1 INTRODUCTION

For starting a new population research project on Herring Gulls (Larus argentatus, L.a.) and Lesser Black-backed Gulls (Larus fuscus, L.f.) for the Edward Grey Institute on Skomer I. Dyfed, Wales, I stayed there from 22 April to 15 July 1978. Besides the mere trapping, colourringing and sexing (by means of bill measurements)of the Gulls, more data were gathered which were used mainly for pair-bond relation and moult investigations. I did not try to investigate breeding success because of the disturbance caused by the trapping operations in the colony.

2 METHODS AND MATERIAL

The Gulls were studied and caught on two study plots, one along the northcoast mainly occupied by Herring Gulls (Herring Gull or HG plot: 240m x 25-30m), the other somewhere in the middle of the island mainly occupied by Lesser Blackbacks (LB plot: 50 x 100m).
Every two days the nests were checked and any new nests were numbered. On as many nests (with eggs) as possible I tried to catch the adult breeding birds. At first success was poor and several nests got lost (because of wrong technique which enabled neighbouring Gulls and Jackdaws to eat the eggs) but later on success was much improved because of changing the technique (the traps being left closed over the nests and opened again about half an hour after release of the trapped bird). Of each (numbered) nest on which catching of adult birds was tried the eggs were measured first.
The construction of suitable traps costed me two precious weeks. These traps were cages of about a metre long made from wire and wire-netting with a sliding door which was released by the bird itself by means of a small hook, nylonwire and a piece of dead Bracken which was laid over the eggs.*) Later in the season funnels were put on some of the 25 traps which were rather good as a trapping mechanism (specially when there was much wind) but unfortunately enabled Jackdaws to walk in and out freely!
Mainly by means of these traps (some by dazzling at night) 73 adult L.a. and 100 adult L.f. were caught, measured and most of them ringed and colourringed. The measurements taken were bill length (to feathers) and depth (at angle of gonys), headlength (bill length and headlength combined), wing chord and weight, moult and in L.f. only, leg colour.
During each nest/egg check in the colonyplots all the fallen primaries were collected.
In the course of the season 350 L.a.chicks and 500 L.f.chicks were colourringed with one white ring on the right leg.

*) see fig. 1.

SEXUAL DIMORPHISM AND SOME OTHER ASPECTS OF THE BREEDING BIOLOGY OF HERRING AND LESSER BLACK-BACKED GULLS ON SKOMER ISL.

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TABLE 1 MEASUREMENTS OF LARUS ARGENTATUS

Bill depth	(pairs)	♂	19.32	(0.78;10)	18.5 - 21.1
	(all, ♂ side)		19.16	(0.77;38)	17.6 - 21.1
	(H)+	♂	19.0	(0.6;148)	16.9 - 21.4
	(pairs)	♀	16.68	(0.69;10)	15.8 - 18.0
	(all, ♀ side)		17.10	(0.61;34)	15.8 - 18.2
	(H)	♀	17.1	(0.9;130)	14.8 - 20.9
Bill length	(pairs)	♂	54.37	(1.66;10)	52.1 - 57.2
	(all, ♂ side)		54.76	(2.03;10)	51 - 58.6
	(H)	♂	54.6	(3.0;148)	49.0 - 64.4
	(pairs)	♀	49.70	(2.77;10)	44.3 - 52.6
	(all, ♀ side)		49.64	(1.87;34)	44.3 - 53
	(H)	♀	50.0	(2.5;130)	43.0 - 56.2
Winglength	(pairs)	♂	427.0	(5.9 ;10)	418 - 436
	(all, ♂ side)		424.5	(7.0 ;37)	411 - 442
	(H)	♂	426	(9.1;127)	399 - 455
	(pairs)	♀	402.9	(7.3 ;10)	387 - 410
	(all, ♀ side)		410.1	(10.0;34)	387 - 431
	(H)	♀	406	(9.4;116)	382 - 427
Weight	(pairs)	♂	973.0	(47.4;10)	895 - 1020
	(all, ♂ side)		946.2	(70.0;37)	770 - 1085
	(H)	♂	977	(68 ; 36)	750 - 1150
	(pairs)	♀	764.4	(53.1; 9)	670 - 855
	(pairs)	♀	760.0	(52.0;10)	670 - 855
	(all, ♀ side)		776.2	(55.3;34)	670 - 880
	(H)	♀	813	(69 ; 32)	690 - 940

(H)+ = according to Harris & Hope Jones (1969).

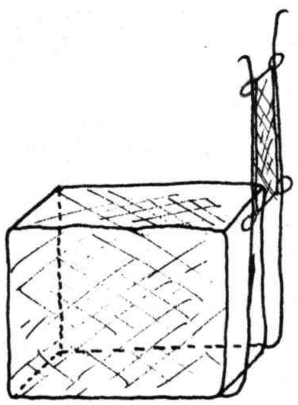


FIG.1 TRAP

TABLE 2 MEASUREMENTS OF LARUS FUSCUS

Bill depth	(pairs)	♂	18.47	(0.73;25)	17.2 - 20.0
	(all, ♂ side)		18.41	(0.74;52)	16.4 - 20.0
	(H)+	♂	17.4	(0.6 ;30)	17.2 - 19.1
	(pairs)	♀	16.64	(0.58;25)	15.6 - 17.9
	(all, ♀ side)		16.54	(0.54;44)	15.5 - 17.9
	(H)	♀	15.9	(0.9; 30)	14.1 - 17.9
Bill length	(pairs)	♂	55.74	(2.25;25)	52.1 - 62.3
	(all, ♂ side)		55.62	(2.34;52)	50.0 - 62.3
	(H)	♂	55.6	(2.3 ;30)	49.0 - 60.0
	(pairs)	♀	50.91	(2.06;25)	47.3 - 55.5
	(all, ♀ side)		50.55	(1.86;44)	46.9 - 55.5
	(H)	♀	50.0	(2.2 ;50)	45.5 - 54.9
Winglength	(pairs)	♂	433.8	(6.64;24)	419 - 444
	(pairs)	♂	433.7	(6.52;25)	419 - 444
	(all, ♂ side)		431.3	(10.0;46)	406 - 444
	(H)	♂	430	(6.6 ;26)	417 - 446
	(pairs)	♀	412.5	(8.6; 25)	386 - 428
	(all, ♀ side)		412.2	(9.6; 36)	386 - 428
	(H)	♀	409	(9.7; 35)	394 - 430
Weight	(pairs)	♂	867.6	(55.1;25)	770 - 980
	(all, ♂ side)		846.3	(74.0;47)	630 - 980
	(H)	♂	880	(61 ; 22)	770 - 1000
	(pairs)	♀	715.0	(55.9;25)	585 - 815
	(all, ♀ side)		699.9	(58.4;36)	585 - 815
	(H)	♀	755	(58 ; 31)	620 - 908

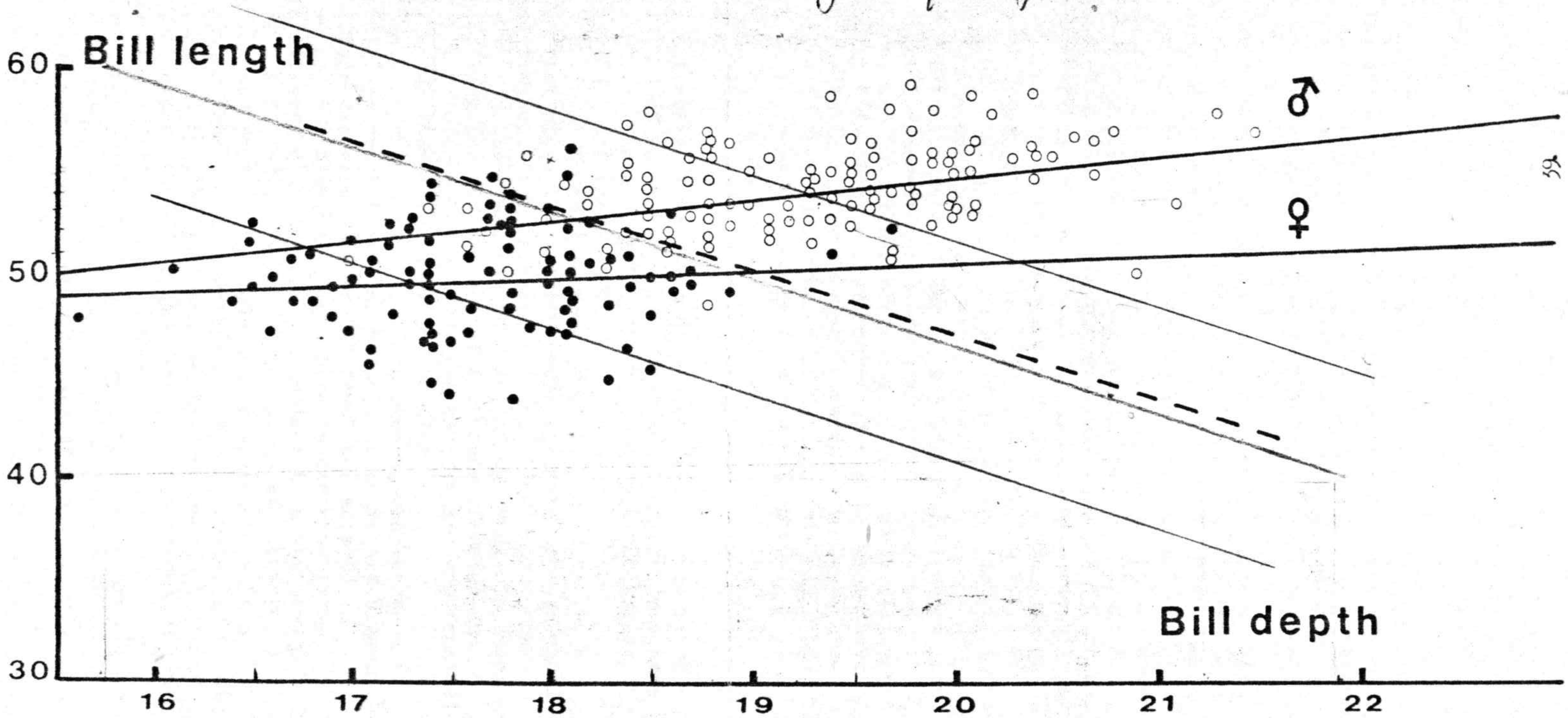
(H)+= according to Harris & Hope Jones (1969).

o = ♂ } Scarborough
• = ♀ }

- - - - - discriminant line for Scarborough birds.

Pencil line is Mike Harris separation line for gulls from Skokholm & Skomer.

Fig. 2.



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3 MEASUREMENTS

3.1 PAIRS

By using the data of Harris & Hope Jones (1969) and of P.Monaghan (letter of Febr.1978, Fig.2) I could divide the trapped birds in birds on the male side and birds on the female side of a dividing line. These measurements and categories, although rather artificial, are to be found in table 1.

When two different birds were caught on the same nest they were considered to be a pair consisting of a male and a female bird. Since no one ever found a pair of Gulls in which the male bird had a smaller bill than the female and since Harris & Hope Jones (1969) found that in 4 cases of mixed L.a.-L.f.pairs in which the males were L.f., these males all were bigger than their L.a. mates although L.a. usually have bigger bills than L.f., I think I can safely consider the biggest bird (the bird with the biggest bill) of each pair to be the male and the smallest the female. Besides, in all pairs obtained thus (10 in L.a.,25 in L.f.) always at least one, but mostly both individuals were clearly in the male or the female area of the sexing table (Fig.2).

Compared with the data of Harris & Hope Jones (1969) we see in table 1 that the measurements of their adult birds (not all breeding birds) are not different from mine in L.a,but bill depth is different in L.f. This is puzzling because if we would have taken measurements in different ways (although I took measurements according to their description of doing it) we would have found these differences in both species and not in one.

3.2 PAIRS AND NON-PAIRS

The measurements of Harris & Hope Jones (1969) were taken from individuals of known sex of which at least a part must have been non-breeders, since normally about 20% of all adults are non-breeders (Kadlec & Drury, 1968).

Though the bill depth measurements of L.f. produced by H. & HJ. differ from mine, these differences are more or less equal in males and females. So I think that it is allowed to compare the difference of their means with that of my study. In doing this and comparing the differences of the means of males and females of H & HJ with the mean differences of males and females of my pairs we see something very interesting.
In argentatus we see that in bill measurements, winglength and weight the differences between individuals of pairs are bigger than the differences of all males and females (table 3).
In fuscus we see the same, although there is one exception, bill length difference in my pairs is smaller than that calculated out of H & HJ and the wing length is the same.(table 4).
It might seem dangerous to conclude that differences within pairs are bigger than those in a random sample from the population, including (some) non-breeders, because this conclusion is based on measurements taken by different observers on different moments and on (partially) different populations.
But I believe that this difference is real because we are able to find similar results in Harris (1964a) and Goethe (1937).
Harris (1964a) gives, apart from plain measurements of males and females of Great Black-backed Gulls (Larus marinus), the measurements of 10 pairs, Goethe (1937) does the same with 7 pairs of Herring Gulls.

TABLE 3	DIFFERENCES BETWEEN MALES AND FEMALES: LARUS ARGENTATUS			
Bill depth	(pairs)	2.64	(0.98;10)	1.2 - 4.1
	(H)[1]	1.9		
Bill length	(pairs)	4.67	(3.70;10)	0.1 - 10.2
	(H)	4.6		
Headlength	(pairs)[2]	10.8	(3.26;10)	4 - 15
Winglength	(pairs)	24.1	(7.64;10)	12 - 34
	(H)	20		
Weight	(pairs)	214.4	(57.5;9)	125 - 295
	(pairs)	213.0	(54.4;10)	125 - 295
	(H)	164		

TABLE 4	DIFFERENCES BETWEEN MALES AND FEMALES: LARUS FUSCUS			
Bill depth	(pairs)	1.82	(0.83;25)	0.5 - 3.5
	(H)	1.5		
Bill length	(pairs)	4.81	(2.75;25)	0.1 - 10.9
	(H)	5.6		
Headlength	(pairs)[2]	9.65	(3.91;25)	4 - 21
Winglength	(pairs)	21.0	(9.94;24)	3 - 45
	(pairs)	21.2	(9.8 ;25)	3 - 45
	(H)	21		
Weight	(pairs)	152.6	(81.3;25)	5 - 355
	(H)	125		

TABLE 5	DIFFERENCES BETWEEN MALES AND FEMALES: OTHER PAPERS	
	L.marinus (Harris, 1964a)	L.argentatus (Goethe, 1937)
Bill length (pairs)	-	5.4
(not all pairs)	-	3.3
Winglength (pairs)	22.5	18.7
(not all pairs)	21.4	19.1
Tail (pairs)	9.9	-
(not all pairs)	9	-
Tarsus (pairs)	6.3	5.5
(not all pairs)	5	3.5
Weight (pairs)	287.3	-
(not all pairs)	227	-

[1]) according to Harris & Hope Jones (1969).
[2]) for headlength measurements see Appendix Ia and 3.4

TABLE 6 PERCENTAGES OF THE DIFFERENCES OF THE DIFFERENCES FROM TABLE 3,4 and 5

	L.a.Skomer	L.a.Goethe	L.f.Skomer	L.m.Harris	mean
Bill depth	32.6	-	19.3	-	26.0
Bill length	1.5	48.3	-15.2	-	11.5
Wing	18.6	-2.1	0	5.0	5.4
Tail	-	-	-	9.5	9.5
Tarsus	-	44.4	-	23.0	33.7
Weight	26.6	-	19.9	23.4	23.3

TABLE 7 MEASUREMENTS CONTRA DATE OF FIRST EGG: SPEARMAN'S RANK CORRELATION TEST: CORRELATIONS

Differences (pairs)

Winglength L.f.	n=22	$p<0.10$	pos.(greater difference → later first egg)
Weight L.f.	n=23	$p<0.10$	pos. idem

Absolute measurements

Males

bill length L.f.	n=23	$p<0.05$	pos. only in pairs,not when combined with "not obtained pairs"
bill depth L.a.	n=14	$p<0.10$	pos. only in "not obtained pairs",not all combined
Weight L.a.	n=14	$p<0.10$	neg. only in "not obtained pairs", not all combined

Females

Bill length L.f.	n=23	$p<0.05$	pos. only "pairs",not all combined
Weight L.a.	n=15	$p<0.05$	neg. only "not obt.pairs",not all combined

The results, presented in table 5, show the same trend (although there is one exception too, this time in winglength of L.a.). Now there is no possible bias, because these measurements are taken by the same person in the same population.

