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A REVIEW OF ROOK STATUS, WITH NEW SOUTH PEMBROKESHIRE DATA, 1986 - 1996

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ABSTRACT

The rook population of southern Pembrokeshire was surveyed using nest counts during two breeding seasons, ten years apart (1986 and 1996). The results were compared over the study period, and analysed with reference to published data for this and other regions. The rookeries were non-randomly distributed, mainly on mixed farmland with limestone soils. Changes in the numbers of rook nests through time were variable within the study area, ranging from nest increases of over 30% in the south-west (Dale, Angle and Castlemartin), to decreases of 47% in the south-east of the county. The average size of rookeries was stable in the south, increased in the west, and decreased in the east. The overall size distribution of rookeries did not alter much between 1986 and 1996, and was similar to that seen in Pembrokeshire in 1975. The number of individual rookeries decreased by as much as 53%, except on the Castlemartin peninsula where an increase of 38% was noted. Overall, there was a slight decrease in total rook nest numbers of about 7% between the two south Pembrokeshire surveys. In contrast, at the national (UK) level, there were estimated increases of about 7% between 1975 and 1980. Subsequent national increases ranging from 5% to 14% were suggested by a combination of results of the Common Birds Census (CBC) and the Breeding Bird Survey (BBS), over the period 1986-1998. A national census in 1996 recorded an increase of about 40% (UK) and 36% (Wales) since 1975. Although parts of south Pembrokeshire have followed these national trends, the general trends there over the last 25 years have been declines between 1971 and 1975, and between 1986 and 1996, with an intervening period (1975-1980) of from 10 to 44% increase. South Pembrokeshire thus appears to be rather uncoupled from the UK trends in rook status, as has been noted for other common resident birds. The BBS report (1999) for the first time showed data between 1994-1998 separately for Wales and Scotland, and indicated a 7% decline in Welsh rooks and a 65% increase in Scotland. Bearing in mind the periods between previous full surveys (20 - 30 years), the strong regional variations, and the decline of many farmland species, it is recommended that more regular rook surveys be carried out at national level, and that local and regional surveys be better co-ordinated during intervening years.

INTRODUCTION

The nominate race of the rook, *Corvus frugilegus* L., 1758, is widely-distributed across the temperate and boreal Palearctic, as far north as 66°N, and east to the Yenisey River and north-western Altai mountains, at altitudes less than 600 m. The subspecies *C. f. pastinator* Gould, 1845, breeds in the central Altai, trans-Baikal, Mongolia and China up to 2,000 m altitudes, and migrates to Korea, Japan and southern China. Madge & Burn (1994) called the rook "a unique crow, its strongly sociable lifestyle and naked face setting it apart from all other northern corvids." Details of rook natural history can be found in Yeates (1934), Coombs (1978) and Cramp & Perrins (1994). It undoubtedly occupies an important place in the rural landscape and cultural life of Britain (Blackburn, 1899).

There are over thirty European nations supporting rook populations, concentrated in two breeding strongholds: one in the countries surrounding the North Sea and southern Baltic Sea, and the other in eastern Europe (mainly Hungary, Romania, Poland, Ukraine, Belarus) and Russia. Western birds are generally sedentary, but in harsh winters tend to move to southern Europe. Those in eastern Europe migrate south in winter towards the Black and Caspian Seas, the middle east and especially Iran (Hagemeijer & Blair, 1997). Very large flocks of rooks move south in October and November over Orenburg (southern Russia) and Aksai (western Kazakhstan), returning in March to Russia. Breeding birds from the easternmost portion of the *C. frugilegus* range in Siberia pass Chokpak, near Almaty in SE Kazakhstan, on their way to winter quarters mainly in NW India. Detailed studies of migrating rooks have been conducted at Chokpak, between 1967 and 1980, by Gavrilov & Gistsov (1985). Spring migrations reached 28,000, peaking in mid-March, and over 10,000 in the autumn, peaking in early October.

In the mid-twentieth century, there were serious declines in rook numbers across Britain and northern Europe (Netherlands, Denmark, Sweden, Poland and Russia), as a result of farming changes, pesticides and persecution (Brenchley, 1986). The rook, at the moment, appears to be stable and is considered secure in Europe (Tucker & Heath, 1994) with an estimated population of at least 3.5 million breeding pairs in western Europe alone. There is also some evidence that rook status can be increased by positive changes in the farming landscape. For example, tall trees are essential for nesting rooks, and the shelter-belts planted in the, otherwise treeless, steppes during the 1950s have resulted in an expansion of the Russian and Ukrainian rook population. Based on extrapolated data, Ukraine had an estimated 2.5 million nests in 1984, an overall density of 4.1 nests km^{-2}, close to the UK average (Serebryakov & Grishchenko, 1990).

In contrast, rook populations in the Netherlands decreased by as much as 80% between 1944 and 1970 due to control methods, including shooting (Feijen, 1976). In Latvia, there was a reduction from 16,000 to 8,000 nests between the mid-1970s and the mid-1980s, again due to hunting pressure (Hagemeijer & Blair, 1997). Shooting took place at more than 60% of Dumfriesshire rookeries in 1993 (Skilling & Smith, 1993). In an isolated rook population in Leon province, NW Spain, Ena (1984) also found a decline between 1976 and 1979. *C. f. pastinator* is comparatively scarce, the trans-Baikal and Chinese population having declined between the 1940s and 1985 (Madge & Burn, 1994). Persecution could also be a factor here.

Rooks mainly occupy mixed farmland (arable and permanent grassland) habitats, building conspicuous nests in tall trees, and often within small villages and hamlets. An act of Parliament in 1424 made legal provision for the destruction of rooks in England. The techniques included netting of cornfields and shooting of young birds in the nests, and young rooks were apparently an item of culinary interest (Coombs, 1978). Current opinion is doubtful whether deliberate persecution makes much difference to rook numbers in Britain (Marchant & Gregory, 1999). Under section 16 of the Wildlife and Countryside Act 1981, the rook may be controlled at any time. Nevertheless, under the European Directive on the Conservation of Wild Birds (EC/79/409), the UK Department of Environment, Transport and Regions (DETR) has an obligation to monitor populations of opportunist birds, including those that may represent pest species. The 1996 national survey was sponsored by DETR to assess the UK status of the rook, and the effects on rooks of the general pest control licence. The rook is probably neutral to agriculture, taking not only newly-sown crops, cereals and vegetables, but also their invertebrate pests.

British Trust for Ornithology (BTO) surveys conducted since 1943-1946 have revealed numerous fluctuations in rook numbers, some of which have only been partly explained. Until 1996, there was little to indicate how rooks had fared since the national survey of 1975 -1977 . Marchant & Gregory (1999) have most recently discussed the 1996 UK status of the rook, under contract to DETR, as described above. Their report estimated an increase in rooks of up to 41% since 1975, but some regional surveys report declines of around 30%, for example in Kent (Martin, 1997), Greater Manchester (Smith, 1997), and Sutherland (Bremner & MacDonald, 1996). The present paper is intended to:

- present Pembrokeshire data to contribute to this discussion for 1986-1996;
- comment on the overall status of the rook, whose widespread and mainly sedentary distribution in the UK makes it an excellent monitoring target;
- suggest an interesting topic for a student project that is available in most parts of the country (except uplands and city centres), between late February and April;
- encourage readers of *Field Studies* to continue the simple and enjoyable task of monitoring rook numbers, not least because of the ongoing serious declines in most farmland bird populations.

