

Abstracts of talks and posters presented at the IWRB/WSG Feeding Ecology Workshop, Hungary



FEEDING STRATEGIES OF COOT IN WINTER. DESCRIPTIVE VALUE AND ADAPTIVE SIGNIFICANCE

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Coot in winter gather mainly in very large groups on open lakes where they feed mostly during the day. Ichkeul Lake is the most important winter area for Coots in North Africa: the maximum numbers (55,000 birds, mean 1982 to 1991) occur early in the season (October to December) with a mean half reduction in January (sometimes in December). This departure is considered as linked to the depletion of the usual food of Coots (aquatic beds of *Potamogeton pectinatus*) and/or to its inaccessibility (high water level).

As part of a long term study initiated in 1982-83, regular diurnal observations on the feeding behaviour of Coots at Ichkeul were carried out during three winter seasons (1988-89, 1989-90, 1991-92). We used a multivariate analysis (AFC) with lines for data and columns for 12 variables (8 behavioural patterns as active variables, 7 time and location values as supplementary variables).

Results indicate a correlation between the feeding behaviour and the environmental variables associated to food availability: from pecking for the best conditions, to sleeping for the worst (when it is an advantage for Coots not to spend energy looking for inaccessible or low energetic food) with all intermediate behavioural patterns.

FEEDING ECOLOGY OF BLACK-TAILED GODWITS FEEDING ON RICE

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Black-tailed Godwits feeding on rice were studied in the Tagus estuary (Portugal) between December 1991 and February 1992. The birds fed on rice grains (left over from the harvest some months before). The rate at which the Godwits took the grains from the mud did not vary in the course of the observation period. In contrast, the daily feeding time was in winter much shorter than later in the season.

A comparison of the frequency distribution of the weight classes of the grains present on a field before and after Godwits had fed on the spot showed that only the heavy rice grains were selected. The digestibility of the rice was determined by a comparison of the energy of rice and faeces and a detailed analysis of the faeces.

Taking all these data together, the daily energy consumption of Godwits in winter and during the pre-migration period could be calculated.

Acknowledgement: The field data were collected with Rob Bijlsma in cooperation with Albert Beintema (IBN) and Rui Rufino (CEMPA). Jan van der Kamp did a lot of the laboratory work back home.

ECTOPARASITES INFLUENCE EGG SIZE IN THE RINGED PLOVER

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Feather mites of the super family *Analoidea* are widespread ectoparasites living on wader remiges. Infestation by a feather mite species *Bychovskia charadrii* was studied in an inland population of Ringed Plover (*Charadrius hiaticula*) breeding in Eastern Poland. Parasite load was found to correlate negatively with egg volume laid by individual females. This reduction in egg size occurred solely via effect on egg length, while egg breadth remained unaffected. Surprisingly, both female body size and physical condition did not influence egg measurements in this sample. It is not clear whether reduced reproductive investment of female plovers is a direct effect of *Bychovskia* or high parasite load is an indicator of otherwise lowered fitness. In any case, the level of infestation by feather mites should be considered as a useful predictor variable in other studies of egg size variation in waders, as a similar significant effect on egg length was found also among female Little Stints (*Calidris minuta*) from Taymyr.

HABITAT UTILISATION BY DUNLIN ON BRITISH ESTUARIES

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The role of physical and environmental factors influencing the likelihood of estuaries being at capacity for Dunlin was investigated by a detailed analysis of the long-term BTO Birds of Estuaries Enquiry data. Four parameters of Dunlin populations on British estuaries were used to indicate the status of each site. These were: the rate of change in numbers over time, the ranked estimate of the likelihood of the site being at capacity, the coefficient of variation in peak counts between winters and the mean density of Dunlin on the site. Multiple regression analyses indicated that these parameters were related to a number of environmental variables. The environmental variables that were found to be significant for one or more of these parameters were: area, longitude, rainfall, widespread, tidal range, temperature, mean concentration of orthophosphate, mean biochemical oxygen demand, maximum biochemical oxygen demand and two sediment parameters which reflect the proportion of silt and fine sand.

In order to investigate further the role of sediments in determining the distribution and density of Dunlin on estuaries, fourteen estuaries were surveyed on five occasions through the winter at low tide and the mean number of birds on each intertidal area was calculated. Sediment samples were taken on representative substrates occurring throughout each estuary. The percentages of sand, silt and clay and fine clay were recorded for each area as well as the yield shear stress. On some estuaries there was insufficient variability in substrate type to obtain any relationship between Dunlin density and sediment composition. However, there was a general relationship on many sites for increasing Dunlin density on areas which had a higher percentage of silt/clay. There was also a negative relationship with yield shear stress; higher densities of Dunlin occurring on softer muds, this was most marked when data were combined for all estuaries.

It was clear that on many soft muddy sites there were very few Dunlin, although high densities of Dunlin only occurred on such sites. However there was a highly significant relationship between the mean silt and clay content within an estuary and the mean density of Dunlin on that estuary, with 75% of the variance in Dunlin density being explained by sediment type. This was a curvilinear relationship with low densities of Dunlin on estuaries which had less than 50% of silt and clay, but for sites that had over 50% of silt and clay there was an increase of approximately 2 Dunlin per hectare for every 10% increase in the proportion of silt and clay.

This gives considerable scope for altering the density of Dunlin that an estuary can support if the sediment regime can be modified. The implications of these findings are discussed in relation to predicting the effect of large scale changes on British estuaries.

CHANGES IN PHENOLOGY AND HABITAT CHOICE OF LIGHTBELLIED BRENT GEESE CAUSED BY LIMITED FOOD RESOURCES AND EXPLOITATIVE FOOD COMPETITION WITH MUTE SWANS AND COOTS

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Light-bellied Brent Geese (*Branta bernicla hrota*) staging in Mariager and Randers Fjords, Denmark, have during the past ten years changed their utilisation of the area considerably. In 1980-83 Brent used the area from November until mid April and fed on submerged vegetation in the shallow fjord areas throughout the staging period; in 1988-90 they used the area from September to early March and 11.5% of their foraging occurred on salt marshes, the remaining 88.5% on submerged vegetation.



The plant communities of the fjord areas were mapped and quantified during the summer of 1989. The use of these by herbivorous waterfowl, i.e. Light-bellied Brent Geese, Mute Swans (*Cygnus olor*) and Coot (*Fulica atra*) was studied by an indirect method in the wintering season 1989–90 by comparing vegetation maps with maps of waterfowl flocks from weekly counts. Results for all species showed there to be a preference for areas dominated by *Ruppia*, followed by *Zostera* and later *Ulva* dominated areas in the course of the wintering season; also a gradient from areas with high densities towards low densities of vegetation was found. Salt marshes were used as foraging areas throughout the season; in autumn salt marsh foraging was quite rare and coincided with wind induced high water levels in the fjord areas; in winter salt marsh foraging appeared more and more important, especially for the Brent Geese, and no influence of water levels on habitat choice was found.

Several studies of Brent Geese have shown that the shift from feeding on seagrasses and green algae towards salt marshes in winter is caused by a lower threshold level of food densities in the seagrass/algae communities, below which the birds migrate away or change habitats. The observed pattern within Mariager and Randers fjords was consistent with these studies. It is concluded that the recent use of salt marshes and earlier migration away from the area is caused by limited food resources found within the fjord areas. The development of the plant areas down to the threshold level is caused by natural die-off of plants and grazing by waterfowl. It is suggested that the Light-bellied Brent Geese are the first to switch from fjord to salt marshes due to exploitative food competition with Mute Swans and Coots.

OPTIMAL DIURNAL HABITAT OF HERBIVOROUS WATERFOWL WINTERING IN THE CAMARGUE

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The objective of the study is to determine the optimal diurnal winter habitat of 4 species of the herbivorous waterfowl: Gadwall (*Anas strepera*), Wigeon (*Anas penelope*), Red-crested Pochard (*Netta rufina*) and Coot (*Fulica atra*). Data comes from monthly census (September to March) carried out 1964/65 up to now (27 years) on 80 localities of the Camargue (South of France). These sites are described according to 9 parameters (2 to 7 modalities): surface, salinity, soil composition, disturbance, border effect, temporariness, status (reserve/hunted), water management and parcelling. All data including null ones is used and each month is treated separately with two kinds of model: a multiple linear regression and a multivariate model (Canonical Correspondence Analysis, CCA).

Surface is important for all species but with different optimal modalities. Disturbance (mostly hunting) is significant for the 3 species of ducks

and salinity for Gadwall, Red-crested Pochard and Coot. Soil composition is a very important parameter for Wigeon. However, it is redundant with salinity. Thus Wigeon prefer medium to large, brackish and sandy areas, which indicates *Ruppia*'s vegetal association when the other species rather like fresh water. The interspecific isolation relates to distinct response to disturbance, surface and temporariness.

At the end of the winter time, birds utilise all available sites, even when hunted, in order either to enhance their energetic requirements (migratory birds) or to find a breeding site (breeding birds).

HIGH COSTS OF LIVING IN TUFTED DUCK (*AYTHYA FULIGULA*) INDUCED BY BULK FEEDING ON ZEBRA MUSSELS (*DREISSENA POLYMORPHA*)

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Tufted Ducks predominantly feed on fresh water mussels in their wintering areas in western Europe. Tufted Ducks can be regarded as "bulk-feeders", ingesting whole mussels and crushing the mussel shells in the muscular gizzard.

We studied the energy budget and feeding behaviour of Tufted Duck under semi-natural conditions where ducks were trained to dive for mussels between 1 and 5 m deep. Experiments using doubly labelled water showed that the daily energy costs are extremely high in winter (ca 6 BMR). The daily ingested food mass can amount to 3 times the body mass of the birds. Ingesting whole mussels (predominantly water and mussel shells, less than 5% is meat) accounts for high costs of food processing, since a lot of energy is involved in heating the ingested food mass from ambient temperature to body temperature and in crushing mussel shells in the gizzard (measured with indirect calorimetry).

Feeding behaviour was strongly related to the temperature of the water. At low temperatures dive duration was shorter, suggesting that diving costs increased. Diving efficiency, however, also increased in colder water, i.e. the ducks ingested more mussels per second foraging under water. The ducks increased their diving efficiency by taking clumps of mussels to the surface. Consequently they were less selective in their choice of prey sizes (more larger mussels were taken). This suggests a shift in balancing diving costs and food processing costs.

METHODS TO MONITOR TIME AND ENERGY BUDGETS OF BIRDS, ESPECIALLY WADERS (CHARADRIIFORMES)

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Time and energy budgets provide manifold insights into the overall relation and adaptation of a species to its environment. They are a funda-

mental tool in ecological research, e.g. to analyse animal environment interactions, regulation of animal numbers, carrying capacity of areas, reproductive strategies as well as consequences of disturbances. Studying time budgets of waders (*Charadriiformes*) we are interested in (a) continuous long-term records of timing and duration of activities, especially foraging behaviour and (b) a method to record body mass data automatically. This paper describes the use of motion-sensitive radio transmitters for long-term monitoring of behaviour patterns and a computer-controlled system to register body mass data of incubating birds continuously.

The combination of radiotelemetry and body mass data registration allows continuous registrations of locomotor activity, foraging behaviour, incubation patterns and body masses of the incubating mates. The telemetry system enables us to analyse the timing of the mentioned parameters as well as to quantify their duration. The nest balances allow to quantify food intake and body mass loss caused by digestion. Altogether, this means the system overcomes the limitations in time and space of visual observations. Visual observations are mostly limited to daytime or to limited areas. However, most wader species are active both at day and night. In all, the developed recording systems make more comprehensive and complete data sets available than visual observations alone. Hence, it enables us to estimate time and energy budgets more exactly.

The described systems have been tested in free living Oystercatchers (*Haematopus ostralegus*). I will present first results and discuss the suitability of the systems for field studies. It should be no problem to bring forward the proposed transmitter design to study activity patterns as well as physiological variables of other species too. The same holds for the design of the electronic nest balances.