⇒ So apparently differences between males and females in pairs are greater than those of all males and females of the population (the expected differences).
This might mean that the ± 20% non-breeders (Kadlec & Drury, 1968) ~~must~~ at least partly consist of birds which were unable to get a partner because of insufficient differences between the two of them.

In table 6 we see that the most important differences seem to occur in the measurements of bill depth, tarsus and weight.

3.3 PAIRS AND DATE OF FIRST EGG

If the above is true, one might expect that pairs with the greatest differences in their measurements have certain advantages. Jehl (1970) showed that in certain arctic Sandpipers similar differences in measurements influence the breeding date: newly formed pairs with the greatest differences tend to mate earlier and start breeding earlier which under arctic conditions has definite advantages (chick survival).
To try to find out if the advantages in Gulls are similar to those in these Sandpipers I tried to find negative correlations like: greater differences in measurements → first egg laid sooner (or males bigger/females smaller → first egg laid sooner).
By means of Spearman's Rank correlation tests I could not find such correlations. I only found weak positive correlations ($p<0.1$) for L.f. winglength and weight (table 7).
Trying to find negative correlations in male absolute measurements (greater size → first egg sooner) I only succeeded weakly in weight in L.a."not obtained pairs" [1]), but these combined with "pairs" gave no correlation. Reverse correlations (positive) were found in L.a. bill depth (weakly) only in "not obtained pairs", not in all birds combined and in L.f. bill length only in "pairs", not in all combined.
Trying to find positive correlations in female absolute measurements (smaller size → first egg sooner) I only found one in L.f. bill length in "pairs", not in all birds combined and a reverse correlation in L.a. weight in "not obtained pairs", not in all combined.

So I never found significant correlations and the ones I found were mostly in the"wrong" direction. Probably such correlations are not to be found when it is impossible to separate old and newly formed pairs, like Jehl could. Besides, Skomer Island is definitely not arctic so there is probably no such selection pressure on early breeding. Besides that, "not obtained pairs" is a filtered group, only the biggest could be called males and the smallest females, so I could only try to find correlations in a rather small range of measurements.

Trying to find an explanation for the weak positive correlations in the pair differences I can only think of the following explanation, although I am far from being able to prove it:

1) Breeding birds of which I did not succeed in getting the mate too, so sex is not certain in part of them namely that part of which bill measurements fall in the area between the two "certain dividing lines" drawn parallel to the main dividing line in fig.2.

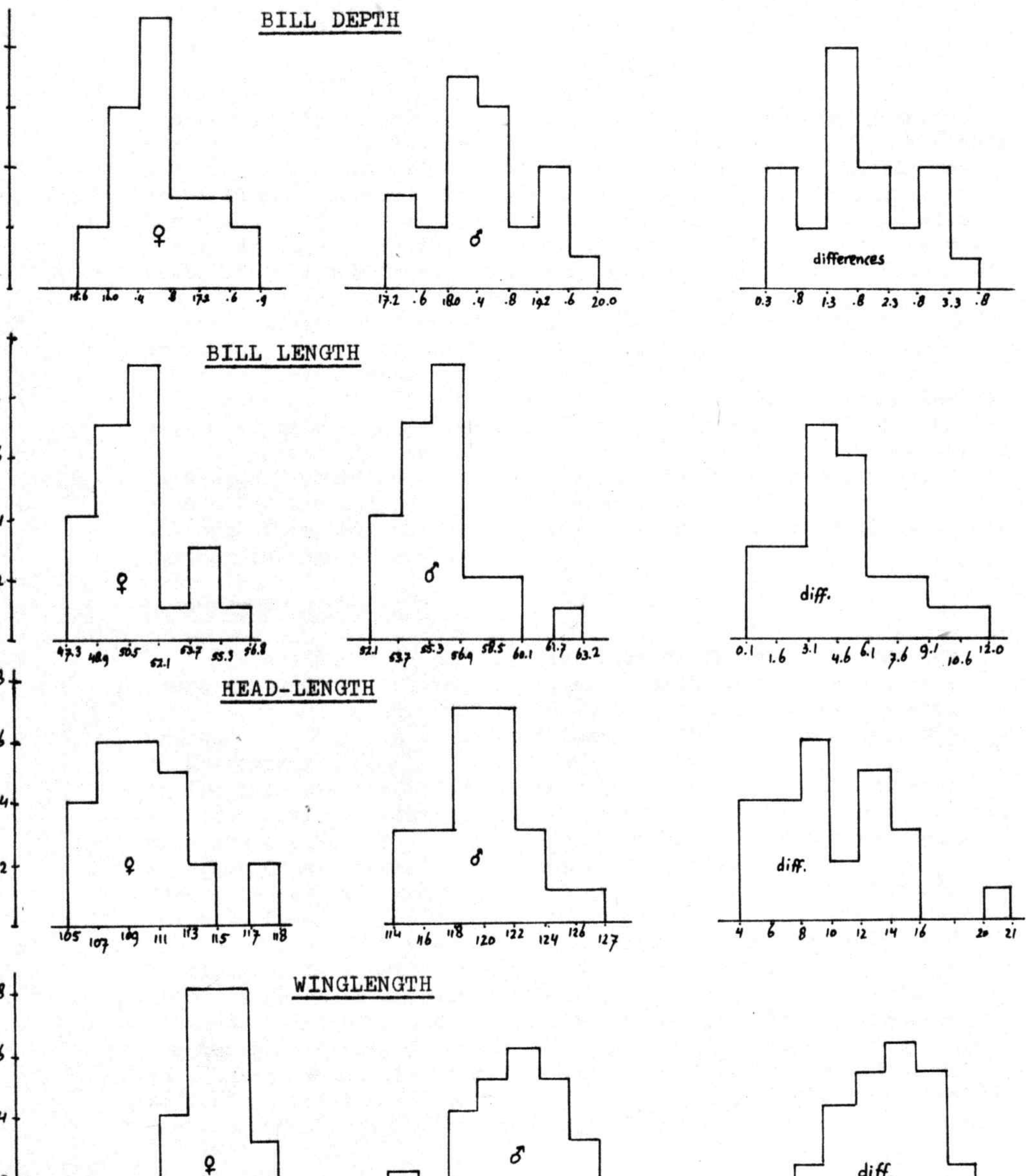


FIG. 3 HISTOGRAMS OF MEASUREMENTS OF 25 PAIRS OF LARUS FUSCUS.

Old pairs breed first, they know each other, are already mated and are able to find a suitable territory soon (usually last year's territory, Tinbergen,1953). The latest breeders are probably mostly newly formed pairs [1]). The latest breeders, so the new pairs, have the greatest differences. So, apparently only the new pairs with the greatest differences are able to breed in the colony. The new pairs with less differences will not succeed in breeding this year but will be more or less routined old pairs next year. So, when catching adults on nests with eggs, the latest breeders one catches are mostly new pairs which succeeded in breeding only because of their sufficient size-differences.

In weight in the L.a. "not obtained pairs" we see in males as well as females a negative correlation. This might mean that birds tend to become lighter later in the season (because only when birds laid eggs I could catch them, so if egg-laying started later, a chance for trapping was present later in the season only). Although this tendency was not to be found in the pairs,I test this further in chapter 3.6 .

3.4 MEASUREMENT HISTOGRAMS OF PAIRS

Since I found in 3.2 that in pairs differences between the sexes are greater than expected, especially in the measurements bill depth and weight (and tarsus), one should expect a selection pressure on small males and big females. This should be visible in histograms.
In fig.3 we see that there is no clear tendency in this direction in L.f., although weak tendencies (female graph steep to the right, male graph steep to the left) are found in bill depth and weight!
In *argentatus* numbers were to small to analyse.
Remarkable are the graphs of bill length, both steep to the right. For this I can't find a proper explanation.

According to Shugart (1977) headlength (combined bill- and headlength) is a better sexdividing measurement than bill length (clearly shown in Appendix I, although not properly measured by me (I used a wingruler and not calipers) in pairs both individuals sometimes have only 0.1 mm difference in bill length, while there is at least 4 mm difference in Headlength), so one should expect to find competition-like graphs (females steep to the right, males steep to the left) in this measurement too. This is not the case.

3.5 LEG COLOUR

Only of L.f. breeding birds the leg colour was noted. The variability runs from very pale yellowish via bright yellow to dull greyish yellow.
The ratio bright yellow - not bright yellow (dull as well as pale) was roughly 1 : 2. There is no statistical difference between males and females in this ratio, although there seems to be a slight tendency of males having more often bright yellow legs than females (Table 8). The cause of these colourdifferences is not clear to me. If this legcolour is age dependant, one should expect that legs are

[1]) A small check of this: all 6 caught birds with juvenile plumage characters (see 6) produced their first eggs during or later than the peak of first-egg laying (see fig.4).

getting paler with increasing age because twice as many birds have not bright yellow legs than those who have and because annual adult mortality is low, so most adults must be old or very old.

TABLE 8 LEGCOLOURS (not bright yellow is dull as well as pale, dull in only 4 cases, 3 ♀,1 ♂)

Pairs	Bright yellow	not bright yellow	
♂	8	16	
♀	6	18	G= 0.4 < χ^2= 3.48 → no corr.
"not obtained pairs"			
♂	9	9	
♀	1	5	G= 2.06 < χ^2=3.48 → no corr.
all ♂♂	17 (40.5%)	25 (59.5%)	
all ♀♀	7 (23.3%)	23 (76.7%)	G=2.31 < χ^2→ no corr.
all birds	27 (32.9%)	55 (67.1%)	

TABLE 9 LEGCOLOURS WITHIN PAIRS

	♂ bright yellow ♀ not br. y.	♀ bright yellow ♂ not br. y.	♂ = ♀
found frequency	7	5	12
expected freq.	6	4	14

G = 0.70 < χ^2, no corr.

3.6 RELATION TRAPPING DATE AND WEIGHT (PAIRS ONLY)

In 3.3 I suggested that later in the season the birds might become lighter. To test this I tested the weights of argentatus before and after 1 June and those of fuscus before and after 15 June by means of a Student's t-test.
It might be that birds starting breeding late are smaller and therefore also lighter in weight. My interest however was centered on the question whether the Gulls are able to retain their weight during the season. Therefore I compared cube root of weight as a percentage of wing length. There are obvious differences in this ratio between males and females, males have more 'body' (weight) per wing than females (table 10). This was already known (Ingolfsson,1969 for instance).

TABLE 10 RATIO CUBE ROOT WEIGHT AS PERCENTAGE OF WING

L.a.	♂	2.32	(0.036;10)	t = 2.50
	♀	2.26	(0.060;10)	
L.f.	♂	2.20	(0.046;25)	t = 2.17
	♀	2.17	(0.056;25)	

Besides, there are obvious differences in this ratio between the both species (Table 11).Herring Gulls have more "body" per wing than Lesser Black-backs. This too is well known.

TABLE 11 RATIO CUBE ROOT WEIGHT AS PERCENTAGE OF WING

L.a.	10 ♂,10 ♀	2.29	(0.056)	t = 7.63
L.f.	25 ♂,25 ♀	2.17	(0.054)	

For the testing for a possible weight-decrease I used a t-test (Table 12). Although I realise that a simple t-test is not the proper method for testing this I consider it a useful and simple indicator for tendencies. In this case I think there is no tendency of becoming lighter in the season.

TABLE 12 RATIO CUBE ROOT WEIGHT AS PERCENTAGE OF WING TESTED AGAINST DATE
see text

L.a.	♂	before 1 June	2.34	(0.022; 3)	t = 1.20
		after	2.31	(0.039; 7)	
L.a	♀	before 1 June	2.26	(0.065; 6)	t = -0.35
		after	2.27	(0.061; 4)	
L.f.	♂	before 15 June	2.20	(0.049;15)	t = -0.095
		after	2.20	(0.045;10)	
L.f.	♀	before 15 June	2.16	(0.049;18)	t = -0.484
		after	2.18	(0.075; 7)	

3.7 DIFFERENCES IN CATCHING TIME BETWEEN THE SEXES

In order to try to find out if there are any differences in catching time between the sexes (because partners have different breeding schedules daily) I made table 13. The expected frequencies are based on the total number of trapped birds in that period. From table 13 & 14 we see that there is no overall tendency present in both species, though from 14.15 - 15.00 hr. very few females were caught, but the observed differences in the expected and observed frequencies are not statistically significant (Chi-square test for goodness of fit).

Table 13 Expected and observed frequencies of birds of more or less known sex ("pairs" and "not obtained pairs", see 3.3):argentatus

time	♂ exp.	obs.	diff.	♀ exp.	obs.	diff.
10.15 - 11.00	1.9	1	-0.9	2.1	3	0.9
11.15 - 12.00	1.6	3	1.4	1.8	2	0.2
12.15 - 13.00	2.9	3	0.1	3.2	5	1.8 ⇐
13.15 - 14.00	2.9	2	-0.9	3.2	3	-0.2
14.15 - 15.00	4.2	7	2.8 ⇐	4.6	2	-2.6 ⇐
15.15 - 16.00	5.5	3	-2.5 ⇐	6.0	5	-1.0
16.15 - 17.00	0.6	1	0.4	0.7	1	0.3
17.15 - 18.00	1.6	1	-0.6	1.8	3	1.2
18.15 ⇒	0.3	1	0.7	0.4	0	-0.4
		22			24	

$n_{tot} = 68$ $G = 7.06 < \chi^2_{df8} = 15.51$ $G=4.40<\chi^2 15.51$

From 14.15 - 15.00 hr. there are many males and few females caught.

Table 14 Expected and observed freqeuncies of birds of more or less known sex (see table 13): fuscus

time	♂ exp.	obs.	diff.	♀ exp.	obs.	diff.
→10.00	7.8	10	2.2 ⇐	5.5	4	-1.5 ⇐
10.15 - 11.00	1.0	1	0	0.7	0	-0.7
11.15 - 12.00	6.7	6	-0.7	4.8	6	1.2
12.15 - 13.00	8.3	7	-1.3	5.9	9	0.1
13.15 - 14.00	0.5	2	1.5 ⇐	0.4	0	-0.4
14.15 - 15.00	7.8	7	-0.8	5.5	4	-1.5 ⇐
15.15 - 16.00	2.1	1	-1.1	1.5	3	1.5 ⇐
16.15 - 17.00	4.2	5	0.8	2.9	3	0.1
17.15 - 18 00	0.5	1	0.5	0.4	0	-0.4
18.15 →	2.1	1	-1.1	1.5	3	1.5 ⇐
		41			29	

$G = 7.28 < \chi^2_{df9} = 16.92$ $G = 5.62 < 16.92$ $n_{tot} = 79$

until 10.00 many males, few females
from 13.15 - 14.00 many males
14.15 - 15.00 few females
15.15 - 16.00 many males
after 18.15 many females

4 EGGS

4.1 MEASUREMENTS

Of all eggs in nests on which catching trials were made maximal length and width were measured. To determine the volume I used the kld^2 formula (k = constant, according to Harris (1964b) 0.476, to Barth 0.5084 and to Spaans 0.5035 (Spaans & Spaans, 1975), l = max.length and d = max.width). I used Harris' k = 0.476.