Methods

Rooks' nests may be easily counted before the appearance of leaves in mid- to late-April in Pembrokeshire's deciduous woodlands and copses. Conspicuous, noisy and gregarious behaviour makes the rook easy to locate, as they usually feed outside woodlands and nest in tall trees (Lack & Venables, 1939). The western European rook population is known reasonably accurately, mainly because it can be counted relatively easily. However, there are difficulties in counting nests in conifers, multiple nests, in very large rookeries, or when counting from a distance. Ratcliffe (1997) indicated that rooks sometimes have young as late as November, but this habit is unlikely to affect the estimates made during the main breeding season, after the March peak in nest construction. Dunnet & Patterson (1968) pointed out that counts made later in the season approximate the maximum count, but suffer the disadvantage that as leaves appear, the visibility of nests declines. Yeates (1934) showed that new nests are constructed as late as early April, but that multiple nests usually only represent one breeding pair. Griffin (1999) has found 21 April as the modal date of maximum counts of 18 rookeries in Durham, and suggested counts should be made after 9 April but before the appearance of leaves (about 25 April). Griffin's suggested correction factor (division by 0.8) for counts made before this asymptote was not applied in the present study, but repeat counts were made at several rookeries near Pembroke, and so the effect of under-counting should be minimal.

Marchant *et al.* (1990) suggested that the rook is best counted during single-species surveys, and is not well represented on Common Birds Census (CBC) plots. For example, in the Pembroke Upper Millpond local nature reserve between 1981 and 1986, rooks were seen only in 1985 and 1986, but were not holding CBC territories (Little & Shaw, 1994). Unpublished census studies at Orielton between 1986 and 1989 also showed no territorial rooks at Limebridge Wood, although two individuals were seen in June 1987. Sage & Vernon (1978) summarise the field method, whereby rookeries are defined as any group of rook nests 100m or more from the nearest neighbouring group. In the present work, no attempt was made to differentiate between active and unoccupied nests, except in the smaller rookeries. Nor were the tree species in use by nesting rooks noted. This was done in both the 1975 and 1996 national surveys (Marchant & Gregory, 1999).

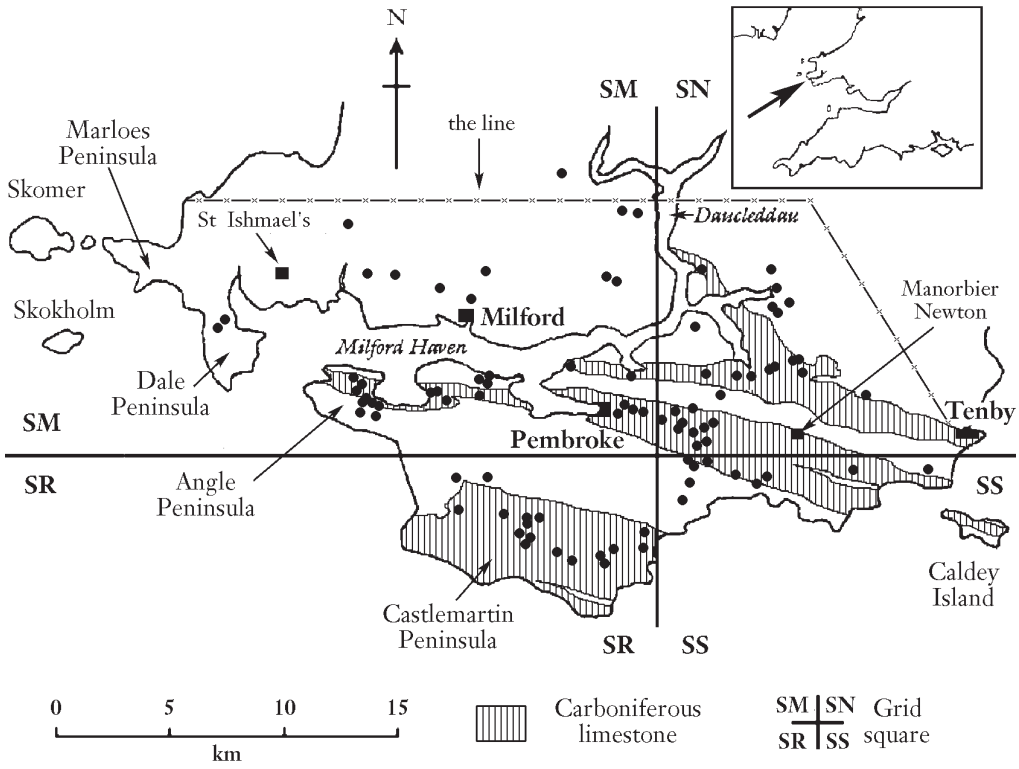

FIG. 1
Locations, ●, of south Pembrokeshire rookeries counted in 1986 and/ or 1996

Two surveys of southern Pembrokeshire's rookeries were conducted between late-February and late April in 1986 and 1996. The 1986 survey was reasonably complete for the southern quarter of the county, and the area covered (~390 km^2) is shown in Figure 1. Note that both surveys omitted rookeries north of the line (labelled in Fig. 1) connecting the villages of St Brides, Walwyn's Castle, Tier's Cross and Johnston, and also within St. Ishmael's, Manorbier Newton and Tenby. Although repeating the earlier survey, the 1996 survey (~340 km^2) omitted the Daucleddau estuary upstream of Llangwm, and also the area near Cresswell Quay. These areas were thus only included in estimates of mean sizes of rookeries, density and nearest neighbour analyses for 1986. Comparisons were made between matched pairs of rookeries between 1986 and 1996, and also of the full data set within the core area, excluding the above areas surveyed only in 1986.

Authorities for the other species of birds mentioned in the text are given by Cramp & Perrins (1994) and Witherby *et al.* (1943).

RESULTS AND DISCUSSION

The raw counts are presented in Tables 1 to 4, divided by 100 km squares of the National Grid Reference (NGR) system. Although arbitrary, the division of the study area into four 100km squares had the advantage of avoiding potential bias, since the counters all lived near the junction of the four squares in Pembroke. As a result, the level of counting effort, in particular of repeat counts, was more evenly distributed among the squares. The locations of rookeries are shown in Fig. 1, which illustrates the clumped distribution.

TABLE 1: Rook nest counts in south Pembrokeshire grid square SM, 1986-1996.

