best to use the percentage of juveniles over the whole season as a productivity index. Few adults are caught in late summer and therefore the percentage of July and August captures which were juveniles would be unlikely to provide a good index of productivity.

10. Methods of calculating confidence intervals for between year changes in the number of adult captures and in the percentage of juveniles are presented.

11. Using a scheme of 100 sites changes of 10 to 14 per cent in the adult population would be detected statistically. With a scheme of this size absolute changes in the percentage of juveniles in the catch of between four and eight would be detected statistically.

12. Confidence limits for changes in adult captures and in the percentage of juveniles were calculated for a variety of different study periods by omitting data for appropriate visits from the calculations. For most species confidence limits were not improved by omitting early or late visits.

13. Significant differences between habitats in the percentage of juveniles were recorded for sixteen species. A significantly higher percentage of juveniles at wetland compared with scrub sites was recorded for nine species, six of which were warblers.

14. Published studies have shown that recapture data of the type generated by the CES scheme can be used to estimate survival rates. The only outstanding methodological problem is that of combining data from a large number of sites and it is not anticipated that this will be difficult to resolve.

15. Recent work on the estimation of survival rates from ringing recoveries suggests that it is desirable to supplement such estimates with those from capture-recapture studies. For species such as warblers capture-recapture estimates of annual survival rates are likely to be more precise than those which can be obtained from the relatively small numbers of ringing recoveries which are reported each year.

16. Detailed habitat recording is essential because of the difficulty of assigning sites to simple habitat categories and because some vegetation changes will take place at most sites. An annual system of habitat recording based on mapping areas of similar habitat and recording their main features on a simple form is proposed.

17. The administration of the scheme is outlined and the resources needed to run it from Beech Grove are assessed. A scheme of 100 sites would require about 11 weeks of staff time per year and would cost about £1400 including salaries. These costs do not include extensive promotion of the scheme or detailed research on its results. They do include the calculation of index values and the preparation of a short annual report.

18. We conclude that the scheme is potentially a very cost effective method of gathering habitat-specific data on population dynamics, and we strongly recommend that it should be taken on by the BTO. Detailed recommendations on the running of the scheme are listed.

1. INTRODUCTION

Population studies of birds require the measurement of three main variables; population size, productivity and survival. Current BTO studies provide only part of the required information. The CBC provides a proven index of adult population size for most woodland and farmland passerines. Nest record card analyses can provide estimates of hatching and fledging success. However this may not give very useful estimates of overall productivity because of replacement nesting which is usually poorly sampled by nest recorders (e.g. Bibby 1978). Ringing recovery data could provide year-specific survival rates for a wide range of passerines now that ringing totals are being collected separately for adults and juveniles (Baillie et al. 1984). However such analyses would not be habitat specific and there would be rather few recoveries for some of the most interesting species, in particular the warblers.

A carefully controlled programme of mist netting within restricted areas of described habitats could help to fill these gaps, and would allow the construction of habitat-specific population models.

The population variables could be measured as follows:

1. Population changes from the numbers of adults caught each year.
2. Post-fledging productivity from the ratio of juveniles to adults caught.
3. Survival from the return of marked birds.

Wetland, scrub and perhaps woodland sites are the most suitable for such work. A programme of summer mist-netting studies at selected sites would thus complement the farmland, woodland and waterways census data provided by the Common Birds Census and the Waterways Bird Survey. The collection of nest record data and ringing data is not currently aimed at specific habitats, although nest recorders are asked to record habitat data on their nest record cards.

Detailed ringing studies based on regular netting at individual sites have been carried out by several ringing groups in recent years. The most notable of these is the Wicken Fen Group, which has published a series of excellent reports that illustrate well the results that can be produced from such studies. A constant effort netting study has been carried out at Marsworth Reservoir, Tring, since 1967, mainly by Bob Spencer. The data from this study have recently been computerised to allow detailed analyses of the results. In 1981 the Ringing and Migration Committee set up a trial Constant Effort Sites scheme to assess the potential for the types of investigation outlined above. This pilot scheme has continued up to the present time (1985) with Mike Boddy acting as organiser. Initially the emphasis was on the production of a "Ringing Index" of changes in adult population size, but more recently juvenile/adult ratios have also received considerable attention.

In March 1984 the Ringing and Migration Committee set up a Technical Review Group to evaluate the results of the pilot Constant Effort Sites Scheme and to report on the desirability of the scheme being taken on by the BTO. Members of the review group were Mr. M.Boddy (trials organiser), Dr. S.T.Buckland, Dr. R.E.Green and Dr. S.R.Baillie (convenor). All of the members of the review group have contributed to the analyses of the data as well as to discussions

about the scheme. We have endeavoured to carry out the analyses of most immediate importance but due to the very limited resources available to us, it has not been possible to carry out all the analyses that we would have liked. Where appropriate we have indicated the need for further analyses. Although there is undoubtedly a need for refinement of some of the methods we have been impressed by the scientific potential of the scheme, and have strongly recommended that it should be continued.

2. METHODS

2.1 Netting regimes

Ringers are asked to visit their site once in each of twelve, ten day periods that cover the months of May to August. If they are unable to cover the whole season contributions covering at least the first six visits are also accepted. The ten day periods are listed each year before the start of the season. Visits should preferably be at least six days apart and the interval between visits should never be less than three days. No precise visit length or time of day are specified, but ringers are recommended to make visits of about six hours, normally fixed in relation to either dawn or dusk. Whatever timing is chosen it is stressed that this should be similar on each visit and that the pattern of visits should be repeated as closely as possible each year. For example, at Marsworth Reservoir, netting takes place between dawn and 0900 hours. Thus visit lengths vary according to the time of year but the pattern of visits is the same in each year.

Trapping data are gathered from a series of standard net sites. The same net sites with the same length and type of nets must be used on each visit. No recommendations are given on the length of netting that should be used. This should obviously be sufficient to catch a reasonable number of birds while not being too much for the ringer to cope with in July and August when large numbers of juveniles are captured. Typically this results in small catches early in the season before any juveniles have fledged. At one series of sites (Type "A", Rigid) no other netting is allowed within 400 m of the site between April and August. In 1983 a second category of sites was introduced

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(Type "B", Flexible) at which additional nets may be used during CES visits. It is recommended that these extra nets should form less than 50% of those in use. At these sites additional ringing visits at any time of year are permitted. At present only the data for birds caught at the standard net sites on the main index visits are recorded on the Constant Effort Site forms.

The number of sites included in the field trials has increased from 17 in 1981 to 47 in 1984 (Table 2.1). In all years most ringers aimed to cover the whole season, with only a small minority attempting only the first six visits. The data from the latter sites are much less useful than those obtained from sites with the full twelve visits. In future it would be preferable to take on new sites only if they can be covered for most or all of the study period. In practice some visits are occasionally missed because of bad weather or other factors. All sites for which the data were reasonably complete have been included in the tables. The frequency of missing visits was low and they did not cause any problem in analysing the data. However, missing visits make manual analysis of the data more complex, as site totals must be recalculated for any pair of years omitting visits that were missing in either year. This will cease to be a problem if the analyses are carried out by computer. In 1981 and 1982 all sites followed a Rigid netting regime. Many of the sites added since 1982 have used Flexible regimes so that, by 1984, 29 Rigid sites and 18 Flexible sites were included (Table 2.1). Flexible sites have encouraged a number of ringers who would not have been prepared to forgo all other summer ringing at their site, to join the scheme.

2.2 Habitat

Ringers participating in the field trials were simply asked to use sites in reasonably uniform and stable habitats that contained a good selection of breeding birds. Ponds used for drinking or bathing were not excluded but ringers were asked to make specific mention of these on their site descriptions. It was envisaged that many of the sites would already be in use as ringing sites and that many ringers would not wish to move to new ringing areas. However, because some habitats are particularly suitable for mist-netting the field trials have been restricted largely to these.

In the first two years of the trials, participants were asked to provide a detailed sketch map of their site with a scale of at least 1:2500. Since 1983 there has been only a small box on the summary sheets for habitat information and no clearly defined instructions for habitat recording have been given. Detailed habitat recording will be an essential part of the scheme in future, and proposed instructions are set out in section 6.

The information on the summary sheets was used to assign sites to one of four main habitat categories (Table 2.2). Most sites were in either dry scrub or wetland, with smaller numbers in deciduous/mixed woodland and in conifer plantations. In 1984 six of the 14 wetland sites contained substantial areas of reed beds, a habitat which should have a high priority for inclusion in the scheme. The other wetland sites were mainly damp areas with willow scrub. Most of the conifer plantations were not intensively managed and also contained some scrub. Their bird populations were little different from those of scrub areas (below).

The ability to obtain data from specific habitats is one of the greatest advantages of the Constant Effort Sites Scheme. The scheme should concentrate on wetland and scrub habitats, with deciduous woodlands also being included if possible. Rapid succession could potentially cause serious problems in interpreting the data and, in the long-term, specific field-work programs may be needed to assess its effects. At present it would be sensible to minimise such problems by excluding sites where succession is likely to be particularly rapid. Plantations should generally be excluded from the scheme for this reason. Some wetland and scrub sites also experience rapid succession and sites where this is anticipated should be avoided. Conversely sites where the habitat is to be maintained at a particular successional stage by active management would be particularly suitable. The wetland and scrub categories are broad ones and will need refinement once further habitat data have been collected. Within these categories reed beds and thorn scrub are readily identified habitats that should receive priority. Many sites inevitably include more than one habitat type but, where possible, sites with a single major habitat would be preferred. Successional changes on a small scale can drastically affect the efficiency of a particular net site and it may be advisable to abandon religious long-term adherence to net sites. Using the same length of net in the same general area may be superior.

One of the assumptions underlying a national study of the type proposed here is that the sites included should be representative of the major habitat types to which they belong, at least at a regional level. Thus, for example, if CES is to provide information about Reed Warblers inhabiting reed beds in southern England it is important that the reed beds studied should be representative of those which occur throughout southern England. The representativeness of the

plots included in the survey will be difficult to assess. As with many BTO schemes, most sites are in southern and eastern Britain (Figure 2.1). Farmland CBC plots in southern Britain have recently been shown to be broadly representative of major land use types, but this approach would not be appropriate for Constant Effort Sites because the habitats involved cover only a very small proportion of the total land area. Investigations of representativeness will only be possible if information on the distribution of different types of scrub and wetland can be obtained from other surveys.

2.3 Continuity of coverage

A major objective of the scheme should be to obtain estimates of annual variations in adult survival. Present methods of survival estimation require long runs of retrap data. It will probably be necessary for a site to be visited for at least four years for it to contribute to the survival analyses (section 5). Continuity of coverage of the sites included in the pilot scheme has been reasonably good, with 12 of the 17 sites started in 1981 still operating in 1984 (Table 2.3). Increased emphasis should nevertheless be given to the importance of retaining sites for long runs of years so that as much of the data as possible can be used for survival analyses. During the pilot survey several sites were lost from the scheme because they were destroyed. The instructions should stress that, for normal participation in the scheme, sites should not be taken on if destruction or major alterations to the habitat are anticipated in the near future. The instructions should also stress that sites taken on by ringers who expect to be in an area for only a short time (e.g. university students) may not be suitable if continuity is unlikely.

Continuity is also important in minimising any fluctuations in population indices resulting from changes in the habitat or geographical composition of the sample. Periodic checks of sample composition will be required to ensure that such drift is not occurring. It will also be necessary to check via the annual habitat recording that succession has not proceeded so far at certain sites that they have changed from, say, wetland to scrub.

2.4 Species composition of the sample

Thirty three species were caught in substantial numbers at the trial Constant Effort Sites. The totals of individuals caught at 43 sites covered for most or all of the 1984 season have been tabulated for adults and juveniles separately (Tables 2.4 and 2.5). For most species more juveniles than adults were captured. Nineteen of the 33 species had over 100 individual adults handled and useful data on these species should be provided by a scheme of the present size. With a scheme of 100 sites we would expect to obtain useful data on most of the 33 species listed. Confidence limits and sample sizes are discussed in sections 3.2 and 4.3.

The species composition of the catch differed markedly between habitats. Most of the Reed Warblers, Sedge Warblers and Reed Buntings were caught at wetland sites while scrub sites were particularly important for Whitethroats, Lesser Whitethroats, Willow Warblers, Linnets, Bullfinches and Yellowhammers. Most of the Goldcrests occurred in conifer plantations as did 10 of the 24 Nightingales. In general the inclusion of deciduous or coniferous woodland sites does not add species to the study, although there may be differences in the population dynamics of particular species between wetland, scrub

and woodland sites. Most species were not recorded at all sites within any habitat. For example, adult Blackcaps were only recorded at nine of the twelve wetland sites while Linnets were only recorded at five of the 19 scrub sites. Furthermore some sites were important for a particular species while at other sites only one or two individuals of the same species were recorded. This is well illustrated by Reed Warblers, 97% of which were caught at only six of the 10 wetland sites at which the species was recorded.

Thirty six species were caught in small numbers at Constant Effort Sites during the 1984 season (Table 2.6). Most of these are very unlikely to be caught in sufficient numbers to provide data on population dynamics although for a few, such as Kingfisher and Great Spotted Woodpecker, useful data could be obtained from a greatly enlarged scheme. Two species on the list had over 50 individuals captured during 1984. Starlings are very unlikely to be sampled in a consistent manner by mist-netting at Constant Effort Sites and should be excluded from the scheme. 137 Bearded Tits were trapped at two sites. If a few more such sites could be added to the scheme it should be possible to obtain useful data for this species.

The data on warblers, provided by the scheme, should be of particular conservation interest. The scheme would provide good data on eight of the nine species of warblers that are widely distributed in Britain, the exception being the Wood Warbler. Most of the species included in the scheme are already covered by the Common Birds Census or the Waterways Bird Survey, although these schemes are providing data from habitats different from those covered by Constant Effort Sites. CES would add Reed Warbler, and perhaps also Willow Tit, Nightingale and Bearded Tit, to the list of species whose populations are monitored by the BTO.

2.5 Collection and analysis of data from the field trials

The data collected in 1981 and 1982 were in a summarised form that did not include the capture histories of individual birds or permit the identification of between-year retraps. For each visit ringers were asked to record the number of new birds for the season (NFY) and the number of birds that had been captured previously during the season, for adults, juveniles and un-aged birds separately. Since 1983 the age and ring-number of each individual has been recorded together with the visits on which the bird was captured. In addition to these detailed records, ringers have always been asked to complete a summary sheet with dates and times of visits and total numbers of individuals of each age category caught on visits 1-6 and 1-12. The instructions and recording forms used during the pilot survey are reproduced in Appendix 1.

Simple analyses involving large numbers of species were carried out from the summary sheets. It was necessary to select a small number of species for more detailed analyses because insufficient resources were available to computerise and analyse all of the pilot data. It was also necessary to restrict these analyses to 1983 and 1984 when the more detailed capture information was collected. The species selected were Blackcap, Willow Warbler, Wren, Blackbird and Bullfinch. They were all captured in adequate numbers at a high proportion of sites and were representative of a range of ecological groups. Most of the detailed analyses presented below refer to these species.

Table 2.1 Number of sites with each netting regime studied during the field trials

Year	Netting regime				
	6 visits (i)		12 visits		Total
	Rigid (ii)	Flexible	Rigid	Flexible	
1981	4	-	13	-	17
1982	5	-	18	-	23
1983	6	2	24	14	46
1984	7	1	22	17	47

(i) Observers aimed to cover either six visits in May and June or twelve visits between May and August. Sites with at least five of the first six visits or with at least nine of the full twelve visits are included.

(ii) At Rigid sites no additional nets were used, and no other ringing was carried out between April and August. At Flexible sites additional nets and ringing visits were permitted but the data from these were excluded from the CES returns.

Table 2.2 Habitats of the sites studied during the field trials

	Habitat (i)					
	Wetland (ii)	Dry scrub	Conifer plantations (iii)	Deciduous/ Mixed Woodland	Unknown	Total
1981	6	6	1	3	1	17
1982	8	7	3	4	1	23
1983	17	13	5	10	1	46
1984	14	20	6	6	1	47

(i) Sites were classified using the brief site descriptions on the annual summary forms. Where a site included more than one habitat it was classified under the category which covered the largest proportion of the site.

(ii) Reed beds and wet scrub areas.

(iii) Most were young plantations and included some dry scrub.

Table 2.3 Continuity of coverage of sites included in the pilot scheme

Year started	Years studied			
	1981	1982	1983	1984
1981	17	17	15	12
1982		6	6	5
1983			25	18
1984				12
	17	23	45	47

Sites with at least five of the first six visits or with at least nine of the full twelve visits are included.

Table 2.4 Numbers of adult individuals of commonly trapped species caught at constant effort sites in each of four habitats in 1984.

Species	Habitat									
	Wetland		Scrub		Conifer		Decid/ Mixed		total	
	ind.	site	ind.	site	ind.	site	ind.	site	ind.	site
No.sites	12		19		7		5		43	
Wren	81	11	111	19	46	6	35	5	273	41
Dunnock	63	10	172	19	55	6	42	5	332	40
Robin	32	11	102	19	39	6	41	5	214	41
Nightingale	14	3	-	-	10	2	-	-	24	5
Blackbird	92	11	293	19	62	7	72	5	519	42
Song Thrush	63	11	81	17	23	6	43	5	210	39
Sedge Warbler	102	10	12	5	1	1	5	1	120	17
Reed Warbler	396	10	10	5	1	1	8	1	415	17
Lesser Whitethroat	25	9	48	12	6	2	3	2	82	25
Whitethroat	13	5	79	10	12	3	3	1	107	19
Garden Warbler	27	9	67	8	38	5	29	4	161	26
Blackcap	106	9	114	17	59	6	67	4	346	36
Chiffchaff	30	6	40	9	33	4	11	2	114	21
Willow Warbler	99	10	395	19	98	7	76	4	668	40
Goldcrest	2	1	15	8	28	5	0	-	45	1
Spotted Flycatcher	7	3	11	5	0	-	12	3	30	11
Long-tailed Tit	34	9	58	10	31	4	14	4	137	27
Marsh Tit	0	0	4	2	11	2	3	2	18	6
Willow Tit	6	5	19	6	5	2	3	1	33	14
Coal Tit	5	2	10	5	4	3	0	-	19	10
Blue Tit	74	12	88	17	36	6	48	5	248	40
Great Tit	49	11	91	17	31	5	31	5	202	38
Treecreeper	14	6	22	8	4	1	8	3	48	18
Jay	2	1	10	8	3	2	3	1	18	12
Tree Sparrow	3	1	26	5	0	-	0	-	29	6
Chaffinch	89	10	120	16	47	7	76	5	332	38
Greenfinch	15	7	40	9	4	2	6	2	65	20
Goldfinch	18	6	20	6	2	1	5	1	45	14
Linnet	20	3	102	5	0	-	0	-	122	8
Redpoll	9	1	69	9	6	3	0	-	84	13
Bullfinch	54	10	146	17	45	5	46	5	291	38
Yellowhammer	9	5	42	9	12	1	9	2	72	17
Reed Bunting	79	11	15	6	0	-	9	1	103	18
Total	1632		2433		752		709		5525	

ind. - number of individuals captured
sites - number of sites at which the species was captured

Data are from sites which were visited at least eight times spread through the breeding season.

Table 2.5 Number of juvenile individuals of commonly trapped species caught at constant effort sites in each of four habitats in 1984.

	Wetland		Scrub		Conifer		Decid/ Mixed		Total	
	ind. (i)	sites	ind.	sites	ind.	sites	ind.	sites	ind.	sites
No. of sites		12		19		7		5		43
Wren	181	11	239	18	101	7	33	5	554	41
Dunnock	100	11	217	17	63	6	30	5	410	39
Robin	157	11	381	19	93	7	80	5	711	42
Nightingale	6	3	2	2	2	1	0	-	10	6
Blackbird	48	9	173	18	21	5	54	5	296	37
Song Thrush	26	10	60	16	10	6	10	4	106	36
Sedge Warbler	128	9	6	4	0	-	2	1	136	14
Reed Warbler	339	9	14	6	1	1	9	1	363	17
Lesser Whitethroat	68	8	40	11	6	3	6	1	120	23
Whitethroat	49	9	85	11	5	2	4	1	143	23
Garden Warbler	52	6	35	11	25	5	10	3	122	25
Blackcap	321	10	192	18	67	7	67	4	647	39
Chiffchaff	196	8	89	7	87	5	7	3	379	23
Willow Warbler	390	11	607	17	121	7	73	3	1191	38
Goldcrest	3	3	26	6	37	3	0	-	66	12
Spotted Flycatcher	13	5	3	3	1	1	5	1	22	10
Long-tailed Tit	65	7	57	6	74	5	18	1	214	19
Marsh Tit	7	2	16	4	23	4	2	1	48	11
Willow Tit	24	7	26	8	12	3	23	2	85	20
Coal Tit	23	1	26	7	32	6	0	-	81	14
Blue Tit	270	12	289	18	163	6	102	5	824	41
Great Tit	138	10	220	16	96	6	77	5	531	37
Treecreeper	36	8	25	10	13	5	7	3	81	26
Jay	1	1	3	1	1	1	6	2	11	5
Tree Sparrow	4	2	16	4	0	-	0	-	20	6
Chaffinch	35	7	60	12	18	4	38	3	151	26
Greenfinch	17	2	17	7	1	1	0	-	35	10
Goldfinch	22	3	2	2	0	-	1	1	25	6
Linnet	6	1	29	3	1	1	0	-	36	5
Redpoll	0	0	24	6	2	1	0	-	26	7
Bullfinch	34	8	115	15	12	4	42	4	203	31
Yellowhammer	11	2	15	6	3	1	4	1	33	10
Reed Bunting	32	9	7	4	0	-	0	-	39	13
	2802		3116		1091		710		7719	

(i) ind. - number of individuals captured
site - number of sites at which the species was captured

Data are from sites which were visited at least eight times spread through the breeding season.

