THE PRIMARY MOULT IN FOUR GULL SPECIES NEAR AMSTERDAM

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CONTENTS

1. INTRODUCTION AND STUDY AREA

This paper deals with the primary moult in Black-headed Gull *Larus ridibundus,* Common Gull *Larus canus,* Herring Gull *Larus argentatus* and Great Black-backed Gull *Larus marinus* in areas near Amsterdam. Though a few studies on the moult of gulls already exist for the NW-European area, e.g. Stresemann & Stresemann (1966), Stresemann (1971), Barth (1975), Harris (1971), Ingolfsson (1970) and Verbeek (1977), such a study has not been published for a Dutch area and not for four *Larus* species at the same time and in the same restricted region. Moreover, for the three first mentioned species new information could be obtained on the timing of moult in relation to the incubation period.

The present study was conducted in three localities in the Netherlands
a) Dunes near Zandvoort, c. 30 km west of Amsterdam (further referred to as Zandvoort area). Breeding area of Black-headed, Common and Herring Gulls, but not of the Great Black-backed Gull. Investigated from April 1977 until all gulls had left the area in September 1977.

b) Unused industrial grounds, a few km northwest of Amsterdam (further indicated as the Amsterdam area) with a breeding colony of Black-headed Gull and one breeding pair of Common Gull but no breeding of Herring or Great Black-backed Gull. Investigated from mid-August until late November 1976, and from early April until late September 1977. In 1976 there was a well-frequented roost of all four species until late November but in 1977 all gulls had disappeared by September.
c) Sewage farm in Amsterdam with foraging but no breeding Black-headed Gulls and no other gulls. Investigated both in 1976 and 1977 from late June until the end of the primary moult.

2. METHODS AND MATERIALS

2.1. MOULT OBSERVATIONS ON DEAD GULLS

An outbreak of botulism at the end of the 1976 breeding season offered an opportunity to record data on the primary moult of recently dead or dying gulls of the four species. For a frequent collection of victims I visited the Amsterdam area many times, twice a week during the peak of the disease and sometimes even three times. The study area measured only some 10 ha so that the victims were easily found.
From a few examples it seems that birds discontinue their moult after being poisoned. The observed pattern of moult in the dead gulls may therefore be the pattern of the day when the birds were poisoned. The interval between the date of poisoning and the recording date, however, is not more than a few days for two reasons.

Firstly, botulinum poisoning works quickly. Mallards *Anas platyrhynchos* succumb half a day to a week after taking up poisoned material, dependent on the intensity of the poisoning. Mallards are less sensitive to the toxine than most other birds, for example gulls (Haagsma *et al.* 1971), so that gulls on average die after a still shorter period.

Secondly, one of the first symptoms of botulism is paralysis of the wings (Haagsma *et al.* 1971). Since the Amsterdam area is fenced and gulls can only reach it on the wing, birds found there could only have passed the very early stages of the disease outside the area.

Table 1 gives the numbers of recently dead or sick gulls with and without primary moult, collected in the months of April to October inclusive. Primary moult scores (**PMS**) were noted according to the system of Newton (1966: 0 = old feather remaining; 1 = old feather missing or new feather completely in pin; 2 = new feather just emerging from sheath or up to ⅓ grown; 3 = new feather between ⅓ and ⅔ grown; 4 = new feather from ⅔ grown to fully grown but with remains of waxy sheath persisting; 5 = new feather fully developed with no trace of sheath remaining at base). The remicle ("11th primary") was omitted from the scoring as in other papers on the subject. Only one wing was scored so that the maximum possible score was 50.

Table 1. Numbers of collected primaries and dead gulls April-October

	Collected primaries				Dead gulls	
	Amsterdam 1976	Amsterdam 1977	Zandvoort 1977	Sewage farm 1976/77	primary moult	no primary moult
Black-headed Gull						
adult	1372	1721	527	87	107	123
sub-adult	120	674	158	10	23	7
Common Gull						
adult	73	106	592	—	13	5
sub-adult	—	9	48	—	5	2
Herring Gull						
adult	809	438	474	—	42	1
sub-adult	—	1468	671	—	19	4
Great Black-backed Gull, adult	59	14	—	—	4	—
	2433	4430	2470	97	213	142

2.2. COLLECTION OF NEWLY SHED PRIMARIES

The method of collecting shed primaries was applied earlier on the Curlew *Numenius arquata* (Sach 1968), the Lapwing *Vanellus vanellus* (Niethammer 1970, Beser 1972, Snow & Snow 1976) and the Oystercatcher *Haematopus ostralegus* (Hulscher 1977). For the present study at least once a week all shed primaries were collected in the same well-defined parts of the areas to avoid inclusion of older feathers. Shed feathers may look fresh even after some weeks, so a seemingly fresh condition is not a reliable criterion for the date of shedding.

