Wing lengths and weights of Wheatears *Oenanthe oenanthe* caught on the north west Norfolk coast in spring, an analysis to determine the incidence and timing of the *leucorhoa* race.

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An analysis is made of wing lengths and weights of 164 male and 145 female Wheatears caught on the North west Norfolk coast in the springs of 1990 - 1996. Wing lengths ranged 92 - 118 mm in males and 90 - 106 mm in females. Mean wing length (in both sexes) was longer in April and May than in March. When wing length frequencies were generated they indicated the presence of two subspecies - 52% nominate oenanthe (males mean wing length 97.9 mm, females 94.4 mm) and 48% leucorhoa (males mean wing length 105.1 mm, females 102.0 mm). Weights ranged 19.9 - 50.0g in males and 19.6 - 48.0g in females. The mean weights (in both sexes) were heavier in April and May than in March and mean weights in May were heavier than in April. 76% of leucorhoa males and 53% of leucorhoa females were caught before 1May and a comparison with other published studies indicates earlier migration of this race along the n.w. Norfolk coast compared to Wales (Skokholm and Bardsey). It is concluded that the North west Norfolk coast intercepts the passage of Greenland/Iceland Wheatears in spring, though the proportions from these two destinations is not yet known.

INTRODUCTION

The world population of Wheatears *Oenanthe oenanthe* has been estimated to be in the region of 125 million (Moreau 1972). With a breeding distribution of about 320 degrees, it is almost circumpolar ranging from north-east Canada to Alaska (Cramp 1988). Only about 1,600 kilometres separate the two breeding populations of Alaska and north-east Canada (Condor 1989).

Four races are recognised:- (1) the nominate *oenanthe* being the main Eurasian race. (2) the East Canadian, Greenland and Icelandic *leucorhoa.* (3) the Spanish, south-east European and central Asian *libanotica.* and (4) the north-west African *seebohmi* (Cramp 1988). Although this paper is concerned with only two of them :- the nominate *O.o.oenanthe* and the *O.o.leucorhoa* races.

Apart from a few stragglers that winter along the eastern seaboard of the United States south to the West Indies, which are considered not to be a distinct wintering population (Snow 1953),and birds that winter regularly in the Tigris and Euphrates valleys of Iraq, the entire Palearctic population winters in Africa, in a broad belt south of the Sahara from the West African coast to the Indian Ocean and south in eastern Africa to northern Zambia (Cramp 1988,

Moreau 1972)). With the *leucorhoa* race wintering almost exclusively in the west, in the Senegambia and Sierra Leone (Cramp 1988).
Wheatears of both European subspecies *O. o. oenanthe* and *O. o. leucorhoa* migrate through western Europe, in spring and autumn. The Greenland Wheatear *O. o. leucorhoa,* migrates directly from the nearctic breeding areas to the coast of western Europe (from Britain south to Spain), it undertakes what may be the longest transoceanic migration of any passerine bird of upto 2,500 km, with many birds being recorded far out to sea in autumn (Snow 1953). The return in spring is thought to take a more overland route (Snow 1953). Occasionally both subspecies have been recorded migrating in very large flocks, with large falls, for example 8,000 on the east coast in Suffolk, and other parts of the east coast in September 1965 (Axell & Pearson 1966, Davis 1966), and on the Isle of Man (10-20,000) in October 1986 (Thorpe 1987, 1992). These falls usually occur in autumn, whereas the return spring migration through the north-west Norfolk coast is more protracted with the first arrivals in early March continuing through April and May and even into early June. Very little or nothing has been published on the spring migration of Wheatears through eastern Britain although data is available for two sites in Wales, Skokholm, Dyfed (Condor 1989) and Bardsey, Gwynedd (Jones 1992).

Three hundred and forty five Wheatears were trapped in spring between 1990-1996 in north west-Norfolk and biometrics were taken on three hundred and nine. The sexes are readily separable using plumage characteristics. Only two birds could not be confidently sexed and were excluded from the analysis. This paper examines these data in order to evaluate the frequency of the races involved and to compare results with other published literature.

