Report of the Dutch-Mauritanian project Banc d'Arguin 1985 - 1986

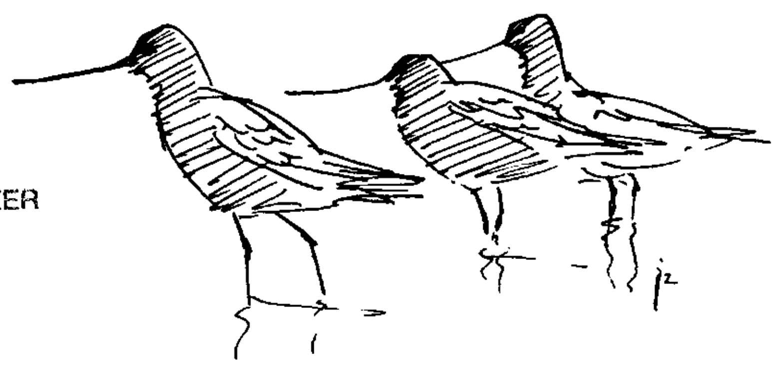
edited by:

Bruno J. Ens

Theunis Piersma

Wim J. Wolff

Leo Zwarts



Parc National du Banc d'Arguin (PNBA)

Dutch Working Group for International Wader- and Waterfowl Research (WIWO)

Research Institute for Nature Management (RIN)

Netherlands Institute for Sea Research (NIOZ)

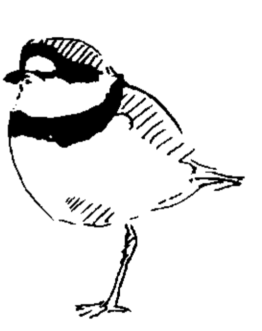
Texel 1989

R.I.N.-RAPPORT /T

DEDICATED

to the memory of our respected friend

Ely ould Elemine



WIWO Rapport 25

RIN-rapport 89/6

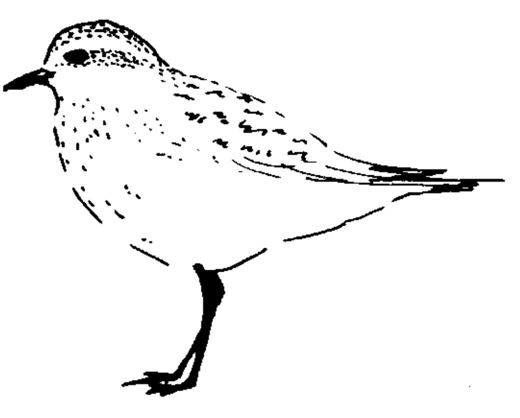
The WIWO report series intends to be a regular medium by which occasional reports of ornithological expedition or journeys can be published. In this way regular distribution and availability are guaranteed. Large quality differences are accepted, since the authors remain responsible.

The RIN reports are a medium to report on research projects by RIN collaborators. The RIN reports have a limited distribution, mainly within The Netherlands.

This report can be ordered by paying Dfl. 35,- on either:
- -postal giro account 2.666.009 or to ABN bank account 57.02.16.613 of Stichting WIWO, Ewijk, The Netherlands, or
- -postal giro account 516 06 48 of Rijksinstituut voor Natuurbeheer, Leersum, The Netherlands.

Postage is included in the price.

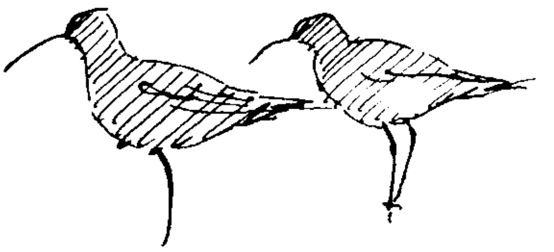
This report is also to be published in French.



COLOPHON

Typing : Michaela Scholl
Figures : Wieberen Planting
Bird drawings: Jos Zwarts

CONTENTS



1. INTRODUCTION

About 7 million coastal waders (Limicoles, Charadrii) migrate annually between vast arctic and subarctic breeding areas and temperate and tropical winter quarters scattered along the eastern shores of the Atlantic Ocean. After a short breeding season in the arctic tundras of NE Canada, Greenland, Iceland, Scandinavia and the northern parts of the USSR these birds arrive at the tidal flats of the Wadden Sea and the estuaries of Great Britain in late summer. After moulting their feathers, some waders stay there to winter but many others migrate further south to spend the winter in SW Europe, West-Africa, and even southern Africa. At least half of the coastal waders using the East Atlantic flyway spend the winter in these African winter quarters (Piersma et al. 1987).

About 1980 it became clear that the tidal flats of the Banc d'Arguin (Fig. 1) in Mauritania were one of the most important wintering areas along the East Atlantic flyway. Over 2 million waders were counted in that region in winter (Trotignon 1980, Altenburg et al. 1982). Remarkably enough food conditions on the Banc d'Arguin appeared to be marginal (Altenburg et al. 1982). Rough calculations based on data collected in February 1980 showed that the total amount of food present would be consumed within two months if no regrowth or resettlement of food organisms would occur. Although some regrowth is likely to occur, it remains to be seen how these birds are able to put on sufficient fat in early spring for their northward migration.

This question - how birds are able to start their spring migration from the Banc d'Arguin in good condition - formed the central theme of the Dutch-Mauritanian project "Banc d'Arguin 1985-86".

To answer this question we have to know how much food is available in spring and especially how much extra food is produced in this period. Secondly we need to know how much food is required by the birds and what is their extra need to put on sufficient fat for the spring migration. Finally we have to know when the birds put on this fat, when they leave and which staging areas they may or have to use.

This is very shortly the programme of the project "Banc d'Arguin 1985-86" developed by the Working Group for International Wader- and

Waterfowl Research (WIWO), the Research Institute for Nature Management (RIN) and the Netherlands Institute for Sea Research (NIOZ). Due to shortage of funds it was not possible to carry out the entire programme

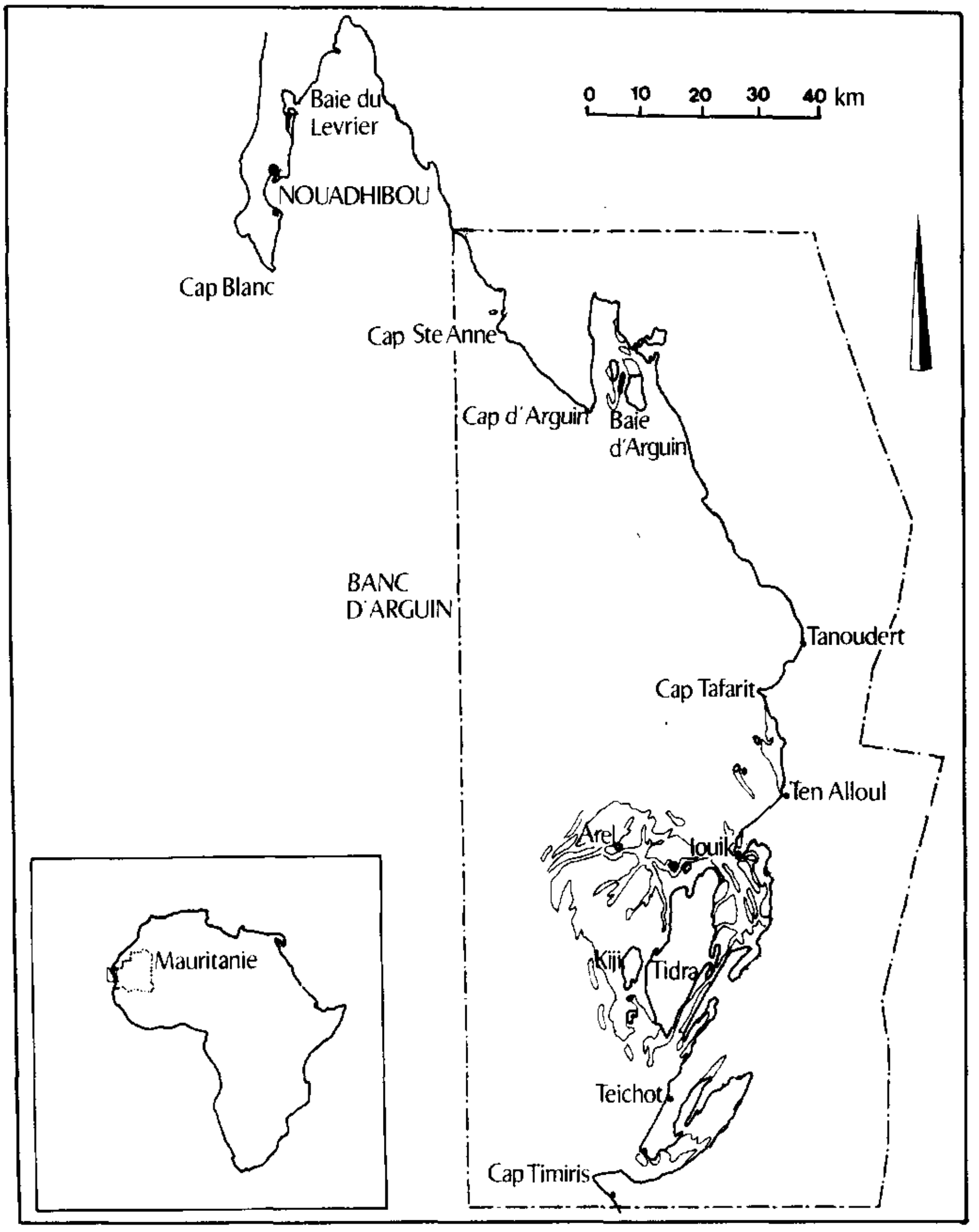


Figure 1.1. Location in Africa and general map of the Banc d'Arguin, Mauritania.

in 1985, as conceived originally. Because the international Wader Study Group had planned an international project to study the movements of waders during spring migration by means of birds with colour marks in the spring of 1985, it was decided to carry out only that part of the project "Banc d'Arguin 1985-86" which supported the international project and to postpone the remainder of the programme to 1986.

From the start of the project it was envisaged that Mauritanian counterparts would take part in the project. Consultation with the Mauritanian authorities resulted in a joint Dutch-Mauritanian project in which on the Mauritanian side the Parc National du Banc d'Arguin and the Directorate for Nature Protection of the Ministry of Rural Development took part.

The aims of the project "Banc d'Arguin 1985-86" were in more detail:

1. Studies on spring migration of waders in relation to feeding condition.

This part of the programme had to lead to a detailed analysis of the origin of waders at the Banc d'Arguin and the timing, patterning and extent of wader migrations from and through Banc d'Arguin in spring, and to an apraisal of the physical changes in the birds themselves which allow them these movements. Information on the fate of the birds after they have left the Banc d'Arguin, had to be gained as a result of these local studies. The research programme to reach these aims consisted of three parts, viz. description of arrival and departure of waders; description of the changes in physical condition of the birds before departure; and description of the routes taken by the waders to reach the breeding grounds and the location of these breeding areas.

2. Studies on the biomass and productivity of the benthic fauna of the tidal flats.

This involved in the first place a general survey of the benthic fauna of the Banc d'Arguin in order to obtain a reference value for the biomass of the entire area. Secondly, growth and production rates of selected invertebrates had to be measured in order to obtain an estimate of benthic productivity. This had to be compared with measurements on biomass removal by predators and other causes, carried out by means of exclosures. Thirdly, it had to be investigated whether invertebrates and small fish migrate with the tides between tidal channels and flats, thus forming an additional source of food for waders which escape the usual methods of low tide sampling.

3. Studies on the feeding behaviour and ecology of waders.

In the first place it had to be determined for as many species of waders as possible what type and size of prey is obtained. Secondly, for one or a few species the food consumption in the field had to be quantified in order to estimate the energetic requirement of the species (daily energy intake). This was combined with data on low-tide feeding densities of waders in order to arrive at an estimate for the consumption at the entire Banc d'Arguin. Thirdly, the extra food intake needed to accumulate migratory fat, had to be determined for birds in captivity. Fourthly, it had to be investigated in wild birds whether fat accumulation prior to migration is due to an increase in foraging effort or an increase in available food.

ACKNOWLEDGEMENTS

The project was supported financially by:

- the Commission of the European Communities (Brussels);
- the National Geographic Society (Washington);
- the Netherlands Ministry of Agriculture and Fisheries (The Hague);
- the Shell Internationale Research Mij (The Hague);
- the Prins Bernhard Fund (Amsterdam);
- the Society for the Protection of Nature Monuments in the Netherlands ("Natuurmonumenten") ('s-Graveland);
- the Netherlands' State Forestry Service ("Staatsbosbeheer") (Utrecht);
- the Fund for Research for Nature Protection (FONA) (Arnhem);
- the British Ornithological Union (London);
- the Bachiene Foundation (Leiden).

The help of the Netherlands' Society for the Protection of the Wadden Sea (Harlingen) in prefinancing the project was invaluable.

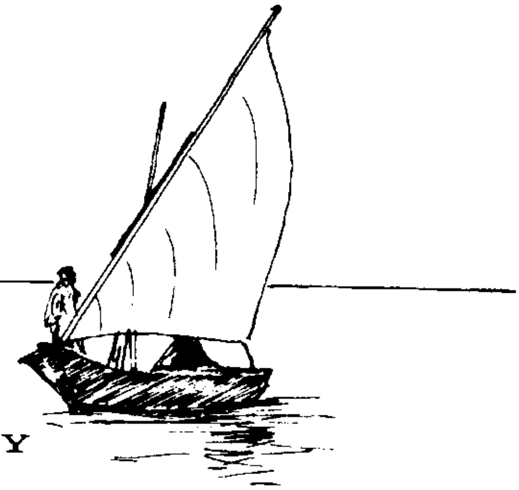
The support of the Mauritanian authorities is gratefully acknowledged. We should like to mention Mr. Gabriel Hatti, Adviser of the Secretary General of the President, Mr. Hadya Amadou Kane, Director of the Directorate for Nature Protection of the Ministry of Rural Development in 1985 and Director of the Parc National du Banc d'Arguin in 1986, Mr. Dah ould Cheikh, Governor of Nouadhibou, Mr. Sy Zakarya dit Sy Kao, Vice-Governor of Nouadhibou, Mr. Mahmoud ould Merzoug, Director of the Directorate for Nature Protection in 1986, and Mr. Abderrahmane Touré, Director of the Parc National du Banc d'Arguin in 1985. We also like to thank José Luis de Torregrosa Garcià of the firm ICOD, the collaborators of the Parc National du Banc d'Arguin, the Campredon family, the Germain family, the "Cooperation de Timiris", and the inhabitants of Iouik and other villages at the Banc d'Arguin.

Material support was given by the Ringing Office of the CRBPO (Musée d'Histoire Naturelle) in Paris, the Bird Migration Centre ("Vogeltrekstation") in Heteren, the Wash Wader Ringing Group, the Royal Netherlands Meteorological Institute (KNMI), the Netherlands' Rijkswaterstaat, the Zoological Laboratory of the University of Groningen, the IJsselmeer Polder Development Authority (RIJP) and numerous relatives and friends.

A special word of thank must go to the many keen fieldworkers who happened to spot waders colour-marked during our expedition, elsewhere in the world. The resightings of these birds have contributed greatly to our knowledge of the migratory routes. The colour-marking registrations were ably administered by Chris Thomas and Dr. Hector Galbraith of the Wader Study Group - Colour-marking register.

During the analysis of the data collected at the Banc d'Arguin we were supported by Dr. Gesa Hartmann-Schröder (Hamburg), Dr. G.C. Cadée (Texel), Rinus Manuels (Texel), Michel Binsbergen (Texel), Drs. J.B. van Biezen (Arnhem), Nienke Bloksma (Groningen), Hew Prendergast (U.K.), Nick C. Davidson (Peterborough), Peter Prokosch (Husum), Denis Bredin (Rochefort), Joop Jukema (Oosterbierum) and many others ...

To all we owe the success of the project!



2. ORGANISATION AND ITINERARY

The project was conceived as a joint Dutch-Mauritanian project. The Mauritanian side was represented by the Parc National du Banc d'Arguin (PNBA) at Nouadhibou and the Directorate for Nature Protection (DPN) of the Ministry of Rural Development at Nouakchott.

Mauritanian participants in the project were:

El Hassane ould Mohammed el Abd, guard of the Biological Station at Iouik (PNBA 1986);
Pierre Campredon, biologist with the PNBA (1985, 1986);
Abou Gueye, head of the Scientific Department of the PNBA (1985, 1986);
Cheikhna ould M'Baré, head of the Dept. of Hunting and Fauna of DPN (1985);

Mohammed M'Bareck ould Soueilem of the Centre National de Recherches Océanographiques et des Pêches (1985) lend his support during a visit of a week to our base camp at Iouik.

At the Dutch side the project was carried out by the Working Group for International Wader- and Waterfowl Research (WIWO), an umbrella organisation for people of different affiliations, the Research Institute for Nature Management (RIN) at Texel and the Netherlands' Institute for Sea Research (NIOZ) at Texel.

Dutch participants in the project were:

Nelly van Brederode: ornithologist and medical dc or at Groningen University (WIWO 1985);
Anne-Marie Blomert: biologist at Groningen University (WIWO 1986);
Sjoerd Dirksen: biologist at Groninger University (WIWO 1986);
Piet Duiven: biological assistant at NIOZ (1985, 1986);
Bruno Ens: biologist at Groningen University (WIWO 1985);
Peter Esselink: biologist at Groningen University (WIWO 1986);
Mark Fletcher: biologist at the Ministry of Agriculture, Food and Fisheries, Great Britain (WIWO 1985);

Roelof Hupkes: biologist at Groningen University (WIWO 1986)
Jan van de Kam: photographer (WIWO 1985, 1986);
Marcel Kersten: biologist at Groningen University (WIWO 1985);
Marcel Klaassen: graduate student at Groningen University (WIWO 1986);
André Meijboom: biological assistant at RIN (1986);
Gerard Moerland: graduate student at RIN (1986);
Theunis Piersma: biologist at Groningen University (WIWO 1985);
Cor Smit: biologist at RIN (1985, 1986);
Tom van Spanje: ornithologist and general coordinator of the project (WIWO 1985, 1986);
Kees Swennen: biologist at NIOZ (1986);
Jaap de Vlas: biologist at the Netherlands Ministry of Agriculture and Fisheries (RIN 1986);
Wim Wolff: biologist at RIN (1986);
Koos Zegers: biological assistent at RIN (1986);
Leo Zwarts: biologist at IJsselmeer Polders Development Authority (WIWO 1986).

The expedition office and secretariat were held by RIN, where Mrs Veronica de Wit spent much time on preparation and coordination until 1986, whereafter Ms. Michaela Scholl was involved in remaining work. RIN also made the services of its workshop available.

Mr. Ekko Smith and Mr. Meinte Engelmoer (WIWO) handled all financial matters, whereas Dr. Gerard Boere (WIWO) acted as a general adviser.

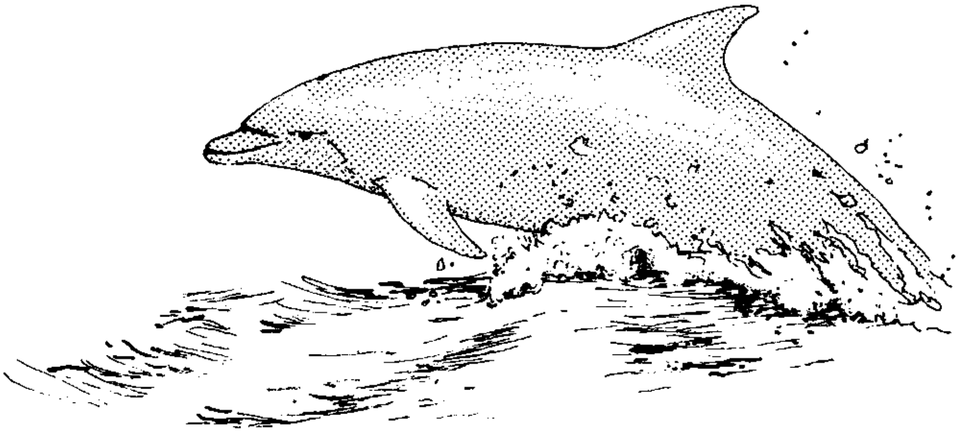
Itinerary

9 - 23 December 1984	: Tom van Spanje, general coordinator of the project pays a preparatory visit to Mauritania.
10 March 1985	: Arrival of Nelly van Brederode, Piet Duiven, Bruno Ens, Mark Fletcher, Jan van de Kam, Cheikhna ould M'Baré, Theunis Piersma, Cor Smit and Tom van Spanje in Nouadhibou.
11 - 19 March 1985	: Preparations for stay at Iouik in Nouadhibou.
20 - 21 March 1985	: Voyage to Iouik by two fishing boats and one Landrover; the night was spent at Ten Alloul.

22 March - 30 April 1985	: Stay in Iouik, where Abou Gueye was already present.
20 april 1985	: Departure of Mark Fletcher.
27 april 1985	: Departure of Nelly van Brederode, Piet Duiven and Marcel Kersten.
1 - 5 May 1985	: Return voyage to Nouadhibou; arrangements for departure from Nouadhibou and departure of all project participants except Abou Gueye and Tom van Spanje.
13 -14 May 1985	: Return voyage of Tom van Spanje.
November 1985	: Visit of Abou Gueye and Cheikhna ould M'Baré to the Netherlands for training in data analysis.

19 January 1986	: Arrival of Tom van Spanje, general coordinator of the project, in Nouadhibou.
2 February 1986	: Arrival of Anne-Marie Blomert, Sjoerd Dirksen, Peter Esselink, Roelof Hupkes, Jan van de Kam, Marcel Klaassen, André Meijboom, Cor Smit, Kees Swennen en Wim Wolff in Nouadhibou. Introduction of Abou Gueye, Mauritanian counterpart.
3 - 4 February 1986	: Unloading of equipment from containers and preparations for stay at Iouik.
5 - 6 February 1986	: Voyage to Iouik by three fishing vessels.
6 - 9 February 1986	: Welcome by El Hassane ould Mohammed el Abd, one of the Mauritanian counterparts. Construction of camp at Iouik. Arrival of Pierre Campredon.
6 February 1986	: Departure of Marcel Klaassen.
11 February 1986	: Arrival of Leo Zwarts.
21-27 February 1986	: Fieldwork in the southern part of the Parc National du Banc d'Arguin by Abou Gueye, Peter Esselink, Jan van de Kam, André Meijboom and Wim Wolff.
2 - 3 March 1986	: First change of personnel. Peter Esselink, Jan van de Kam, Cor Smit, Kees Swennen and Wim Wolff leave and Piet Duiven, Marcel Klaassen, Gerard Moerland and Jaap de Vlas arrive.

30 - 31 March 1986	: Second change of personnel. Sjoerd Dirksen, André Meijboom and Jaap de Vlas leave and Cor Smit, Wim Wolff and Koos Zegers arrive.
9 April 1986	: Departure of Leo Zwarts.
21 - 23 April 1986	: Preparations for departure. Dismantling of the camp at Iouik.
24 - 25 April 1986	: Return voyage to Nouadhibou by two local fishing vessels. The night was spent at the Ile d'Arguin.
26 - 27 April 1986	: Loading of equipment into transport container. Final arrangements and courtesy visits in Nouadhibou.
28 April 1986	: Departure of all remaining Dutch participants except for Piet Duiven and Tom van Spanje.
1 May 1986	: Departure of Piet Duiven.
15 May 1986	: Conclusion of the project in Mauritania by Tom van Spanje.
9 September - 4 October 1986	: Visit of Abou Gueye and Mr. Mamadou Alassane Sall to RIN at Texel for training in data analysis.
22-26 September 1986	: Visit of Mr. Kane Hadya to the Netherlands.



3. METEOROLOGICAL MEASUREMENTS

Cor J. Smit, Anne-Marie Blomert & Leo Zwarts

3.1 Introduction

In order to measure the conditions birds encounter when staying at the Banc d'Arguin, registrations of the most important weather parameters were made. We used stamped equipment, set to our disposal by the Royal Netherlands Meteorological Institute (KNMI) at De Bilt, The Netherlands. The following measurements were taken:

- temperature at 10 cm and 150 cm height;
- atmospheric pressure;

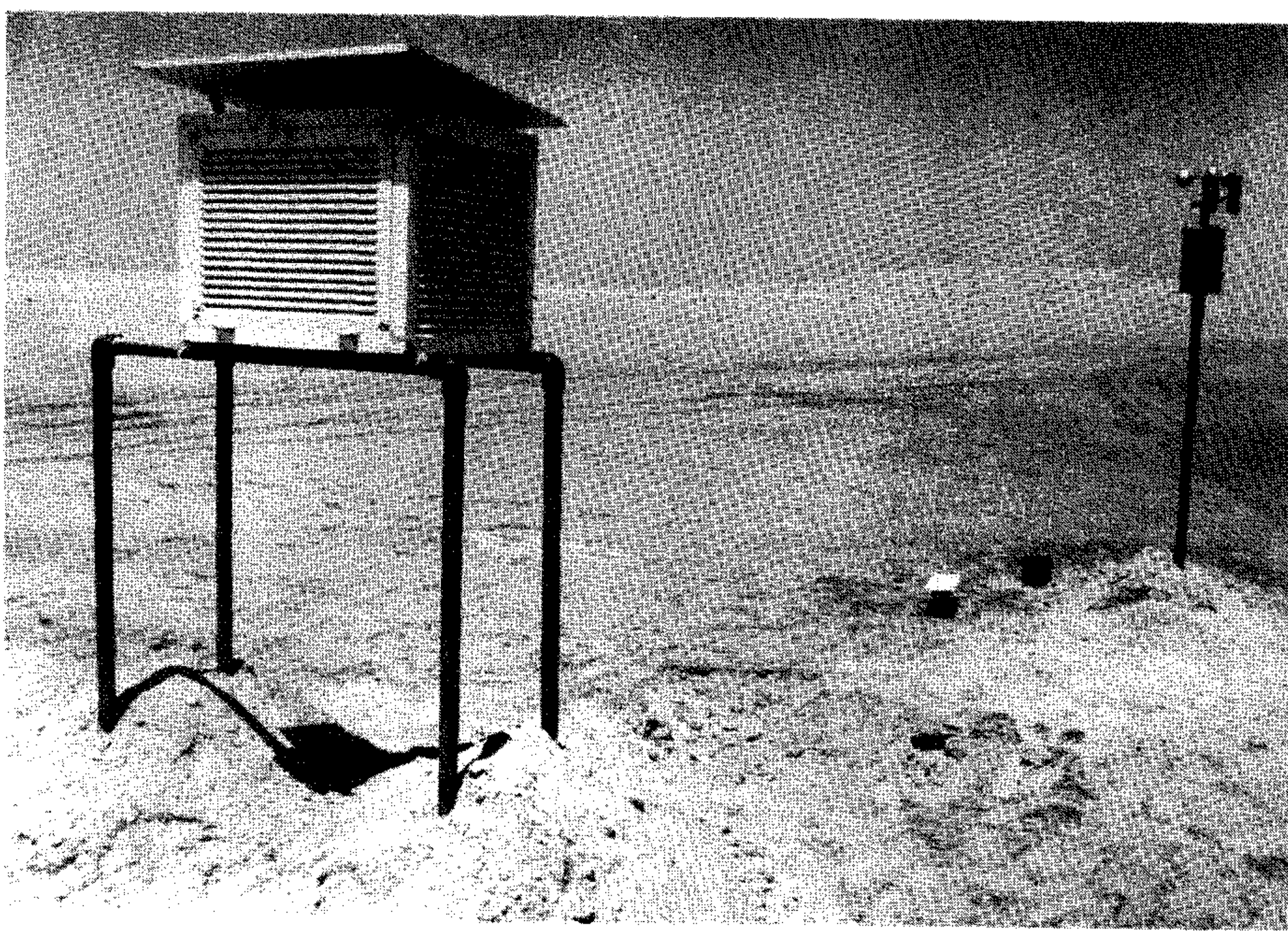


Figure 3.1. The weather station at the Iouik camp, as it was used in 1985 and 1986. From left to right: the weather box at 150 cm, holding minimum and maximum thermometers, thermograph, barograph and hydrograph, the 10 cm thermometers stand, precipition meter and wind meter.

- relative humidity;
- wind force and direction;
- precipitation.

3.2 Methods

The set-up of the Iouik weather station is shown in figure 3.1 Temperatures were measured under standard conditions at 10 and 150 cm, using a stand and weather box respectively. In both situations the equipment was protected against direct radiation from the sun. Temperature registrations at 10 cm were made using minimum and maximum thermometers allowing for an accuracy of 0.1°C. Temperatures at 150 cm were measured using comparable thermometers but were also registered continuously with a Fuess thermograph. Registrations of the latter instrument were read every hour, with an accuracy of full degrees Celsius.

Atmospheric pressure was measured continuously at 150 cm height in a standard weather box, using a Fuess barograph. Registrations were read every hour with an accuracy of full mbar.

Relative humidity was measured continuously at 150 cm height in a standard weather box, using a Fuess hygrograph. Registrations were read every hour with an accuracy of full %.

Windforce and direction were measured continuously at about 2 m height, using a Lambrecht wind meter at a site about 10 m from the camp. As a result of favourable wind directions, no turbulence could occur due to the presence of the camp. Wind direction was registered continuously too. Both types of registrations were read every hour. Wind direction was classified as one out of 8 categories (W, NW, N, NE, E, SE, S, SW).

Precipitation was measured using a standard precipitation meter on a stand. Due to sand and dust storms the meter had to be cleaned regularly.

All instruments sustained the harsh climatic situation at the Banc d'Arguin in a good way. Some slight and unimportant failures were due to inexperience in handling the equipment. After return in the Netherlands hourly measurements were stored into the VAX/VMS computer of the Research Institute for Nature Management. Results were calculated using Genstat statistical programmes. Most results were analyzed in two ways:
- a calculation of maximum, mean and minimum values over 24 hours, for the whole observation period at the Banc d'Arguin. Mean values were calculated using all 24 hourly data;

- a calculation of mean values per hour over several periods. For 1985 these were chosen more or less arbitrary. Periods were 24 March-8 April, 9-17 April and 18-29 April. For 1986 mean values were calculated for 10-day periods, except for the start and the end of the observation period.

For several meteorological parameters attempts are made to compare the results of the registrations at the Iouik camp with data from permanent registrations of Nouadhibou Airport. These data were liberally set at our disposal by Messrs. Ahmedou O. Abdallah and Georges Joseph (Agence pour la Sécurité de la Navigation Aerienne en Afrique et à Madagascar - ASECNA).

3.3 Results

3.3.1 Temperature

Figures 3.2 and 3.3 show maximum, mean and minimum temperatures for the 1985 and 1986 registration periods respectively. Figure 3.2 shows a gradual but striking decrease in mean temperatures in the course of the 1985 season.

Figure 3.4, showing mean temperatures over 3 registration periods in 1985, demonstrates that the decrease in mean values is mainly due to a dramatic drop in temperatures between 9 a.m. and 7 p.m. in the second and third registration period. Minimum temperature vary between 15^{o}C and 20^{o}C, both at 10 and 150 cm height, and remain fairly stable in the course of time. Figures 3.3, 3.5 and 3.6, showing the 1986 pattern, demonstrate a gradual decrease in temperatures in the early part of the registration period, again as a result of dropping temperatures during mid-day. From early March onwards a slow increase in mean temperatures can be noted, especially due to increasing minimum temperatures. For 1986 especially the relatively low minimum temperatures in February are striking.