HUNTING EFFECTS ON WILDFOWL AND WADERS IN MONTEPULCIANO LAKE

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During 1990 a census was carried out on the bird communities in the Montepulciano Lake, Tuscany, Central Italy, the first year after hunting prohibition. The annual turnover of the bird communities was investigated by a modest version of the line transect method. Two census trips were undertaken, one in wet riparian habitat and the second along the side of the Phragmitetum.

Each transect was visited twice in each month from January to December 1990. The data were compared with a previous census carried out in 1983, when hunting activity was still practised. Moreover, winter counts of Ducks and Coots (1990 and 1991) were compared with previous winter counts (from 1983 to 1989) when hunting was allowed.

The results show the effects of hunting, particularly for what concerns numbers, population, distribution and behaviour of wildfowl and waders.



but also herons, rails, grebes, raptors and small passeriforms. The most interesting results are:

- ◆ direct impact on water species for which hunting is allowed (*Anatidae*, *Caradriidae*, *Rallidae*);
- ◆ direct and indirect impact on water species for which hunting is prohibited (*Podicipedidae*, *Ardidae*, *Laridae*, etc.);
- ◆ increase of number of waterfowl during autumn-winter (hunting season) after hunting prohibition;
- ◆ Mallard (*Anas platyrhynchos*) and Garganey (*Anas querquedula*) number of pairs increase and new breeding site for Shoveler (*Anas clypeata*), Pochard (*Aythya ferina*) and Ferruginous Duck (*Aythya nyroca*) after hunting prohibition.

PESTICIDE POISONING OF WILDFOWL IN ENGLAND AND WALES

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The use of toxic chemicals as pesticides carries a potential risk for wild and domestic animals. The Wildlife Incident Investigation Scheme was set up to examine animals suspected of being poisoned by pesticides in England and Wales.

The Scheme operates as a post-registration procedure to monitor the effects of approved pesticides on wildlife and as part of the enforcement of relevant animal or pesticide legislation involving the use of agricultural chemicals. The Scheme operates by a combination of methods including field inquiries, to help identify the cause of an incident; post mortem examination, which may result in tests to ascertain whether disease contributed to the death; and laboratory analytical studies carried out on tissues from the dead animal to determine the presence of a range of pesticide residues.

The Scheme is particularly reliable for detecting deaths of large-bodied animals such as wildfowl. During the last ten years (1982-1991) 85 incidents involving wildfowl deaths have been reported through the Scheme. The cause of death has been identified in 52% of these incidents and agricultural chemicals were implicated in 28 (33%). In the remainder the cause of death has not been established.

The cause of poisoning of wildfowl by agricultural chemicals can be assigned to one of four categories.

1. The deliberate abuse of one of these compounds, either as a result of an illegal pest control method to kill the wildfowl suspected of causing damage, or where the birds have been poisoned as a result of eating bait illegally placed for some other target species. The nine incidents in this category either resulted in the deaths of Mute Swans (*Cygnus olor*) or Mallards (*Anas platyrhynchos*) with numbers killed varying up to 100 in one case.

2. Misuse of chemicals arises when wildfowl are killed due to the careless, accidental or wilful failure to adhere to the correct practice of using

the compound. This includes incidents where spilt dressed grain is not adequately cleared up or the chemical is poorly stored thus allowing access by wildfowl. There were only two wildfowl incidents in this category, both involving Mallard.

3. Wildfowl may be poisoned as a result of the approved use of a product which may have been applied according to the recommended use of that compound. The 12 incidents in this category were found to have resulted from one of three types of treatments. Insecticidal seed treatments were implicated in five incidents involving poisoning of Bewick's Swans (*Cygnus columbianus*), Whooper Swans (*Cygnus cygnus*), Brent Geese (*Branta b. bernicla*), Canada Geese (*Branta canadensis*), Pink-footed Geese (*Anser brachyrhynchus*), Greylag Geese (*Anser anser*) and Mallards. Insecticidal sprays were found to be the cause in five incidents involving Bewick's Swans; Canada, Brent and Greylag Geese, all of which had been grazing on recently sprayed crops. There were two incidents implicating insecticidal granules, when Mallards and Shelducks (*Tadorna tadorna*) were found poisoned.

4. Where there is no evidence to assign the cause of wildfowl poisoning to one of the above categories then the incident can be allocated to unspecified use. There were five incidents in this category involving chemicals which are used as seed dressings, granular applications and sheep dip preparations. Birds poisoned included Mallards and Teal (*Anas crecca*).

The WIIS has highlighted problems found with pesticides after their registration, and this has resulted in the withdrawal or modification of use of these compounds and has proved to be a valuable tool in protecting wildfowl. As new chemicals are introduced the Scheme provides a useful method of ensuring that if problems arise, they can be identified at an early stage and necessary action taken.

The Scheme as a regulator of enforcement action remains a potent force in ensuring that perpetrators of illegal poisoning of wildfowl will, wherever possible, be prosecuted and hence help to eliminate or reduce this indiscriminate and cruel practice.

PRE-NESTING FEEDING ECOLOGY OF PINK-FOOTED GEESE IN SOUTHERN ICELAND

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Breeding success in Pink-footed Geese is highly correlated with spring meteorological conditions in Iceland where a large proportion of the British wintering population breeds.

We have studied the distribution, abundance and habitat use of Pinkfeet between their arrival in the lowland agricultural areas of southern Iceland and their movement to their ultimate interior breeding areas. In late springs, persistent snow cover delays occupancy of nesting sites and may therefore influence clutch size and hence overall breeding success. We have also investigated

feeding behaviour and diet selection to assess forage quality, feeding site selection and food availability in contrasting seasons and examine their effects on accumulation of reserves on arrival in Iceland. Such information gives us a clearer understanding of the importance of spring feeding amongst Pinkfeet and provides a basis for conservation management recommendations.

BREEDING POPULATIONS OF AQUATIC BIRDS IN THE HYPERTROPHIC HIDVEGI LAKE (KIS-BALATON RESERVOIR) IN HUNGARY – A PRELIMINARY ASSESSMENT

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Thirty species of breeding aquatic birds were recorded in the 51 km² Hidvegi Lake in 1988, the first year of operation of a newly flooded reservoir. The primary purpose of the reservoir is to reduce the phosphorus loading by the Zala River before entering to Lake Balaton, the largest lake in Central Europe. This newly created wetland is now an important, well protected habitat for breeding of aquatic birds in Hungary. *Anas platyrhynchos* (750 pairs), *Phalacrocorax carbo* (600 pairs), *Fulica atra* (200 pairs), were the most numerous breeding birds.

Although total phosphorus concentration was extremely high in the reservoir, increased concentration of phosphorus was noted near the Cormorant colony, a good example of significant nutrient loading of a waterbody by colonial birds. The migrating species with the largest number of individuals (at a given time) were *Anser fabalis* 2000, *Anas crecca* 1000, *Aythya ferina* 700, *Bucephala clangula* 700 and *Aythya fuligula* 600. The number of birds is monitored and changes will be assessed in this newly created waterbody as it undergoes changes in time.

SPREADING RINGED PLOVER AND COMMON SANDPIPER IN THE WESTERN UKRAINE

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Both of these wader species are irregularly distributed in the Ukraine. In the Western Ukraine these waders live near the river valleys. Most breed in highland river valleys in the Ukrainian Carpathians up to an altitude of 800 metres above sea level. The number of Ringed Plovers is 3000 pairs and Common Sandpiper 1500 pairs (according to the Atlas of Western Ukraine Breeding Birds and modern accountings). Common Sandpiper are found during the breeding season in 142 out of 217 25 x 25 kilometre squares and its breeding is improving in 56 squares.



EFFECTS OF MOORLAND FRAGMENTATION ON BREEDING CURLEW (*NUMENIUS ARQUATA*) IN ORKNEY

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Moorlands and other semi-natural habitats in the Orkney Islands have become fragmented as a result of agricultural improvements, and in many areas of Orkney improved grasslands, intensively managed for beef cattle, are now the predominant habitat. The extent of fragmentation is greatest in lowland areas (i.e. <100 m above sea level) where remnants of semi-natural habitat range from <1ha to 300 ha in area. Within these remnant areas Curlews (*Numenius arquata*) nest at extremely high densities (frequently 1.0–1.5 pairs.ha⁻¹), whilst on relatively intact moorlands (>1000 ha in area, and generally above 100 m above sea level) nesting densities are lower (ca 0.1 pairs.ha⁻¹). Despite the high densities on the fragmented areas of semi-natural habitat few Curlew nest in the surrounding improved grasslands.

This study investigates (i) factors associated with variation in the nesting density of Curlew on areas of semi-natural habitat and (ii) using radio-tagged and individually colour-ringed birds, the extent to which Curlews nesting on remnants of semi-natural habitat depend upon the surrounding improved grasslands, both as feeding habitat for adults and as chick-rearing habitat. Studies of bird diets and invertebrate abundance are undertaken to identify the extent to which selection for particular habitats is related to between-habitat differences in food supply.

NUMBERS AND DISTRIBUTION OF WESTERN PALEARCTIC GEESE AND SWANS AT THE LOWER ELBE

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The Lower Elbe reaches from Hamburg to the point where the Elbe flows into the North Sea. Until the 1970's there existed spacious pasture land along the coastal area, flooded periodically by high tides. Intensive embankments, reducing the marshes to 66% (today 7300ha) and a chain of industrial settlements diminished the great importance of the nature dramatically. The species rich community of meadow birds is threatened by extinction (e.g. *Limosa limosa*), the wild stocks of threatened plants (e.g. *Fritillaria meleagris*) are diminishing, though the importance of the Lower Elbe for migratory birds is still noticeable.

The Lower Elbe is part of the East Atlantic Flyway of coastal birds. A lot of species resting in the neighbouring Wadden Sea occur also at the Lower Elbe; some prefer this freshwater marsh area. These birds are *Cygnus bewickii* (up to 25% of the world population), *Branta leucopsis* (up to 20%), *Anser anser* (about 10% of the North Western Europe population) and *Anser a. albifrons* (up to 2.5% of the Siberian population

migrating to Western Europe). Further species are Mute Swan, Whooper Swan, Brent Goose, Canada Goose, Bean Goose and Pink-footed Goose.

While the Southern coastal area (Lower Saxonia) has been designated as "wetland of international importance", an appropriate conservation status for the Northern coastal area in Schleswig-Holstein is still missing. In order to assess the importance of the Northern coast, the dispersal of the swans and geese along a twenty kilometre coastal area of the Lower Elbe – the Pinneberger Elbe shoreland – was investigated in 1991/92.

The species with highest numbers are the Greylag Goose, White-fronted Goose and Bewick Swan. The Greylag Geese rested in four sub-groups covering areas between 2 and 12 km². They preferred places rich with *Schoenoplectus* spp and flooded green vegetation. Similarly, the White-fronted Geese spent most of the time in flooded green vegetation, but also accepted non-flooded stands with high ground water level. The Bewick's Swan preferred flooded green vegetation but also rested on arable land, mainly rape fields. Necessary for all three species is the linking of the grazing places with sleeping areas free of disturbances caused by human activity. The sleeping areas are located in the low water zones and mudflats of the Elbe.

Main threats further reducing the importance of the Lower Elbe for migratory birds are the plan for deepening the Elbe to allow the Pan-Max container traffic, further embankments and a motorway across the river.

LEKING IN WADERS

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An operational definition of a lek mating system is a population in which males provide no parental care, males aggregate to display, males do not provide resources essential for breeding and in which females can freely choose among the aggregated males. Any species in which at least one population exhibit such a mating system is called a lekking species.

In waders (Charadriiformes), as elsewhere in the animal kingdom, lekking is a rare mating system and is established in three species in the Scolopacidae. Lekking probably evolved independently in the Great Snipe (*Gallinago media*) and in the ancestor to the two sister species, the Ruff (*Philomachus pugnax*) and the Buff-breasted Sandpiper (*Tryngites subruficollis*). It is questionable if the mass flights American Woodcock (*Scolopax minor*) and the Pin-tailed Snipe (*Gallinago stenura*) are equivalent to leks. Circumstantial evidence from a subspecies of the Common Snipe, the Faeroe Island Snipe (*Gallinago gallinago faeroensis*) suggest that lekking may occur also in this case.