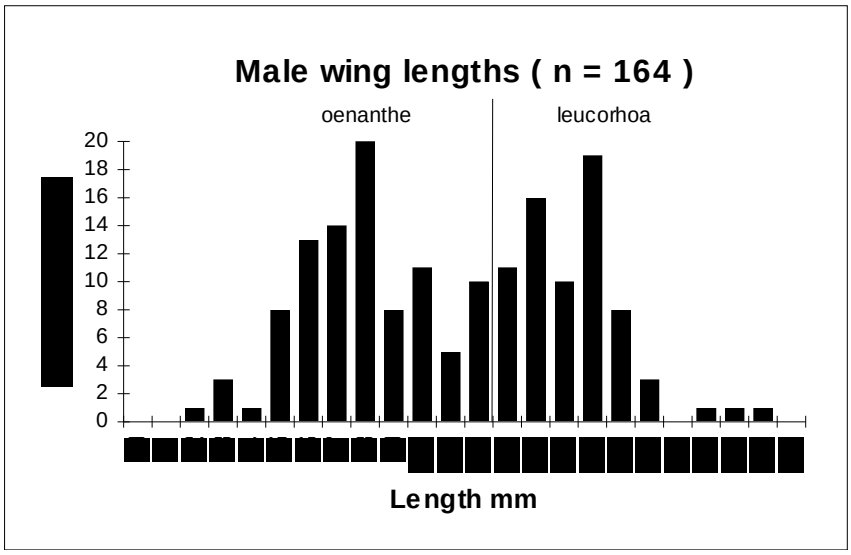
MATERIALS AND METHODS

Birds were trapped using either drop door Potter traps measuring 325 mm long x 250 mm wide x 250 mm high or spring nets of our own design with a basal area of 300 mm x 300 mm, baited with mealworms, the larvae of the flour beetle *Tenebrio molitor,* although most were caught in the spring nets.
The study area was between Snettisham, National Grid Reference TF6433 and Warham TF9544, most birds were captured between TF6433 and TF6637. Data were available for 164 males and 145 females. Birds were sexed using plumage characters and only two birds could not be sexed. Ageing is less certain and although most adult males can be separated from 1st summer birds (in their second calendar year), with females this separation is more difficult (Svensson 1992). In this paper all age classes are aggregated and no attempt is made to separately analyse the different ages, although separation and analysis on the basis of sex is. Wing length was measured to the nearest 1 mm along the straightened, flattened chord using method three as described by Svensson (Svensson 1992). Weight was measured to the nearest 0.1 g on a Pesola spring balance.
All Wheatears caught in spring, that detailed biometrics were available for, were included in the analysis, except for the two birds that could not be sexed, data were available for March, April and May, and additionally for three females caught in June.

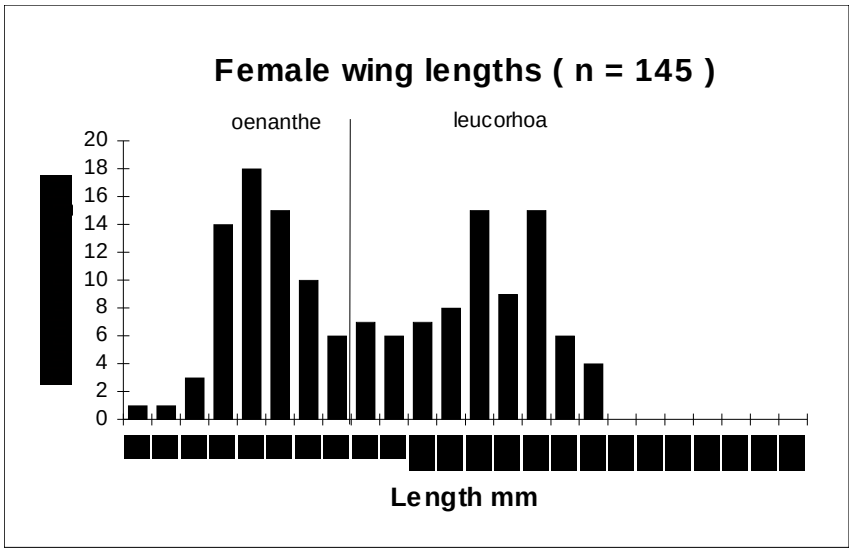
RESULTS

Wing length.

