Estuary counts made during the 1978/79 winter and comparison with counts for previous years indicated that many birds which did not die left the area during the cold spell and returned subsequently. Ringing recoveries showed two Redshank movements south, one to the Firth of Clyde and one to North Berwick. Redshank numbers in March had not fully recovered from the cold weather, being lower than in the previous four years. Oystercatcher numbers had fully recovered by March, and were in line with the steep trend of increase which has been apparent over the last ten years.

Amongst both Redshanks and Oystercatchers found dead there was a higher proportion of young birds than in autumn cannon-netted samples. The proportion of first year Redshank on the Ythan in autumn was about 40% which is relatively high compared with other sites. Considerable confidence may be had in this figure as it is based on consistent results from three fairly large cannon-netted samples. Spring trapped samples of Redshank on the Ythan and at Fraserburgh, a rocky shore site in N.E. Scotland, contained very few young birds, suggesting that the majority of first year birds had died during the cold spell. Weights of first year Redshank in autumn were about 10g lighter than those of adults, suggesting that a difference in condition at the beginning of the winter might be responsible for the differential mortality. However carcass analysis of an autumn caught sample of Redshank revealed no difference in the fat and water content of adults and juveniles, but a significant difference in lean dry weight. It is not known which component of lean dry weight was involved except that it was not the pectoral muscles. It seems likely that the difference in mortality might be due to differences in foraging ability between young birds and adults, and this possibility now requires to be investigated.

The full results of this study are currently being prepared for publication. The work was carried out jointly with Chris Spray who helped with the field work and Nick Davidson who carried out carcass analysis. We are grateful to all those who helped with counting and cannon-netting.

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WADER RINGING ON THE SEWAGE FARMS OF MÜNSTER, FEDERAL REPUBLIC OF GERMANY

by OAG Münster

For more than 11 years waders have been ringed at Münster sewage farms. The habitat for waders has changed during this period. The object of this report is to give brief descriptions of the area and of the study of waders there.

The Site

Münster sewage farms were established around 1900. They are situated on flat land at the edge of the town. In the early years following their establishment the sewage was often used to fertilize the soil of the fields and only temporary spots of open water and mud appeared. The supply of water increased after 1962; simultaneously the area used for purification was enlarged and the water was often held in one hectare basins at a depth of 5 to 20 cms. Permanent water and mud-filled ponds were present in every season after 1965. The site reached its maximum size in 1969 and 1970 when sewage was distributed over an area of about 600 ha; about 240 ha were constantly flooded.

The sewage farms are a mosaic of small ponds separated by small dykes and roads. The roads give a view of nearly all the ponds in the farms, even from a car. The opportunity of watching birds from a car has proved to be very popular and several thousand ornithologists visit the sewage farms annually. The roads also facilitate field studies of waders. Various plants grow at the edges of the ponds - mainly reeds and primary colonizers. Some basins are totally overgrown by these plants.

Because they are shallow and contain large amounts of nutriments in the water the ponds contain many invertebrates. A sample area of one m^2 may contain up to 50 000 chironomid larvae and several hundreds of thousands daphnia. These huge quantities of small animals are an excellant food resource for waders and ducks. From 1960 the sewage farm developed into one of the most significant inland resting and moulting grounds for these species in Germany. It is not a coastal site so the species which occur differ in some ways from those of estuaries and seashore. Species like Oystercatcher Haematopus ostralegus and Knots Calidris canutus, which are common coastal waders, do not occur in great numbers at the sewage farm, whereas freshwater-associated species are common, for example up to 4000 Snipe Gallinago gallinago, 1500 Ruffs Philomachus pugnax, 350 Wood Sandpipers Tringa glareola, 220 Green Sandpipers Tringa ochropus, 170 Greenshanks Tringa nebularia and 150 Spotted Redshanks Tringa erythropus occur each day during migration periods.

The sewage farms are also important for resting and breeding ducks. For example up to 900 Garganeys Anas querquedula could be seen in summer, with a maximum of 32 breeding pairs. Breeding waders are Oystercatcher, Lapwing Vanellus vanellus, Little Ringed Plover Charadrius dubius, Snipe, Black-tailed Godwit Limosa limosa and Redshank Tringa totanus.