4.2 INFLUENCE OF FUSCUS ON ARGENTATUS' EGGS

I compared the eggs of argentatus-3-clutches laid in a (nearly) pure argentatus colony (HG plot) with those laid in a mainly fuscus colony (LB plot). The results in table 15 show clearly that eggs in the "pure" colony are significantly bigger than those laid among fuscus. Not only all eggs were bigger in the HG plot but also when per clutch divided in 2 biggest (mainly a and b eggs) and smallest (mainly c eggs).
The eggs from the HG plot are of similar size as those measured by Harris on Skomer in 1962, those from the LB plot differ significantly.
In table 16 (egg-volume in relation to clutch-size) we see that argentatus-eggs in 2- and 3-clutches are on average not smaller on the LB plot than on the HG plot, though this is clearly so in 3-clutches. This may be an effect of small sample size.

⇒ So L.a. have smaller eggs (in 3-clutches) when they breed among L.f.. What could be the reason for this ? I think there are two main reasons, 1° they breed scattered and not in L.a subcolonies among L.f.*) 2° L.f. prey on each others' and on L.a. eggs much more than L.a. do. So L.a. breeds under sub-optimal conditions and this might be the reason for producing smaller eggs (The possibility of those LB plot eggs being relays (or even protracted layings because of predation) is rather big but should not be of much influence on eggvolume, as is shown by Harris, 1964b, table 7).

Is there a similar influence of L.a. on L.f.eggs ? Unfortunately I could only trace two L.f.nests among L.a.(a 2- and a 3-clutch). So I was unable to study this. The measurements in table 17 and 18 show on the contrary that these 5 eggs were slightly on the big side.

In table 16 and 18 we see that argentatus'eggs are bigger than fuscus'eggs. This is well known (Harris, 1964b for instance).

4.3 EGG VOLUME IN RELATION WITH CLUTCH-SIZE

In table 16 and 18 we see that in L.a.in the HG plot and in L.f. mean egg volume decreases when clutch-size decreases. This is well known and for instance well shown by Spaans & Spaans (1975).

*) They are of low social rank.

TABLE 15 HERRING GULL: EGG MEASUREMENTS: 3-clutches

					t
Length					
Biggest 2 eggs	HG plot	69.56	(2.85;76)	63.7 - 77.4	2.63
	LB plot	67.66	(3.00;20)	63.4 - 74.0	
Smallest eggs	HG plot	66.64	(2.54;38)	60.6 - 71.5	2.47
	LB plot	64.38	(2.78;10)	60.2 - 68.2	
Biggest 2 eggs, both plots		69.16	(2.97;96)	63.4 - 77.4	5.85
Smallest eggs		66.17	(2.72;48)	60.2 - 71.5	
All eggs	HG plot	68.59	(3.07;114)	60.6 - 77.4	3.17
	LB plot	66.56	(3.28;30)	60.2 - 74.0	
Width					
Biggest 2 eggs	HG plot	48.11	(1.57;76)	45.1 - 51.3	3.79
	LB plot	46.61	(1.61;20)	42.2 - 48.7	
Smallest eggs	HG plot	46.39	(1.66;38)	41.4 - 50.1	2.36
	LB plot	45.02	(1.47;10)	42.0 - 47.3	
Biggest 2 eggs, both plots		47.79	(1.68;96)	42.2 - 51.3	5.66
Smallest eggs		46.10	(1.71;48)	41.4 - 50.1	
All eggs	HG plot	47.53	(1.79;114)	41.4 - 51.3	4.00
	LB plot	46.08	(1.72;30)	42.0 - 48.7	

Smallest eggs: 60.2 x 43.7 (54.72cc,LB plot) & 60.6 x 41.4 (49.44cc,HG plot)
Biggest eggs : 77.4 x 50.8 (95.08cc,HG plot) & 67.3 x 51.3 (84.31cc,HG plot)

			n(clutches)
Mean egg (3-clutches)	HG plot	68.6 x 47.5 (73.67cc)	n(clutches)=38
	LB plot	66.6 x 46.1 (67.37cc)	10
	Harris, 1964b	68.0 x 47.7 (73.65cc)	100

Length, all eggs	HG plot	68.59	(3.07;114)	t= 1.90
	Harris	67.97	(2.93;300)	
	LB plot	66.56	(3.28;30)	-2.47
	Harris	67.97	(2.93;300)	
	both	68.17	(3.21;144)	0.65
	Harris	67.97	(2.93;300)	
Width, all eggs	HG plot	47.53	(1.79;114)	-0.66
	Harris	47.67	(1.82;300)	
	LB plot	46.08	(1.72;30)	-4.58
	Harris	47.67	(1.82;300)	
	both	47.23	(1.87;144)	-2.34
	Harris	47.67	(1.82;300)	

Mean egg (2-clutches)	HG plot	68.8 x 47.2 (72.96cc)	n=13
	LB plot	68.7 x 46.6 (71.01cc)	5

TABLE 16 EGG-VOLUME IN RELATION TO CLUTCH-SIZE: ARGENTATUS

3-clutches	HG plot	73.97	n=114	both 72.60	
	LB plot	67.39	30		
2-clutches	HG plot	73.68	24	both 73.87	72.86 (2- and 1-clutches)
	LB plot	74.63	6		
1-clutches	HG plot	69.99	3	both 69.84	
	LB plot	69.61	2		

TABLE 17 LESSER BLACK-BACKED GULL: EGG MEASUREMENTS, MAINLY 3-CLUTCHES

					t
Length	Biggest two eggs	66.88	(2.84:46)	62.0 - 74.3	4.67
	Smallest eggs	63.53	(2.73;23)	59.2 - 69.2	
	Both (all 3-clutches)	65.76	(3.20;69)	59.2 - 74.3	1.72
	All 1- & 2-clutches)	64.95	(2.31;72)	60.1 - 71.9	
	All eggs LB plot	65.34	(2.79;143)	59.2 - 74.3	-1.21
	All 5 eggs HG plot	66.86	(0.86; 5)	65.5 - 67.8	
Width	Biggest two eggs	47.05	(1.45;46)	42.6 - 49.9	4.79
	idem	47.14	(1.49;48)	42.6 - 49.9	
	Smallest eggs	45.32	(1.33;23)	42.1 - 47.7	4.55
	idem	45.45	(1.46;24)	42.1 - 48.6	
	Both (all 3-clutches)	46.58	(1.67;72)	42.1 - 49.9	1.97
	All 1- & 2-clutches	46.04	(1.62;72)	41.3 - 49.7	
	All eggs LB plot	46.31	(1.67;144)	41.3 - 49.9	-0.82
	All 5 eggs HG plot	46.92	(0.95; 5)	45.9 - 48.4	

Smallest eggs: 59.2 x 43.8 (54.06cc) and 63.0 x 41.3 (51.15cc)
Biggest eggs: 74.3 x 47.9 (81.15cc) and 66.0 x 49.9 (78.23cc)

Mean egg	3-clutches LB plot	65.8 x 46.5 (67.72cc)	23	(number of clutches)
	HG plot	67.3 x 47.1 (71.07cc)	1	
	Harris	66.5 x 46.5 (68.44cc)	59	
	1- & 2-clutches LB pl.	65.0 x 46.0 (65.47cc)	43	
	HG pl.	66.2 x 46.7 (68.72cc)	1	
	All clutches LB plot	65.3 x 46.3 (66.63cc)	66	
	HG plot	66.9 x 46.9 (70.05cc)	2	

3-clutches,all eggs,length					
	Harris	66.47	(2.84;177)	59.2 - 75.4	1.69
	LB plot	65.76	(3.20; 69)	59.2 - 74.3	
	HG plot	67.33	(; 3)	66.9 - 67.8	
width	Harris	46.47	(1.57;177)	41.2 - 49.6	-0.49
	LB plot	46.58	(1.67; 72)	42.1 - 49.9	
	HG plot	47.07	(; 3)	45.9 - 48.4	

TABLE 18 EGG-VOLUME IN RELATION TO CLUTCH-SIZE: FUSCUS

3-clutches	LB plot	67.80	69
2-clutches	LB plot	65.85	60
1-clutches	LB plot	64.75	12

4.4 SEASONAL VARIATION IN EGG-VOLUME

Like Spaans & Spaans (1975) I tried to find if eggs become smaller when they are laid later in the season. In table 19 we see that L.a.eggs of 3-clutches after 11 May are smaller than before. The biggest eggs are found in the period 1-5 May (in all clutches). This is unlike Harris who said that there was no difference in egg- or clutch-volume per layingdate (Harris,1969,p.74), but agrees with Spaans & Spaans (1975) and Davis (1975).

TABLE 19 MEAN EGG VOLUMES PER LAYING DATE (n):ARGENTATUS

	before 1 May	1-5 May	6-10 May	11-15 May	after 15 May
3-clutches	73.52(8)	74.56(18)	74.20(12)	65.56(6)	66.99(5)
2-clutches	73.97(5)	78.43(2)	68.39(1)	74.53(3)	66.15(2)
1-clutches	63.97(2)	76.42(1)	72.42(2)	-	-

TABLE 20 MEAN EGG VOLUMES PER LAYING DATE (n):FUSCUS

	10-20 May	21-31 May	1-10 June	after 10 June
3-clutches	67.36(12)	68.58(11)	67.82(1)	-
2-clutches	68.65(9)	68.60(10)	58.86(2)	62.27(10)
1-clutches	76.40(1)	64.22(6)	61.93(2)	65.51(2)

In table 20 we see that this is not similarly shown for the fuscus 3-clutches, because the numbers were too small. Where the numbers are best (2-clutches) we see indeed a similar situation: mean volumes after 1 June are smaller than before.
The biggest eggs are found in the 21-31 May period for 3-clutches and in the 10-20 May period for the 1- and 2-clutches.

This decline of egg-size is said to be found also by Davis in 1973 according to Davis & Dunn (1976,p.68).

4.5 SHAPE DIFFERENCES IN EGGS OF ARGENTATUS AND FUSCUS

During the dividing of 3-clutches in smallest and 2 biggest eggs I noticed a striking difference between the two species in the percentage of clutches in which smallest width and smallest length occurs in a different egg. Table 21 shows these percentages and differences.
In L.f. this occurs in only 8.7 % while in L.a. this occurs from 26.3 % in the HG plot to 50 % in the LB plot.
Similarly I produced table 22 for the biggest eggs in all 3-clutches. This time there was no such difference between the species. This is to be expected because it is much easier to tell what is the smallest egg than what is the biggest egg in a clutch, because usually c-eggs are notably smaller than the other two, so the chance that smallest width and smallest length occur in the same egg is much larger in c-eggs, than is the chance that in a- and b-eggs biggest length and biggest width are found in the same egg.

TABLE 21	3-CLUTCHES IN WHICH SMALLEST WIDTH AND SMALLEST LENGTH DO NOT OCCUR IN THE SAME EGG (PERCENTAGES)				
L.a.	HG plot	26.3 %	(n=38)	both 31.3 %	$G=2.07 < \chi^2=3.48$, not sign.
	LB plot	50.0 %	(n=10)		
L.f.			(n=23)	8.7 %	$G=4.34 > \chi^2=3.48$, significant

TABLE 22	3-CLUTCHES IN WHICH BIGGEST WIDTH AND BIGGEST LENGTH DO NOT OCCUR IN THE SAME EGG (PERCENTAGES)				
L.a.	HG plot	44.7 %	(n=38)	both 43.8 %	$G=0.07 < \chi^2=3.48$, not sign.
	LB plot	40.0 %	(n=10)		
L.f.			(n=23)	52.2 %	$G=0.44 < \chi^2=3.48$, not sign.

Now what can be the reason for these interspecific c-egg differences ? One reason could be that the difference between a/b-eggs and c-eggs is larger in fuscus than in argentatus. To test this I produced table 23 out of table 15 and 17.

TABLE 23	MEAN VOLUMES OF BIGGEST TWO EGGS AND SMALLEST EGGS PER CLUTCH; VOLUME OF SMALLEST EGG AS A PERCENTAGE OF VOLUME BIGGEST EGGS		
L.a.	69.2 x 47.8	75.26cc	
	66.2 x 46.1	66.98cc	⇒ 89.0 %
L.f.	66.9 x 47.1	70.64cc	
	63.5 x 45.3	62.03cc	⇒ 87.8 %

Although this tendency is present I don't think this alone can cause the differences from table 21.
Another explanation could be that L.f.eggs are more regular in shape than those of L.a. If so, the ratio width/length of the eggs must be more constant in L.f.eggs than in L.a.eggs, so their standarddeviation must be smaller (when numbers are equal).

TABLE 24 MEAN RATIO WIDTH/LENGTH OF EGGS OF 3-CLUTCHES

	n	mean	SD	CV (SD as % of mean)
L.a. HG plot	114	0.694	0.032	4.6
LB plot	30	0.694	0.038	5.5
both	144	0.694	0.033	4.8
L.f.	69	0.708	0.029	4.1

In table 24 we see that there is indeed such a tendency, although the numbers of eggs of both species are not quite equal.
We also notice a difference in variance between L.a.eggs from the HG plot and from the LB plot.
Besides we see that there are differences in this ratio between the two species. This is tested in table 25.

TABLE 25	MEAN RATIO WIDTH/LENGTH OF EGGS OF 3-CLUTCHES, t-TESTS				
L.a. L.f.	HG plot	0.694 0.708	(0.032,114) (0.029, 69)	-2.88	significant
L.a. L.f.	LB plot	0.694 0.708	(0.038; 30) (0.029; 69)	-1.98	nearly sign.
L.a. L.f.	Total	0.694 0.708	(0.033;144) (0.029; 69)	-2.92	significant

⇒ So, egg-shapes are more regular in L.f. than in L.a.,they are most irregular in the L.a.-LB plot population, although this big SD is partially due to low numbers.

⇒ The width/length ratio of eggs is significantly bigger in L.f.than in L.a., so eggs of Lesser Black-backed Gulls are more spherical than those of Herring Gulls.

5 SOME MORE BREEDING DATA

5.1 FIRST-EGG DATES

The number of clutches started every two days is shown in Fig.4 and 5.

5.1.1 HERRING GULL

In Fig.4 the number of clutches started every two days is summarised and also the mean date of first-egg laying and the number of clutches started by birds with some juvenile plumage characters (mostly alula and primary coverts, see 3.3 and 6) for the HG plot. Unfortunately I was unable to trace the start and the end of the laying period, so my data are biassed. Since I started catching the adults not before 16 May (in fact mainly since 22 May) my first-egg dates are not really biassed because of disturbance caused by trapping operations.
According to Spaans & Spaans (1975), Barth calculated in 1967 Harris'(1964b) mean first-egg date from Skomer 1962 as being 6 May, Davis (1975) gave peaks around 10 May for the years 1969, 1970 and 1972 on Skokholm. So, although the 1978 spring was very cold and wet (indeed) the mean and peak first-egg laying date (usually close together) were not late at all, they were in fact on the early side (mean 4.4 May).
In Fig.4a we find two peaks, these are similar to those of Fig.4, Harris (1964b).

The LB plot data are shown in fig.4b. These 23 clutches show a mean first-egg date of 8.5 May,a bit later than in the HG plot (although numbers are very unequal: t= -2.51). The reasons for this might be the similar suboptimal conditions ("stress"?) as stated in 4.2. (see note on p. 14).