The searches have not been extended to the entire study areas, because of the time required for searching and the corresponding disturbance in the colonies in the first period of the moult. In all diagrams and tables the dates are the averages between the date of search and that of the previous collection. A total of about 9,500 primaries were collected for this study as specified in table 1.

An advantage of this „feather search method" (**FSM**) is that much more data can be obtained than with other known peaceful methods. The disadvantages are mainly:

— no estimate can be obtained of the percentage of birds not yet or no longer moulting, and

— the end of the primary moult can only be estimated by extrapolation from the date of shedding of primary 10 (= p.10).

2.3. IDENTIFICATION OF PRIMARIES COLLECTED

2.3.1. Sub-adult primaries

The inner primaries of the oldest year classes of sub-adult Common,

Herring and Great Black-backed Gulls are sometimes coloured like adult ones and could therefore not always be separated from the adult material. Primaries with even the slightest brown shade were considered sub-adult. It was not possible to separate the various sub-adult year classes of the above three species accurately. Since in the above three species the outermost primaries of the youngest moulting year class have no distinguishable pattern, identification of these primaries was not always possible.

2.3.2. Inner adult primaries

The outer 5 to 6 primaries of the four species can be fairly easily distinguished by pattern, but identification of the inner 4 to 5 is only possible on a basis of their length. There is much overlap in length of adjacent primaries and the histogram of the lengths of the primaries collected in the field does not show any indication of borderline areas between these. Therefore, sets of primaries of known order were collected and measured from dead birds in the period May-September. To save space the data obtained are only given for the Black-headed Gull (Table 2). The observed minima and maxima clearly demonstrate the degree of overlap.

Table 2. Lengths (mm) of primaries of adult Black-headed Gull (n = 113)

Primary no.	$\bar{x}$	s.d.	Observed min.	Observed max.	Calculated limits for this study
1	123.4	4.9	110	136	⩽129
2	135.3	5.9	120	151	130—141
3	148.5	6.6	126	164	142—155
4	163.5	6.8	145	182	156—171
5	179.5	7.2	162	199	172—187
6	196.8	7.6	178	218	188—205
7	213.6	7.9	193	234	identification by pattern
8	231.0	8.3	208	248	
9	241.5	7.8	223	259	
10	237.4	7.5	217	255	

The arbitrary limit between two adjacent primaries as used in this study is set at the point where the probability of a primary noted as p.x being a short p.(x + 1) is equal to the probability of a primary noted as p. (x + 1) being a long p.x. So, for averages of large numbers of primaries, any misidentifications would cancel out. First appearance of a particular primary in the collected material is only accepted as such, if it is consistent with the results of following collections, just as the last finding date is only accepted as such, if it is consistent with collections on preceding dates.

2.3.3. Inner sub-adult primaries

Since sub-adult primaries are on average shorter than the corresponding

Table 3. Lengths (mm) of inner primaries of sub-adult Black-headed Gull (n = 14)

Primary no.	$\bar{x}$	s.d.	Calculated limits for this study
1	118.5	4.9	$\leqslant$ 123
2	128.5	5.5	124—135
3	141.7	5.8	136—148
4	155.4	6.1	149—163
5	171.4	6.6	164—179
6	188.1	7.1	180—196

adult ones, separate tables for identification of sub-adult primaries were required. Data for sub-adult Black-headed Gull are given in Table 3.

2.4. "AVERAGE" PRIMARY PER DATE OF COLLECTION

Moult observed by FSM cannot be expressed in PMS. For use in diagrams of this paper I therefore calculated the average primary number per date of collection, for example

$$\frac{100 \text{ x p.1} + 200 \text{ x p.2} + 100 \text{ x p.3}}{400} = 2.$$

Of 108 dead adult Black-headed Gulls with primary moult, the PMS was noted at which each primary was shed as tabulated in Table 4. For the other gull species these tables are omitted; they show the same pattern.

Table 4. PMS at which each primary was shed in adult Black-headed Gull (n = 108)

Freshly shed primary no.	1	2	3	4	5	6	7	8	9	10
Range PMS at that time	1	2—6	3—10	4—16	7—19	13—25	23—29	33	35—39	40—43
Mean PMS at that time	1.0	4.0	6.1	8.5	15.3	20.7	27.3	33.0	36.8	41.5
Numbers	4	6	12	22	21	13	12	2	4	12

2.5. AVERAGE DATE OF SHEDDING PER PRIMARY

This is the average of the dates on which a certain primary (for example p.1) was found. Reliable figures can only be obtained, if the numbers of birds remain fairly equal over the period in which this primary is shed. Therefore, in spite of the large numbers of primaries collected, the average date of shedding could only be calculated in a limited number of cases, mainly in adult Black-headed and Herring Gulls.