The positive development of the site did not last long. In 1971 the supply of water was reduced by half and plants started to overgrow the dried-up ponds. The site deteriorated drastically when in 1975 the water was reduced again because of the construction of a new purification plant. Only 17 ha of open water remained for the resting waders.

It was the plan and intention of the Münster town authorities that the purification plant should replace the old sewage farms which would then be available for agricultural and industrial use. Since the publication of these plans in 1968 the members of the OAG Münster have been trying to save at least a part of the former sewage farms. This was done by informing the inhabitants of Münster, the politicians and the administrative representatives in Northrhine-Westfalia about the outstanding importance of the site for migrating waders and ducks. This work succeeded and in 1976 233 ha of the sewage farm were leased by the government of the federal state of Northrhine-Westfalia. The "Biologische Station" - an association founded by the members of the OAG Münster (that means Ornithological Working Group of Münster) - was asked to carry out habitat management in the new reserve, mainly removal of vegetation which had overgrown the ponds. Thus the activities of the

Table 1. Ringing Totals 1969-1978

	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	Total
Oystercatcher *Haematopus ostralegus*	-	1	1	1	-	1	1	-	1	1	7
Little Ringed Plover *Charadrius dubius*	9	11	24	13	18	24	23	34	5	20	181
Ringed Plover *C.hiaticula*	30	36	3	10	32	4	5	1	-	1	122
Grey Plover *Pluvialis squatarola*	1	2	1	-	1	-	-	-	-	-	5
Lapwing *Vanellus vanellus*	243	278	417	341	205	173	196	79	53	93	2078
Knot *Calidris canutus*	-	1	-	3	5	-	-	1	-	1	11
Sanderling *C.alba*	-	3	-	-	3	-	-	-	-	-	6
Little Stint *C.minuta*	11	10	-	17	43	2	14	3	2	13	115
Temminck's Stint *C.temminckii*	5	3	2	-	6	-	6	1	-	-	23
Pectoral Sandpiper *C.melanotos*	-	-	-	-	2	-	-	-	-	-	2
Curlew Sandpiper *C.ferruginea*	29	16	4	26	26	4	23	2	-	5	135
Dunlin *C.alpina*	39	72	8	36	157	11	9	7	1	1	339
Broad-billed Sandpiper *Limicola falcinellus*	-	-	-	2	-	-	-	-	-	-	2
Ruff *Philomachus pugnax*	309	304	597	502	370	555	539	282	50	192	3700
Jack Snipe *Lymnocryptes minimus*	9	10	14	6	4	23	7	6	-	2	81
Common Snipe *Gallinago gallinago*	260	313	212	261	406	242	338	173	45	107	2357
Great Snipe *G.media*	-	-	1	-	-	-	-	-	-	-	1
Woodcock *Scolopax rusticola*	-	-	-	-	-	-	-	1	1	1	3
Black-tailed Godwit *Limosa limosa*	8	5	50	41	53	59	58	48	30	18	370
Bar-tailed Godwit *L.lapponica*	1	2	-	3	-	-	-	-	-	-	6
Curlew *Numenius arquata*	3	1	-	1	1	1	-	1	-	2	10
Spotted Redshank *Tringa erythropus*	4	27	16	50	51	36	46	32	1	3	266
Redshank *T.totanus*	31	39	17	32	39	21	26	22	14	25	266
Marsh Sandpiper *T.stagnatalis*	-	-	-	1	-	-	1	-	-	-	2
Greenshank *T.nebularia*	34	43	75	129	127	83	146	77	15	50	779
Green Sandpiper *T.echropus*	34	28	63	84	43	61	71	40	6	19	449
Wood Sandpiper *T.glareola*	49	137	94	101	73	55	123	48	44	95	819
Common Sandpiper *Actitis hypoleucos*	102	91	141	133	166	98	113	43	21	45	953
Turnstone *Arenaria interpres*	1	-	-	-	-	-	-	-	-	-	1
Red-necked Phalarope *Phalaropus lobatus*	-	1	-	-	-	-	-	1	-	-	2
										Total:	13,091

ringing group during the past three years have often had an agricultural character! As a result the area covered by open water was enlarged again. Simultaneously the numbers of resting waders (which had been quite low in 1975 and 1976) rose again. Nearly all the diagrams in fig.1 exhibit the same trend: relatively high numbers in 1972 and 1973, diminishing numbers until 1976 and rising numbers from then on.