5.1.2 LESSER BLACK-BACKED GULL

Fig.5 is similar to Fig.4. The start and the end were both rather well traced. Although I started catching (and disturbing) on 1 June I believe that the main bulk of data is without bias. The 1978 21 May-peak is similar to those of Skokholm in 1976 (± 24,21 and 30 May, Davis & Dunn,1976) and definitely not on the late side (in spite of the terrible weather).

NUMBER OF CLUTCHES STARTED EVERY TWO DAYS

FIG.4a Larus argentatus, HG plot

Mean: 4.4 May SD 7.0 days n = 115

| = nests of pairs of which a bird showed juvenile plumage characters, so new pairs.

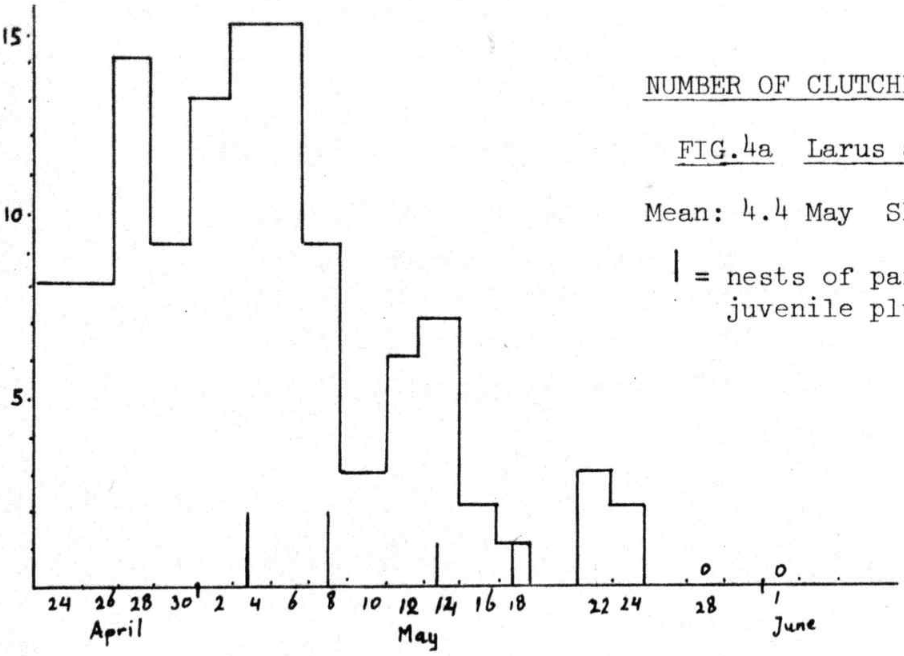


FIG.4b Larus argentatus, LB plot

Mean: 8.5 May SD 7.7 days n = 23

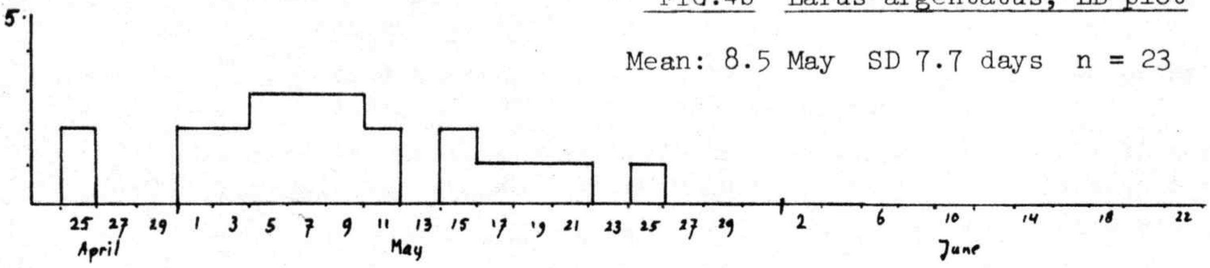
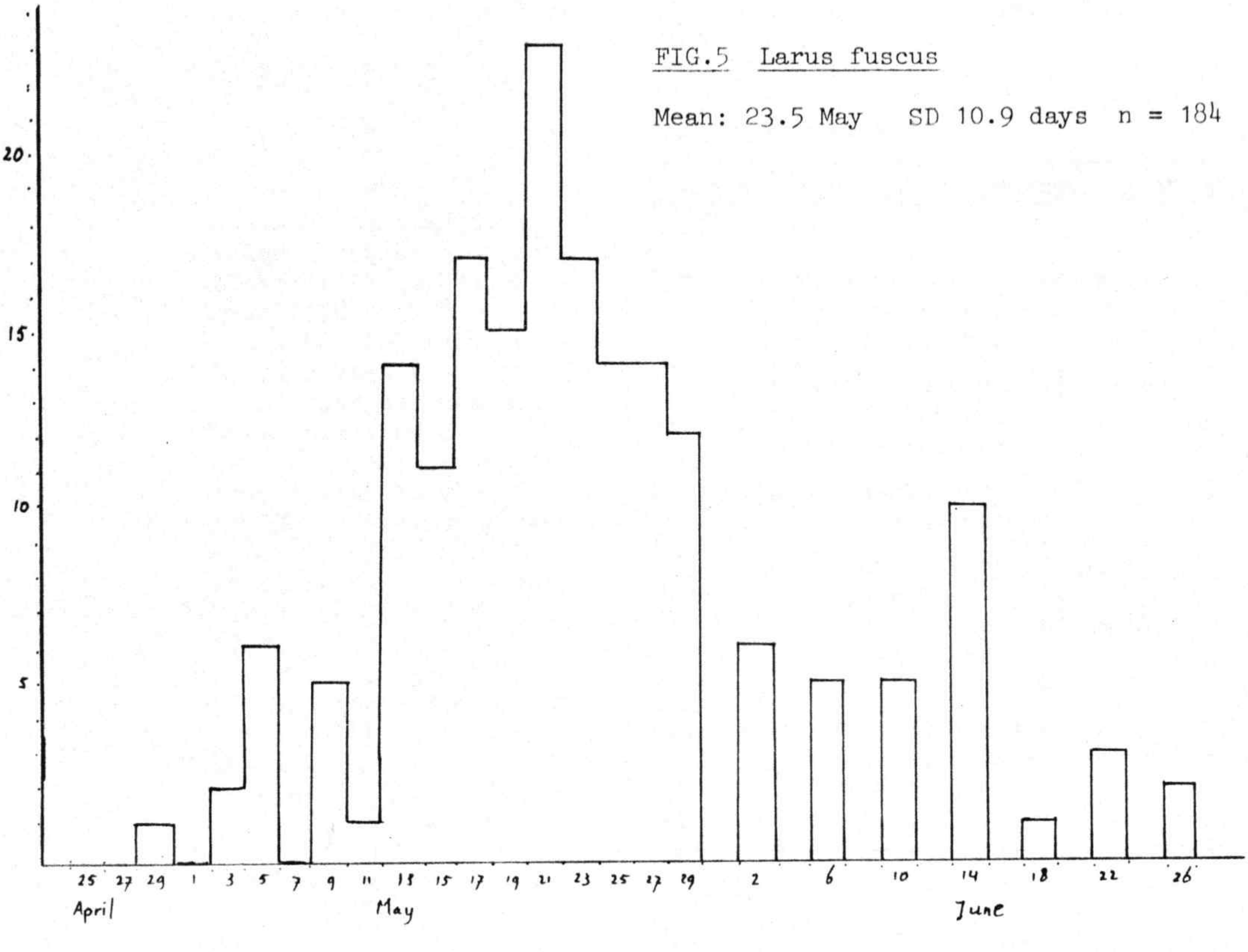


FIG.5 Larus fuscus

Mean: 23.5 May SD 10.9 days n = 184



5.2 NEST DENSITY (compare appendix IIIb and c).

The HG plot nest density (nearly all L.a.) was:

- max.number of nests (= clutches) present on one day: 107 (16 and 18 May) so maximum density: 148.6 - 178.3 pairs/ha
- total number of nests: 120, so total density: 166.6-200 pr/ha

According to Spaans & Spaans (1975) some other density data were:

all nests (so total density):

Terschelling,Holland:	30.5 pr/ha
Schiermonnikoog,Holland	6.5
Little Sister Isl,USA	172
Wilhelmshaven, WDR	827
Skomer,1978	167 - 200

The LB plot nest density (with a rather small % of L.a. in between) was:

- max.number of nests on one day: 113 (with 15 L.a.,27 May) so maximum density 226 pairs/ha.
- total number of nests : 199 so total density 398 pr/ha.(including a number of replacement clutches).

According to Davis & Dunn (1976) a Skokholm density was c.40 nests/ha. Their calculator must have been broken down for 100 nests/acre = $\frac{100}{4047}$ X 10.000 = 247 nests/ha ! (p.75). Besides, from their fig.4 & 5 I calculated densities of 5.33 and 4.67 pairs per $(15\ yd)^2$, mean is 5 pair/ $(15\ yd)^2$ = 266 pair/ha, which is even higher. Nevertheless, the 1978 Skomer densities (which one is the most useful ?) are more or less the same as these Skokholm densities.

5.3 MEAN CLUTCH-SIZES

In table 26 the mean clutch-sizes are shown.

The L.a.HG plot mean is similar to those of Spaans & Spaans (1975;2.74) and Harris (1964b; 2.8). The L.a.LB plot mean is "clearly" less (t=1.40). Is this "stress" because of suboptimal conditions (see 4.2 and 5.1.1) again, combined with heavy L.f. predation ? (see note on p.14). The L.f.LB plot mean "before disturbance" is clearly less than the 2.71 and 2.67 means of Davis & Dunn (1976) of Skokholm 1976 and the 2.7 mean of Harris (1964b) on Skomer 1962. The main reason for this must be the heavy intraspecific predation (Davis & Dunn,1976). This is also shown in the L.f.LB-plot "disturbance"(several times a day) mean of only

TABLE 26 NUMBERS OF CLUTCHES AND MEAN CLUTCH-SIZES

L.a. HG plot	3-clutches	96	mean 2.78 (0.49)
	2-clutches	18	
	1-clutches	4	
L.a. LB plot	3-clutches	17	mean 2.61 (0.72)
	2-clutches	3	
	1-clutches	3	
L.f. HG plot	3-clutches	1	mean 2.5
	2-clutches	1	
L.f. LB plot until start of disturbance (1/6) no relays			
	3-clutches	65	mean 2.13 (0.85)
	2-clutches	39	
	1-clutches	45	
Later than 1/6 (disturbance)			
	3-clutches	0	mean 1.44 (0.51)
	2-clutches	12	
	1-clutches	15	

1.44 (no 3-clutches at all), very heavy predation, not only intra-specific but of Jackdaws too (see 2).

6 THE NUMBER OF ADULT BIRDS WITH SOME JUVENILE PLUMAGE CHARACTERS

As mentined in 3.3 (footnote) there was a small number of trapped argentatus breeding birds with juvenile feather characters, mainly in alula and primary-coverts and sometimes in (middle) tail-feathers. In argentatus there were 6 such birds: 8.2 %. In fuscus I noticed 2 such birds (2 %), but it is likely that I didn't notice all of them (the characters are not very obvious in L.f. because of the dark plumage). Two of the 6 L.a. were males, three possible males and one was possible female (based on Fig.2). Of the two L.f. one was a female and the other a possible male (based on Harris & Hope Jones,1969,fig.1c).
So apparently (at least in L.a.) more males occur with these characters, but numbers are far to low to be sure. If real, this suggests younger age at first breeding for males than for females.

7 POSTURES

7.1 LONG-CALL POSTURES

Brown (1967) distinguished between four extremes in Long-call Throwdown and Throwback postures (1 and 3 in Fig.6), I distinguished between 7 (3 in Throwdown, 4 in Throwback) because I thought Brown's drawings oversimplified. In fact, his "typical fuscus" throwback 1-drawing only occurred in 4 % of the cases studied. Besides, his table 3 which distinguishes between:

Throwdown a Head lowered to breast
b Head lowered below breast
Trowback a Head and neck in line with body
b Head more vertical than body

is rather more vague. Nevertheless, when we compare both tables we see that in L.f, Throwdown 1 occurs more on Skomer (82 %) than on Walney (70 %), while the same posture occurs less in L.a.(8.6%, 23.0%). Most L.a. use the Throwdown 2 posture (Table 27).

TABLE 27 LONG-CALL POSTURES

		L.f.	%		L.a.	%
Throwdown	1	23	82.1		3	8.6
	2	5	17.9		22	62.9
	3	0	0		10	28.6
				t = 7.94		
Throwback	1	2	4.4		0	0
	2	32	71.1		12	19.7
	2 - 3	10	22.2		30	49.2
	3	1	2.2		19	31.1
				t = 6.98		

Concerning the throwback postures,we are able to lump 1 and 2 as well as 2-3 and 3 together to be able to compare these figures with Brown's.

TABLE 28	COMPARISON OF TABLE 27 WITH BROWN (1967) %		
		fuscus	argentatus
Throwback	a(=2-3 + 3)	24.4	80.3
	b(= 1 + 2)	75.5	19.7
Brown	a	39.1	62.1
	b	60.9	37.9

Though my figures in table 28 seem to show that both species tend to differ more from each other on Skomer than on Walney, table 27 shows that there is much overlap (much more than I had hoped), so I have to agree with Brown that these differences in these postures cannot be one of the main separating mechanisms between the two species.

7.2 STARING-DOWN POSTURE

Reading Goethe's (1957) paper on the Staring-down posture awakened my interest in this subject. From his text I got the impression that the staring-down posture could resemble the Throwdown posture of the Long-call, so I expected a difference in this "looking at feet" posture between the two species. During my observations I noticed soon enough that there was not such a difference, both species adopted postures similar to Throwdown 2 and 3 (Fig.6), some individuals even did both in succession, so I did not try to test this further.

8 COLONY CENSUS

On 21, 30, 31 May and 3 June a Gullcensus was made. I only counted birds breeding and also some birds which were apparently defending territories and some pairs among the breeding birds. I excluded birds on "clubs".

TABLE 29 CENSUS RESULTS (BREEDING PAIRS)		
	L.a.	L.f.
Skomer coast (without Neck)	1050	300 - 500
Skomer inland (without Neck)	480	5830
Neck (total)	625	720
	2155	6850 - 7050

If we compare these results (table 29) with Harris (1964b) we see that the L.a. population only doubled since 1962, while the L.f. population became five times as large. This could be due to the breeding-habitat preferences of both species, L.a. on the cliffs, L.f. inland. The cliff area is only a narrow strip while the flat inland area is much bigger, so the suitable L.a.-cliff area is sooner overpopulated than the inland L.f.area. So possibly the argentatus cliff area is full, while there is some more room in the inland vegetated area's. This is also likely because the percentage of L.a. breeding inland (among the L.f. or in a particular rocky inland area, Noth Wick Ridge) has increased from 4.7 % in 1962 (Harris,1964b) to 31.4 % in 1978. In that case one might expect that the percentage of L.f. breeding on the coast (6.4 % in 1962) should have decreased; this is not the case (4.9 - 7.9 %). A possible reason for this is the aggression of L.f., they are able to maintain themselves easily even in an "overpopulated" L.a.colony.