A comparison of maximum and minimum temperatures at 10 and 150 cm shows that maximum levels at 10 cm generally exceed the levels measured at 150 cm by up to 5^{o}C. High ground temperatures are mainly due to reflection of heat from the soil. Minimum temperatures at 10 cm generally are only slightly under those measured at 150 cm.

3.3.2 Atmospheric pressure

Data on atmospheric pressure for 1985 showed a systematic difference

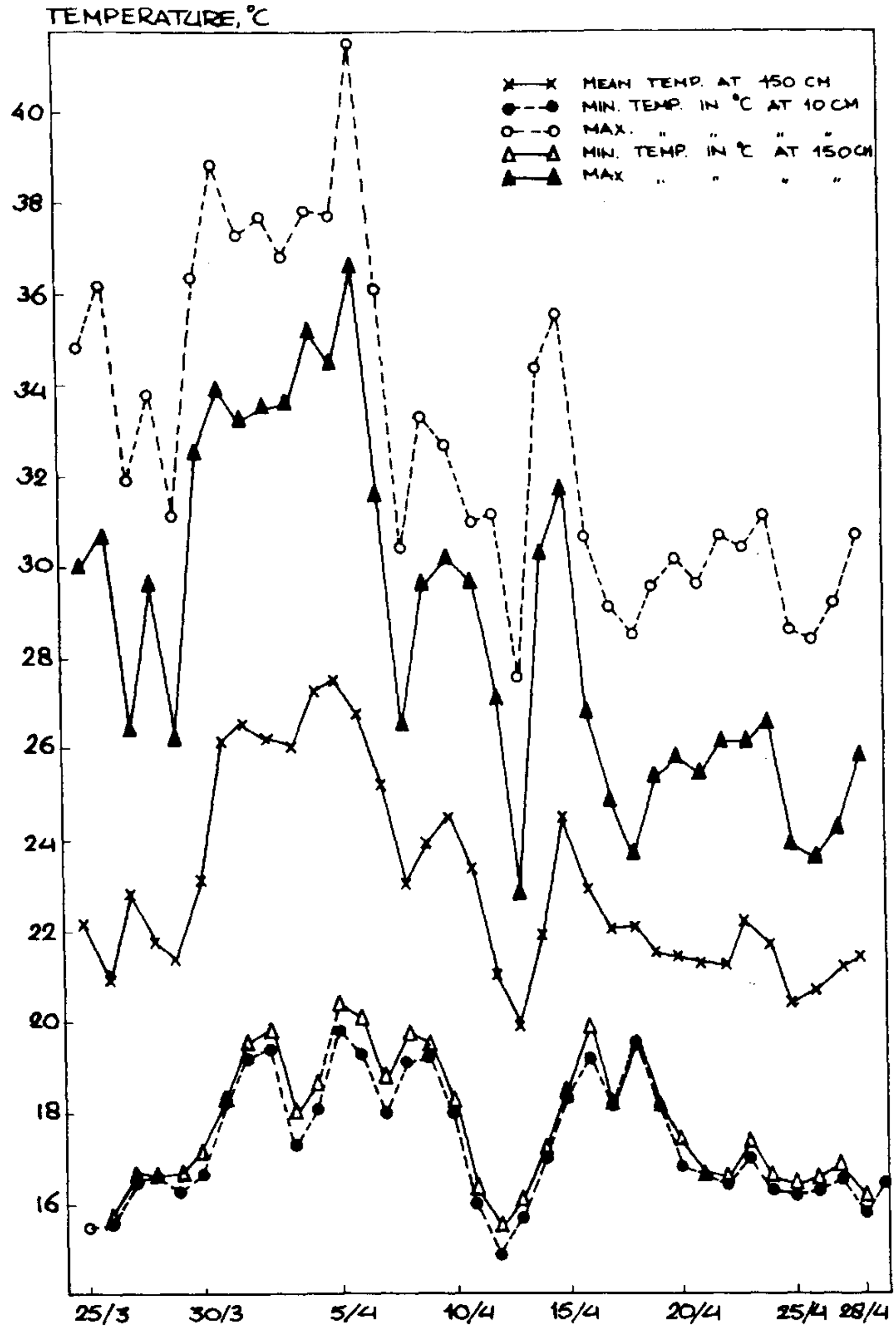


Figure 3.2. Minimum and maximum temperatures for each day at 10 and 150 cm height and mean temperatures calculated over 24 hourly registrations at 150 cm at the Iouik camp in 1985.

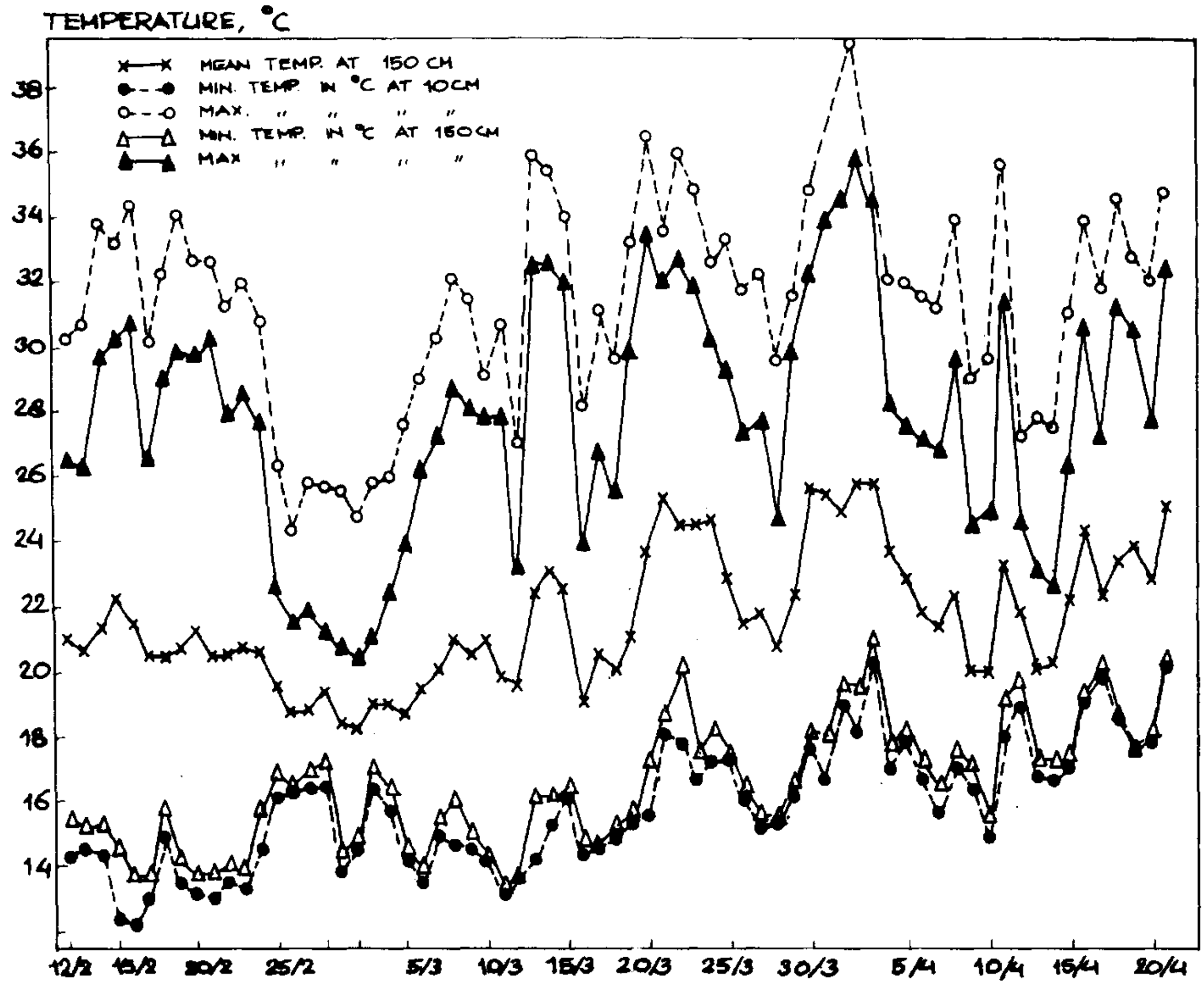


Figure 3.3. Minimum and maximum temperatures for each day at 10 and 150 cm height and mean temperatures calculated over 24 hourly registrations at 150 cm at the Iouik camp in 1986.

compared to those in 1986 and to international weather maps for the 1985 observation period. Apparently the barograph which was used was not functioning properly, possibly as a result of damage due to transportation of the equipment. It appeared impossible to correct for these differences and for this reason the results have not been included in this report. As far as the 1985 data can be used, we see rather regular fluctuations in air pressure, however with a very obvious increase from 10-13 April 1985. The 1986 data, depicted in figures 3.7, 3.8 and 3.9 show a rather constant mean pressure of about 1017 mbar, gradually decreasing towards the end of the observation period. There is a very obvious dip in pressure levels from 22-28 February 1986, which

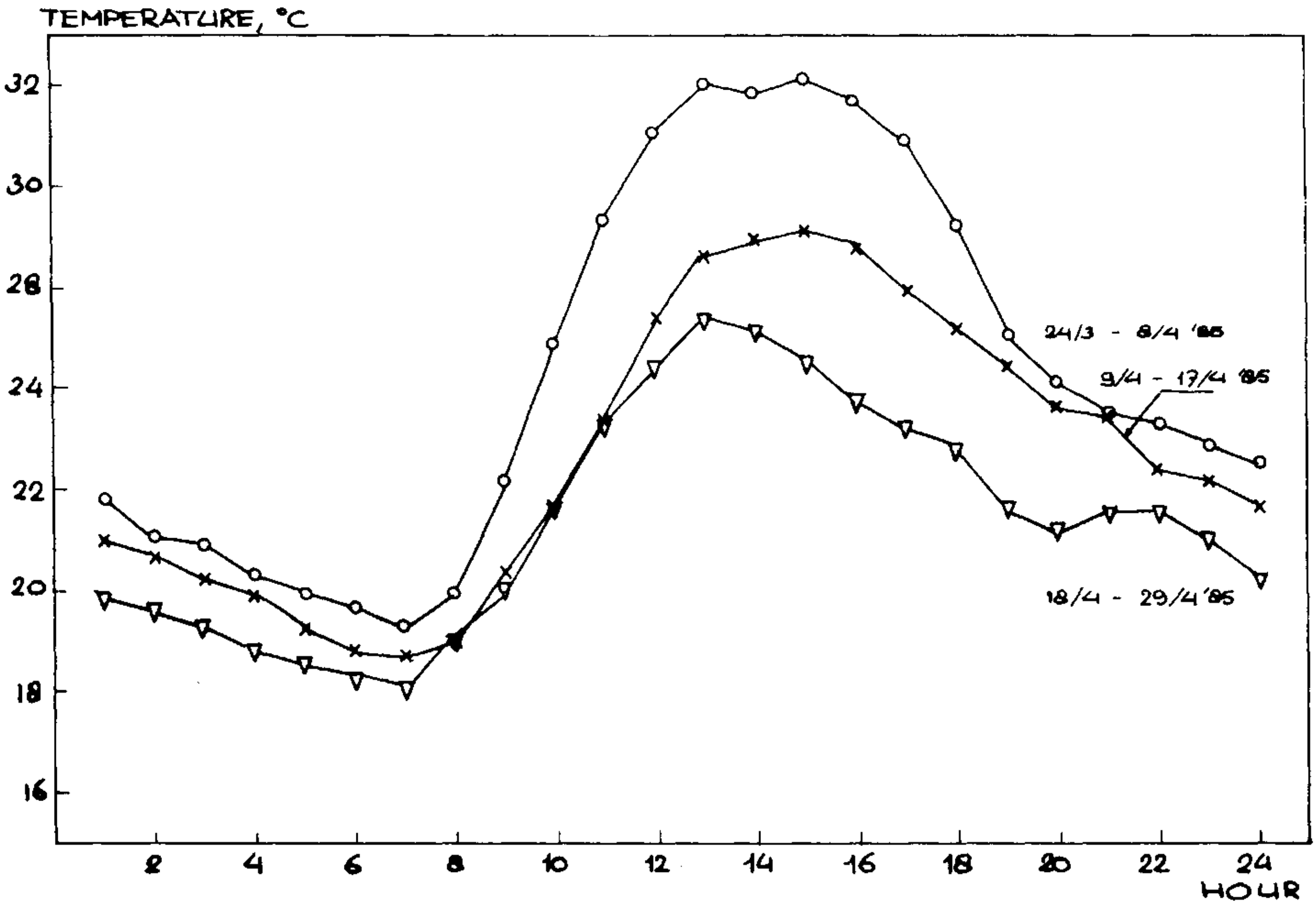


Figure 3.4. Mean temperatures (°C) per hour over three observation periods at 150 cm in 1985.

will be discussed later on in this chapter (3.5.1). Pressure levels in the course of the day show a highly identical pattern for all decades, with a high pressure level by the end of the morning and low pressure by the end of the afternoon. This diurnal pattern of atmospheric pressure is comparable for the situation met in Northwest Europe, through the difference in high and low pressure is somewhat larger, probably due to the more intense heating up of the atmosphere. This diurnal pattern has little in common with the weather situation itself. It is mainly caused by the attracting forces of sun and moon.

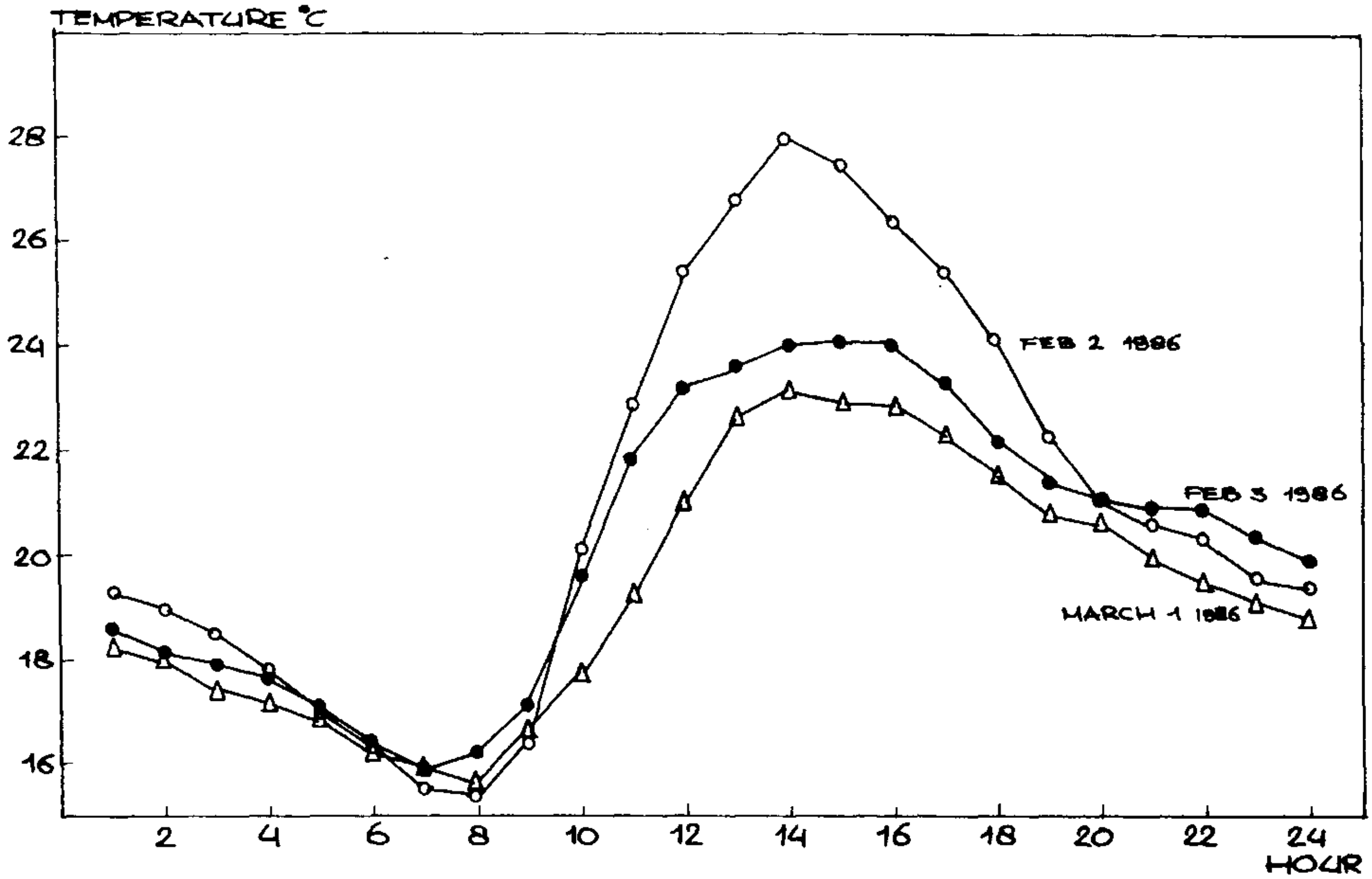


Figure 3.5. Mean temperatures (°C) per hour over three decades (12 February-9 March) at 150 cm in 1986.

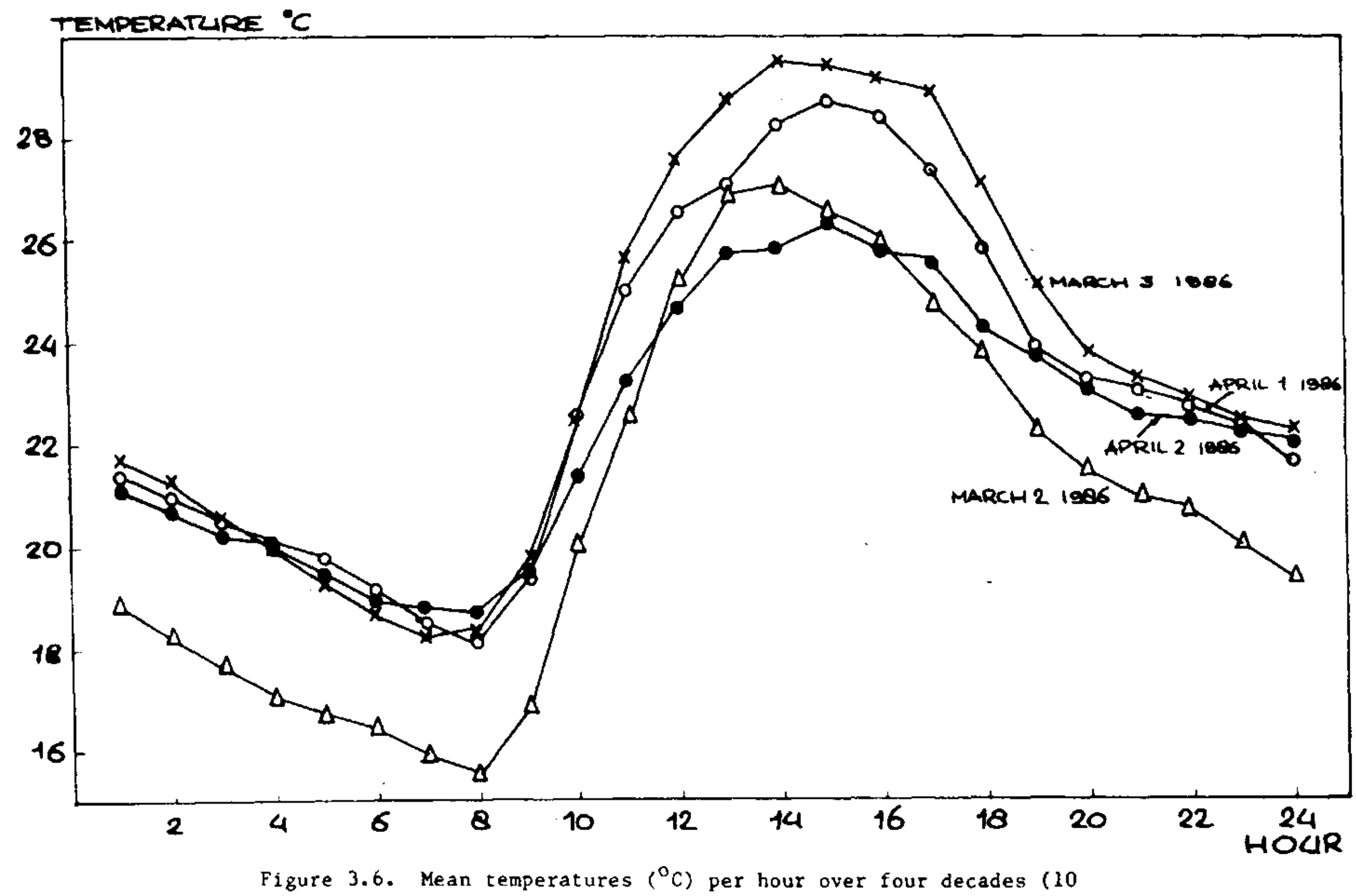


Figure 3.6. Mean temperatures (°C) per hour over four decades (10 March-21 April) at 150 cm in 1986.

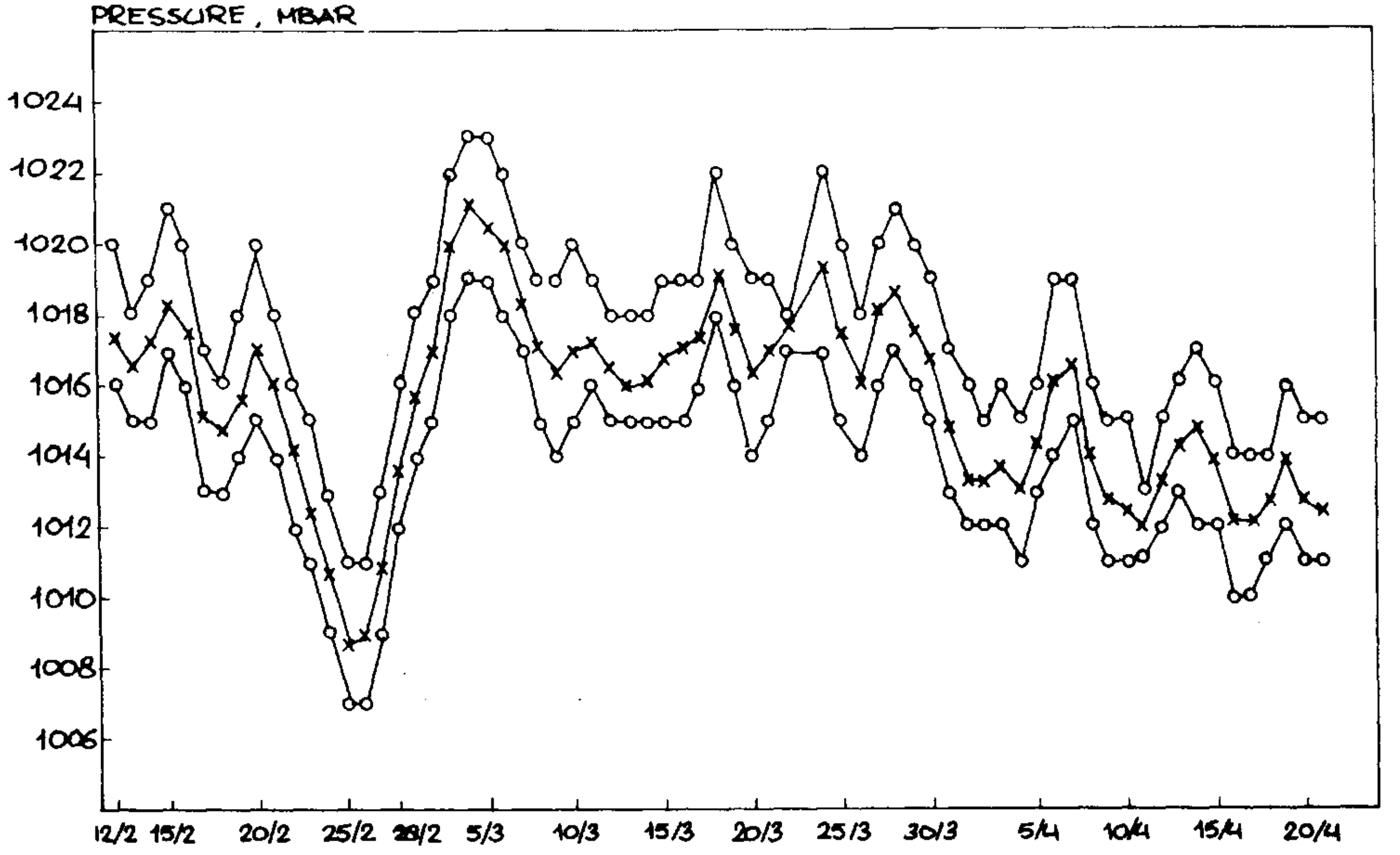


Figure 3.7. Minimum, mean and maximum data for atmospheric pressure (mbar) for each day in 1986. Mean data were calculated over 24 hourly registrations.

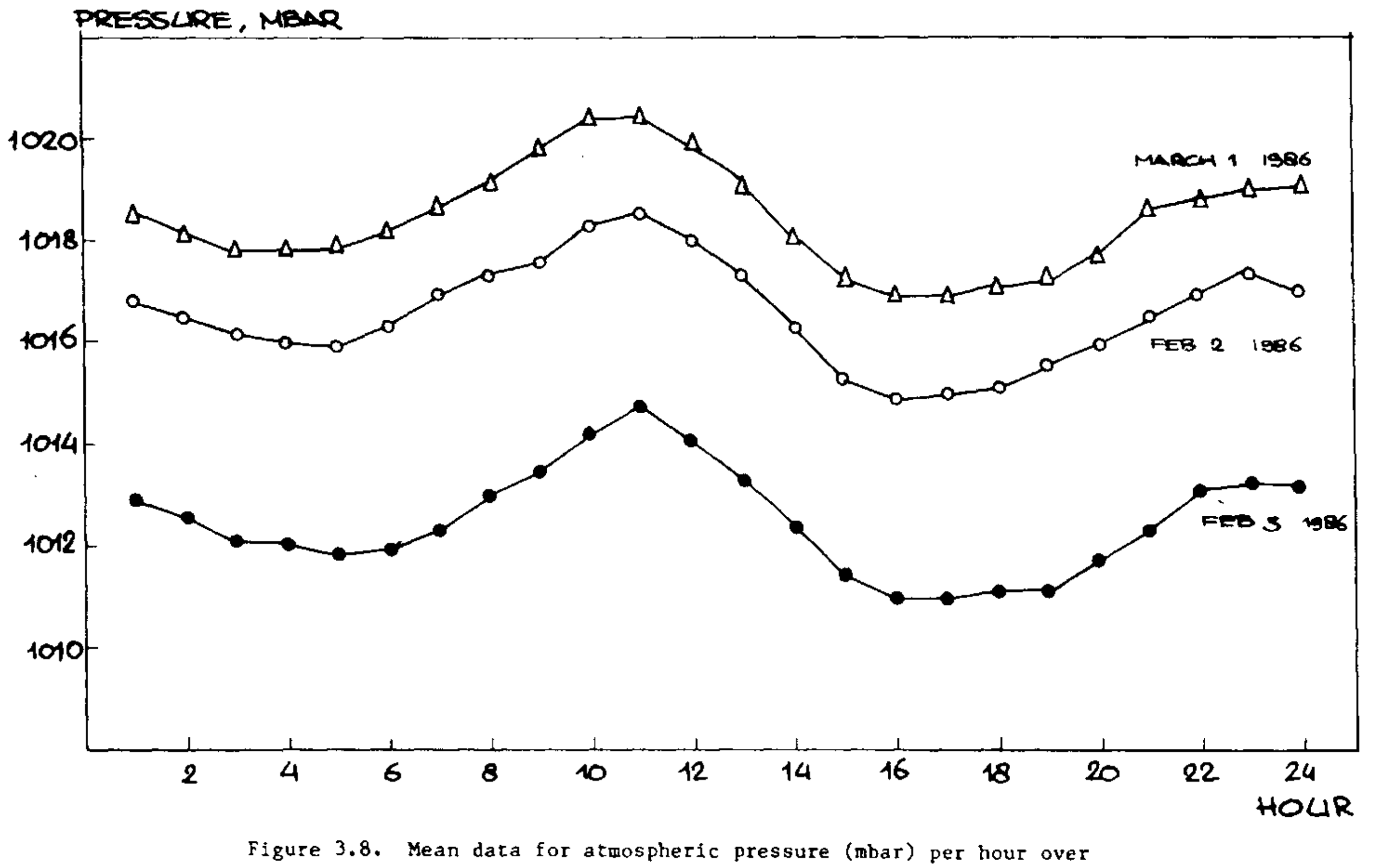


Figure 3.8. Mean data for atmospheric pressure (mbar) per hour over three decades (12 February-9 March) in 1986.

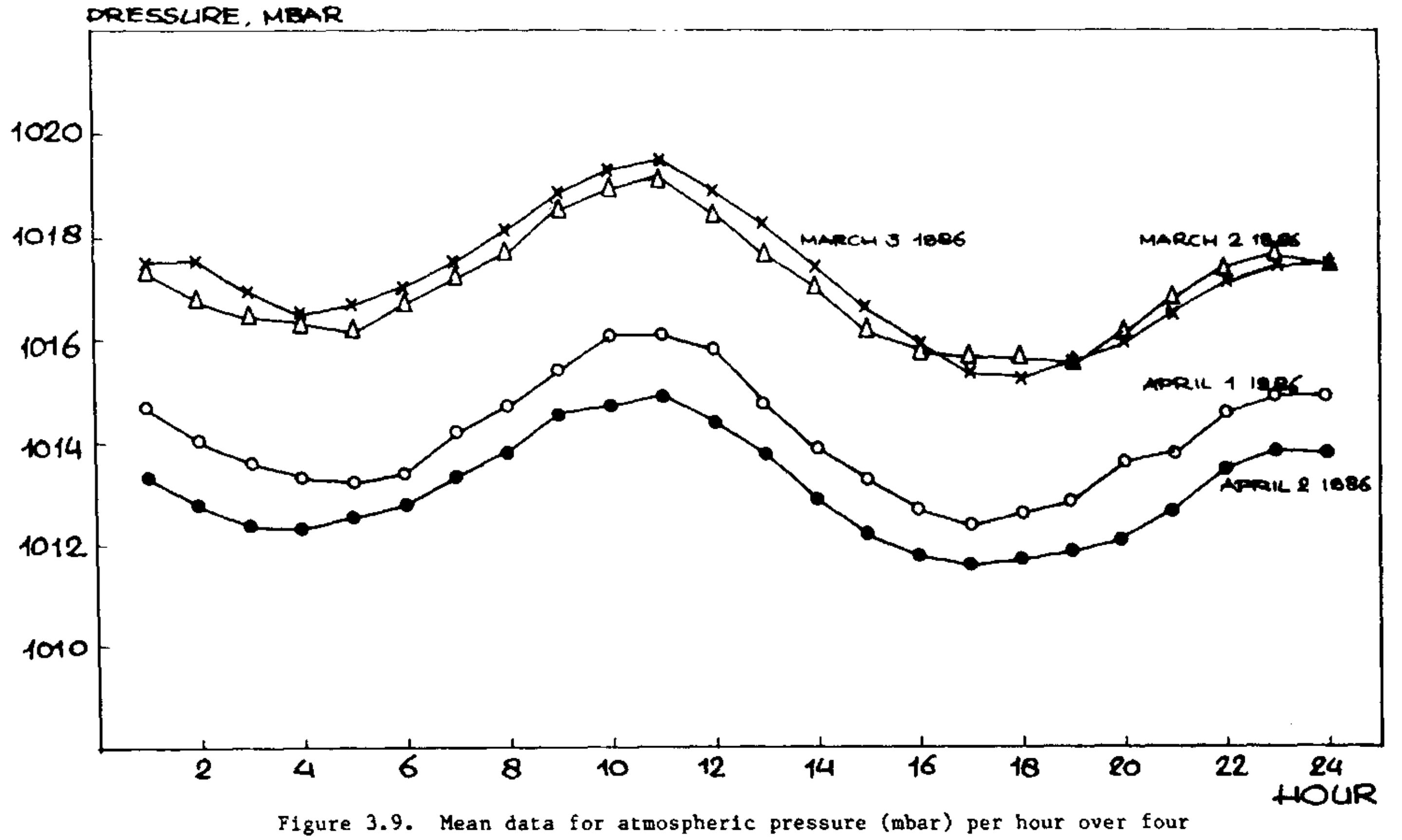


Figure 3.9. Mean data for atmospheric pressure (mbar) per hour over four decades (10 March-21 April) at the Iouik camp in 1986.