Wing length frequencies were generated for both sexes and are shown in Figures 1a and 1b. There is a very large range of values:- males 92-118 mm and females 90-106 mm. The graphs of both sex classes exhibit a bimodal distribution indicating the presence of two populations.



1a.



1b

Figures 1a and 1b: Wing length frequencies for Wheatears caught in north west Norfolk spring 1990-1996.

Separation of the data by calendar month shows quite substantial differences and is shown in Table1.

Table 1: Wing length of Wheatears caught on the north west Norfolk coast in spring, 1990-1996, showing sample size (n), mean and standard deviation (s) and range.

	Males				Females			
Month	*n*	*Mean*	*s mm*	*Range*	*n*	*Mean*	*s mm*	*Range*
March	31	97.5	1.80	93-101	17	94.5	1.23	93-97
April	106	101.8	4.60	93-118	90	97.8	4.34	90-106
May	27	102.9	3.70	92-110	35	101.7	2.63	94-105
June					3	102	2.00	100-104

Mean wing lengths for females were significantly lower than for males ($t = -5.429$, $df = 307$, $P < 0.0001$). In all three months the mean wing length for females is lower than for males and was significantly lower in March ($t = -6.197$, $df = 46$, $P < 0.0001$), and in April ($t = -6.206$, $df = 194$, $P < 0.0001$), but there is no significant difference between the sexes in May. Additionally for both sexes the mean values for March are significantly lower than for April (females: $t = -3.147$, $df = 105$, $P = 0.0021$, males: $t = -5.074$, $df = 135$, $P < 0.0001$), and for females the mean values for April are also significantly lower than for May ($t = -4.987$, $df = 123$, $P < 0.0001$). These differences together with the large range of wing length values indicate the presence of Wheatears from more than one population or subspecies. Wing lengths given for ssp. *oenanthe* range from: males 93-102 mm, females 90-97 mm and for ssp. *leucorhoa* males 99-110 mm, females 96-108 mm (Cramp 1988). Svennson (1992) suggesting criteria for the separation of the *leucorhoa* race states that males having a wing length >102 mm and females with a wing length >97 mm should be *leucorhoa*. When these criteria are applied, the analysis indicates two discrete populations with parameters as shown in Table 2.

Table 2: Wing length values of two populations of Wheatears passing through the north west Norfolk coast in spring, 1990-1996.

	Males				Females			
Population	*% of total*	*Mean*	*s mm*	*Range*	*% of total*	*Mean*	*s mm*	*Range*
Small birds (= *oenanthe*)	57	97.9	2.36	92-102	47	94.4	1.49	90-97
Large birds (= *leucorhoa*)	43	105.5	2.45	103-118	53	102.0	2.26	98-106

It can be seen that for males 57% were ssp. *oenanthe* and 43% were ssp. *leucorhoa* whilst for females 47% were ssp. *oenanthe* and 53% were ssp. *leucorhoa*. However this takes no account of the overlap in wing length ranges of the two subspecies of males 99-102 mm, and females 96-97 mm, a range of values to which no definite sub speciation can be applied, and is shown in the graphs in Figs2&3.

The separation being effected at, for males:- >102 mm wing length = *leucorhoa*, and for females:- >97 mm wing length = *leucorhoa*, assumes that all the birds of both sexes which fall in the overlap area are *oenanthe*. This question of the overlap in wing length values, of both sexes, and for both races, is returned to in the discussion towards the end of this paper.

Weights

For this parameter there was a very large range of values:- in males from 19.9 to 50.0 g, and in females from 19.6-48.0 g, the heaviest Wheatears of both sexes were more than double the weight of the lightest. In all these analyses, the mean weights for males were higher than for females in each month (March-May) and for both sexes there was an increase in the mean weights over the preceding month (March-May), in addition the mean weights of an admittedly small sample (n = 3) of females captured in June also showed an increase over the preceding month and is only included for completeness, these results are shown in Table 3.

Table 3: Weights of Wheatears caught on the north-west Norfolk coast in spring, 1990-1996. Although only 3 females were caught in June and no males they are included for completeness.