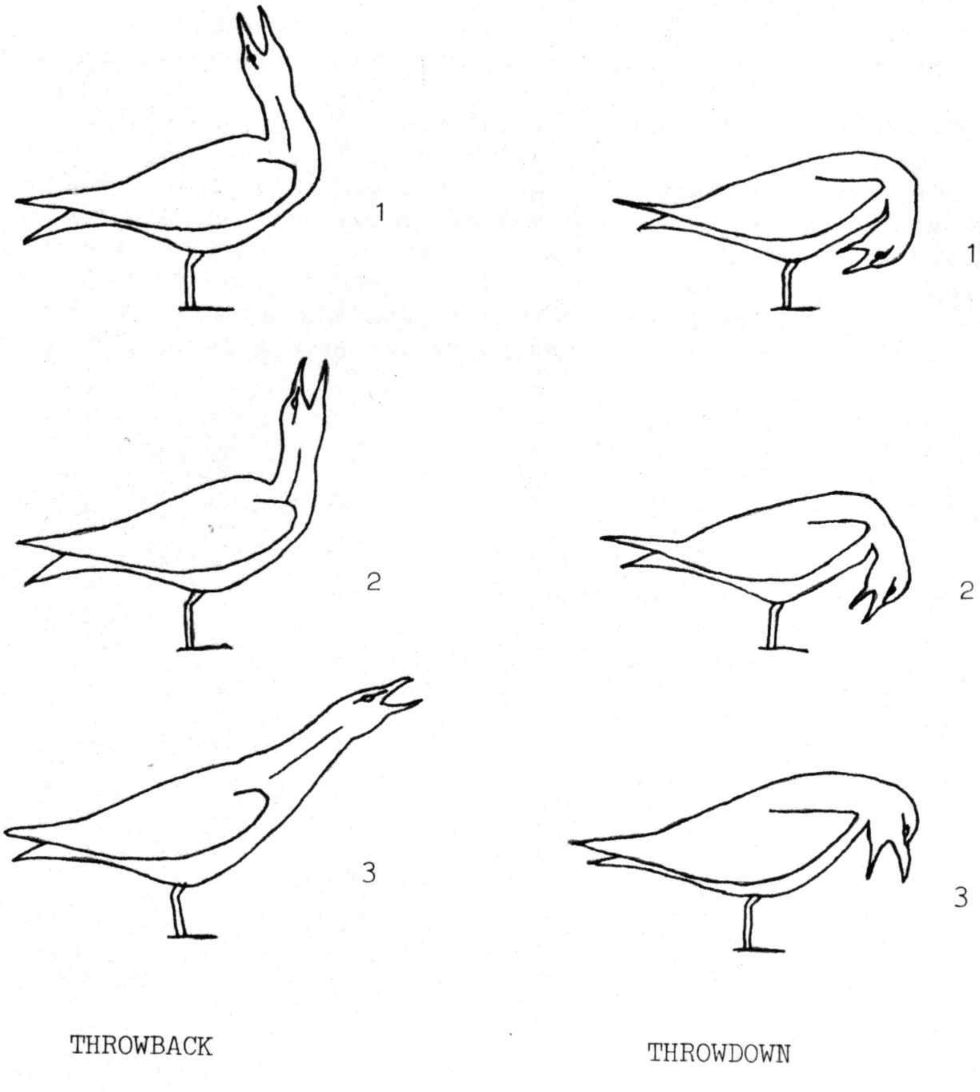


FIG. 6 LONG-CALL POSTURES (Partially after Brown, 1967)

9 HYBRIDS

On 20 June I caught a bird (GP 80459) among L.f. which not only had started primary moult ($4^1 5^1 0^8$, it was the first "fuscus" in doing so) but had a pale orange orbital ring and pale flesh-yellow legs. I did not notice a striking difference in mantle colour with the other birds, but it definitely was a bit paler.

Harris, Morley & Green (1978) suggest that any Herring/Lesser Black-backed Gull with a mid-grey mantle, pale yellow legs and an orange-yellow eye-ring in the breeding season can be assumed to be a hybrid.

Therefore I consider this bird a hybrid. This is not very unlikely because cross-fostering experiments in the sixties were carried out on nearby Skokholm and even some on Skomer (Harris, Morley & Green, 1978).

On 1 July during dazzling Gulls at night we caught and ringed a bird (GP 80489) which at first glance looked like a hybrid but later on was mentioned a Herring Gull because it was drizzling that night, so the bird was a bit wet and therefore the mantle-colour looked darker. The orbital ring appeared orange-yellow and the legs flesh-coloured in these poor light conditions. The bird showed a few juvenile plumage characters (see 6). So, I am not sure this was a hybrid, but the possibility exists.

10 PRIMARY MOULT

10.1 HERRING GULL

Harris (1971) studied the primary moult of the Herring Gull on Skomer in the sixties. In his sample of 275 adult birds in May not a single one had started moult. This is unexpected as Barth (1975:386) found that in many places the start of the moult is about mid-May to early June. Verbeek (1977) showed that in 1973 and 1974 on Walney Island primary moult started on 22 May but shed (adult) first primaries were found already on 15 May. My results show that moult on Skomer in 1978 started even earlier, the first moulting breeding bird caught on 16 May (with moultscore 7!), the first shed (adult) first primaries found on 26 April ! Out of 53 trapped breeding birds 35 (= 66.0 %) had started their primary moult in May (Harris nil), in June 9 out of 14 (64.3 %, Harris: 7.5 %), in July 2 out of 2 (Harris: 18.8 %).

The rather striking difference (May) is likely to be at least partly due to the catching dates of the samples. My sample was taken in the second half of May and though Harris didn't mention any dates of catching we may suppose that this sample was mainly obtained in the first half of the month. This would explain the difference, because primary moult obviously starts about mid-May. Therefore the differences in the May-samples are probably due to different catching dates instead of being the result of a forward shift of the onset of the primary moult in the course of ten years.

In addition, looking at Harris' data (1971: 116), we see a complete lack of low moult scores, which indicates that Harris must have missed the onset of the moult (compare Verbeek, 1977: 88).

10.2 LESSER BLACK-BACKED GULL

The first (symmetrical) moulting bird (apart from the hybrid, see 9) was trapped on 20 June with moultscore 7 ($5^1 2^1 0^8$), the other investigated birds with moult were caught on 23/6 (score 1 and 3), 28/6 (score 3) and on 1/7 (score 1). Until 20/6 64 birds were caught of which none showed moult. From 20/6 until 1/7 17 birds were caught of which 6 birds (35.3%) showed primary moult. So moult started in 1978 on 20 June.

Although Harris (1971) didn't get any birds to handle of late June his figure (p.116) suggests that moult started late June in the sixties too. Verbeek (1977) found the start in late May on Walney Island.

10.3 MOULT STUDIED BY THE FEATHER SEARCH METHOD (FSM)

10.3.1 HERRING GULL

All primaries found in the study plots in the Gull colonies were collected. I separated these in adult and immature primaries. All feathers which showed traces of brown colour were considered immature (Walters 1978). The first adult primaries were seen on 26/4 and collected on 28/4.

Adult primaries were grouped by 4-day periods. Average length per period is plotted in fig.7. In this figure the dots refer to the HG plot, the asterisks to the LB plot. I have calculated the regression-equations for both plots separately, but these were so similar that they could be combined to a single equation: length = 0.44 date + 184.8 (r^2= 0.89, n = 412) in which the date is the number of days from 1 May.

Though both regression lines nearly coincide, it is interesting to note that in the early stages the average primary length in the HG plot is slightly larger than in the LB plot. Later on, the LB plot provided the longest primaries. However, the averages for the later periods in the Lb plot were calculated from extremely small samples and are therefore hardly reliable. In addition, the samples were mainly collected in the clubs, while the earlier ones were found mainly among the nests. I conclude that the high values obtained in the later periods pertain to non-breeders or failed breeders. The lower values in the earlier periods are mainly from nesting birds and do not differ in this respect from the material from the HG plot. The shorter mean primary length per period in the LB plot might be an indication that the LB plot Herring Gulls start their primary moult later than the HG plot birds. This confirms that the former are of 'low social rank' (cf.sections 4.2, 4.5, 5.1.1, and 5.3).

The regression equation l = 0.44 d + 184.8 cannot be the proper one for the entire moult, since according to this equation P_{10} should only be shed 314 days after P_1. Estimates of the duration of the primary moult in the Herring Gull range from 4 to 6 months (Harris 1971; Walters 1978). My data show a slow start of the moult. If I had had the opportunity to collect later in the season I might have found an S-shaped moult curve as was shown to exist by Walters, even if I did not divide my sample in P_1 to P_{10}, but only plotted increase of length with date.

So, though the outcome of the FSM is not very satisfying in this case, it still shows that the moult of 'breeding' Herring Gulls may start as early as 26 April. Also, the observed moult in the trapped breeding birds does not seem to be different from the picture obtained by FSM. Apparently the speeding up of the primary moult is postponed until the Gulls have finished breeding.

In fig.7 the mean lengths of P_1, P_2 and P_3 are also indicated. These were calculated from a small sample of dead Herring Gulls found on Skomer. The means were:

P_1: 176.8 (range 168 - 186; n= 8)
P_2: 195.8 (187 - 209; 9)
P_3: 214.8 (205 - 225; 10)

10.3.2 LESSER BLACK-BACKED GULL

The collected primaries could not be divided properly into adult and immature feathers. Therefore I plotted them all together in fig.8. This means that the results are not comparable with those for the Herring Gull, nor with the moult data collected from trapped breeding birds. These start their primary moult much later than indicated by FSM. The start of the moult of adult breeding birds may cause the conspicuous drop in the average primary length shortly after 20 June.

The first L.f.primaries were collected on 5 May (Verbeek 1977 on 22 May). In fig.8 the mean lengths of P_1 and P_2 are shown. These were based on the calculated means from samples of reference L.f. found dead on Skomer. These means were:

P_1: 179.3 (range 169 - 195; n = 6)
P_2: 195.5 (184 - 214; 6)

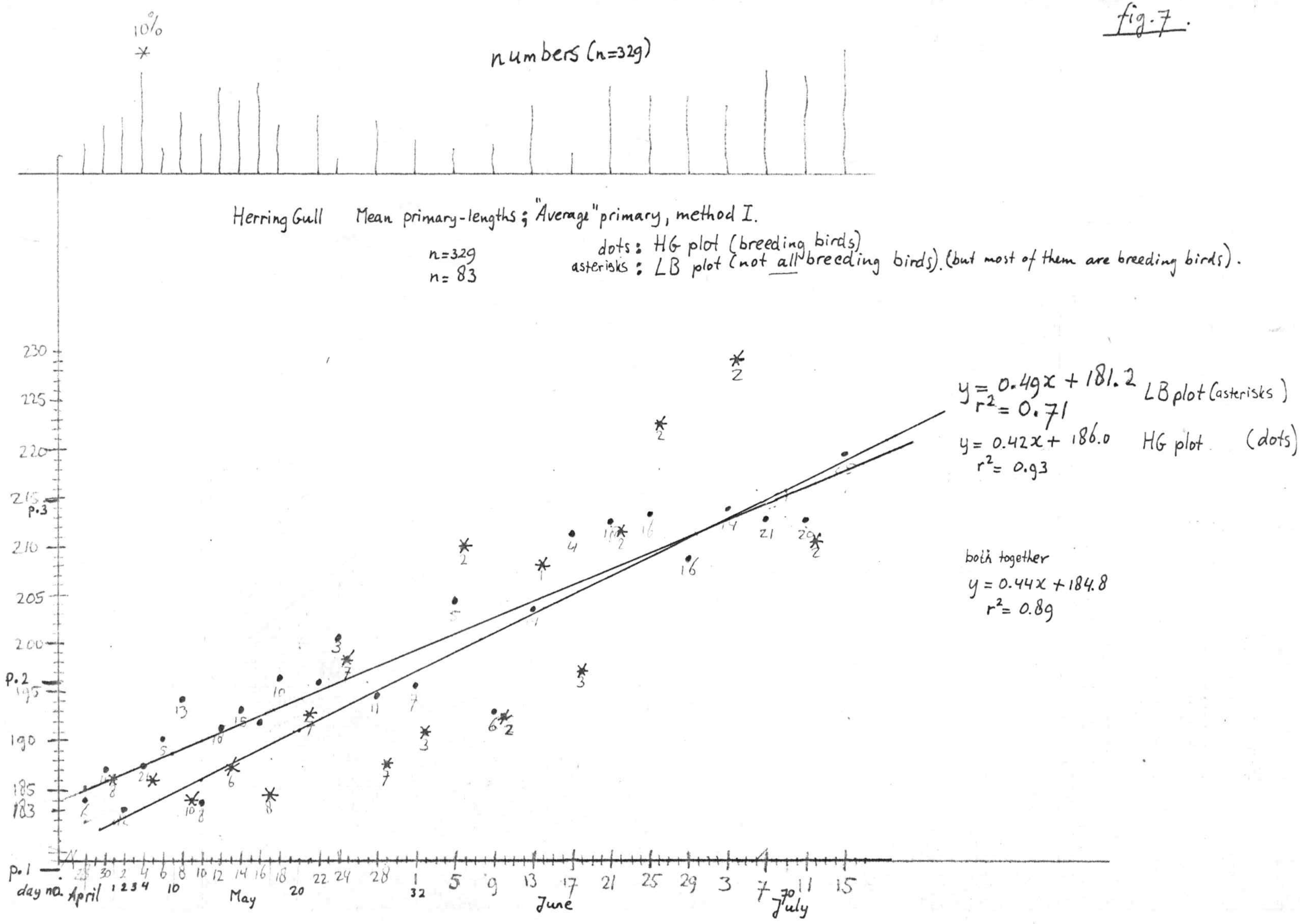
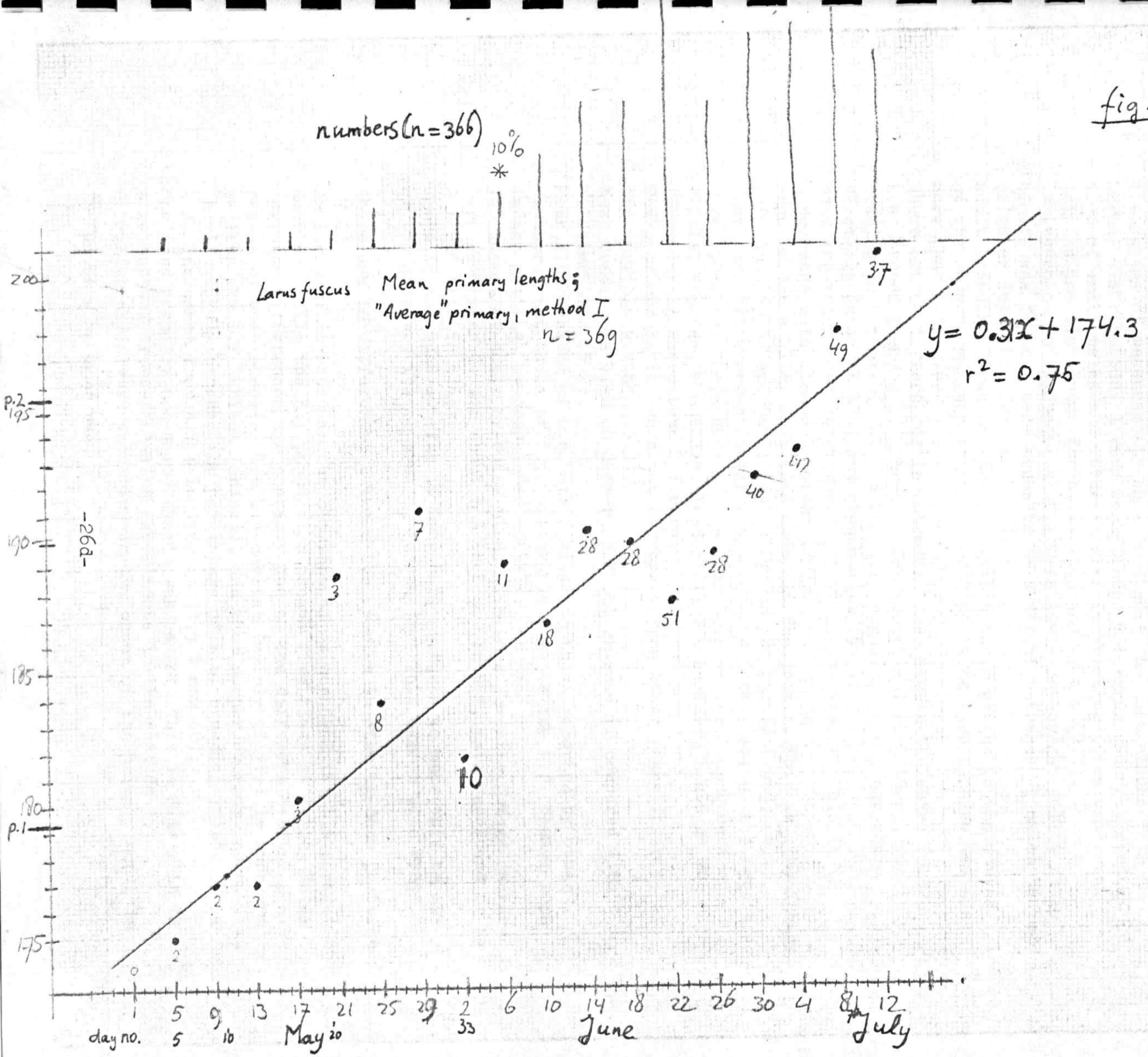