2.6. SAMPLING

In both methods (2.1. and 2.2.) sampling was not always at random. Collecting in breeding colonies is strongly biased towards breeding birds and we may expect that moult will be less advanced in these birds than in their congeners leaving the colony after accomplished or interrupted breeding. Part of this problem was solved by the inclusion of roosts in or nearby the colonies.

3. RESULTS

3.1. BLACK-HEADED GULL, ADULT

In Fig. 1 the results of FSM are shown in terms of "average" primary per date of collection. The curve in the progress of the primary moult is due:
— partly to the moult itself which is not quite equally spread over the moulting period,
— partly to the way of calculating "average" primaries since, obviously, lower than p.1 and higher than p.10 are not possible, and
— partly to the method of sampling which includes gradually more late moulters and so tends to prolong the end of the moulting period (see 2.6.).

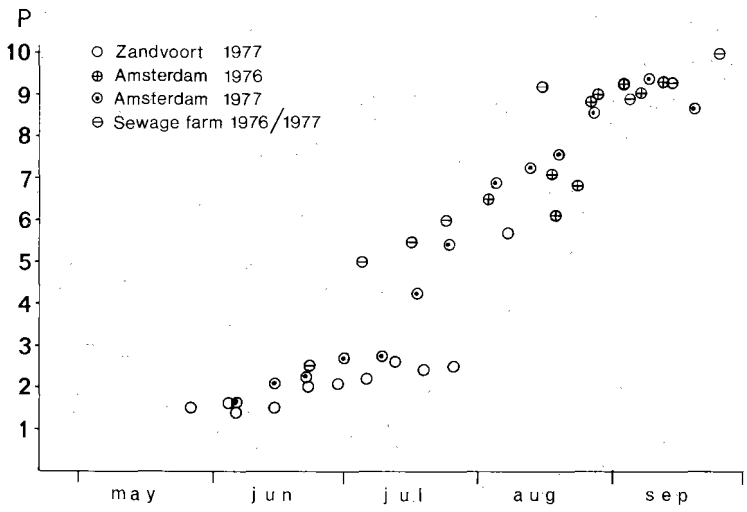

Fig. 1. Adult Black-headed Gull. "Average" primary (P) against time.

Fig. 1 shows a markedly slow primary moult in the Zandvoort colony without roost, a much more upward tendency in the curve for the Amsterdam colony 1976 and 1977, including roosting birds, and the most advanced averages for birds in a foraging area outside breeding colonies. Since Fig. 1 only indicates **average** primaries per date of collection, much of the existing spread of the

moult is not shown. For example, freshly shed p.1 were found from 26 May until 31 July (1977) with average shedding date of 27 June in the Amsterdam colony and 29 June in the Zandvoort area. Table 5 shows these details for all primaries.

Table 5. Dates of shedding of primaries in adult Black-headed Gull (between brackets numbers of primaries)

Primary no	Amsterdam 1976 averages	Amsterdam 1977 averages	Zandvoort 1977 averages	First and last dates
1	—	27/6 (367)	29/6 (211)	26/5—31/7
2	—	29/6 (367)	1/7 (147)	27/5—19/8
3	—	4/7 (310)	7/7 (94)	30/5—21/8
4	—	10/7 (203)	11/7 (53)	11/6—27/8
5	—	21/7 (126)	—	18/6—27/8
6	—	29/7 (99)	—	28/6— 3/9
7	—	5/8 (120)	—	6/7— 7/9
8	15/8 (216)	13/8 (69)	—	22/7—23/9
9	21/8 (81)	25/8 (46)	—	31/7—24/9
10	1/9 (42)	8/9 (14)	—	9/8—24/9

The first four primaries were shed at shorter intervals than the later ones which is also known for other species, for example for the Curlew (Sach 1968). The primary moult progresses from p.4 onward at equal intervals and the result of FSM is in agreement with the straight regression line calculated for the semi-monthly average PMS in dead gulls (1976), at a rate of 0.56 PMS per day. Using this moult rate and the facts of Tables 4 and 5, we can conclude that on average the primary moult finishes in the latter half of September, though some late birds will not be ready before the first half of October. This implies an average duration of the primary moult of about three months (late June until late September) and a maximum duration of about 4½ months (end of May until first half of October). In 100 dead gulls on average 3.1 primaries p wing were growing simultaneously at death.