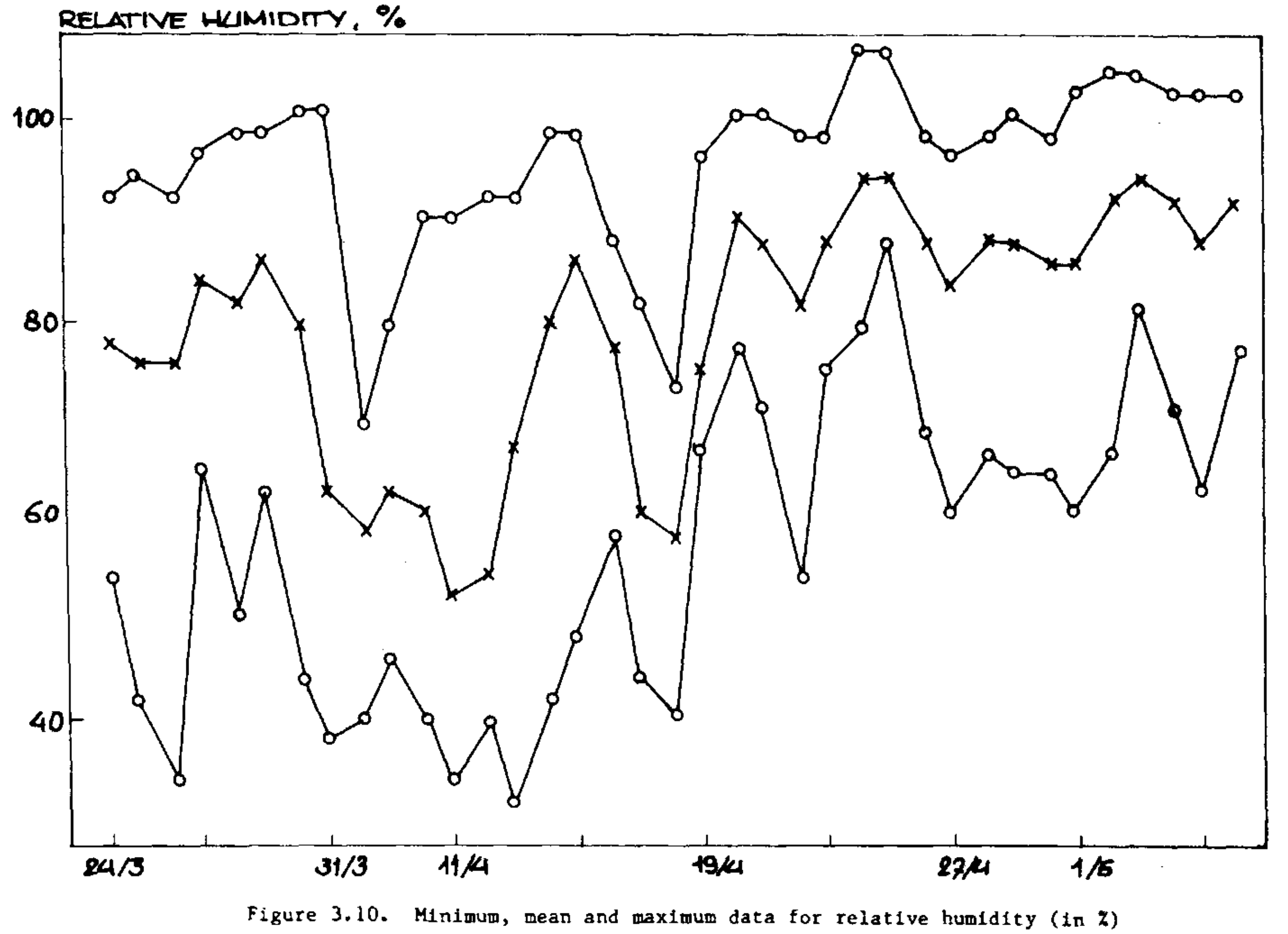


Figure 3.10. Minimum, mean and maximum data for relative humidity (in %) for each day in 1985. Mean data were calculated over 24 hourly registrations.

3.3.3 Relative humidity

Relative humidity in the course of the season is depicted in figures 3.10 and 3.11. In both years the maximum relative humidity values go up to 90 or 100%, and sometimes even exceed the latter value. The minimum humidity values vary greatly, on some days they even go up to 75%. As a result the

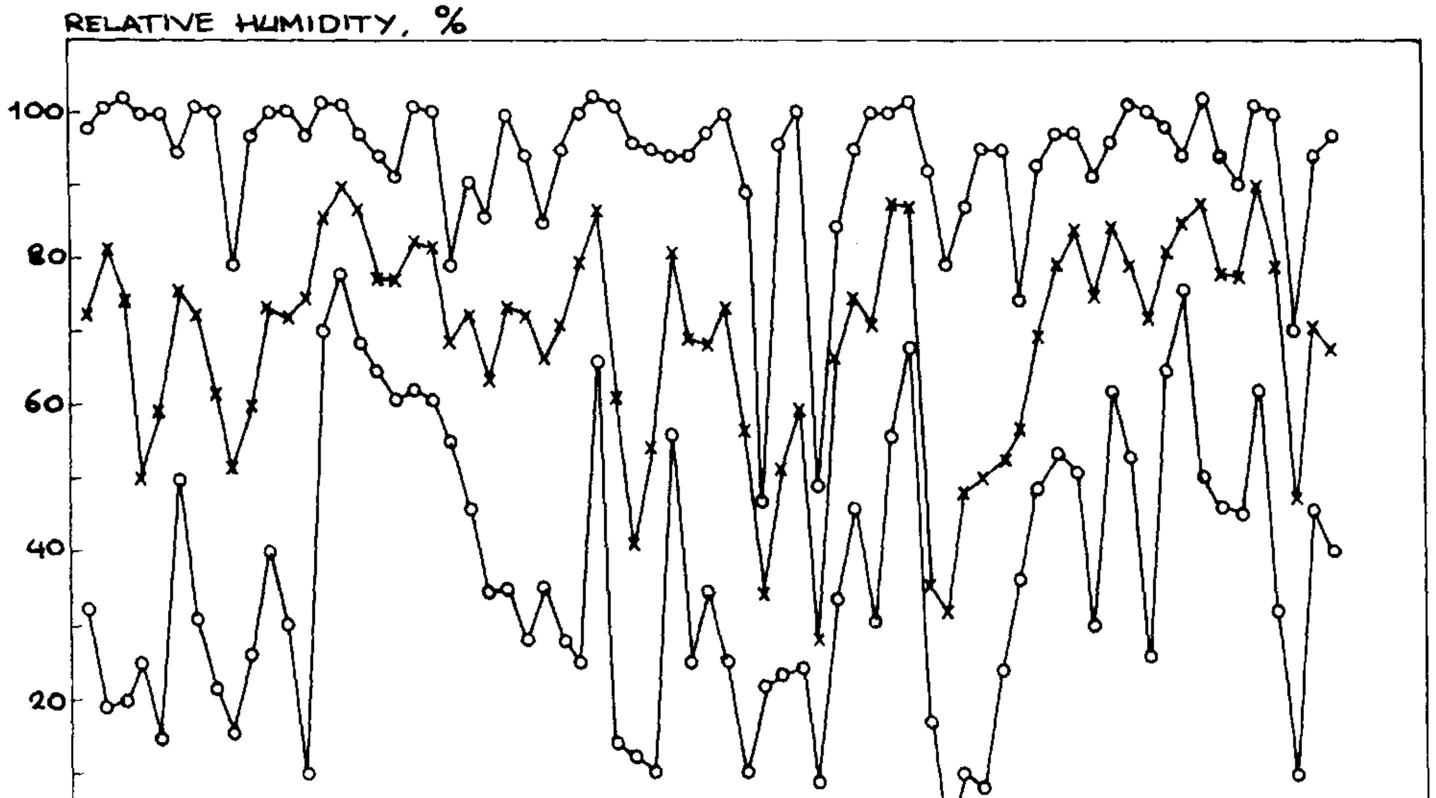


Figure 3.11. Minimum, mean and maximum data for relative humidity (in %) for each day in 1986. Mean data were calculated over 24 hourly registrations.

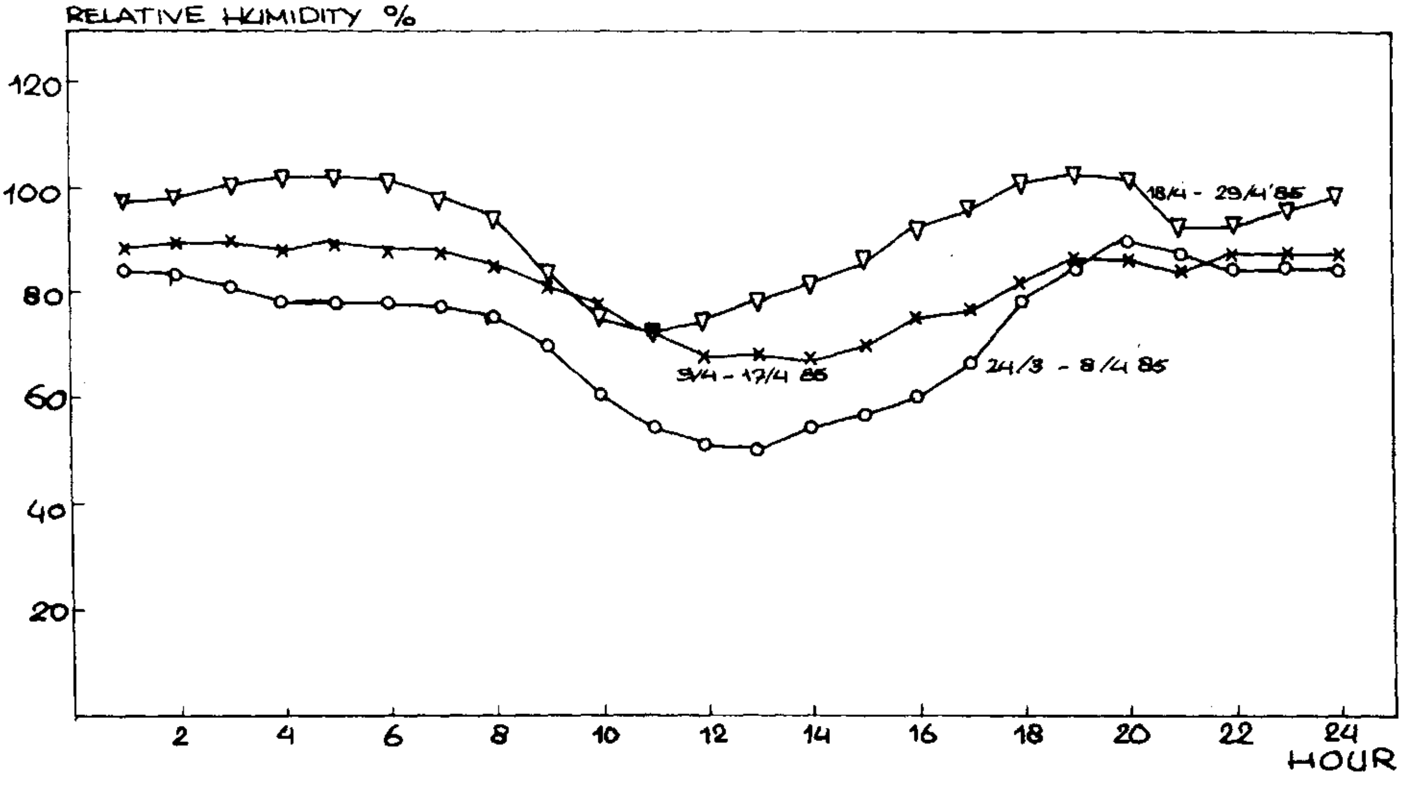


Figure 3.12. Mean data for relative humidity (in %) per hour over three registration periods in 1985.

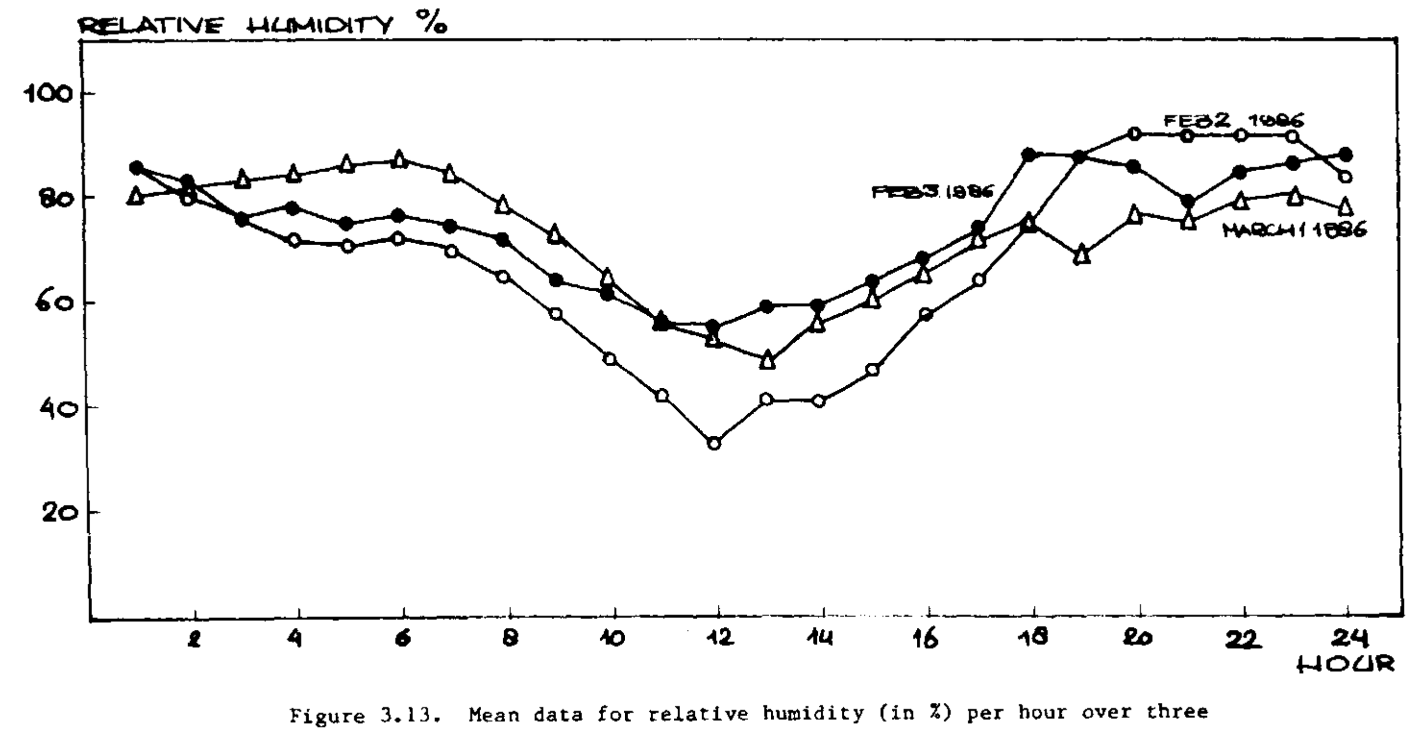


Figure 3.13. Mean data for relative humidity (in %) per hour over three decades (12 February-9 March) in 1985.

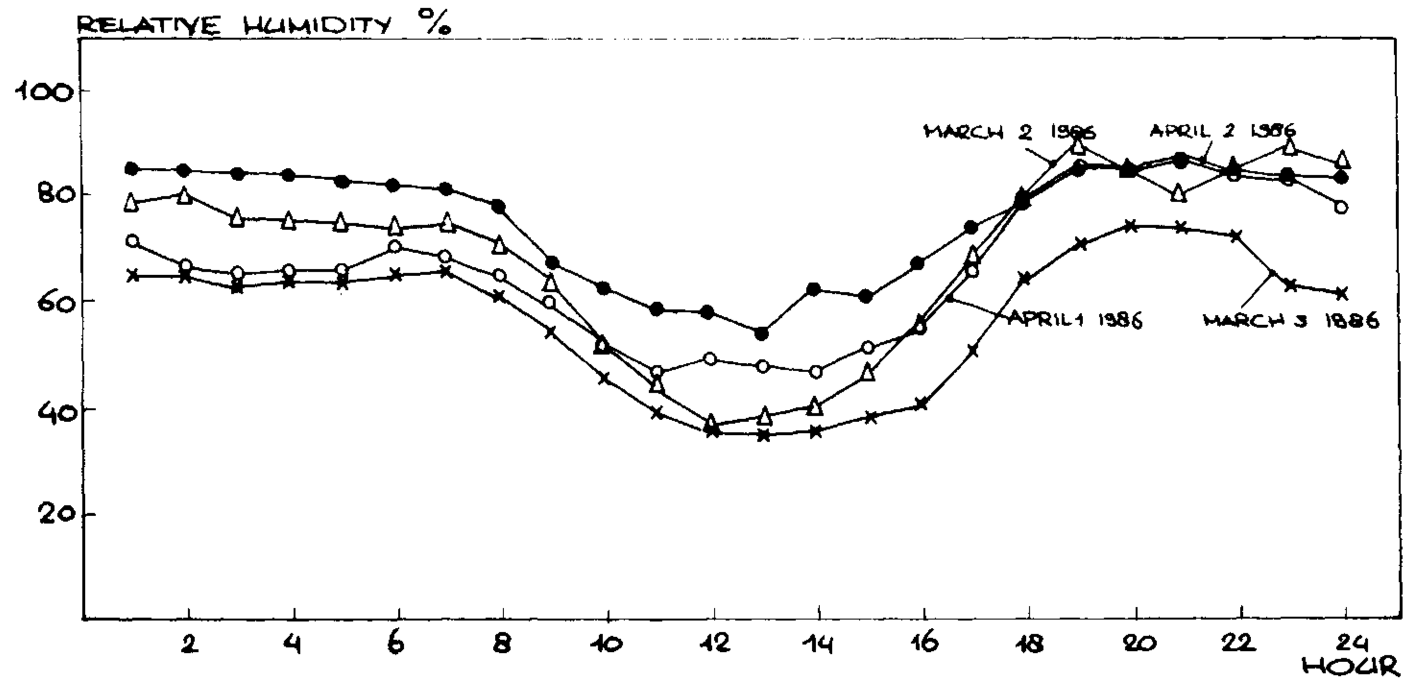


Figure 3.14. Mean data for relative humidity (in %) per hour over four decades (10 March-21 April) in 1985.

mean relative humidity values fluctuate rather strongly as well, generally being in the 40-80% range. No regular pattern is detectable, nor can obvious correlations be found with other meteorological parameters. There is, however, a very regular diurnal pattern, depicted in figures 3.12, 3.13 and 3.14. These graphs show relatively high humidity levels, especially at night. In some nights these high levels lead to dew formation. These 'wet' nights are those exceeding or coming close to 100% relative humidity, shown in figures 3.10 and 3.11. The total number of 'wet' nights, however, has been considerably higher than may appear from figures 3.12 and 3.13. The reason is that in the latter graphs we are dealing with mean values over 7-16 hourly values, less humid nights causing the hourly mean to drop to less than 100%.

3.3.4 Wind force and wind direction

Wind speed data for the 1985 and 1986 observation period are shown in figures 3.15-3.19. Figures 3.15 and 3.17 demonstrate a gradual increase of wind speed in the course of the 1985 observation period. Especially the relatively high wind levels at night in the third period were a very serious problem for mist net catching. There is also an increase in mean wind speed in the 1986 season, though less obvious as compared to 1985. Average wind directions are depicted in figures 3.20 and 3.21 showing that prevailing winds in February and early March come from the north, though no consistent pattern in wind directions can be noted. From mid March onwards the 1985 and 1986 seasons can be compared. Both years show highly consistent patterns in wind directions. During the last March decade prevailing winds at night and in the morning were coming from the northeast. In the afternoon and the evening prevailing winds came from the north. Early April shows a shift towards more northerly directions. This shift continues over the third period, showing prevailing northeast winds in the afternoon. Northeast winds were only registered very briefly in the morning. There is no obvious correlation between a certain wind speed and wind direction.

Figure 3.4 shows a remarkable increase in temperatures from 8-10 p.m. during the third registration period in 1985. This increase can be explained by a shift in prevailing wind directions during this period from the northeast to north. Winds from the northwest arrive at the registration site after having crossed the relatively narrow peninsula separating the Baie d'Aouatif from the Atlantic Ocean. Winds from the north have to cross a much larger stretch of desert. A sudden shift in wind direction around 8 p.m. therefore starts carrying relatively warm wind from the still relatively warm desert to the camp. Other registration periods also show this change in wind direction though the effects on temperature are less striking.

The drop in maximum temperatures in 1985 (Fig. 3.5) seems to be highly correlated with changes in wind direction in the course of the observation period. In the first period high temperatures were registered during the morning and early afternoon. In these situations the wind was blowing from the northeast until about 1 p.m., and even from the east at 10 and 11 a.m., bringing warm winds from the Sahara to the camp. As soon as the wind changed to the north temperatures began to drop gradually. In the second period winds were blowing from the northeast only from 5 until

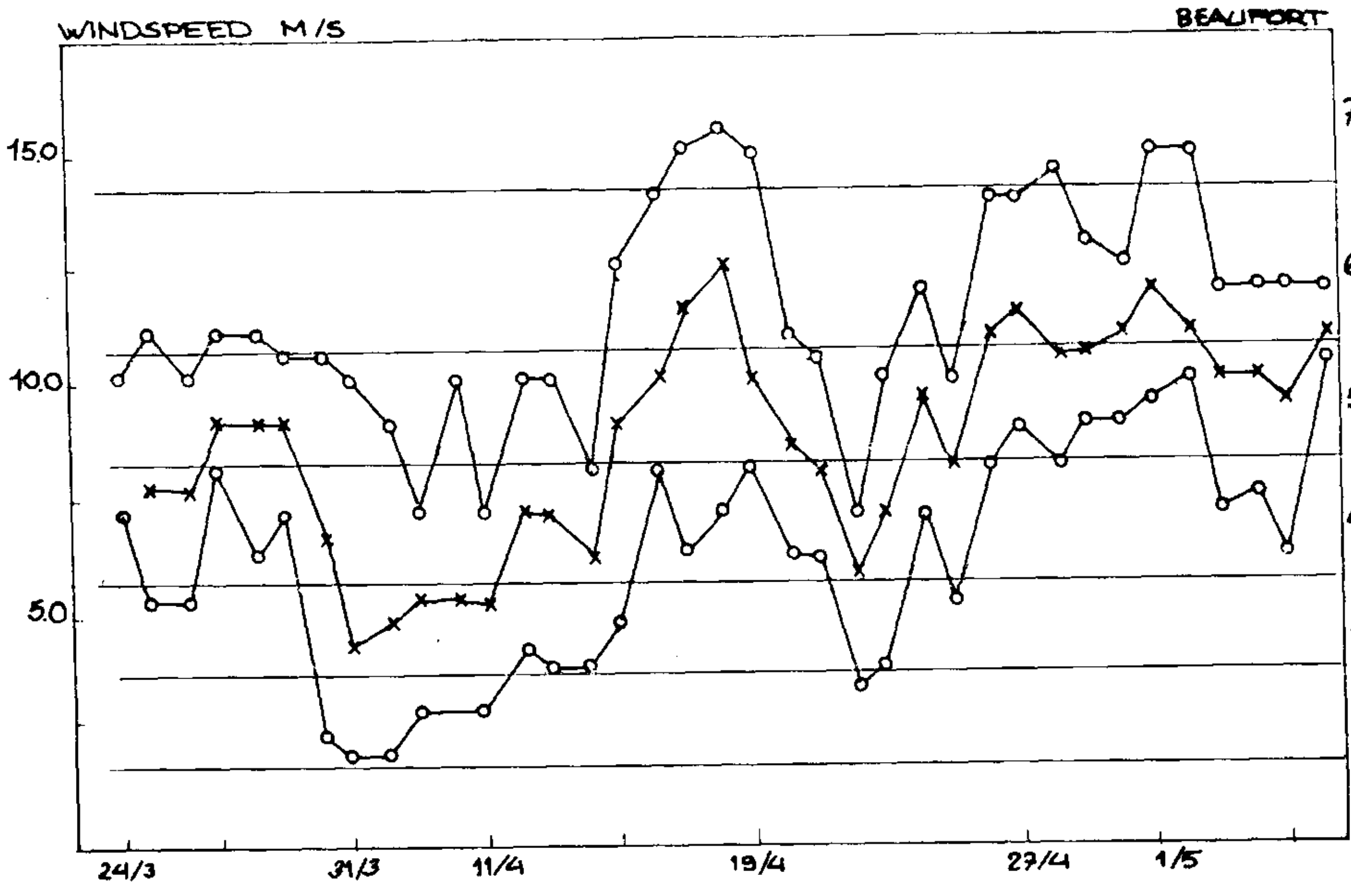


Figure 3.15. Minimum, mean and maximum wind speed (in m/s-left scale; Beaufort-right scale) for each day in 1985. Mean data were calculated over 24 hourly registrations.

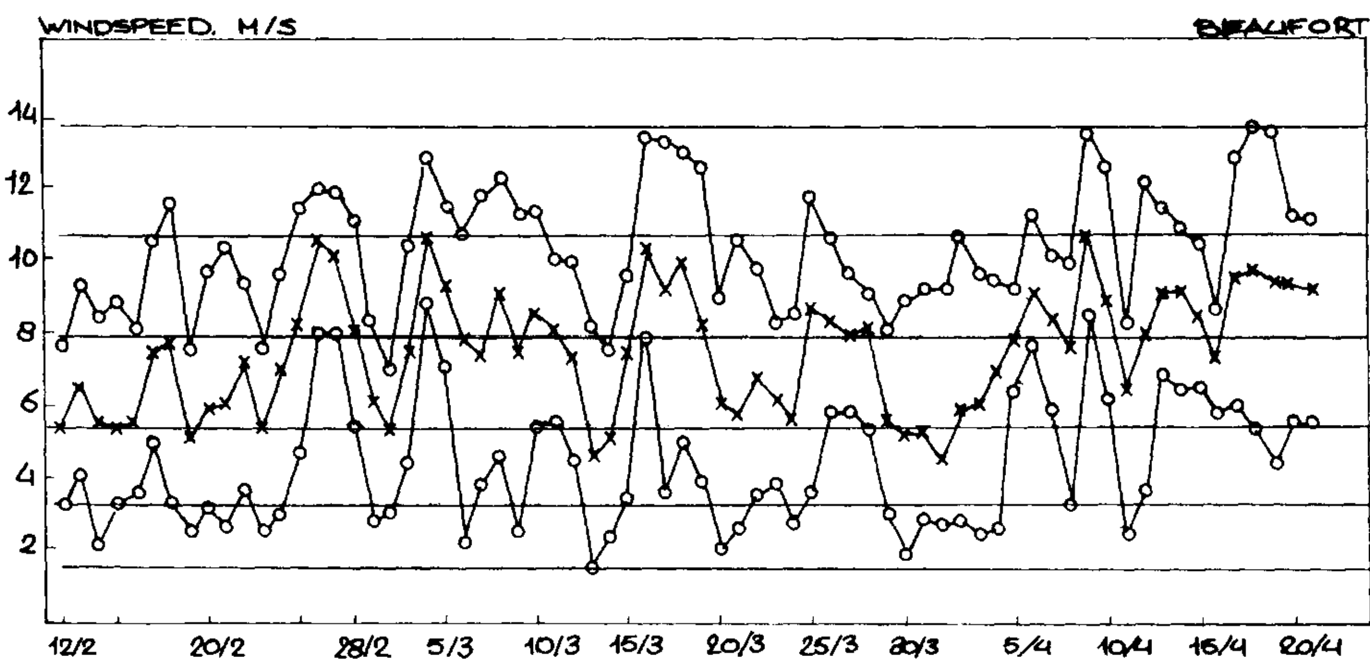


Figure 3.16. Minimum, mean and maximum wind speed (in m/s - left scale; Beaufort - right scale) for each day in 1986. Mean data were calculated over 24 hourly registrations.

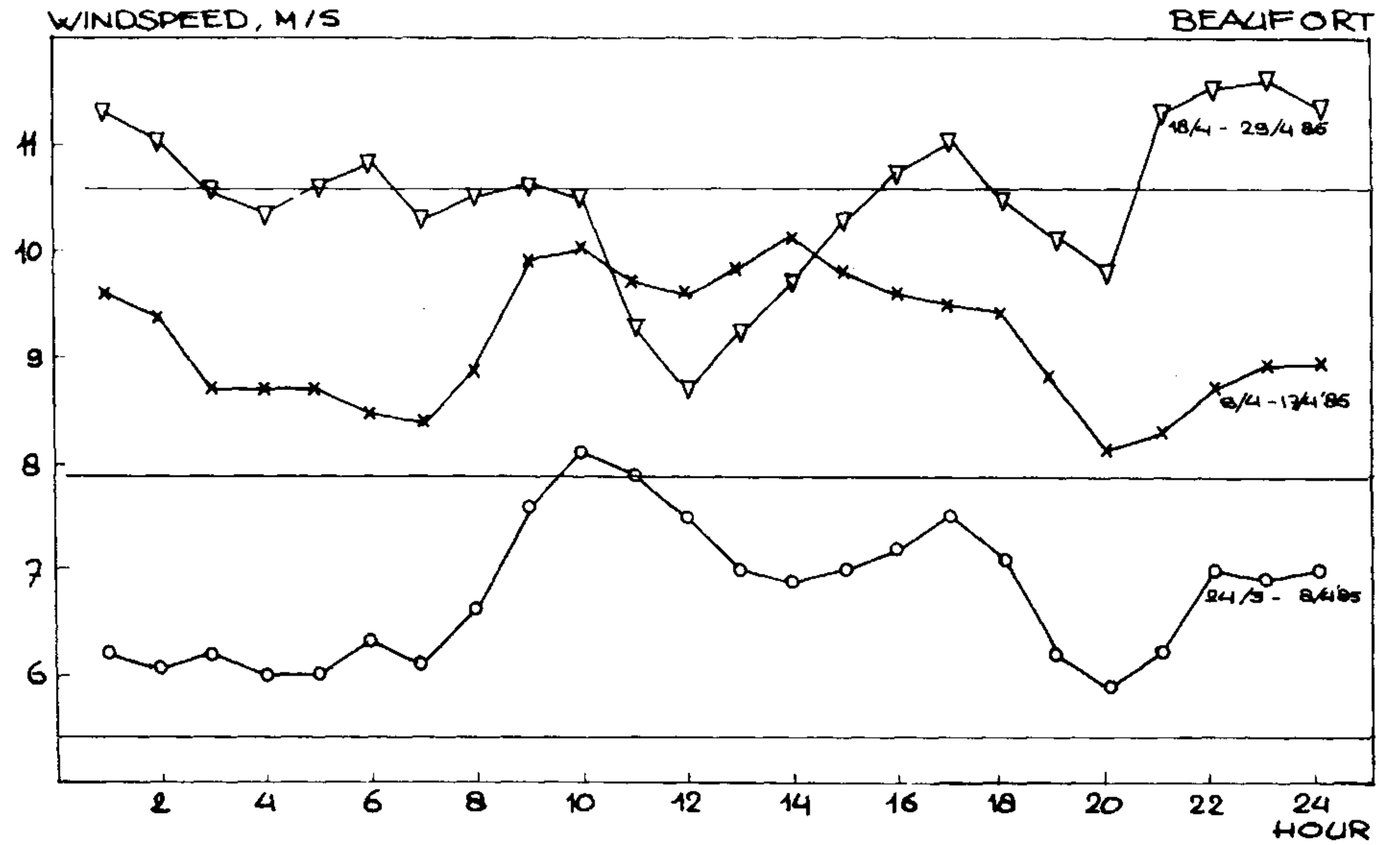


Figure 3.17. Mean wind speed (in m/s-left scale; Beaufort-right scale) per hour over three registration periods in 1985.