fig. 7.
numbers (n=329)
10%
Herring Gull Mean primary-lengths; "Average" primary, method I.
n=329
n= 83
dots: HG plot (breeding birds)
asterisks: LB plot (not all breeding birds). (but most of them are breeding birds).
y = 0.49x + 181.2 LB plot (asterisks)
r² = 0.71
y = 0.42x + 186.0 HG plot (dots)
r² = 0.93
both together
y = 0.44x + 184.8
r² = 0.89
230
225
220
215
p.3
210
205
200
p.2
195
190
185
183
p.1
day no.
April
May
June
July

fig. 8



numbers (n = 366)
10%
Larus fuscus
Mean primary lengths;
"Average" primary, method I
n = 369
y = 0.3x + 174.3
r² = 0.75
200
p.2
195
190
185
180
p.1
175
-26d-
day no.
May
June
July

11 CONCLUSIONS

Differences in measurements between the sexes appear to be bigger in pairs than in random samples of adults, suggesting that part of the adults can't get mates because of insufficient differences in (bill-depth ?) measurements between the two (3.2).
There are no real correlations to be found between (bill) size and date of first egg like Jehl (1970) could with some Arctic Sandpipers. Only very weak positive correlations are found between differences between individuals of pairs and date of first egg. An explanation for this can be that new pairs (late starters) are only able to breed when they have sufficient size-differences (3.3).
Histograms of measurements show no significant deviations from a normal distribution. A very weak tendency towards underrepresentation of small males and large females in breeding pairs was found only in the histograms for bill-depth and weight (3.4).
In leg-colour of L.fuscus a bright-yellow - not-bright-yellow ratio of 1:2 was found. There seems to be a slight tendency of males having brighter legs than females (3.5).
Adult breeding birds are able to retain their weight in the course of the season. Males have more "body" per wing than females and L.a. more than L.f.(3.6).
There are no differences in catching time between the sexes (3.7).
L.a. breeding among L.f. breed under suboptimal conditions, possibly leading to "stress".*) This is shown in egg-size (4.2), egg-shape (4.5), first-egg dates (5.1.1) and clutch-size (5.3).
Mean egg-volume decreases when clutch-size decreases. This is in accordance with Spaans & Spaans (1975).
Eggs become smaller when laid later in the season. This is like Spaans & Spaans (1975) and Davis (1975) but unlike Harris (1969) (4.4).
There are differences in egg-shape between both species, L.f.eggs are more spherical than those of L.a. (is this because L.a. breeds on cliffs, similar to Guillemot/Razorbill ?). Besides, L.a.eggs are more irregular in shape than L.f.eggs.
Peaks of egg-laying were not different from other years in spite of the terrible weather (5.1).
Nest density is high on Skomer, but not extreme if compared with Wilhelmshaven (5.2).
Mean clutch-sizes of L.a. are similar to those reported by other authors, but those of L.f. differ clearly. Is the L.f. Skomer-population getting "overpopulated" ?(5.3).
The amount of adult breeding birds with some juvenile plumage characters (4^{th} year ?) was about 8 % in L.a.. In L.f. this was found to be 2 % but this is biassed (6).
There is too much overlap in Long-call postures to make this be one of the main species-separating mechanisms. This agrees with Brown (1967) (7.1).
There are no differences between the species in Staring-down postures (7.2).
An increase is noted in the populations, since 1962 the L.a.population doubled, while the L.f.population became five times as large. These increase-differences are probably due to the different habitat preferences of both species. The L.a.habitat (mainly cliffs) is much smaller than the L.f.habitat (inland), and thus sooner overpopulated. This is also likely because the percentage of L.a. breeding inland among L.f. increased from 4.7 % in 1962 to 31.4 % now (8).
One (and possibly one more) hybrid was caught. This is likely to be a remnant of cross-fostering experiments in the sixties (9).
A striking difference was noted in the onset of the primary moult in

*) They are of low social rank.

L.a. between the 1978 results and those of Harris (1971). This is possibly due to different sample dates (10.1). The 1978 results are similar to those of Verbeek (1977) and Barth(1975).

12 SUMMARY

During a stay on Skomer Island, Wales, in spring 1978 for starting a long-term population project, several data were gathered on the breeding biology of Larus argentatus and L.fuscus.
Differences in measurements between the sexes appeared to be bigger in pairs than in random samples of adults, suggesting that part of the adults can't get mates because of insufficient differences in (bill?) measurements between the two partners.
Eggs of L.f. appeared to be more spherical and more constant in shape than those of L.a.
L.a. breeding among L.f. breed under suboptimal conditions. This is shown in egg-size and -shape, first-egg dates and clutch-size.
Peaks of egg-laying were not different from other years in spite of the terrible weather.
Primary moult started in Mid-May, so not Late-June as suggested by Harris.

13 ACKNOWLEDGEMENTS

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Very grateful I am to Dr.C.Perrins who made this all possible and for his advice, and to Dr.J.Wattel for arranging this project for me and for guiding this report.

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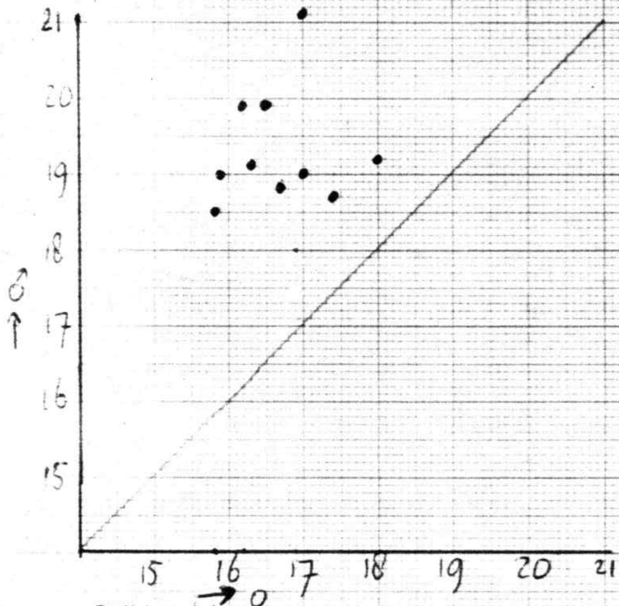
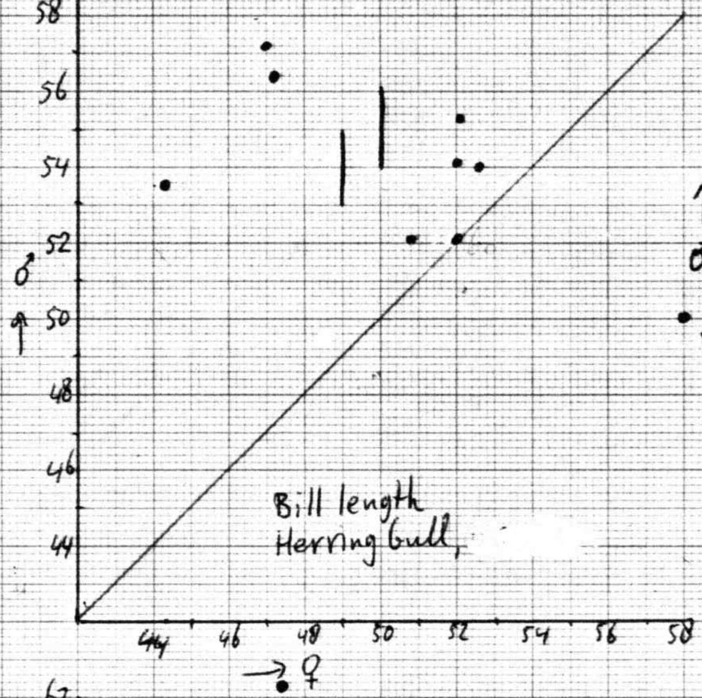
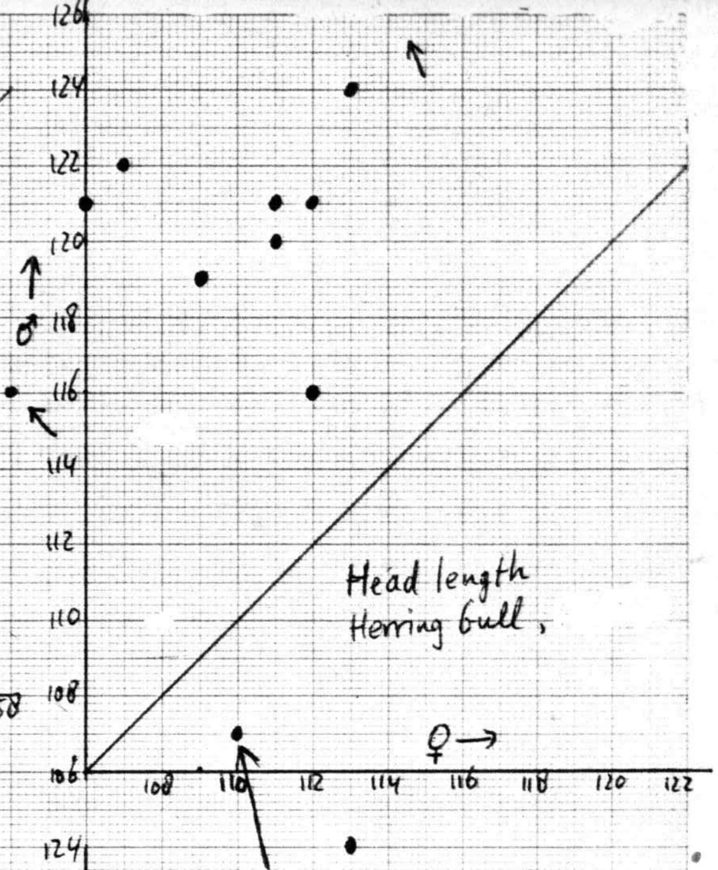