Ringing

Regular wader catching started in 1969. Before ringing began little was known about the waders using the site. Observations had shown that at least some individuals of a few wader species used the site to moult their flight feathers. The aim of ringing is to gain insight into the resting and moulting biology and the origins of the waders occurring at the site. To obtain these ends some plans and objections were formulated (also see Harengerd, Prünte & Speckmann 1972) :

1. an evaluation of wader migration phenology, split up, if possible, into age and sex groups and groups of different geographical origins
2. a collection of biometrical data
3. a detailed study of weights of resting waders
4. a description of moult
5. an analysis of lengths of stay of individual waders in the study area
6. an investigation of return rates of ringed birds in subsequent migration periods
7. the interdependencies between these aspects of research.

To obtain the data to answer these questions, the birds first had to be caught! The next step was to work out appropriate catching methods. Catching by wire cage traps was not practical because of widely varying water levels. Cannon netting was also not advisable because the nets would press the caught birds into the soft and sticky mud. Also it would have been difficult to get a cannon-netting licence to work in a suburban area. Catching waders with spring operated nets baited with meal worms was only partially effective. In the end 40 m mist nets proved to be the best method

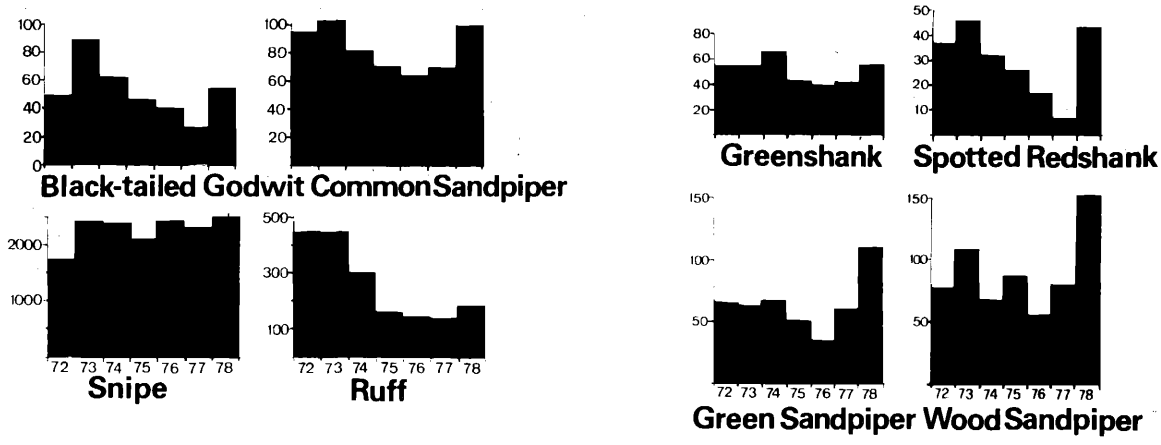


Fig.1: Mean daily resting numbers of several species of waders during their specific autumn migration periods in the years 1972 to 1978.

of catching waders here and four-shelf nets with a mesh width of 30 mms are now generally used.

Catching is done at night when the mist nets are set up on ponds where waders roost. The roosts are found by searching with a hand operated spotlight the night before the proposed catching is planned. Nets are set at dusk: at least three men must help to erect a 40 m mist net in the soft mud on the bottom of the ponds. The number of nets used depends on the number of night roosts found and the number of people available. Up to 20 nets were used on some nights. Nets remain set all night and are taken down the next morning. Most birds are usually caught at dusk and dawn when many birds move between those ponds used by day and those used by night. Catching success can be improved by flushing the waders during the night. For some species, especially Black-tailed Godwit, Greenshank and Spotted Redshank, good results were obtained by playing tape recordings of their calls beneath the mist nets.

Catching with mist nets of course depends on the occurrence of fine weather; it is not possible during windy and rainy nights. Mist and - sometimes - bright moonlight lessen the catching success. Unlike coastal regions weather conditions are quite often favourable at Münster so that regular mist netting is possible; usually twice a week during the main ringing season.