Table 2.6 Numbers of adults and juveniles of less commonly trapped species caught at constant effort sites in 1984

	Adult		Juvenile		Total	
	ind.	sites	ind.	sites	ind.	sites
Sparrowhawk	2	1	2	2	4	3
Kestrel	1	1	-	-	1	1
Red-legged Partridge	1	1	-	-	1	1
Woodcock	-	-	1	1	1	1
Woodpigeon	8	5	4	2	12	6
Turtle Dove	8	4	3	3	11	6
Cuckoo	6	4	-	-	6	4
Tawny Owl	2	2	-	-	2	2
Long-eared Owl	1	1	-	-	1	1
Kingfisher	10	6	12	4	22	6
Green Woodpecker	1	1	1	1	2	2
Great Spotted Woodpecker	10	8	6	3	16	9
Lesser Spotted Woodpecker	1	1	-	-	1	1
Swallow	11	5	3	3	14	7
House Martin	19	3	-	-	19	3
Tree Pipit	7	3	1	1	8	4
Meadow Pipit	5	1	3	1	8	1
Grey Wagtail	3	2	7	2	10	3
Pied Wagtail	1	1	4	2	5	3
Dipper	2	2	-	-	2	2
Redstart	2	2	7	4	9	5
Whitethroat	-	-	2	1	2	1
Ring Ousel	1	1	-	-	1	1
Redwing	1	1	-	-	1	1
Mistle Thrush	3	3	1	1	4	4
Cetti's Warbler	11	2	6	2	17	2
Grasshopper Warbler	3	2	-	-	3	2
Wood Warbler	-	-	1	1	1	1
Pied Flycatcher	-	-	4	3	4	3
Bearded Tit	27	2	110	2	137	2
Nuthatch	9	5	4	4	13	6
Magpie	2	2	4	3	6	5
Carrion Crow	-	-	1	1	1	1
Starling	22	4	45	5	67	7
House Sparrow	2	2	3	3	5	5
Siskin	5	1	2	1	7	1

ind. - number of individuals captured at all sites
sites - number of sites at which one or more individuals were captured

Data are from the same 43 sites used in Tables 2.4 and 2.5

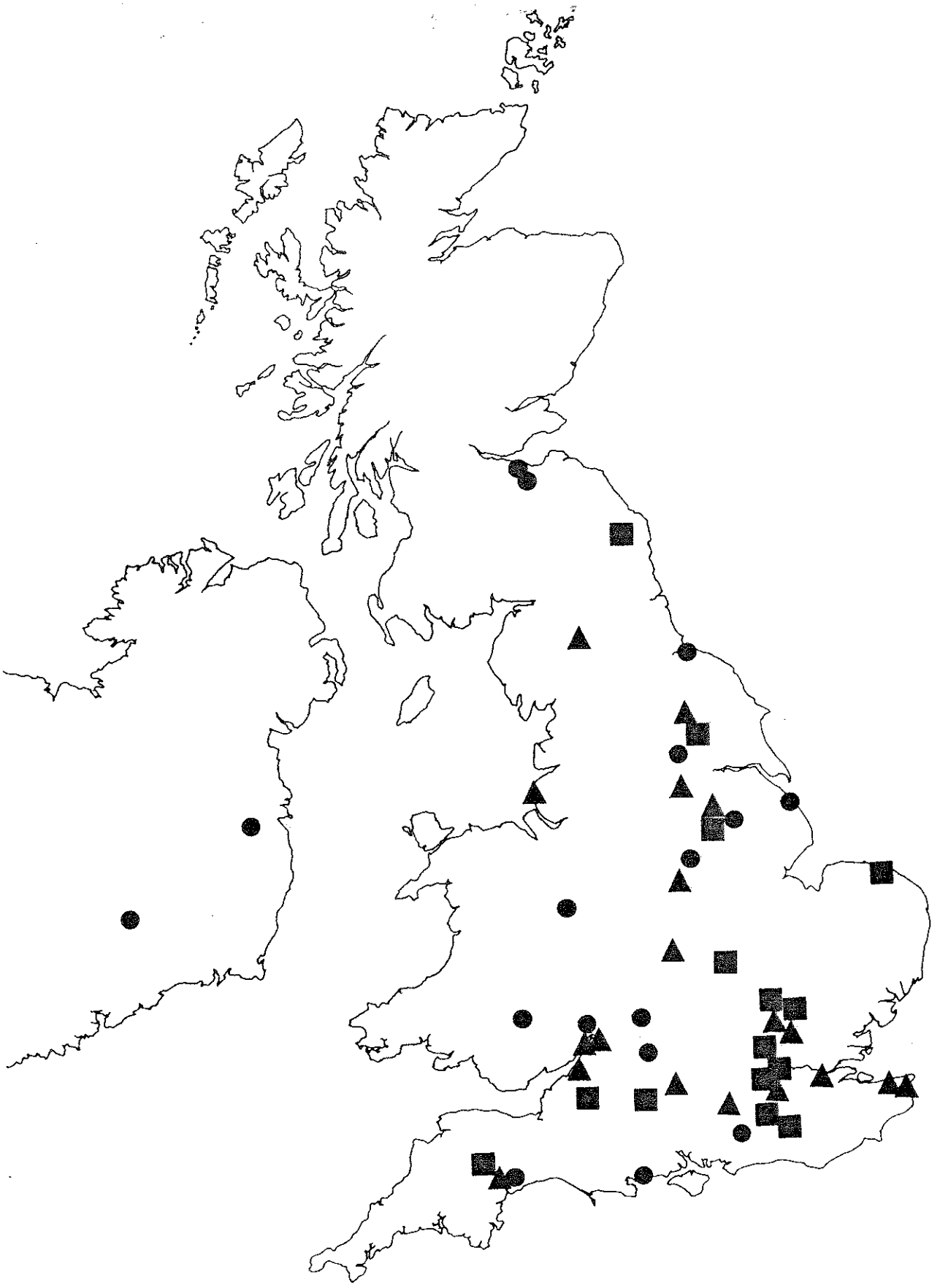

Figure 2.1 The distribution of Constant Effort Sites used between 1981 and 1984.

Habitats are wetland (▲), scrub (●) and woodland (■).

3. ADULT POPULATION SIZE

3.1 Seasonal pattern of adult captures

It is important to understand seasonal variations in the pattern of adult captures because they could affect the between-year comparisons of numbers caught. Two points are of particular interest with respect to such comparisons. Firstly, between year comparisons are likely to be most accurate if seasonal capture patterns are similar each year. The occurrence of marked differences in capture patterns between years might result from differences in adult behaviour. Such differences might mask changes in population size. Secondly, measurements of population change are likely to be more accurate if a high proportion of the adults using a site are caught in each year. Information on seasonal variation in capture patterns should also indicate whether data from part of the season (such as visits 1-6) are likely to provide meaningful measures of population change.

Seasonal capture patterns were analysed by adding together the data from sites where all 12 visits were completed. Complete data were available from 29 sites in 1983 and 25 sites in 1984, with 18 sites in common between the two years. For each year four graphs were plotted; the number of adults caught on each visit, the cumulative number of adults caught, the percentage of the adults caught on each visit which had been recorded previously in the season, and the number of new adults for the season that were caught on each visit. These sets of four graphs need to be considered together in order to interpret seasonal variation in the pattern of captures.

Sets of graphs for 1983 and 1984 for each of the five study species (Blackcap, Willow Warbler, Wren, Blackbird and Bullfinch) are presented in Figures 3.1 to 3.5. For all five species the seasonal variation in capture patterns was similar in 1983 and 1984.

The number of adults of all species, caught on each visit, declined through the season (Figures 3.1-3.5 a). A similar but more marked trend is shown by the numbers of individuals caught for the first time on each visit (Figures 3.1-3.5 d). Three main factors may explain the decline in total adult captures through the season; emigration from the study plots, behavioural changes affecting catchability, and direct avoidance of mist-nets or net sites. Emigration from the study areas is unlikely to be a major cause because the decline starts while birds are still occupying breeding territories. Several studies suggest that if adults abandoned their breeding territories they would be replaced by adults from elsewhere (e.g. Krebs 1971). If the emigration was part of a normal dispersal process, immigration into the study area by unmarked birds would be expected. In either case immigration into the study areas by unmarked birds unaccustomed to mist-nets would result in an increase in the number of new birds captured. Most species show no evidence of such an increase. A small increase in captures of new adult Blackcaps occurred in both years (Figure 3.1 d), probably corresponding to the dispersal of birds that had completed breeding. However, the peak was much too small to account for the overall seasonal decline.

Behavioural changes that would affect vulnerability to capture in mist-nets are those that affect the amount of time spent flying, and perhaps also attentiveness to the presence of nets. Adults of all

the species considered here undergo a complete moult in late summer. Passerines are thought to spend less time flying when they are moulting their flight feathers. The periods when birds are normally recorded in moult were determined from the data in Ginn and Melville (1983) and have been marked on the figures. Numbers of all species caught during the moult period are low. However, the decline in adult captures always starts well before the onset of moult. Behavioural changes associated with the breeding cycle are more complex. During territorial establishment males in particular are actively defending their territories and may be particularly vulnerable to capture. Incubating birds spend much of their time on the nest and are less likely to be caught. Conversely, birds which are feeding young spend nearly all their time foraging and flying to the nest, and will have a higher probability of capture. If these factors were strongly influencing capture patterns, a decline in captures during incubation, followed by an increase during brood rearing, would be expected. No such pattern is apparent from the data although some minor fluctuations may be attributable to these factors. Their effects may be masked by the lack of synchrony between breeding pairs. The seasonal capture pattern is similar for all species despite the fact that when the CES season begins in early May the resident species Wren and Blackbird are well into their breeding cycles while many Blackcaps and Willow Warblers have arrived only recently. Bullfinches do not normally start breeding until late April, with some nesting attempts initiated as late as mid-August (Newton 1972). Their young appear in the mist-netted samples later than the other species considered here (section 4).

Neither emigration nor behavioural changes offer a full explanation of the seasonal decline in adult captures. Birds which have been caught early in the season undoubtedly learn to avoid

recapture, either by avoiding the area where they were caught or by evading the net. Many ringers have provided anecdotal evidence that birds can learn to avoid mist-nets but quantitative data for passerines breeding in Britain are lacking. Trap-shyness has been demonstrated for Yellow Wagtails caught at a migration roosting site (Buckland and Hereward 1982).

The percentage of captures that were retraps of birds caught previously during the same season (percent retraps) increased through the season for Blackbird and Bullfinch, reaching about 50% by the end of August (Figures 3.4 & 3.5 c). Similarly the percentage of Wrens which had already been captured increased to over 50% by late July but it then decreased through August (Figure 3.3 c). However, August samples of adult captures were small for all species. The pattern for Blackcap was similar to that for Wren but showed wide fluctuations and a lower maximum percent ringed (Figure 3.1 c). Dispersal of adults in July followed by some passage in August may have contributed to this pattern, but again there were few August captures. For Willow Warbler the percent retraps reached a peak of about 50% in June, but then it declined slowly to reach about 20% by late August (Figure 3.2 c). This decline suggests that the small numbers of new birds caught later in the season had not occupied breeding territories on the study sites but had dispersed from other areas. We have suggested above that birds which have been previously captured within the same season are less likely to be captured than new birds. If this is correct the percent retraps in mist-netted samples taken at the end of the season will underestimate the percentage of the population which has been handled during the season. Thus the above figures which suggest that at least 50% of adults are handled during the season are almost certainly conservative.

The shape of the graphs of cumulative number of individuals caught against number of visits should provide additional evidence as to whether most adults have been captured by the end of the season. If the curve levels off towards the end of the season it indicates that few additional adults are being captured, while a continuing increase would suggest that many birds remain to be captured. The date at which the graph levels off should provide some indication of the number of visits needed to catch most of the adults. The rate of increase in the cumulative number of adults captured declines towards the end of the season for all species (Figures 3.1 - 3.5 b). Very few new Wrens and Blackbirds are added towards the end of the season, while for the other species, small numbers of individuals continue to be added at each visit. Even with a greatly increased frequency of visits it is unlikely that these curves would level off completely, because natural populations are rarely closed. The levelling off of the cumulative numbers of new individuals caught could simply result from the low numbers of adults captured later in the season. However we have argued above that this decline is largely due to trap-shyness, and would expect birds that had not been caught to remain vulnerable to capture. The increase in the percent retraps through the season provides further evidence that a high proportion of the local breeding birds have been captured by late August.

The seasonal patterns of captures of adult birds described above give rise to the following points which require further testing:

1 Birds which have been captured previously in the season are less likely to be captured than those which have not.
2. A high proportion of the resident population is captured during each season.

3. There is no large scale immigration into the study areas between May and August.

Carrying out CES netting at sites with colour-ringed populations where most individuals were marked and of known status would be the best way to examine these hypotheses. However, because such an approach would be extremely time consuming methods which are more amenable to participation by amateur ringers should be considered. It would be useful to check the proportion of birds which have been handled during the present season by direct observations at a range of sites. This could be done at new sites simply by recording the percentage of birds that had metal rings but at established sites it would be necessary to use some form of temporary year-specific colour marks. Between year recapture analyses would also provide data on the frequency with which individuals known to be alive (because they were recaptured later) were recorded in particular years. However, this method would not allow us to distinguish between individuals which had been present but evaded capture and those which had bred away from the site in a particular year.

Field experiments to test the recapture avoidance hypothesis could be set up, using experimental sites where netting was started later in the season. This would provide a direct test of whether the failure to catch many adults later in the season is solely due to trap-shyness. Finally the probability of recapture at the same site in subsequent years should be examined for adults first caught at different stages of the season. A low recapture probability would be expected for birds first caught towards the end of the season, which are thought to be transients.

If further studies show that adult populations are effectively

closed for part of the season then the possibility of using "removal" type estimates of adult populations should be investigated. That is the decrease in the proportion of new birds trapped as the season progresses could yield an absolute population estimate. This technique would need to be validated against known populations of colour-marked birds.

3.2 Calculation of standard errors and confidence limits for an index of changes in the number of adults caught

We used as an index of year to year change in adult catch;

$$r_i = \frac{(a_i - a_{(i-1)})}{a_{(i-1)}} \qquad (3.1)$$

Where the a_i are numbers of adult catches for all common sites in the year i. The simplest way to calculate a standard error for r_i would be to obtain the binomial standard error of p_i where,

$$p_i = \frac{a_i}{(a_i + a_{(i-1)})} \qquad (3.2)$$

or

$$p_i = \frac{(r_i+1)}{(r_i+2)} \qquad (3.3)$$

$$S_{p_i} = \sqrt{\frac{p_i\,(1- p_i)}{(a_i + a_{(i-1)})}} \qquad (3.4)$$

Confidence limits for p_i would be calculated in the usual way and the upper and lower limits substituted in equation 3.3 to give limits for r_i. Although such techniques have been widely used they may be invalid because some individuals are included in both years.

For this approach to be valid underlying changes in populations must also be similar across sites. To check this assumption we carried out goodness-of-fit tests on sites x years contingency tables of numbers of adults caught for ten species (Table 3.1). Four of the ten species showed a significant departure from a pattern of uniform proportional difference in catch between years across sites.

For both reasons given above our preferred method for obtaining standard errors for the r_i is to calculate:

$$S_{r_i} = \sqrt{\frac{n \sum_{j=1}^{n} \left(d_{ij} - r_i \, a_{(i-1)j} \right)^2}{(n-1) \left(\sum_{j=1}^{n} a_{(i-1)j} \right)^2}} \qquad (3.5)$$

where $d_{ij} = a_{ij} - a_{(i-1)j}$

n is the number of sites

and a_{ij} is the catch of adults in year i at the j th site.

Table 3.2 shows values of S_{r_i} for five species calculated from CES pilot data for 1983-84 for 21-26 sites per species. From equation 3.5 it can be seen that if the number of sites in the scheme were to be increased with the mean catch per site remaining the same then S_{r_i} would be proportional to $1/\sqrt{n}$. Table 3.2 shows expected standard errors if 100 CES sites were in operation and compares them with standard errors of 1981-82 farmland CBC index changes. With a sample of 100 sites the standard errors of a CES index based on adult catches would be broadly similar to those for a CBC based on 84 plots. The precision of the CES estimate would be expected to be better than CBC only for a few species, notably the Acrocephalus warblers.

3.3 Effects of curtailing the regime of trapping visits on the precision and consistency of the CES index of change of adult catch

The precision of percentage changes in adult bird catches might be improved by excluding data from some trapping visits. For example, migrants trapped in spring and autumn whilst on passage might increase variability and reduce consistency between sites. Underlying changes in breeding populations might be better reflected if data from spring and autumn visits were excluded. Against this sample sizes would be reduced by restricting the number of visits used and this would reduce the precision of the estimates. We investigated this by artificially generating numbers of captures from alternative netting regimes by omitting birds only recorded in certain combinations of visits. The standard error of r_i is used as the criterion for assessing effects of this procedure. Figure 3.6 shows the results of this analysis. There was rather little effect of

visit regime except for the obvious one that S_{r_i} tended to increase as the numbers of birds trapped declined. For four out of five species S_{r_i} was smallest or within 0.1% of the smallest value when all 12 visits were used. For Willow Warbler excluding early visits appears to increase the precision of the estimate. It is noteworthy that this species has the strongest spring peak in numbers of new adults caught, perhaps because of spring passage (Figure 3.3). The actual estimates were not affected in any systematic way. This analysis needs to be repeated for more species and years but it would seem that there is usually no benefit to be gained from reducing the number of visits used in calculating the index. However for some species exclusion of data from spring or autumn visits might be beneficial.

3.4 Consistency of the index of adults captured between habitats

Indices of change of CES adult captures were calculated for wetland, scrub and woodland sites separately for the five species in Table 3.2 to test for differences in trends between habitats. No significant differences were found but the numbers of sites available per habitat were too small to provide meaningful support for the null hypothesis.

3.5 Direct validation of indices of population change

It is extremely difficult to demonstrate the accuracy of any census method because the exact size of the population in a given area is rarely known. One approach is to compare two or more methods and to conclude that both are reliable if they give similar results. This approach can be extended by comparing new methods with well

tested ones. Indirect validation studies generally involve experiments or observations to test assumptions that underlie the use of a particular method.

It has been suggested that estimates of population changes using trapping data from Constant Effort Sites may be validated by comparison with those from the Common Birds Census. The latter method is well established and has been extensively validated in recent years (O'Connor and Fuller 1984). However, any comparisons between national or regional CBC and CES indices must be treated with extreme caution because the two surveys are carried out in different habitats and there is increasing evidence that population changes and other aspects of the population dynamics of individual species differ between habitats. Thus, while positive correlations would suggest agreement between the two methods lack of correlation would not prove that one of the methods was unreliable since it might simply reflect differences between habitats.

The most satisfactory approach to such comparisons would be to plot national or regional CES and CBC indices for each species against one another. However, it is preferable to use at least eight years of data for such an analysis. With a sample of eight years the critical value of the correlation coefficient (r) is 0.707; if the true correlation is this high, about 50% of the variation in one variable is explained by the other. It will be several years before sufficient data are available. An alternative approach might be to plot estimated population changes from CES and CBC for individual pairs of years against each other, with one point representing each species. However we do not consider such an analysis to be valid, because there will almost certainly be differences in the accuracy with which the two schemes measure population changes of different

species.

One validation analysis that could be carried out with existing data, but which was not a priority for inclusion in this report, is a comparison of the long-term CES data from Marsworth Reservoir with a regional CBC index. The results of this analysis would need to be treated with caution since it would be equivalent to comparing results from a single CBC plot in an atypical habitat with a regional index based mainly on farmland and woodland sites.

A much better means of checking the validity of population changes estimated from mist-netting is to conduct censuses on and immediately around sites used for CES netting. Mapping censuses would be ideal for this purpose but unfortunately they are too time consuming to be carried out as part of a CES visit. It is therefore unlikely that many ringers would be able to invest the extra time needed to complete a mapping census. The maps from this type of study would need to be analysed by a trained CBC analyst, and there is no prospect of sufficient time being available at Beech Grove. We have therefore started a programme of point counts at Constant Effort Sites (Appendix 2). Field trials were carried out by Mike Boddy at Theddlethorpe, Lincolnshire, in 1984 and at many Constant Effort Sites in 1985. The method is probably less accurate than a full CBC but has the advantage that early in the season, when catches are low, observations can be made between net rounds. Also, the results are reported in the form of simple numerical data amenable to computerisation and analysis. The counting methods will be evaluated and may require some revision in the light of the 1985 results. Point counts should be continued for several years as a validation exercise.

Table 3.1 Results of chi-squared tests to detect sites x years interactions in the number of adults caught. CES pilot data for 1981, 82, 83.