Site Number	Location	NGR	1986 count	1996 count
SM1	Dale, Blue Anchor	806057	130	160
SM2	Dale	809060	11	0
SM3	Capeston	864097	22	Not counted
SM4	St. Botolph's	891077	22	Not counted
SM5	Milford Haven	911069	19	12
SM6	Herbrandston	872077	0	39
SM7	Upper Scoveston	929074	72	28
SM8	Houghton	980071	9	Not counted
SM9	Williamston	988070	13	Not counted
SM10	Middle Hill	956118	59	Not counted
SM11	Llangwm	987095	22	Not counted
SM12	Black Tar Point	998094	12	Not counted
SM13	Angle	865030	12	14
SM14	Angle Estate #1	870028	18	29
SM15	Angle Estate #2	871024	61	74
SM16	Angle Estate #3	872023	0	31
SM17	Hardingshill	875019	22	10
SM18	Jeffersonwalls	874015	34	55
SM19	West Angle Road	869016	0	2
SM20	Eastington	901025	10	24
SM21	Rhoscrowther	903023	2	16
SM22	East Pwllcrochan	921032	0	22
SM23	West Pwllcrochan	918034	30	102
SM24	Upper Hentland	918024	60	35
SM25	Pembroke Dock	961035	72	45
SM26	Monkton	972011	9	12
SM27	Bangeston Hall	991030	21	0
SM28	Grove	991007	8	19
SM29	Pembroke #1	992011	14	21
SM30	Pembroke #2	996010	9	7
SM31	Pembroke #3	999009	2	4

South Pembrokeshire rook numbers and density

The overall changes in the number of rook nests were not dramatic during the period 1986 to 1996 (Table 5). There was a 6.9% reduction from 1,243 to 1,157 nests when comparing matched pairs of rookeries (allowing apparent movement of the rookery no more than about 100m between surveys, and thus following the definition of Sage & Vernon, 1978). Comparing all rookeries (and thus allowing for possible movements of rookeries of up to about 2,000m between surveys), there was a reduction from 1,452 to 1,343 nests (-7.5%). By either method of comparison, a slight decrease is likely to have occurred in south Pembrokeshire's rook population in the decade up to 1996.

However, looking at the four 100 km grid squares separately, decreases (of at least 47%) were evident only in squares SN and SS, the two eastern-most squares in the study area (Table 5). Note that for square SN, only a few rookeries were involved in the comparisons. Squares SM and SR in the west had increased by 6.9% and 37% respectively (matched pairs of rookeries only), or by almost 14% and 30% respectively (all rookeries). However, only the Castlemartin Peninsula showed an increase in the number of rookeries (38%). Rookery numbers decreased elsewhere by between 9 and 53%. The main rook nest decreases were

TABLE 2: Rook nest counts in south Pembrokeshire grid square SN, 1986-1996.

Site Number	Location	NGR	1986 count	1996 count
SN1	Garron Pill	019078	28	Not counted
SN2	Cresswell Bridge	051072	28	Not counted
SN3	Cresswell Arms	051068	20	Not counted
SN4	Cresswell	050065	18	Not counted
SN5	Carew Mountain	051059	11	Not counted
SN6	Freestone Hall	054056	11	Not counted
SN7	Cresselly	062060	16	Not counted
SN8	West Williamston	034055	37	Not counted
SN9	Upton	019048	111	Not counted
SN10	Sageston #1	060032	12	Not counted
SN11	Sageston #2	057032	Not counted	43
SN12	Coachlands	069034	Not counted	20
SN13	Carew Cheriton	046029	29	Not counted
SN14	Milton	039029	28	28
SN15	Upper Nash	029021	33	Not counted
SN16	B4318	072028	74	Not counted
SN17	Ivy Tower	090023	6	Not counted
SN18	North Down	008012	22	0
SN19	Windsor	015013	8	Not counted
SN20	Lamphey #1	014008	5	0
SN21	Lamphey #2	018006	10	Not counted
SN22	Lamphey #3	011003	5	0
SN23	Lamphey #4	013003	15	0
SN24	Lamphey #5	016004	17	3
SN25	Lamphey #6	017002	5	11
SN26	Lamphey #7	014000	6	2
SN27	N. Upper Nash	023028	Not counted	29

seen in Pembroke Dock, Bangeston Hall, Lamphey, Hodgeston and Manorbier (mostly in grid squares SN and SS). The reasons for these decreases are uncertain, but may have resulted from different arable farming regimes in the south-east, combined in some cases with persecution. The Pembrokeshire early potato industry is currently in difficulties, and this may have resulted in increased grassland in the western and southern districts (Donovan, pers. comm.). Whatever the main adverse factors on the rook population might be in south Pembrokeshire, these factors appear to predominate in the eastern squares, whereas a perhaps more favourable balance of food resources (arable, pastoral, and possibly coastal) is accessible to the western rooks.

In previous Pembrokeshire records dating back to 1894, summarised by Donovan & Rees (1994), rooks were widely-distributed except in the Preseli Hills (North Pembrokeshire), on the offshore islands and in eastern Pembrokeshire. The 1943-1946 BTO census recorded 9,664 nests in 147 Pembrokeshire rookeries (average 66 nests/rookery). Barrett (1959) mentioned 105 nests at Blue Anchor Wood, Dale. For the BTO atlas between 1968 and 1972, breeding was confirmed in every 10km square within the study area, except western Marloes Peninsula and the offshore islands (Sharrock, 1976). Skokholm and Skomer Island reports indicate very rare rook sightings in March/April and June respectively (Barrett, 1959; WWNT, 1974), and more regular occurrences in mixed

TABLE 3: Rook nest counts in south Pembrokeshire grid square SR, 1986-1996.

Site Number	Location	NGR	1986 count	1996 count
SR1	Castlemartin	911990	11	0
SR2	Brownslade	911977	7	69
SR3	Corston	928992	11	0
SR4	North Merrion	938974	67	44
SR5	East Merrion #1	944970	0	5
SR6	East Merrion #2	945968	0	18
SR7	East Merrion #3	943967	0	2
SR8	Thorne	946965	0	8
SR9	Hayston	944964	0	4
SR10	Loveston	949970	23	0
SR11	Bosherston	963950	4	31
SR12	Stackpole #1	977958	87	0
SR13	Stackpole #2	973956	0	14
SR14	Stackpole #3	975955	0	14
SR15	Stackpole Quay #1	991964	4	0
SR16	Stackpole Quay #2	992959	3	74

corvid flocks in the autumn (Sutcliffe, pers. comm.). Saunders (1986) reported post-breeding rooks in the Preseli Hills and even on Grassholm Island. Wintering was confirmed in every 10km square in Pembrokeshire with numbers below 3.4 birds km^{-2}, but wintering rooks were more numerous in the Dale and Angle areas (from 3.4 to 8.9 birds km^{-2}). Wintering rooks were also confirmed in the western Marloes Peninsula and the offshore islands (Lack, 1986).