The nets are examined continuously during the night. Caught birds are transported to the Biological Station in jute or cotton sacks and remain in these sacks in darkness during the night. They are released next morning after taking down the mist nets. Processing the birds usually takes place during the night and in the early morning. All the ringing work is done by the members of the OAG Munster, about a dozen in number, who all work honorarily, and who are assisted by pupils and students during the holidays.

Catching by mist nets at the sewage farms is perhaps not as effective as cannon-netting on the coast; the maximum catches in Munster are about 280 birds,but catches rarely exceed 150 birds. The catching rate for different wader species is very variable: thus a high proportion of the resting Calidris-species are often caught whereas relatively few Snipe and Tringa species are netted, compared with the numbers present. The reason for the low ringing totals for species like Dunlin and Knot is because they are scarce at this site. Altogether some 13 000 waders were caught at the Munster sewage farms between 1969 and 1978; for totals see table 1.

Despite the unfortunate fact that only relatively few birds are caught at a time, this does give the opportunity for somewhat longer examination of each individual bird. After diagnosis of age, if possible, sex, the birds are ringed. To evaluate some of the questions mentioned earlier simple ringing does not yield sufficient data. It proved to be necessary to mark the caught birds so that each individual could be recognised in the field for several years. For this we chose colour ring combinations - each bird getting a new combination of one steel and up to five plastic colour rings. Colour rings are always put on above the intertarsal joint. The plastic rings are quite easily recognized with a telescope. Problems arise when rings become dirty and pale after several years. Also colour rings are sometimes lost. Nevertheless the true combinations can be deduced in most cases. Species colour ringed are Black-tailed Godwit, Spotted Redshank, Redshank, Greenshank, Wood Sandpiper, Green Sandpiper and Ruff.

After ringing the condition of the feathers is examined and the state of moult is recorded in detail. To date thirteen species of waders have been found moulting flight feathers at the sewage farms, including Lapwing , Snipe , Black-tailed Godwit, Wood and Green Sandpipers and Ruffs which obviously use the site regularly as a moulting ground.

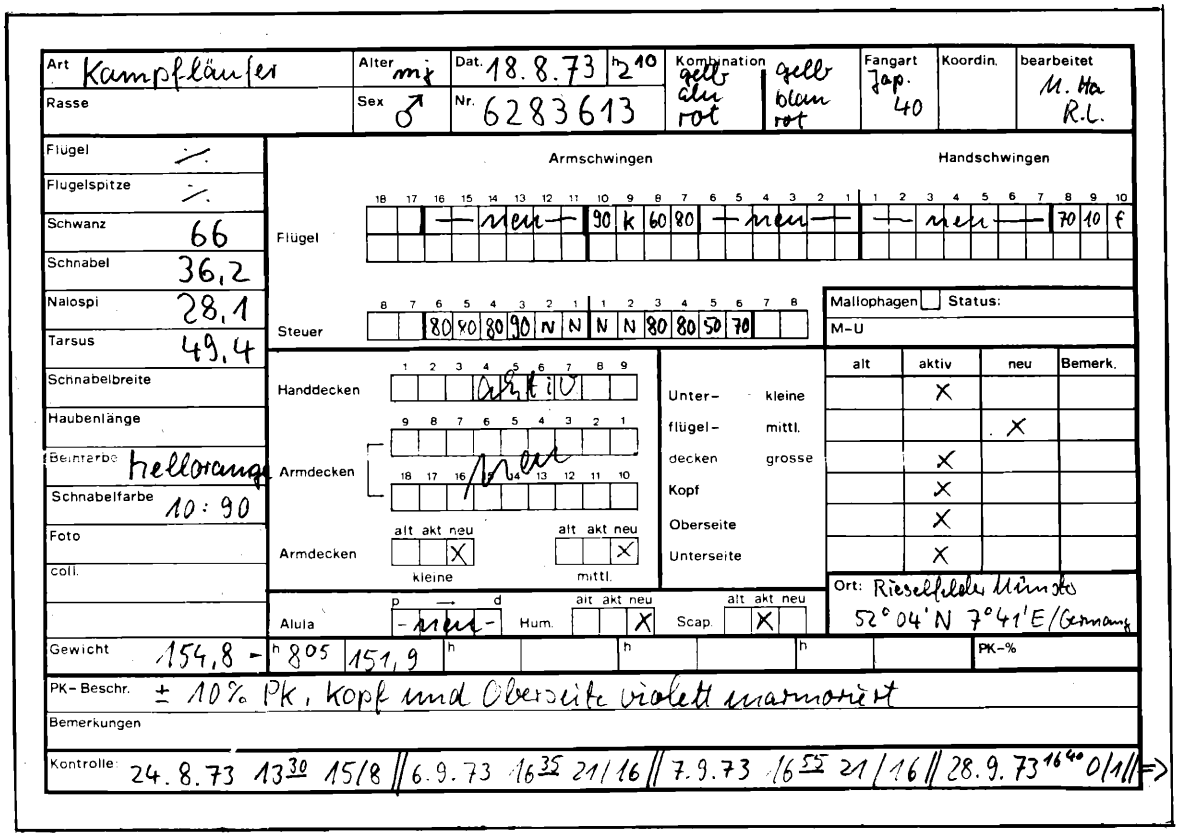
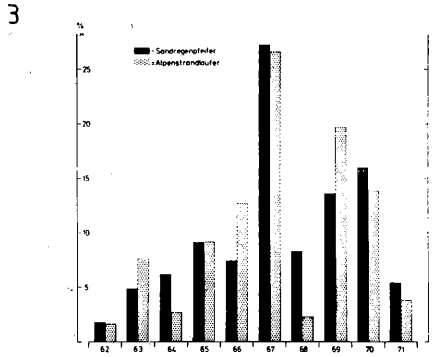