3.2. BLACK-HEADED GULL, SUB-ADULT

In this species the sub-adults represent one year class and the moult showed a better homogeneity than in sub-adults of the larger gulls in this study (Fig. 2, based on FSM). Some one-year-old Black-headed Gulls do breed, but probably not all birds of this year class seen in the colonies. Counts made during April to July 1977 inclusive showed that 2.3 to 6.7% (mean 4.8%) of all Black-headed Gulls present in the Amsterdam colony, and 0.8 to 3.8% (mean 2.2%) in the Zandvoort colony were one year old. Any influence of breeding on the timing of the moult might be less than in adults, but more than in sub-adults of the larger gulls. The average date of shedding of p.1 in the Zandvoort area was 3 June (1977) (first mid-May, last 9 July, n = 145), sub-adults being about three weeks ahead of the adults. The first p.10 was

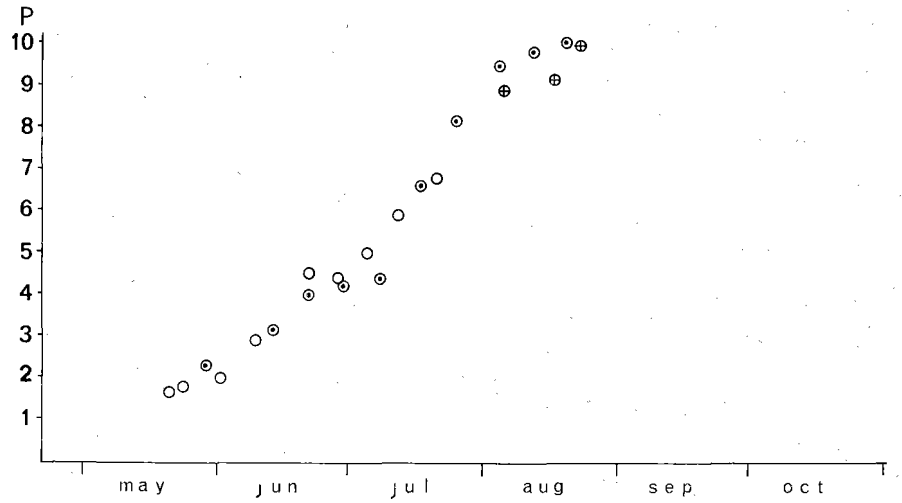

Fig. 2. Sub-adult Black-headed Gull. "Average" primary (P) against time. Symbols as in Fig. 1.

found 17 July, the last 29 August with an average of 7 August (n = 125), which is about four weeks ahead of the adults.

The primary moult was on average finished in the second half of August, but late birds did not complete moult before the second half of September and birds on the sewage farm outside the breeding areas finished on average by mid-August. The primary moult lasted about 2½ months on average and about 3½ months at most. The data from dead gulls suggest a slightly earlier beginning and a later end (mid-May and first half of September on an average) but the number of observations is rather small (23) and unevenly spread over the period (18 in July alone), so that the estimate of start and finish according to this method relies too heavily on the extrapolation of little, heterogeneous material. Based on FSM the average rate of the moult was 0.64 PMS per day.

3.3. COMMON GULL, ADULT.

Fig. 3 shows the primary moult according to FSM. The regression lines in the figure demonstrate the difference in timing in and outside the breeding colonies. Apparently, these straight regression lines do not allow conclusions from extrapolation over some weeks and the less so for the start of the moult: there are no grounds to think that this start will be by mid-April as this extrapolation might suggest for adults on roosts!

Average dates of shedding could not be calculated for all primaries; what is known is tabulated in Table 6. There is no indication that the intervals between shedding of the inner primaries would be shorter than average as was found in adult Black-headed Gull. The average p.10 was shed in the first half