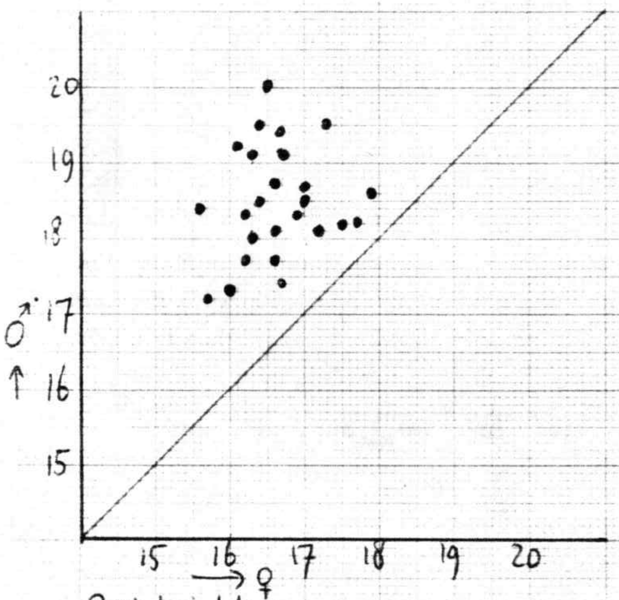
Bill height ♀ 10 pairs
Herring Gull,



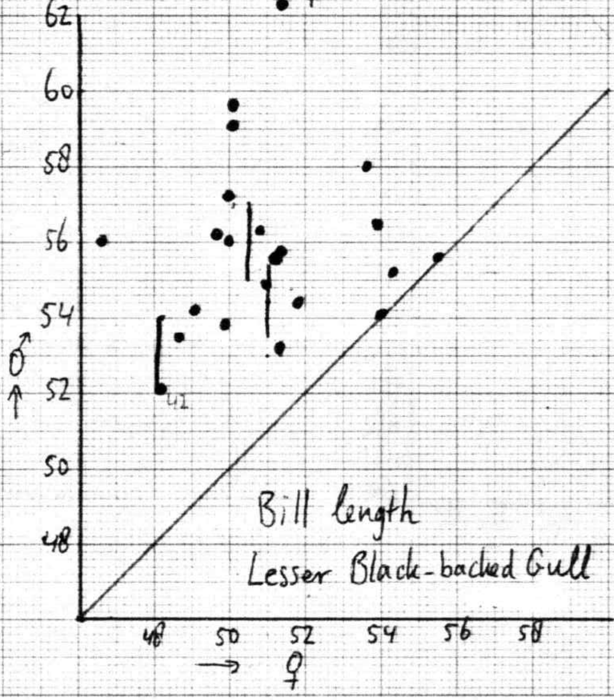
Bill length
Herring Gull,



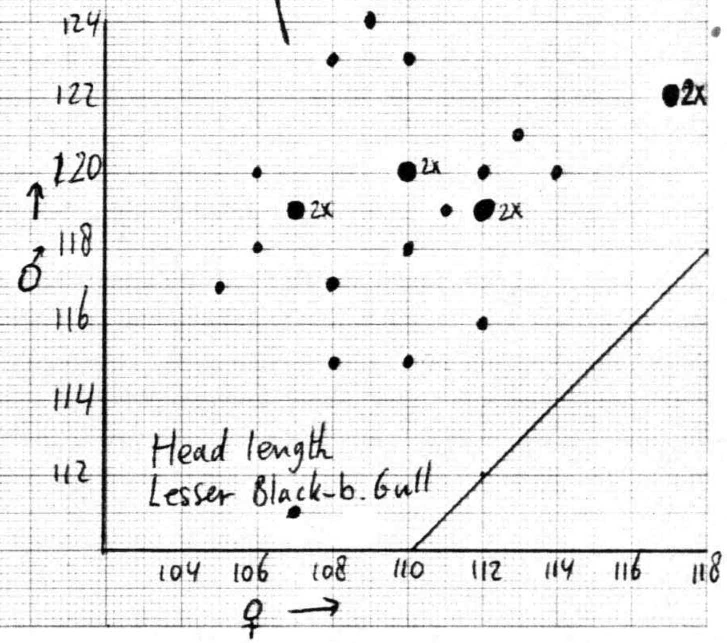
Head length
Herring Gull,



Bill height
Lesser Black-backed Gull, 25 pairs

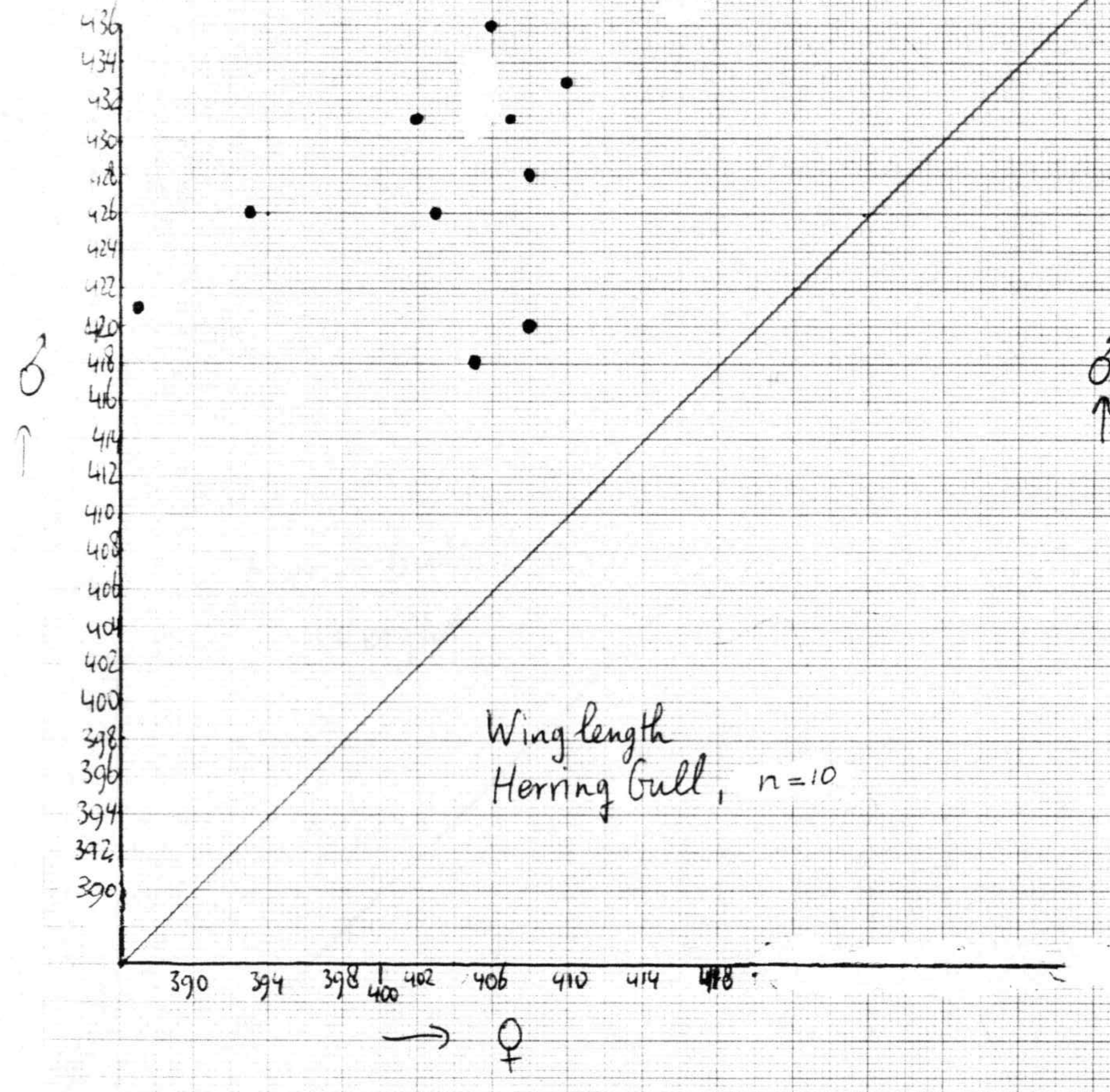


Bill length
Lesser Black-backed Gull

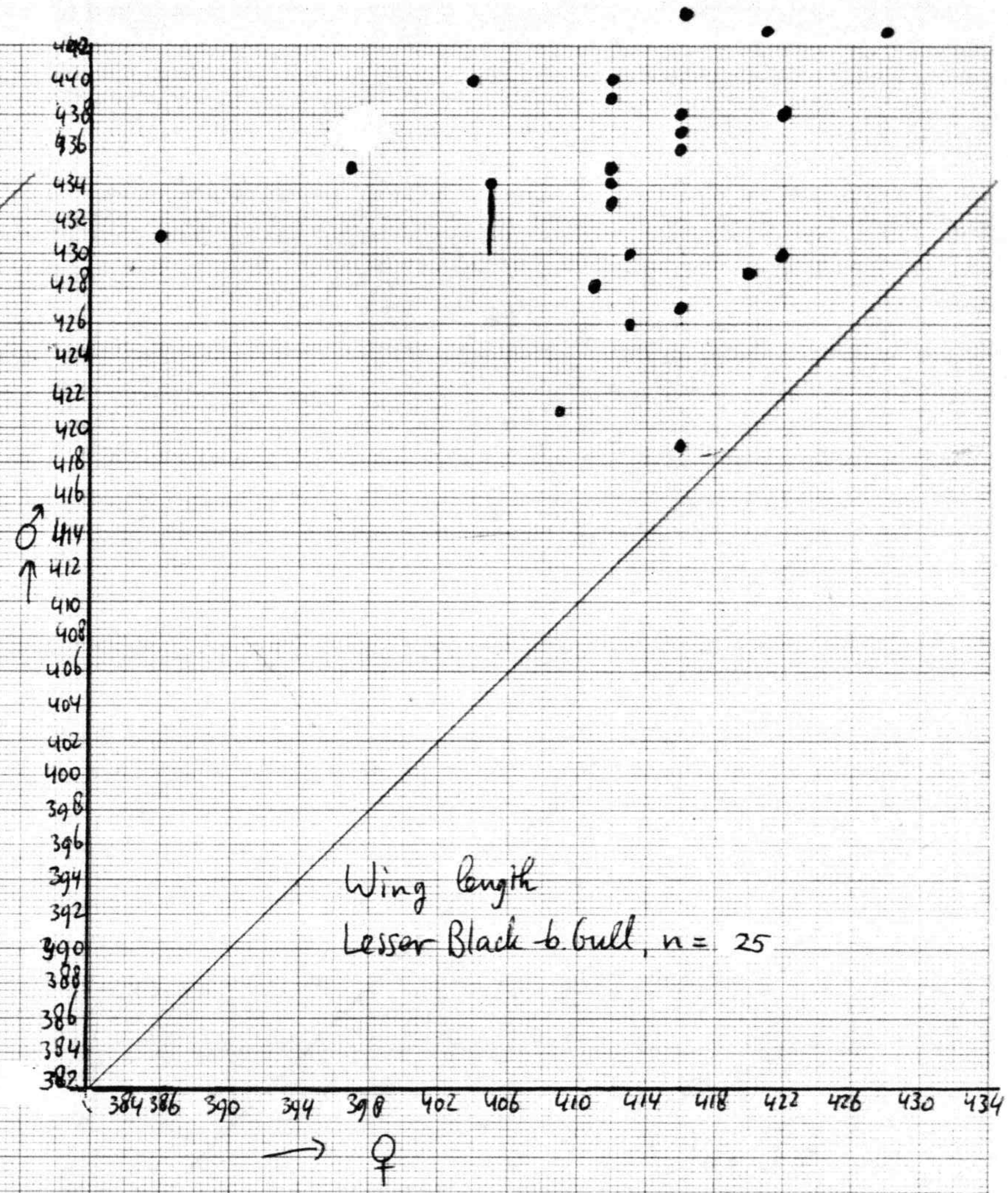


Head length
Lesser Black-b. Gull

Appendix Ib

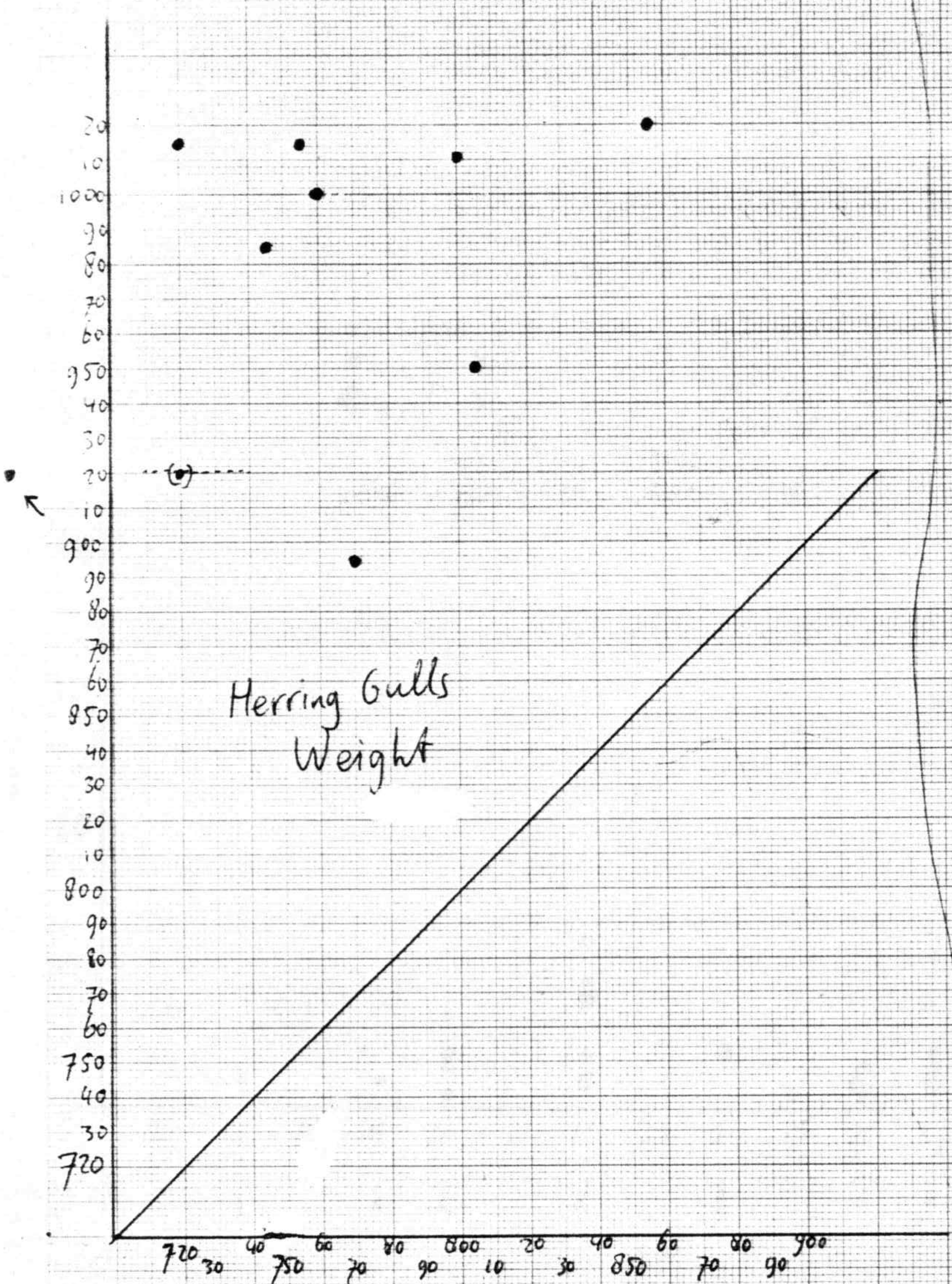


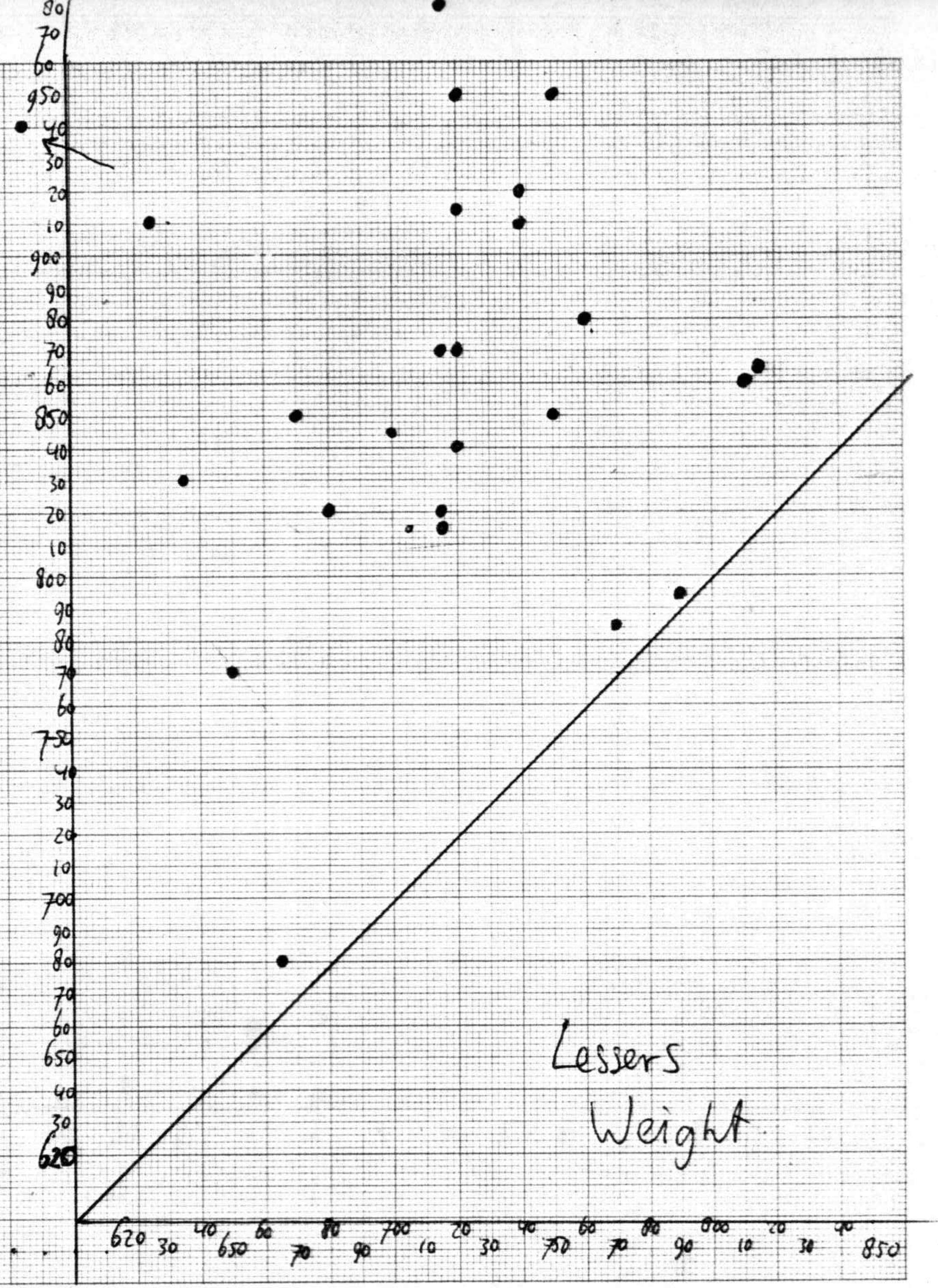
Wing length
Herring Gull, n=10
♂
♀