	Males				Females			
Month	*n*	*Mean*	*s mm*	*Range*	*n*	*Mean*	*s mm*	*Range*
March	31	24.6	2.34	19.9-30.0	17	23.6	2.55	19.6-28.5
April	105	27.7	3.77	21.6-43.8	86	25.5	3.22	20.0-36.0
May	27	34.3	7.87	20.9-50.0	35	32.6	5.20	24.2-48.0
June					3	40.6	5.12	35.8-46.0

Table 4: Weights of two populations of Wheatears caught on the north-west Norfolk coast in spring 1990-1996.

	Males				Females			
Population	*% of total*	*Mean*	*s mm*	*Range*	*% of total*	*Mean*	*s mm*	*Range*
Small birds (= *oenanthe*)	57	25.7	2.76	19.9-41.7 *	47	23.7	2.04	19.6-29.0
Large birds (= *leucorhoa*)	43	31.5	4.84	23.0-43.8	53	30.5	5.26	20.6-48.0

* two outlier values of 45.3 g and 50.0 g, both with wing lengths of 102 mm excluded from the analyses.

Both these birds (males caught in May), although racially assigned as *oenanthe* on the basis of the method used for separation (Svensson's criteria), fall within the overlap range quoted for *leucorhoa* and referred to and shown graphically previously. These very high weights would make more sense if these birds were in fact *leucorhoa.*

Timing

Wing length values were plotted against date of capture both for males and females. The resultant graphs (Figs 2&3) show that in every month "small" birds of both sexes were in evidence. Whilst "large" birds did not appear until, in the case of males the 9 April with the majority not appearing until the 16 April, and in the case of females apart from single records on the 4 April and 13 April the majority not until after the 17 April. Only ten males and two females with wing lengths within the ssp. *oenanthe* range were caught after 1 May. Analyses revealed that of the 70 males with wing lengths >102 mm, (43% of the total males captured, ie of both races), 53 (76%) were in April, and 17 (24%) were in May. Of the 77 females with wing lengths >97, (53% of the total females captured, ie of both races), 41 (53%) were in April, and 33 (43%) were in May, and 3 (4%) were in June. This is shown in Table 5.

Table 5: The numbers of Wheatears of both races caught in spring 1990-1996 relative to the month of capture.

	Males				Females			
Month	*oenanthe*		*leucorhoa*		*oenanthe*		*leucorhoa*	
	n	*% of total*	*n*	*% of total*	*n*	*% of total*	*n*	*% of total*
March	31	33%	nil		17	25%	nil	
April	53	56%	53	76%	49	72%	41	53%
May	10	11%	17	24%	2	3%	33	43%
June	nil		nil		nil		3	4%
Total by race	94	100%	70	100%	68	100%	77	100%
Total birds	164 Males				145 Females			

These results were further investigated in relation to the incidence of each race by splitting April and May into two periods, from the 1-15 April and 16-30 April, and from 1-15 May and 16-31 May, March was not split as no *leucorhoa* birds of either sex were involved.
Analyses of the data showed that of the:-
ssp. *oenanthe* 33% of males and 25% females were in March. 42% of males and 49% of females were during 1-15 April, and 15% of males and 24% of females during 16-30 April.
and of:-
ssp. *leucorhoa* 7% of males and 2.5% of females were during 1-15 April, 69% of males and 51% of females were during 16-30 April, 17% of males and 21% of females during 1-15 May, and 7% of males and 22% of females during 16-31 May. This is shown in Table 6.

Table 6: The numbers of each race of Wheatears caught in spring 1990-1996 showing the occurrence in each month further subdivided into two parts.

	Males				Females			
Month	*oenanthe*		*leucorhoa*		*oenanthe*		*leucorhoa*	
	n	*% of total*	*n*	*% of total*	*n*	*% of total*	*n*	*% of total*
Mar	31	33%	nil		17	25%	nil	
Apr 1-15	39	42%	5	7%	33	49%	2	2.5%
Apr 16-30	14	15%	48	69%	16	24%	39	51%
May 1-15	6	6%	12	17%	1	1%	16	21%
May 16-31	4	4%	5	7%	1	1%	17	22%
Jun 1-16	nil		nil		nil		3	3.5%
Total by race	94	100%	70	100%	68	100%	77	100%
Total birds	164 Males				145 Females			

These results, whilst not dissimilar to the finding of Condor (1989) who considered that most Wheatears passing through Skokholm (Dyfed) "after 15 April, and particularly after 1 May" were of the *leucorhoa* race, show that it is mainly in the second half of April that the leucorhoa race passes through the Norfolk coast. Whilst Jones (1992) states that "it is in May that the larger, heavier birds pass through Bardsey".