Fig.2: Ringing data card, for explanations see text.



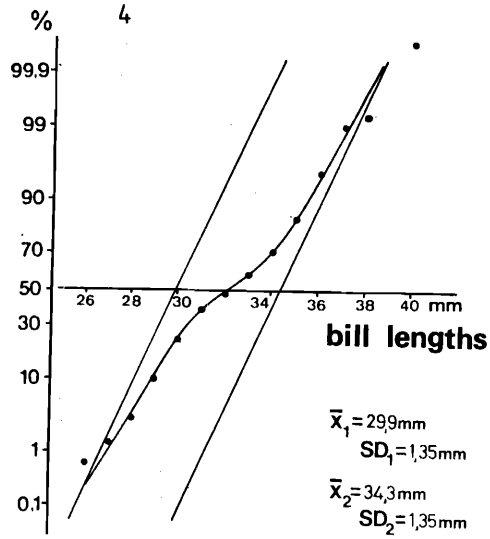
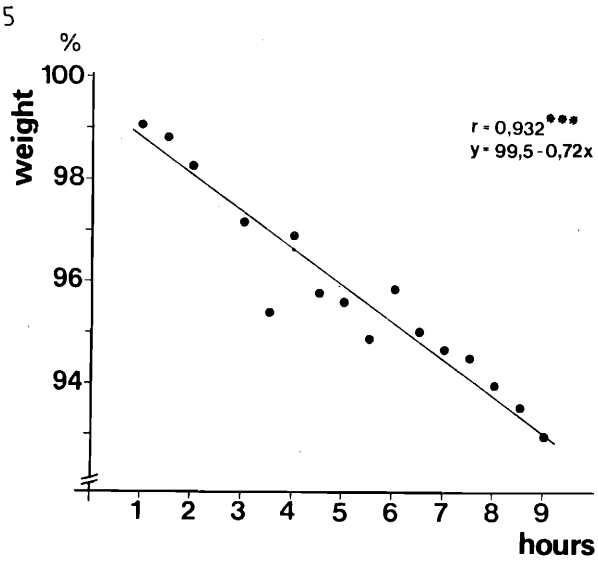


Fig.3: Numbers of Dunlins (dotted columns) and Ringed Plovers (black columns) per day in the years 1962 to 1971. Numbers are percentages of the sum of the relative frequencies.

Fig.4: Percentage cumulative frequency distribution of bill lengths of 306 juvenile Dunlins (dots). The straight lines mark the theoretical distributions of the two distinct samples. Means and standard deviations of these two distributions are also given.