Pembrokeshire had 10,109 nests in 281 rookeries (average 36 nests/rookery) in 1971, but this had declined by 18% to 8,280 nests in 268 rookeries (average 31 nests/rookery) in 1975 (Saunders, 1971; Donovan & Rees, 1994). This decline in numbers of nests was greater than the 11% decline reported for Pembrokeshire by Sage & Vernon (1978) for the same period. There was an average of 5.2 nests km^{-2} in 1975 (Sage & Vernon, 1978), generally higher than those calculated for 1986 and 1996 (Table 6). From the 1975 maps presented by Sage & Vernon, there were between 1.0 and 9.9 nests km^{-2} over most of Pembrokeshire, except the area around Carmarthen Bay (from 0.1 to 0.9 nests km^{-2}), and

TABLE 4: Rook nest counts in south Pembrokeshire grid square SS, 1986-1996.

Site Number	Location	NGR	1986 count	1996 count
SS1	South Lamphey #1	012999	0	5
SS2	South Lamphey #2	014998	12	11
SS3	South Lamphey #3	017999	7	0
SS4	Portclew	013988	27	14
SS5	East Trewent	012977	19	0
SS6	Hodgeston	031994	108	63
SS7	Moor Farm West	041985	0	9
SS8	Calvesland	046988	16	0
SS9	Manorbier	064983	45	12
SS10	Norchard	082995	57	49
SS11	Penally	115994	19	0

TABLE 5: Summary of changes in Pembrokeshire rook nest counts, 1986-1996.

	All comparable rookeries			Matched pairs of rookeries		
Year 100km grid square	1986 Nests	1996 Nests	percentage change	1986 Nests	1996 Nests	percentage change
SM	668	761	13.9	624	667	6.9
SN	257	136	-47.1	103	44	-57.3[A]
SR	217	283	30.4	206	283	37.4
SS	310	163	-47.0	310	163	-47.0
Totals	1,452	1,343	-7.5	1,243	1,157	-6.9

[A]= small sample size (<10)

the Preseli Hills. This equated to between 21 and 40 rookeries per 10 km square from Haverfordwest to Cardigan, but under 20 rookeries per 10 km square in the present study area.

The second BTO breeding bird atlas was based on surveys that were carried out from 1988 to 1991 (Gibbons *et al.*, 1993). The rook abundance map given in this atlas agrees well with the general patterns found in the present survey between 1986 and 1996, with greater relative abundance in grid squares SM and SR than in the eastern squares. Judging by our data, square SS was, however, a rather separate case, with a density of 5.6 nests km^{-2} in 1996, even after a 47% decline since 1986 (Table 6). The general trend of higher abundance in western Pembrokeshire that was mapped by Gibbons *et al.* appeared to continue to 1996, although Donovan & Rees (1994) suggested that colonisation of the east was occurring. The second breeding bird atlas (Table 13 in Gibbons *et al.*, 1993) also suggested that the habitat range of the rook was contracting nationally, although there is no evidence of this in the general distribution maps they presented. Indeed, Gibbons *et al.* themselves saw no noteworthy differences between the 1968-1972 and 1988-1991 atlas databases. In Pembrokeshire, breeding was indicated by Gibbons *et al.* in the western Marloes Peninsula (but not the offshore islands) during fieldwork for the 1988-1991 atlas, although this may have been a mapping error (Rees, pers. comm.).

Hughes (1993) counted up to 22 rookeries between 1986 and 1993 within 16 km of Haverfordwest, and found the numbers to be generally stable. Large declines at three rookeries were the result of trees being felled or of deliberate persecution, but numbers overall were maintained, possibly by redistribution among other rookeries.

South Pembrokeshire rookery size distribution

Between 1986 and 1996, the size frequency distribution of south Pembrokeshire's rookeries

TABLE 6: Rook nest densities for 1986 and 1996 in south Pembrokeshire.

100km grid square	Nests km^{-2} (1986)	Nests km^{-2} (1996)
SM	3.5	4.0
SN	2.5	2.6
SR	3.3	4.3
SS	10.7	5.6

TABLE 7: Size frequency distribution of Welsh (Marchant & Gregory, 1999) and south Pembrokeshire (this study) rookeries.

Number of nests	Percentage Wales 1975	Percentage South Pembrokeshire 1986	Percentage Wales 1996	Percentage South Pembrokeshire 1996
1-20	59	58	61	53
21-40	24	23	19	23
41-60	9	6	4	11
61-80	4	7	11	9
81-100	2	1.5	3	0
101-120	2	3	2	2
>121		1.5		2

remained broadly similar (Kolmogorov-Smirnov two-tailed test, D=2.45, no significant difference in cumulative size distribution). Over half the rookeries were of less than 20 nests in both years (Table 7). About the same proportion in both years (4%) had more than 100 nests. However, there was some evidence that more rookeries were found in the middle size range (41 to 80 nests) in 1996 (20%) compared with 1986 (13%).

Grid square SS had a greater proportion of rookeries of less than 20 nests in 1996 (72%) compared with 1986 (56%). Combined with a smaller nest count, this reflects a reduction in the rook population in square SS, particularly noticeable at Manorbier and Hodgeston. Grid square SN had no rookeries of more than 60 nests observed in 1996 compared with 8% above 60 nests in 1986, probably the result of a very small 1996 sample.

Rook nests in grid square SM increased in total in spite of seven rookeries not being re-counted in 1996, with the rise occurring mainly in rookeries with between 21 and 40 nests. There were also an additional 70 nests found in 1996 near Pwllcrochan Flats on the southern shore of Milford Haven, making a total of 102 nests in 1996. This colony is also the main winter roost for the area, attracting birds across Milford Haven (Rees, pers. comm.). Other winter roosts are found near the Mariners Hotel (Haverfordwest), at Decoy Lake (Orielton) and in the Carew/Cresswell River area. The large rookery at Dale (also square SM) had also grown from 130 to 160 nests between 1986-1996, continuing the growth from 105 nests in 1958 (Barrett, 1959). Sage & Whittington (1985) found a similar increase in the percentage of larger rookeries nationally, when the general population was expanding. Population increase is focussed on the larger colonies (Cramp & Perrins, 1994).

The 'tail' in the size distribution that consists of larger rookeries may represent the principal rookeries in the area, from which expansion into sub-optimal breeding areas takes place in favourable years, perhaps involving less experienced birds. Lack (1986) mentions that in any one region, several core rookeries form the winter roost of not only those birds breeding at the site each year, but also of those rooks that breed in nearby rookeries, to which they return in late February. Griffin (1999) considered that non-breeders are recruited to particular rookeries before the breeding season. In Durham rookeries, he also noticed that nest-building at smaller rookeries was less synchronous than at those with >25 nests.

The mean size of active rookeries was between 21 and 34 nests in 1986, and between 19 and 35 in 1996, depending on the grid square. Mean rookery size in grid square SM increased from 29 to 35, while square SN decreased from 23 to 19 nests (t tests, both

significant at $p<0.01$). The other two 100 km squares remained similar in terms of the mean number of nests in active rookeries, as detected by the t distribution. Both the size distribution and the mean size of rookeries were similar to those reported by Sage & Vernon (1978) for Pembrokeshire in 1975. The size distributions are also quite similar to those for Wales as a whole in both 1975 and 1996 (Marchant & Gregory, 1999). Average Pembrokeshire rookery size has, however, clearly decreased since the 1940s census when it was over 60 nests/rookery (Donovan & Rees, 1994). Additionally, the average size of the Haverfordwest rookeries counted by Hughes (1993) from 1986 to 1993 was between 40 and 50 nests, somewhat larger than in the present study area to the south.