On the basis of separation by wing length, males of the *leucorhoa* race are moving through the area mostly during the period 16-30 April (69%), while females are more protracted 16-30 April (51%), 1-15 May (21%), and 16-31 May (22%). Differential migration of the sexes with a temporal gap between males and females, has been commented upon by researchers in Italy (Spina et al 1994)

Reference to Table 5 shows that 76% of all *leucorhoa* males were caught before 1 May and 53% of *leucorhoa* females. It would appear that migration of the *leucorhoa* race along the Norfolk coast is earlier than in Wales with most males occurring in April not May. This discrepancy warrants further investigation, but is outside the scope of this present paper. .

DISCUSSION

All the Wheatears involved in this study are migrants as it is thought that the north west Norfolk coast does not support a breeding population.

The separation of the races on the basis of wing length values using criteria suggested by Svensson (1992) errs on the side of caution in that it is the higher values for the nominate *oenanthe* that pertain. Values at the lower end of the *leucorhoa* range cited by Cramp (1989) are dismissed insofar as they would count for inclusion within the range of values of *oenanthe*, at the highest value, the 'overlap range'. This is shown graphically in Figs 2&3 where it can be seen that for males in all three months (March, April and May), there are some that fall within this range. Conversely, for females, whilst some fall within this range in March and April, none do so in May.

This poses the question as to where those males that fall within this range, at these late dates, (particularly after 15 April), might be heading given that both Condor (1989), and Jones (1992) consider that the local breeders of Skokholm and Bardsey would have arrived and be established on territory in March and early April. After the 3 May, within this overlap area, no males were caught with wing length values less than 100 mm, values which are within the range of birds of the *leucorhoa* race, it may well be that given the lateness of the dates, that these too are *leucorhoa.*

This paper indicates that 43% of males and 53% of females caught in spring can be referred to the larger subspecies *leucorhoa,* and 57% of males and 47% of females are of the nominate *oenanthe.*

The ultimate destinations of the two races is not known at present, and as there have been no ringing recoveries of the study birds so far, must remain a matter for speculation. The nominate *oenanthe* are probably heading for destinations within Britain, Faroe or the north western continental mainland and Scandinavia.

The *leucorhoa* race breeds in Greenland, Iceland and N.E.Canada, the Icelandic population are slightly smaller than the Greenland population but are included taxonomically with this form. Measurements for Greenland and Iceland breeders are given in Cramp (1988), taken from skins whose wings would have shrunk by between about 1 and 2 mm in length. Comparison with north west Norfolk live birds is shown in Table 7.

Table 7. Wing length measurements (from skins) for Wheatears from Greenland (two samples) and Iceland (Cramp 1988) compared with live-bird mean measurements for *leucorhoa* caught in north-west Norfolk.

	Males			Females		
Location	*n*	*Mean*	*Range*	*n*	*Mean*	*Range*
Greenland	18	105.2	101-109	16	101.6	99-105
Greenland	36	105.1	102-110	37	103.4	100-108
N.W.Norfolk	70	105.1 *	103-110 *	77	102.1	98-106
Iceland	49	102.6	99-107	23	99.0	96-103

* two outliers (1 at 115 mm and 1 at 118 mm) excluded, to include them inflates the mean to 105.5, a value which might indicate that this population was headed for N.E.Canada!

The Norfolk birds, excluding the two outlier values, fit very well between the sets of data for Greenland and Iceland. Bergmann's rule states that, among the forms of polytypic species, body size tends to be larger in the cooler parts of the total range and smaller in the warmer parts.The recording in N.W.Norfolk of male wing lengths up to 118 mm and female up to 106 mm, might indicate the presence of some Greenlanders under Bergmann's rule, but this present paper is unable to answer the question unequivocally, and we cannot say whether Norfolk migrants are destined for Greenland or Iceland or to both, and in what proportions.