Species	chi-squared	d.f.
Wren	23.95	20
Dunnock	37.45 *	22
Robin	33.70	22
Blackbird	28.98	22
Song Thrush	32.50	22
Blackcap	31.32 *	18
Willow Warbler	29.39	20
Blue Tit	38.48 *	22
Great Tit	27.36	22
Bullfinch	47.70 ***	20

* P<0.05
*** P<0.001

Table 3.2 Standard errors for percentage changes in adult catch at CES sites for five common species for 1983-84 pilot data from 21-26 sites per species. Also shown are estimated standard errors for a hypothetical 100 site CES and standard errors of the 1981-82 CBC for farmland based on 84 plots. Note that CBC errors are asymmetrical but approximate s.e.s have been calculated by dividing the 95% confidence range by 3.92.

Species	CES		CBC
	21-26	100	84 plots
Wren	10.8	5.4	3.0
Blackbird	11.3	5.5	3.0
Blackcap	13.6	6.7	6.5
Willow Warbler	12.3	6.0	4.0
Bullfinch	11.4	5.2	5.5

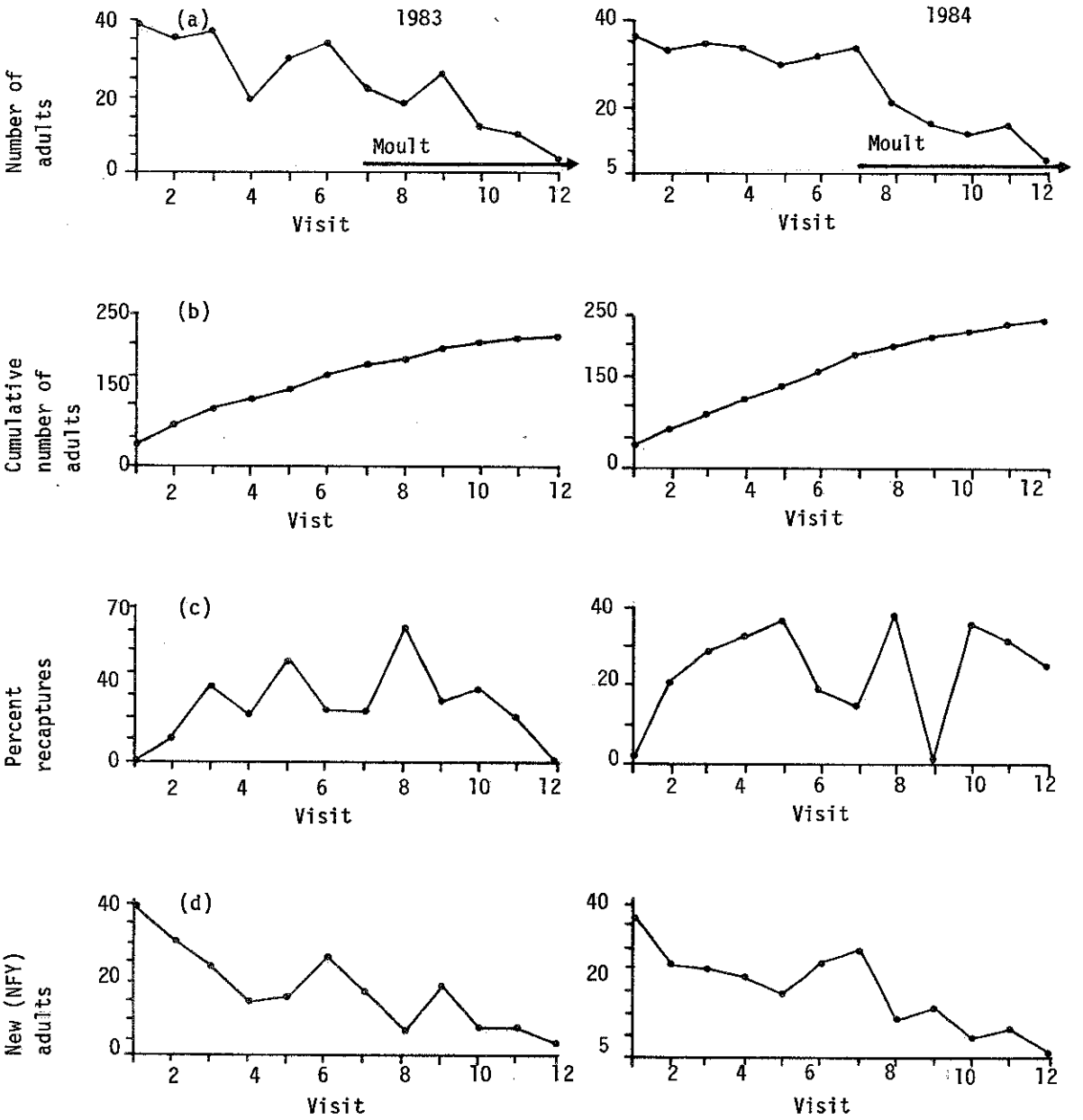

Figure 3.1 Seasonal variation in captures of adult Blackcaps in 1983 and 1984

Data are from all sites with 12 complete visits (1983 n = 29, 1984 n = 25)

(a) Number of birds caught on each visit
(b) Cumulative number of individuals caught
(c) Percentage of the birds caught on each visit which had been caught previously during the same season
(d) Number of new birds for the season (NFY) caught on each visit

Moult period from Ginn and Melville (1983)

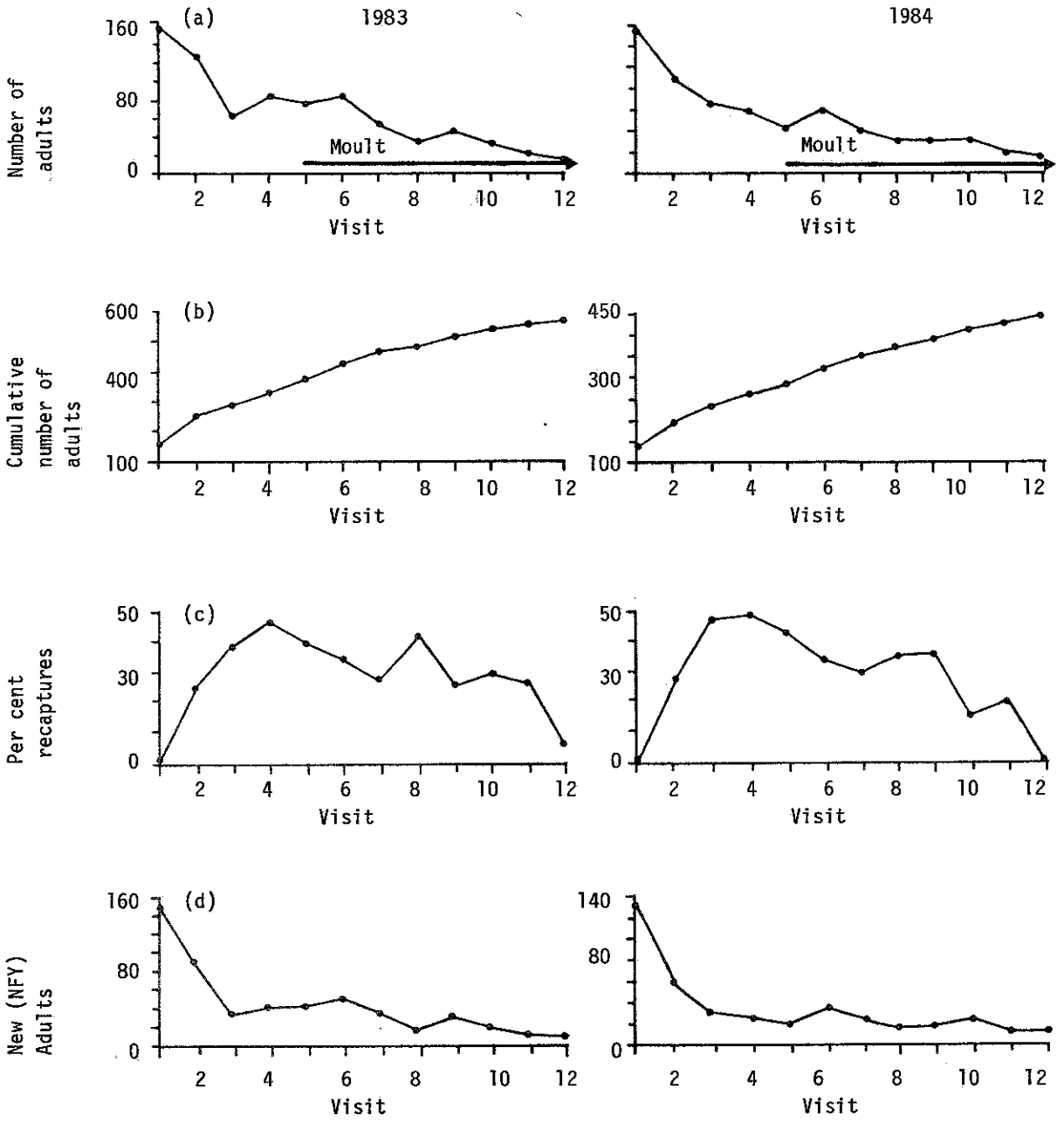

Figure 3.2 Seasonal variation in captures of adult Willow Warblers in 1983 and 1984
Data are from all sites with 12 complete visits (1983 n = 29 1984 n = 25)

(a) Number of birds caught in each visit
(b) Cumulative number of individuals caught
(c) Percentage of birds caught on each visit which had been caught previously during the same season
(d) Number of new birds for the season (NFY) caught on each visit

Moult period from Ginn and Melville (1983)

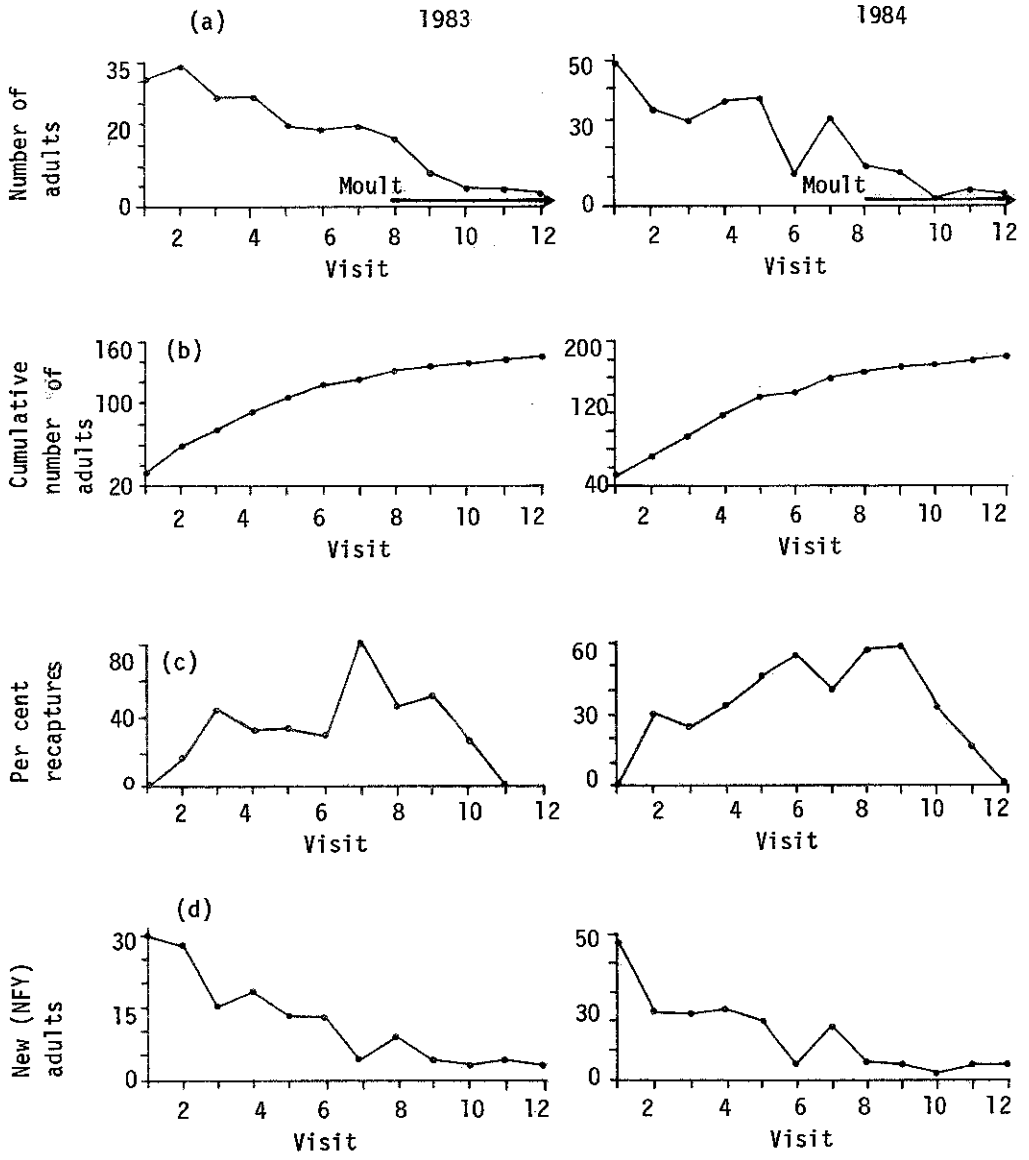

Figure 3.3 Seasonal variation in captures of adult Wrens in 1983 and 1984
Data are for all sites with 12 complete visits
(1983 n= 29 1984 n = 25)

(a) Number of birds caught on each visit
(b) Cumulative number of individuals caught
(c) Percentage of the birds caught on each visit which had been caught previously during the same season
(d) Number of new birds for the season (NFY) caught on each visit

Moult period from Ginn and Melville (1983)

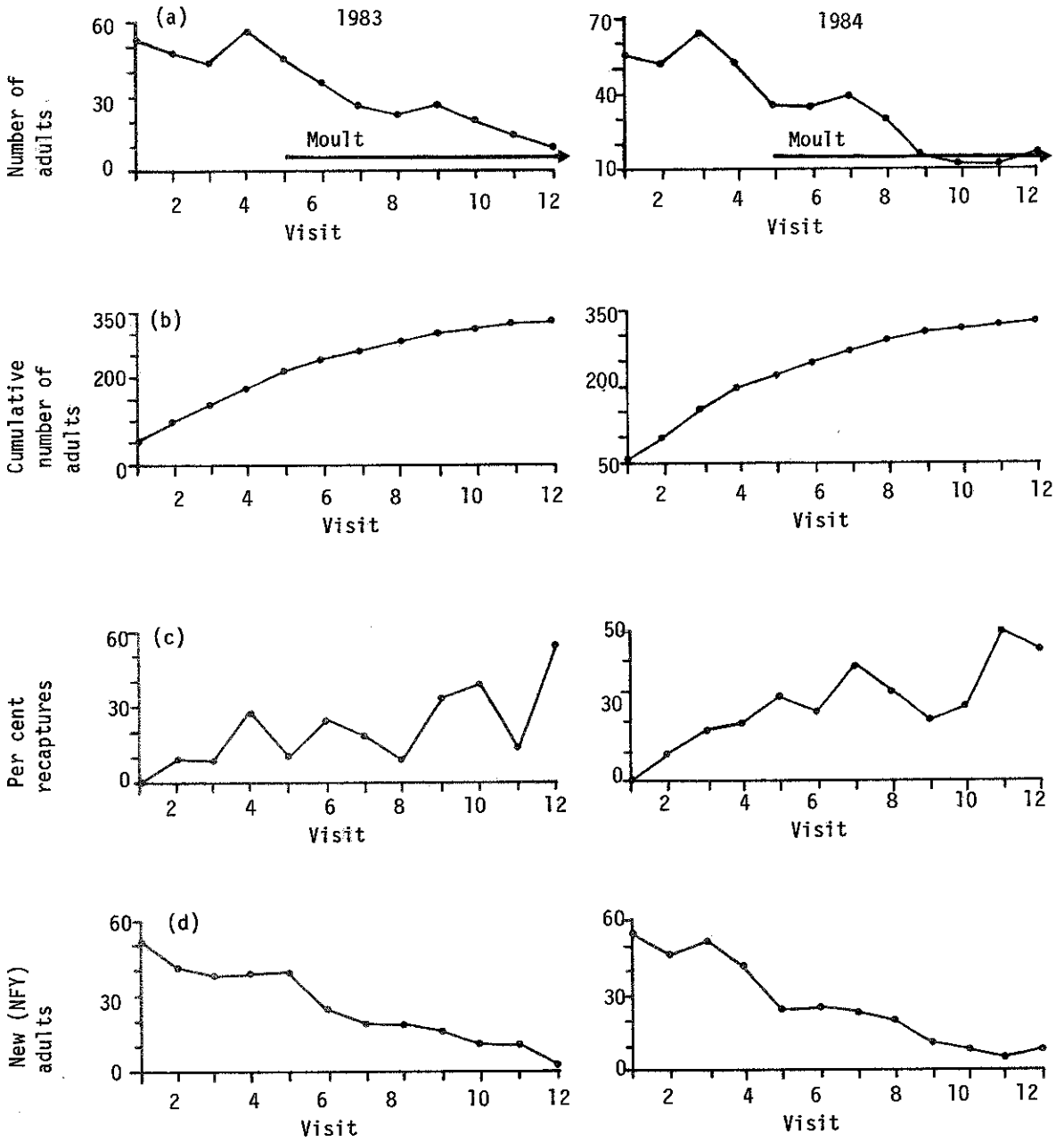

Figure 3.4 Seasonal variation in captures of adult Blackbirds in 1983 and 1984
Data are from all sites with 12 complete visits (1983 n = 29, 1984 n = 25)

(a) Number of birds caught on each visit
(b) Cumulative number of individuals caught
(c) Percentage of the birds caught on each visit which had been caught previously during the same season
(d) Number of new birds for the season (NFY) caught on each visit

Moult period from Ginn and Melville (1983)

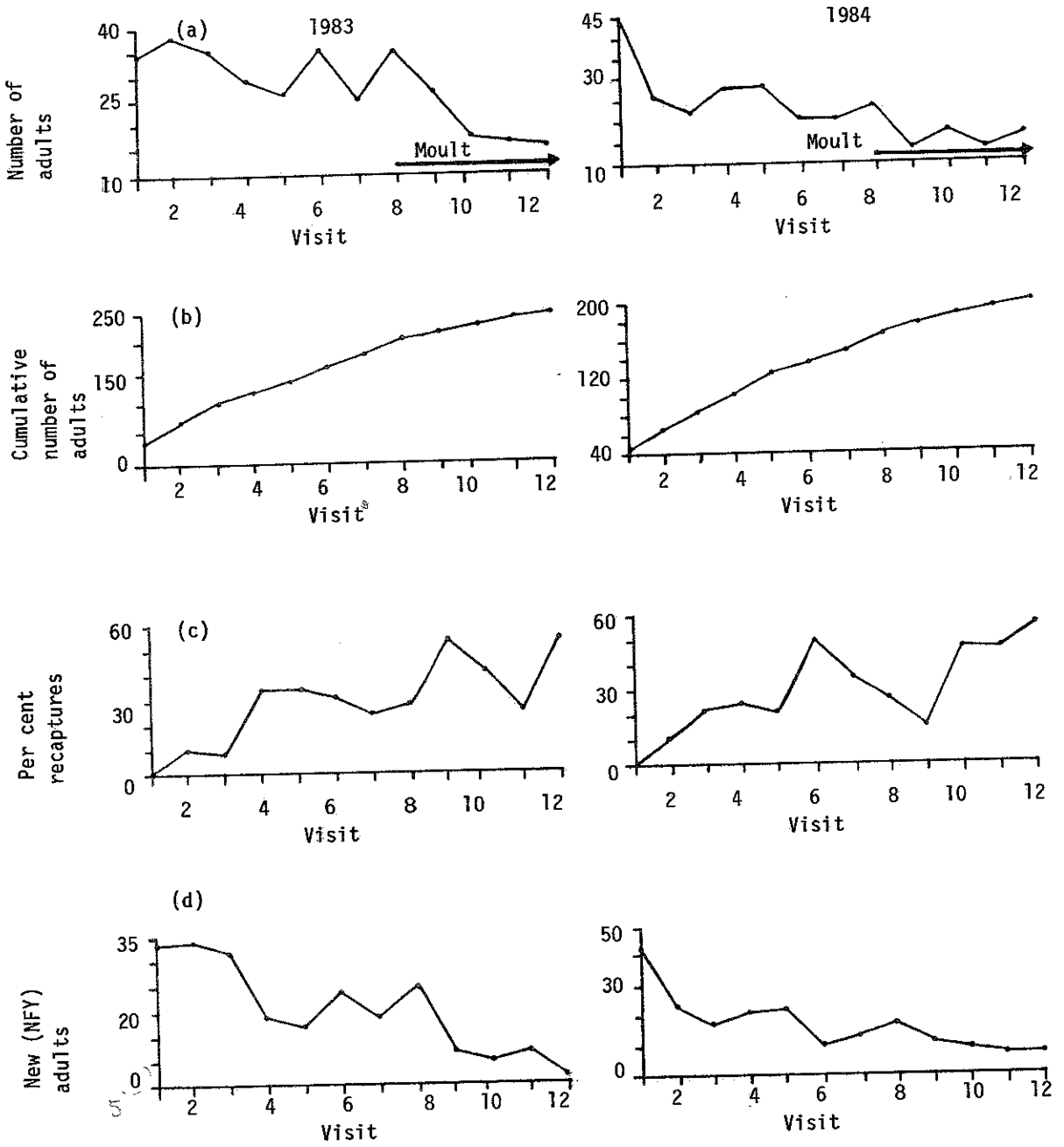

Figure 3.5 Seasonal variation in captures of adult Bullfinches in 1983 and 1984
Data are from all sites with 12 complete visits (1983 n = 29, 1984 n = 25)