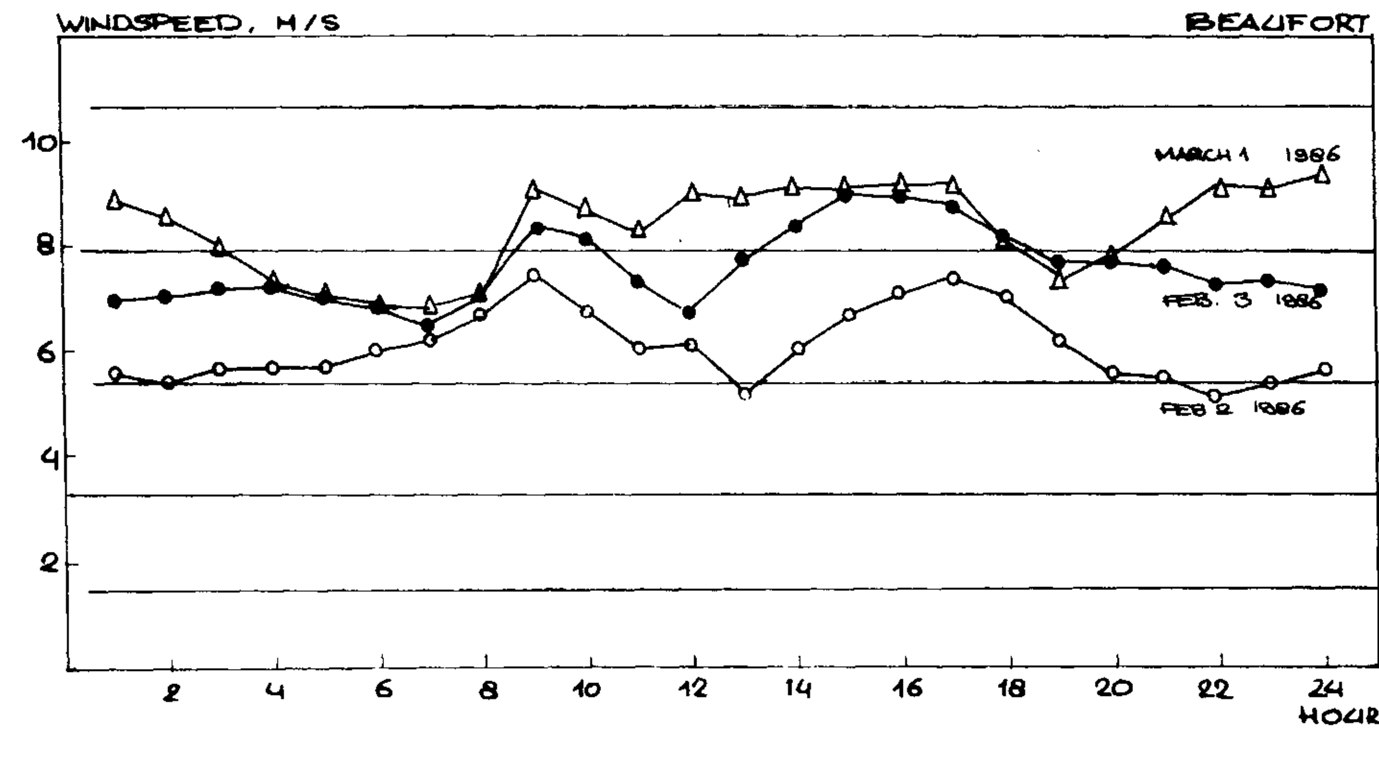


Figure 3.18. Mean wind speed (in m/s-left scale; Beaufort-right scale) per hour over three decades (12 February-9 March) in 1986.

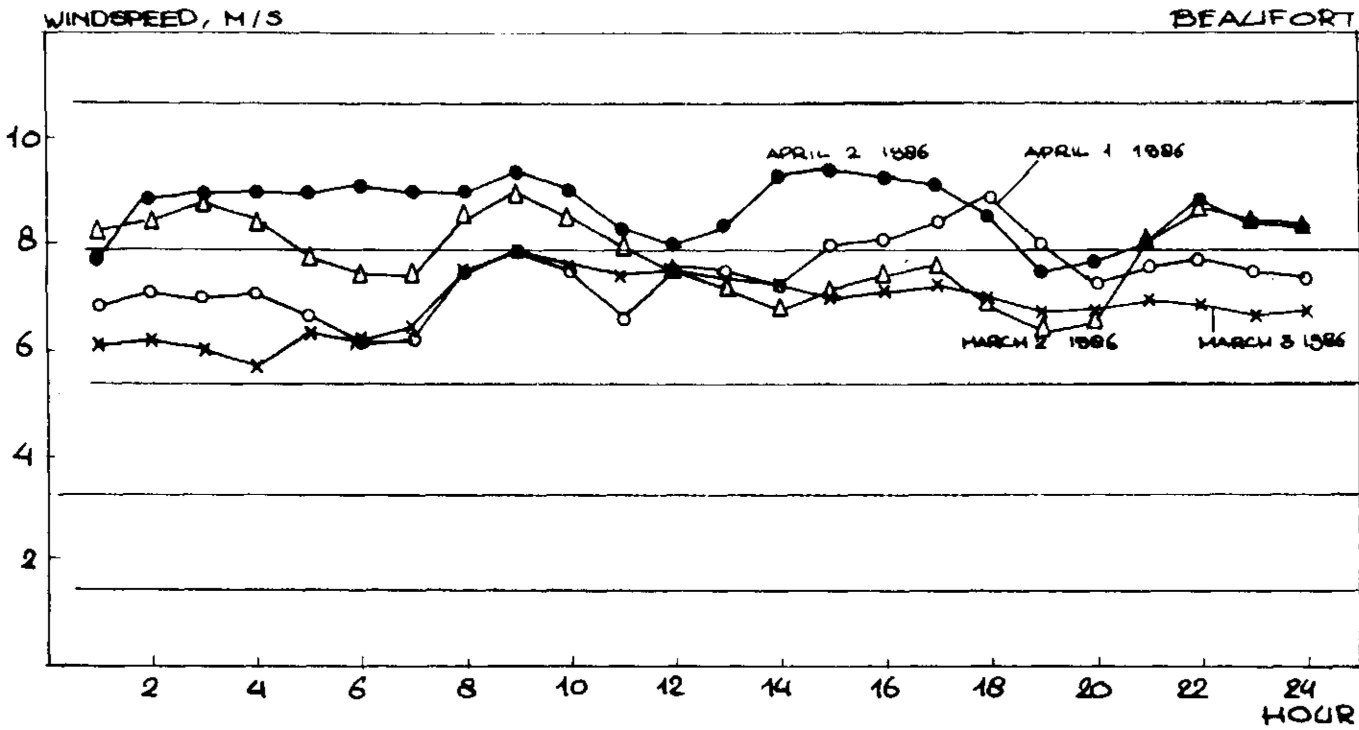


Figure 3.19. Mean wind speed (in m/s-left scale; Beaufort-right scale) per hour over four decades (10 March -21 April) in 1986.

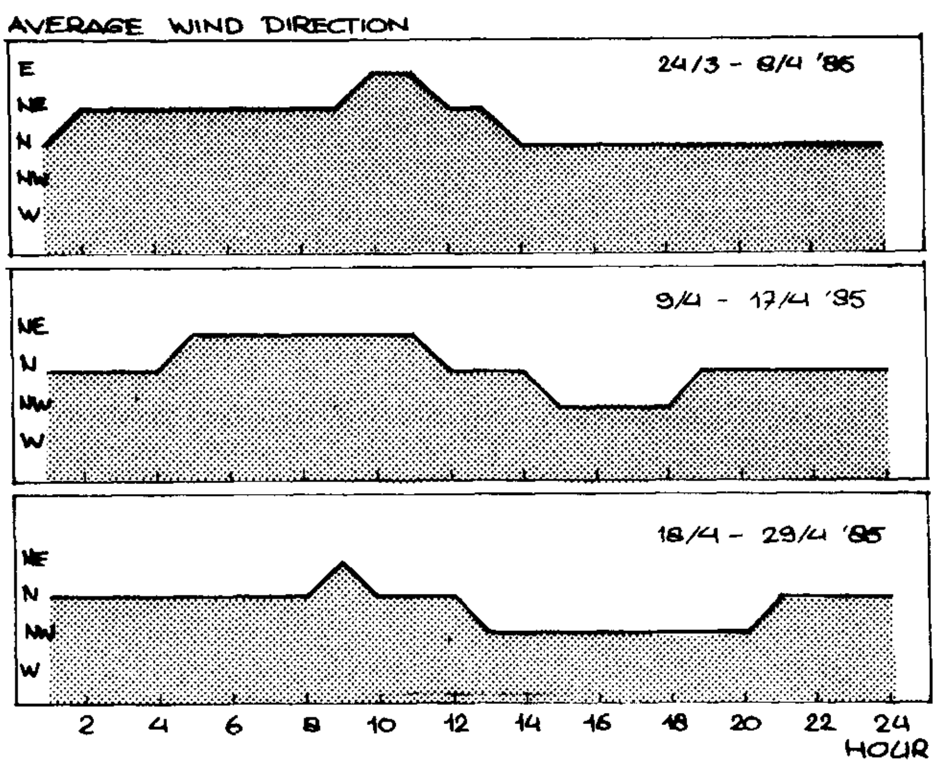


Figure 3.20. Average wind direction per hour over three registration period in 1985.

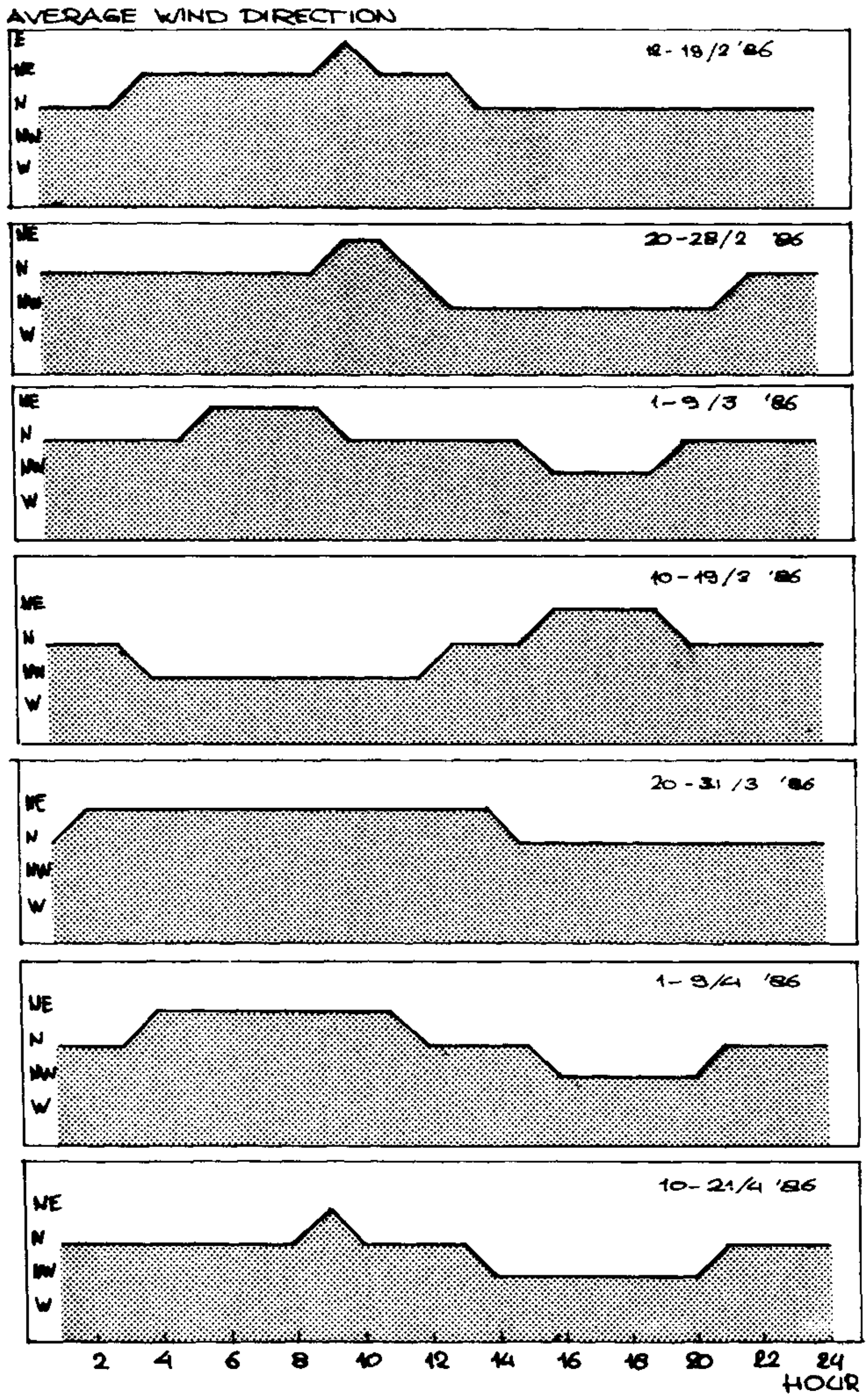


Figure 3.21. Average wind direction per hour over seven registration periods in 1986.

11 a.m.. No prevailing winds from the east were registered any more. A shift of wind direction at 3 p.m. towards the northwest resulted in an almost immediate drop of temperatures. During the third period in 1985 the wind changed towards the northwest already at 12 a.m., again resulting in a flow of relatively cool ocean air. For 1986 more or less comparable correlations can be found.

The diurnal pattern of changing humidity levels can often be correlated by the turning of the wind too. Wind from the northwest lead to the arrival of relatively wet air from the sea. However, not in all situations the turning of the wind alone can explain the humidity increase. Wind direction, wind speed and large scale meteorological patterns (the weather situation at the Atlantic Ocean) all play a part.

Chapter 3.5.1 describes the effects of the passage of high pressure areas, moving eastward north of Mauritania.

3.3.5 Precipitation

In 1985 one shower was recorded during the whole observation period. The phenomenon occurred on 14 March, from 0.30-0.45 a.m., and yielded 0.2 mm rain. In 1986 there were two showers on 10 February, lasting from 6.15-7.00 a.m. and 8.35-8.45 a.m., with some very light drizzle in the period in between. This extremely long lasting wet intermezzo, however, only yielded 0.1 mm of rain in total. Additionally there was rainfall in the night of 21-22 April from 10.20 p.m. until 2.30 a.m. and from 4.30-4.35 a.m. Though the drops were large, they were falling far apart. Therefore the shower yielded no registrable amount of rain.

3.3.6 Dust and sand storms

In this chapter a dust storm is defined as 'the air filled with light dust, allowing for a visibility of over 1 km'. During a sand storm larger particles are being transported on heavy winds, the visibility decreasing to less than 1 km. Dust and sand storms are difficult to record systematically, mainly because there is no obvious transition between clean air and dust storm. When sailing by ship along the Sahara, close to the coast, one can always see a yellowish brown foglike dustlayer over the Sahara. In the camp a severe dust or sand storm not only severely hampered the visibility and the normal daily routine but also solar radiation. On 11 April 1985 for instance, after a day with a severe sand storm, maximum temperatures were reached as late as around 4-5 p.m. by

Table 3.1. Data on dust and sand storms recorded in Iouik in 1986 and information on windspeed and direction during these occasions. Wind speed data (in m/s) refer to the beginning and the end of the dust storm period, together with some intermediate values.

Date		Time	Wind speed	Wind direction
February	18	10-14	11.5 --> 5.3	east
	21	11-13	9.6 --> 6.7	northeast
	25	14-16	11.4 --> 10.4	northwest
	27	16-18	11.2 --> 11.4 --> 10.8	northwest
March	4/5	13- 3	10.1 --> 12.8 --> 10.5	north
	6	12-15	9.1 --> 8.4	northeast
	8	10-14	10.6 --> 9.8	northeast
	9	9-13	11.3 --> 8.1	northeast
	16/17	19- 4	11.5 --> 13.3 --> 10.3	northeast
	18	8-12	11.9 --> 12.9 --> 9.8	northeast
	21	10-14	9.0 --> 10.5 --> 8.8	east
	22	9-11	9.7 --> 6.4	northeast
	24	16-17	7.8 --> 7.5	northeast
	25	16-20	10.7 --> 11.7	northwest
April	2	9-10	9.9 --> 10.5 --> 8.4	northeast
	9	12-14	10.9 --> 11.3	north
	12	14-16	12.1 --> 10.7	northwest
	17	16-17	11.8 --> 11.3	northwest
	18	9-11	12.4 --> 13.2 --> 10.5	north
	19	2-17	12.6 --> 13.4 --> 8.0	northeast
	20	7- 8	11.0	north

the time the amounts of sand and dust in the air gradually got smaller. Light dust storms occur relatively often, as can be seen from table 3.1. This table only shows dates at which dust storms were recorded in 1986. In 1985 only records of sand storms were made. Sand storms occur at a rather low frequency. In 1985 sand storms were recorded on 10 April and 11 April. Figure 3.15 shows that sand storms in 1985 were recorded on days with a maximum force of 15 m/s and winds from the northeast. On other days with winds from the northeast (for example 2-6 April) wind force was considerable smaller. On days with relatively strong winds (19-21 April and 25-26 April) without sand storms, prevailing wind directions were northwest or north. In 1986 less severe sand storms were recorded on 4 March and 19 April. A comparison of table 3.1 and figure 3.16 shows that dust storms were recorded on days with maximum wind speeds over 8 m/s and a wind direction from either east or northeast. Days with dust storms and wind from north or northwest all had a maximum wind speed over 11 m/s.

3.4 Registrations at Iouik compared to those from Nouadhibou

Figure 3.22 shows maximum, mean and minimum temperatures for Nouadhibou Airport from 1952 to 1985. Maximum and minimum temperatures for February–April coincide rather well with those measured at Iouik. Mean temperatures in Nouadhibou, however, are somewhat lower. An explanation may be that the Atlantic Ocean and the Baie de Lévrier are almost completely encompassing the city, as a result of which the heating up of the area in the course of the day proceeds less rapidly. Especially in the second part of March and early April the morning winds in Iouik come from the northeast, i.e. parallel to the coast and partly from the Sahara. These winds contribute to a relatively quick heating up of the

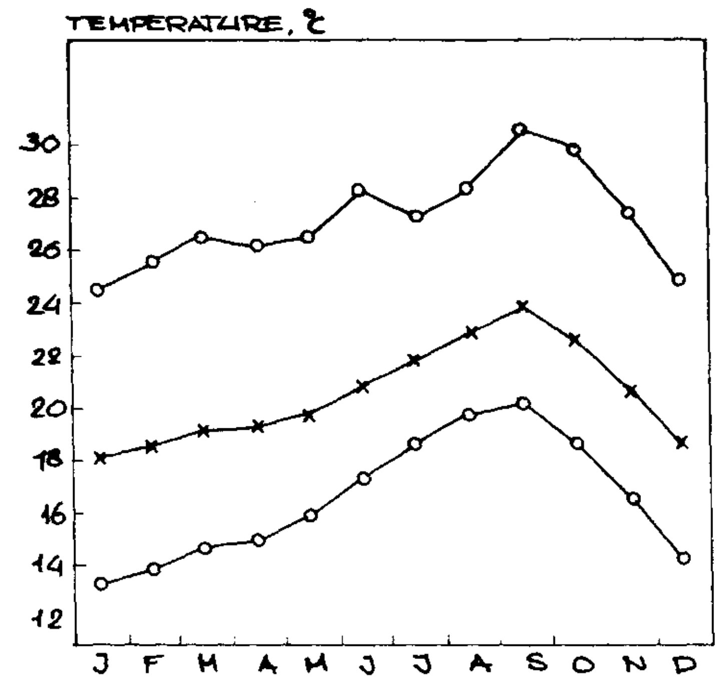


Figure 3.22. Mean minimum, mean maximum and mean temperatures (calculated over eight daily measurements) at Nouadhibou Airport in the course of the year. Minimum and maximum values were calculated for 1953–82, mean temperatures for 1961–85. Data: ASECNA, Exploitation Météorologique, Nouadhibou).

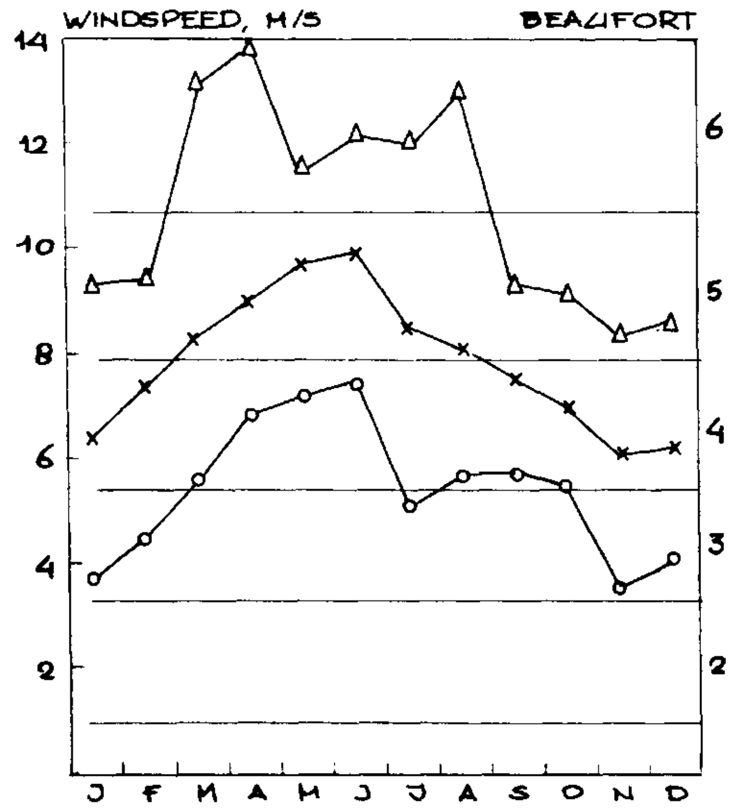


Figure 3.23. Maximum mean, mean and minimum mean wind speed (in m/s-left scale; Beaufort-right scale) per month at Nouadhibou Airport from 1961-85. For each month and year mean wind speed data were calculated. For this graph maximum and minimum values were selected and mean values calculated over the whole observation period. Data: ASECNA, Exploitation Météorologique, Nouadhibou.

camp surroundings as soon as the sun rises. Increasing wind speeds as they were measured at Iouik, are in good agreement with an increase measured at Nouadhibou Airport. Figure 3.23 depicting mean values for 25 years, obviously shows increasing levels from December to June and decreasing levels from July-November, though the pattern of mean maximum and mean minimum levels is somewhat more complicated. Obviously there are rather large differences between years. Figure 3.24 shows wind directions at Nouadhibou Airport in the course of the year, the percentage of time without wind being highly limited. In January and February northeast winds are very frequent, from March to May there is a gradual increase of winds from the northwest. Winds from the north and northwest dominate highly in August, from September onwards northeast winds become more frequent again. This pattern is in good agreement with findings at the Banc d'Arguin.

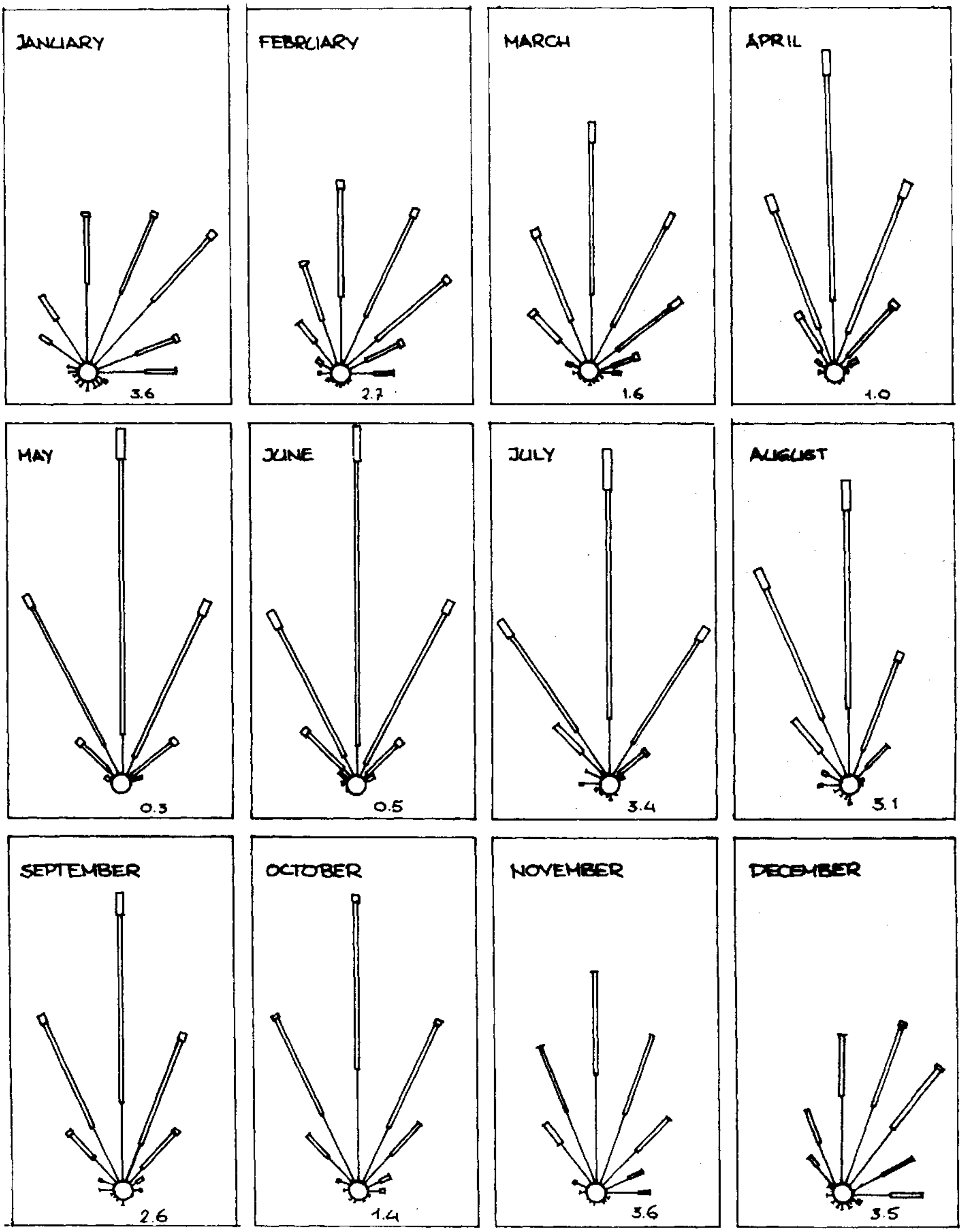


Figure 3.24. Frequency of wind directions throughout the year at Nouadhibou Airport. The length of the arms in the graphs depicts the percentage of time a certain wind direction has been measured, the width of the arms denotes wind speeds: narrow 1-6 m/s, moderate 7-13 m/s, wide $\geq$ 14 m/s. The figure in the centre denotes the percentage of time with wind silence. Data: ASECNA, Exploitation Météorologique, Nouadhibou.

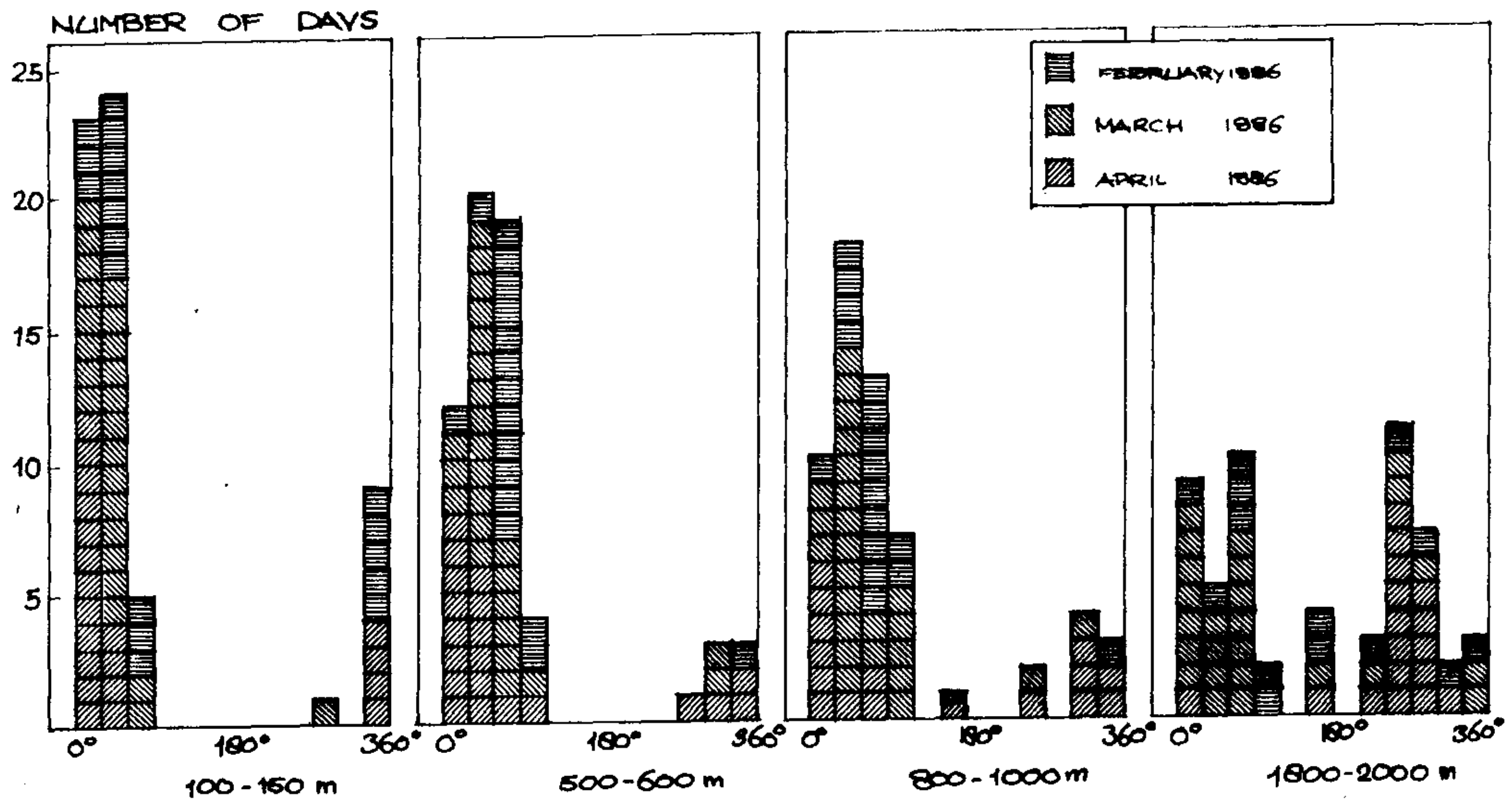


Figure 3.25. Frequency diagrams showing 12 a.m. registrations of wind direction at Nouadhibou Airport at different altitudes between 21 February and 21 April 1986. Data: ASECNA, Exploitation Mètéorologique, Nouadhibou.