In this review I will summarise the knowledge of lekking in waders and contrast the differences between the most well studied species. I would

also like to stress the problems of classifying species as lekking. Mating systems are the outcome of the behaviour of individuals in a population interacting, and the mating system may thus change, conditional upon a number of factors. Such factors may be environmental heterogeneity, including resource distributions, local densities and life history constraints. Also, since the variation in male reproductive success often is very large in lek mating systems, alternative reproductive behaviour is favoured. Such alternative strategies may affect the mating system of any population and may also provide a key as to why lekking occurs.

DOES HABITAT STRUCTURE INFLUENCE THE OCCURRENCE OF TERRITORIALITY IN WINTERING WADERS?

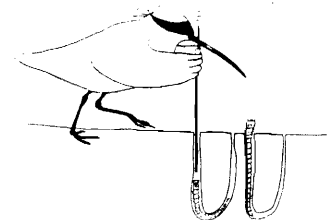
Hermann Hötter, Adolf Brutt Str.37, 2250 Husum, Germany

Most wintering Palearctic waders spend the winter gregariously in flocks. Single individuals or sometimes many birds of various species, however, have been found to be territorial in winter. During studies of wintering Avocets *Recurvirostra avosetta* in France, Portugal and Senegal and wintering Little Stints *Calidris minuta* in Senegal it appeared that territoriality only occurred where natural boundaries such as clear-cut edges of waterbodies, salina dams, etc facilitated the establishment of territories. Territoriality was never observed on open mudflats without distinct physical structures. Some aspects of the winter territorial behaviour of Avocets and Little Stints are described. The hypothesis that habitat structures release territorial behaviour is tested for several other wader species wintering in Senegal.

HABITAT AND PREY SELECTION OF TACTILELY VS VISUALLY FORAGING WADERS AT THE BERG RIVER ESTUARY, SOUTH AFRICA

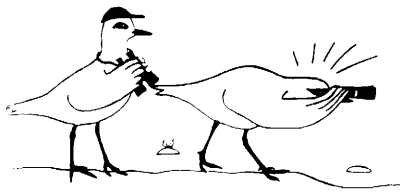
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Site preference of two migrant waders representing different foraging guilds, Curlew Sandpiper (tactile forager) and Grey Plover (visual forager) were studied in detail at the Berg River estuary, South Africa.



Curlew Sandpiper density was significantly and positively correlated with the combined density of their preferred prey *Ceratonereis keiskama* and *C. erythraeensis*. They consumed these worms in proportion to their occurrence in the substratum. Curlew Sandpipers' preference for muddy substrata with minimal vegetation cover was interpreted as a means of reducing the energetic costs of tactile foraging.





Grey Plover density was positively correlated with the biomass of *C. erythraeensis*. They fed on the largest nereids regardless of their abundance. Their ingestion rate increased as the biomass of both *Ceratonereis* species increased. The distribution of Grey Plovers on the estuary was independent of sediment type but was closely linked to vegetation cover.

The success rate of Curlew Sandpiper was positively correlated with their own density. Foraging and success rates of Grey Plovers were highest when the density of conspecifics was lowest. A positive linear correlation existed between foraging rate of Grey Plovers and the total density of migrant waders.

USE OF TEMPORARY FOOD RESOURCES BY MIGRATING DIVING DUCKS

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150,000 Tufted Ducks (*Aythya fuligula*) and 80,000 Pochards (*Aythya ferina*) spend their winter time on the lakes and rivers of Switzerland where they mainly feed on Zebra Mussels (*Dreissena polymorpha*).

A few lakes, among them Lake Sempach, with no Zebra Mussels and therefore only small populations of wintering diving ducks, offer excellent conditions to study their migratory behaviour, particularly relations between food resources and stopover time.

On Lake Sempach, numbers of Tufted Ducks and Pochards increase rapidly when the spawn of *Coregonus* fish becomes available for a limited time and drop again after only two or three weeks. Observations of colour-tagged Tufted Ducks indicate a high turnover rate and thus only short staging times. Radar studies and short-term ringing recoveries give further evidence for regular movements of diving ducks during the whole wintering season. This flexible behaviour enables them to detect and exploit temporary food resources.

OHRID LAKE ORNITHOFAUNA: FAUNISTICAL AND STRUCTURAL CHARACTERISTICS

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Aiming to obtain a real picture of the Ohrid Lake winter ornithofauna, and to contribute to the international process for protection of waterfowl, a winter census was carried out during the period 1988–1991.

The count was performed using a slightly modified method of Willi, 1970 (from Schnaider 1986) during the second half of January and first half of February, at the same time of day and under similar weather conditions. Taking into account only waterfowl connected with open water during the day, each research year about 35,000 birds were counted at the Macedonian part of Ohrid Lake.

The most numerous among them were Coots (*Fulica atra*) with 12,200–32,100 individuals or 50.2–65.3% of the total number of individuals. Second, in 1988 and 1990 were Pochards (*Aythya ferina*) with 7,057 (14.4%) and 8,267 (25.3%) individuals respectively. In 1989 and 1991 in the second place were Little Grebe with 3,250 (13.4%) and 3,605 (10.2%) individuals respectively. Faunistical analyses considering the number of individuals as separate members of different faunistical types, clearly show diminution of Palearctic (PA) elements with 66 to 82%. Faunistical diversity was the highest in 1989 (1.72), as a result of the lowest dominance index in that period (63.59%), which coincides with the results for Lake Dojran.

Index of species diversity was the highest in 1989 (1.66) compared with 1988 and 1990 (1.0), the reason being the same as in the previous case (lowest dominance index).

The level of similarity of the ornithofaunas among the separate years was 60–88.9%, which is an indication of the low level of winter ornithofauna composition in Ohrid Lake, which makes it possible to be predicted.

A joint project with Albanian ornithologists would award a greater validity of data, which can be usefully applied in the process of the lake ornithological composition monitoring.

FORAGING ECOLOGY OF REDHEADS WINTERING ON THE NORTHERN COAST OF THE GULF OF MEXICO

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Redheads (*Aythya americana*), like other species of diving ducks, congregate in large flocks on the wintering grounds with the largest concentrations found in estuarine open-water areas on the northern and western coast of the Gulf of Mexico. A population of about 20,000 Redheads winters in Chandeleur Sound, Louisiana, USA.

We studied diet, body composition, time-activity budgets and nutrition in that population over the winters (November through March) of 1987–88 and 1988–89. We collected 287 birds over the two year period.

For the 190 birds with esophageal food present, 83% of the diet was plant material (primarily roots and rhizomes of the seagrass *Halodule wrightii*). Animal matter (primarily marine gastropods) was higher ($P < 0.05$) in the diets of birds collected >50 m from the shoreline, and in adult males and females from late winter.

Body protein did not change ($P > 0.05$) over the winter, but body lipid content showed an increase ($P < 0.01$) from early to late winter for all sex/age groups. Based on 1,261 flock scans, feeding activity was greatest in early winter and showed a decrease ($P < 0.05$) from early to late winter; resting activity increased ($P < 0.05$) over the same period. Birds fed more ($P < 0.05$) during low tides and close to shore. Head dipping and tipping accounted for 83% of the feeding behaviours; only 6% of the birds fed by diving.

Nutritional composition and energy content of *Halodule* did not change ($P > 0.05$) over the winter but above ground and below ground biomasses showed decreases ($P < 0.0001$). *Halodule* was neither the most nutritious, not the most abundant, seagrass species on the study area. Food availability, tides, nutritional need and energetics probably play a role in the differences shown.

THE USE OF INTERTIDAL ESTUARINE AREAS BY FEEDING BIRD ASSEMBLAGES: A STUDY IN THE TAGUS ESTUARY (PORTUGAL)

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A winter survey of all bird species feeding on several intertidal areas of the Tagus Estuary was made to study spatial patterns of species associations, covariation and assemblage structure. Therefore, 29 sectors were defined and the number of feeding birds of all species present counted several times during winter. At the same time, several habitat variables were measured, mainly related to substrate type and human presence.

Five groups of sectors with similar bird assemblage structure were identified by cluster analysis. Sectors within each one of these groups had in common the same most abundant species and the five dominant species were Dunlin, Avocet, Redshank, Lesser Black-backed Gull and Black-headed Gull. Nevertheless, a great structural variability inside each group was found and their location in an ordination space showed that they were not individualised entities but parts of a gradient.

Sediment type explained the distribution of the several assemblage types throughout the estuary. Sectors dominated by Lesser Black-backed Gull occurred near to the mouth of the estuary or in the main river. Assemblage dominated by Dunlin, Avocet and Black-headed Gull seemed to represent to various degrees a gradient in sediment type. Redshank dominated assemblage type was a special case of the typical Avocet dominated one.

POPULATION TRENDS OF SHOREBIRDS IN EASTERN CANADA

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Population trends of shorebirds in Eastern



Canada were analysed using data from the Maritimes Shorebird Survey (MSS) collected between 1974 and 1990. The MSS consists of volunteer observers who count shorebirds during southward migration at study areas in the Maritime Provinces of Canada every second week from mid July to mid October.

Population trends were estimated for 12 species of shorebirds using data from 15 sites which had received at least eight years of coverage during the 17 year period 1974–1990. Peak migration periods were defined for adults of each species and an annual population index derived as the mean of all counts obtained during the peak period.

After log transformation, data were analysed by three methods: route regression, involving calculation of the weighted average of trends over all sites for each species; Theil's method, involving a non-parametric ranking procedure to obtain a slope coefficient; and paired t-test comparisons to determine whether mean abundances had changed between early (1974–79), middle (1980–85) and late (1986–90) segments of the study period.

Route regression indicated that one species, the Semipalmated Sandpiper (*Calidris pusilla*), had declined significantly ($p < 0.05$) during the study period, while Theil's method showed statistically significant declines for Semipalmated Sandpiper and Least Sandpiper (*Calidris minutilla*), with borderline decreases ($0.1 > p > 0.05$) for Black-bellied Plover (*Pluvialis squatarola*), Red Knot (*Calidris canutus*) and Short-billed Dowitcher (*Limnodromus griseus*) and a borderline increase for Whimbrel (*Numenius phaeopus*). Paired t-test comparisons indicated that Semipalmated Sandpipers, Least Sandpipers and Red Knots had decreased significantly between early and recent years of the study period.

Route regression analyses showed that whereas a majority (8/12) of the species declined over the entire study period, most (10/12) of the species declined during the early period, most increased (9/12) during the middle period and most (8/12) again declined in recent years. Analysis of the statistical power of the surveys showed that the present investigation, involving coverage of 9–15 sites for 8–17 years, should be able to detect a plus or minus 5% population trend with 90–95% power. Possible reasons for population changes are discussed.

CHANGES IN ABUNDANCE AND REPRODUCTION OF SELECTED WATERFOWL SPECIES IN SOUTH BOHEMIA DURING SEVERAL LAST DECADES

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A dramatic change in numbers of water birds was noted in the early 1980's. The breeding numbers of the most abundant duck species and of some other waterfowl, which have been increasing for several decades, began to decline abruptly in

many fishpond regions. These declines are different from any other changes in abundances of terrestrial bird species. Our investigations were initiated at that time in order to obtain missing data, determine the range of these declines, and find possible explanations.

In many fishpond regions of Czechoslovakia, an increase of mortality was recorded in many aquatic birds (most frequently due to botulism) between 1975 and 1983. A significant decline in the reproductive capacity (i.e. clutch size, brood size, numbers of breeding pairs and their ratio to the total number of duck populations) was observed in most ducks and other waterfowl species in the 1980's. Therefore, not only the abundance of selected waterfowl species was studied, but the changes in their reproductive parameters were investigated as well. Populations of the following waterfowl species were analysed in this way: *Podiceps cristatus*, *Cygnus olor*, *Anser anser*, *Anas sp.*, *Aythya sp.*, *Bucephala clangula*, and *Fulica atra*.