(a) Number of birds caught on each visit
(b) Cumulative number of individuals caught
(c) Percentage of the birds caught on each visit which had been caught previously during the same season
(d) Number of new birds for the season (NFY) caught on each visit

Moult period from Ginn and Melville (1983)

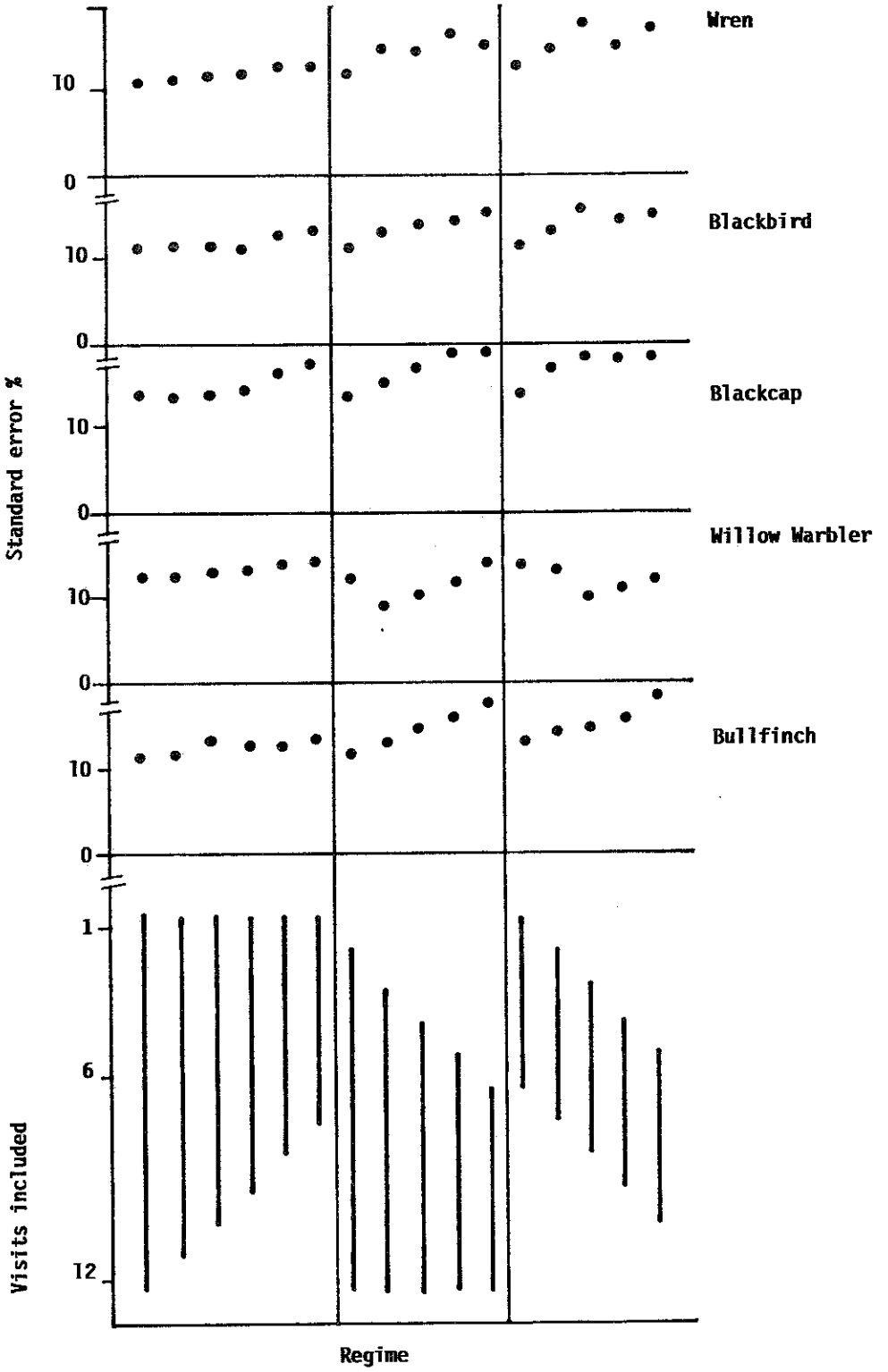

Figure 3.6 Standard errors of the percentage change in number of adults caught between 1983 and 1984 in relation to trapping regime. Combinations of trapping visits from which data were used are shown in the lowest section of the diagram. See section 2.1 for the timing of visits.

4. THE NUMBER OF JUVENILES CAPTURED AND THE RATIO OF JUVENILES TO ADULTS

4.1 Seasonal pattern of juvenile captures

It is important to understand the patterns of juvenile captures because they might affect between year comparisons of the numbers of juveniles caught and of juvenile to adult ratios. As with adults (section 3.1) it is of interest to know whether the pattern of captures is similar each year, and what proportion of the juveniles using a site is captured.

Methods of analysis were exactly as for adults. Data for sites where all 12 visits were completed were added together. Four graphs were plotted for each year; the number of juveniles caught on each visit, the cumulative number of juveniles caught, the percentage recaptures recorded on each visit and the number of new juveniles caught on each visit. These sets of graphs should be considered together to interpret seasonal variation in the pattern of captures. Sets of graphs for 1983 and 1984 for each of the five study species (Blackcap, Willow Warbler, Wren, Blackbird and Bullfinch) are presented in Figures 4.1 to 4.5. Capture patterns, like those of adults, were similar in both years.

The appearance of juveniles in the netted samples is determined largely by the timing of fledging. A rapid increase in juvenile captures generally occurs over a period of about a month (3 visits) after which numbers of juveniles caught remain high and relatively stable. Few juveniles are caught before late June (visit 6), although

a considerable number of Blackbirds were caught before then, particularly in 1984. The marked fall in the numbers of Willow Warblers caught at the end of the season corresponds to the autumn migration. A period of several visits when numbers of juvenile captures remain relatively constant is very evident for Blackcap and Blackbird, but is slightly less marked for Willow Warbler and Wren. Bullfinches breed later than the other species and in both years substantial numbers of juveniles were caught only from late July (visit 9). Numbers of captures continued to increase until the end of the CES season in late August.

Juveniles are thought to be more mobile than adults in late summer and consequently a lower proportion of juvenile than adult individuals using a site are likely to be captured. The percentage of juveniles which had been handled previously increased through the season for Blackcap, Wren and Blackbird to reach values of between 20% and 40% by the end of August (Figures 4.1, 4.3 and 4.4 c). These values were lower than those for adults of the same species. Bullfinches reached a value of only about 10% ringed by the end of the season, probably because the juveniles became available for capture later than those of the other resident species (Figure 4.5 c). Few juvenile Willow Warblers were retrapped and the percentage of birds which were already ringed did not exceed 5% (Figure 4.2 c). The effect of trap-shyness on these results is unknown and it is possible that the percentage of juveniles captured was higher than is indicated by these figures.

High turnover of juveniles at the study sites is also indicated by the cumulative numbers of juveniles caught, most of which increase at a fairly constant rate through July and August (Figures 4.1 - 4.5 b). The increase in captures of new Willow Warblers is lower in the

second half of August. By this time many individuals have migrated from the study areas, and some of those present will be migrants from elsewhere. The graphs of the number of new individuals caught on each visit (Figures 4.1 - 4.5 d) are similar to those for the total number of individuals caught on each visit because the retrap rate is low.

It should be possible to obtain a meaningful index of the size of the juvenile population from CES netting because the seasonal capture patterns of juveniles are consistent between years. However, in contrast to adults, there is probably considerable turnover of juveniles at the study sites and the proportion of juveniles which is captured may be low. Observational studies, similar to those suggested for adults, are needed to measure the effects of trap-shyness and the turnover of juveniles using the study sites. An index of the numbers of juveniles captured each year might be affected by annual variation in dispersal as well as by changes in productivity. However, we think it unlikely that variation in dispersal will severely bias any productivity index. This could be checked in two ways. Firstly, the retrap rates of juveniles caught at the study sites would be expected to differ if there were major differences in dispersal. Secondly, distances between the ringing and recovery places of birds ringed as nestlings or juveniles could be used to assess annual differences in dispersal for a few widely ringed species.

4.2 Seasonal variation in the percentage of juveniles

The juvenile population size at the end of the breeding season depends on the size of the adult breeding population, on fledging success and on post-fledging survival of juveniles. Therefore, if we

require an index of productivity (young produced per adult), it is better to consider the percentage of juveniles in the population at the end of the breeding season rather than the number of juveniles captured. If a random sample of the population at the end of the season could be obtained using mist-nets, productivity would be easy to measure. However, few adults are trapped in August due to moult and to trap-shyness. An alternative approach is to consider the percentage of juveniles caught over the season as a whole. This will not provide an absolute measure of productivity because although a high proportion of the adults using each site are captured during the study period this is not true for juveniles. Thus the number of juveniles captured is determined largely by the number of netting visits in July and August, which is arbitrarily determined by our study design. However, providing that trapping efficiency is constant in each year, it should be possible to obtain a valid index of changes in productivity.

The percentage of juveniles caught on each visit and the cumulative percentage of juveniles over the whole season are plotted for each of the five study species in Figures 4.6 to 4.8. These data are derived from those presented above for numbers of adult (section 3.1) and juvenile (section 4.1) captures. Patterns for 1983 and 1984 are similar which follows from the similarity of the capture patterns of each age class between years.

The percentage of juveniles on each visit increased rapidly over a period of about a month during which juveniles first appeared in large numbers. It then remained high for the rest of the study period. About 80% of the Blackcaps, Willow Warblers and Wrens that were caught in July and August were juvenile. The percentage of juvenile Bullfinches increased later, but also reached 70% to 80%

juveniles by late August. The increase in the percentage of juvenile Blackbirds in the catches started earlier and was more gradual, but it still reached values of over 60% by the end of the season. In 1984 there were two rapid increases in the percentage of juvenile Blackbirds caught, one in mid-June and the other in late July, perhaps corresponding to different broods.

For four of the five species, the cumulative percentage of juveniles increased rapidly when the juveniles appeared but this rate of increase declined towards the end of the season. The last two visits caused little change in the cumulative percentage of juveniles for Blackcap and Willow Warbler (Figure 4.6) while for Wren and Blackbird (Figure 4.7) there was a slight increase. Only for Bullfinch (Figure 4.8) did a steep increase continue until the end of the season, perhaps as a consequence of the late breeding season of this species or because of dispersal bringing new birds into range of the nets. Note that in Section 4.4 late season trapping of young Bullfinches is shown to contribute to between-site variation in the annual change in productivity index.

4.3 Calculation of standard errors and confidence limits for an index of change in productivity from CES data

A simple estimate of change in productivity between two years would be:

$$V_i - V_{(i-1)} \qquad (4.1)$$

where $$V_i = \frac{b_i}{(a_{i\bullet} + b_{i\bullet})} \qquad (4.2)$$

b_{ij} is the number of juveniles caught at the jth site in year i.

$b_{i\bullet}$ is the number of juveniles summed over sites in year i

See section 3.2 for other notation.

As in section 3.2 we examined the appropriateness of binomial confidence limits by testing for three-way interactions in a sites x years x ages contingency table of numbers of birds caught (Table 4.1). We found evidence of interactions in five of ten species and therefore used the ratio estimates. We calculated the standard errors of the V_i as

$$S_{V_i} = \sqrt{\frac{n\left(\sum_{j=1}^{n} b_{ij}^2 - 2V_i\sum_{j=1}^{n} b_{ij}(a_{ij}+b_{ij}) + V_i^2\sum_{j=1}^{n}(a_{ij}+b_{ij})^2\right)}{(n-1)\left(\sum_{j=1}^{n}(a_{ij}+b_{ij})\right)^2}} \qquad (4.3)$$

The standard error of the difference $V_i - V_{(i-1)}$ is given by

$$\text{s.e.d.} = \sqrt{S_{V_i}^2 + S_{V_{(i-1)}}^2} \qquad (4.4)$$

As for the index of adults caught this s.e.d. would be expected to be proportional to $\frac{1}{\sqrt{n}}$

where n is the number of sites.

Table 4.2 shows s.e.ds from CES pilot data for 21-26 sites per species and expected s.e.ds from a scheme with 100 sites. For comparison the mean absolute difference between years in the proportion of juveniles was 7%. The precision of the estimate of index change is therefore fairly satisfactory even with a moderately expanded sample of CES sites.

4.4 Effects of curtailing the regime of trapping on the index of change in productivity

We altered the regimes of visits used in calculating the index of change in productivity for five species in the same way as in section 3.3, except that a smaller set of regimes seemed reasonable. The results are shown in Figure 4.9. Using data from all twelve visits gave the smallest or near smallest s.e.d in all species tested except Bullfinch in which exclusion of juveniles caught on late visits reduced the s.e.d. sharply. This might be due to the exclusion of late-summer feeding groups on clumped seed sources. The patchy distribution of seeds and the flocking habit would lead us to expect this effect in other finch species. As in section 3.3 there seems to be little scope for reducing the number of trapping visits for most species but exclusion of captures of juveniles from the later visits might be beneficial for some species.

4.5 Habitat differences in the percentage of juveniles

Habitat differences in the percentage of juveniles may reflect differences in productivity between habitats or differences in habitat use by juveniles in late summer. It is important to establish whether such differences exist both because they may bias productivity indices and because they may provide information on habitat use. We therefore calculated the percentage of juveniles over the whole 1984 season for wetland, scrub, conifer plantations and deciduous woodland separately (Table 4.3). Only species with a sample of at least 20 individuals in each habitat were included.

The percentage of juveniles was significantly higher in wetland than in scrub for six species of warblers and for Long-tailed Tit, Greenfinch and Goldfinch. For warblers at least, this probably represents a movement into wetland areas in late summer rather than high breeding success in these areas. The percentage of juveniles in scrub and in conifer plantations differed significantly for two species. Long-tailed Tits had a higher percentage of juveniles in conifer plantations while a higher percentage of juvenile Bullfinches was recorded from scrub. This similarity between scrub and conifer plantations is probably because the conifer plantations used for Constant Effort Sites usually contain some scrub and are not managed intensively for forestry. Eight species showed a significant difference in the percentage of juveniles between scrub and deciduous woodland, seven of the eight having a higher percentage of juveniles in scrub. Five of these seven species were residents but they also included Blackcap and Willow Warbler. These differences are more

likely to reflect a genuine difference in productivity between the two habitats, but further data on dispersal are needed to confirm this.

Indices of change in productivity were calculated for wetland, scrub and woodland for the five study species (Blackcap, Willow Warbler, Wren, Blackbird and Bullfinch). No significant differences were found in the pattern of year to year change between habitats but sample sizes per habitat were small. Thus although there are differences in the percentage of juveniles recorded from different habitats, there is no evidence that between year changes in the percentage of juveniles differ between habitats. Further analyses of this type will need to be carried out when more data have accumulated.

Table 4.1 Results of chi-squared tests to detect sites x years x ages interactions in CES pilot data for 1981, 82, 83.

species	chi-squared	d.f
Wren	35.65 *	20
Dunnock	24.19	22
Robin	46.69 **	22
Blackbird	23.78	22
Song Thrush	29.44	22
Blackcap	20.97	18
Willow Warbler	41.34 **	20
Blue Tit	46.13 **	22
Great Tit	32.88	22
Bullfinch	58.00 ***	20

* P<0.05
** P<0.01
*** P<0.001

Table 4.2 Standard errors of differences in percentages of juveniles in CES catches for five common species between 1983 and 1984. S.e.ds are shown for the actual data from 21-26 sites per species and for a hypothetical scheme with 100 sites.

species	21-26 sites	100 sites
Wren	3.4	1.7
Blackbird	5.8	2.7
Blackcap	5.9	2.8
Willow Warbler	5.2	2.5
Bullfinch	9.3	4.1

TABLE 4.3 The percentage of juveniles recorded at sites in four different habitats in 1984.

	Wetland		Sig.	Dry Scrub		Sig.	Conifer plantations		Sig.	Decid/Mixed Woodland	
	%juv	n	(1)	%juv	n	(1)	%juv	n	(1)	%juv	n
Wren	65.2	184		68.3	350		68.7	147	**	48.5	68
Dunnock	62.6	147		55.8	389		53.4	118	*	41.7	72
Robin	83.3	168		78.9	483		70.5	132	**	66.1	121
Blackbird	34.4	122		37.1	466		25.3	83		42.9	126
Song Thrush	29.2	72		42.6	141		30.3	33	**	18.9	53
Reed Warbler	42.7	532		58.3	24						
Lesser Whitethroat	70.4	81	**	45.5	88						
Whitethroat	75.9	54	**	51.8	164						
Garden Warbler	62.3	61	***	34.3	102		39.7	63		25.6	39
Blackcap	73.7	300	**	62.7	306		53.2	126	*	50.0	134
Chiffchaff	88.3	179	***	69.0	129		72.5	120			
Willow Warbler	77.6	371	***	60.6	1002		55.3	219	**	49.0	149
Long-tailed Tit	67.0	91	*	49.6	115	**	70.5	105		56.2	32
Willow Tit	81.5	27		57.8	45				*	88.5	26
Coal Tit	82.1	28		72.2	36		88.9	36			
Blue Tit	78.4	282		76.5	378		81.9	199	*	67.5	151
Great Tit	73.3	161		70.7	311		75.6	127		71.3	108
Treecreeper	75.0	40		53.2	47						
Chaffinch	26.5	117		33.3	180		27.7	65		33.3	114
Greenfinch	56.7	30	*	29.8	57						
Goldfinch	64.7	34	***	9.1	22						
Linnet	23.1	26		22.1	131						
Bullfinch	33.3	63		44.1	261	**	21.1	57		47.7	88
Yellowhammer	55.0	20		26.3	57						
Reed Bunting	23.1	78		31.8	22						

Only samples with n > 20 are included. Date are from 11 Wetland sites, 19 Dry scrub sites, 7 conifer plantations and 5 deciduous/mixed woods.
Calculations are based on the numbers of adult and juvenile individuals caught during the whole season (May to August)
(1) Chi-squared test between habitats in the adjacent columns
*** P<0.001 ** P<0.01 * P<0.05 all other differences not significant.