Local factors affecting South Pembrokeshire rooks

The distribution of rookeries was compared in terms of the degree of clustering in the landscape, using nearest-neighbour analysis. In 1986, the mean distance between neighbouring rookeries was 1,140 m, and by 1996 this had declined slightly to 1,050 m. However, there was no difference in the high degree of clustering observed, with the rookeries in both years being described as non-randomly distributed in the study area overall. However, the rookery distribution is apparently contagious along some of the east-west main roads connecting the main villages, especially in the south Pembrokeshire peninsula. The above distributions of rook nests found in 1986 and 1996 agree very well with the tetrad survey map presented by Donovan & Rees (1994), at least for the south Pembrokeshire peninsula. In this 1984-1988 survey by Donovan & Rees, rooks were breeding in over 47% of Pembrokeshire tetrads. These authors also considered that hedgerow removal had not been particularly drastic in Pembrokeshire. Rooks avoid the acid soils of higher ground, the centres of larger settlements, and the abundant oil refinery habitats, although even the latter have been known elsewhere to provide nesting sites, for example, at the Isle of Grain refinery in Kent (Sage & Vernon, 1978).

The changes in rook status among the four south Pembrokeshire 100 km grid squares are thought unlikely to be a reflection of climatic and weather differences, leading to year-to-year changes in rook numbers. Donovan & Rees (1994) recorded Mathew's observation that thousands of rooks perished in the winter of 1880, but Lack (1986) has reported that rooks are generally resilient to the British winter. In addition, rook movements would overcome the effects of slight climatic differences over such small distances, and Lack also quotes distances of 20 km as part of the rook's daily pattern of movement.

As also observed nationally by Sage & Vernon (1978), there appears to be a link between the distribution of south Pembrokeshire rookeries and the underlying soils and geology. The main concentrations of rookeries are found on the well-drained rendzinas of the Carboniferous limestone of the Castlemartin peninsula and south-east of Pembroke (Fig.1). Lower densities occurred on the more acidic soils of the Coal Measures and Old Red Sandstone. Donovan & Rees (1994) show that the Castlemartin peninsula is among the more diverse parts of Pembrokeshire, having over twice the average number of breeding bird species per tetrad.

Yeates (1934) and Madge & Burn (1994) mentioned that rooks are found in winter along the seashore, but if used by rooks, Pembrokeshire's rich intertidal feeding areas would not confer much competitive advantage to birds from the different grid squares. This is because there are both rocky and sandy intertidal feeding grounds within each of the 100 km squares, thanks to the penetration of the Daucleddau estuary deep into southern Pembrokeshire. Cramp & Perrins (1994) list, among the rook's diet, the following marine

species: shrimps, mussels and slipper limpets. Rooks are known to feed on crabs and molluscs in southern and eastern Britain, often in family groups in early autumn, but the habit appears less common in Pembrokeshire, particularly on muddy shores. Berrow *et al.*, (1992) documented the hooded crow, *Corvus corone cornix*, caching mussels on a hillside near Lough Hyne, Ireland. The mussels were usually retrieved within three days, during high tide when intertidal feeding sites were inaccessible. Young (1990) reported magpie, *Pica pica*, eating mussels.

The second survey (February to April 1996) took place when the *Sea Empress* oil spill occurred (15 February 1996). If large numbers of rooks were using intertidal feeding areas during the spill, it might be expected that some rook casualties would have occurred, as half of the shoreline in the study area was heavily oiled, although not the inner Cleddau estuary (Little *et al.*, 1997). SEEEC (1998) reports that in addition to almost 3,500 waterfowl, waders, and seabirds, there were a jackdaw, *C. monedula*, and two carrion crows, *C. corone corone*, found dead. Unless among the 61 unidentified corpses, no oiled rooks were found.

Rooks are among those corvids that scavenge on waste disposal sites, particularly on larger landfills that are close to the rookeries, and especially during spells of cold weather when regular food supplies may be in short supply. Landfills at Waterloo, Kilgetty and Tier's Cross have been historically available to rooks within the study area. Darlington (1969) reported mixed flocks of about 100 corvids such as rook, jackdaw and carrion crow using landfill sites. Although rooks feed alongside jackdaws and crows in terrestrial habitats, including roadsides (insect and vertebrate carrion), the habit may not have been transferred to the intertidal zone. Mabey (1974) reported that rooks may also benefit from the roadside availability of insects and earthworms brought to the surface by heavy vehicle vibrations. Marchant & Gregory (1999) refer to 'road-kill' and landfill as possible reasons for the increase in rook populations since the 1970s. Other corvids are increasing, and Marchant & Gregory have now demonstrated an increase in rooks, in spite of dramatic changes in farming practices and habitats with which the rook is more closely associated than are other corvids. Ratcliffe (1997), examining the relationships among the corvids, noted occasional predation on young rooks by ravens, *C. corax*, amongst examples of peaceful co-existence.

According to Dresser (1959), there were ratios of arable land (cereals, early potatoes) to permanent grassland in the Dale Peninsula in roughly the proportions suggested by Brenchley (1984) as being most favourable to rooks (45:55). In Pembrokeshire as a whole, the ratio is about 30:70 (Dyfed County Planning Department, 1989), declining to about 10:90 in Dyfed* as a whole (Saunders, 1986). Saunders reported that the arable:grass ratio in Dyfed was decreasing between 1975 and 1984 due to declining cereals and beef cattle fodder crops and increasing permanent grassland. In complete contrast, in arable counties of England such as Cambridgeshire, the ratio is 95:5, and the only grasslands available to rooks are restricted to paddocks, recreational areas and rough ground (Bircham *et al.*, 1994). In Pembrokeshire, the area around the former tank and artillery range at Castlemartin has experienced a large expansion of rooks both in terms of total numbers, and in the number of individual small rookeries around the camp headquarters at Merrion. Even during its use as a military training area, or perhaps because of this use, the tank/artillery range may have been a safe haven for rooks, providing unimproved calcareous grassland, nearby arable fields, copses with tall trees, and an absence of deliberate persecution.

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* Dyfed : A large Local Authority formed by amalgamating the counties of Cardiganshire, Carmarthenshire, and Pembrokeshire. It persisted for about 20 years from the mid 1970s to the mid 1990s.