Changes in total abundance (number of censused individuals in breeding period), clutch size, brood size, size of breeding composition of duck populations were compared between species and over time.

POPULATION DYNAMICS OF SOUTH SWEDISH GREYLAG GEESSE

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Neck-banding of Greylag Geese has been undertaken annually since 1984 in an area with an increasing breeding population in southernmost Sweden resulting in 243 adults and 692 yearlings being marked up to 1991. Through a network of observers staging and wintering areas for many of these were established. In addition data on survival and breeding performance were collected in Sweden.

The majority spent the winter in Coto Doñana after a brief staging in the Netherlands but a proportion wintered in the Dutch Delta area. Geese from the different lakes occurred mixed in the winter areas. Annual survival rates differed markedly between the first winters (85/86–88/89) and the two last winters (89/90–90/91) being 87 and 80% for adults and 69 and 77% respectively for fledged yearlings. The lower survival in the last two winters could be related to high hunting pressure in Spain. The survival rate for young geese wintering in the Dutch Delta was significantly higher than for those wintering in Spain. The same tendency (not statistically significant) was found for adults.

Overall, 56% of the pairs produced a brood of, 87% of families raising at least one young to fledgling. The mean clutch in the population was 5.30, mean brood size at first observation 4.66 with a mean brood size at fledgling of 3.30. The annual mortality from hatching to fledgling being 30%, significantly higher for broods experiencing wet conditions during their first days.

The production of young for early and late arriving

(related to the annual median date) pairs were 4.8 and 3.5 young respectively (significant difference). The survival to fledgling was also higher for the early pairs. The production of young was lower after a change of partner in cases where the old partner had died. A significant correlation was found with the breeding result in the preceding year indicating an effect of experience. Greylag Geese wintering in the Dutch Delta and Spain did not differ in brood size but geese wintering in Holland returned significantly earlier than those wintering in Spain.

Based on the productivity and survival values obtained during the present period it was calculated that 100 pairs wintering in Holland will produce about 50 pairs recruiting to the population at an age of four years compared to 24 years for those wintering in Spain. A small proportion are recruited at an earlier age but the study has been too short yet to establish the normal age of first breeding.

SOIL-WATER CONDITIONS AND BREEDING SNIPE

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Previous research has indicated that the length of the breeding season for breeding Snipe is, in part, determined by the softness, and so the penetrability, of the soil. Snipe cease to attempt to breed once the soil penetrability exceeds a certain level. On the peat soils of the RSPB reserve at West Sedgemoor on the Somerset Levels, this force is exceeded once the water table drops to about 35 cms below field surface. Subsequent management of RSPB lowland wet grassland reserves has been aimed at maintaining a water table at or above this level.

Recent research has considered the relationship between soil penetrability and water conditions for a range of soil types. The link between soil penetrability, water table and ditch water level has been shown to be general for peat soils at a variety of sites. If ditch water levels are maintained within about 30 cms of the field surface then the soils will be soft enough for breeding Snipe. On clay soils, however, soil penetrability is only weakly correlated with water table – although there is a strong link with soil moisture content (or gravimetric wetness). One factor that affects the gravimetric wetness of the soil is the likelihood of flooding in the late winter/early spring. The implications of this for management of lowland wet grassland reserves on clay soils are discussed.

POLYANDRY IN WADERS

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In all forms of polyandry exhibited by waders, males assume most or all parental care. However, females exhibit four different tactics of mate acquisition: sequential and simultaneous resource-defense, and sequential and



simultaneous mate-access. A detailed, long-term study of the Spotted Sandpiper (*Actitis macularia*) revealed that individual females showed all four tactics, and that the frequency of the different tactics was age but not size dependent.

The overall incidence of polyandry was higher among old (59%) than yearling females (27%). Polyandrous females of each age employed different mating tactics. (1) Yearlings were typically sequentially resource-defence polyandrous. (2) Two year olds were primarily simultaneously polyandrous, mixing resource-defence and mate-access polyandry equally. (3) Older females were primarily simultaneously resource-defence polyandrous.

We subjected data from 17 years to multiple logistic regression analysis in order to determine which variables were associated with interclutch movement for polyandrous females. Female interclutch movement was associated with experience on a territory: females tended to stay on territories where they and/or their mates had breeding experience, and females that moved went to a place where their mates had a history of breeding success. Until now, experience based changes in mating tactics have not been documented for birds. The labile mating system here described provides insights into the evolution of the various sorts of polyandrous mating systems exhibited by waders.

SEX-SPECIFIC BENEFITS OF MATE-DESERTION AND THE EVOLUTION OF AVIAN POLYGAMY

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The evolution of avian polygamy has been traditionally analysed in terms of the costs and benefits of desertion by one or both sexes. Desertion occurs when the benefits gained from alternative reproductive opportunities compensate for the lower output from the present brood that would result from reduced parental care. Most theoretical and experimental work targeted towards describing the occurrence of polygamy across genera, species and individuals has concentrated upon the costs of desertion rather than the benefits, but no clear difference has emerged between monogamous and polygamous cases.

Here, I use a repeated intra-family comparative analysis to demonstrate that the costs of desertion are not significantly different between monogamous and polygamous species. The potential benefits of desertion are, however, significantly higher in polygamous species. Additionally, variation in the sex-specific benefits of desertion, rather than the costs, best predicts the distribution of the evolution of polyandry as opposed to polygyny across avian families displaying uniparental care – polygynous groups breed at high density whereas polyandrous groups breed at low density.

Mate desertion is, therefore, rare in the polyandrous groups because the benefits of doing so are low due to the low probability of finding subsequent mates. It is suggested that biparental care is the ancient state in these families. At low breeding density females may benefit more than males by deserting their partner because females may produce a second clutch. Hence, at low breeding densities biparental care or double-clutching is expected. At higher breeding density either sex may desert and polygyny or polyandry ensue. The mating system may, therefore, be determined by the sex in which the tendency to desert develops first – in families in which parental care and/or double-clutching is common there may be a greater chance that this will be the female.

These predictions are then tested at two further taxonomic levels, firstly between species of Charadriidae and then between populations within species of Charadriidae. It is found that, in both tests, the occurrence of polygamy is associated with high breeding density and polygynous species tend to breed at higher density than polyandrous species.

THE BREEDING BIOLOGY AND BEHAVIOUR OF THE PURPLE SANDPIPER (*CALIDRIS MARITIMA*) IN SVALBARD

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Breeding Purple Sandpipers were studied during 3 summers in two study areas in Svalbard. Two aspects are presented: (1) results on the breeding biology in general, and (2) the roles of the sexes during incubation in particular.

(1) The Purple Sandpiper breeds monogamously; males and females are monotypical, but the females are larger. Males initiated courtship and defended territories from other males. Nests were laid over a 5 week period and occurred in very low densities (1–4 nests/km²). The clutch size was always 4, which in total, averaged almost 70% of the laying females weight. Contrary to previous belief, male and females incubation times were approximately equal, when summed for each nest over the entire incubation period. Incubation shifts were extremely long, averaging 17 hours, and birds were almost never absent from the nest. Broods were almost always attended only by the male at least until they fledged (21–24 days of age).

(2) During the first half of the incubation period, males increased their incubation effort from less than 10% to over 50% of the time. Males also incubated significantly less during the day than at night in the first and second weeks. In literature, it has been postulated that male shorebirds incubate more at night because of either food availability, energetic costs of incubation or predation pressure variations with the time of day. None of these were accepted as an explanation for the observed pattern in this study. Instead, I conclude that male incubation effort was low during early incubation because of the time spent

in territorial activity and, possibly, extra-pair copulation (EPC) attempts and time spent foraging. Males increased their incubation effort with time because the territorial activity and chances of obtaining EPCs decreased with time. Also, the females could have increased time spent foraging to rebuild reserves for possible re-laying or early departure, while also increasing the males investment in the nest. Males incubated mostly at night probably because territorial activity and EPC attempts took place mainly during the day.

ESTIMATING CHICK SURVIVAL RATE IN THE PURPLE SANDPIPER (*CALIDRIS MARITIMA*) USING A NEW METHOD

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In shorebirds, estimates of chick survival are rare. A few studies, however, have obtained survival estimates by following individual broods from hatching to fledging. The problem with this method is that sample size will necessarily be small and following broods may affect their survival rate. Another method, used by Graul (1975) estimates chick mortality from hatching to fledging by taking the average brood size of newly fledged chicks as a percent of that of newly hatched chicks. However, the averages will depend on sample size and how many age groups are considered. Moreover, this method will not give the rate of survival, or, at what age chicks are most likely to suffer mortality. Estimating the chick survival rate is important for understanding the selection pressures operating on the parents.

I studied the survival rate of Purple Sandpiper chicks in Svalbard, Norway. Re-sightings were obtained in only 14 broods. However, a total of 64 broods were captured. Based upon the brood sizes and ages, I developed a mathematical model in order to estimate the probability of survival from hatching to each age category chosen. The product of the probabilities in all age categories gave survival to fledging. This method allows data from single captures of broods to be used, which increases sample size, and the rate of survival can be estimated to any age (i.e. does not assume constant mortality). In addition, data on total brood loss can be incorporated into any age category. It is important to emphasise that obtaining total brood loss data is a difficult field problem. In this study, I obtained the percent total brood loss by recording the number of broods absent from the mudflats to which juveniles flocked upon fledging. The model showed that there was no trend for the probability of survival to increase with age, and 35% of the chicks survived to 35 days old. In addition, the standard errors indicated that estimates of survival to young ages were most accurate while estimates to i.e. fledging had a large SE. Importantly, given a data set such as the one obtained in my study, which perhaps can be obtained for other species as well, it is possible to estimate chick survival rates without having to follow individual broods.



MASS AND TIME DEPENDENT COMPATABILITY OF BREEDING PLUMAGE COMPLETION AND REFUELLING IN A LONG-DISTANCE MIGRANT: ARE RED BREASTS HONEST SIGNALS OF MIGRATORY QUALITY IN BAR-TAILED GODWITS?

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Bar-tailed Godwits (*Limosa lapponica*) show a partial moult of contour feathers before flying to their subarctic breeding grounds. This moult starts in February on the West African wintering grounds, is suspended in late April before the flight to the staging sites in Western Europe and is continued by more than half of the birds during their stage in May in the Dutch Wadden Sea.

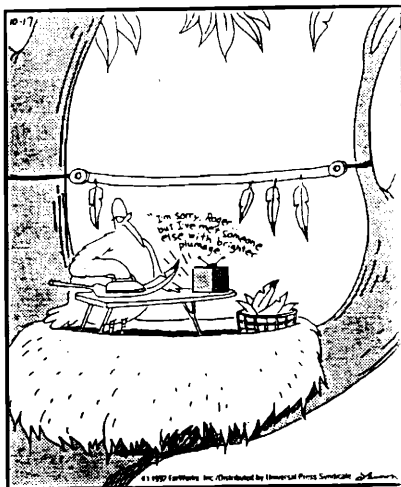
During moult the appearance of the plumage changes from a dull grey in a winter plumage to an intense rusty red in birds with a complete breeding plumage. The total mass of the plumage remains the same. Moult is scheduled earlier and is more intense in males than in females.

The duration of contour feather growth on the Dutch staging area is estimated to be 12 days, leading to an estimated daily dry feather production of 1.11–1.53 g/d. On the Dutch staging area moulting individuals of either sex had a more complete breeding plumage than nonmoulting birds and were always heavier. Very few birds started moult in the last 12 days before northward departure, indicating that time provides a critical constraint on the occurrence of moult. Although the extra costs of moult are estimated at only 7% of the costs of the simultaneous energy storage, the sited related difference in the mass of moulting individuals suggests that the decision to moult depends also on nutritional factors.