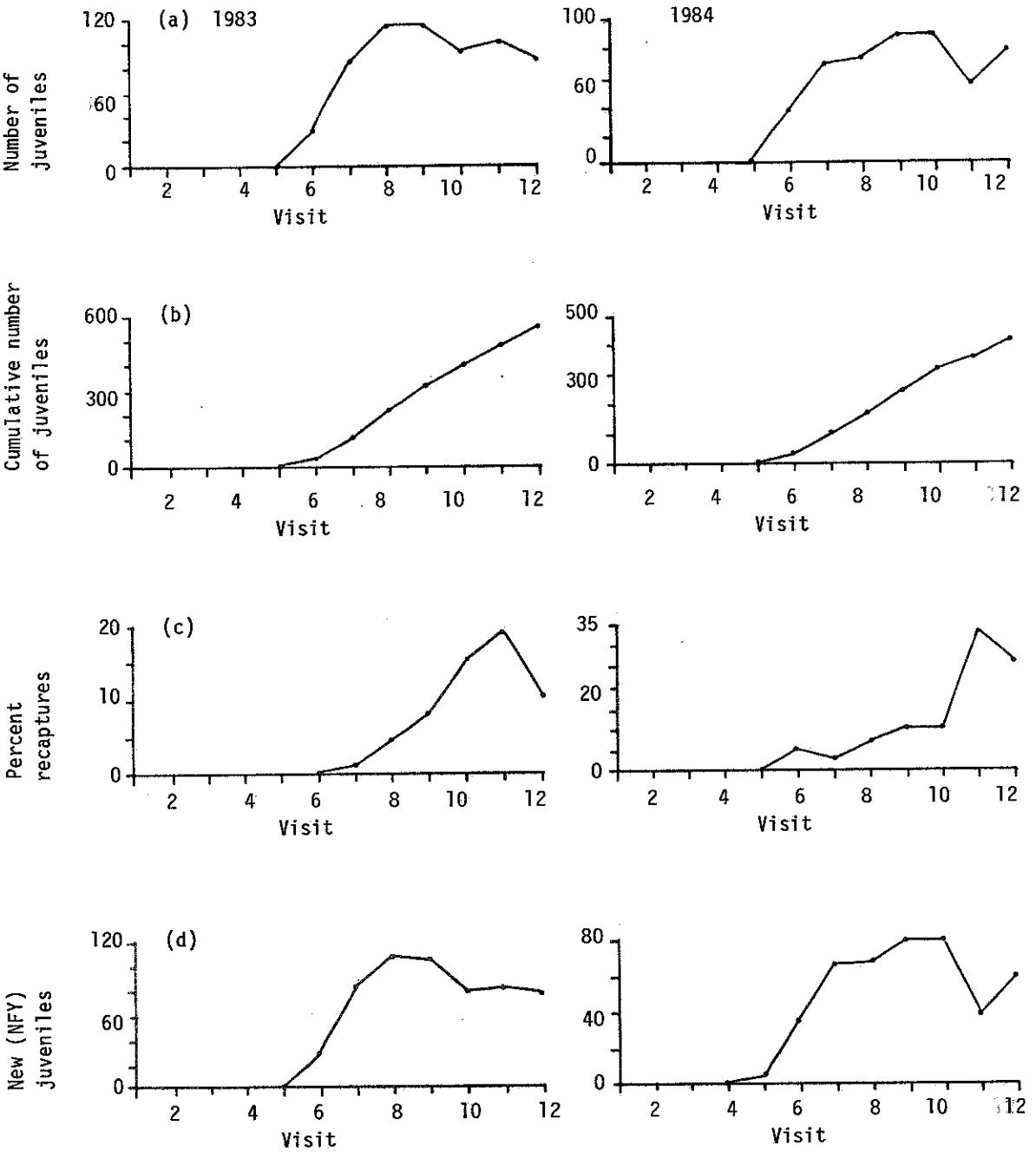

Figure 4.1 Seasonal variation in captures of juvenile Blackcaps in 1983 and 1984
Data are from all sites with 12 complete visits (1983 n = 29, 1984 n = 25)

(a) Number of birds caught on each visit
(b) Cumulative number of individuals caught
(c) Percentage of the birds caught on each visit which had been caught previously during the same season
(d) Number of new birds for the season (NFY) caught on each visit

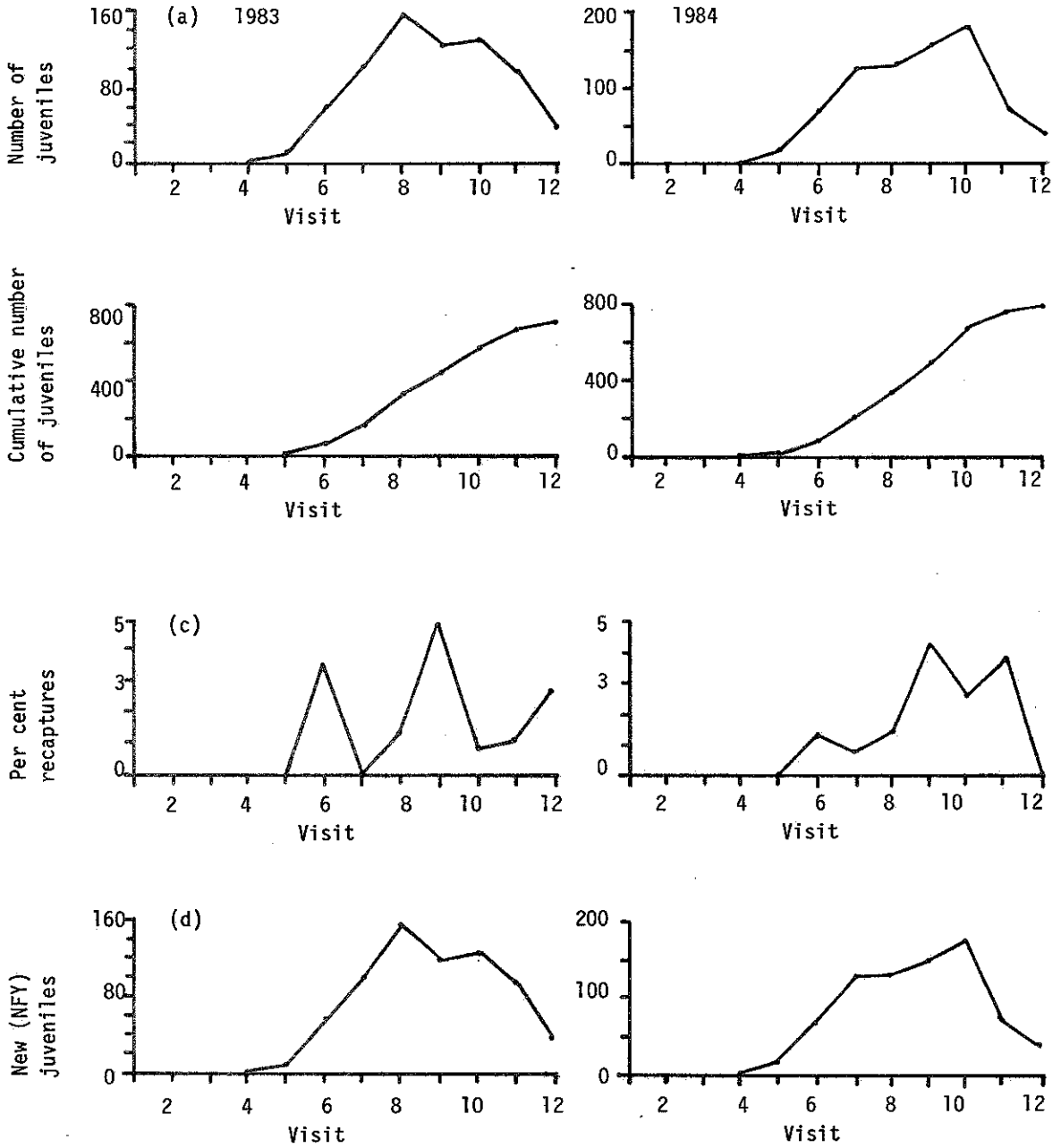

Figure 4.2 Seasonal variation in captures of juvenile Willow Warblers in 1983 and 1984
Data are from all sites with 12 complete visits
(1983 n = 29, 1984 n = 25)

(a) Number of birds caught on each visit
(b) Cumulative number of individuals caught
(c) Percentage of birds caught on each visit which had been caught previously during the same season
(d) Number of new birds for the season (NFY) caught on each visit

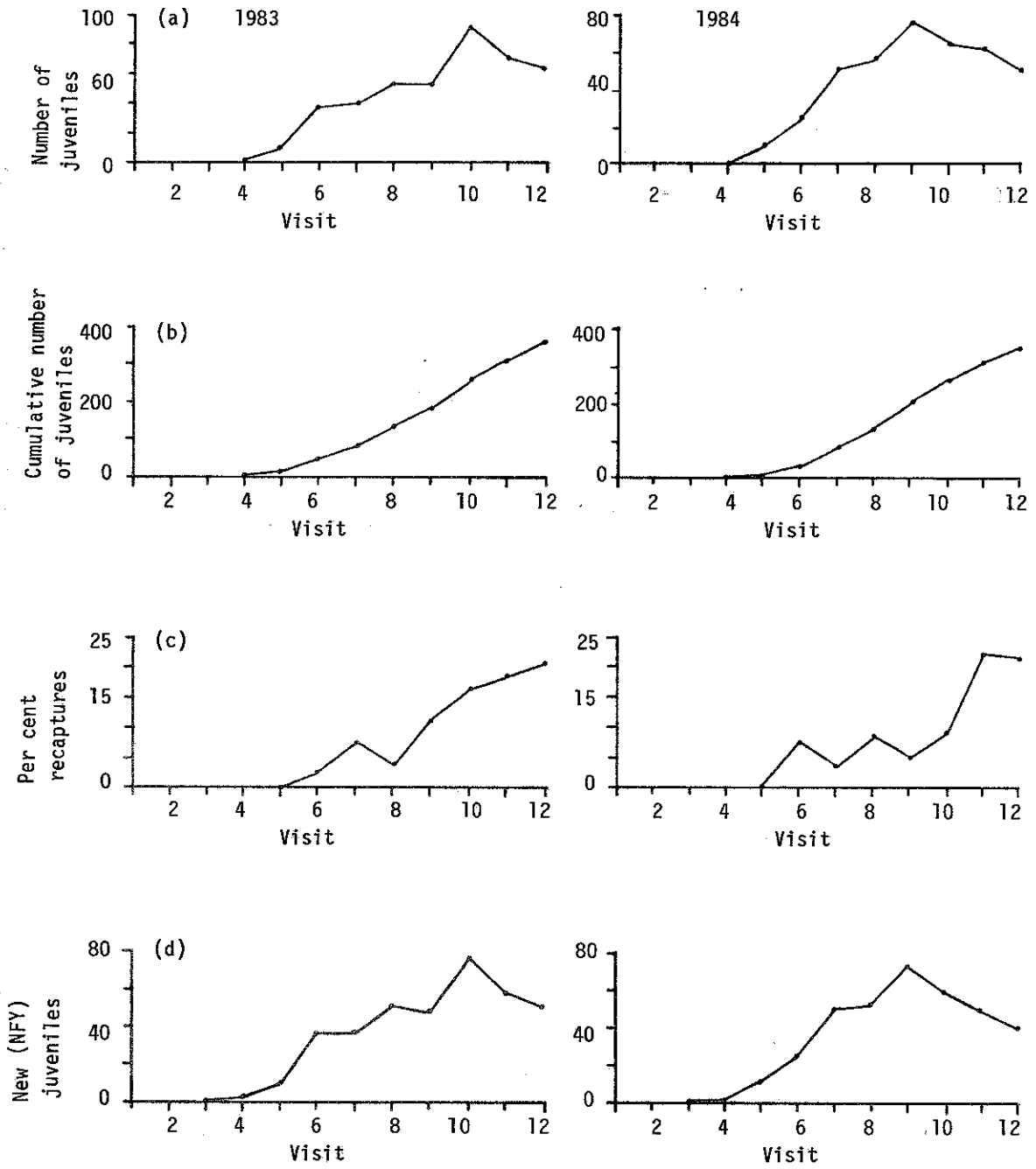

Figure 4.3 Seasonal variation in captures of juvenile Wrens in 1983 and 1984
Data are from all sites with 12 complete visits
(1983 n = 29, 1984 n = 25)

(a) Number of birds caught on each visit
(b) Cumulative numbers of individuals caught
(c) Percentage of the birds caught on each visit which had been caught previously during the same season
(d) Number of new birds for the season (NFY) caught on each visit

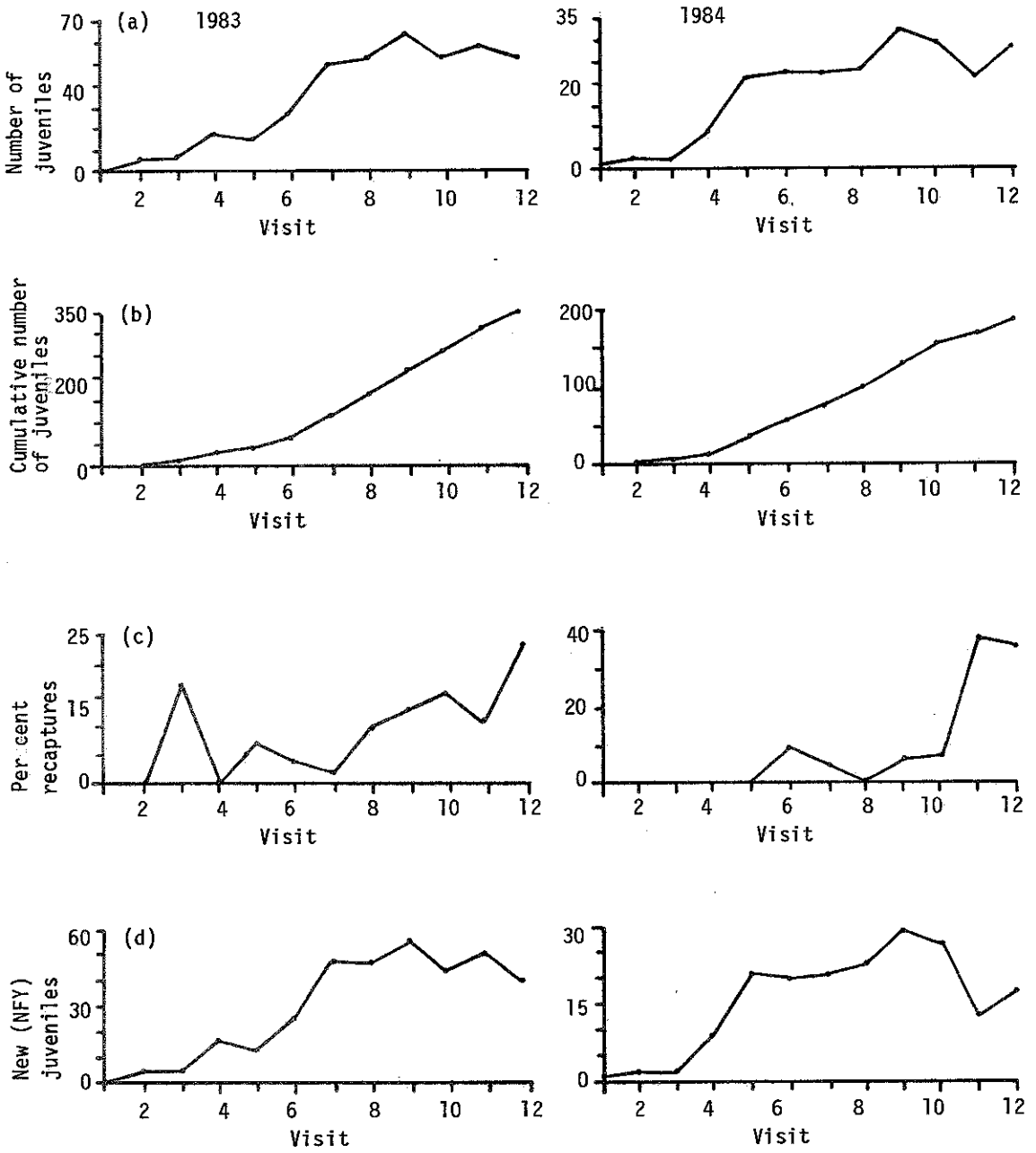

Figure 4.4 Seasonal variation in captures of juvenile Blackbirds in 1983 and 1984
Data are from all sites with 12 complete visits (1983 n = 29, 1984 n = 25)

(a) Number of birds caught on each visit
(b) Cumulative number of individuals caught
(c) Percentage of the birds caught on each visit which had been caught previously during the same season
(d) Number of new birds for the season (NFY) caught on each visit

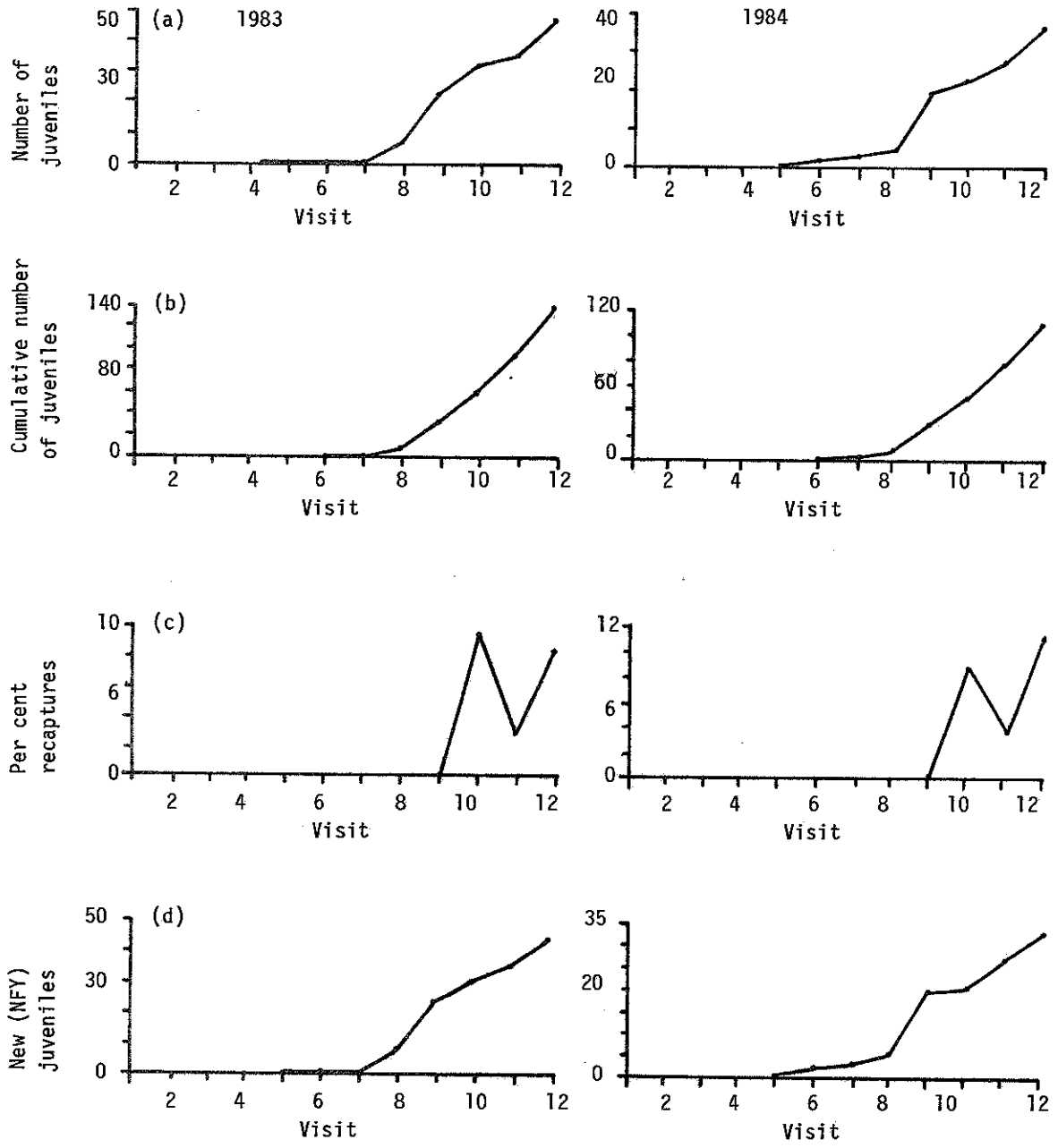

Figure 4.5 Seasonal variation in captures of juvenile Bullfinches in 1983 and 1984
Data are from all sites with 12 complete visits (1983 n = 29, 1984 n = 25)

(a) Number of birds caught on each visit
(b) Cumulative number of individuals caught
(c) Percentage of the birds caught on each visit which had been caught previously during the same season
(d) Number of new birds for the season (NFY) caught on each visit

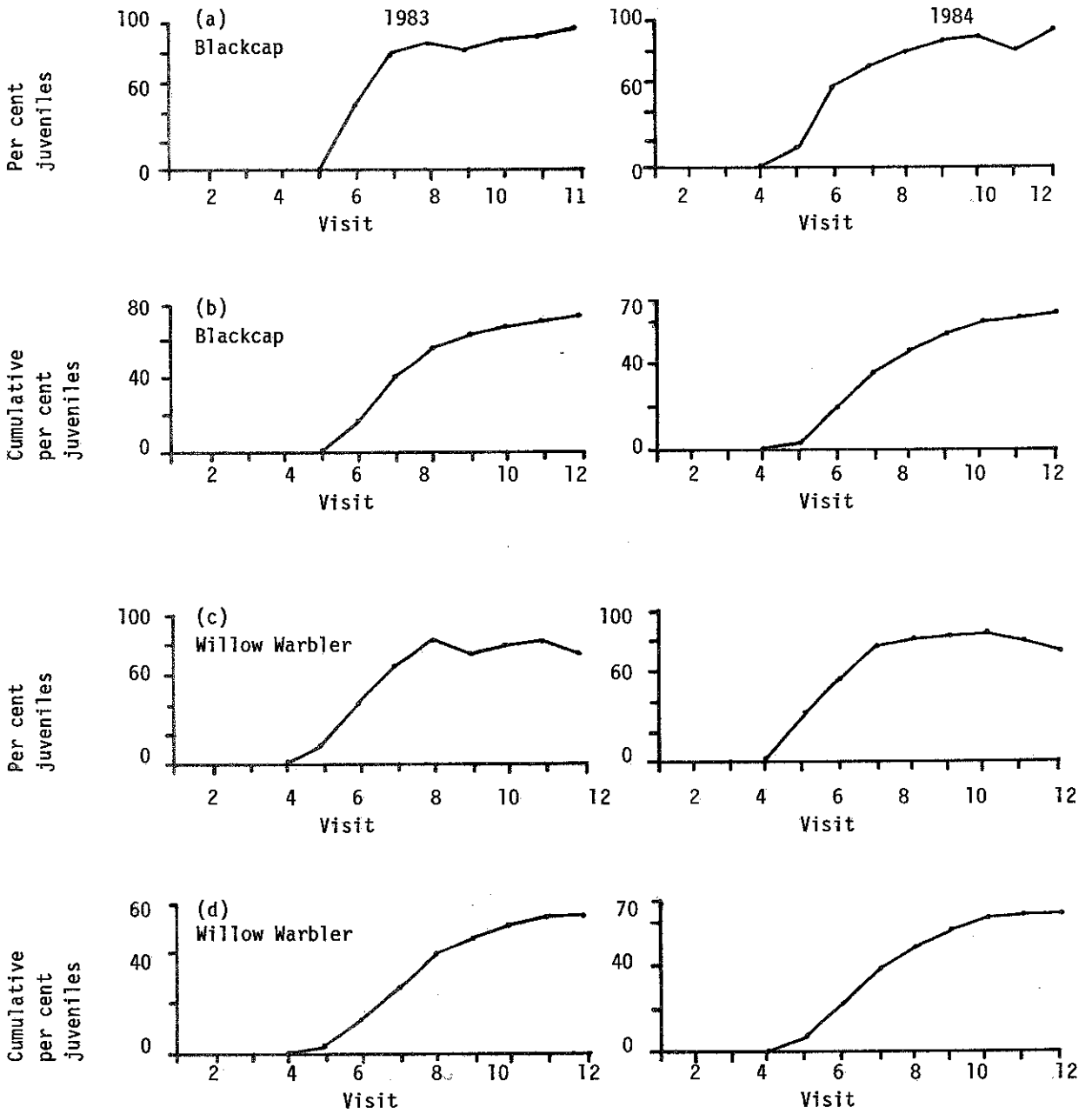

Figure 4.6 Seasonal variation in the percentage of juveniles for Blackcaps and Willow Warblers captured in 1983 and 1984 Data are from all sites with 12 complete visits (1983 n = 29, 1984 n = 25)