Rook breeding and wintering national overview

Highest UK rook densities occur in flat to moderately sloping agricultural areas below 300 m in altitude in Scotland, Ireland and central southern England. Here, rook breeding densities commonly reach 20 nests km^{-2} in favourable habitats (Hagemeijer & Blair, 1997). Witherby *et al.* (1943) earlier reported rook nest densities ranging from 0.4 km^{-2} (Harrow), 1.9 km^{-2} (North Wales), 12.9 km^{-2} (upper Thames valley), to 23 km^{-2} (Edinburgh area). They suggested an average UK density of 6.2 nests km^{-2}. Comparison of the very similar breeding (Sharrock, 1976) and wintering (Lack, 1986) distributions of rooks, and ringing studies, show that the rook is a relatively sedentary species in Britain, with adult site fidelity of up to 72%, although juveniles may disperse over 100 km. Sharrock found rooks in 82% of 10 km national grid squares in spring, and Lack found them in 83% of squares in winter.

Busse (1969) showed that continental birds augment the UK winter population, arriving from Netherlands and Germany, and swelling rook numbers in winter to 4 million birds. Gregarious foraging reduces wasteful feeding effort and energy spent looking out for predators, and rooks are adept at seeking out patches of rich feeding territory. In winter, they feed on seeds, waste root crops and invertebrates, often in the company of starlings *Sturnus vulgaris*. In contrast to jackdaws, with which rooks also feed, grassland invertebrate prey is taken from relatively deep (5 cm) in the ground. Communal winter roosts may be shared with jackdaws, carrion crows, and occasionally ravens. Fuller (1982) pointed out that whereas rook breeding takes place in only 10-20% of British woods, winter feeding within woodland habitats takes place in 50-60% of woods. However, along with the kestrel *Falco tinnunculus* and carrion crow, the rook is a specialist in breeding along woodland edges and feeding outside, mainly in neutral grasslands.

Each UK breeding pair usually rears two young, of which 30-40% survive to breed in the second year (Lack, 1986). At the eastern extremity of the rook's range, Gavrilov & Gistsov (1985) report an average brood of 2.3 in Kazakhstan, but that the survival rate of young is less than 50% by the autumn migration. In the early 1950s when rooks first colonised maturing plantations on Shetland, a success rate of three young per brood was reached, and the number of nests increased rapidly from 9 to about 200 in 25 years (Berry & Johnston, 1980). Feare *et al.* (1974) showed that in the breeding season grasslands are the preferred feeding habitat. This is because the rook nestlings benefit from the invertebrate protein found in grasslands.

From analysis of over 1,300 rook stomachs, vegetable matter comprised 59% and animal material 41% of the rook's diet. Cereals were over 35% of the vegetable matter, and earthworms were about 44% of the animal material, which also consisted of molluscs, millipedes and spiders. Insects comprised 32% of the animal material, and consisted of, in addition to mainly Coleoptera, the larvae from several insect orders. Carrion taken included remains of duck, lapwing *Vanellus vanellus*, passerines, and also of small fish (Witherby *et al.*, 1943). In common with other crows, the rook hoards acorns and pine cones during the autumn glut and the birds retrieve some of their cache on colder days (Waite, 1985).

National rook surveys 1946 and 1975

Changes in the national status of the rook are summarised in Table 8. The first British Trust for Ornithology (BTO) national survey of rooks (1943 to 1946) covered two-thirds of Britain, and indicated a total population of 1,413,000 nests, excluding Ireland (Fisher, 1947 and 1948). This was an increase of some 20% since the late 1920s (Brenchley, 1986). Increased tillage improved supplies of earthworms, as Britain brought additional land into

TABLE 8: Summary of population estimates for the rook in Great Britain and Isle of Man, unless otherwise shown.

Period	Breeding pairs (million)	Percentage change	Reference
Late 1920s	1.18		Brenchley, 1986
1920s to 1946	1.41	+20	Fisher, 1947; Brenchley, 1986
1946 (Wales)	0.09		Fisher, 1947
1946 to 1975	0.80	-43	Sage & Vernon, 1978
1946 to 1975 (Wales)	0.04	-60	Sage & Vernon, 1978
1970 to 1990		-0.4	Gibbons *et al.*, 1993
1975 to 1980	0.86	+8	Sage & Whittington, 1985
1986 to 1995	0.98	+14	BTO, 1996
1986 to 1996 (S Pembs)		-7.5	**This study**
1994 to 1997	1.03	+5	BTO, 1998
1975 to 1996	1.14	+43	Marchant & Gregory, 1999
1975 to 1996 (Wales)	0.05	+36	Marchant & Gregory, 1999
1994 to 1998 (UK)	1.13	+10	Noble *et al.*, 1999
1994 to 1998 (Wales)		-7	Noble *et al.*, 1999

cultivation, particularly during World War II. When comparing the 1946 and earlier surveys, it should be recognised that the proportion of grassland was atypically high in the 1920s and 1930s (O'Connor and Shrubb, 1986).

The 1975 national BTO rook survey showed that the population was about 800,000 nests, again excluding the whole of Ireland (Sage & Vernon, 1978). This showed a decrease of 43% in breeding rooks (Table 8), and a smaller overall size of rookery, between the 1940s and 1975. The 1975 population appeared to have contracted to the 1920s levels or below, for those counties directly comparable (Brenchley, 1986).

Lower breeding densities were found in eastern cereal-growing areas, with typical numbers of nests km^{-2} in 1975 lower than in northern and western mixed farming regions. Wales is not a particular rook stronghold, although Pembrokeshire is one of the most important Welsh counties, as shown in Table 9. In 1975, there was a positive correlation ($p<0.05$) between the number of rook nests and the amount of grassland in Wales, but no such relationship was found in England. The mean number of nests per rookery in Welsh counties in 1975 ranged from 16.8 to 41, with an overall average of 25.2 nests. Pembrokeshire's average was 30.9 nests (Table 9). Both in terms of rook nests per rookery and overall density, Pembrokeshire is close to the UK national averages (Sage & Vernon, 1978). For the counties selected in Table 9, it is interesting to note only a weak positive correlation (Spearman Rank correlation coefficient $r_s=0.45$, $p=0.05$) between the number of nests per rookery and nests km^{-2}.

The total number of nests in Wales in 1975 was 38,916 distributed among 1,546 rookeries. This compares to Fisher's estimate for 1945-1946 of 98,250 nests in Wales (60% decrease). The UK as a whole (including Northern Ireland) had 907,717 nests distributed between 28,390 rookeries in 1975. Intermediate surveys carried out between 1946 and 1975 on a local level allowed Sage & Vernon (1978) to pinpoint the start of the decline in rook populations to the late 1950s, but none of the reported local surveys was from Wales.

In Pembrokeshire, Sage & Vernon (1978) estimated 8,900 nests in 1945-1946 compared with 8,280 in 1975 (-6.9%). However, Donovan & Rees (1994) reported the

TABLE 9: Typical range in densities of breeding rooks found in 1975, except where shown (Sage & Vernon 1978, Sage & Whittington 1985, Gibbons *et al.* 1993, Hagemeijer & Blair 1997, Marchant & Gregory, 1999).