We argue that in view of the tight time/energy schedules faced by these long-distance migrant godwits, only individuals which have sufficient energy/nutrient reserves for the time of the year due to a better feeding or flying performance, can afford to upgrade their plumage on the staging areas. The extent and quality of the breeding plumage could thus provide males as well as females with an indicator of the migratory quality of potential mates.

By Gary Larson

THE FAR SIDE



FACTORS AFFECTING SITE SELECTION BY SWANS IN WINTER

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The distribution of Bewicks Swans (*Cygnus c. bewickii*), Whooper Swans (*Cygnus cygnus*) and Mute Swans (*Cygnus olor*) in Britain and Ireland was recorded at monthly intervals during the 1990–91 winter. The swans in Britain and Northern Ireland were counted mainly at sites included in the National Waterfowl Counts Scheme; additional information for sites in the Irish Republic was collected by the Irish Wildlife Service. The total number of each species present, the number of cygnets in the flock and brood sizes were recorded at each site. Additional information was recorded concerning the type of habitat being used by the birds, including the predominant crop being eaten by the swans, if known.

This paper considers whether there is a significant difference in the types of habitats selected by each of the swan species during the winter season, with a view to determining any changes in their food preferences in relation to food availability. Changes in the distribution of the family parties, which are usually the dominant social units within the wintering flock, are analysed in detail to determine whether a disproportionate number of families tend to occur in the best feeding areas. Changes in the distribution of families, and of the population as a whole, during the winter is also considered in relation to the routes taken by the migratory Bewick's and Whooper Swans.

THE ECOLOGY OF TEAL AND PINTAIL IN AN ESTUARINE ENVIRONMENT

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After two winters of study, the usage made of the Mersey Estuary by internationally important Teal and Pintail populations was still uncertain. To determine their movements and preferred feeding sites, Teal and Pintail were radio-tracked over the 1990/91 and 1991/92 winters.

Teal were caught at three different sites and the three "populations" seemed discrete, using different parts of the estuary. The Teal were never found outside the immediate vicinity of the Mersey. Teal used channels in the estuarine saltmarsh more at high tide, when some would feed by following the line of the rising tide. On spring tides some Teal fed on the flooded saltmarshes. Teal distributed themselves similarly during the day and at night, except for the extensive night time use that they made of a nearby, man-made sludge pool rich in plant seeds. This artificial site, though small in area and not created for birds, was used very heavily until it froze over. During cold weather, Teal sheltered in saltmarsh.

Radio-tagged Pintail were never tracked away from the Mersey Estuary. Saltmarsh was used

mainly at high tide, but usually the majority of birds were found on estuarine mudflats. Saltmarsh was also used more during the day than at night and it is speculated that this may have been in response to disturbance.

Radio-tracking showed that the estuary and its mudflats were essential feeding grounds for the large populations of Teal and Pintail recorded on the Mersey. Sampling the invertebrates and seeds of the Mersey revealed very few seeds on the mudflats but high invertebrate densities. Similarly, channels in the saltmarsh held more invertebrates than seeds. Both of the duck species were very dependent on an invertebrate diet. Any changes to the estuary that would lessen the availability of mudflats would be likely to lead to reductions in the populations of Teal and Pintail.

FACTORS AFFECTING WADER USE OF MEDITERRANEAN SALINAS AND RELATED COASTAL HABITATS OF SOUTH EASTERN SPAIN

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Comparative use of salinas and related coastal habitats by waders was investigated in Alicante Province and Murcia Region (South Eastern Spain). Monthly censuses were conducted during a year cycle in operational and derelict salinas and nearby coastal wetlands to determine their use as feeding areas. Information was also collected on the degree of water permanence and food resources were indexed by sampling representative saltpan habitats. In temporarily flooded areas changes in water level and/or percentage area covered by water were also measured or estimated. All environmental information was gathered on a monthly basis.

Comparisons between types of wetlands were made on the basis of wader densities, and local changes in numbers were interpreted taking into account migration patterns, food resources and hydrological regimes. The results agree with the idea, recognised elsewhere, that natural or traditionally managed habitats (e.g. coastal bay and lagoon shorelines, river mouths through littoral barriers etc) that experience aperiodic water level fluctuations can be high quality feeding places for waders in Mediterranean coastal areas. Their contribution to total wader figures is, however, limited by their low surface area, poor predictability of hydrological fluctuations and human disturbance.

In operational salinas, the physical limitation originated by prevailing high water levels can set a limit to their use by waders. Conversely, use of physically attractive shorelines (e.g. natural lagoons managed for salt production) may be prevented by the lack of food organisms brought by extremely saline conditions. In both situations, unpredictable events like floods, wind (exposing wet sediments or concentrating prey organisms), or the development of floating vegetation mats acting like feeding substratum, can play a vital



role in resource availability.

The study of wader numerical response to different hydrological regimes coexisting synchronically in a relatively small area seems useful in the establishment of guidelines for wetland management, particularly in areas formerly exploited by man (e.g. derelict salinas).

EFFECTS OF COASTAL ENGINEERING WORKS IN THE OOSERSCHELDE, S W NETHERLANDS, ON NUMBERS OF NON-BREEDING WATERBIRDS

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Coastal engineering works caused the loss of 33% of the 170 km² of tidal flats in the Ooserschelde estuary, S W Netherlands, in 1982–87. Non-breeding waterbird populations were censused monthly during five years before and three years after the construction of the works.

Waders and ducks displaced from the lost flats did not resettle into the remaining area, and numbers declined in most species. This decline was not a result of changes in the total West European wintering populations, and was most severe for species with a concentrated distribution in the part of the estuary where most habitat loss occurred.

It is concluded that waterbird numbers in the area were (and are) close to carrying capacity, and that ongoing geomorphological changes may further reduce populations.

RESTORATION OF MAN-MADE WETLANDS IN NORTHERN SWEDEN

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Many wetlands, formerly used as water meadows, have recently been transformed to waterfowl habitats by increasing the water level. The rise of water level causes a die-off of the dominating vegetation (*Carex* and *Equisetum*). The decaying vegetation now becomes a substrate and food for many early invertebrate successors in the wetland ecosystem, e.g. *Chironomide* and *Asellus*. The duck populations respond to the improved food conditions by increasing in numbers.

After some years, however, the production of suitable food items for ducks decreases as a result of successive decreasing plant substrate. The paper deals with the problem of how to increase the production once more after such a period of decreasing production. It could be performed by lowering the water level again, thereby allowing the vegetation to increase prior to a repeated raising of the water level. The possibility to utilise timothy and other grasses as an alternative to the natural vegetation, repre-

sented in the seed bank in the bottom layer, is discussed. The utilisation of such different types of substrates by decomposers and other invertebrates is documented in field experiments.

WADER STUDIES AT KOSSUTH UNIVERSITY, DEBRECEN

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The group is interested in two major aspects of shorebird biology: evolutionary biology and conservation. Waders have diverse mating systems and variable parental care, which have been attracting considerable interest among evolutionary biologists. One of the most fascinating questions is how this diversity evolved. In Lapwings (*Vanellus vanellus*) both parents stay with the family throughout the brood care, so most adults end up with biparental care and monogamy. Liker investigates which factors prevent both sexes acquiring more than one mate. The case of the Kentish Plover (*Charadrius alexandrinus*) is different: one parent leaves shortly after hatching, so both sequential polyandry and sequential polygyny can occur. Which parent should leave? Szekely is studying this question by comparing the costs and benefits of males vs females in two behavioural options; (1) deserting and seeking a new mate and (2) staying with the family.

In 1992 three undergraduate projects were launched. (i) Clutch size and egg size of some waders decline throughout the breeding season. Noszaly investigates the factors which cause this reduction. (ii) Plovers, and some other waders as well, cover the egg with nest material before they leave the nest. Various hypotheses have been put forward to explain that behaviour, although predictions of these hypotheses have not been tested. Lengyel is going to study these hypotheses by both observation and experiment. (iii) Predation of clutches may relate to frequency of nest visit. Ablonczy investigates whether this relation exists by performing a field experiment.

The other major interest of the group is in conservation biology. Currently studies are being carried out on the breeding biology of a grassland population of both Lapwings (Liker) and Kentish Plovers (Szekely) and it is the aim to find out whether their reproductive rate is high enough to maintain the population. To increase the hatching success of Kentish Plover, a small enclosure was set up in 1992. Although the enclosure protected the eggs effectively from predators, there was an individual variation on how easily they accepted the enclosure.

In future it is expected to continue the study of both aspects of shorebird biology, but more effort should be made to combine both approaches in addressing specific questions.

WINTERING STRATEGIES OF DUCKS. RELATIONS TO THEIR BREEDING STRATEGIES

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For the last 10 years, several papers put the emphasis on a direct correlation between the body conditions of birds at the end of the winter season and their efficiency during the following breeding season. On the other hand, mostly thanks to the many data on time-budgets of most duck species in winter, the time allocation of activities on the 24 hour cycle reveals a high prevalence of feeding and sleeping behaviour, partly correlated with each other, and a much lower duration of other activities like swimming, preening and displaying. In spite of specific important patterns, the first two activities are almost exclusive at the beginning and at the end of the winter season, the last 3 occurring mostly during the intermediate period (mid-winter).

The concept of winter strategy points out the links between the 3 successive periods: it is an advantage for a given bird to arrive first at a wintering ground, to store reserves rapidly until reaching its maximum weight (1st period) so that it can spare time for displaying and pairing (2nd period) and have, as a paired individual, the best access to food resources at the end of the winter (3rd period). As a consequence, it increases the chances of being in the best physiological condition at the right time before the breeding season and to have the highest efficiency in terms of reproduction.

So some important links appear between the beginning of the winter season and the breeding time: the winter strategy is not only a specific adaptation to the winter time but rather a sum of adaptive mechanisms according to which individuals being the most performant in autumn increase the probability of being the most efficient breeder 10 months later.

PHILOPATRY AND ITS CONSEQUENCES FOR BREEDING LAPWINGS (*VANELLUS VANELLUS*)

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In the last twenty years the Lapwing (*Vanellus vanellus*) has declined in Britain. The decline has not occurred as a result of a reduction in adult or first annual survival rates. Rather, the decline is believed to be associated with a reduction in breeding productivity brought about by the effects of changing land-use and farming practices on the Lapwings breeding habitat.

Lapwing populations in lowland, arable areas have become fragmented and locally extinct whilst in upland areas, where grasslands have been partially improved, the Lapwings fortune has fluctuated. In some areas, breeding densities have remained high despite poor breeding success. Such populations will persist only if: (1) other populations currently produce more than the required number of fledglings to maintain a stable population and there is immigration from these populations; (2) the preferred breeding habitat is actually a population sink, selected despite the likelihood of breeding failure; (3) adults live longer and breed at an earlier age than currently



estimated.

As part of a study to investigate philopatry (the tendency of an individual to breed in the natal area) and breeding site-fidelity in Lapwings, young and adult Lapwings were captured and individually colour marked in two study areas in the north of England. In 1990, 293 near fledged young and 124 adults were individually colour ringed with a further 289 young and 99 adults colour marked in 1991. In addition to the marking programme, breeding density and breeding productivity have been calculated for the main field types.

Return frequencies of adults and young birds have been estimated from re-sightings of colour ringed birds. In 1991, 105 of an estimated 171 surviving first years (first year survival = 60%) were seen within 4 km from where they were born. Of these, 61% bred or held a territory with 16% breeding in the natal field and 47% breeding in the same or an adjacent field to where they bred in 1990. Lapwings are therefore highly philopatric and exhibit a high degree of breeding site-fidelity.

From the return frequencies and dispersal patterns of young and adults and from survival estimates the population dynamics of the Lapwing in each study area is currently being modelled.

COMPARATIVE DIURNAL AND NOCTURNAL FORAGING BEHAVIOUR AND ENERGY INTAKE OF GREY PLOVERS AND WHIMBRELS

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Calculations of the energy budgets of non-breeding waders have frequently been hampered by ignorance of their nocturnal activities. Nocturnal energy intake rates have been estimated by various indirect methods, but few studies have measured actual intake rates.