(a) Percentage of Blackcaps caught on each visit which were juveniles
(b) Cumulative percentage of Blackcaps which were juveniles
(c) Percentage of Willow Warblers caught on each visit which were juveniles
(d) Cumulative percentage of Willow Warblers which were juveniles

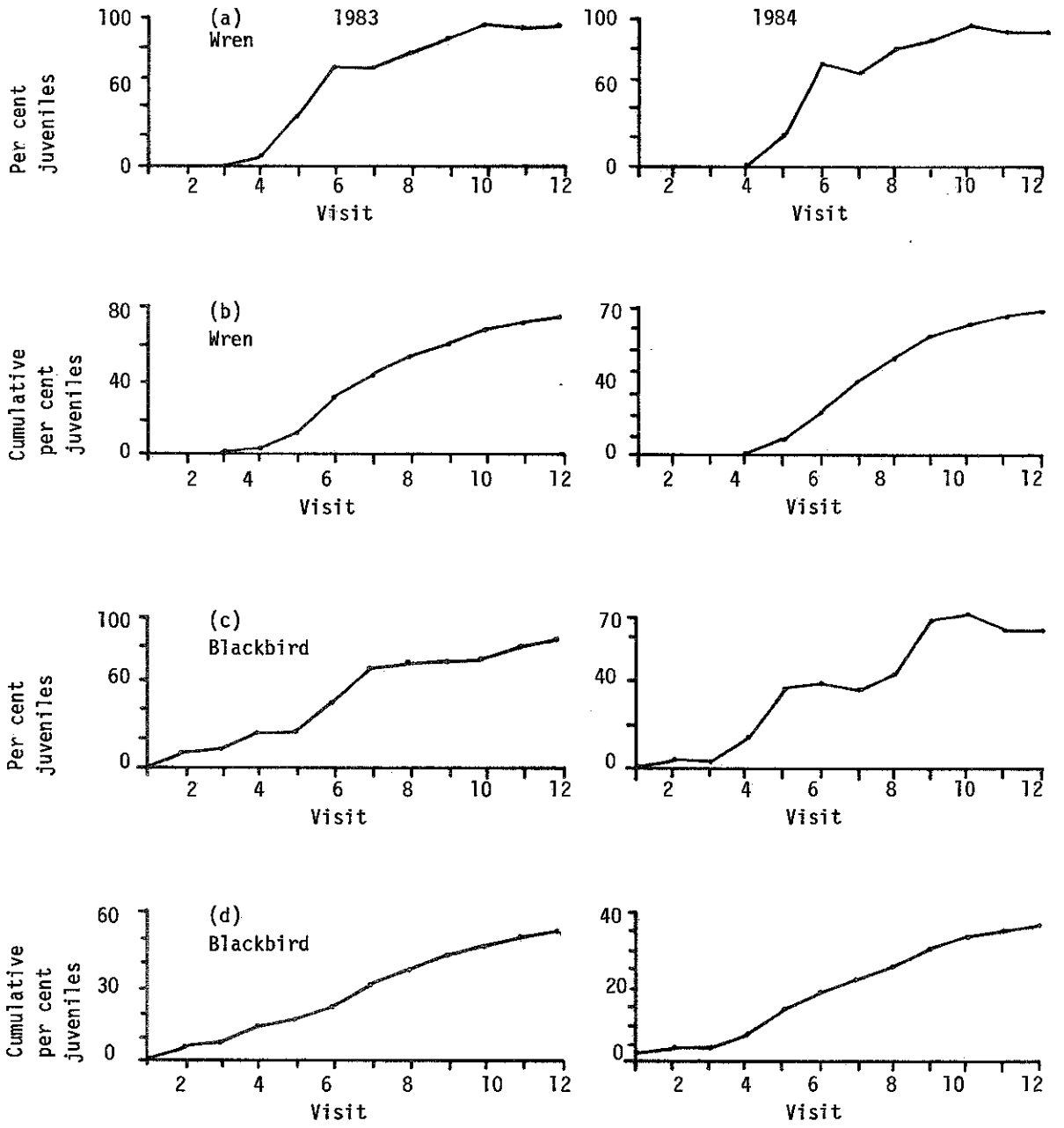

Figure 4.7 Seasonal variation in the percentage juveniles for Wrens and Blackbirds captured in 1983 and 1984 Data are from all sites with 12 complete visits (1983 n = 29, 1984 n = 25)

(a) Percentage of the Wrens caught on each visit which were juveniles
(b) Cumulative percentage of Wrens which were juveniles
(c) Percentage of the Blackbirds caught on each visit which were juveniles
(d) Cumulative percentage of Blackbirds which were juveniles

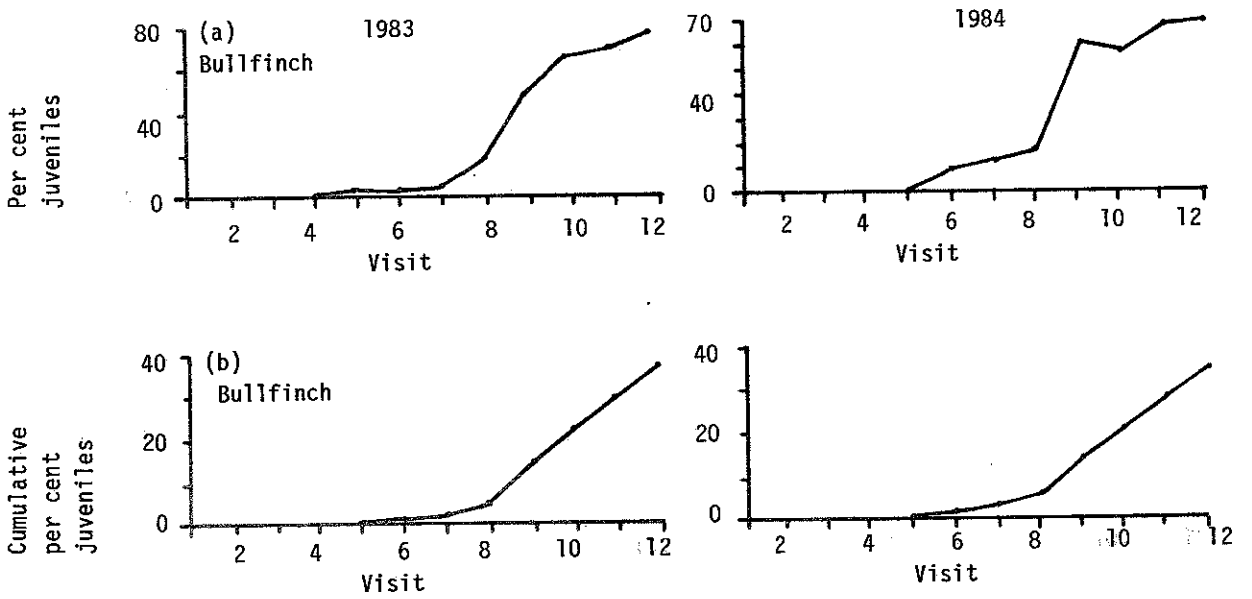

Figure 4.8 Seasonal variation in the percentage juveniles for Bullfinches captured in 1983 and 1984

Data are from all sites with 12 complete visits (1983 = 29, 1984 = 25)

(a) Percentage of the Bullfinches caught on each visit which were juveniles

(b) Cumulative percentage of Bullfinches which were juveniles

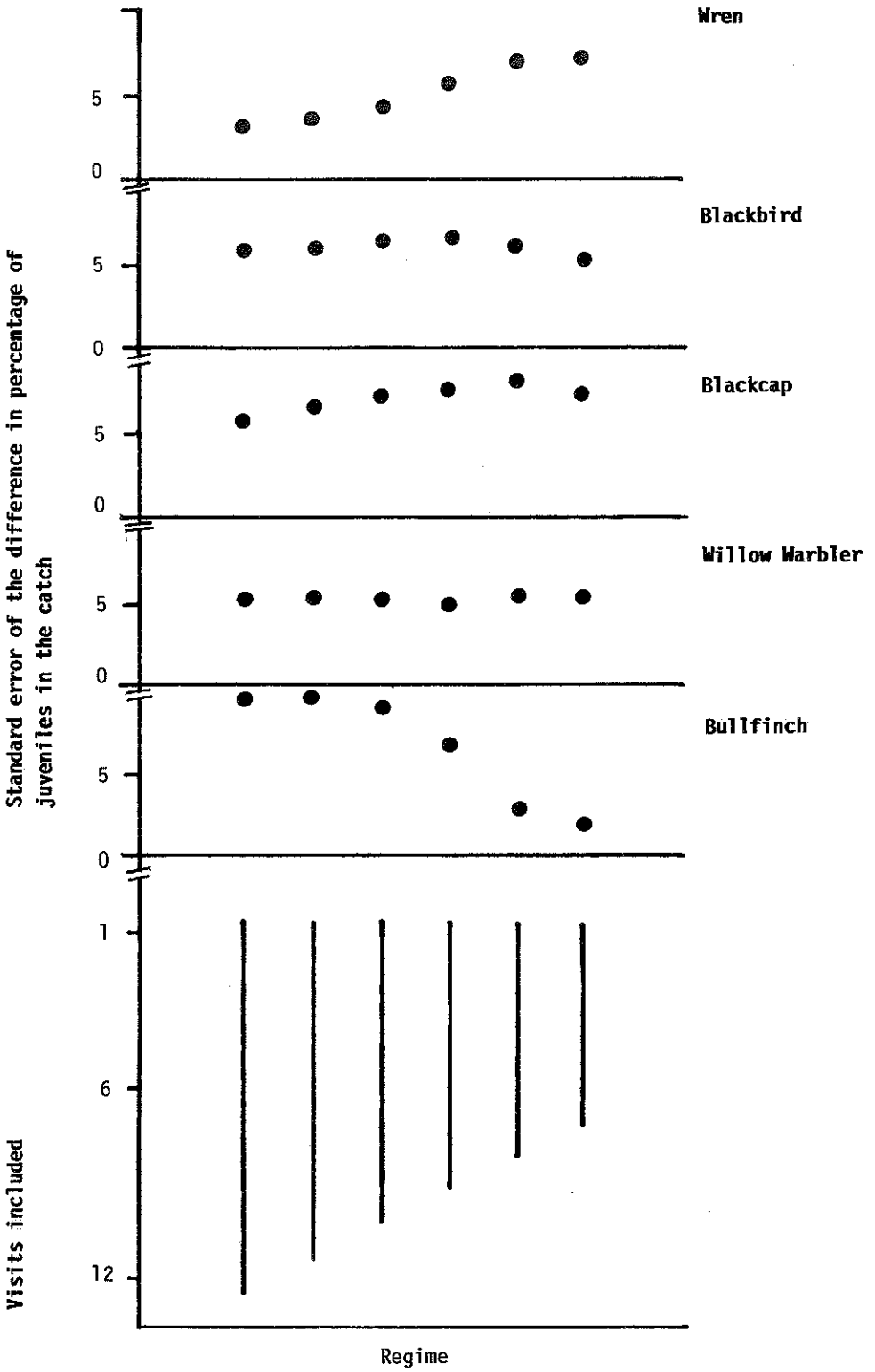

Figure 4.9 Standard errors of the differences between percentages of juveniles in the catch in 1983 and 1984 in relation to trapping regime. Totals of juveniles were taken from the combinations of visits shown in the lowest section of the diagram. Numbers of adults were taken from the regime giving the lowest standard error in Figure 3.6

5. ESTIMATION OF ANNUAL SURVIVAL RATES

Three methods are commonly used to estimate annual survival rates of bird populations, analyses of recoveries of dead birds, recaptures of birds ringed in previous seasons and resightings of colour-marked birds. The last two methods may both be regarded as capture-recapture methods, the only difference being that in the latter case recapture may be achieved without netting the bird. Constant Effort Sites provide data which can be used to make capture-recapture estimates of survival rates.

Several of the simpler and most extensively used methods of estimating survival rates from ringing recoveries have been criticised recently either because they are extremely sensitive to violations of the underlying assumptions (Lakhani and Newton 1983) or because the models do not provide an acceptable fit to the observed data (Anderson et al. 1981, Anderson et al. 1985). It is not appropriate to review these problems in detail here but the following general conclusions are relevant:

1. The assumption that both recovery and survival rates are constant is rarely supported by empirical data. Because recovery rates cannot be assumed to be constant it is necessary to know the numbers of ringed birds in each cohort so that models including explicit estimates of recovery rates can be used.

2. Models which estimate age-specific survival rates from birds ringed as young are unreliable (North and Cormack 1981, Lakhani and Newton 1983, Anderson et al. 1985). Valid models for

estimating age-specific survival rates from ringing recoveries require recoveries of birds ringed as young (chicks or juveniles) to be analysed together with recoveries of birds ringed as adults (Brownie et al. 1978).

3. It is highly desirable to supplement estimates of survival and recovery rates from ringing recoveries with independent estimates of one or more of these parameters (Lakhani and Newton 1983). Capture recapture studies could provide an excellent source of such additional estimates. It may be useful to combine recapture data and recoveries of ringed birds in a single model (Buckland 1980).

The most suitable set of models currently available for the analysis of ringing recovery data is that of Brownie et al 1978). The recent introduction of age-specific totals lists will enable these models to be used for analyses of the national recovery data for selected species within about five years (or earlier if historical data can be extracted). However, there are many species for which there will be insufficient recoveries to estimate annual survival rates with sufficient precision for population modelling. Also ringing recoveries cannot provide habitat-specific survival estimates. It is important, therefore, that additional information on survival should be obtained using capture-recapture techniques.

The basis of capture-recapture survival estimation is simple. A cohort of birds is marked in one year and marked individuals surviving to the next year are recorded. If the whole study population was recaptured each year the survival rate could be estimated directly. As this is rarely the case it is necessary to estimate the number of marked birds which survive to year two but

which are not recorded. Such estimation requires recapture data from year three onwards, which are used to estimate trapping efficiency in year two. Thus in theory at least three and in practice at least four or five years of recapture data are needed before reliable estimates of survival can be made (Buckland 1982, below).

Most capture-recapture models are concerned with estimating population size and birth rate as well as survival. Without additional data they do not allow us to distinguish birth from immigration or death from emigration. For breeding passerines additions to the adult population through birth cannot occur (i.e. we distinguish juveniles from adults in our data), while for most species large scale permanent emigration from the study areas is unlikely. Capture-recapture models and their underlying assumptions have been thoroughly reviewed by several authors (Begon 1979, Blower et al 1981, Seber 1982). The models most appropriate for the analysis of CES data are the Jolly-Seber model as modified by Buckland (1980, 1982) and perhaps also Cormack's model (Cormack 1964, Clobert et al 1985).

This approach has been shown to provide reliable survival estimates for many bird populations. Published examples encompassing data gathered using a wide range of field methods include Fulmars (Dunnet and Ollason 1978), Gallahs (Buckland et al 1983), Canada Geese (Parkin and White-Robinson 1985) and Reed Warblers (Long 1975). The Wicken Fen Group have carried out a summer mist-netting program at Wicken Fen, Cambridgeshire which gathers data very similar to those which will accrue from the CES scheme. Their retrap data provided sensible estimates of survival for a range of passerine species including Reed Warbler, Sedge Warbler, Blue Tit, Long-tailed Tit, Wren and Dunnock (Green 1977, Innes 1978, 1979). These analyses

were mostly carried out using Leslie and Chittys Model B (Leslie and Chitty 1951) but reanalysis of the Reed Warbler data showed that this also fitted Buckland's modification of the Jolly-Seber model. The extension to current methodology which will be required for analysis of the CES data is the ability to combine recapture data from several sites. In principle this should not provide a serious problem as cohorts from individual sites can be combined in a way analogous to that which is used to combine cohorts by date or by age (Buckland 1982). Such analyses could not be carried out on the CES pilot data, as only two years of detailed capture information were available to the review group (section 2). They should be carried out when five years' data have accumulated.

Two areas could be investigated sooner than this using recapture data from individual sites at Wicken Fen, Marsworth Reservoir and Treswell Wood. These data cover long runs of years and are computerised. Estimated survival rates between the year of initial ringing and the following year are often extremely low, and must be rejected from any analyses. This is mainly because the ringed sample includes passage birds which do not revisit the site regularly, while nearly all birds retrapped in years after ringing are breeding residents. Green (1976) examined this problem using the Wicken Fen Reed Warbler data and found that sensible estimates of survival were obtained if only birds caught in two or more weeks during their year of ringing were included. This approach should therefore be evaluated for a greater range of species and sites, as it allows more of the data to be used for survival analyses. Different criteria may be appropriate for other species.

A frequently violated assumption of capture-recapture techniques is that of equal trapability. It may occur because individuals

occupying territories at the edge of the study area are less likely to be captured than those on the centre. Buckland (1982) has shown that unequal trapability usually causes the last few survival estimates in any series to be too low. It may also bias the estimated survival between the year of ringing and year one, because the number ringed is known exactly while the estimate of the number of marked birds alive in year one may be affected by unequal trapability. He has devised an ad hoc procedure for eliminating these estimates and it will probably be necessary to apply this to the CES data. Analyses of the long-term data sets could provide provisional information on how many survival estimates need to be omitted. This approach applies to absolute estimates of survival, which can usually only be made at least two years after the year under consideration (above). However, the proportion of ringed birds returning each year may provide an immediate index of survival if, as should be the case with CES, trapping effort is reasonably constant. Green (1976) found little variation with the efficiency with which Reed Warblers were trapped in different years, even although a strictly constant netting regime was not in use. Further trapping efficiency estimates from the long-term recapture data would be useful.

Although it would be preferable to keep trapping effort constant there may be some danger in using exactly the same net sites every year, as resident individuals might learn to avoid capture in different seasons as well as within seasons (section 3). This is most likely to affect recaptures of resident species when trapping continues throughout the year. It may be better to use a constant amount of net but to vary the sites used but this requires further evaluation. Useful information on this problem could be obtained from recaptures made in the additional nets used at flexible sites. Indeed, because all summer captures at a site can usefully contribute

to Jolly-Seber survival estimates we strongly recommend that data from all summer trapping at Constant Effort Sites should be recorded. It is obviously essential that data from CES visits and constant net sites should be recorded separately from other data.

The CES scheme is unlikely to provide good estimates of first year survival because juveniles may not breed in the immediate vicinity of their natal areas. However, it may provide an index of first year survival. For some species it will be possible to examine correlations between these first year return rates and first year survival estimated from ringing recoveries when sufficient data have accumulated. A high correlation would suggest that the return rates provide a good index of survival. For several resident species birds which are one year old may be distinguished from older birds using plumage characteristics. These data could easily be recorded and in combination with other data might provide some indirect information on the first year survival of the species concerned.

6. HABITAT RECORDING

The value of the CES scheme as a means of collecting habitat-specific information on population dynamics has been stressed in several of the previous sections. Very broad habitat categories have been used in this report and it would be preferable to have much more detailed habitat data so that sites can be classified in a more objective manner.

Vegetation changes at Constant Effort Sites may take place slowly as a result of succession or very rapidly due to active management or habitat destruction. It is essential that such changes should be properly documented so that they can be taken into account when interpreting changes in bird populations. Habitat changes may be regarded as a nuisance because they may make it necessary to reject from some between-year comparisons sites that have been altered. However they may also provide excellent "experiments" for investigating the effects of habitat changes on bird populations.

Proposed instructions for habitat recording are set out below. Observers would be asked to mark the main areas of habitat within their sites on a map, and to record information about each of these on a habitat recording form (Figure 6.1). These methods are similar to those now being used for Woodland Common Birds Census plots (O'Connor and Fuller 1984).

Instructions for habitat recording at Constant Effort Sites

The type and structure of vegetation affect both the breeding birds present and the ease with which they can be caught in mist

nets. At many constant effort sites, particularly those in scrub or marshland, vegetation structure is changing over the years due to succession. Hence it is important to document changes in vegetation at individual sites and it is now necessary to standardise the collection of habitat data to permit a more thorough comparison of sites and years.

Please prepare a 1:2500 sketch map of the site extending at least 100 metres beyond the outermost net sites. Please indicate on it:

tracks or rides
ditches and streams
marshy areas
the nature of habitat on the boundary of the site
(e.g. barley field, suburban gardens etc.)
mist net sites (rigid and flexible sites shown
separately)
nestboxes
open water
a reference point identifiable on a 1:50000 OS Map
with 6 figure grid ref.

Divide up the map with coloured lines to separate broad vegetation types, label the areas with key letters and make habitat notes on each area on the recording form. The rows on the form ask for the following information.

1) HABITAT TYPE; broad categories such as woodland, scrub, reedbed, field etc.

2) WOODY VEGETATION; list the tree/shrub species comprising more than 10% cover.
Include bramble and gorse in this category.
Record the approximate average height of the canopy of woodland or scrub to the nearest metre. Estimate the proportion of the area overshadowed by woody vegetation on a five point scale (1 - less than 20%, 2 - 20-40% etc.).