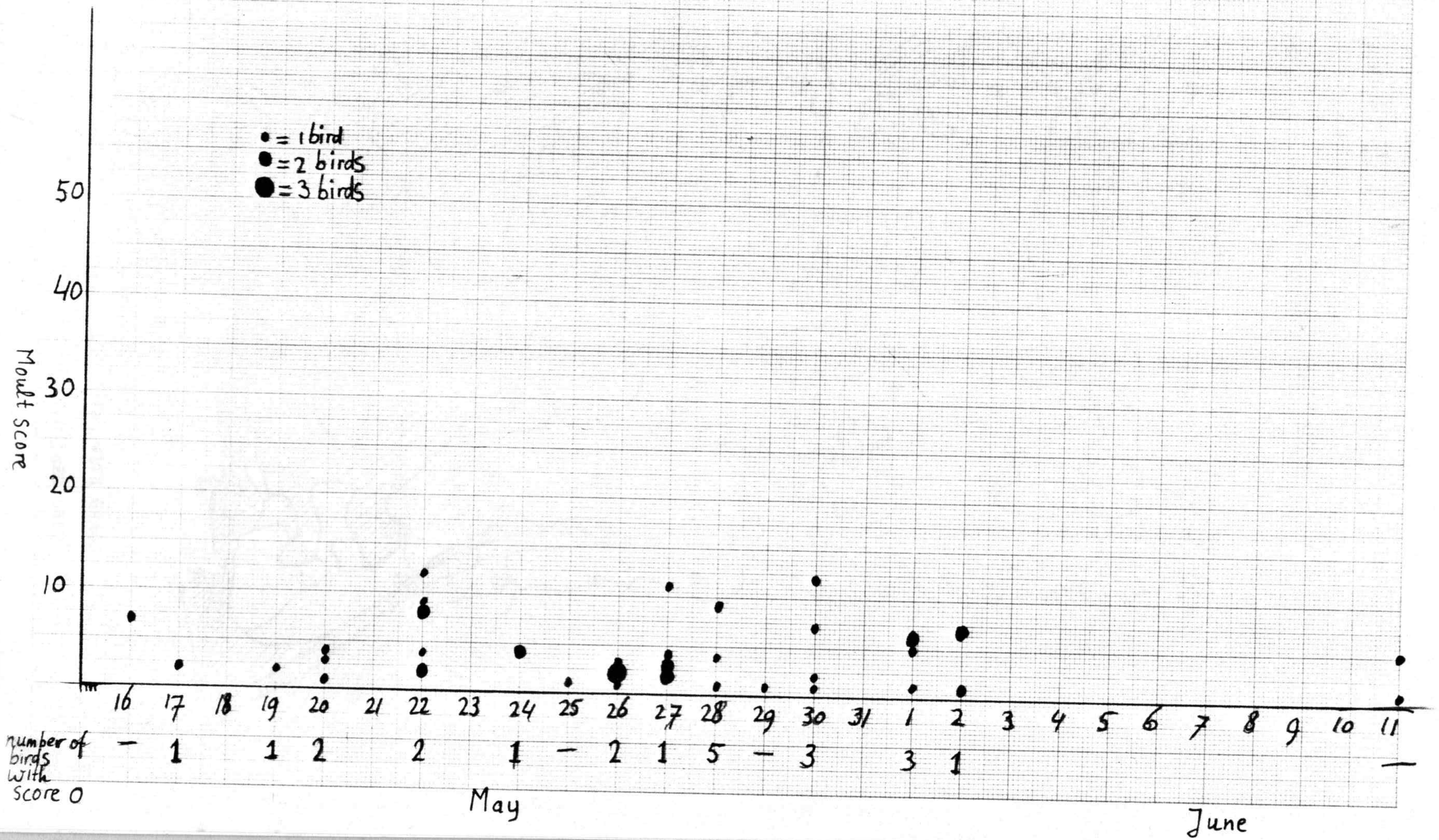
Wing length
Lesser Black-b. Gull, n= 25
♂
♀

Appendix Ic





Moultscores of Herring Gulls

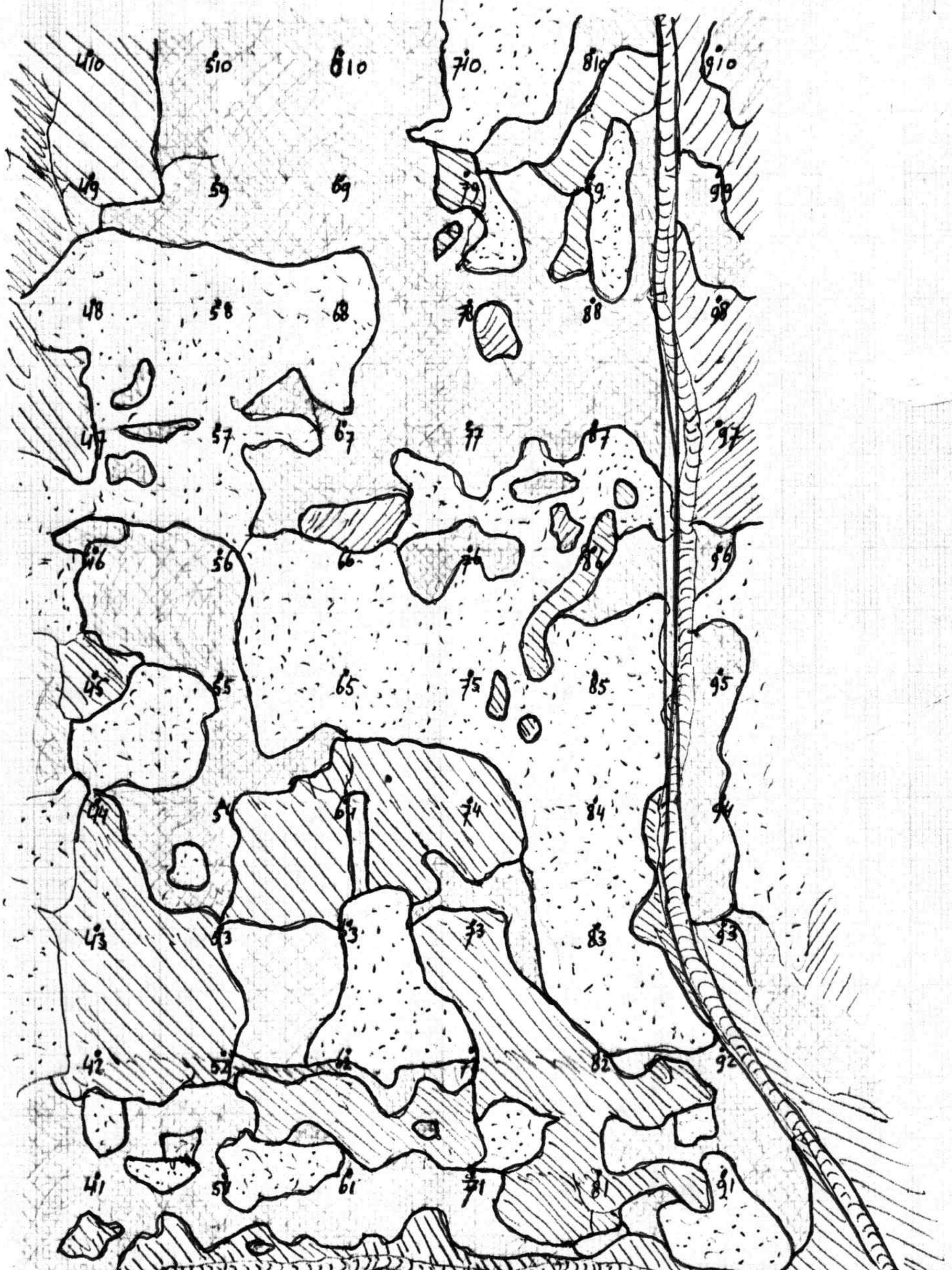


Appendix III a

SKOMER LB PLOT: VEGETATION

1978

→ N



J.E.W. 12/7/78

= WALL

= BRACKEN ONLY

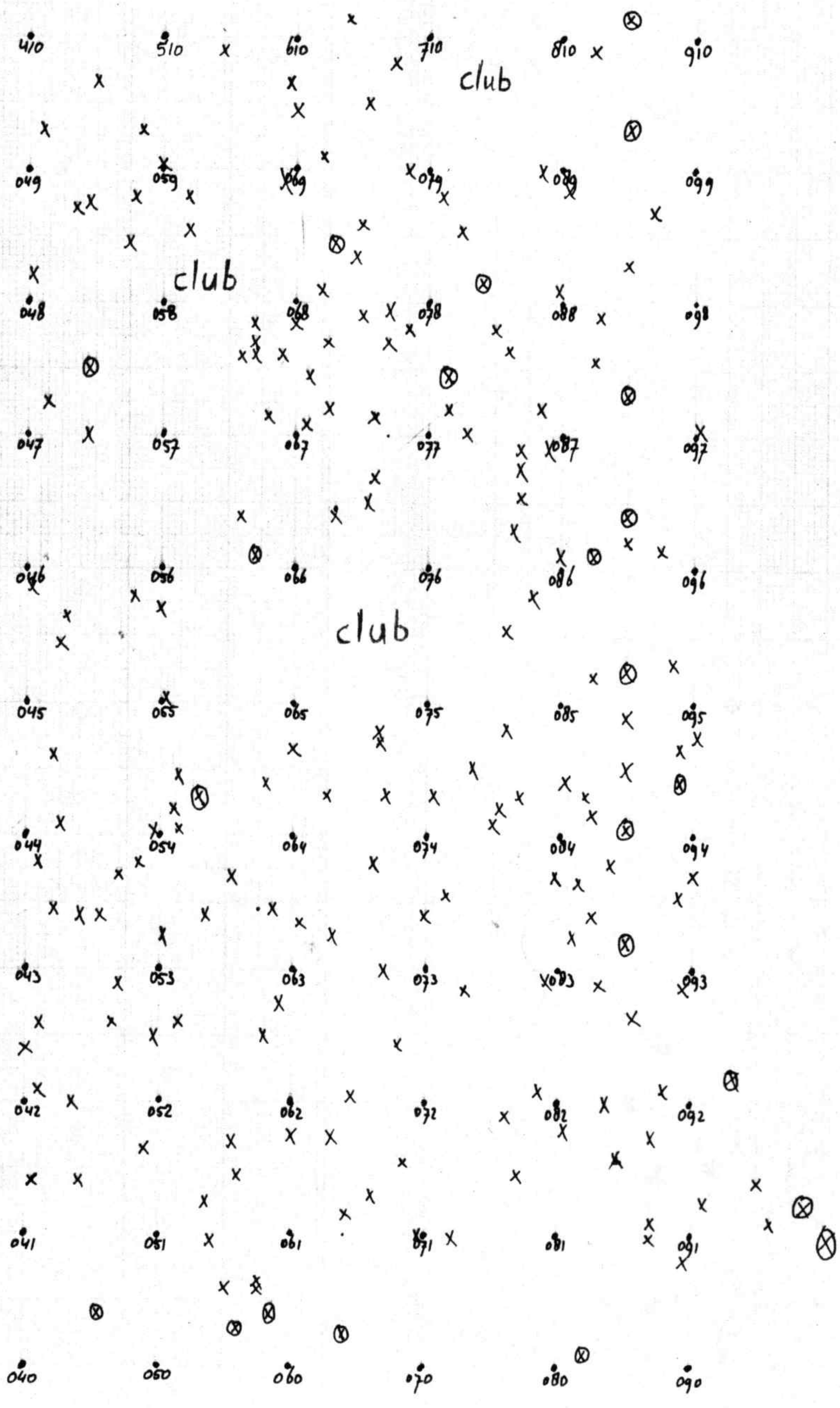
= BRACKEN MIXED WITH GRASS

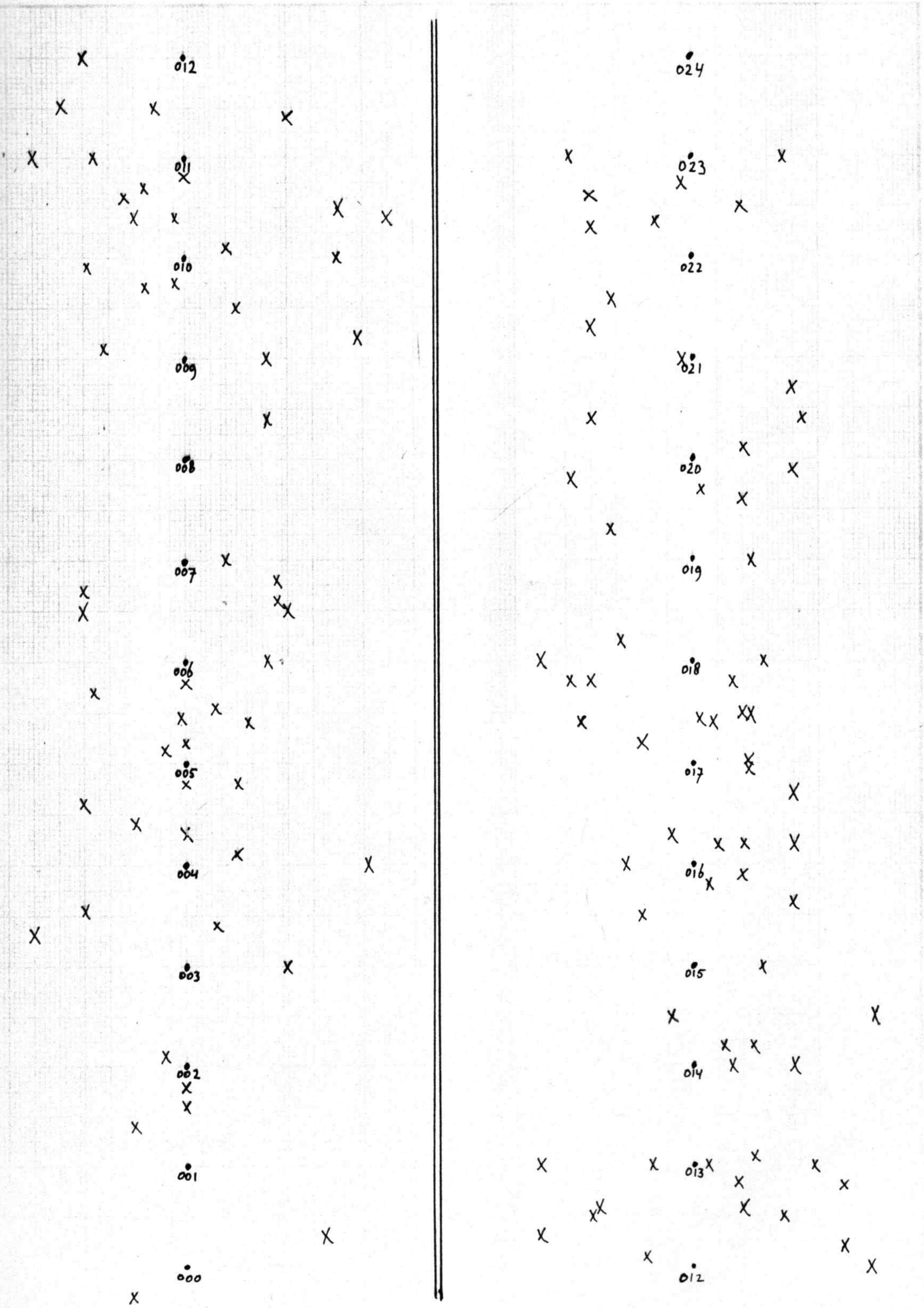
= GRASS ONLY, RATHER SHORT

APPENDIX IIIb ALL 1978 NESTS IN THE LB PLOT

⊗ = ARGENTATUS

X = FUSCUS





APPENDIX IIIc ALL 1978 NESTS IN THE HG PLOT
THE NUMBERED STAKES ARE PROJECTED AS ON A LINE