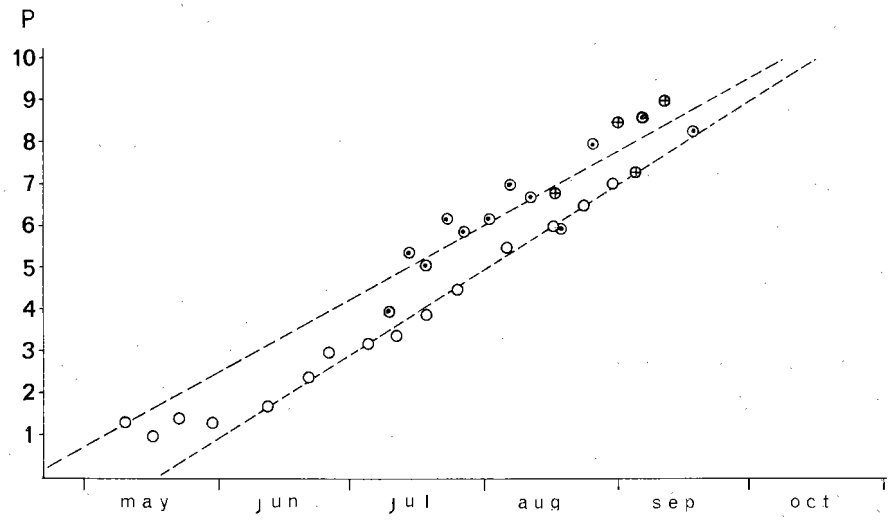

Fig. 3. Adult Common Gull. "Average" primary (P) against time. Symbols as in Fig. 1.

Table 6. Dates of shedding of primaries in adult Common Gull (combined areas)

Primary no	First date	Last date	Average date	n
1	20/5	23/7	18/6	110
2	26/5	30/7	28/6	105
3	28/5	13/8	11/7	105
4	19/6	13/8	18/7	131
5	19/6	21/8	25/7	94

of October. Since shedding of p.10 corresponds with an average PMS of 42, the average finish of the primary moult is estimated end October, late birds finishing early November.

The data obtained from dead gulls (1976) are few (n = 13, but evenly spread over the moulting period). They support the above findings, suggesting an average onset in mid-May and an average finish in mid-October. So, the average duration of the primary moult was about 4½ months (maximum about 6 months) with an average moult rate of 0.37 PMS per day.

3.4. COMMON GULL, SUB-ADULT

Results from FSM show that sub-adults were on average 20—25 days ahead of the adults, this interval being for five (!) dead birds 20 to 52 days with an average of 37 days. The duration of the moult and the moult rate could not reliably be derived from the scanty material available.

3.5. HERRING GULL, ADULT

Fig. 4, based on FSM, shows much less difference between birds in and

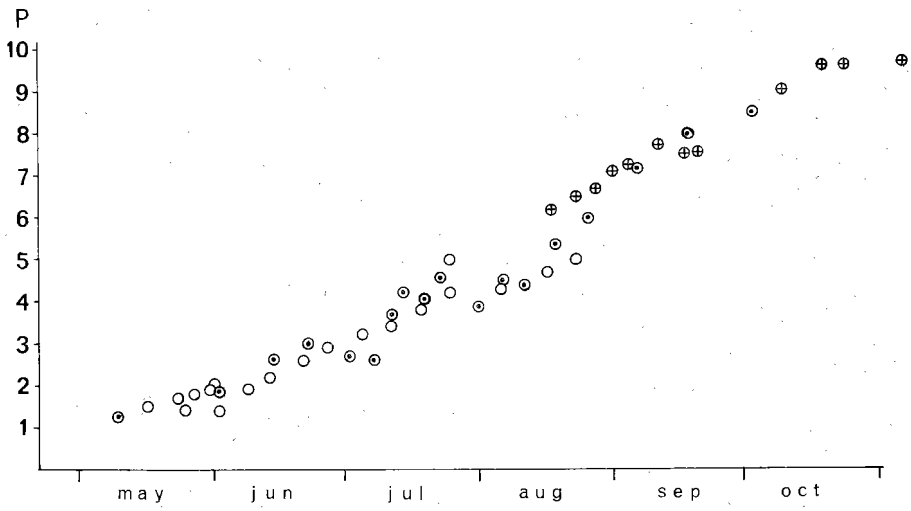

Fig. 4. Adult Herring Gull. "Average" primary (P) against time. Symbols as in Fig. 1.

outside the breeding areas than in Black-headed and Common Gull (Fig. 1 and 3). First, last and average dates of shedding of each primary are given in Table 7. For p.8 the material was not fit for the calculation of an average shedding date; the approximate date mentioned is estimated from the averages for the adjacent primaries. The average interval between shedding of adjacent primaries was 17 days and the calculated data do not show any significant deviations from this average at the beginning or at the end of the moult. As shedding of p.10 corresponds with PMS 42, the average finish is estimated at the end of November (last birds finishing as late as mid-December).