3) FIELD LAYER: describe the field layer in terms of the main species groups present, e.g. ungrazed grass, bare ground with nettle beds, reeds etc. Make special mention of large areas of plants which attract seed eating birds such as thistles, chickweed, fat-hen, plantains etc. and indicate the period for which these special features were available.

4) For marshy areas and open water indicate the water depth in late May - early June. For temporary water give the period for which there was standing water.

Make the vegetation assessment in late May - early June. A new record should be made each year.

If possible have last year's habitat records available to clarify any changes.

Figure 6.1 Proposed habitat recording form for Constant Effort Sites

BTO **CONSTANT EFFORT SITE**

SITE NAME: SITE NO:

GRID REF: YEAR:

HABITAT RECORDING FORM (Use one column for each habitat area)

KEY LETTER							
HABITAT CATEGORY							
WOODY PLANTS (dominant species)							
Average canopy height (m)							
Proportion of area overshadowed by trees or bushes (score 1-5)							
FIELD LAYER (prominent species groups)							
MARSH & WATER Average depth: 1 = 1-10 cm 2 = 11-30 cm 3 = 31-100 cm 4 = 100 cm + Give duration of flooding for temporarily wet areas.							
NOTES							

7. ADMINISTRATION OF THE CONSTANT EFFORT SITE SCHEME

7.1 General administration

We include here all routine circulations and correspondence with participants including the filing of returns. Data processing and analysis are considered separately below. Tasks are divided into those which are dependent on the number of sites included in the scheme and those which are not. It is assumed that all documents and address labels will be produced on the BTO's word-processor.

At present contributors receive two main circulations per year. Instructions and recording forms are sent out in February or March accompanied by an annual report for the previous year. This annual report must also be sent to those who are unable to continue their sites. Returns come in mainly between July and October. These are photocopied and returned to the contributors along with a letter acknowledging their data and a copy of the preliminary results. We assume that the practice of returning photocopies of observers' own data would be discontinued but that they would be sent a printout of their data for checking. It might also be necessary to discontinue the distribution of preliminary results in the autumn unless data entry is carried out in-house.

Tasks independent of the number of participants

	Organiser (hours)	Secretary (hours)
Revision of recording forms and instructions and preparation of a covering letter (February)	20	20
Preparation of letters and other documents sent out after receipt of returns (August)	3	3
Preparation of preliminary results by computer	3	
Preparation of annual report (including version for BTO News or Ringer's Bulletin	20	20
Total	46	43

Tasks dependent on number of participants
Figures are minutes per site

	Organiser (minutes)	Secretary (minutes)
Duplication and circulation of pre field season documents including annual report. 30 double sided sheets per participant (February-March)		10
Addition of individual notes to about 50% of circular letters. Direct onto word-processor or by hand (February-March).	15	
Correspondence and phone calls to contributors (March-June)	12	6
Duplication and circulation of acknowledgements for returns with printout of data and preliminary results (July-October)		3
Addition of individual notes to the above circulation. Direct onto word-processor or by hand.	15	
Filing and collation of returns	6	
Follow up of late returns	6	
Total	48	25

Thus for the present scheme of about 50 sites, 40 hours work for the organiser and 21 hours works for the secretary are required. For 100 sites these figures become 80 hours and 42 hours respectively.

7.2 Data collection

We proposed using the following forms for the 1986 season.

1. Annual summary form
2. Capture calendar for each species
3. Habitat recording form
4. Point count form

Except for the habitat recording form these would be the same as those used in 1985. To facilitate entry onto the computer, observers would be asked to enter the visit number in the boxes of the capture calendar rather than a cross.

7.3 Computer processing of data

Computerisation of the data is essential for the efficient production of results from this scheme. Even manual calculation of the index figures is complex and time consuming as allowance must be made for missing visits. A major objective of the scheme should be the estimation of annual survival rates and this will require complex tabulations of the recapture data. The main computerisation should be of the individual capture calendars which record ring-numbers and the visits on which each bird was caught. Capture calendars for five species, Willow Warbler, Blackcap, Wren, Blackbird and Bullfinch for 1983 and 1984 were computerised using the Prime line editor and the time taken to enter the data was recorded. Costings for both in-house data entry and for entry by a commercial punching service (Alpha-Numeric Ltd.) were then calculated as follows:

	1983	1984
Number of sites	46	50
Number of birds of five species	5002	4992
Total number of birds	14890	13896
Mean birds per site	324	278

(a) In-house - times in hours

Time to enter five species	19.5	18.0
Time to enter all species	58.0	50.0
Time per site	1.26	1.00
Time per 100 sites	126	100

(b) Commercial punching (79p per 1000 characters)

Cost for all species	£131	£117
Cost per site	£ 2.85	£ 2.35
Cost per 100 sites	£285	£235

(The direct cost of employing someone in-house is about £2.50 per hour which gives costs per site of £3.15 in 1983 and £2.50 in 1984.)

In addition to the raw capture data, a small amount of data from the summary sheets, particularly that specifying dates and times of visits. will need to be entered. The species total on the summary sheets would be generated from the raw data by computer. It would probably be sensible to ask observers to enter totals on the forms as this will add to their own interest in the scheme and will be useful for checking purposes. Computer checks would be carried out on the raw data and in addition printouts would probably be returned to observers for checking. Manual checking of a few data sets not checked by observers would probably be necessary. At present we are running a trial point count scheme and the small amount of data from this will also need to be computerised. This is currently regarded as a validation exercise and not as part of the long-term scheme. These processes including any necessary correspondence with observers will add about 0.5 hours per site. Using the higher estimate of punching time (1983) this gives 1.76 hours per site for data entry and correction.

7.4 Development of data processing facilities

If data processing is to be carried out on the BTO computer it will be necessary to develop appropriate software either by writing FORTRAN programs or by customising the CIS database package. Steve Buckland's programs for estimating survival rates from retrap data have been implemented on the BTO machine and it would also be possible to adapt the CBC programs for some aspects of CES data analysis. The following functions will be required:

1. Data input and checking.

2. Production of suitably formated output to return to ringers for checking.

3. Production of tables of adults and juveniles caught, of juvenile/adult ratios and of return rates. The program should include facilities to exclude sites for which the data are not sufficiently complete. It should be possible to select data by region or by habitat.

4. Calculation of indices of changes in numbers and of changes in juvenile/adult ratios with confidence limits. Such tables would form the basic material for the annual report. Data selection facilities as in 3.

5. Tabulation of data for input to Steve Buckland's Jolly/Seber analysis program. Data selection facilities as in 3.

Development of this software together with appropriate documentation

would take four to six weeks. The work could be carried out as a vacation job by a suitably qualified student.

7.5 Overall costings

At present about 50 sites are included in the scheme. It would be prefereable to increase this figure to about 100 sites. Costings for these two options are given. Staff time is costed at £3 per hour. Postage and photocopying are costed at £1 each site per annum.

(a) Present scheme (c.50 sites)

	Organiser	Secretary
Administration independent of number of sites	46	43
Administration dependent on 50 sites	40	21
Data processing for 50 sites		88
Total (hours)	86	152

238 hours staff time	£714
Postage and photocopying	£100
Total	£814

(b) Enlarged scheme (100 sites)

	Organiser	Secretary
Administration independent of number of sites	46	43
Administration dependent on 100 sites	80	42
Data processing for 100 sites		176
Total (hours)	126	261

387 hours staff time	£1161
Postage and photocopying	£200
Total	£1361

In addition to these recurrent costs there would be the cost of developing the necessary software (section 7.4). This would be about £500.

7.6 Possible source of funding

The resources necessary to run the present scheme are relatively small, amounting to 6 to 10 man weeks per year or less than 1/4 of a full time post. Moreover only two to three weeks of this is work that requires some biological knowledge, the rest being secretarial and data entry. More time from the organiser would be required if he/she was to develop the scheme or was to carry out more than the routine analyses. The following options should be considered:

(a) Work to be undertaken by the holder of the Ringing Office post started this year and funded from the ringing permit fees.

(b) Clerical/secretarial work involved to be undertaken by an MSC-funded post. The holder of such a post within the Ringing Office could also relieve scientific staff of some other routine duties to enable them to find the 2 to 3 weeks necessary to run the Constant Effort Site Scheme.

(c) If a replacement amateur organiser could be found, work undertaken by the Ringing Office could be limited to data processing. However, the Ringing Office would still need to have the capability to take over running the scheme in the event of the organiser having to give it up at short notice.

(d) Funds should be sought for an additional full-time post for

someone to develop projects within the ringing scheme. Up to half of such a post might be taken up with developing the CES scheme in the short term, but less would probably be required after the first few years. This is clearly a long-term option as substantial funding would be required.

We suggest that the resources necessary for the short-term (one or two years) continuation of the CES scheme should be sought through option (b). Depending on other calls on staff time within the Ringing Office it might be necessary to maintain the scheme at its present level rather than expanding it. Longer term support might come from option (a) once the Recovery Archive work is complete, or from option (d).

A short project to develop the software for processing the CES data would be eligible for a grant under the British Ecological Society Small Ecological Projects Scheme. We suggest tht an application should be made for funds to undertake this work during the summer of 1986.

Computerisation of the data gathered so far will also be necessary. This could be carried out either by the proposed MSC person within the Ringing Office or possibly under our existing MSC scheme.

7.7 Research use of the data

The above costings only cover the routine administration of the scheme and calculation of a standard set of annual results. The main value of these data will be for research on the population dynamics of the species concerned, probably in combination with other BTO

data. Such research will be most productive when at least five to 10 years of data have accumulated. Survival estimates based on shorter runs of data are unlikely to be reliable. Such research would be most appropriate for permanent BTO research staff, and under present arrangements it is most likely that the work would be undertaken by Stephen Baillie.

8. RECOMMENDATIONS

1. The scheme should be continued because it is a cost effective means of gathering habitat-specific data on population dynamics. Habitat-specific data on survival, and on productivity after the fledging stage, are not gathered by any other current BTO schemes. The wetland and scrub habitats studied complement the farmland, woodland and waterways coverage provided by the Common Birds Census and the Waterways Bird Survey.

2. The scheme is of direct scientific and applied value but it also provides a valuable framework for obtaining useful results from passerine ringing. At present much passerine ringing is open to the criticism that its aims are ill-defined. The CES scheme provides the ordinary passerine ringer with an opportunity to contribute to a project that will produce results that are both of scientific interest and that have applications for conservation.

3. One of the main strengths of the CES approach is that the data are gathered from specific habitats. The implications of this are that:
   (a) Detailed habitat recording is essential.
   (b) The scheme should be restricted to specific habitats. In order of importance these should be:
      (i) Wetlands, especially reed beds
      (ii) Scrub
      (iii) Deciduous woodland

It is important to ensure an adequate representation of each habitat type which is included. Although the scheme might be extended to other habitats in the future, these should not be included at present. In particular plantations should be excluded because of the problems caused by rapid succession.

4. Survival estimation using presently established statistical techniques requires long runs of recapture data. It may be possible to obtain an index of survival from return rates in the year after capture using constant effort netting but this requires further evaluation. On the basis of current techniques we suggest that:

(a) Sites should be added to the scheme only if there is a reasonable prospect of their being run for at least five years.

(b) Current methods of estimating survival rates require that as large as possible a proportion of the population should be caught each year but they do not require constant effort as such. Therefore the constant effort requirement could be relaxed although it will be necessary to ensure that a large number of visits are made, spread throughout the breeding season.

(c) All catching at a site during the summer period should be recorded. Birds caught in non-CES nets should be recorded separately.

(d) Sites at which very few birds are caught should be excluded from the scheme, as sampling of the population involved is unlikely to be sufficiently intensive.

5. The constant effort rules could probably also be relaxed for the estimation of juvenile/adult ratios but field experiments are needed to confirm this.

6. Constant Effort Sites are unlikely to contribute substantial new information on population levels at a national scale beyond that already obtained from the Common Birds Census and the Waterways Bird Survey. However, it is important that changes in numbers should be measured at Constant Effort Sites so that this information can be combined with data on productivity and survival.

7. A program of point counts at Constant Effort Sites has been instigated to check the validity of population changes measured by mist-netting. The counting methods used should be checked in the light of the first year's results. These counts should be continued for several years as a validation study.

8. The cost of running the scheme is about £800 per annum for 50 sites or £1400 for 100 sites. In the short-term we suggest that the scheme should be run by the holder of the new Ringing Office post funded from the permit fees, with clerical/secretarial help from an MSC-funded post. Some options for longer-term support for the scheme are suggested.

9. The present review group should now be disbanded. If the scheme is continued a steering group should be established. A further review similar to that which has just been undertaken should be made after five years.

ACKNOWLEDGEMENTS

The development of the idea of a Constant Effort Site Schemes in Britain owes much to the pioneering study at Marsworth Reservoir by Bob Spencer, and to preliminary research on the Marsworth data carried out by the late Adrian Cawthorne. We should like to thank them together with all those ringers who participated in the field trials for the Constant Effort Sites Scheme. Without their help this review would not have been possible. The other members of the review group would also like to thank Mike Boddy who carried out all the organisation and administration of the field trials.

Three computerised sets of retrap data were obtained for the review group. These were from Marsworth Reservoir, Tring (Bob and Alison Spencer, BTO), Wicken Fen, Cambridgeshire (Chris Thorne) and Treswell Wood, Nottinghamshire (Chris du Feu and John McMeeking). We thank all these people for allowing us free access to their data. Although it has not been possible to present detailed analyses of these data sets in this report they will be very useful for further work on survival estimation which we hope to carry out in the coming months. The late Adrian Cawthorne, Mrs. Gladys Rance and Sue Tyler carried out much of the computerisation of the Marsworth data.

Computerisation of samples of the pilot data and typing of much of this manuscript were carried out by Mrs. Janet Mewis. Dr. Helen Smith provided critical comments on drafts of the manuscript. This work was carried out while Stephen Baillie held a post at the British Trust for Ornithology funded by the Nature Conservancy Council.

REFERENCES

Anderson, D.R., K.P. Burnham and G.C. White. 1985. Problems of estimating age-specific survival rates from recovery data of birds ringed as young. J.Anim. Ecol. 54: 89-98.

Anderson, D.R., A.P. Wywialowski and K.P. Burnham. 1981. Tests of the assumptions underlying life table methods for estimating parameters from cohort data. Ecology 62: 1121-1124.

Baillie, S.R., R.E. Green and C.J. Mead. 1984. Age specific totals lists. Ringers' Bulletin 6: 65-67.

Begon, M. 1979. Investigating animal abundance: capture-recapture for biologists. Edward Arnold, London.

Bibby, C.J. 1978. Some breeding statistics of Reed and Sedge Warblers. Bird Study 25: 207-222.

Blower, J.G., L.M. Cook and J.A. Bishop 1981. Estimating the size of animal populations. Allen and Unwin, London.

Brownie, C., D.R. Anderson, K.P. Burnham and D.S. Robson. 1978. Statistical inference from band recovery data - a handbook. U.S. Fish and Wildlife Service Resource Publication 131, Washington D.C.

Buckland, S.T. 1980. A modified analysis of the Jolly-Seber capture-recapture model. Biometrics 36: 419-435.

Buckland, S.T. 1982. A mark-recapture survival analysis. J. Anim.Ecol. 51: 833-847.

Buckland, S.T. and A.C. Hereward. 1982. Trap-shyness of Yellow Wagtails Montacilla flava flavissima at a pre-migratory roost. Ringing and Migration 4: 15-23.

Buckland, S.T., I. Rowley and D.A. Williams. 1983. Estimation of survival from repeated sightings of tagged galahs. J.Anim.Ecol. 52: 563-573.

Clobert, J., J.D. Lebreton, M. Clobert-Gillet and H. Coquillart. 1985. The estimation of survival in bird populations by recaptures or sightings of marked individuals. pp. 197-213 in Morgan B.J.T. and P.M. North (Eds.). Statistics in Ornithology. Springer-Verlag: New York.

Cormack, R.M. 1964. Estimates of survival from the sighting of marked animals. Biometrics 51: 429-438.

Dunnet, G.M. and J.C. Ollason 1978. The estimation of survival rate in the fulmar Fulmarus glacialis. J.Anim.Ecol. 47: 507-520.

Ginn, H.B. and D.S. Melville 1983. Moult in Birds. British Trust for Ornithology Guide Number Nineteen. Tring.

Green, R.E. 1976. The survival rate of adult Reed Warblers. Wicken Fen Group Report 7: 16-21.

Green, R.E. 1977. Adult survival rates for Reed and Sedge Warblers. Wicken Fen Group Report 8: 23-26.

Innes, J.L. 1978. Adult survival rates for Blue and Long-tailed Tits. Wicken Fen Group Report 9: 14-16.

Innes, J.L. 1979. Annual survival of Wrens and Dunnocks. Wicken Fen Group Report 10: 16-19.

Krebs, J.R. 1971. Territory and breeding density in the Great Tit Parus major L. Ecology 52: 1-22.

Lakhani, K.H. and I. Newton. 1983. Estimating age-specific bird survival rates from ring recoveries - can it be done? J.Anim.Ecol. 52: 83-91.

Leslie, P.H. and D. Chitty. 1951. The estimation of population parameters, I. The maximum-likelihood equations for estimating the death-rate. Biometrics 38: 269-292.

Long, R. 1975. Mortality of Reed Warblers in Jersey. Ringing and Migration 1: 28-32.

Newton, I. 1972. Finches. Collins, London.

North, P.M. and R.M. Cormack. 1981. On Seber's method for estimating age-specific bird survival rates from ringing recoveries. Biometrics 37: 103-112.

O'Connor, R.J. and R.J. Fuller. 1984 (Eds.). A re-evaluation of the aims and methods of the Common Birds Census. Nature Conservancy Council CST Commissioned Research Report, British Trust for Ornithology, Tring.

Parkin, D.T. and R. White-Robinson. 1985. The effect of age on survival in the Canada Goose, Branta canadensis, in Nottinghamshire. pp. 323-340 in Morgan, B.J.T. and P.M. North (Eds.). Statistics in Ornithology. Springer-Verlag: New York.

Seber, G.A.F. 1982. The estimation of animal abundance and related parameters. 2nd edition. Griffin, London.

APPENDIX 1

RECORDING INSTRUCTIONS FOR THE PILOT SURVEY

Field trials for the 'Ringing Index'

CONSTANT-EFFORT SITES TYPE "A" (RIGID)

Type of ringing site required:

Any site of reasonably uniform and stable habitat which contains a good selection of breeding birds. It is preferable that the site should be one in which the ringers currently have established net sites and a reasonably standard netting routine. Exposed sites are unlikely to be suitable.

'Index' sites, which do not have to be particularly large, must be free from any ringing disturbance for at least one month prior to commencement of the 'Index' work in the first week of May each year. It would be advantageous to have no ringing on the site at all, other than that during the months of May to August for the 'Index' field trials. If this condition cannot be met, this does not rule out the use of the site for Ringing Index work, but full details should be supplied on the 'summary sheet'. No netting should take place, and no birds from other nets should be released, within 400 metres ($\frac{1}{4}$ mile) of any of the 'Index' net sites during the period April until the last Index visit.

Period of study:

May and June as a minimum: continued consecutive visits through until the end of August if possible.

Frequency and timing of visits:

All visits must be consecutive to be of value, with six as the minimum number (i.e. visits 1-6 covering May and June). Please do all twelve visits if at all possible, as the latter six provide most of the data on juveniles. July visits, for those who cannot continue in August, would be welcomed.

Visit periods

Visit no.	First and last dates in period for 1985	No. of included Saturdays/ Sundays
1	May 1st to May 11th	3 + 1 Public Holiday
2	May 12th to May 21st	3
3	May 22nd to June 1st	3 + 1 Public Holiday
4	June 2nd to June 11th	3
5	June 12th to June 22nd	3
6	June 23rd to July 2nd	3
7	July 3rd to July 13th	3
8	July 14th to July 23rd	3
9	July 24th to August 3rd	3
10	August 4th to August 13th	3
11	August 14th to August 24th	3
12	August 25th to September 1st	3 + 1 Public Holiday

The last date in each even-numbered visit (No.2, 4, 6, etc.) is a Saturday. In the event of inclement weather having prevented ringing on any of the dates within the period, it would be permissible to do the ringing visit on the Sunday (i.e. the first day of the subsequent even period). The interval between visits should not normally be less than six days: under no circumstances should the interval be less than three days.

The visit pattern should be repeated as far as possible in each year of the study. However, the recording forms are designed so that comparative annual totals can be adjusted during analysis, to take account of one or two visits missed in one of the years.

Netting intensity and consistency:

The amount of mist-netting used will obviously vary from one study area to another, according to the number and ability of the ringers regularly available. It is important that the net positions and the number and type (i.e. length, height and mesh) of nets remain constant for each visit in both initial and subsequent years.

Aim to have constant-time netting sessions of about six hours, and fix your time of operation in relation to the clock or to dawn or dusk. Only in the event of inclement weather should the time of day or the length of the visit be changed. If a visit is shortened to less than one-half of the normal duration by inclement weather conditions, it should if possible be repeated within the same visit period. Record the original visit data if a repeat cannot be made, but comment (on the 'summary sheet') on the early termination: assuming that the repeat visit is successfully made, discard (for the purposes of the 'Ringing Index') all the data from the original shortened visit (again comment, to the effect that it is a 'repeat visit'). Only if a bird handled during the discarded visit (either as a newly-ringed individual, or as a retrap) is captured in the repeated, or any other, Index visit should it appear on the species sheets.