Region surveyed	Nests rookery^{-1}	Nests km^{-2}	Region surveyed	Nests rookery^{-1}	Nests km^{-2}
NJ 93 (Grampian)		63.3	Yorkshire	34.2	4.0
Kildare (1981)		47.4	Cardiganshire	24.9	3.3
Londonderry	48.6	12.6	Cambridgeshire	17.7	2.7
Isle of Wight	24.7	10.3	Caernarvonshire	32.2	2.0
Aberdeenshire	139.1	9.7	Wales (overall)	25.2	1.9
Oxfordshire	22.6	7.9	Lincoln	21.3	1.8
Dumfriesshire	78.0	7.8	Norfolk	20.2	1.3
Fife	49.7	5.7	UK (overall)	31.9	4.4
Pembrokeshire	**30.9**	**5.2**	Wales (overall, 1996)	25.4	
Hampshire	23.3	5.0	UK (overall, 1996)	36.7	
Suffolk	17.3	4.1	Western Europe (overall)		0.7

decline as -14% over the same period, and as -18% from 1971 to 1975, using an intermediate Dyfed Wildlife Trust survey (Saunders, 1971). The number of nests in Pembrokeshire declined from 9,330 to 8,280 (-11.2%) between 1971 and 1975, as reported by Sage & Vernon (1978). By either estimate, the decline was quite rapid especially between 1971 and 1975, and its timing is approximately consistent with the arrival of Dutch elm disease in Pembrokeshire from 1969.

Rook nests have long been associated with the higher branches of elms. Osborne (1982) summarised the evidence that rooks preferred elm trees; as many as 78-90% of rooks nested in elms in Oxfordshire, Isle of Wight and Gloucester in the 1930s. This declined to 37-66% by the time of the 1975 survey (Sage & Vernon, 1978). Osborne also showed that rooks continued to nest in dead elms, and as a result, were more conspicuous during counts made late in the season when leaves would normally have obscured the nests. Once felled, however, the dead trees obviously would no longer be available as nest sites. Bircham *et al.* (1994) referred to a drastic decline in Cambridgeshire rooks as a result of Dutch elm disease although, nationally, the effects of the disease were not considered to have affected rook populations as much as did agricultural changes during the 1960s and 1970s (Tapper, 1981).

Climate was thought to be partly responsible for the national rook decline between 1945 and 1975, with increased numbers during periods of climatic amelioration, and declines in years with cooler springs and wet summers. Local surveys have often shown fluctuations that are not easily explained climatically, but the availability of food seems to explain how rook numbers may vary with farming practices. In Hertfordshire, there was an 84% increase in nests between 1945 and 1961, followed by a decline of 32% to 1971, with a trend to smaller colonies. The declines were variously attributed to stubble burning (less grain), urban expansion and the use of organochlorine pesticides during the 1960s (Sharrock, 1976). Changes from pastoral to arable tillage, with increased mechanisation, have reduced the availability of both cereal and invertebrate foods (Marchant *et al.*, 1990).

Sample square rook survey 1980

The 1980 BTO sample survey of 482 randomly-selected 10km grid squares estimated a modest 6-7% increase to about 855,000 nests, excluding Ireland (Sage & Whittington,

1985). This survey confirmed the larger size of rookeries in northern Britain, and also showed an overall larger rookery size, and more nests concentrated into fewer colonies, compared to 1975. The rookery size frequency distributions given by Sage & Whittington (1985) showed a slight increase in rookery sizes greater than 25 nests. Gibbons *et al.* (1993) believed this was evidence that the small, new rookeries founded in the late 1970s when the rook's fortunes began to improve, had continued to grow in size. In the 100km grid squares covering Pembrokeshire, there was a 10-25% increase in rook nests, and a 3-11% increase in the number of rookeries between 1975 and 1980 (Sage & Whittington, 1985).

Most of the changes in the late 1970s noted by Sage & Whittington (1985) were positive in the north and west, whereas there were still pockets of decline in East Anglia and southern England, where cereal tillage far outweighs pasture. Those squares in eastern Britain that did show increases between 1975 and 1980 were located mainly along the east coast; areas such as the Forth, Tees, Humber, Wash and Suffolk. Prater (1981) noted that carrion crows scavenge intertidally in large numbers, particularly in western and northern estuaries, but like Fuller (1982) and Ferns (1992), he did not mention rooks in this connection. However, Madge & Burn (1994) indicate a possible connection between rooks and lowland coasts. Perhaps coastal grasslands, or coastal micro-climates, or the behaviour of immigrant continental rooks, help to explain this coastal habit in eastern Britain.

Recent national trends

The turnaround in British rook populations noted by Sage & Whittington (1985) in the second half of the 1970s was endorsed by Marchant *et al.* (1990), who plotted the proportion of CBC plots where rooks nested from 1965 to 1988. There was a steady increase from only 2% in the early 1970s when small rookeries were deserted, to 12% by the late 1980s. In 1989, the percentage of CBC plots with rooks holding territory was 13.6%, compared with a mean percentage of 8.6% between 1979 and 1988 (Marchant, 1991). Danish rook populations also increased in the late 1980s (DOFF, 1989).

Gibbons *et al.* (1993) showed no major differences in national rook distribution since the 1968-1972 atlas. They estimated the Irish population at 520,000 pairs, and showed a very slight drop of -1.2% in Irish rooks, compared to a drop of only -0.4% in Britain, since 1968-1972 (Table 8). There is a higher relative abundance of rooks in Pembrokeshire, parts of Carmarthenshire and the Lleyn Peninsula/ Anglesey, than in a broad swath of Wales from Caernarvonshire to Cardiff (Gibbons *et al.*, 1993). The second breeding bird atlas may thus reflect a closer, tentative link between the fortunes of western Welsh and Irish birds, than between western Wales and the rest of England and Wales. Witherby *et al.* (1943) commented on rook movements across St. George's Channel, and Donovan & Rees (1994) summarised information regarding onshore movements of rooks into Pembrokeshire during March and early April, and large (up to 350 birds) movements offshore to the west in November. Rooks cross other sea areas on migration, for example, between Scandinavia and Scotland. Berry & Johnston (1980) quoted Fair Isle Bird Observatory data that showed declining movements of rook across the Fair Isle channel in the 1970s, perhaps due to decreased breeding success in Scandinavia.

Since 1994, the DETR has received reports on common opportunist species from the BTO on a yearly basis. Although the rook has not been formally indexed by the CBC, as noted above, indications are that the rook increased by 14% between 1986 and 1995 (BTO, 1996), continuing the rise in population since 1975 suggested by Sage & Whittington (1985) and Marchant *et al.* (1990). A new BTO survey called the Breeding Bird Survey (BBS) has been in operation since 1994. The BBS covers many more plots than the CBC

(currently over 2,100 compared to about 240 for the CBC), and distributes them more evenly across Britain. Early indications from the BBS showed that rooks increased by 10% (see Table 8), according to comparisons made between 1994 and 1998. Although parts of south Pembrokeshire have followed these trends, the general trend here has been a slight decline overall between 1986 and 1996, indeed since 1971, except for a period of slight increase between 1975 and 1980.