The data obtained from dead gulls (1976; n = 42, evenly spread over the

Table 7. Dates of shedding of primaries in adult and sub-adult Herring Gull (combined areas)

Primary no	Adult				Sub-adult				Interval between adult and sub-adult in days (averages)
	first date	last date	average date	n	first date	last date	average date	n	
1	15/5	16/ 7	31/ 5	149	±10/4	13/ 6	17/5	115	14
2	20/5	21/ 8	18/ 6	202	±15/4	4/ 7	18/5	244	31
3	22/5	21/ 8	5/ 7	158	20/4	17/ 7	21/5	258	45
4	9/6	27/ 8	25/ 7	162	27/4	31/ 7	2/6	193	53
5	25/6	14/ 9	10/ 8	81	27/4	21/ 8	14/6	245	57
6	17/7	23/ 9	25/ 8	163	3/5	27/ 8	26/6	306	60
7	28/7	12/10	7/ 9	282	11/5	27/ 8	10/7	239	59
8	15/8	21/10	±23/ 9						
9	27/8	12/11	12/10	52	11/6	12/10	±3/8	365	±70
10	17/9	19/11	30/10	75					

moulting period) suggest an average onset in the first half of June (6 June) and an average finish towards mid-November, thus generally supporting the results of FSM. The average duration of the primary moult was about 6 months (maximum about 7 months) with an average moult rate of 0.28 PMS per day. The moult patterns of 42 dead gulls showed that on average 2.2 primaries per wing were growing simultaneously until death.

3.6. HERRING GULL, SUB-ADULT

The average shedding date of p.1 was 17 May (1977) and the — restricted — extrapolation of the straight regression line through PMS against time for dead birds (1976) gives 13 May (combined areas; n = 19, evenly spread over the period). Early birds, however, already started in the first half of April. The finish could not be established from data of FSM, since too many p.8, p.9 and p.10 could not be identified with sufficient accuracy. According to PMS in dead gulls the average finish was at the end of September, the average duration of the moult was about 4½ months and the moult rate on average 0.37 PMS per day. More details are given in Table 7. The primary moult in sub-adults started earlier and progressed more rapidly than in adults. The short intervals between the average shedding dates of p.1, p.2 and p.3 may partly be attributed to arrival of birds already in moult.

3.7. GREAT BLACK-BACKED GULL, ADULT

Since only four dead victims of botulism were found in moult, conclusions can only be drawn from results of FSM. The "average" primary collected was 5.5 in the second half of August, increasing to 7 during September, to 9 in October and to 10 in the second half of November. The average date of shedding of p.10 was in early November. Accordingly, the average finish of the primary moult was estimated by mid-December, the latest birds finishing early January. Direct observations on the onset are not available. By extrapolation the time of the beginning is estimated at mid-May. For the risks of such an extrapolation see, however, under section 3.3. Based on the latter half of the moulting period the average moult rate was 0.23 PMS per day.

3.8. PRIMARY MOULT AND REPRODUCTION

Fig. 5 shows the incubation period and the timing of dropping p.1 in adult Black-headed Gulls in the breeding colony near Amsterdam and in adult Common and Herring Gulls in their breeding colonies near Zandvoort. Line A reflects the increase of just completed clutches (with the exception of late — mostly replacement clutches), expressed in percentages of the final total numbers. B indicates the (estimated) hatching time of the chicks, assuming all broods of A to be successful. C shows the cumulative percentages of newly shed p.1 in the respective colonies. Fig. 5 suggests that early breeders are also early moulters. This may be right in many cases, but it should be emphasized

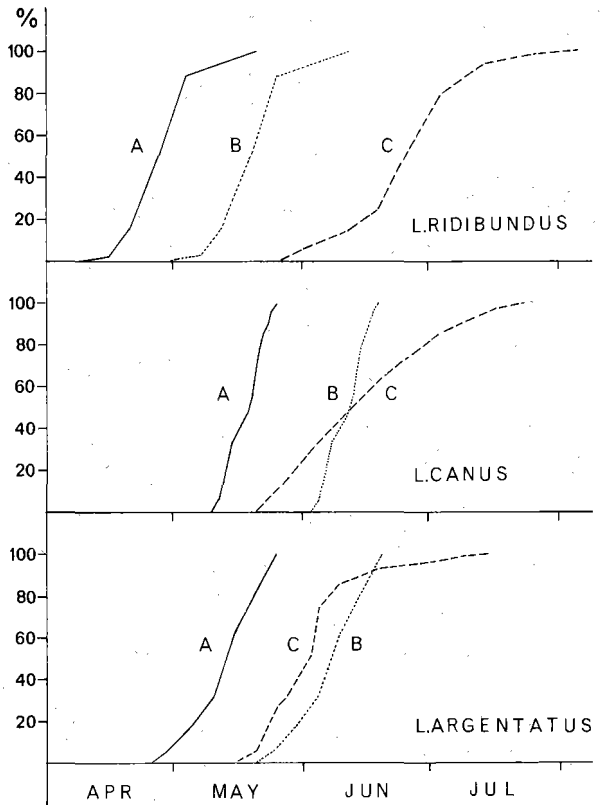

Fig. 5. Primary moult and reproduction. A – B Period of incubation of eggs. C Shedding of p.1. Further explanation in the text.