Fig 2: Wing lengths, date trapped and numbers caught of male Wheatears in north west Norfolk spring 1990 - 1996. (n = 164).

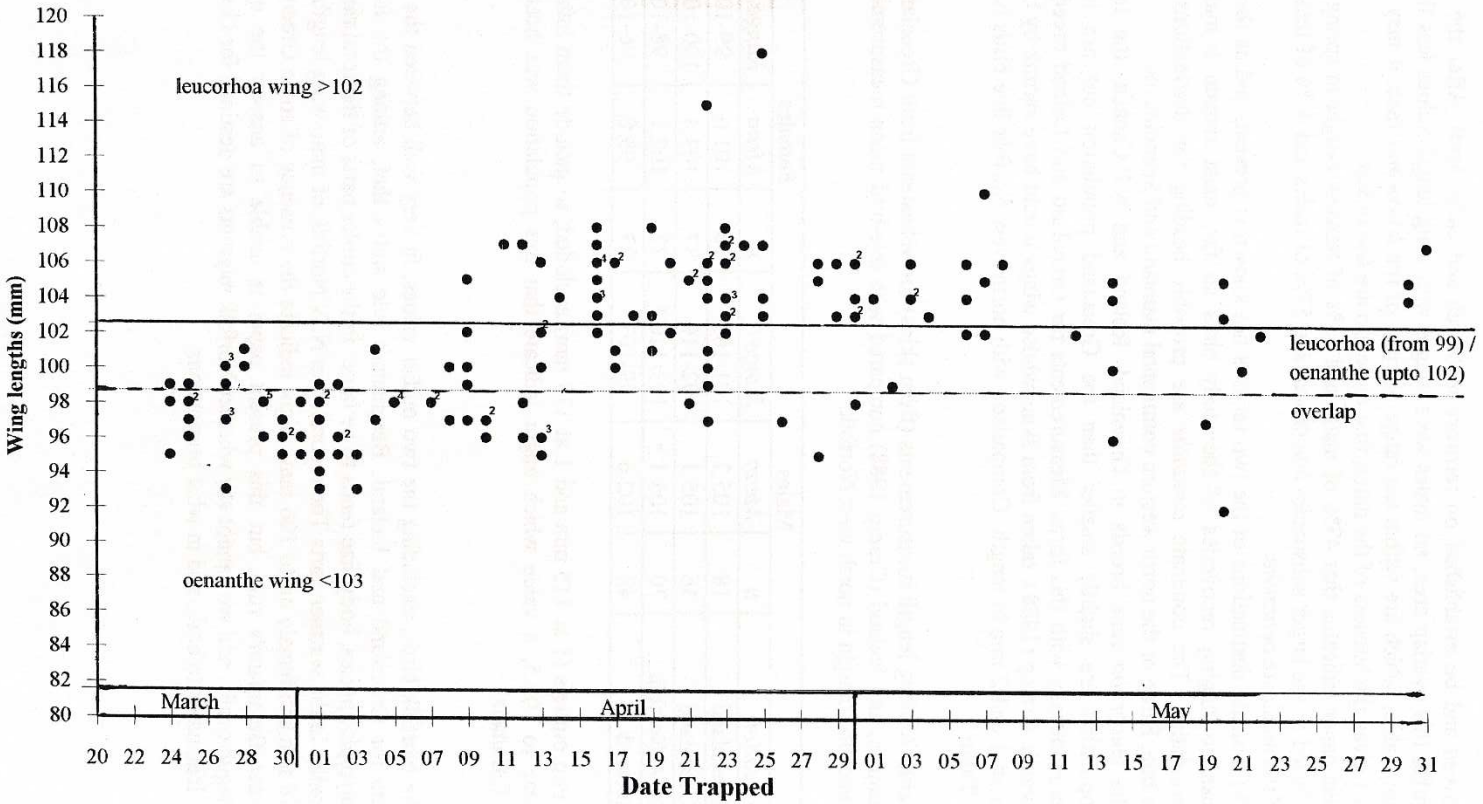
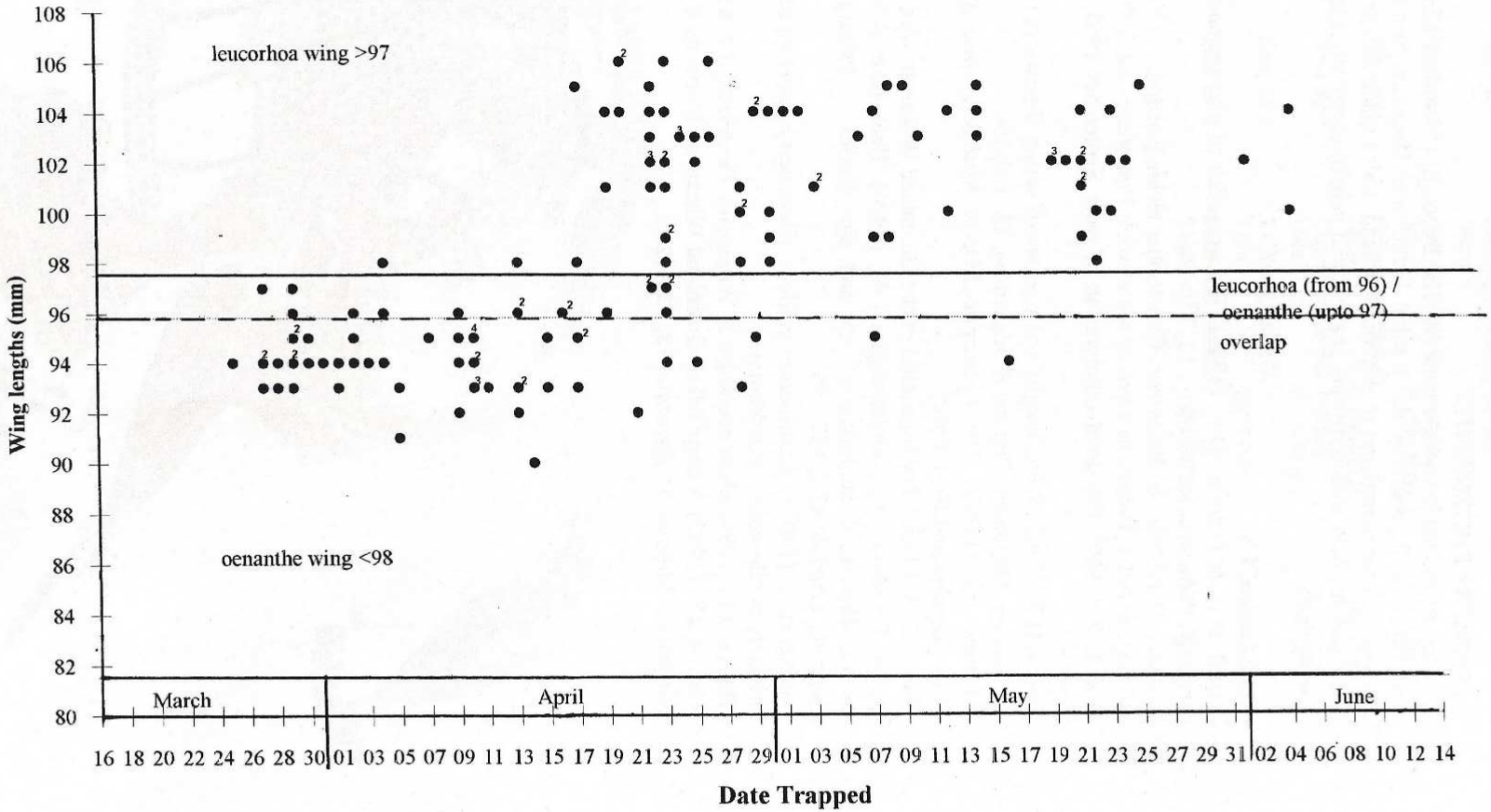


Fig 3: Wing lengths, date trapped and numbers caught of female Wheatears in north west Norfolk spring 1990 - 1996. (n = 145)



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