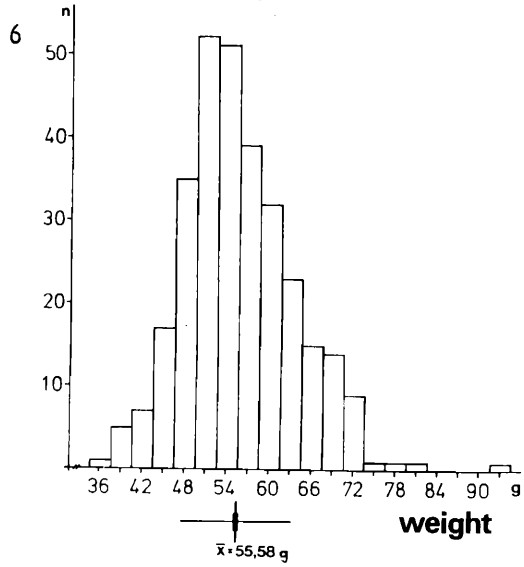
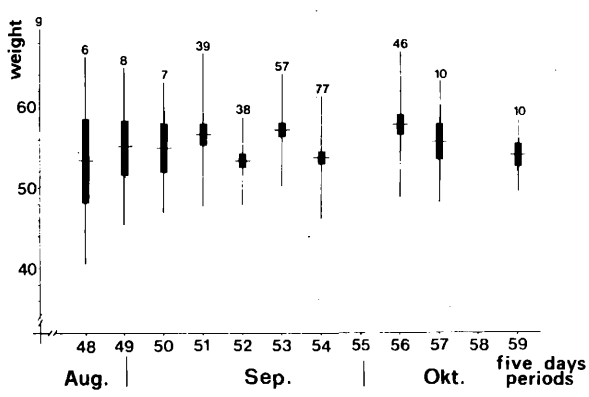


Fig.5: Relative nocturnal decreases of weights of Dunlins. Regression line through the mean decreases of weights calculated for intervals of 30 minutes. The equation of the regression line and the statistically highly significant correlation coefficient also given.

Fig.6: Frequency distribution of weights of 304 juvenile Dunlins. Mean (vertical line), standard deviation (horizontal line) and standard error of mean (thick bar) are given below the base.



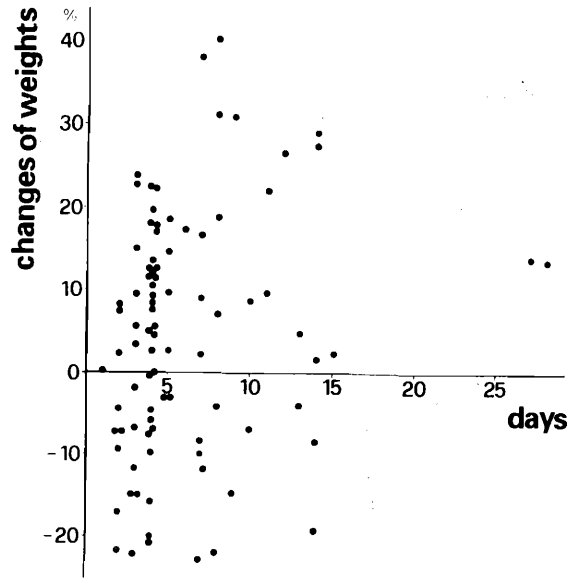


Fig.7: Mean values of weights of juvenile Dunlins per five days periods. The horizontal lines mark the means, the rectangles their standard errors, the vertical lines the standard deviations of the samples. The small numbers indicate the sample sizes.

Fig.8: Relative changes of weights of recaptured juvenile Dunlins (n=66). Base: days between capturing; ordinate: changes of weight , relative.

Next several measurements are taken from each bird: wing length - always maximum chord -, the distance between the innermost secondary and the longest primary (Flügelspitze), tail length, bill length, Nalospi (bill length to nostril) and length of tarsus. Birds are not always measured by the same person. We hope to minimize differences between measurers by regular check measurings. Last, but not least, birds are weighed - usually twice a night - first shortly after ringing and again shortly before release in the morning. Thus weight loss during the night can be calculated and weights of birds weighed at different times during the night standardized.