Without the use of weather baloons it is almost impossible to gather data on wind direction and speed at higher altitude. For this reason such measurements have not been carried out at Iouik. In Nouadhibou however, such measurements have been done. Figure 3.25 shows frequency distributions of wind directions at 4 altitudes at 12 a.m. for the same period as our observations at Iouik. We can see a gradual shift in wind directions at higher altitudes. At a low level (100-150 m) winds from the north-northwest, north and north-northeast dominate highly. At 1800-2000 m, however, apart from winds from northerly directions, there are rather frequently winds from the southwest to the northwest. In April 1986 winds from this directions were even dominating! Unfortunately only very few registrations were carried out at 6 p.m.. The few data available only allow us to conclude that at low altitudes winds from the north-northwest

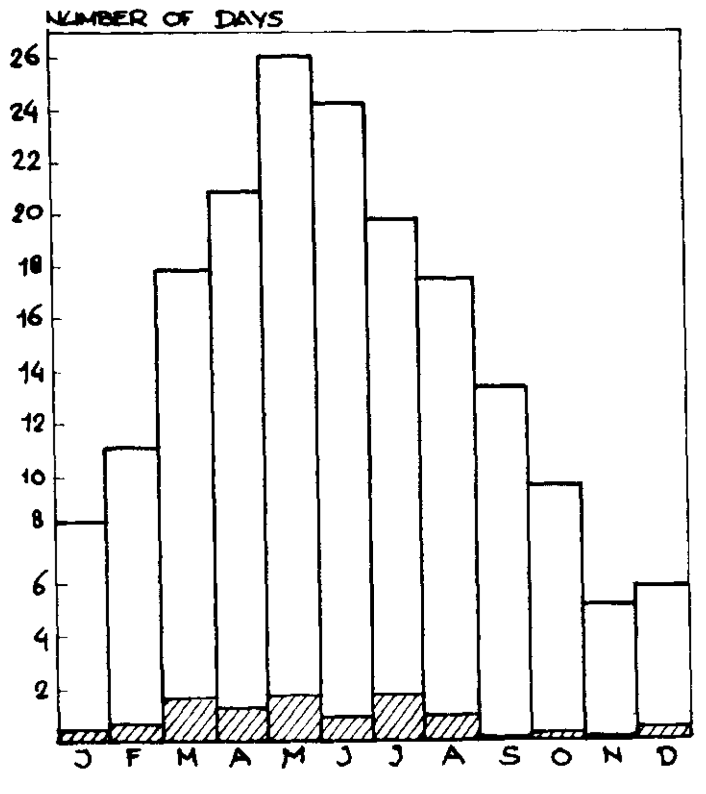


Figure 3.26. Mean number of days with light dust storms (visibility ≥ 1 km) and sand storms (visibility < 1 km, hatched) at Nouadhibou Airport from 1954-1985. Data: ASECNA, Exploitation Météorologique, Nouadhibou.

and north were highly dominating. There is one observation from Iouik which can be compared to Nouadhibou. On 11 April 1986 at 9.30 a.m., when the wind at ground level was coming from the northeast, at high altitudes cloud veils were coming over from the southeast. Balloon registrations on the same day in Nouadhibou at 12 a.m. show that at 100 m altitude the wind was coming from the north-northeast, and at 1800 m from the south-southeast. A comparison of wind directions at Iouik and recordings made at Nouadhibou at 12 a.m. at 100 m altitude shows that the difference in wind directions between the two stations normally has a maximum of 30°.There are no indications for systematic differences in wind directions between the two stations. These data suggest that wind directions from Nouadhibou Airport may be used to predict, with rather good accuracy, the wind directions at Iouik.

Figure 3.26 depicts the mean number of days per month with sand storms, allowing for less than 1 km visibility at Nouadhibou. On average in spring and summer 1-2 days per month with sand storms can be registered though in some years the number may be as high as 6. From September onwards sand storms at Nouadhibou decrease in number. The same applies for the mean number of days with dust in the air allowing for a visibility of more than 1 km. There is a striking resemblance between this graph and the picture of mean wind speeds (Fig. 3.23).

3.5 Large-scale weather patterns

The general meteorological picture of West Africa and the adjoining central eastern part of the Atlantic Ocean in spring is characterized by a belt of high pressure over the Atlantic Ocean (atmospheric pressure 1015-1040 mbar) and an area of low pressure over central northern Africa (pressure under 1010 mbar). Further north of this rather stable area we find the belt bringing the always changing mixture of high and low pressure areas to West European countries (Fig. 3.27). The presence of the high pressure area over the Atlantic Ocean, which is mostly found between 10° and 40° N and the low pressure area over northern Africa lead to a stable and highly predictable wind pattern known as the northeast trade winds. On the Mauritanian coast these winds blow more or less continuously from northern directions the whole year round (compare figure 3.24). The high pressure areas in the 10-40° N area are not static, but mostly move to the east, expand or decrease in size and may change in pressure. These movements and changes largely explain the differences in weather from day to day along the Mauritanian coast.

Two examples, based on data from weather maps of the Deutscher Wattendienst, Offenbach, will be described:
On 8 April 1985 a high pressure area (1035 mbar) was found at the Atlantic Ocean, halfway between the American coast and the Canary Islands (35^o N, 50^o W). By that time the Banc d'Arguin was situated in a broad zone of relatively calm air with an atmospheric pressure of about 1013 mbar. During the following days the high pressure area slowly moved eastward, leading to a gradually increasing wind speed on the West African coast and increasing atmospheric pressure. On 11 and 12 April the centre of the high pressure area was situated over the Azores and even reached 1040 mbar, leading to north-northeast winds of 15 m/s on the Canary Islands and 25 m/s on the Cape Verdian Islands. On the Banc d'Arguin this weather situation led to dust and sand storms. On 13 April a low pressure area, coming from the Sahara, gradually spread out in northeast direction, leading to calmer weather conditions on the West African coast. On 14 April the Azores high pressure area only measured 1030 mbar, still slowly moving east. By 15 April it arrived in Northwest Spain, pushing the North African low pressure area towards the east too. From 17 April onwards another high pressure area at the centre of the Atlantic Ocean started going the same direction but appeared to follow a more southerly route in the following days. Because of its different route and lower maximal pressure (about 1030 mbar) the effects on the Banc d'Arguin were well notable (rather strong winds from the north) but not as intense as during the passage of the high pressure area the week before. By 22 April it had lost some pressure (1020 mbar) and was situated west of the Canary Islands, a day later it started to expand due to which wind speeds gradually dropped on the West African coast.

The extraordinary dip in atmospheric pressure from 21-28 February 1986 is explained by the rather northerly passage of a high pressure area. On 21 February a large high pressure area of over 1020 mbar was situated west of the Canary Islands. Two days later it had settled over Morocco and southern Spain, leading to rather low pressure at its southern range and easterly winds. At the same time a low pressure area of less than 1010 mbar over Central Africa was spreading northward. By this time on the whole Central Atlantic 1010-1015 mbar was measured. On 25 February the low pressure zone had moved even further north, the high pressure zone over North Africa losing much of its power and breaking up into several pieces. The situation started recovering to normal by 26 April when another high pressure area started forming on the central part of the Atlantic Ocean, southwest of the Azores, expanding its range swiftly in the following days. By early March the situation was more or less back to normal again. The spreading out of the low pressure area over Northwest Africa by the end of February lead to relatively low maximum temperatures at the Banc d'Arguin from 25 February until 4 March 1986 and to prevailing winds from the nothwest during the afternoon, bringing in relatively cool and humid air from the Atlantic Ocean.

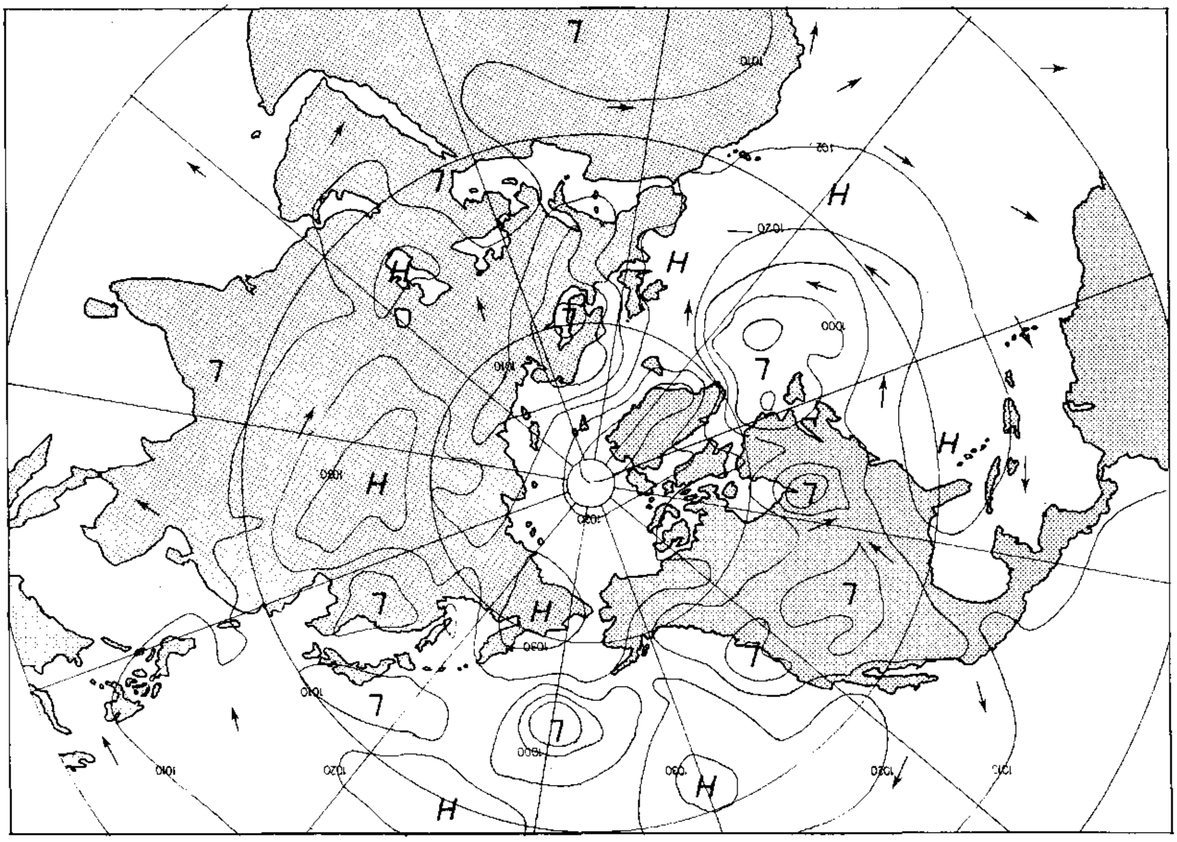


Figure 3.27. Weather situation on 28 March 1985 at the northern hemisphere, with emphasis on the location of high and low pressure areas and wind directions. Modified after: Europäischer Wetterbericht, Deutscher Wetterdienst, Offenbach (daily issues).

4. HYDROGRAPHICAL MEASUREMENTS

Cor J. Smit, Anne-Marie Blomert, André Meijboom, Wim J. Wolff
& Leo Zwarts

4.1 Introduction

Though information on the moments of high and low water and predictions on tide levels is permanently available for Dakar, Senegal (Admirality Tide Tables), only limited information on tidal parameters for the Banc d'Arguin was available. In the literature only the shape of one tidal curve, based upon measurements during 12 hours was available for Iouik, next to a map showing cotidal lines for part of the Banc d'Arguin

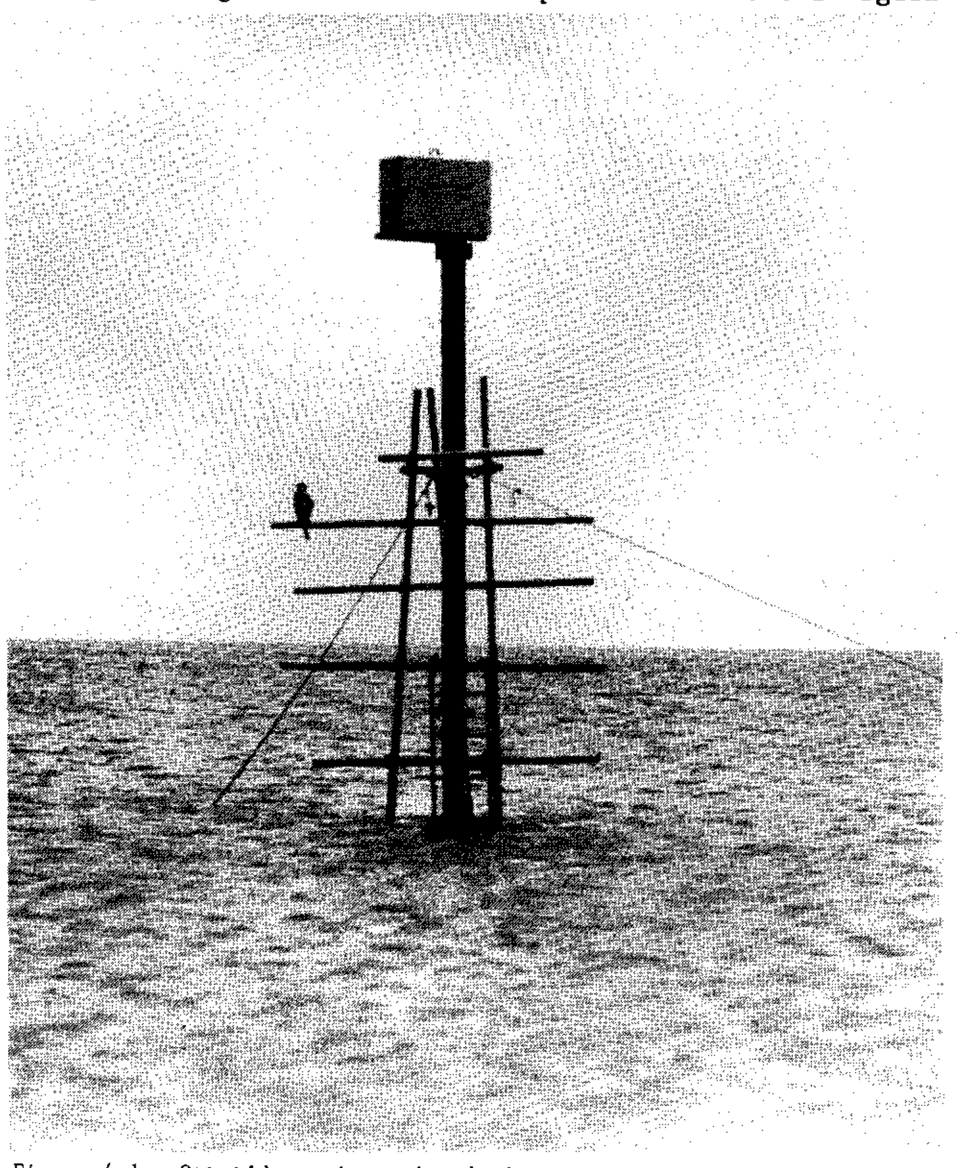


Figure 4.1. Ott tide registration device mounted on a hollow pipe on the edge of the channel close to the Iouik camp. The small ladder was often used by roosting Reed Cormorants *Phalacrocorax africanus*.

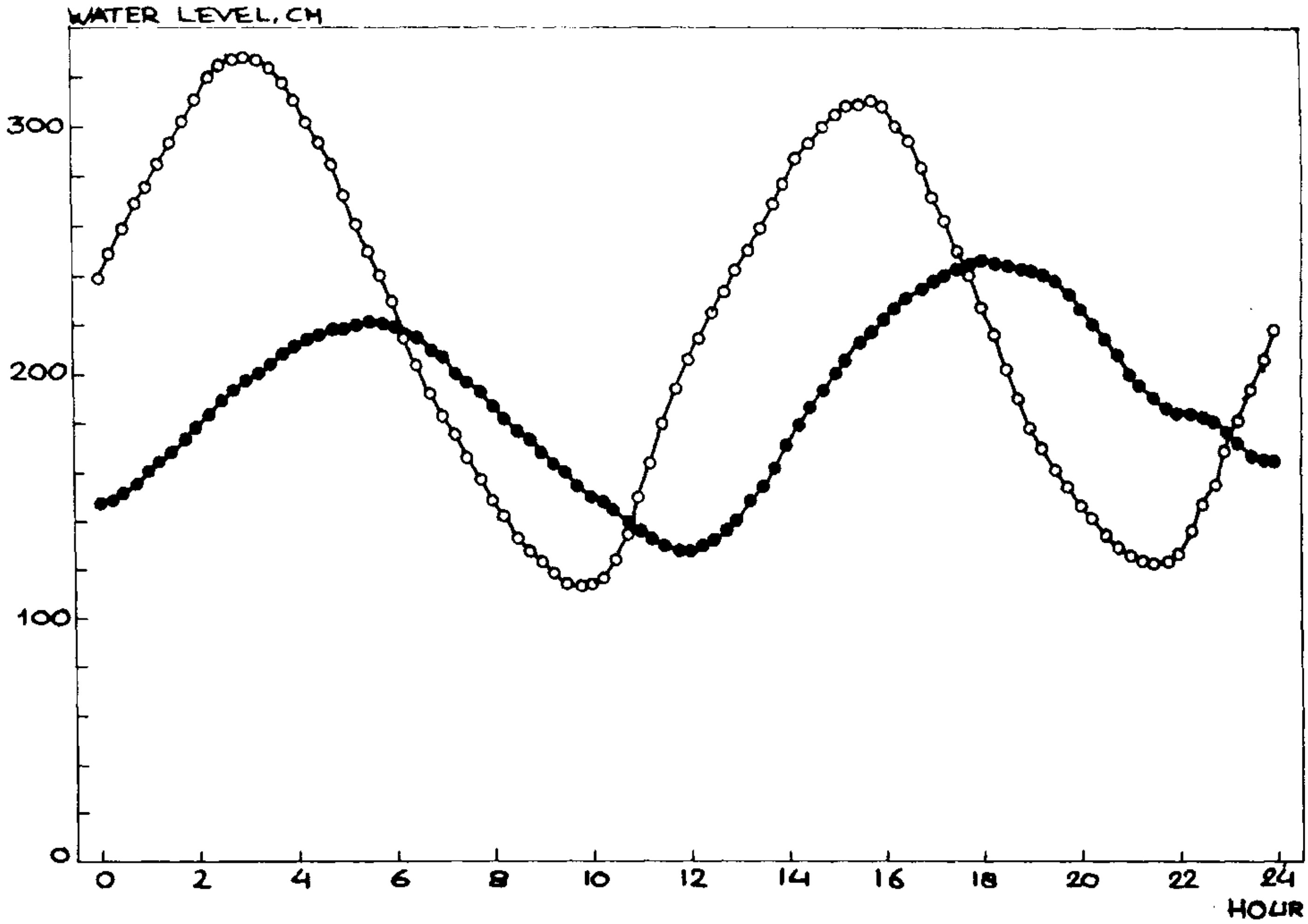


Figure 4.2. Quarterly registration of the tide height in the channel next to the camp near Iouik. The y-axis for this graph was chosen arbitrary. Open symbols denote measurements from 12 March 1986 (around spring tide), dots refer to 18 March 1986 (around neap tide).

(Altenburg et al. 1982). During the 1985 and 1986 expeditions a continuous registration of tidal fluctuations was made. These measurements were mainly taken to determine the duration of the flooding of the tidal flats, in order to quantify duration of the feeding time available to the birds in the course of time. Because it may be of benefit for future research at the Banc d'Arguin the results of the tidal registrations are presented here, next to an analysis of the measured parameters. This analysis allows for predictions on the moments of high and low water as well as tide levels in the Baie d'Aouatif, based upon known parameters for Dakar.

Seawater temperatures have been measured both in 1985 and 1986, but the frequency in 1986 was much higher. Only the 1986 data have been analysed. During April 1986 water temperature and salinity have been determined at a number of stations in the vicinity of Iouik. The aim of

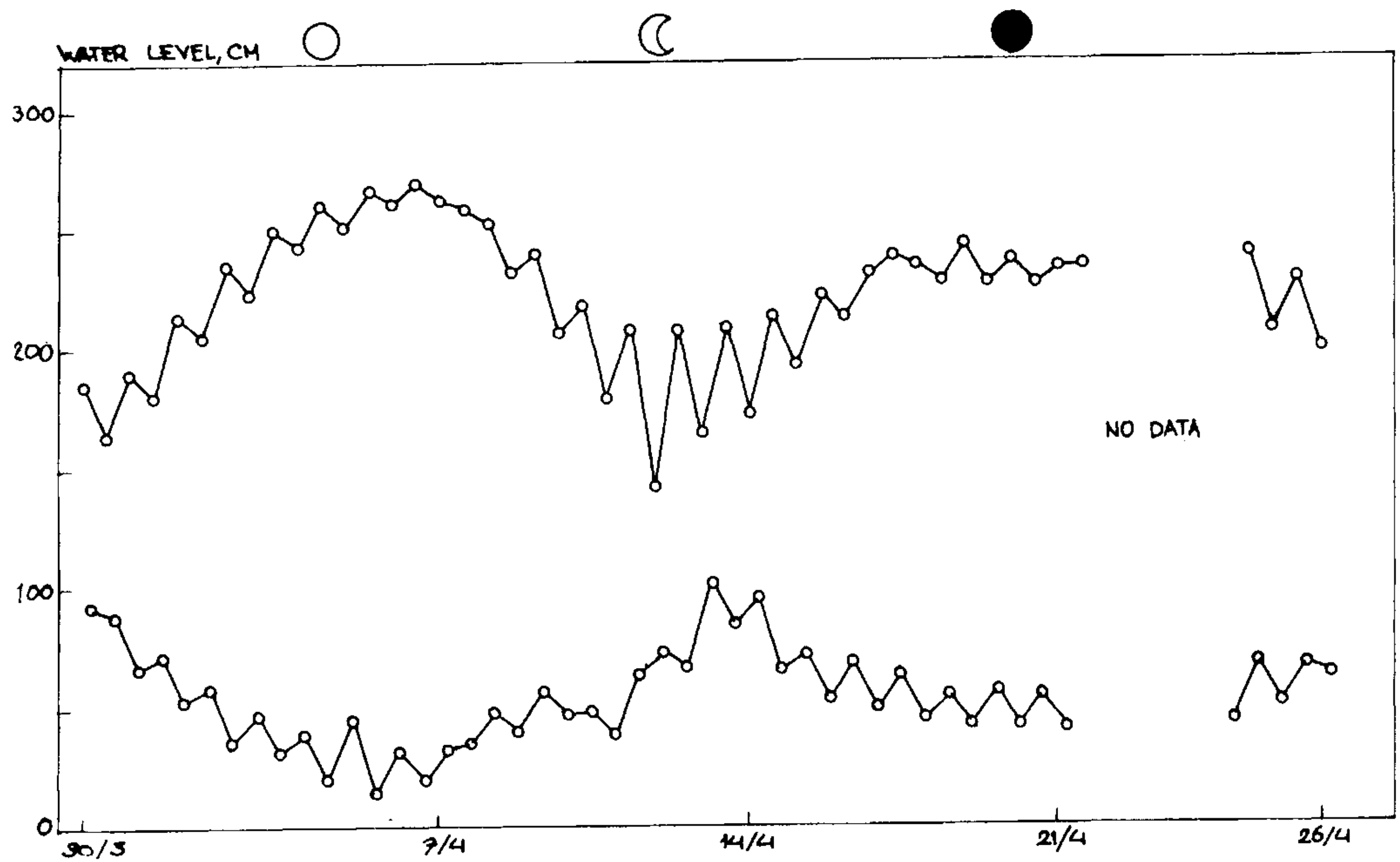


Figure 4.3. Successive registrations of tide levels during high tide (upper curve) and low tide (lower curve) in the course of time during the 1985 registration period. Symbols in the top part denote moon phases, indicating full moon and new moon.

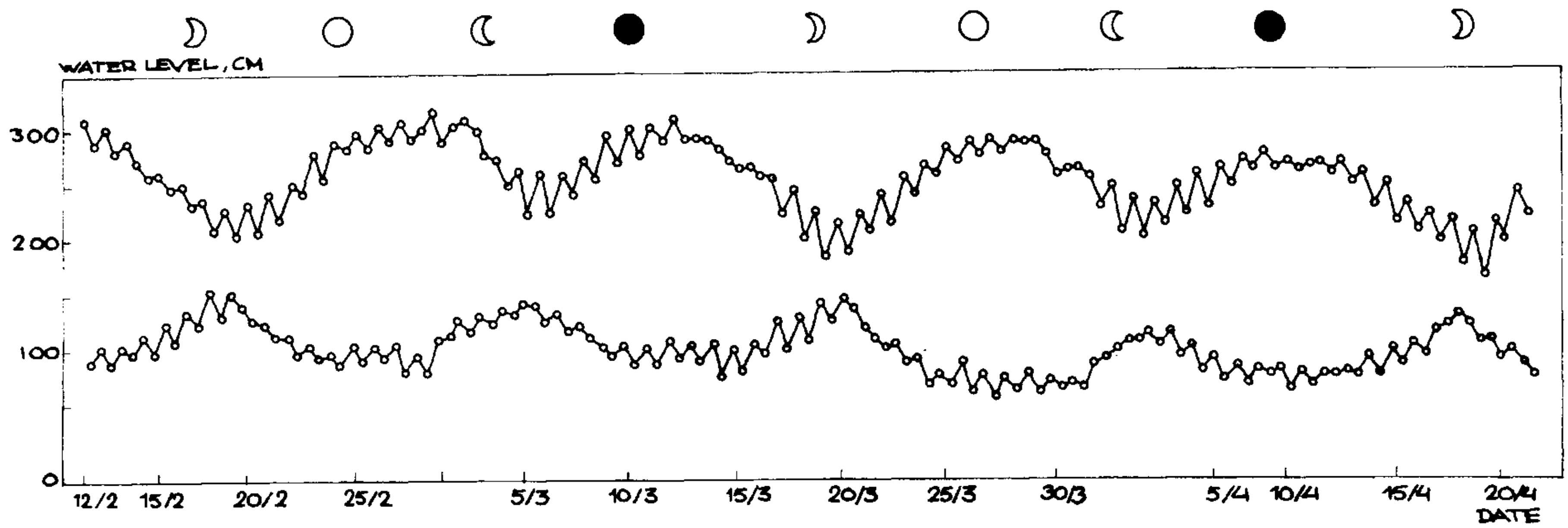


Figure 4.4. Successive registrations of tide levels during high tide (upper curve) and low tide (lower curve) in the course of time during the 1986 registration period. Symbols in the top part denote moon phases, indicating full moon and new moon.

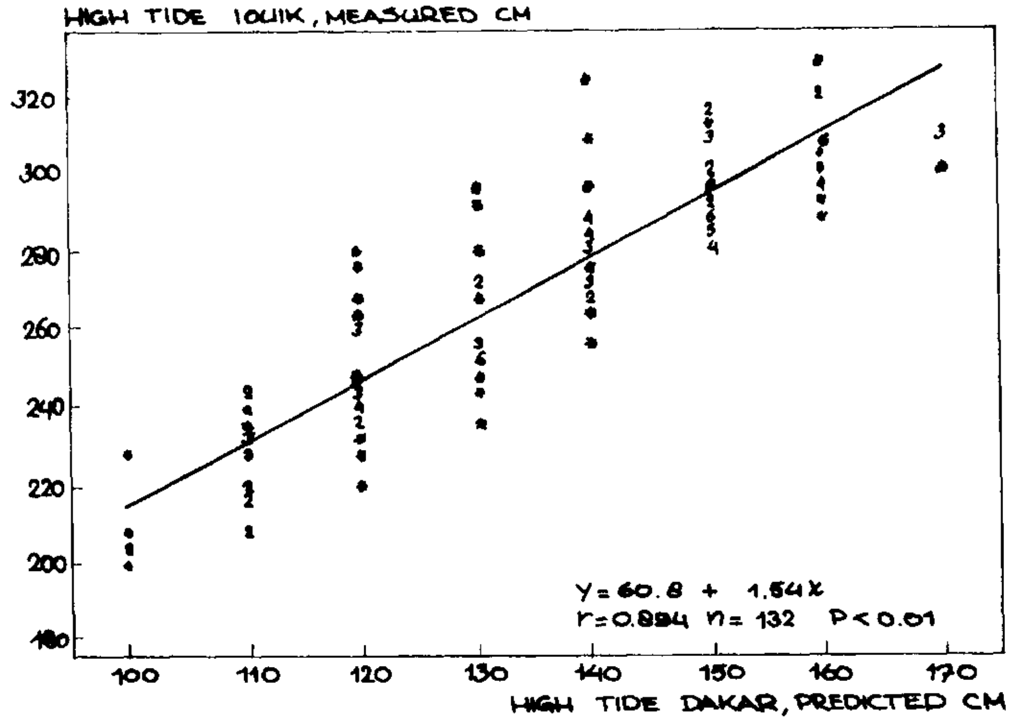


Figure 4.5. Measured water levels at high tide in Iouik (cm) in relation to the predicted water levels in Dakar, Senegal (cm) from 12 February - 21 April 1986.