Using sophisticated night-viewing equipment, we were able to measure the intake rates and other foraging parameters of Whimbrels and Grey Plovers during consecutive day and night low tide periods. Both species foraged visually at night as well as during the day, although Whimbrels are not obligate visual feeders. Their foraging behaviour changed in order to compensate for the reduced visibility and fewer small prey were taken. However, both species were able to achieve net energy intake rates at night similar to daytime rates, and both obtained almost half of their daily energy intake at night during the pre-migratory period.

INDEX NUMBERS FOR WATERBIRD POPULATIONS

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A major problem with generating index numbers for waterbird populations is that the total population size is unknown due to missing counts at

some sites and incomplete counts at others. In this paper we propose a multiplicative model that enables such missing counts to be imputed and assesses the value of incomplete counts.

Each observation is modeled by three factors assumed to be independent: a site factor, a year factor and (if counts are made more frequently than annually) a month factor. The set of year factors provides estimates of the relative importance of sites and the month factors describe migration phenology. Bootstrap methods are used to produce approximate confidence intervals for the index numbers. The paper is illustrated by results from the Bird of Estuaries Enquiry of the British Trust for Ornithology.

OUTER HEBRIDEAN RINGED PLOVERS (*CHARADRIUS HIATICULA*) IN WINTER: FEEDING RATES IN TERRITORIAL AND NON-TERRITORIAL INDIVIDUALS

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Between October 1983 and December 1987, the year round behaviour and ecology of Ringed Plovers were studied on the island of South Uist in the Outer Hebrides, Scotland. In winter major and consistent differences in spacing behaviour between colour-ringed individuals during and between bouts of foraging were observed. Feeding and energy intake rate and time budget comparisons were obtained between adult "free-feeders" (birds which showed no obvious aggression whilst feeding close to other birds) and other adults, especially those which held territories for most of the winter (long-term).

The method used for recording feeding rates involved the estimation not only of the length of worm taken, but also its thickness. Field tests with models showed thickness estimates to be reasonably accurate. This method made estimates of energy intake more accurate and allowed for worm breakage during extraction.

Rates of energy intake (excluding non-feeding time) were consistently higher in long-term territorial than in free-feeders. The nature of the dietary difference varied through the winter, but territorial consistently captured more high quality prey, regardless of site or the springneap cycle. Evidence was obtained that this foraging advantage accrued from avoidance of interference, optimal use of resources (in the case of one bird holding two territories) and resource conservation.

This correlates between the occurrence of territoriality in Ringed Plovers and individual and environmental variables (age, sex, biometrics, plumage, temperature, wind force, topography, food patchiness, etc.); and the net gains of this feeding advantage in relation to overall time budgets in daylight and territorial costs, will be described elsewhere.

MONOGAMY IN WADERS

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Our paper examines aspects of monogamy and its relationship to other mating systems in waders, with an emphasis on Scolopacidae sandpipers and the calidridine sub-family.

Monogamy is taken to be the mating state when males and females have one mate only during the period from copulation to independence of young. Monogamous individuals may employ additional promiscuous tactics whereby extra-pair copulations (EPCs) are sought or solicited. Information on the extent of EPCs in monogamous waders is scant. Limited data on copulation behaviour for several species are presented and these, together with other features of monogamous wader social organisation, suggest that EPCs are probably uncommon.

A low level of promiscuity and mate fidelity are two key components of monogamy. Divorce rates and the duration of mate fidelity vary across monogamous waders, but two groups can be recognised: "annual" monogamists, where mate fidelity is limited to a single breeding season or attempt, and "perennial" monogamists where a pair may stay together for longer. Divorce in perennial monogamists can be viewed largely as a response to breeding success and, probably, the availability of alternative partners, but breeding success seems to play at best a minor role in explaining divorce in annual monogamists. Mate fidelity covaries with site fidelity and it is suggested that annual/perennial mate fidelity differences are governed by site fidelity differences and that site fidelity is dependent on the predictability and quality of breeding resources.

Several hypotheses have been put forward to explain the evolution of monogamy and other mating systems in waders. Three hypotheses are examined using recent reviews and data on social organisation in calidridines: (1) the "breeding resource" hypothesis and the conservative/opportunistic dichotomy between monogamous and polygamous species; (2) the "migration distance" hypothesis and (3) the "attacking ability/body size" hypothesis. Each hypothesis has weaknesses and areas needing further studies are highlighted.

SEASONAL CHANGES IN INTAKE RATE OF GREAT CRESTED GREBES

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Gut contents of more than 1300 Great Crested Grebes (*Podiceps cristatus*), drowned in fishing nets while wintering on Lake IJsselmeer in the Netherlands, were examined on fish prey composition and mass. Because of a constant pellet ejection rate throughout the season, the total amount of fish in the gut represents an index of



the real intake during the day of the fatal diving session. We will call this index the daily intake equivalent.

The reconstructed total prey mass per stomach increased roughly three-fold, from 30 to 90 g, in the course of the wintering period (August–March), except in juvenile birds for which prey weight decreased again from February onwards.

In adult males, adult females and juveniles a significant relation exists between the monthly average air temperature and the daily intake equivalent. Hence, thermostatic costs seem to account for a large part of the variation in their daily intake. Taking the three groups together total prey mass was significantly related to the monthly average air temperature and mean fresh body mass of the birds, together explaining 31% of the total variation. Including monthly average wind velocity increased and explained variation only by 1%. The residual variation could be partly due to body weight changes. Including this variable in the equation, however, did not significantly improve the regression.

An attempt has been made to assess the real total prey mass of the birds. The angle between air temperature and total prey mass should be identical to the total conductance of a free living bird.

We will also discuss the behavioural implications to these findings. Do the Grebes move to better fishing grounds in the course of the winter, thereby achieving a higher daily intake rate, or do they catch bigger fish during the cold months?

STABLE CARBON ISOTOPES AND FEEDING ECOLOGY OF REDHEAD DUCKS

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Variation in the ratio of stable carbon isotopes ($\delta^{13}\text{C}$, expressed in ppt) was examined in tissues from Redheads (*Aythya americana*) collected from two bays within the wintering range in Texas and from wetlands on the breeding grounds in South Dakota.

Mean $\delta^{13}\text{C}$ values from Texas Redheads in winter from Redfish Bay were -12.4 for flight muscle, -13.4 for subcutaneous fat and -10.7 for gizzards. Mean $\delta^{13}\text{C}$ values from Texas Redheads in winter from Baffin Bay were similar (-14.6 for flight muscle, -15.8 for subcutaneous fat and -13.2 for gizzards).

These values for Redhead tissue approach the $\delta^{13}\text{C}$ value (-10.9) of shoalgrass (*Halodule wrightii*), the species of seagrass upon which Redheads are almost totally dependent for food in winter. In contrast, $\delta^{13}\text{C}$ values for breeding Redheads from South Dakota differed sharply (-22.2 for flight muscle, -28.0 for subcutaneous fat and -22.9 for gizzards).

These results indicate that chemistry of stable carbon isotopes can provide a new analytical tool

in the investigation of feeding ecology, nutrient dynamics and habitat use of waterfowl.

ENERGY INTAKE AND RATE OF FATTENING UP IN MIGRATING WHIMBREL

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There is a large variation in the rate of fattening up in waders preparing for long distance flight. When all available studies are taken together, the daily mass increase, expressed as percent increase relative to the tropical winter mass, amounts to, on average, 2% and varies between less than 1% and more than 4%.

In order to investigate the constraints in the rate of fattening up, we studied the feeding ecology of Whimbrels in the premigration period on a winter site (the Banc d'Arguin, Mauritania, in February–April) and on a Dutch stop-over site (NE part of Friesland in April/May). The Whimbrels preyed on crab species in the tidal habitat of the Banc d'Arguin and took leatherjackets in the Dutch inland grassland.

The paper shows that the energy intake depends on the available feeding time, the gross intake rate during feeding and the digestibility of the prey. The rate of fattening up appears to be determined by the daily energy intake.

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Posters

REDUCTION IN AREA SIZE FOR WADERS IN THE WESTERN UKRAINE

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The contemporary avian fauna in the Western Ukraine consists of 330 species, including 38 species of waders, 14 species (36%) of which breed in this territory. For up-to-date wader numbers in the Western Ukraine we used figures from the Atlas of Breeding Birds in the region (field work was carried out from 1982–1986). As well as this we also used census data from the period of 1987–1992.

In the region the range is decreasing for 6 species (*Tringa ochropus*, *T. glareola*, *T. nebularia*, *T. stagnatilis*, *Philomachus pugnax* and *Gallinago media*). As for the other 8 species, we noticed an increase in distribution (most of all *Numerius arquata* and *Limosa limosa*). In general, in the Western Ukraine, over 25000 pairs of waders breed. *Tringa glareola*, *Tringa nebularia* and *Gallinago media* have the most restricted range.

EFFECTS OF LAND RECLAMATION OF THE BREEDING OF COLLARED PRATINCOLES (*GLAREOLA PRATINCOLA*) IN SW SPAIN

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The Collared Pratincoles (*Glareola pratincola*) main breeding population in Europe is in SW Spain in the marshes of the Guadalquivir river. Here, reclamation of more than 70% of the marshland for agricultural purposes has been the most serious hazard for pairs breeding outside the National Park of Doñana (some 2750–3000 pairs in 1990).

In spite of these changes in habitat, Pratincoles keep on breeding in the same places where there used to be marshes. But not all crops allow settlement due to early seeding, fast growth of plants or dense cover at the time of settling. This reduces the arable land where birds can settle mainly to cotton fields and fallow lands.

Hatching success was studied in two colonies located in cotton fields and one in marshland. The percentage of eggs hatched per clutch was much higher ($p=0.000$) in marsh habitats. Clutch losses were due to tractors running over them (51% of all clutches) or nest abandonment after disturbance (14.3% of all clutches). Effects of land use practice on chick survival are discussed.

BREEDING OF *CHARADRIUS ALEXANDRINUS* IN DOBRUDJA, ROMANIA

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In the spring of 1992 we studied 18 nests of Kentish Plover (*Charadrius alexandrinus*) in colony. The nests were among lagoons with brackish water, near to Lake Sinoie. We analysed the clutch size distribution and the relationship between the clutch size and egg size in the nests. We studied the vegetation (composition and covering) in the area of the nest colony.

WINTERING SHOREBIRD DISTRIBUTION RELATED WITH PREY DENSITY IN THE ESTUARY OF RIVER ODIEL

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There have been few studies carried out and consequently, there is little information about the relationships between feeding distribution of waders and their prey distribution in coastal areas of the Iberian Peninsula.

The present work shows the distribution of the principal shorebirds species in the salt marshes of the River Odiel, Southern Spain. The density of prey and distribution of birds are plotted on maps and discussed. Energy requirements and diet of species and their biological adaptations are also discussed.

POPULATION DYNAMICS AND ECOLOGICAL CHARACTERISTICS OF CORMORANT (*PHALACROCORAX CARBO*) IN THE AZOV-BLACK SEA REGION

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For the last 10–15 years impetuous growth of the continental Cormorant (*Phalacrocorax carbo sinensis*) in number, increase of its area and expansion to many new reservoirs have been taking place in coastal areas.

The registrations, carried out by the experts of the Ornithological Station from 1985–1992, showed that the size of Cormorant population increased from 4500 pairs in 1984 to 25248 pairs in 1992. The number of breeding pairs in separate regions has been recorded. Every year Cormorants redistribute among neighbouring colonies in the region depending on the situation and characteristics of a season (water level, condition of food supply, weather conditions, disturbance).

According to location, the type of nest construction and reproduction characteristics, three types of colonies are distinguished: (1) In trees in plavni forests of large river deltas (5% of the total number of nests, 3 colonies), (2) on sea islands and spits (90% of the nests, 21 colonies), and (3) in reed beds in the plavnis of rivers and lagoons (5% of nests, 4 colonies). 20–50 years ago colonies of the first kind predominated.