Tape lures should not be used at any time during an 'Index' visit.

Recording:

The recording system has been modified, so that it now involves no more than writing down the ring number of each bird captured and entering a cross (X) against each visit number when the bird is caught.

A standard set of recording sheets (numbered 1 to 24) is provided for each Index site, together with a summary sheet. After each 'Ringing Index' visit you should record every bird you capture, except for House Sparrows. You will find that sheet numbers 1 to 20 contain sections allowing up to 50 (sheets 1 to 8), 25 (sheets 9 to 16), or 10 (sheets 17 to 20) ring number entries for both adults and juveniles and that each of these sheets has been allocated to a particular species. Please use them just for the species listed as on most sites there will prove to be adequate spaces for all but one or two species. Sheets 21 to 24, which contain a number of non-allocated sections, should be used for species not listed, or as continuation sheets when allocated sheets prove not to be adequate (in which case mark the first sheet - "cont. on p. x"). If you run out of space, use photocopies or plain paper, and attach to the set.

Ageing and sexing should be done using standard techniques (Svennson and/or Ringers Bulletin). It should be possible to age correctly all adults and juveniles in May and June, and the great majority for most species in July and August. Bear in mind that unaged or wrongly aged birds will be detrimental to the study.

Adults - any bird hatched before the current calendar year: Euring code 4, 5, 6.

Juveniles - any bird hatched in the current calendar year: Euring code 3J, 3.

/N.B. for the purposes of this study 'juvenile' is taken to include birds which have completed post-juvenile moult./

Fully-grown - any fledged bird whose year of hatching is quite unknown: Euring code 2.

Record the ring numbers of any 'fully-grown' birds in the 'juvenile' section; instead of using an 'X', enter 'FG' under the appropriate visit number.

Summary sheet:

Please enter the site name, county, coordinates and ringer/Group. Your site number (used for my records) and the year will already be on this sheet, and it would be helpful if you would enter them on each of the species sheets.

On the right-hand side of the sheet, you should fill in a short site description, dates and times of your 'constant-effort' mist-netting visits and a brief note on the weather conditions.

At the bottom of the sheet, you should enter the amount of netting used (number of nets and total length), but ignore the 'additional nets' and 'other mist-netting visits' questions, which are only relevant to Type"B"(flexible) sites.

After the sixth Index visit, and again when you have made your final Index visit, you should enter (in the appropriate columns) the total numbers of individual adults, juveniles and 'fully-grown' birds you have handled in those periods. /We have denoted these birds as NFY ("new for year")./

As soon as possible after your last visit (within two weeks?), please send the completed set of sheets to me. Receipt will be acknowledged with a photo-copy of the summary sheet. Once all results are in, the data will be analysed and a report prepared for contributors and the Ringing and Migration Committee.

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January, 1985

CONSTANT-EFFORT 'RINGING INDEX' TRIALS

SITE NO.

SUMMARY SHEET

SITE NAME:

YEAR:

COUNTY:

COORDS:

RINGER/GROUP:

	SUMMARY OF VISITS 1-6 NFY BIRDS			SUMMARY OF VISITS 1- NFY BIRDS		
	AD	JUV	FG	AD	JUV	FG
KINGFISHER						
GT SP. WOODPECKER						
SWALLOW						
TREE PIPIT						
WREN						
DUNNOCK						
ROBIN						
NIGHTINGALE						
REDSTART						
BLACKBIRD						
SONG THRUSH						
SEDGE WARBLER						
REED WARBLER						
LESSER WHITETH'T						
WHITETHROAT						
GARDEN WARBLER						
BLACKCAP						
CHIFFCHAFF						
WILLOW WARBLER						
GOLDCREST						
SPOTTED FLYCATCH.						
LONGTAILED TIT						
MARSH TIT						
WILLOW TIT						
COAL TIT						
BLUE TIT						
GREAT TIT						
NUTHATCH						
TREECREEPER						
JAY						
TREE SPARROW						
CHAFFINCH						
GREENFINCH						
GOLDFINCH						
LINNET						
REDPOLL						
BULLFINCH						
YELLOWHAMMER						
REED BUNTING						
TOTALS:						

SITE DESCRIPTION:

VISIT NUMBER	
1	DATE: TIME: TO DESCRIP. of WEATHER: COMMENTS:
2	DATE: TIME: TO DESCRIP. of WEATHER: COMMENTS:
3	DATE: TIME: TO DESCRIP. of WEATHER: COMMENTS:
4	DATE: TIME: TO DESCRIP. of WEATHER: COMMENTS:
5	DATE: TIME: TO DESCRIP. of WEATHER: COMMENTS:
6	DATE: TIME: TO DESCRIP. of WEATHER: COMMENTS:
7	DATE: TIME: TO DESCRIP. of WEATHER: COMMENTS:
8	DATE: TIME: TO DESCRIP. of WEATHER: COMMENTS:
9	DATE: TIME: TO DESCRIP. of WEATHER: COMMENTS:
10	DATE: TIME: TO DESCRIP. of WEATHER: COMMENTS:
11	DATE: TIME: TO DESCRIP. of WEATHER: COMMENTS:
12	DATE: TIME: TO DESCRIP. of WEATHER: COMMENTS:

AMOUNT OF 'CONSTANT' NETTING USED: ..... NETS = ... FEET/METRES
DELETE (/) VISIT NUMBER IF ADDITIONAL NETS WERE USED: 1,2,3,4,5,6,7,8,9,10,11,12
WERE OTHER MIST-NETTING VISITS MADE TO THE SITE BETWEEN 01 MAY & LAST 'INDEX' VISIT: YES/NO
LIST DATES OF ADDITIONAL VISITS:

SITE NAME:

RINGER/GROUP: YEAR:

SPECIES:

ADULTS RING NO.	1	2	3	4	5	6	7	8	9	10	11	12	JUVENILES RING NO.	1	2	3	4	5	6	7	8	9	10	11	12

SPECIES:

ADULTS RING NO.	1	2	3	4	5	6	7	8	9	10	11	12	JUVENILES RING NO.	1	2	3	4	5	6	7	8	9	10	11	12

SPECIES:

ADULTS RING NO.	1	2	3	4	5	6	7	8	9	10	11	12	JUVENILES RING NO.	1	2	3	4	5	6	7	8	9	10	11	12

SPECIES:

ADULTS RING NO.	1	2	3	4	5	6	7	8	9	10	11	12	JUVENILES RING NO.	1	2	3	4	5	6	7	8	9	10	11	12

Field-trials for the 'Ringing Index'

CONSTANT-EFFORT SITES TYPE "B" (FLEXIBLE)

Type of ringing site required: Any general passerine ringing site, preferably where there is a reasonable breeding population. Data from ponds (i.e. drinking/bathing areas for birds) are welcome, but should be clearly indicated as such under 'Site Description', because of potential variability in numbers caused by weather conditions.

Period of study: May and June as a minimum: continued consecutive visits through until the end of August if possible.

Frequency and timing of visits: No restrictions at all on mist-netting visits to the ringing site at any time of the year. However, bear in mind that this study is taking place during the breeding season and keep disturbance to a minimum practical level.

For the purposes of the Ringing Index, we need details from three visits per month, one in each of the visit periods listed below. Information from other visits you make should not be entered on the recording sheets.

If you make more than a single visit during one of the periods listed below, record the information from the first visit only, unless for example the first visit has been shortened by rain, in which case you should enter only the data from the second visit.

Try to ensure that there are at least three days (preferably more) prior to each Index visit, during which no ringing takes place on the 'constant-effort' site. If no visits are made during a particular 'visit period', supply data from your nearest available visit (either before or after the 'visit period' that has been missed).

Visit periods

Visit no.	First and last dates in period for 1985	No. of included Saturdays/ Sundays
1	May 1st to May 11th	3 + 1 Public Holiday
2	May 12th to May 21st	3
3	May 22nd to June 1st	3 + 1 Public Holiday
4	June 2nd to June 11th	3
5	June 12th to June 22nd	3
6	June 23rd to July 2nd	3
7	July 3rd to July 13th	3
8	July 14th to July 23rd	3
9	July 24th to August 3rd	3
10	August 4th to August 13th	3
11	August 14th to August 24th	3
12	August 25th to September 1st	3 + 1 Public Holiday

The visit pattern should be repeated as far as possible in each year of the study. However, the recording forms are designed so that comparative annual totals can be adjusted during analysis, to take account of one or two visits missed in one of the years.

Netting intensity and consistency: The amount of mist-netting used will obviously vary from one study area to another. An advantage of the Type "B" (flexible) constant-effort sites is that you can have the

standard sets of nets required for the Ringing Index, and then add extra nets according to the prevailing circumstances on each visit. You must, of course, exclude from the Index recording forms any birds caught in these extra nets.

It is important that the numbers, positions and lengths (and preferably also type and height) of the Index nets remain constant for each visit in both initial and subsequent years. Aim to have constant-time netting sessions, and try to fix your commencement in relation to dawn or dusk.

Whilst it is not sensible to fix a definitive minimum for the number of 'constant-effort' nets required, as this will depend mainly on the particular site involved, it is unlikely that less than three would prove to be of great value: six to twelve would probably be more usual, depending on the number and abilities of the personnel regularly available.

The 'Index' nets can form a separate section of the overall netting site, or may have other nets mixed in with them: if the latter, the 'Index' nets should normally form at least 50% of the total nets. Obviously the less 'interference' from other nets the better.

Tape lures should not be used at any time during an 'Index' visit.

Recording:

The recording system has been modified, so that it now involves no more than writing down the ring number of each bird captured and entering a cross (X) against each visit number when the bird is caught.

A standard set of recording sheets (numbered 1 to 24) is provided for each Index site, together with a summary sheet. After each 'Ringing Index' visit you should record (with just two exceptions, mentioned below) every bird you capture in any of the 'constant effort' nets. You will find that sheet numbers 1 to 20 contain sections allowing up to 50 (sheets 1 to 8), 25 (sheets 9 to 16), or (10 sheets 17 to 20) ring number entries for both adults and juveniles, and that each of these sections has been allocated to a particular species. Please use them just for the species listed, as on most sites there will prove to be adequate spaces for all but one or two species. Sheets 21 to 24, which contain a number of non-allocated sections, should be used for species not listed, or as continuation sheets when allocated sheets prove not to be adequate (in which case mark the first sheet - "cont. on p. x"). If you run out of space, use photocopies or plain paper, and attach to the set.

N.B. Every bird captured in an 'Index' net, whether already ringed or not, should be recorded on the sheets unless (a) it is a House Sparrow, or (b) it has been caught earlier during the same mist-netting visit in a non-Index net. /The exclusion of these latter birds is necessary to obtain consistency in treatment: we cannot afford to have variations between sites, or even from visit to visit on the same site, in the way in which 'same-day retraps' are recorded./

Ageing and sexing should be done using standard techniques (Svennson and/or Ringers Bulletin). It should be possible to age correctly all adults and juveniles in May and June, and the great majority for most species in July and August. Bear in mind that unaged or wrongly aged birds will be detrimental to the study.

Adults - any bird hatched before the current calendar year: Euring code 4, 5, 6.

Juveniles - any bird hatched in the current calendar year: Euring code 3J, 3.

/N.B. for the purposes of this study 'juvenile' is taken to include birds which have completed post-juvenile moult./

Fully-grown - any fledged bird whose year of hatching is quite unknown: Euring code 2.

Record the ring numbers of any 'fully-grown' birds in the 'juvenile' section; instead of using an 'X', enter 'FG' under the appropriate visit number.

Summary sheet:

Please enter the site name, county, coordinates and ringer/Group. Your site number (used for my records) and the year will already be on this sheet, and it would be helpful if you would enter them on each of the species sheets.

On the right-hand side of the sheet, you should fill in a short site description, dates and times of your 'constant-effort' mist-netting visits and a brief note on the weather conditions.

At the bottom of the sheet, you should enter the amount of constant-effort netting used, indicate whether additional netting was used during these visits, and list dates (e.g. as, say, 07/05; 12/08 etc.) of non-Index visits.

After the sixth Index visit, and again when you have made your final Index visit, you should enter (in the appropriate columns) the total numbers of individual adults, juveniles and 'fully-grown' birds you have handled in those periods. /We have denoted these birds as NFY ("new for year")./

As soon as possible after your last visit (within two weeks?), please send the completed set of sheets to me. Receipt will be acknowledged with a photo-copy of the summary sheet. Once all results are in, the data will be analysed and a report prepared for contributors and the Ringing and Migration Committee.

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January, 1985

Conducting 'point-counts' at constant-effort mist-netting sites

Introduction

The C.E.S. Technical Review Group has been asked, by the Ringing and Migration Committee, to carry out a detailed investigation of the scientific potential of constant-effort netting. Of primary importance to the Review Group, is to know whether or not the sampling of populations of passerine birds during the breeding season, by constant-effort mist-netting, provides data which reflect the true structure of that population. These data can only be tested statistically against a totally independent estimate of the population structure, obtained by the use of some quite different surveying technique.

The territory (or cluster) mapping method, as operated in the Common Birds Census, would provide excellent comparative material, but is rather time consuming. However, the 'point-count' technique, which is quite widely used on the Continent and in America to obtain estimates of population density, is much less demanding of field and desk time, and should provide adequate information for our purposes. We request that 'point-counts' be done at all constant-effort sites during 1985 and 1986.

A pilot survey was done on two constant-effort netting sites in 1984; the counting was found to be interesting and enjoyable, and the results were in line with capture totals for adults. We need 'point-counts' done at all of your sites as well, though, in order to provide full validation of constant-effort netting.

Setting-out a 'point-count' survey

(i) Number of points at which to count: 3 to 7 (aim to do 5, if possible)

Most netting sites are of a modest size and it is possible that, on a few, all (or most) birds that are singing could be heard from one point! Unfortunately, though easy to survey this would not provide enough information for later analyses: so we are requesting you to count from a minimum of 3 points. Because you will normally be doing the counts during constant-effort netting visits (see (iii) below), we are also restricting the maximum number of points, for large sites, to 7.

(ii) Positioning of point-count centres: 60 to 150 metres apart

Select suitable points within your constant-effort netting area from which to look for and listen to birds. These points should be easily approachable, with minimal disturbance to nearby bird life and, once located, should be clearly marked on the 'ground', and on a map, so that exactly the same point is used for each count in 1985 and 1986. No point-count centre should be more than 25 metres from some part of the nearest c.e.s. net. Number each point (from 1 to 7) and always use the same number for the same point. Try to ensure that the inner recording zones (30 metre radius circles - see (vi)) are typical of the breeding (and mist-netting) habitat.

(iii) Number and timing of counts: 3, to be done during c.e.s. visits 1 or 2; 3 or 4; and 5 or 6

Resident species tend to nest early, migrants later. We need to cover both, and also try to ensure that we do not totally miss species which

have short song periods, e.g. Sedge Warblers and Lesser Whitethroats. Try to do your counts during c.e.s. visits 1, 3 and 5. If counts are done other than during a c.e.s. visit, this should be noted on the Recording Sheets (see (ix) below). The minimum interval between counts - if one has been delayed - should be 7 days. Avoid inclement weather for counts.

(iv) Length of count at each point: 8 minutes exactly, commencing immediately on entering the 30 metre recording circle (see v)

Birds generally tend to move away from the observer as he approaches the point-count centre. If they were initially within the inner recording zone (a 30 m radius circle (see vi)), they should be recorded there, rather than in the outer zone (beyond 30 m (see vi)), or density estimates will be biased; so start your stop-watch as you walk into the inner circle, and commence recording from that moment. A period of 8 minutes should enable you to record the majority of birds within sight or sound: a longer time span would produce proportionally fewer new records, and would allow more bird movement to occur, with potential duplication of records.

(v) How many points to be counted on each visit?: All that you have set out on your c.e.s. site (range 3 to 7 (see (i))

Only under exceptional circumstances (such as heavy rain, causing cessation of both netting and 'counts') should the point-counts be split between two days/c.e.s. visits. Even then, it would be better to do a complete recount at all points during the latter visit. Vary the order in which you do your counts on the three visits (e.g. if you have four points to count: 1,2,3,4; 2,4,3,1; 4,1,3,2 would be appropriate variations in the order of counting).

(vi) Recording zones: **Within** 30 metres, and **beyond** 30 metres

There is a sudden falling-off in the detectability distance of birds that varies in a species-specific manner. However, within a circle of 30 metres radius most mobile birds of all species should be detected during a recording period of 8 minutes (see (iv)). In the past, it has only been possible to calculate densities of bird populations if the distance from the observer to each individual has been recorded during the 'point-count'. However, Steve Buckland, a member of the C.E.S. Technical Review Group, has developed a method of calculating these densities based just on the two zones listed above: so, please, also record all birds heard or seen beyond 30 metres. [Note that birds flying over should be excluded, though birds seen in song/display flight are to be included, e.g. Skylark, Lesser Redpoll, Whitethroat.]

A particular difficulty that may occur on many c.e. sites, is that a loud song (say from a Song Thrush perched high in a tree) may be heard from all 'point-count' centres, because the whole site is quite small. Though it will not totally resolve the problem, it will help during analysis if all birds that are estimated to be more than 100 metres from the observer are marked as such (see attached Recording Sheet for details).

(vii) Time of day for counts: preferable 1 to 4 hours after dawn

Counts should not be made during the first hour after dawn, or the last hour before dusk, because of the rapid changes in the numbers of birds singing. Avoid counts during the afternoon, but early evening is acceptable if your c.e.s. netting is done then. Ensure, however, that all of your counts are done at approximately the same time of day.

(viii) Training/experience required to do 'point-counts' successfully

(a) Decide first who is going to do the point counts on your c.e. site, and then ensure that he/she does all counts (if possible) during both 1985 and 1986. (This is because we are trying to obtain comparative data from the two years, and wish to minimise the number of variable factors.)

(b) The person chosen should know all bird-songs and calls likely to be encountered. Experience in CBC work will be especially helpful in this respect. Beware particularly of the similarities of Garden Warbler and Blackcap songs (my own pet hate!), and those of Reed and Sedge Warblers.

(c) Practice the estimation of 30 metre (and 100 metre) distances in appropriate habitat: use your c.e. site for this if possible during the early part of the season, deciding where the 30 metre (and 100 m) radius circles are from each point-count centre. Measure your distances accurately during this training stage (8.20 x 12 ft mist net poles are equal to 30 metres).

(d) Carry out some trial counts during April, to gain in expertise. Don't forget that we only want one record for each bird located during a count. Try to follow the movements of any mobile birds, so that you do not duplicate them when they reappear in a new place*. Avoid being flustered in the first minute or two of a count - 8 minutes is quite long, and will give you time to sort everything out.

* If during a count you locate a bird which you know to have been recorded during an earlier count from a different point, you should still record it as normal.

(ix) Completion of the Recording Sheets

Some guidance notes are given on the Sheets.

You will find the Sheets are rather cramped for entry space, but this will help to minimise both your paperwork, and save on postage costs. Please try to avoid errors when using the Sheets - it will be easy to put an entry in the wrong row or column if you are not careful. An example of a completed form is attached. Three blank sets of two Sheets each (numbered for 'point-counts' 1-4, and 5-7) are also enclosed, one set for each of the three counts (see (iii)).

(x) Returning Recording Sheets

Please return the completed sheets to me immediately after the third count, so that all analyses can be done before most c.e.s. returns begin to arrive at the end of August.

Mike Boddy,
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Notts.
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POINT-COUNTS AT CONSTANT-EFFORT NETTING SITES

Date: Time: Observer: SITE NO.

Weather: YEAR

Remarks: Site name:

	POINT				POINT				POINT				POINT			
	0-30 m		Over 30 m		0-30 m		Over 30 m		0-30 m		Over 30 m		0-30 m		Over 30 m	
	SONG	OTH.	SONG	OTH.	SONG	OTH.	SONG	OTH.	SONG	OTH.	SONG	OTH.	SONG	OTH.	SONG	OTH.
WREN																
DUNNOCK																
ROBIN																
BLACKBIRD																
SONG THRUSH																
SEDGE WARBLER																
REED WARBLER																
LESSER WHITETHROAT																
WHITETHROAT																
GARDEN WARBLER																
BLACKCAP																
CHIFFCHAFF																
WILLOW WARBLER																
GOLDCREST																
SPOTTED FLYCATCHER																
LONGTAILED TIT																
MARSH TIT																
WILLOW TIT																
COAL TIT																
BLUE TIT																
GREAT TIT																
TREECREEPER																
CHAFFINCH																
GREENFINCH																
GOLDFINCH																
LINNET																
REDPOLL																
BULLFINCH																
YELLOWHAMMER																
REED BUNTING																

Notes: (a) This form should be used for your fieldwork, fastened to a clipboard, or fixed to a piece of ply or hardboard using elastic bands.

(b) If you have four or less 'points' from which to count, use the form numbered Point 1 . . . to Point 4; otherwise use both forms. (Always use the same number for a particular 'point'.)

(c) Use the 'SONG' column for any bird heard singing.

(d) Use the 'OTH.' column for any other record of a bird seen or heard: exclude birds obviously flying over without stopping.

(e) Observe in all directions around you (i.e. from the 'point') and, record all observations you estimate to be within 30 metres in the '0–30 m' column.

(f) All other observations should be recorded in the 'OVER 30 m' column.

(g) Mark your records 𝍸 etc.

(h) Mark all records over 100 metres with a cross - 𝍸