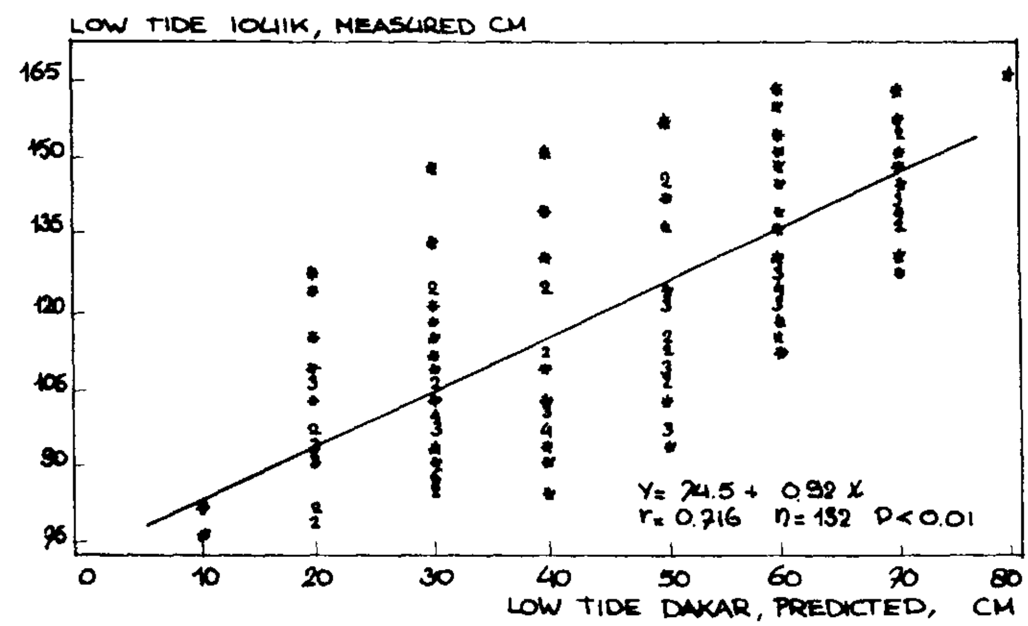


Figure 4.6. Measured water levels at low tide in Iouik (cm) in relation to the predicted water levels in Dakar, Senegal (cm) from 12 February - 21 April 1986.

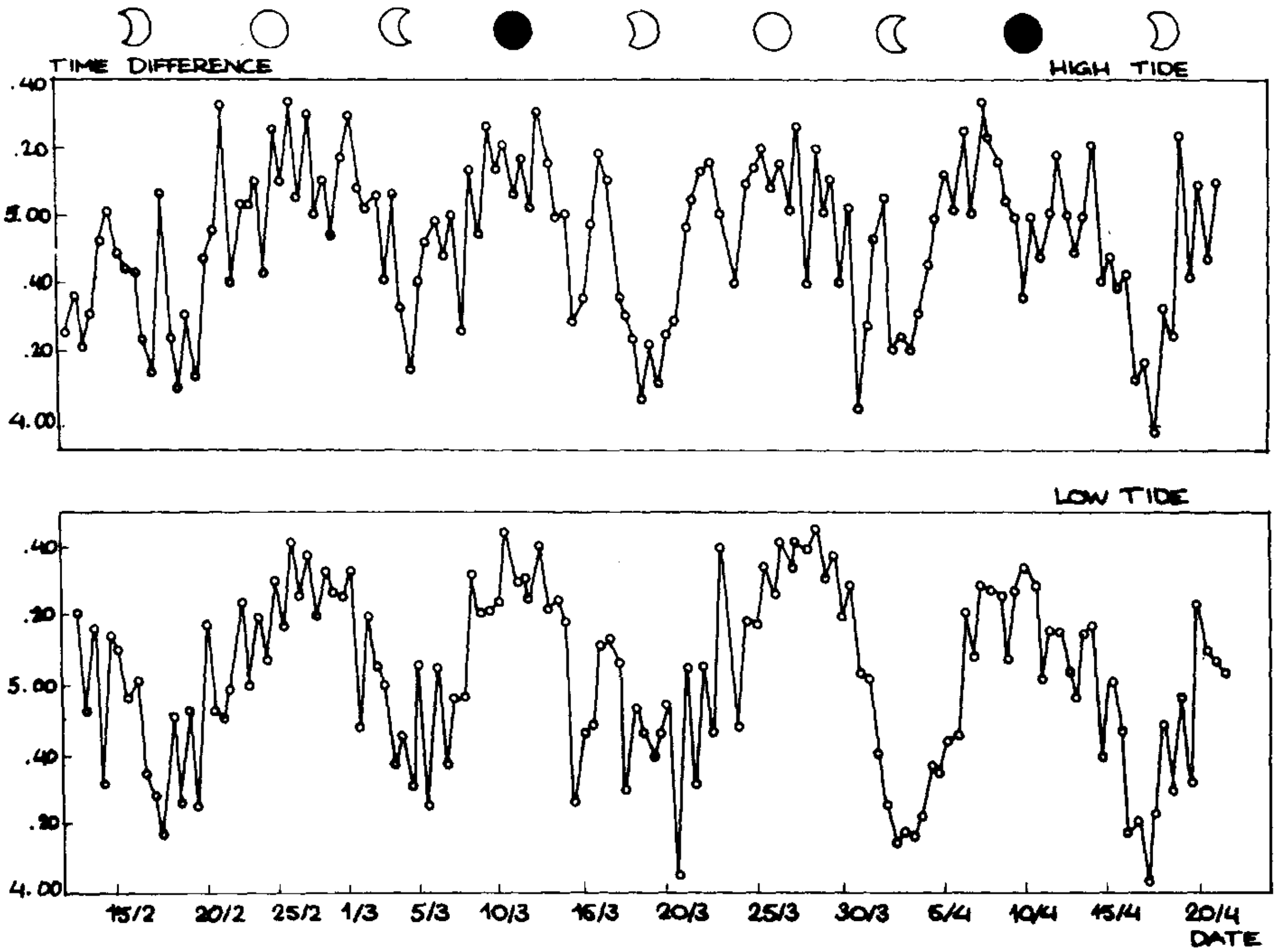


Figure 4.7. Differences in hours and minutes between the moments of high and low tide in 1986 in Iouik (measured) and Dakar, Senegal (predicted) in the course of time. Symbols in the top part denote moon phases (compare figure 4.3).

these samples was to obtain a general picture of the distribution pattern of water temperature and salinity.

4.2 Methods

Registrations were made using a mechanical Ott XX tide registration device, mounted on a hollow pipe of about 6 meters length and 20 cm diameter (Fig. 4.1). The whole installation was borrowed from Rijkswaterstaat, Den Oever (Ministry of Public Works and Transport, Directory Noord-Holland), and was verified and stamped prior to the expeditions. The installation was set up in the channel next to the camp at a site, deep enough to allow for continuous measurements. The registration part consists of a cilinder floating freely at the water surface inside the hollow pipe, which is connected through a wire to a pen. Registrations were made continuously on rotating sheets of paper, the running speed of which is steered by a clock. The final result of the measurements consists of a graph showing continuous registrations of water levels in the course of time.

Seawater temperature was measured with hydrographical thermometers with an accuracy of 0.1 ^{o}C. These were equipped with a small container to store a certain amount of sea water to allow for correct temperature reading. Temperatures at Iouik generally were taken 2-4 times daily, standing kneedeep in the water of the channel close to the Iouik camp. On some days temperatures were taken more frequently to analyse the influence of the tides and air temperature.

Observations at other stations were made from a small boat. Temperature measurements were made with an hydrographical thermometer which was moved through the water at about 0.4 m depth. Temperature readings were made after 1 min.

Sea water samples were collected in polyethylene,bottles thoroughly rinsed with sea water before collecting the samples. The bottles were closed very tightly and transported to the Netherlands where Mr. R. Manuels (Netherlands Institute for Sea Research) carried out the salinity determinations. To this end the samples were diluted with an equal quantity of distilled water (accuracy $\pm$ 0.01 g) after which salinity was determined by measurement of conductivity. The salinity thus determined was multiplied by a factor 2. All measurements were carried out at least in duplo.

4.3 **Results**

4.3.1 Tides

An example of two 24 hours graphs of tide levels is given in figure 4.2. The curve is a typical example of semi-diurnal ocean tidal curve. This is somewhat surprising, considering the fact that the tidal current, coming from the south is blocked by the island of Tidra and has to go about a long way to reach Iouik from the northwest. Apparently the tidal channels between Iouik and the open ocean are wide enough to allow the tidal water masses to flow in and out unhampered. There is an obvious difference in tide height between spring tide (open symbols) and neap tide (dots) as well as generally there is a difference in tide heights between two succeeding high and low tides. This difference, the dissimilarity of the diurnal tide, also appears from figures 4.3 and 4.4 showing the successive levels of high and low tide in 1985 and 1986. The explanation for the diurnal dissimilarity is the position of sun and moon. Both objects, and the interacting gravitational forces they bring about, are positioned quite differently in a 12 hours interval, but are rather comparable in position when considering a 24 hours period. Two successive high and low tide levels therefore may show considerable differences, much more as when two succeeding morning or evening tides are compared. Figure 4.4 also shows that the level of high tides gradually decreases in the course of time. In many places in the world the highest spring tides occur towards the equinoxes, i.e. around 21 March and 21 September 21, when day and night are equally long and sun and moon are most nearly in line. This phenomenon may well explain the decrease in high tide levels, noted in Iouik, but measurements over a longer period will be needed to demonstrate it more clearly.

Figures 4.3 and 4.4 also show that two succeeding spring tides and neap tides have different high and low tide levels. This difference is brought about by differences in gravitational forces, caused by the position of sun and moon in two weeks intervals (alternately positioned on the same side of the earth and on opposite sides). One may also notice that a spring tide leading to a large tidal amplitude is followed by a neap tide showing the same, whereas spring tides with a relatively small amplitude are being followed by neap tides showing the same characteristic.

The average tidal amplitude at Iouik over 3½ spring and neap tide periods (from 18 February - 10 April 1986, corresponding to 90 high tides and 95 low tides) amounts to 1.61 m and therefore coincides with the normal tidal amplitude found on open ocean coasts. During spring tides the tidal amplitude approximately is 2.00 m (1.85-2.15 on average, mean over 4 spring tide periods), during neap tides to 1.00 m (0.80-1.40 m, mean over 5 neap tide periods).

Except for two registrations of the moment of high tide at the island of Nair in 1985 no tide registrations elsewhere at the Banc d'Arguin were made. Data from Nair indicate that high tide can be expected about 5-10 minutes prior to Iouik.

Tides in Iouik were compared to those in Dakar by using our measured data and the predicted data from the Admiralty Tide Tables for Dakar. Tide height at Iouik appears to be highly correlated to those predicted for Dakar (Fig. 4.5 and 4.6). There is, however, quite a large variation in the measured data, especially for low tides. Using figures 4.5 and 4.6 both high and low tides, the low water level at Iouik can be predicted with an accuracy of c. 30 cm (being the range of deviations from the mean), though in most cases with a higher accuracy. Evidently wind is a factor influencing the tide height at Iouik. An analysis of the difference between the prediction for Dakar and the measured value for Iouik, in relation to wind speed and wind direction shows that winds from western directions generally yield somewhat higher water levels in Iouik as predicted. On the other hand winds from easterly directions generally lead to somewhat lower water levels. Our analysis however also does not fully explain the differences we encountered.

The moment of high tide in Iouik on average lags 4 hours and 55 minutes behind Dakar (mean over 133 high tides from 12 February and 21 April 1986). For low tides the time lag amounts to 5 hours and 3 minutes (mean over 133 low tides in the same period). Figure 4.7 demonstrates that around full and new moon the time lag is somewhat larger, both for high water and for low water. For periods around half moon the time lag is relatively short. For high tides around spring the time lag amounts to 5.07 hours (mean over 40 high tides), for high tides around neap tide the time lag is 4.43 hours (n=51). For low tides the figures are 5.24 hours (n=45) and 4.49 hours (n=48) respectively.

4.3.2 Seawater temperatures

Water temperatures in the channel close to the Iouik camp show a gradual increase in the course of the season, starting from approximately 19°C by mid February to about 21°C by mid April. Figure 4.8 clearly shows this increase. At the same time this graph demonstrates that the increase in water temperature coincides to some extent with the air temperature increase. Because of the relatively slow heating up of the water, a sudden increase in air temperatures is not immediately reflected in water temperatures. The same applies for an air temperature decrease but the course of air temperatures is well reflected in water temperature changes.

Apart from changes in seawater temperature during the whole observation period there are notable differences in the course of the day. Figure 4.9 shows an increase in water temperatures as soon as morning sun heats up the water of the channel. The highest water temperatures are measured from 12 a.m. onwards. The best conditions for

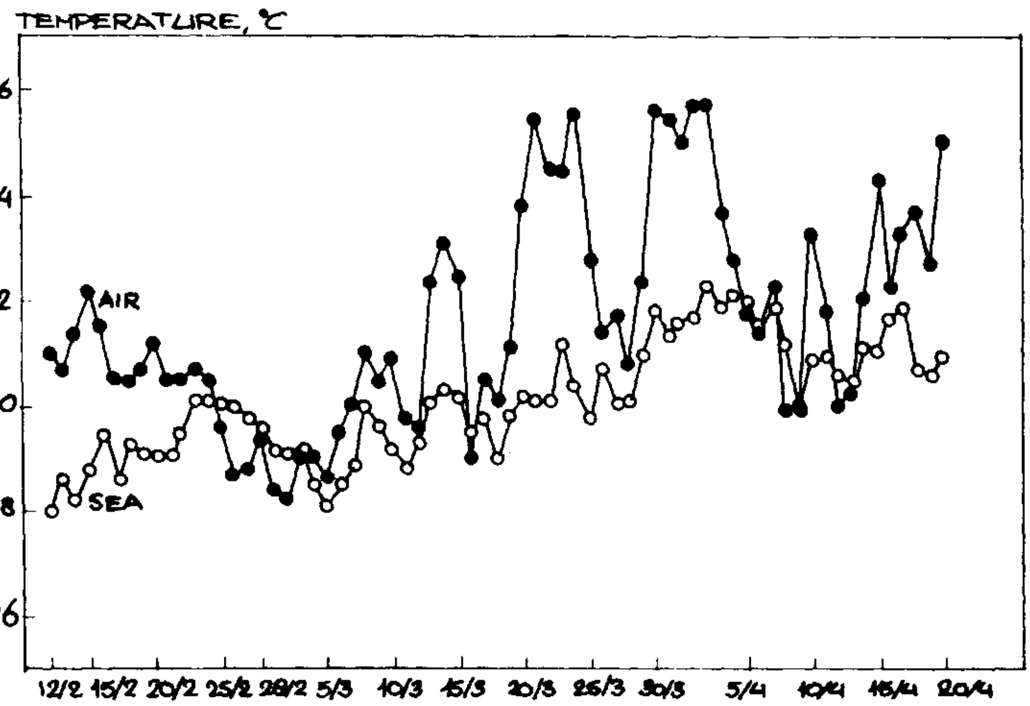


Figure 4.8. Mean sea water temperatures (°C) in the channel near the Iouik camp and daily mean air temperatures (°C) in the course of the 1986 observation period.

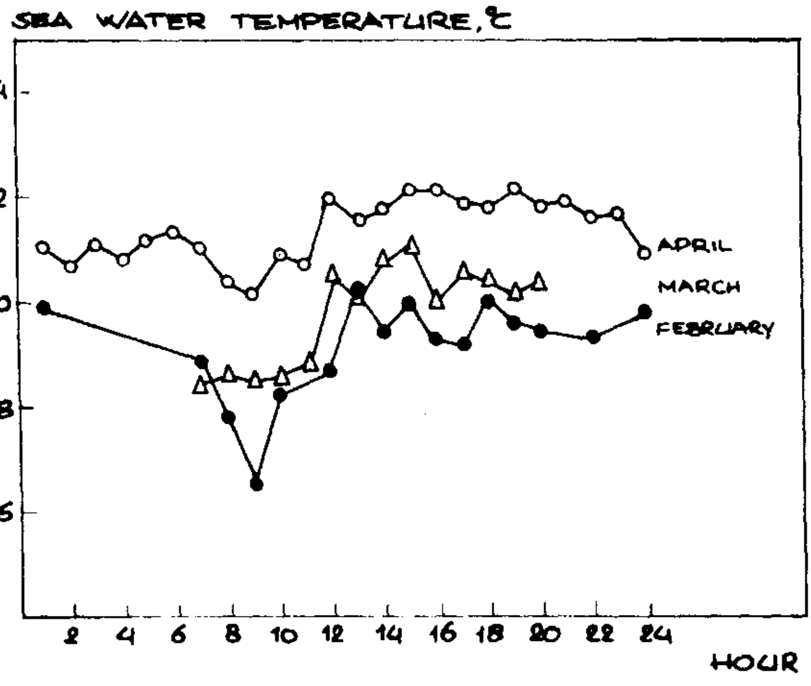


Figure 4.9. Mean sea water temperatures (°C) per hour in the channel near the Iouik camp in February-April 1986.

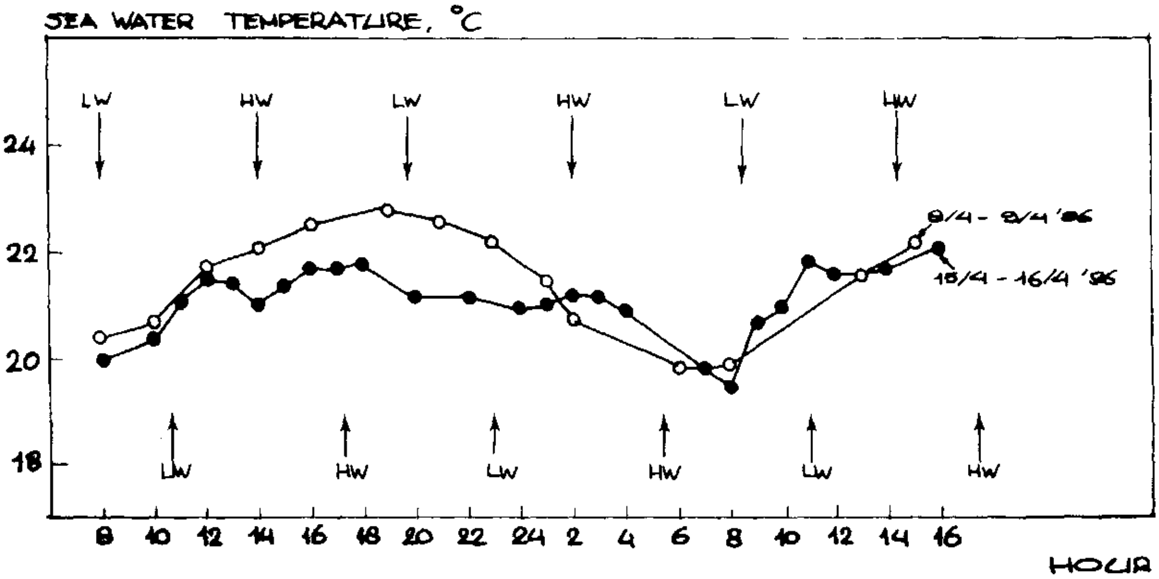


Figure 4.10. Sea water temperatures in the channel near the Iouik camp on 8/9 April 1986 (open circles) and 15/16 April 1986 (dots) in relation to high water (hw) and low water (lw).

taking a refreshing but not unpleasant bath are between 1 and 4 p.m. Somewhat later during the day declining air temperatures turn bathing to be less agreable. During the night seawater temperatures may drop considerably though figure 4.10 demonstrates this is not necessarily the case. Figure 4.10 shows successive seawater temperatures in two days in relation to high and low tide. On 15 April the temperature in the channel at 8 a.m. amounted to 20°C (lower graph). As a result of an increasing air temperature in the course of the day, the water temperature in the channel decreased as well, until about 1 hour after low water. By then somewhat colder water from the large tidal inlet west of Iouik came in, causing a temporary drop in water temperatures. Maximum air temperatures on this day were measured between 12 a.m. and 3 p.m. and amounted to 26.4°C. These temperatures resulted in a renewed warming up of the channel water. Due to the fact that air temperatures during the night only slightly dropped to 21°C, the water temperature did not decrease as well. On the contrary, the incoming high tide even allowed for a slight increase at 2 a.m. in the morning of 16 April. Minimum air temperature in the early morning was 18.3°C. These relatively low air temperatures in the early morning at the same time resulted in a gradual cooling off of the channel water on 16 April, from 8 a.m. onwards the course of the seawater temperatures is very much the same as on the day before. 8 April, was a warmer day as compared to 15 April. Maximum temperatures were measured around 12 a.m. and amounted to 29.6°C. These relatively high maximum temperatures resulted in higher water temperatures as compared to 15 April. The 9 hours difference in high and low water resulted in a more gradual course of water temperatures.

Table 4.1. Observations of temperature and salinity near Iouik in April 1986.

Nr.	Place	Date	Time	HW/LW Iouik	Temp.	Sal.
1.	Near Biological Station	11 April	7.15 h	LW 9.15	-	40.82
2.	Opposite Iouik	11 "	7.30 h	"	-	40.54
3.	N of Tidra	11 "	7.40 h	"	-	39.41
4.	NW of Tidra, NE of Arel	11 "	8.00 h	"	-	38.21
5.	Main channel N of Arel	11 "	8.30 h	"	-	38.27
6.	S of Arel	11 "	9.00 h	"	-	38.23
7.	Baie d'Aouatif, near Biol. Station	12 April	15.55	HW 16.00	21°.4	40.33
8.	" , NW corner	12 "	16.00	"	21°.4	40.43
9.	" , N part	12 "	16.05	"	21°.5	40.60
10.	" , NE corner	12 "	16.10	"	21°.4	41.10
11.	" , NE corner, end of channel	12 "	16.15	"	21°.4	41.22
12.	" , E part over flats	12 "	16.20	"	22°.0	41.36
13.	" , near Biol. Station	16 April	12.15	LW 12.00	21°.4	40.76
14.	" , NW corner	16 "	12.23	"	21°,2	40.94
15	" , N part	16 "	12.28	"	21°.2	41.01
16.	Baie d'Aouatif, NE corner	16 "	12.32	LW 12.00	21°.2	41.63
17.	" , NE corner, end of channel	16 "	12.37	"	21°.4	41.88
18.	Baie d'Aouatif, near Biol. Station	16 "	13.40	"	21°.2	40.73
19.	Opposite Iouik	16 "	13.45	"	20°.9	40.23
20.	N of Iouik, entrance of channel	16 "	14.00	"	22°.0	39.89
21.	N of Kiaone-West	16 "	15.07	"	22°.2	39.73
22.	Halfway Kiaone and Iouik	16 "	15.30	"	22°.2	39.92
23.	NNE of Arel	7 April	-	LW at Arel	-	37.84
24.	S part of Bay NE of Serini	20 April	-	HW at Serini	-	54.50

4.3.3 Salinity

Table 4.1 summarizes all observations. Figure 4.11 presents a general picture of the distribution of salinity in the vicinity of Iouik in April 1986. Figure 4.12 gives the results of two series of observations in the main channel of the Baie d'Aouatif.

Earlier observations on temperature and salinity of the Banc d'Arguin have been published by Reyssac (1977) and Sevrin-Reyssac (1982, 1984). These may be summarized as follows. In the offshore areas salinities are about 35-36^{o}/oo S. In the area around Arel values of about 38^{o}/oo occur, whereas close to the shore (e.q. near Iouik and Teichot) values over 40^{o}/o occur. In hydrographically isolated waters, such as the Baie de St.

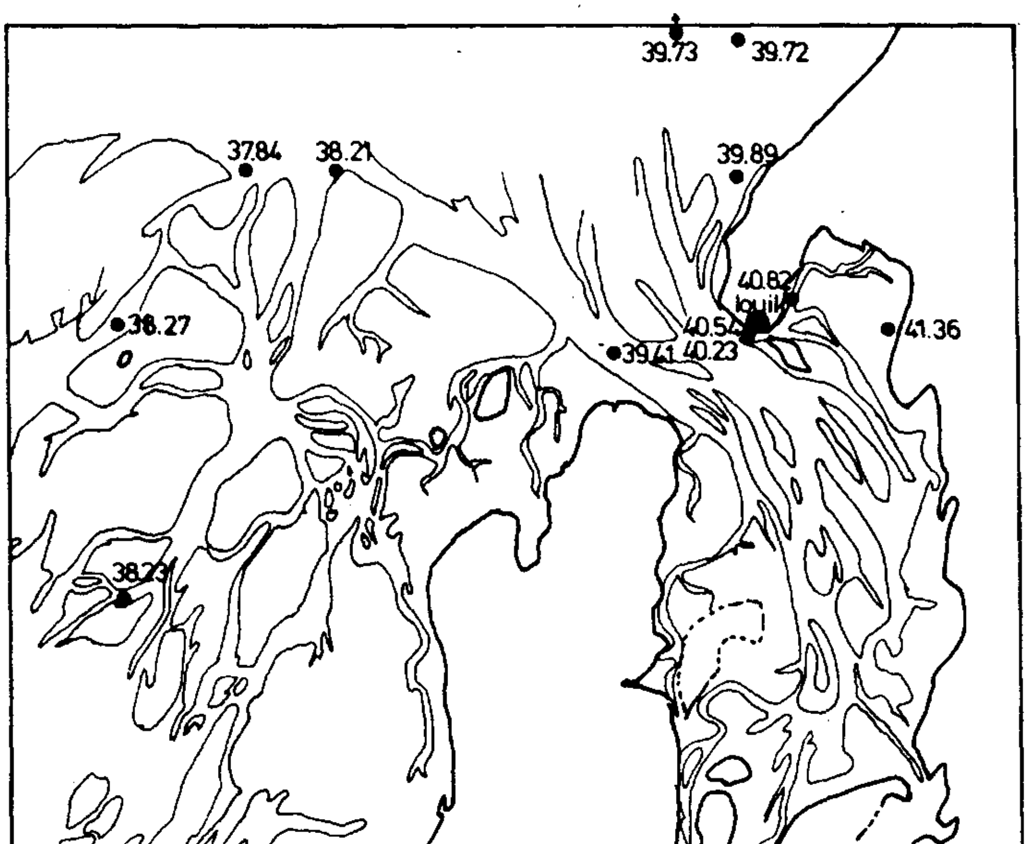


Figure 4.11. Salinity (o/oo) in tidal channels.

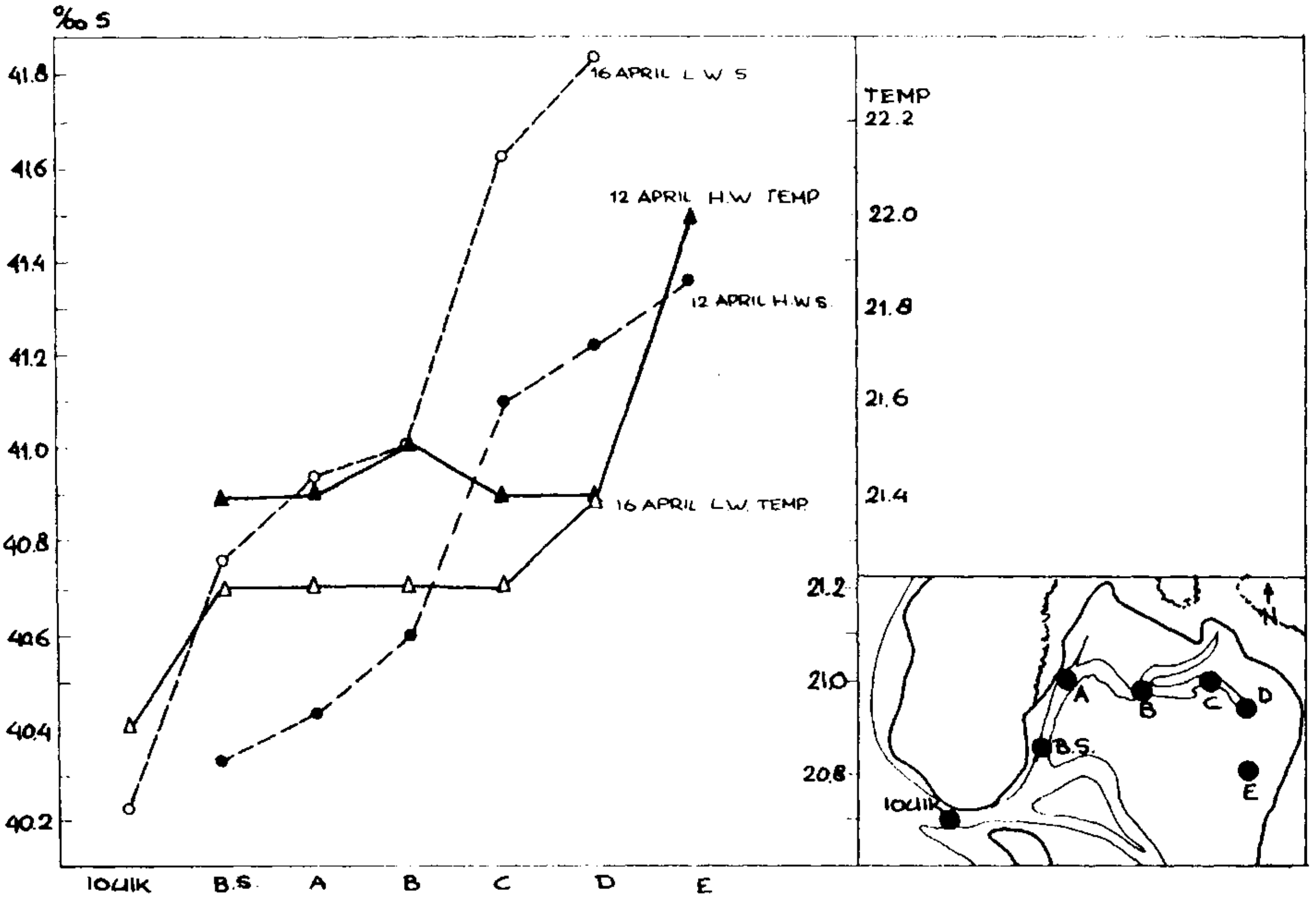


Figure 4.12. Salinity (o/oo) and temperature of the sea water in the Baie d'Aouatif.

Jean, very high values (up to 81.6^{o}/oo S) have been registered.

Our observations fit perfectly in this pattern. Near Arel we observed salinities of about 38^{o}/oo, near Iouik 40–41^{o}/oo and in the isolated bay northeast of Serini we found 54.5^{o}/oo. Hence, a gradient of salinity occurs from the coast to open sea. This is confirmed by the data in figure 4.12. In the main channel of the Baie d'Aouatif an increase of salinity was observed from the seaward end at Iouik to the landward end, with higher salinity values at low tide. As pointed out before this is due to the strong evaporation at the Banc d'Arguin.

Temperature measurements show a more regular pattern. Table 4.1 and figure 4.3 show that the maximum difference was only 1.3^{o}C. Temperatures recorded by Sevrin-Reyssac (1984) in March are slightly higher.

5. WADER AND WATERBIRD COUNTS 1985

Theunis Piersma, Abou Gueye & Cheikhna Mbaré

During the expedition several counts of the waders and waterbirds of certain areas were made. Both on the Presqu'ile de Cap Blanc near Nouadhibou and in the Baie d'Aouatif and surroundings near Iouik, counts were performed. Figure 5.1 shows the counting trajects in the Baie d'Aouatif and figure 5.2 the delineation of the counting trajects on Presqu'il de Cap Blanc. It should be clear that on Presqu'ile de Cap Blanc not all areas where waders could possibly occur, were covered. The northern part of the Baie de l'Etoile, and the beaches near La Guera on the west side of the peninsula, for example, were not visited during the counts. The results of the wader counts are presented in tables 5.1 to 5.8 and the results of the waterbird counts in tables 5.9 to 5.16.