There are often differences between the local status of common birds and the trends measured in national surveys, particularly it seems for resident species in west Wales (Little & Shaw, 1994). Whereas mild winter weather in Pembrokeshire may be a positive factor compared to eastern Britain for some species, the rook does not seem to have benefited in south Pembrokeshire as much as the 1975-1980 sample counts nationally might have suggested (Sage & Whittington, 1985). Until the 1996 national census, there was an over-reliance by some of those making conservation assessments of the rook on this period of increase, which most recent national data tend to confirm (except Gibbons *et al.*, 1993). However, neither the two national BTO breeding atlases nor the two primary surveys of British common birds (CBC and BBS) are ideally suited to rook nest counts, in cases where the CBC census plots or BBS line transects do not occur near rookeries.

Marchant & Gregory (1999) recently estimated an increased population of the rook since 1975 of 43% in the UK, 36% in Wales and 55% in Scotland (Table 8). However, they accept that the increase may have already levelled off in some regions including mid-Wales, and that the 1975 counts may have been low, which would bias the increase upwards. The BBS (Noble *et al.*, 1999) shows that sufficient data are now being collected to report Scottish and Welsh trends 1994 - 1998 separately from the UK. These authors reported that rooks occur on 50% of plots, and that rooks in Wales declined by 7% since 1994. This decline was in marked contrast to the Scottish rooks (+65%) and UK rooks as a whole (+10%), as shown in Table 8. The BBS report gave the 1994-1999 changes as; Wales, +1%; Scotland, -6%; Northern Ireland, +107%; England, +4%; and the UK as a whole, +8%. Clearly, there are marked regional, national and temporal variations in rook status.

Impacts of farming practices

Rooks are undoubtedly sensitive to cropping practices. For example, in Fife both in 1945 and 1990 there was a link between rook numbers and variation in the proportions of cereals and grasslands, but this did not hold in 1978, when persistent chemicals were thought to have adversely affected population size. Overall, the rook declined by 60% in Fife between 1945 and 1990. The loss of grassland was the main cause of the rook decline between the 1950s and the middle 1970s, according to Sage & Whittington (1985). The peak of persistent organochlorine usage was between the late 1950s and early 1960s, and the regions of Britain with most intensive use of these chemicals were those suffering greatest rook declines. The north and west generally received fewer applications of agrochemicals, and have also recovered most quickly from these declines (Sage & Whittington, 1985). However, Sage & Vernon (1978) had earlier stated that apart from limited evidence in Nottinghamshire, there was no proof of a link between pesticide use and rook decline. Madge & Burn (1994) reported declines in rook numbers in Romania as a result of pesticide use. Ratcliffe (1997) reviewed the possible impact on corvids of DDT used in UK sheep dips between 1950 and 1965. For ravens and rooks, it was found that the eggs of both species had up to 1ppm DDE (a metabolite of DDT), but that shell thinning was only significant for the rook (5% reduction in shell thickness between 1958 and 1969, $p<0.001$).

A widespread change from pasture and mixed farming has overtaken western Europe

since the 1940s, resulting in farm intensification, hedgerow removal, and the reduction in crop rotations and fallow. At the same time, there has been increased use of inorganic fertilisers and pesticides, and a peak in use of herbicides in the 1980s. O'Connor & Shrubb (1986) thought that the most significant recent changes are not necessarily in the agricultural habitats themselves, so much as in farming practices. For example, the shift from spring-sown cereals to autumn-sown cereals has adversely affected the spring availability of invertebrates for farmland birds. The use of combine harvesters may also have penalised rooks that formerly foraged on stooks for three or so weeks during the harvest. This caused late summer and early autumn food shortages, further exacerbated by stubble burning. In addition, grassland invertebrates may be in short supply in dry summers (Dunnet & Patterson, 1968). Stubbles in winter have also decreased due to autumn tillage and burning. Chater (1996) has linked increased stocking rates on grassland to improved invertebrate feeding for rooks in Ceredigion. Without contesting the rook's links with the farming landscape, Marchant & Gregory (1999) have tentatively ascribed the rook's general increase since 1975 to a reduced dependency on arable farmland. There is evidence that new foraging opportunities have been successfully exploited by rooks (*e.g.*, landfill, road-kill), and there is no evidence that persecution has affected overall population levels.

Conservation assessment

The rook is on Appendix III of the Bern Convention, and thus warrants international protection in areas important for migration. Tucker & Evans (1997) classified rooks as 'priority D' for their importance in arable and improved grassland habitats in Europe. The classification means that >75% of the rook's breeding population depends on arable and improved grassland habitats, irrespective of the rook's overall conservation status. This prioritisation also recognises the need to protect representative or characteristic, as well as threatened, species, and thus has the aim of biodiversity conservation in the wider environment. A generally low level of impact (<20% predicted decline over the next 20 years) was envisaged by Tucker & Evans (1997) on the rook in these habitats, if current trends continue. The main threats were seen as crop improvements, land abandonment, low stocking levels, and autumn sowing.

It remains to be seen what changes in rook status will take place in Pembrokeshire, and nationally, when the effects are felt of recent changes in:

- agricultural subsidies (*e.g.*, set-aside replaced in Wales by Tyr Gofal)
- organic farming and lowland forestry
- increased winter stubbles, oil seed rape and linseeds
- lower stocking levels due to the beef crisis and to foot-and-mouth disease.

For these reasons, it is useful to monitor populations of common birds, as reflected in the DETR's use of BTO data in the UK 'quality of life indicators' (DETR, 1999). It is suggested that full national UK rook censuses should be undertaken more regularly than previously. Local and county level surveys should be better co-ordinated during the intervening periods between national censuses. These recommendations are based on the intervals between the previous three (20 - 30 years), and on the serious and unexplained declines in many other farmland bird species. Additionally, Britain and Ireland are vital to the European and thus global status of the rook. About 14% of the European breeding population is dependent on the UK (Table 10). Finally, there are already signs that global climate change has begun to affect UK bird populations. A common, widespread and easily monitored species such as the rook, for which there are regional and national baseline data, offers many of the advantages of a sentinel organism for the wider countryside.

TABLE 10: Estimates of European breeding pairs of rook *Corvus frugilegus* L., not including *C.f. pastinator* (Hagemeijer & Blair 1997†, Madge & Burn 1994*), and total number of priority bird species* that breed in arable and improved grassland habitats in Europe (Tucker & Evans 1997).

Nation	Breeding pairs (million)	Priority European species* Species number	% of total
Russia	3.16	70	86
United Kingdom	0.95	44	54
Belarus	0.91	57	70
Ukraine	0.44	66	81
Republic of Ireland	0.43	30	37
France	0.16	63	78
Lithuania	0.10	52	64
Hungary	0.10	58	72
Romania	0.10	64	79
Moldova	0.06	53	65
Germany	0.04	55	68
Turkey	0.02	61	75
Others combined	0.20		
New Zealand (introduced 1978 N Island)	0.03†		
Total	6.70		

* Priority species are the most significant bird species for habitat-conservation measures. Britain and Ireland have the two lowest numbers of the priority species in arable and improved grassland habitats, but a large (about 15%) share of the rook population; a characteristic species of this habitat.

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