In new colonies among breeding birds, adult birds (more than 3 years old) comprise 10–15% of the population, two or three year old birds comprise 60–70% and one year old birds 2025%, i.e. formation of new colonies is due to population

reserve. Fertility and reproduction success are high in new colonies. The clutches consisted of 3–10 eggs, on average 3.99 eggs, broods consisted of 2–6 birds, on average 3.0 nestlings, reproduction success was 75–82%; in old colonies these indices are certainly lower. Pressure from Herring Gulls (*Larus argentatus*) in island polyspecific colonies causes simultaneous appearance of large groups of Cormorants in the colonies in spring, a high degree of their nesting synchronisation (75–85%), high hatching success and the formation of very dense micro-colonies consisting of bordering neighbouring nests.

Since 1990, stabilisation of Cormorant population size at a high level has been noticed in the region. This is ensured by increasing of the spectrum of nesting sites (settling of sea islands), by enrichment of food supply (owing to the construction of fish breeding ponds, rice fields, distillation of the Sivash, increase in fish fry, etc), by reduction of human pressure and by repetition of favourable warm-winters. In severe winters a lot of Cormorants migrate to the western, eastern and southern coasts of the Black Sea, 120–1200 km away.

AGRICULTURAL PRESSURE INFLUENCES WADERS ON NW BLACK SEA COAST

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Coastal areas of the North West Black Sea region have been under intensive pressure by man's agricultural activity during the last decades and now vast draining of the marshes, the use of pesticides and other chemical substances together with the development of artificial irrigation systems and cattle breeding are the most serious factors threatening wetlands. As a result of this agricultural pressure, the number of many waders has decreased and some have stopped nesting there.

In the second half of the 19th century, the nesting grounds of *Vanellus spinosus*, *Numenius tenuirostris* and *Vanellus gregaris* (Nazarenko 1980) were destroyed by ploughing, the most characteristic of man's agricultural activities, and the use of the Black Sea and Azov Sea limans caused a decrease in the nesting places of *Numenius arquata*, *Burhinus*, *Glareolidae*, *Himantopus himantopus* and *Recurvirostra avosetta*. It has been reported that *Avocet* have nested only twice in the Odessa region in the last 30 years. Populations of *Glareola pratincola* and *Himantopus himantopus* have sharply decreased in the area between the Danube and Dniester rivers during the last 20–25 years. In 1964–65 about 400 pairs of *Himantopus himantopus*, 500 pairs of *Recurvirostra avosetta* and 3000 pairs of *Glareola pratincola* were nesting in the Soviet part (Kilia Region) of the Danube Delta (Nazarenko) but because of drainage and cattle these have now disappeared. Today there exists a stable number of *Vanellus vanellus*, *Tringa totanus* and some *Charadrius alexandrinus* although the number of Kentish Plover nests have been steadily decreasing over the past 3–5 years in the

Odessa, Kherson and Nikolaev regions.

Changes of biotopes have also caused a decrease in the number of migrating birds such as *Charadrius morinellus*, *Pluvialis apricaria*, *Glareolidae*, *Philomachus pugnax*, *Lymnocyptes minimus*, *Gallinago media*, *Phalaropus lobatus* and some others.

BREEDING BIOLOGY OF LAPWINGS (*VANELLUS VANELLUS*) IN SOUTHERN HUNGARY

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Breeding biology of Lapwings was studied in an alkaline grassland "puszta" in 1990–91. The characteristics of breeding season, the physiognomy of vegetation, clutch size, egg size and the hatching success were investigated.

The vegetation cover was 20–100% and the height of plants was 5–10 cm around the nests. The clutch size was 3.8±0.8mm (breadth) (mean ± SD). The size of egg was smaller than those in the West European populations and similar to the egg size of East European populations. The hatching success was 51.5 and 55.6% in 1990 and 1991 respectively.

The most frequent reason of failure was predations, particularly by birds; Magpies (*Pica pica*), Black-headed Gulls (*Larus ridibundus*), Marsh Harriers (*Circus aeruginosus*) and mammals, egg small mammals and straying dogs have taken a heavy toll.

RESERVOIR AND BIRDS: AN EXAMPLE OF THE KIEV RESERVOIR

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Region of study: the Dnieper valley in the North Ukraine from Kiev to Chernobyl. Period of study: 1962–1963 – preparation of a reservoir bed; 1964–65 – filling; 1966–1985 – the Kiev Reservoir existed before the accident at the Chernobyl nuclear power station.

Mass redistribution of ornithofauna and ecological plasticity on the background of territorial conservatism are the main things in birds life during preparation of future reservoir beds.

Increased concentration of the birds of water marsh ornitho-complex in the upper reservoir is especially typical during the filling of a bed. A shallow island zone is formed here, which is shelter not only for forced out aquatic and shore-birds but for new incoming species. Thus in the upper Kiev reservoir in the first years of its existence there was great congestion, with *Podiceps cristatus*, *Anas platyrhynchos*, *Anas crecca*, *Anas ferina*, *Larus ridibundus*, *Sterna hirundo*, *Sterna albifrons*, *Chlidonias nigra*, *Charadrius dubius*, *Vanellus vanellus*, *Haematopus ostralegus*, *Tringa totanus*, *Limosa limosa* and others being present.



New habitats attracted new nesting species for the region of study; *Larus canus*, *Larus argentatus*, *Larus minutus*, *Xenus cinereus*, *Egretta alba*, *Cygnus olor*, *Panurus biarmicus*, *Fulica atra*, *Aythya fuligula* and *Podiceps nigricollis* which were recorded before now became main species.

In due course complexes of both old and new species broke up. After research proposals for improving conditions for shore and aquatic birds were made. The most reasonable among them are the following: mowing the thick growth; relocation of beavers to conditions suitable for them; planting of fodder grass; making of islands during dredging of navigation channels, of a horseshoe like form or with inner lagoons to neutralise the negative influences of changeable water levels; making of artificial nests made of any material suitable for the water regime. In the course of the experiment 40–60% of the nests were settled by ducks in waterbird colonies.

THE "MONITORING WATER BIRDS BREEDING POPULATIONS BY THE TWO-CHECK METHOD" IN CZECHOSLOVAKIA: SELECTED RESULTS OF FIRST FIVE YEARS

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Studies of the variation in numbers and of the composition of bird fauna in the Czechoslovakian fishponds were initiated in 1988 under the program "Monitoring water birds breeding populations by the two-check method in Czechoslovakia". This program was aimed at obtaining data on the composition of bird fauna on as many ponds in different regions as possible. The results are being used for:

1. studying long-term trends in abundances of particular water bird species
2. assessment of their ecological requirements
3. studying the structure of bird fauna of our fishponds and its variability in different fishpond types and in various parts of Czechoslovakia.

Furthermore, the results obtained can be utilised in faunistics and nature conservation.

In all ponds under study two checks are carried out during each breeding season, one of them in the second part of May and the other one in the second part of June. On each check all adult birds of the species under study were counted during walking around each pond. We assessed numbers of all species of Columbiformes, Podicipediformes, Pelecaniformes, Ciconiiformes, Anseriformes, Ralliformes, Charadriiformes, Lariformes, *Alcedo atthis* and those species of raptors and passeriformes which live in aquatic and marsh habitats.

During a five year study, which was made possible due to the collaboration of about 60 ornithologists, data were obtained from 600 water bodies of the total area about 120 km² in area located in various parts of Czechoslovakia, including three shallow impounded river dam lakes in

southern Moravia (the Nové Mlýny system), totalling approximately 32 km². Since 1991, our program also includes collecting data on the breeding of the particular species under study, i.e. data on clutch size, brood size, breeding success and ecological requirements of the species.

SEX-ROLE REVERSAL AND SEXUAL SELECTION IN THE EURASIAN DOTTEREL (*CHARADRIUS MORINELLUS*)

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The sex roles are reversed in the Eurasian Dotterel (*Charadrius morinellus*); females compete for access to males on a mating arena and are potentially polyandrous whilst males provide all parental care. This study describes the mating system in detail and draws attention to its similarities with the analogous example of lekking in polygynous species.

The potential for, and temporal variation in, sexual selection acting within the study population over two years was studied by observing indices of intra-sexual and inter-sexual display. Intra-sexual plumage variation is prominent in both sexes and it is demonstrated that bright females fight more and win more fights than do dull females. This is not, however, because bright females have an intrinsically higher resource holding potential but because they initiate more fights. Bright females also do more courting than do dull females, and all females prefer to court bright males. Bright females get mates earlier in the season, as, via assortative mating, do bright males. Bright males are in better condition than dull males and bright males are less likely to desert the clutch during periods of prolonged bad weather. This leads to the suggestion that females choose bright males because they are likely to be better parents. Active choice by females for males of high phenotypic quality is, however, contrary to what would be predicted if the mating system of the Dotterel truly represented sex-role reversed lekking.

This poses the question of which parameters need to be considered in order to predict the direction of mate choice. Traditionally it is assumed that the sex with the highest parental investment will be the choosy sex – the Dotterel, however, is an exception to this rule because although the male provides most of the parental care it is the female which is the choosy sex.

Further anomalous species are discussed and a model is introduced which analyses sex differences in both potential rate of reproduction and variation in mate quality. This model is successful in predicting the direction of mate choice in all the previously anomalous cases if the potential reproductive rate of the female is N times greater than the potential reproductive rate of the male then the male will be the choosy sex unless the net benefits of choice to the female are more than N times as great as the net benefits of choice to the male.

FEEDING DISTRIBUTION OF WINTERING WADERS IN CADIZ BAY

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10,000 ha of Cadiz Bay, Southwest Spain, have recently been declared a National Park. Nevertheless, a high human impact has been affecting bird populations for the last ten years.

Principal human activities have been reclamation of intertidal zones for bivalve culture and changing saltpans to fishponds. This human influence has accelerated from 1987 to the present time. The effect of these alterations on the habitat used by waders (Perez-Hurtado & Hortas, 1992) and the importance of Cadiz Bay to wintering populations and migrations (Perez-Hurtado & Hortas, in prep) were the principal reasons for analysing the differences in bird distribution before and after the principal habitat changes in Cadiz Bay. The distribution patterns are discussed in terms of biological adaptations, habitat use and human influence.

THE IMPORTANCE OF CADIZ BAY TO WINTERING SHOREBIRDS IN THE EAST ATLANTIC FLYWAY

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Although there is little knowledge about Cadiz Bay wader populations, recent studies done by the authors show the Bay to be an important wintering area for shorebirds.

The population numbers in winter of 1990/91 were around 25,000 wintering birds and some species such as Black-winged Stilt (*Himantopus himantopus*), Avocet (*Recurvirostra avosetta*), Ringed Plover (*Charadrius hiaticula*), Kentish Plover (*Charadrius alexandrinus*) and Black-tailed Godwit (*Limosa limosa*) were more than 1% of the total Atlantic flyway population. The population size and specific percentages are minimal conditions needed to include Cadiz Bay as a Ramsar area. The aim of this paper is to show data supporting the relative importance of Cadiz Bay as a wintering area and to compare the value of some species numbers in relation to the East Atlantic flyway populations.

SIGNIFICANCE OF THE CHANNEL PART OF THE LOWER AND MIDDLE DANUBE RIVER FOR WATERFOWL DURING THEIR AUTUMN MIGRATION

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The Danube is one of the largest European rivers and is therefore important for waterfowl during breeding, moulting, migration and winter period. The present report focuses on its significance during autumn migration.

Data were collected during the International



Ecological Expedition "The Blue Danube-90", which took place from 14 September to 9 October, 1990. Birds were registered from Vienna to the river mouth by a research craft, a length of over 2000 km, of which a route of 1360 km was investigated. During the observations, species composition, numbers and distribution as well as behaviour were recorded. Over the entire length of the route, the following numbers were recorded: 39,314 Mallards (*Anas platyrhynchos*), 32,176 Cormorants (*Phalacrocorax carbo*), 27,235 Black-headed Gulls (*Larus ridibundus*), 4,755 Herring Gulls (*Larus argentatus*), 3,400 Coots (*Fulica atra*) and hundreds of herons, waders, geese, teals and diving ducks.