Table 5.1 summerizes the results of the three counts in the Baie d'Aouatif and compares these with the results of an earlier count of the same area, in January 1980 (Altenburg et al 1982). It was encouraging to discover that the total number of 141,000 waders and also the breakdown in different species is comparable between the January 1980 and the March 1985 count. Encouraging, because this suggests both some constancy in wader populations, consistency between the counts and only limited departure of waders to the north before we (finally!!) arrived on the study site. In spring 1985, the total numbers of waders steadily declined. One of the counting trajects (VI, the Northwest Bay or Ebelk Aiznai in Hassania) was counted more frequently during the study period (Table 5.2; see also Table 5.17 for data from 1986), but wader numbers showed the same general trends there.

The counts on the Presqu'ile de Cap Blanc were made just before and just after the period of stay at Iouik, and therefore yield data on numbers of waders from a longer time span (range of dates) than for the Baie d'Aouatif. Table 5.6 shows that numbers of waders counted during low tide or during high tide were not very different (not consistently different between the species anyway). A comparison between tables 5.6 and 5.7 shows that between 15 March and 3 May, total numbers had declined by 1500/4000 x 100% = 38%. This compares with a 42% decline in the Baie d'Aouatif (Table 5.1).

The results of the waterbird counts in January 1980 and March 1985 also show rather good resemblance. Only the number of Spoonbills appeared to have increased dramatically (due to the settlement in the breeding colony on the Isle of Zira in early March), and the number of Lesser Black-backed Gulls had decreased (departure on northward migration?). Tables 5.14 to 5.16 nicely illustrate that the number of (mainly juvenile) Greater Flamingo's around Nouadhibou remained rather constant through March-May.

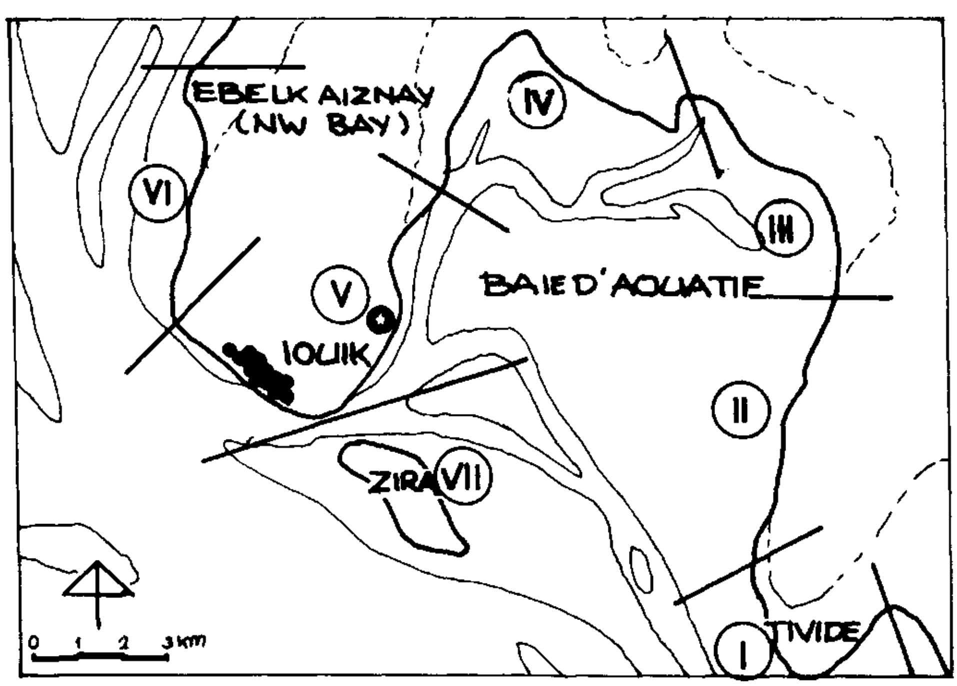


Figure 5.1. Map of the Baie d'Aouatif, the Presqu'île d'Iouik and surroundings. The star indicates the camp site. Counting trajects are indicated by Roman numerals.

Table 5.1. Results of the high tide counts of waders in the Baie d'Aouatif and surroundings in spring 1985. For comparison, the results of the high tide count of the same area by Altenburg et al. (1982) in January 1980 are also listed.

	19 January 1980	24 March 1985	17 April 1985	25 April 1985	Departed 24 March-25 April in %
Oystercatcher	4987	1065	275	393	- 63%
Avocet	0	0	4	0	-
Ringed Plover	11053	4522	3555	2928	- 35%
Kentish Plover	870	1383	850	456	- 67%
Grey Plover	2231	1253	1921	1702	+ 36%
Knot	40560	45513	40754	19028	- 58%
Sanderling	978	479	520	938	+ 96%
Little Stint	703	3122	5052	4345	+ 46%
Curlew Sandpiper	8385	4412	13633	5164	+ 17%
Dunlin	43427	56085	22163	31845	- 43%
Bar-tailed Godwit	32107	18518	14578	13312	- 28%
Whimbrel	612	245	476	244	0%
Curlew	358	320	52	0	-100%
Redshank	3552	2978	965	699	- 77%
Greenshank	486	54	148	237	+339%
Common Sandpiper	0	0	0	17	-
Turnstone	1539	640	1016	758	+ 18%
Total	151848	140589	105912	81983	- 42%

Table 5.2. Results of the high tide counts of waders in Ebelk Aiznai (the Northwest Bay, area VI) in spring 1985. On 14 April only the Bar-tailed Godwits were counted here: 2304 individuals. + = present, but not counted. The count of 7 May was kindly made available by Pierre Campredon.

	24 March	3 April	16 April	22 April	24 April	27 April	7 May
Oystercatcher	49	116	34	130	45	75	109
Ringed Plover	540	264	344	221	180	400	330
Kentish Plover	15	90	13	+	60	5	102
Grey Plover	325	127	400	646	385	232	321
Knot	10830	8383	9080	6326	6200	3500	3191
Sanderling	30	50	104	495	55	322	160
Little Stint	100	60	375	700	350	315	140
Curlew Sandpiper	300	195	3210	608	700	695	1082
Dunlin	3700	3220	2375	2560	2200	2422	1437
Bar-tailed Godwit	1282	2275	2507	1410	1525	822	760
Whimbrel	+	+	271	210	34	190	129
Curlew	70	3	1	3	0	0	0
Redshank	51	200	191	14	+	68	55
Greenshank	0	10	1	0	0	60	181
Common Sandpiper	0	0	0	0	0	0	3
Turnstone	21	24	193	201	?	158	63

Table 5.3. Results of the high tide wader count on 24 March 1985 in the Baie d'Aouatif and surroundings. See figure 5.1 for delineation of the 7 counting trajects.

	Traject							
	I	II	III	IV	V	VI	VII	Total
Oystercatcher	126	327	28	397	9	49	80	1065
Ringed Plover	603	715	363	1111	390	540	800	4522
Kentish Plover	160	70	218	770	25	15	125	1383
Grey Plover	233	450	86	20	9	325	130	1253
Knot	9716	21352	365	2760	0	10830	500	45513
Sanderling	28	7	39	140	165	30	70	479
Little Stint	30	655	260	1720	7	100	350	3122
Curlew Sandpiper	100	1300	848	1540	4	300	320	4412
Dunlin	14305	16825	7155	7080	3685	3700	3335	56085
Bar-tailed Godwit	738	10978	601	3509	10	1282	1400	18518
Whimbrel	17	28	73	60	7	+	60	245
Curlew	10	20	17	43	0	70	160	320
Redshank	872	1800	0	165	0	51	90	2978
Greenshank	0	20	0	14	0	0	20	54
Turnstone	23	72	17	35	432	21	40	640
Total								140598

Table 5.4. Results of the high tide wader count on 17 April 1985 in the Baie d'Aouatif and surroundings. See figure 5.1 for delineation of the 7 counting trajects. In traject IV three Avocets were seen, and in traject VI one.

	Traject							
	I	II	III	IV	V	VI	VII	Total
Oystercatcher	33	39	9	51	34	34	75	275
Ringed Plover	287	972	870	1080	2	344	0	3555
Kentish Plover	56	31	420	314	16	13	0	850
Grey Plover	584	241	398	232	0	400	66	1921
Knot	4442	11400	5800	2330	2	9680	7700	40754
Sanderling	57	33	90	131	105	104	0	520
Little Stint	1125	190	1660	1702	0	375	0	5052
Curlew Sandpiper	3541	5100	730	700	2	3210	350	13633
Dunlin	2258	1560	4700	7365	5	2375	3900	22163
Bar tailed Godwit	3581	1503	1508	1670	9	2507	3800	14578
Whimbrel	105	0	51	37	12	271	0	476
Curlew	0	0	0	11	0	1	40	52
Redshank	103	621	0	50	0	191	0	965
Greenshank	20	116	1	10	0	1	0	148
Turnstone	89	211	0	44	475	193	4	1016
Total								105908

Table 5.5. Results of the high wader counts on 25 April 1985 in the Baie d'Aouatif and surroundings. See figure 5.1 for delineation of the 7 counting trajects.

	Traject							
	I	II	III	IV	V	VI	VII	total
Oystercatcher	58	27	28	95	9	45	131	393
Ringed Plover	173	340	1410	546	99	180	180	2928
Kentish Plover	30	38	150	160	18	60	0	456
Grey Plover	174	173	626	285	9	385	50	1702
Knot	2800	250	6938	2290	0	6200	550	19028
Sanderling	46	10	510	192	45	55	80	938
Little Stint	850	580	850	1620	55	350	40	4345
Curlew Sandpiper	560	604	660	1980	10	700	650	5164
Dunlin	7400	4510	7700	8215	280	2200	1540	31845
Bar-tailed Godwit	1600	370	3480	4052	5	1525	2280	13312
Whimbrel	66	41	69	21	8	34	5	244
Curlew	0	0	0	0	0	0	0	0
Redshank	30	5	275	8	0	378	3	599
Greenshank	30	0	150	27	0	0	30	237
Common Sandpiper	0	1	16	0	0	0	0	17
Turnstone	22	33	190	43	263	140	67	750
Total								81983

Table 5.6. Results of the wader counts of part of the Presqu'île de Cap Blanc (see figure 5.2) on 15 March 1985.

	Ia	IIa	IIb	IIIa	IIIb	Total	Total
Hour	11-13	13-17	16-18	10-13	17-19		
Tide	low	after low	before high	low	high	a	b
Stone Curlew	0	0	0	20	35	20	35
Oystercatcher	32	16	27	35	54	94	81
Little Ringed Plover	0	0	0	2	5	2	5
Ringed Plover	76	6	51	279	320	351	371
Kentish Plover	52	5	103	8	10	65	113
Grey Plover	66	89	67	25	10	180	77
Knot	180	30	180	82	15	292	195
Sanderling	72	1357	1869	74	195	1503	2059
Little Stint	0	0	25	0	0	0	25
Curlew Sandpiper	0	0	2	0	0	0	2
Dunlin	597	0	50	64	28	661	78
Ruff	0	0	0	0	1	0	1
Black-tailed Godwit	0	0	0	1	1	1	1
Bar-tailed Godwit	341	35	124	99	110	475	234
Whimbrel	48	1	1	12	10	61	11
Curlew	14	1	2	2	12	17	14
Redshank	59	0	1	1	1	61	2
Greenshank	0	0	1	12	21	12	22
Wood Sandpiper	0	0	2	0	0	0	2
Common Sandpiper	4	0	1	6	6	10	7
Turnstone	88	21	19	112	104	221	123
Total						4026	3467

Table 5.7. Results of the wader count of part of the Presqu'île de Cap Blanc (see figure 5.2) on 3 May 1985 (15 March 1985 is given for comparison).

	I	II	III	Totals 15 March	3 May
Oystercatcher	2	13	18	94	33
Little Ringed Plover	0	0	10	5	10
Ringed Plover	16	11	83	371	110
Kentish Plover	5	103	20	113	128
Grey Plover	49	32	33	180	114
Knot	90	22	139	292	251
Sanderling	241	385	631	1503	1257
Little Stint	1	25	6	25	32
Curlew Sandpiper	1	0	0	2	1
Dunlin	56	45	27	661	128
Bar-tailed Godwit	153	34	35	475	222
Whimbrel	41	3	9	61	53
Curlew	3	0	3	17	6
Redshank	33	0	0	61	33
Common Sandpiper	4	2	2	10	8
Turnstone	96	86	108	221	290
Total				4091	2676

Table 5.8. Results of a wader count of the old harbour of Nouadhibou (Area III, Fig. 5.2) on 10 May 1985.

Species	**Number**
Stone Curlew	**2**
Oystercatcher	**11**
Little Ringed Plover	**2**
Ringed PLover	**75**
Kentish Plover	**17**
Grey Plover	**8**
Knot	**142**
Sanderling	**215**
Little Stint	**5**
Curlew Sandpiper	**0**
Dunlin	**12**
Bar-tailed Godwit	**83**
Whimbrel	**8**
Curlew	**1**
Turnstone	**50**
Total	**631**

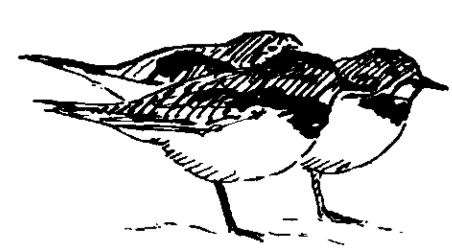


Table 5.9. Results of the high tide counts of waterbirds in the Baie d'Aouatif and surroundings in spring 1985. For comparison, the results of the count of the same area in January 1980 (Altenburg et al. 1982) are also listed.

	19 January 1980	24 March 1985	16/17 April 1985	24/25 April 1985
Cormorant	253	308	158	287
Long-tailed Cormorant	875	920	483	471
White Pelican	20	0	6	13
W. Reef Heron (blue)	101	53	75	217
Little Egret (white)	45	11	0	
Grey Heron	186	172	104	83
Spoonbill	191	1043	843	-
Greater Flamingo	360	480	424	491
Black-headed Gull	12	6	0	1
Grey-headed Gull	45	22	82	26
Slender-billed Gull	218	713	2435	1666
Lesser Black-backed Gull	814	25	8	4
Gull-billed Tern	8	0	107	191
Caspian Tern	391	10	5	234
Royal Tern	114	360	734	258
Sandwich Tern	4	0	8	1
Common Tern	0	30	162	129
Bridled Tern	0	0	0	2
Little Tern	14	0	43	62
Black Tern	0	0	2	0

Table 5.10. Results of the count of waterbirds in the Baie d'Aouatif and surroundings on 24 March 1985. See figure 5.1 for delineation of the 7 counting trajects. On traject II no birds were noticed.

	Traject						
	I	III	IV	V	VI	VII	total
Cormorant	0	0	18	0	90	200	308
Long-tailed Cormorant	0	0	0	0	320	600	920
W. Reef Heron (blue)	2	0	0	1	15	35	53
Little Egret (white)	1	0	0	0	7	3	11
Grey Heron	40	0	26	0	60	46	172
Spoonbill	95	0	48	0	200	700	1043
Greater Flamingo	260	122	13	0	65	20	480
Black-headed Gull	0	0	0	6	0	0	6
Grey-headed Gull	1	0	0	4	2	15	27
Slender-billed Gull	17	0	7	139	0	550	713
Lesser Black-backed Gull	0	0	25	0	0	0	25
Caspian Tern	0	0	0	0	10	0	10
Royal Tern	0	0	0	0	70	290	360
Common Tern	0	0	0	0	30	0	30

Table 5.11. Results of the count of water birds in the Baie d'Aouatif and surroundings on 16/17 April 1985. See figure 5.1 for delineation of the 7 counting trajects.

	Traject							
	I	II	III	IV	V	VI	VII	total
Cormorant	0	0	12	3	0	16	127	158
Long-tailed Cormorant	0	0	15	45	8	138	277	483
White Pelican	0	0	0	0	0	0	6	6
W. Reef Heron (blue)	0	0	2	5	11	4	53	75
Grey Heron	4	16	5	15	0	23	41	104
Spoonbill	3	0	0	12	0	28	800	843
Greater Flamingo	75	67	76	109	0	51	46	424
Grey-headed Gull	0	0	0	0	2	0	80	82
Slender-billed Gull	0	0	0	5	78	27	2325	2435
L. Black-backed Gull	3	0	0	5	0	0	0	8
Gull-billed Tern	35	31	13	8	0	0	20	107
Caspian Tern	0	3	2	0	0	0	0	5
Royal Tern	4	1	0	0	15	204	510	734
Sandwich Tern	0	0	0	2	0	6	0	8
Common Tern	0	0	0	2	30	130	0	162
Little Tern	2	0	0	0	2	39	0	43
Black Tern	0	0	0	0	0	2	0	2

Table 5.12. Results of the cour* of waterbirds in the Baie d'Aouatif and surroundings on 24/25 April 1985. See figure 5.1 for delineation of the 7 counting trajects.

	Traject							
	I	II	III	IV	V	VI	VII	total
Cormorant	4	3	6	3	1	20	250	287
Long-tailed Cormorant	4	0	0	20	0	60	387	471
White Pelican	1	0	0	0	0	0	12	13
W. Reef Heron (blue)	0	0	0	0	1	0	216	217
Grey Heron	0	7	0	16	1	5	54	83
Spoonbill	0	11	0	9	0	17	+	> 37
Greater Flamingo	64	0	194	72	0	70	91	491
Black-headed Gull	0	0	0	0	1	0	0	1
Grey-headed Gull	0	0	0	0	8	1	17	26
Slender-billed Gull	1	2	12	150	10	31	1460	1666
L. Black-backed Gull	0	0	0	0	0	0	4	4
Gull-billed Tern	48	23	21	8	2	4	85	191
Caspian Tern	1	0	7	0	5	1	220	234
Royal Tern	0	0	0	0	10	28	220	258
Sandwich Tern	0	0	0	0	1	0	0	1
Common Tern	3	0	0	0	6	120	0	129
Bridled Tern	0	0	0	0	0	0	2	2
Little Tern	0	0	0	0	10	52	0	62

Table 5.13. Results of the high tide counts of waterbirds in Ebelk Aiznai (the Northwest Bay, area IV) in spring 1985.

	24 March	16 April	22 April	24 April	27 April	7 May
Cormorant	90	16	95	20	40	72
Long-tailed Cormorant	320	138	260	60	30	198
W. Reef Heron (blue)	15	4	4	0	0	2
Little Egret (white)	7	0	0	0	0	0
Grey Heron	60	23	4	5	14	4
Spoonbill	200	28	8	17	34	25
Greater Flamingo	65	51	60	70	73	167
Grey-headed Gull	2	0	1	0	0	0
Slender-billed Gull	0	21	31	?	0	20
L. Black-backed Gull	0	0	0	?	1	0
Gull-billed Tern	0	0	4	?	+	21
Caspian Tern	10	0	1	?	0	6
Royal Tern	70	204	28	?	40	32
Sandwich Tern	0	6	0	?	3	17
Common Tern	30	130	120	?	6	70
Little Tern	0	39	52	?	49	51
Black Tern	0	2	0	?	0	31

Table 5.14. Results of the counts of of waterbirds of part of the Presqu'île de Cap Blanc (see figure 5.2) on 15 March 1985.

Hour Tide	Ia 11-13 low	IIa 13-17 after low	IIb 16-18 before high	IIIa 10-13 low	IIIb 17-19 high	Total a	Total b
Cormorant	0	23	11	7	6	30	17
Cattle Egret	0	0	0	6	0	6	0
W. Reef Heron (blue)	0	0	0	1	1	1	1
Little Egret (white)	10	1	1	2	1	13	2
Grey Heron	10	9	6	33	36	52	42
Spoonbill	16	1	0	12	12	29	12
White Stork	0	6	6	0	0	6	6
Greater Flamingo	12	0	0	31	31	43	31
Black-headed Gull	0	0	0	42	120	42	120
Slender billed Gull	0	0	61	20	254	20	315
L.Black-backed Gull	0	362	270	178	420	540	690
Caspian Tern	2	63	52	74	39	139	91
Royal Tern	0	16	1	8	0	24	1
Sandwich Tern	0	8	91	12	10	20	101
Common Tern	0	2	0	8	0	10	0

Table 5.15. Results of the counts of waterbirds of part of the Presqu'île de Cap Blanc (see figure 5.2) on 3 May 1985.

	I	II	III	Total
Cormorant	0	3	0	3
Cattle Egret	0	0	1	1
W. Reef Heron (blue)	1	0	0	1
Little Egret (white)	5	1	4	10
Grey Heron	3	0	25	28
Spoonbill	0	9	7	16
Greater Flamingo	29	6	31	66
Slender-billed Gull	0	0	60	60
L. Black-backed Gull	14	321	350	685
Caspian Tern	3	16	45	64
Royal Tern	0	28	0	28
Sandwich Tern	0	80	68	148
Common Tern	0	395	30	425
Black Tern	0	37	7	44
White-winged Tern	0	0	3	3
Little Tern	7	39	2	48

Table 5.16. Results of a count of waterbirds of the harbour of Nouadhibou (Area III, Fig. 5.2) on 10 May 1985.

Species	Number
W. Reef Heron (blue)	2
Little Egret (white)	3
Grey Heron	12
Spoonbill	8
Greater Flamingo	26
Black-headed Gull	15
Slender-billed Gull	13
Lesser Black-backed Gull	130
Audouin's Gull	29
Gull-billed Tern	1
Caspian Tern	118
Royal Tern	23
Sandwich Tern	16
Common Tern	53
Little Tern	7
Black Tern	15

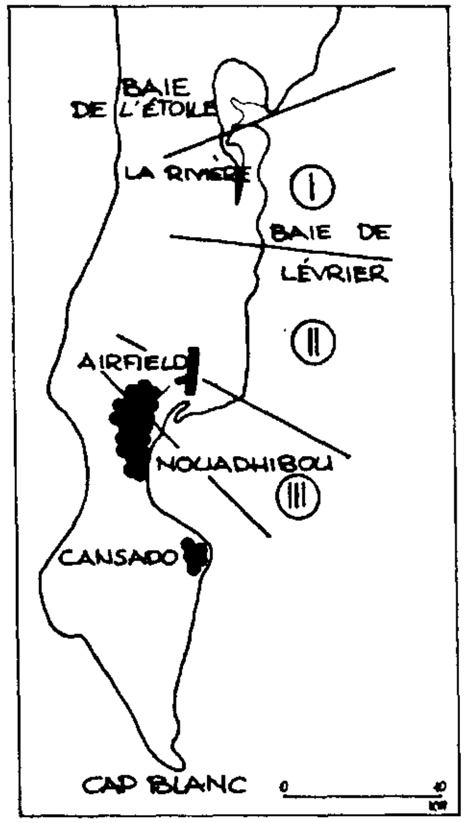


Figure 5.2. Map of Presqu'île de Cap Blanc indicating the counting transects I, II, and III.

Table 5.17. Results of some incidental high tide counts in the Northwest Bay in February 1986.

Species	8 February	13 February	22 February
Oystercatcher	220	210	287
Ringed Plover	485	700	649
Kentish Plover	?	21	30
Grey Plover	269	642	115
Knot	5600	2750	3500
Sanderling	289	295	189
Little Stint	?	300	164
Curlew Sandpiper	520	440	500
Dunlin	4025	1950	4600
Bar-tailed Godwit	4100	2190	?
Whimbrel	400	8	511
Curlew	42	80	73
Redshank	490	67	41
Greenshank	7	13	1
Turnstone	148 (12 Feb.)	69	57

6. VISIBLE MIGRATION 1985

Nelly E. van Brederode

6.1 Method

During our study at Iouik we made many observations on visible migration, most of them in the Baie d'Aouatif. It was in this area that we were most active with mist netting, cannon-netting and feeding observations. Apart from the observations during these activities systematic data were collected at the north side of this bay. During these observations time, locality, species, number of birds in each flock, height and direction were recorded. On a few occasions, like when watching from a hide, it was possible to make notes on the plumage and sex of the birds.

6.2 Results

In this chapter the results of our migration observations at the Iouik peninsula and the surrounding mudflats of the Northwest Bay and the Baie d'Aouatif are given. The results of the occasional observations at other are given separately in table 6.1.

Observations on migration are usually associated with quiet weather and a high tide only shortly before dark. We will see how much this is true for the Banc d'Arguin (Fig. 6.1).

When we arrived at Iouik on 21 March the weather was rather quiet. From 27 to 29 March the wind increased for the first time during our stay climbing to a mean of 8-9 m/sec. We had our first experience with mild sandstorms. After these three days with hardly any signs of migration the wind suddenly dropped to 7 m/sec and less on 30 March and the next eight days. From 8 April onwards the wind increased again. Notwithstanding the increasing wind, one flock of 80 Grey Plovers left that evening. For the following five days the mean force was 9-13 m/sec and visibility was greatly impaired by sandstorms, especially on 11 April. On 14 April when the wind had dropped below 8 m/sec and visibility was good, strong migration was observed again. Also on the following three out of four days with windforce below 8 m/sec migration was seen. From 19 April onwards the wind speed was 10-12 m/sec for seven days. During this period however only a slight drop of the wind, especially in the afternoon gave rise to migration activities. On 21 and 22 April the wind dropped to 8-9 m/sec for three, respectively five hours. On 25 April the wind dropped to 10 m/sec from 6.00 h to 19.00 h. This slight improvement gave rise to massive departure.

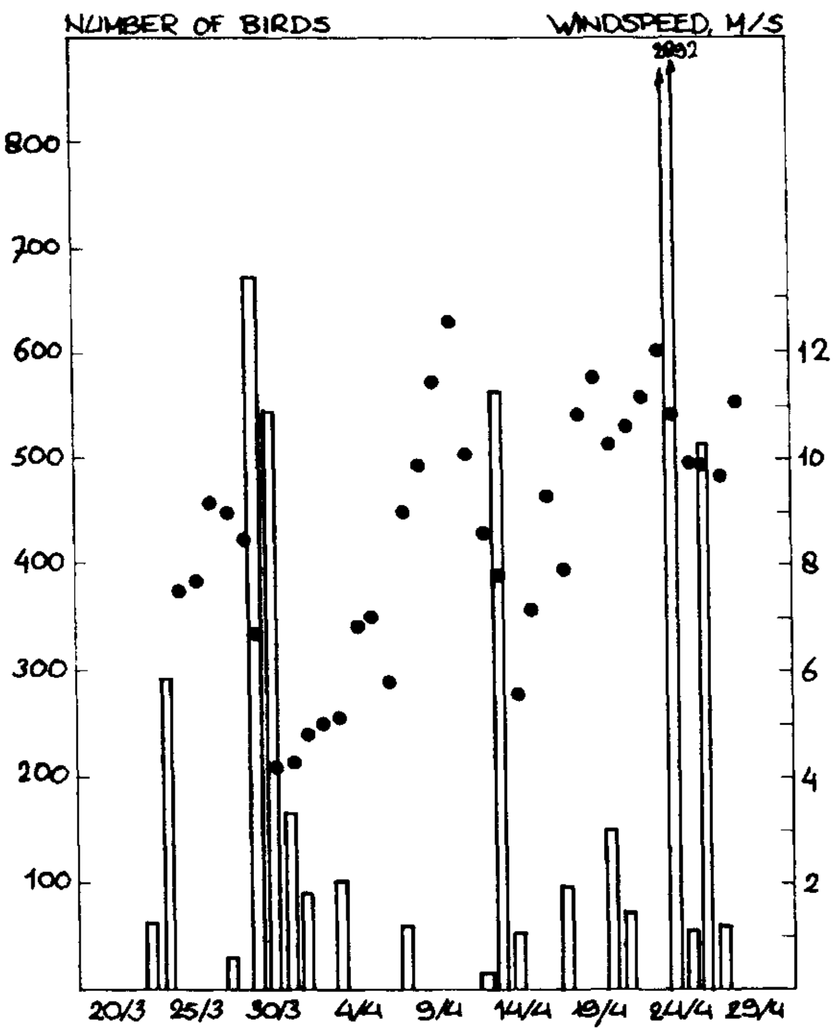


Figure 6.1. Number of birds leaving in northerly direction from Baie d'Aouatif and Northwest Bay (columns) and strength of the wind (m/sec) on these days (dots).

The impression is that not so much the windforce by itself kept birds from migrating. Usually a few days with increasing windspeed and especially impaired visibility by sandstorms like on 10, 11, 12 and 24 April, followed by better weather conditions in comparison would give rise to strong migration, especially the first day after the weather improvement. The mean windforce on the first day of these migrating periods was 7 m/sec on 30 March, 8 m/sec on 14 April and 11 m/sec on 25 April.

Migration mostly occurred between 17.00 h and 19.30 h (Fig. 6.2). Birds left between 15.00 h and 16.00 h only on 25, 26 and 27 April, when strong migration occurred after a period with strong winds and impaired visibility. After 20.00 h birds were only heard on 30 March and 31 March. This is in contrast with the situation in spring at Sidi Moussa, Morocco, where migration was observed several times almost every night (Van Brederode et al. 1982). The study at Sidi Moussa took place right along the migration corridor. At the Banc d'Aouatif however, our camp was about 2 km southwest from the northern side of this bay, the place from where the birds tended to leave. Also, the nights at Sidi Moussa were very quiet. At the Banc d'Arguin however very few nights were suitable for hearing birds at all. The fact that no birds were seen leaving before 15.00 h is probably not caused by the locality of the camp. Our activities during the day were spread across the entire peninsula and its surrounding mudflats. Between 17.00 h and 19.00 h the number of birds

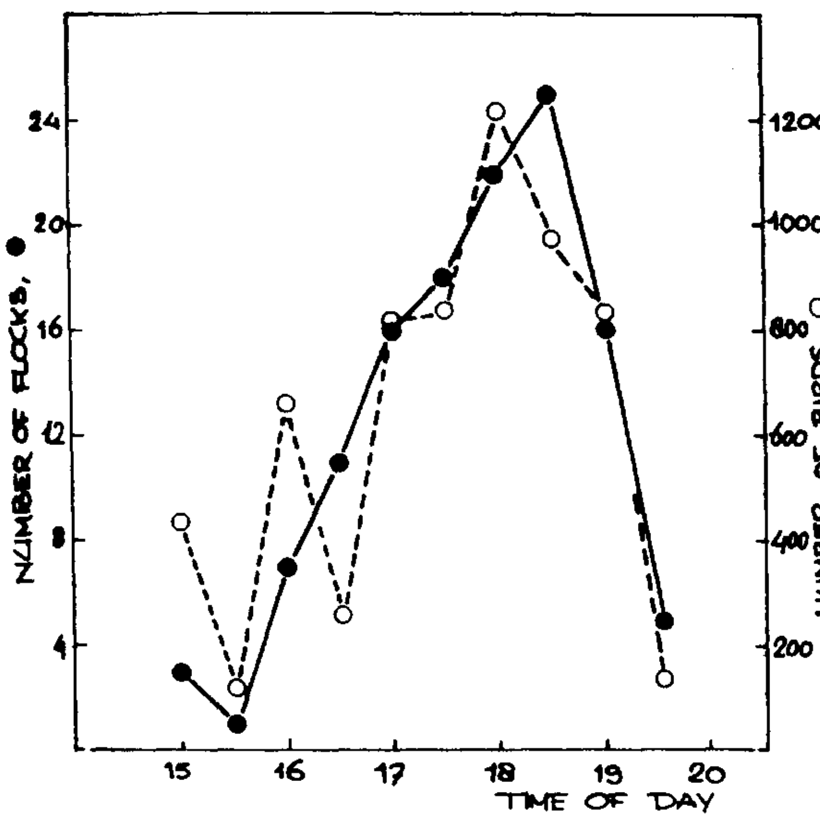


Figure 6.2. Number of flocks of migrating waders (dots) and numbers of waders (open circles) leaving the Baie d'Aouatif and the Northwest Bay at a given time a day (15 stands for 15.00-15.29 h, etc.) from 24 March till 29 April.

leaving is related well to the number of flocks. This is in contrast with the situation between 15.00 h and 17.00 h when birds left in large numbers in only a few flocks or only a few left in several flocks (Fig. 6.2).