that this conclusion cannot be drawn from the available material. Fig. 5 demonstrates that there were striking differences between the three species as to the timing of reproduction and moult. In the Black-headed Gull there was a wide gap of time between hatching of the eggs and the onset of the primary moult. Overlap of incubation and primary moult was mainly restricted to replacement clutches (not only near Amsterdam, but also in the Zandvoort colonies, not illustrated in Fig. 5). In the Herring Gull, however, the primary moult started generally during the main incubation period. Also half of p.2 were shed in this period. In the Common Gull about half of p.1 were shed in the incubation period, the species also in this respect being intermediate between Black-headed and Herring Gull.

4. DISCUSSION

For comparison of the results obtained near Amsterdam and Zandvoort with those from elsewhere, most information available is on adult Herring

Gulls. The diagram in Harris (1971) (based on 30 actively moulting gulls) indicates an average onset of the primary moult on Skomer and Skokholm (Wales) in mid-June and an average finish at the end of October. Birds caught on eggs had PMS of 8 and 9 on 9 and 11 June, respectively, and may have started primary moult just after mid-May. An average finish in late October means that the last birds will finish by late November, though Harris did not find moulting birds that late (however $n_{nov} = 6$). On Walney Island, England, Verbeek (1977) found the first shed primaries on 15 May, as I did in the Netherlands. At the end of June, he states, all gulls had begun to moult their primaries, but one of his diagrams suggests that the last birds had started by about 8 July. Verbeek had to discontinue his activities in early August, so that his statements about the finish of the primary moult rely (too) heavily on extrapolation. Also from the Walney Island colony N. Tinbergen (in Stresemann 1971) reports of a PMS of 11 on 11 June for the most advanced bird out of ten, which means a start of the primary moult in mid-May.

In the northwest German islands Mellum and Trischen most Herring Gulls were in primary moult on 3 and 9 June respectively, most p.1 and p.2 and some p.3 but no p.4 having been shed (G. Sach, in Stresemann 1971). The data are presented in quite a different way, but suggest a similar progress of the primary moult as in the Dutch region.

Barth (1975) bases his conclusions on 196 actively moulting adults in southern and Central Norway, when stating that the average onset of the primary moult takes place in mid-May and the average finish in early December.

The above data are summarized in Table 8. The disparities may be partly ascribed to insufficient material, too much extrapolation and differences in interpretation. Moreover, there is much individual variation in the date of shedding of each particular primary (adult Black-headed Gull on average 67 days between first and last dates of shedding, adult Herring Gull on average

Table 8. Primary moult in adult Herring Gull in northwest Europe

Area	Author	Onset		Finish	
		average date	first dates	average date	latest dates
South and Central Norway	Barth 1975	mid-May	?	early Dec.	?
Skomer/Stokholm, Wales	Harris 1971	mid-June	mid-May	end Oct.	?
Walney Island, England	Verbeek 1977 Stresemann 1971	mid-June	mid-May	mid-Oct.(?)	mid-Nov.(?)
Amsterdam, Netherlands	Walters this study	end May	mid-May	end Nov.	mid-Dec.

76 days). During the long period of the moult gulls from other — possibly distant — colonies may join in the roost populations and might cause changes in the average moult patterns. For these reasons no definite conclusions on any ecological or geographical differences can be drawn from the data of the present and the above mentioned publications on the Herring Gull.

Primary moult and incubation

The period of egg-laying appears to be quite similar in the areas investigated (Skomer and Skokholm and Walney Island, Verbeek (1977), Mellum, Stresemann (1971), South and Central Norway, Barth (1975) and Amsterdam-Zandvoort, present study). In these areas there is no overlap of the main period of egg-laying and primary moult; moult starts during incubation. Diagrams combining non-cumulative breeding facts with cumulative moult figures do suggest an overlap in some cases (Verbeek 1977). Since the earliest birds starting moult may be the earliest in egg-laying as well, other evidence is needed to prove primary moult during egg-laying.