Based on bird distribution in the channel part of the river, on species composition and quantity, as well as on the hydrological regime of the valley and the relief, 5 parts of the Danube can be distinguished.

(1) The part of the lower Danube from mouth to the city of Siliistra with a length of 335 km. Investigation was made on 285 km. In the channel part of the river rather low numbers were recorded – 26.7 birds per kilometre of the route. Cormorants (1,925 individuals) and Black-headed Gulls (5,070) were numerous. The low numbers of birds on this part can be explained by the fact that here the river valley is characterised by lakes, marshes, estuaries and ponds, which results in a wide distribution of the birds.

(2) The part of the lower Danube from the city of Siliistra to the hydro-electric station "Ferrous Gates" with a length of 604 km (records were made on 425 km). This area is characterised with the highest quantity of waterfowl in the channel part of the lower and middle Danube (182.1 birds per 1 km of route). The most numerous here were Mallards (30,650 individuals – 78% of all recorded during the expedition), Cormorants (26,011 – 80.8%), Black-headed Gulls (16,900 – 62.1%) and Greylag Goose (*Anser anser*) (500 – 100%). A large variety of species was recorded.

(3) "The Ferrous Gates" – the Danube part, that crosses Katarakty, 100 km in length – from the hydro-electrical station to the river entrance and to the mountain system. The entire length was investigated. This part presents a typical mountain reservoir with profound depths and a full absence of shoals. Therefore, for waterfowl species, there are no suitable areas, which results in a near absence of these birds.

(4) The river head of Jerdap Storage Lake – the calculation was made on a stretch of 20 km from the Danube mouth to the mountain system Katarakty to the city of V. Gradische. Here there are typical conditions of the river head of the plain storage lake: large flood areas, many islands and shoals, which are favourable for the birds living near the water. Only here, out of all parts of the river channel investigated during the expedition, were noted high numbers of Coots (3,400), Mallards (950) and Cormorants (ca 600).

(5) The middle Danube – from the city of Belgrade to the city of Vienna (830 km). Records

were made over a length of 530 km. The number of birds in this part of the river, as a whole, is rather low – 37.5 of birds per 1 km route. The most numerous bird species were the Mallard (7,345) and the Black-headed Gull (5,050). In this part of the river channel we registered the greatest numbers of Herring Gulls (3,320 – 69.8%) of the whole expedition. Relatively numerous were Cormorants (3,640). The quantity of herons, Grey Heron (355) and Great White Egret (102) was rather high.

Summarised, it can be stated that during the autumn migration, the lower and middle Danube valley, in particular its channel part, are of great importance for waterfowl as a place of rest and feeding.

ARTIFICIAL POND USE BY WATERBIRDS IN RELATION TO PHYSIOGNOMY AND WATER QUALITY

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Irrigation ponds are a major feature of agricultural landscapes of semi-arid southeastern Spain. The creation of new intensive agricultural areas supplied by large hydraulic works has caused the density of ponds to increase considerably in a region traditionally devoid of water resources and consequently lacking large palustrine areas. Artificial ponds allow waterbird species to expand their ranges outside coastal wetlands and inland reservoirs, the sole areas formerly occupied.

The use by waterbirds of these new habitats for breeding was investigated in Murcia Region, a priority area for irrigated agriculture development in the last decades, and henceforth holding a large number of such man-made waterbodies. The study area was a 5 km wide belt surrounding a natural coastal wetland, the Mar Menor Lagoon. There, ponds were mapped and visited once during two consecutive breeding seasons. Information was collected on area, submerged and emergent vegetation cover, water level, substrate type, shore slope and water origin (including the degree of sewage input, whose treatment is one of the complementary and often the sole function of ponds). All waterbirds were counted and any trace of breeding recorded.

Since all ponds are similar in design and construction, water quality (and particularly sewage input) appears as the main factor explaining total waterbird density, species richness and the use of ponds by waders like the Black-winged Stilt (*Himantopus himantopus*). Conversely, species like *Tachybaptus ruficollis* preferred ponds with at least some submerged or emergent vegetation, required for nest placement, and to which excess nutrient loading can be detrimental. Implications of the results for artificial and natural wetland management, wetland creation and restoration, and waterbird conservation are discussed, with emphasis on the possible use of some species as environmental quality indicators in nearby natural habitats.

REVIEW OF PAPERS ABOUT WATERFOWL FEEDING PRESENTED AT ALL-UNION SEMINAR "MODERN STATUS OF THE WATERFOWL RESOURCES". MOSCOW, 20-23 OCTOBER 1984

Jevgeni Shergalin, Menzbier Ornithological Society, Lauteri 1-48, Tallinn, EE0001, Estonia

Mineev, Yu. N. Ducks feeding peculiarities in Bol'shezemel'skaya tundra. Proportions of Trichoptera, Chironomides, molluscs, other invertebrates, seeds and veget. parts of plants and detritus in feeding of Teal, Wigeon, Pintail, Garganey, King Eider, Scaup, Velvet and Common Scoter and Long-tailed Duck are given in Table.

Kurilovich, L. Ya. & Tarkhanova, M. A. Feeding peculiarities of some diving ducks broods in Kandalaksha Nature Reserve. Specific and age peculiarities in feeding of Velvet Scoter, Goldeneye and Red-breasted Merganser ducklings are considered. Also daily distribution of forage seeking activity of Velvet Scoter and Goldeneye ducklings is also described.

Zinov'ev, V. I. Waterfowl in anthropogenous landscapes. Feeding peculiarities in some waterfowl species on sewage farms in Kalinin (now Tver) vicinity are described. Proportions of water molluscs, water larvae of insects, water insects, seeds of plants and vegetative parts of plants in gizzard of Mallard (n=24), Teal (16), Garganey (7), Pintail (4), Shoveler (5), Wigeon (8), Pochard (6) are given in Table.

Papchenkov, V. G. Vegetative forages of Anatidae, its productivity and stock dynamics on shoals of Kuibyshev water reservoir. Table 1 gives characteristic of generative parts of some macrophytes sprouts (10 species), Table 2 – productivity of generative organs of some macrophytes (7 species), Table 3 – dynamics of seed stocks (5 species) in researching wetlands (kg/dry matter), Table 4 – dynamics of hydrophytes biomass there (6 species) in tn/dry matter.

Kazakov, B. A., Lomadze, N. Kh., Goncharov, V. T. & Minin, V. V. About autumn feeding of Anseriformes in Western Predkavkaz'e (territory to the North of the Caucasus). Table shows composition of the Mallards forage in % in autumn 1979/80/81 on Vesselovskoe water reservoir.

Zhivoglyad, A. F. Fodder plants of wetlands in Volga river and delta and its productivity. Table contains crop capacity of fodder plants (39 species) in different groups of wetland types (in damp state). Crop capacity of spore's seeds (g/m), vegetative parts (kg/m), plants (centre/ha).

Golovach, O. F. Study of autumn feeding of Anatidae on Kievskoe and Kanevskoe water reservoirs.

Lysenko, V. I. Feeding peculiarities and provision of forages in Anseriformes on the SouthEast of the Ukraine. Feeding of geese, White-fronted Goose, Red-breasted Goose, Dabbling Ducks, Mallard and Diving Ducks are shown separately



Frolova, Ye. S. & Drobovtsev, V. I. Role of molluscs in waterfowl feeding in Northern Kazakhstan. Role of molluscs in benthos biomass (g/m) is shown in Table 1, role of molluscs in benthos biomass of lakes in row of watersheds is shown in Table 2.

Andrusenko, N. N. & Andrusenko, Nat. N. To characteristic of Pintail and Mallard feeding on Tengiz Lake. Contents of stomachs in 72 Pintails and 25 Mallards were analysed.

Prokofev, S. M. To waterfowl feeding on lakes of the steppe belt of Khakasia. Contents of 22 stomachs in 6 species in spring and 132 stomachs of 11 species in autumn were analysed.

Avilova, K. V. & Martynovich, N. V. Peculiarities of texture of trophical apparatus in Anseriformes. Ecology-morphological analysis of trophical apparatus in *Anas* and *Branta* species, Swans, Eiders, diving ducks, dabbling ducks, *Aythya* species are considered separately.

NATURAL HABITAT LOSS AND CHANGES IN THE CAMARGUE FROM 1942 TO 1984. WHAT ABOUT THE FUTURE?

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The Camargue is a wetland world famous for its untamed habitats and the symbolic value of some of its landscapes and birds. It benefits from several natural and international measures of protection (National Reserve, Regional Park, Patrimonium List of UNESCO, Ramsar Wetland List, Departmental and Private Reserves). Among its 145,000 ha as a whole, it looks well protected.

Yet a detailed analysis of aerial photographs reveals (Tamisier 1990) big changes in habitats. From 1942 to 1984, 40,000 ha of natural habitats, mostly wetlands, were claimed for agriculture, salt and industry (1,000 ha per year). Today, only 41% of the Camargue's surface (60,000 ha) is still natural, out of which 20,000 ha are actually

protected. The remaining 40,000 ha, all in private properties, are under no protection at all and mostly used for hunting, with deleterious effects on habitats and bird populations. So the wetland loss occurs both in quantitative and qualitative terms.

These changes were the right answer of the landowners to the economical rules. In the present situation there are no longer actual risks of extension of agriculture, salt or industry. The near future relies on the uncontrolled development of hunting and tourism which become the most beneficial activities for private owners. The protection of the remaining natural habitats of the Camargue is linked to our capability in elaborating new strategies: these strategies are based on the fact that protection of nature and short term economy are rather antinomic. They should include that moral bodies (e.g. state, EEC) as well as industrial companies in the context of sponsoring, buy or rent private land for protection and education without immediate profit goal.

An unfaithful Curlew Sandpiper?

A. Paul Martin, John D. Uttley & Les G. Underhill

Martin, A.P., Uttley, J.D. & Underhill, L.G. 1993. An unfaithful Curlew Sandpiper? *Wader Study Group Bull.* 66: 41-42.

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Curlew Sandpipers *Calidris ferruginea* are generally faithful to their non-breeding sites (Elliott *et al.* 1976; Western Cape Wader Study Group (WSWSG) unpubl. data, APM unpubl. data), as are most other wader species (Evans & Townsend 1988). Therefore, the following observation, though not conclusively demonstrating movement between non-breeding sites in subsequent years, is noteworthy.

On 22 February 1985, APM ringed an adult Curlew Sandpiper at the Swartkops estuary (33° 52' S, 25° 37' E), near Port Elizabeth, Cape Province, South Africa, and on 4 September 1987, this bird was recaptured at Khor Dubai (25° 15' N, 55° 19' E), Dubai, United Arab Emirates, on the southeast shore of the Arabian Gulf (Uttley *et al.* 1988). This represents the first movement of a Curlew Sandpiper between southern Africa and the Arabian Gulf, other recoveries being closer to the Great Circle route lying further to the north, through the

Black and Caspian Seas (SAFRING, unpubl. data, Uttley *et al.* 1988). Biometric details taken at the time of ringing and recapture agreed closely (Table 1). Using the means (and standard deviations) for bill-length of Elliott *et al.* (1976) (males 36.8 (1.7) mm, females 40.9 (2.0) mm), the probability that this bird was a male (using the larger bill-length of 37.5 mm) was 0.95.

Compared with average masses in late August and September of 63.9 g in both 1986 ($n=53$) and 1987 ($n=71$) for Curlew Sandpipers caught at Khor Dubai, the retrapped bird, with a mass of 80 g on 4 September, was clearly fattening for migration, preparing to move southwards either after completing moult, or perhaps after suspending moult, say, once the sixth primary had finished growing. Three Curlew Sandpipers which had suspended moult were trapped at Khor Dubai: 14 October 1986, 5⁶⁰⁴, 80 g; 21 September 1987, 5⁶⁰⁴, 86 g; and