Measurements, moult data and other specifications are registered on ringing cards (fig.2). The spaces along the top of the cards are reserved for name of the species, age, sex, ring number and the colour ring combination. On the left there is a column for biometrical data including notes for leg and bill colour. The central and right side of the card is used for recording moult and the bottom part for a description of nuptial plumage. Controls - which are usually resights - may also be written on the bottom of the card and more space is available on the back of the card.

The field work on Münster sewage farm does not end with ringing, however. To get information on the length of stay of ringed birds, regular surveys are undertaken. Excursions into the area have taken place nearly each day since 1969. These excursions have yielded nearly 50 000 sight controls of colour-marked birds in the years 1969 to 1978 and also detailed data on numbers - not only of waders.

Using a car for bird-watching is almost obligatory for several reasons: first the birds are much more easily flushed by a pedestrian than by a car. Thus reading colour ring combinations from a car is much easier than on foot. Secondly the distances which must be covered during one excursion are quite great: during the main migration period they comprise up to 80 kms. The durations of the surveys vary between one and a half hours in winter when there are almost no waders in the reserve - apart from Snipes and Green Sandpipers - and up to eight hours in summer.

The evaluation of the data has proved to be somewhat difficult. Problems arise mainly because of the large amount of material collected for some species. Suitable methods of handling the data had to be found. The most reasonable way to analyse the material seemed to be by electronic data processing. Fortunately there was the opportunity to use the computer at the University of Münster for the examination of ringing cards of frequently ringed species.

Publications are usually prepared by one or two members of the group and then discussed at a meeting of all members. Some years ago we decided to publish papers under a common name. Most of the material however has still to be evaluated. Papers have already appeared on the migration phenology of waders (Harengerd, Prünte & Speckmann 1973), on biometrics and moult of the Snipe (OAG Münster 1975) and on biometrics of the Dunlin (OAG Münster 1976).

Resting Phenology and Biometrics of Dunlin

Data on migration phenology and biometrics of Dunlin have been worked out and these data allow a preliminary picture of the occurrence of Dunlin at this inland site to be drawn. There are at least two astonishing phenomena. First there are great fluctuations in resting numbers from year to year (fig.3), which match those of Ringed Plovers Charadrius hiaticula. There seems to be a real coherence in the occurrence of these species. The reasons for this are not evident so far. The second phenomena is that nearly all Dunlins caught are juveniles. Of 319 caught during the autumn migration periods from 1969 to 1975 only 12 were adults. The diagrams and figures therefore refer only to juveniles.

The mean bill length of about 29.9 mms for the males and 34.3 mms for the females - obtained by drawing the percentage cumulative frequency distribution of bill lengths on Gauss paper (fig.4) - suggest that most of the caught birds were Calidris a. alpina and a few C. a. schinzii. Remarks on the origin of the Dunlins remain speculative without recoveries of ringed birds in the breeding areas.

Most caught birds are weighed twice a night. Fig.5 shows the relative nocturnal weight loss. The relative loss is about 0.7 per cent per hour and seems to remain stable even when there are longer time intervals between the weighings. Using these data all weights were calculated back to 10 p.m.. The frequency distribution of these standardized weights is shown in fig.6 and statistical treatment shows that it is not a normal distribution.

Mean weights from various samples show little change during the autumn migration period (fig.7) - a trend of the mean values does not occur. The weights of Dunlins caught in the sewage farms are somewhat difficult to interpret: it would be very useful to have information on the length of stay of individual birds. Similarly the weight changes of recaptured birds did not show a clear trend (fig.8). Most recaptures unfortunately occurred very shortly after the first capture. If the periods which elapsed had been longer a clearer trend might have appeared.

These notes may be sufficient to illustrate, at least in part, our evaluation of the Dunlin material. Dunlin ringing at Münster sewage farms - as at other sites - asks more questions than it answers.

Finally we should like to point out one thing: During the catching season - say April, May and July to September - there is the opportunity (especially for young ornithologists) to come and take part in several activities at the Biological Station mainly concerning registering and ringing waders but also carrying out habitat management. Basic accomodation will be provided.

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