The opinion of Stresemann & Stresemann (1966) that adults of the gull species migrating over short distances start primary moult immediately after or just before the end of the feeding period of the young (p 237) apparently was not correct for all gull species. Stresemann (1971) changed his mind on receipt of field data from several gulleries. His new statement (p 228) that the stage of development of the offspring apparently does not regulate the start of the moult in gulls, may not be correct either for a species like the Black-headed Gull, but comes closest to the situation outlined above for the Herring Gull.

Primary moult and size of the gulls

Within the small group of the four *Larus* species discussed in the present study the moult lasts longer as the species is larger. More gull species from more regions should be investigated (considering any migratory or other ecological differences) to test a possible general validity of this relation. To be more precise on the quantitative aspect of any relation a definition of size is required. Instead of wing length as in normal taxonomic practice, the total length of the ten primaries could be used for this purpose. In adult Black-headed and adult Herring Gull (the best-known samples of this study) this total length averages 1,870 and 2,640 mm, respectively. Clearly, these figures are not directly proportional to the duration of the primary moult (3 and 6 months respectively). The relatively slow moult in the Herring Gull may be explained by the fact that in this species fewer primaries are growing simultaneously (2.2 as compared to 3.1 in Black-headed Gull). Strikingly, the duration of moult in Herring Gull can even be found exactly from that in Black-headed Gull with the following calculation:

$$3 \text{ months} \times \frac{2640}{1870} \times \frac{3.1}{2.2} = 6 \text{ months.}$$

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6. SUMMARY

In the Amsterdam-Zandvoort area in the Netherlands in 1976 and 1977 a study was conducted on the primary moult in Black-headed, Common, Herring and Great Black-backed Gulls. Two methods were used: registration of primary moult score in recently dead gulls and collection of newly shed primaries. Special attention is paid to the identification of the primaries. A detailed description of the timing of the primary moult in adults and sub-adults is given. The average duration of the primary moult was 3 months in adult Black-headed, 4½ months in adult Common and 6 months in adult Herring Gulls. Sub-adults were earlier and had a shorter moulting period: 2½ months in Black-headed and 4½ months in Herring Gull. The onset of the primary moult was not known for the Great Black-backed Gull, not breeding in the Dutch area, for the other three species earliest in the Herring Gull, slightly later in Common Gull and latest in Black-headed Gull. Practically all adult Herring Gulls started primary moult during the incubation of the eggs, much fewer adult Common and practically no adult Black-headed Gull did so. The finish of the primary moult was earliest in adult Black-headed, slightly later in adult Common, still later in adult Herring and latest in adult Great Black-backed Gull (until early January by the latest). Recent literature on the primary moult in gull species in northwest Europe combined with the present study does not present enough material from which definite conclusions on any ecological or geographical differences can be drawn.

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8. SAMENVATTING

In de zone Amsterdam-Zandvoort werd in 1976 en 1977 de rui der grote slagpennen bij Kok-, Storm-, Zilver- en Grote Mantelmeeuw bestudeerd. Twee methoden werden toegepast: registratie van rui-scores aan vers-dode vogels en inzameling van vers geworpen grote slagpennen. Speciale aandacht wordt geschonken aan de determinatie van de gevonden grote slagpennen. Een

gedetailleerde beschrijving van de rui-perioden bij adulte en sub-adulte meeuwen wordt gegeven. De gemiddelde duur van de rui der grote slagpennen was 3 maanden bij adulte Kokmeeuwen, 4½ maand bij adulte Stormmeeuwen en 6 maanden bij adulte Zilvermeeuwen. Sub-adulte meeuwen waren vroeger dan de adulte en hadden een kortere ruiperiode: Kokmeeuwen 2½ maand en Zilvermeeuwen 4½ maand. Het begin van de rui der grote slagpennen kon bij de Grote Mantelmeeuw, die hier niet broedt, niet worden vastgesteld; van de overige drie soorten begon deze rui het eerst bij adulte Zilvermeeuwen, iets later bij Storm- en nog iets later bij Kokmeeuwen. Praktisch alle adulte Zilvermeeuwen begonnen met de rui tijdens het bebroeden der eieren, veel minder adulte Storm- en praktisch geen enkele adulte Kokmeeuw. De rui werd het eerst afgemaakt bij adulte Kokmeeuwen, iets later bij adulte Storm-, nog later bij adulte Zilver- en het laatst bij adulte Grote Mantelmeeuwen (tot uiterlijk begin januari). Recente literatuur over de rui der grote slagpennen bij meeuwensoorten in N.W. Europa, gecombineerd met de resultaten van het hier beschreven onderzoek, blijkt onvoldoende materiaal te bieden, waaruit definitieve conclusies over mogelijke ecologische en geografische verschillen getrokken kunnen worden.

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