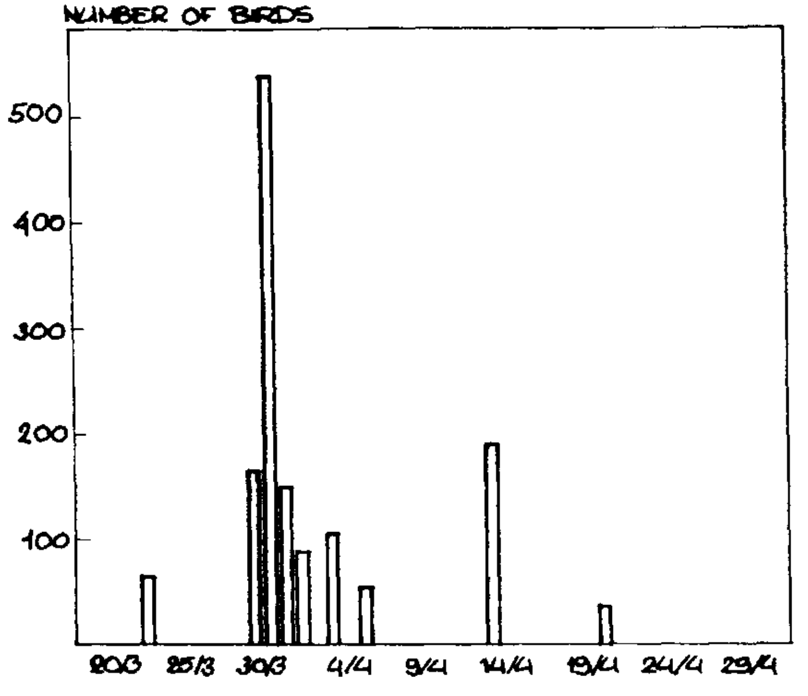


Figure 6.3. Numbers of Oystercatchers leaving in northerly direction from the Baie d'Aouatif and the Northwest Bay.

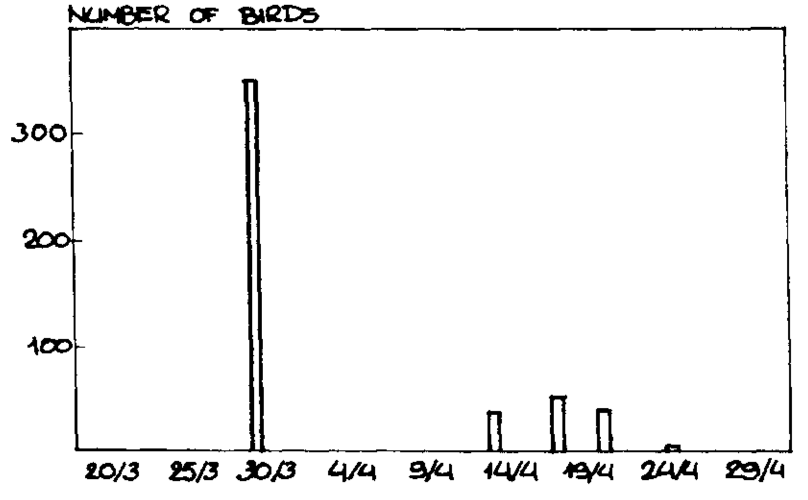


Figure 6.4. Numbers of Redshank leaving in northerly direction from the Baie d'Aouatif and the Northwest Bay.

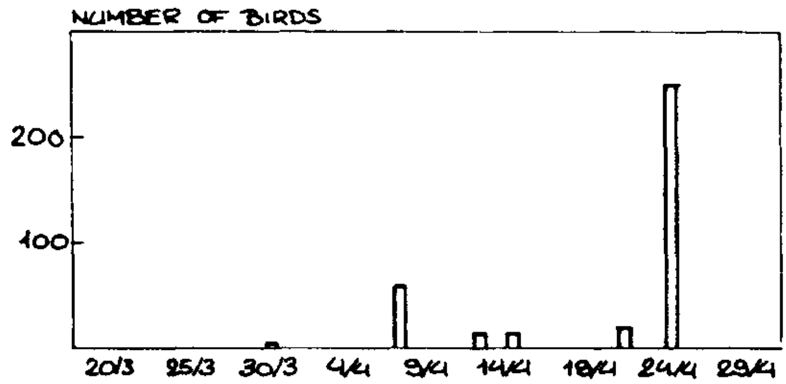


Figure 6.5. Numbers of Grey Plovers leaving in northerly direction from the Baie d'Aouatif and the Northwest Bay.

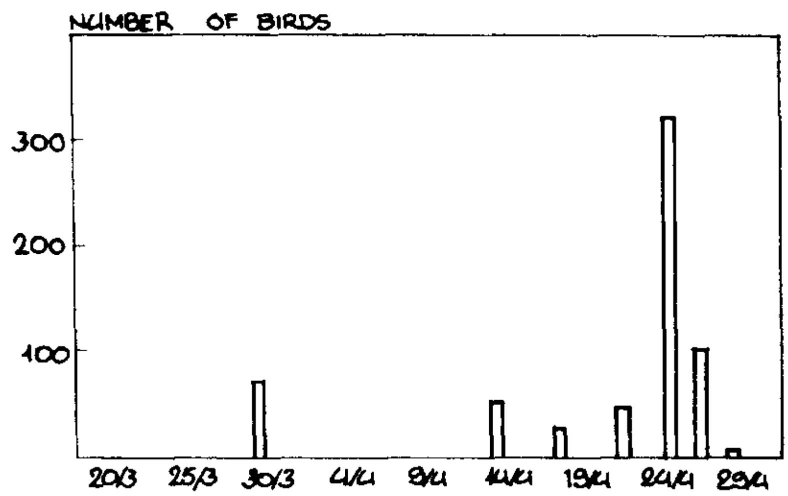


Figure 6.6. Numbers of Knots leaving in northerly direction from the Baie d'Aouatif and the Northwest Bay.

The time of high tide is thought to be of importance, that is birds tend to leave when the tide is high just before dark. On 30 March, 14 and 25 April departure was most intense. On 30 March high tide occurred at 20.25 h (Admiral Tide Tables), so the rising of the tide could very well be of influence. However, on 14 April the tide was low at 15.45 h, so birds were still feeding on the mudflats at dusk. On 25 April high tide was at 16.50 h. Indeed on this day the first flock left at 15.00 h. Although the tide was already going down at dusk large flocks were still leaving from high tide roosts. High tide just before dark is probably a favourable condition but not the only one.

In same wader species like Oystercatcher, Curlew and Redshank the

Table 6.1. Data of waders leaving Mauritania from other sites than the Northwest Bay or the Baie d'Aouatif.

Date	Place	Time	Species	Number	Direction
4 April	Nouadhibou	11.00	Redshank	20	N
6 April	Nair	17.30	Oystercatcher	55	N
		17.45	Curlew	12	N
20 April	Nair	17.50	Turnstone	242	N
21 April	Nair	16.30	Bar-tailed Godwit	20	N-NE
		16.45	Bar-tailed Godwit	30	N-NE
		17.10	Bar-tailed Godwit	40	N-NE
		17.45	Bar-tailed Godwit	26	N-NE
		17.45	Whimbrel	60	N-NE
1 May	Ile d'Arguin	16.30	Bar-tailed Godwit	160	N-NW
		17.25	Dunlin	405	N-NW
			Knot	100	N-NW
			Bar-tailed Godwit	170	N-NW
		17.35	Dunlin	20	N-NW
10 May	Nouadhibou	15.00	Knot	30	N
		17.05	Ringed Plover	12	N

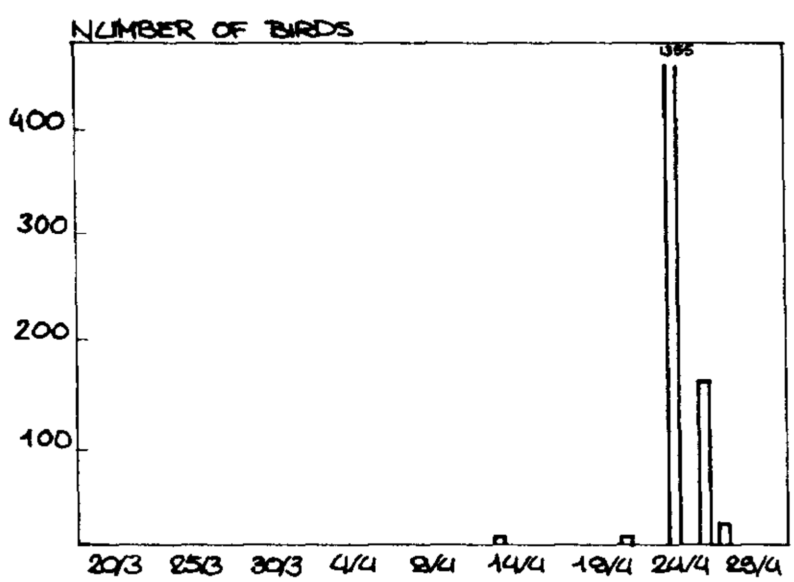


Figure 6.7. Numbers of Bar-tailed Godwits leaving in northerly direction from the Baie d'Aouatif and the Northwest Bay.

Table 6.2. Detailed data for the Baie d'Aouatif on the increase and decrease of numbers of waders between the high tide counts on 24 March, 17 and 25 April, and the total number of birds which were seen leaving during these periods.

Species	24 March-17 April			17 April-25 April		
	Increase	Decrease	Visible Migration	Increase	Decrease	Visible Migration
Oystercatcher		721	1295	51		37
Ringed Plover	29		25		633	-
Kentish Plover		406	-		441	-
Grey Plover	657		90		188	20
Knot		10219	121		11696	68
Sanderling	37		30	387		-
Little Stint	2005		33		722	-
Curlew Sandpiper	6281		-		6259	-
Dunlin		33162	195	12217		-
Bar-tailed Godwit		7565	4	1236		1
Whimbrel	20		5	-	-	4
Curlew		79	209		11	-
Redshank		2063	385		456	88
Greenshank	113		157	60		63
Turnstone	240		-		268	-

relation between the decrease in numbers and the intensity of the visible migration was very clear (Table 6.2, Fig. 6.3 and 6.4). The numbers of Redshank for example decreased rapidly between the end of March and mid April. During this period the numbers of birds which were noted to be leaving were higher than between the middle and the end of April when numbers decreased only a little. The same probably is true for Grey Plovers. However we did not perform a high tide count after 25 April to show the probable decrease in numbers after the strong migration on this date (Fig. 6.5).

In some species the decrease in numbers is rarely or not always accompanied by visible migration. In Kentish Plovers, Little Stints, Curlew Sandpipers and Turnstones only one migration observation was noted for each of them (Table 6.2). In Kentish Plovers and Curlew Sandpipers numbers decreased by two thirds between two or three high tide counts. Numbers dropped significantly in Whimbrels and especially Knots and Bar-tailed Godwits at a time with only very few visible signs of migration, while this could be very obvious at other times: on 25 April 319 Knots, 1355 Bar-tailed Godwits and 105 Whimbrels were seen to leave. In the preceeding month only 189, 5 and 35 (Fig. 6.6 and 6.7).

In Ringed Plovers and Dunlins (Fig. 6.8) a strong decrease in numbers was not accompanied by strong visible migration. Especially for these two species this is in contrast with experiences in Morocco, where they gave most frequent notes on migration (Van Brederode et al., in prep.). Especially in Dunlins the different situation at night might have been important, because at Sidi Moussa 72% (n=95) of the migrating flocks were heard at night, for Ringed Plovers this was 31% (n=39) (Van Brederode et al., in prep.). The high tide counts show that migration was present as well (Table 6.2). In some species like Oystercatcher, Grey Plover, Dunlin, Bar-tailed Godwit and Greenshank (Fig. 6.9) in which visible migration can be very obvious, very few or no birds were seen leaving while their numbers increased, so the influx of birds could exceed the numbers of birds leaving. In Oystercatchers, at the time in which immigration occurred, visible migration was clearly less than at the time between the first and the second high tide count when numbers decreased.

Other species in which numbers increased like in Curlew Sandpipers, Little Stints, Sanderling and Turnstones visible migration was infrequent anyway. Birds leaving from the Baie d'Aouatif and the Northwest Bay were heading north or northwest, so at least when starting off they were following the coast line. Most birds would fly low over the shebka or climb immediately to a height of 100-150 m. At two occasions birds were flying very high and probably left from another site: 200 Turnstones flying in northerly direction on 20 April at Nair and 62 Whimbrels flying in the same direction on 25 April above the Baie d'Aouatif. On only a few occasions it was possible to make observations on the plumage and sex of the leaving birds. In Dunlins about one third (n=43) were in full summer plumage on 24 March and all of them on 14 April (n=30) and 25 April (n=35). In Grey Plovers 14 out of 16 were leaving in full winter plumage on 15 April. On 25 April however 38% (n=242) were in summer plumage. In Knots only one third (n=228) was in full summer plumage at the end of April. Of the Bar-tailed Godwits leaving at the end of April 44% were female (n=132).

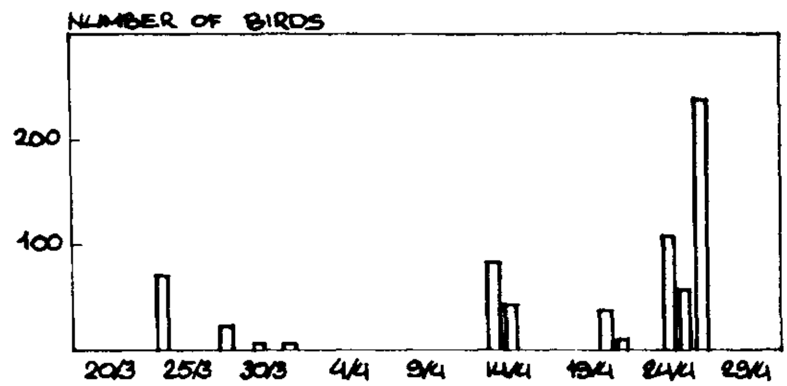


Figure 6.8. Numbers of Dunlins leaving in northerly direction from the Baie d'Aouatif and the Northwest Bay.

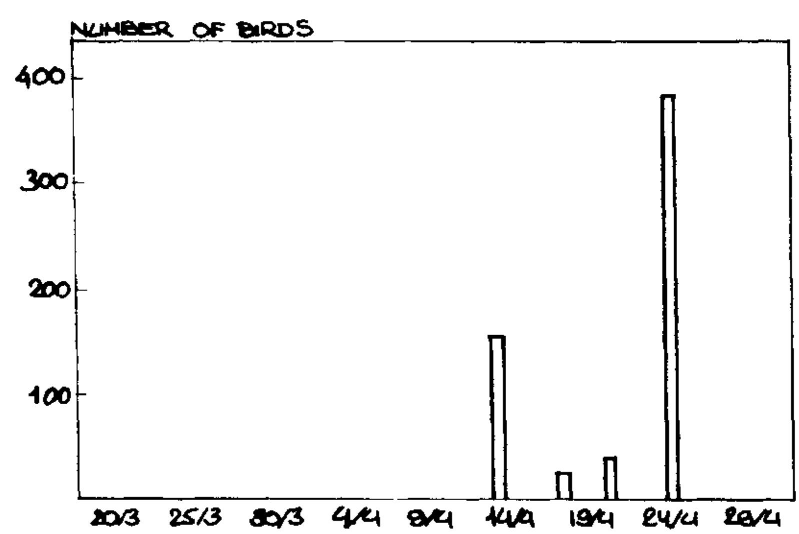


Figure 6.9. Numbers of Greenshanks leaving in northerly direction from the Baie d'Aouatif and the Northwest Bay.

7. WADER CATCHES

Piet Duiven & Theunis Piersma

7.1 Methodology

Normally speaking this should be a continuous story of cannon net catches of huge numbers of waders. As had been described in the project proposal 'large catches should be attempted in March, early April and the end of April'. Enthusiastic informations by observers with good acquaintance with the local situation made that we had good hope to realise catches of large numbers indeed. For this aim we had taken four cannon nets with us. Two sets of the type that is being used by the Wash Wader Ringing Group and another two sets of the Vogeltrekstation-type (Bub 1969) in use by

Table 7.1. Numbers of waders captured near Iouik on the Banc d'Arguin, Mauritania in March and April 1985.

Species	Newly ringed	Controls (foreign)	Recaptures (own rings)	Total
Oystercatcher	2			2
Avocet	2			2
Ringed Plover	55		2	57
Kentish Plover	10			10
Grey Plover	13			13
Knot	284	1	2	287
Sanderling	34			34
Little Stint	169	1	5	175
Curlew Sandpiper	42		1	43
Dunlin	430	1	11	442
Bar-tailed Godwit	85			85
Whimbrel	27			27
Redshank	29		1	30
Turnstone	214	2	10	226
Total	1396	5	32	1433

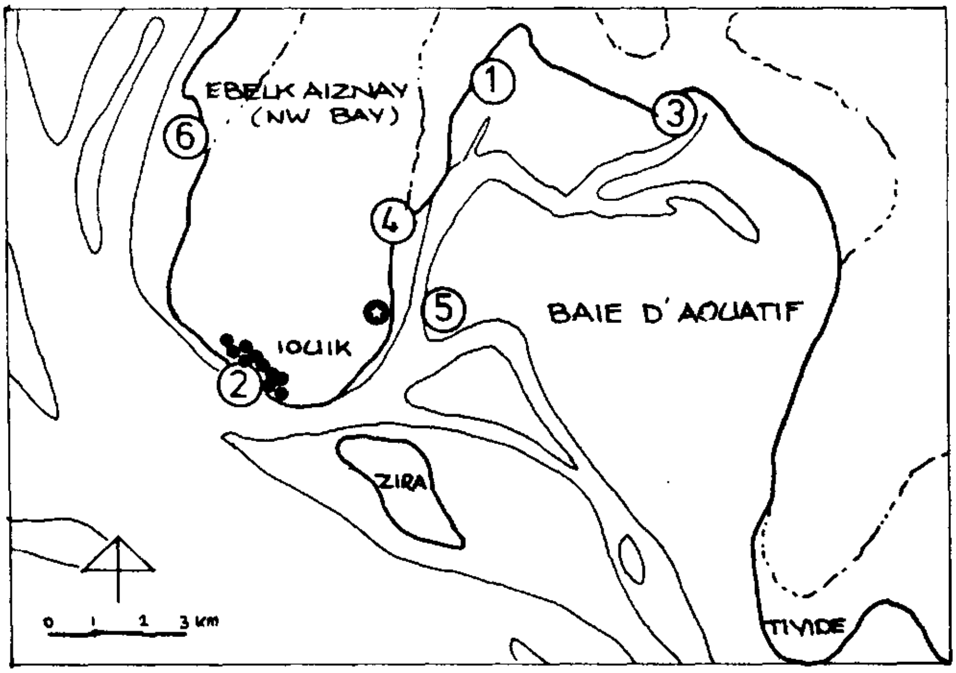


Figure 7.1. Locations where wader catching attempts were made. On locations 1 and 5 only mist-netting was done, on location 3 and 4 only cannon-netting. On location 6 both mist- and cannon-netting was performed whereas on location 2 clap- and cannon-netting was done. The star indicates the camp site.

the Bird Research Group of the Netherlands Institute of Sea Research (NIOZ), Texel. The Wash-nets were under supervision of Mark Fletcher, whereas the NIOZ-nets were handled by Piet Duiven.

To assess the total numbers of waders in the Baie d'Aouatif and in the North-west Bay we started counting on the very first day after our arrival. We thus got an idea of the potential catching sites at the same time. There were many high tide roosts, but in spite of the large numbers of birds and hard labour of the whole expedition team we only got small catches off and on.

Several reasons can be pointed out for the cause of this meagre catching results. The surroundings of the high tide roosts were in all cases very extensive, extremely flat and mostly without any trace of vegetation. Depending on the species the birds roosted on land close to the water, or just in the water. Unfamiliarity with the tidal currents, the water levels to be expected and the effect of wind on this, were big handicaps to find the exact position for setting the nets. Sometimes the nets were flooded, and sometimes the nets were far out of reach of the water. There were also high tide roosts in the middle of the sebkha. Setting nets here was simple madness Mark told us. But ...we did, for it was so frustrating to see all the birds without any possibility to catch them. By observing frequently where they were grouping we saw they flew and walked to the same area, but they never used exactly the same spot. The birds were not shy at all and could be approached easily. However, if they did not go to the right place (our nets!) directly, we did not succeed in getting them in front of the nets within the catching distance. We failed notwithstanding well executed driving by the team members, and the subtle crawling actions by Mark and Cor like skilful infantry men.

The only place where we could be fairly sure to catch birds was the beach of the fishing village of Iouik. Turnstones and Sanderlings were foraging here close to the huts on drying fish and further along the beach on carrion and were used to regular disturbance by people walking around. With fish remains and kitchen leavings we could lure these species to our nets.

A problem not yet mentioned was a more technical one. When we wanted to fill the cartridges for the first time, Mark detected that the powder

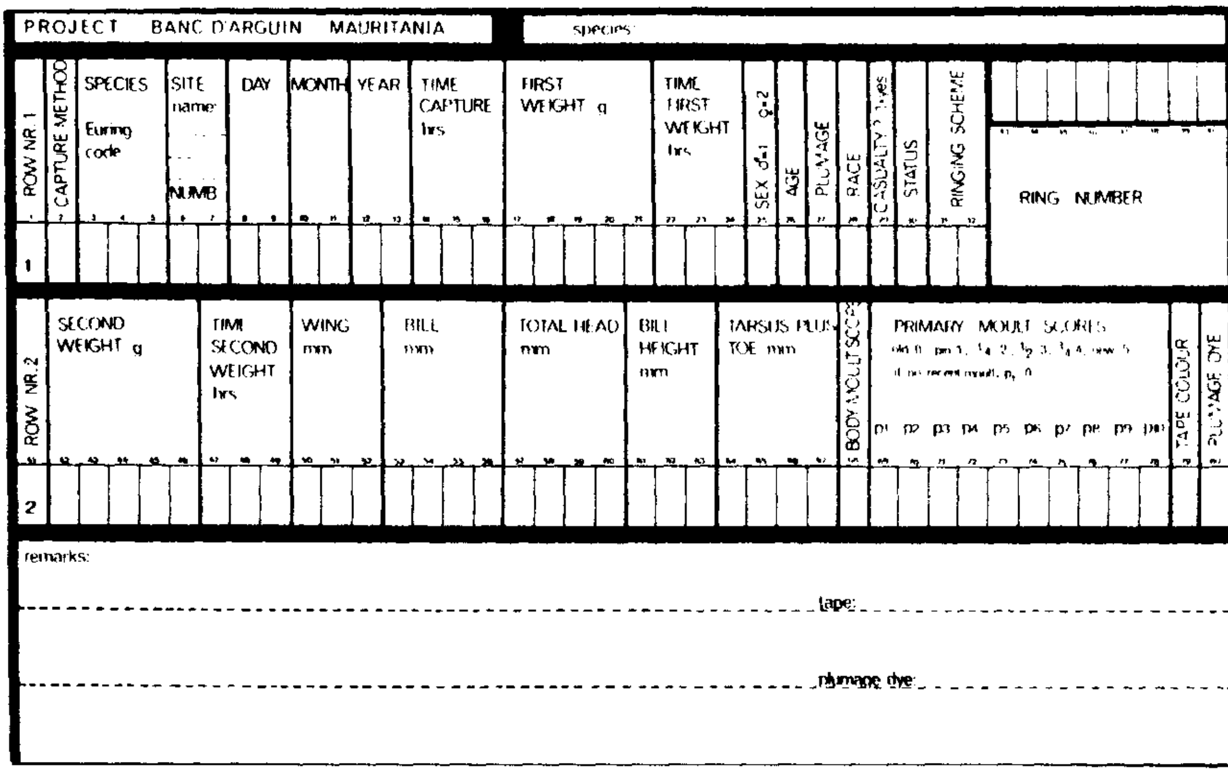
Table 7.2. Numbers of waders (recaptures excluded) captured with different type of net near Iouik in March/April 1985.

Species	Type of net Mist	Clap	Cannon	Total
Oystercatcher	1	1		2
Avocet	2			2
Ringed Plover	46		9	55
Kentish Plover	10			10
Grey Plover	11	1	1	13
Knot	268	1	16	285
Sanderling	22	11	1	34
Little Stint	170			170
Curlew Sandpiper	33		9	42
Dunlin	397		34	431
Bar-tailed Godwit	71		14	85
Whimbrel	6		21	27
Redshank	29			29
Turnstone	60	156		216
Total	1126	170	105	1401
Total in %	80	12	8	100

Table 7.3. Numbers of waders captured per day (recaptures excluded) near Iouik during the study period March (3) - April (4) 1985.

Date	22/3	23/3	24/3	25/3	26/3	27/3	29/3	30/3	31/3	1/4	2/4	3/4	6/4	8/4	9/4	10/4	11/4	12/4	13/4
Oystercatcher																			
Avocet				2															
Ringed Plover	6	2	1	4		2		1	2	1	1			9		2	3		3
Kentish Plover	2				2				1			1							1
Grey Plover	2				2	1							1						
Knot	16	7			9	2		3	1	18	6	22	16		1	10	17	6	14
Sanderling					2		1				1	2					2	1	1
Little Stint	7				3			1	1	16	4	7				4	6	7	11
Curlew Sandpiper	1				6			7		4	3	4	2			1	2	1	
Dunlin	88	9	3	3	27	2		18	5	18	27	14	18			4	17	4	6
Bar-tailed Godw.	5								1	3	5	3			15	3	11	4	2
Whimbrel						1			1						21				1
Redshank	10				8				1	1		1							1
Turnstone				1	38		22	6	10	3		10				9			20
Totals	137	18	4	10	97	8	23	36	23	64	47	64	37	9	37	33	58	23	60

Date	14/4	15/4	15/4	17/4	18/4	19/4	21/4	22/4	23/4	24/4	25/4	27/4	28/4	29/4	Totals
Oystercatcher			1											1	2
Avocet															2
Ringed Plover		4	5	1	1	1	4	1	1						55
Kentish Plover		1			1				1						10
Grey Plover	1	1			1			2	1		1				13
Knot	6	23	42		19	5	1	37	3		1				285
Sanderling	2	3	1		2			5		2	2	7			34
Little Stint	27	37	21	4	12			2							170
Curlew Sandpiper	1	1	3	1	2			3							42
Dunlin	7	64	44	5	22		1	19	5						431
Bar-tailed Godw.	1	12	12	2	6				1						85
Whimbrel		1	1		1										27
Redshank			2	1	1	1		2							29
Turnstone	7	5			3	1		5		17	27	14	14	4	216
Totals	52	152	132	14	71	8	6	76	12	17	31	16	21	5	1401



LEGEND BIOMETRY/RINGING DATA SHEET

CAPTURE METHOD: 1 = cannon-net
2 = mist-net
3 = dazzling
4 = cage-trap
5 = clap-net

SPECIES (Euring):

450 Oystercatcher	WE, WI, BI, BIWI
470 Ringed Plover	WE, WI, BI, TOHE, TATO
486 Grey Plover	WE, WI, BIHE, BI, TOHE, TATO
496 Knot	WE, BI, WI, TOHE, TATO
497 Sanderling	WE, WI, BI, TOHE, TATO
501 Little Stint	WE, WI, BI, TOHE, TATO
509 Curlew Sandpiper	WE, WI, BI, TOHE, TATO
512 Dunlin	WE, WI, BI, TOHE, TATO, race
534 Bar-tailed Godwit	WE, WI, BI, TATO
538 Whimbrel	WE, WI, BI, TATO
539 Curlew	WE, WI, BI, TATO
546 Redshank	WE, WI, BI, TOHE, TATO
548 Greenshank	WE, WI, BI, TATO
561 Turnstone	WE, WI, BI, TATO

SITE NUMBER: see local-reference list

TIME(S): in 24 hrs, 1/10 hr (e.g. 5.1)

AGE: 2 = full-grown
4 = 1st year
5 = 2nd year
6 = >2nd year
7 = 3rd year
8 = >3rd year

PLUMAGE: Blank = no record
1 = full winter plumage
2 = trace of summer plumage
3 = ¼ of summer plumage
4 = ½ of summer plumage
5 = ¾ of summer plumage
6 = trace of winter plumage
7 = full summer plumage

RACE: Blank = not recorded or indistinguishable
1 = C. a. alpina
2 = schinzii
3 = arctica
4 = schinzii/arctica (where identity not certain but the bird is one of these two).

STATUS: Blank = newly ringed
1 = control, no ring added or replaced
2 = control, ring added or replaced
3 = 1st recapture
4 = 2nd recapture
5 = 3rd recapture
6 = 4th recapture
7 = 5th recapture
8 = 6th recapture
9 = ≥ 7th recapture

RINGING SCHEME: 01 London, UK
02 Washington, USA
03 Reykjavik, Iceland
04 Stavanger, Norway
05 As, Norway
06 Oslo, Norway
07 Stockholm, Sweden
08 Göteborg, Sweden
09 Helsinki, Finland
10 Copenhagen, Denmark
11 Viborg, Denmark
12 Kalø, Denmark
13 Arnhem, Holland
14 Leiden, Holland
15 Helgoland, Germany
16 Radolfzell, Germany
17 Rossiten, Germany
18 Hiddensee, Germany
19 Sempach, Switzerland
20 Bruxelles, Belgium
21 Jersey
22 Paris, France
23 Aranzadi, Spain
24 Donana, Spain
25 Madrid, Spain
26 San Sebastian, Spain
27 Oporto, Portugal
28 Warsaw, Poland
29 Gdansk, Poland
30 Matsalu, Estonian SSR
31 Tartu, Estonian SSR
32 Riga, Latvian SSR
33 Moscow, USSR
34 Praha, Czechoslovakia
35 Budapest, Hungary
36 Sofia, Bulgaria
37 Bucarest, Romania
38 Zagreb, Yugoslavia
39 Bologna, Italy
40 Valetta, Malta
41 Cyprus
42 Tunis, Tunisia
43 Jos, Nigeria
44 Nairobi, Kenya
45 Livingstone, Zambia
46 Pretoria, S.Africa

BODY MOULT SCORE: Blank = not recorded
0 = no moult
1 = light moult
2 = medium
3 = heavy moult

TAPE COLOUR: 0 = no tape
1 = white
2 = yellow
3 = blue
4 = green
5 = red
6 = green/yellow striped

PLUMAGE DYE: 0 = no dye applied
1 = picric underwing only) Knot
2 = picric on tail and/or wing bar) Sanderling
3 = picric both under and upper-side) Bar-tailed Godwit
) Grey Plover
) Redshank
) Curlew Sandp.

4 = rhodamine underwing only)
5 = rhodamine on tail and/or wing bar) Ringed Plover &
6 = rhodamine both under and upper-side) Dunlin

Figure 7.2. Lay out of the biometric and ringing data form used on the Banc d'Arguin in 1985 and 1986. The form is based on an earlier one developed by the Wader Study Group (cf. Pienkowski 1980).

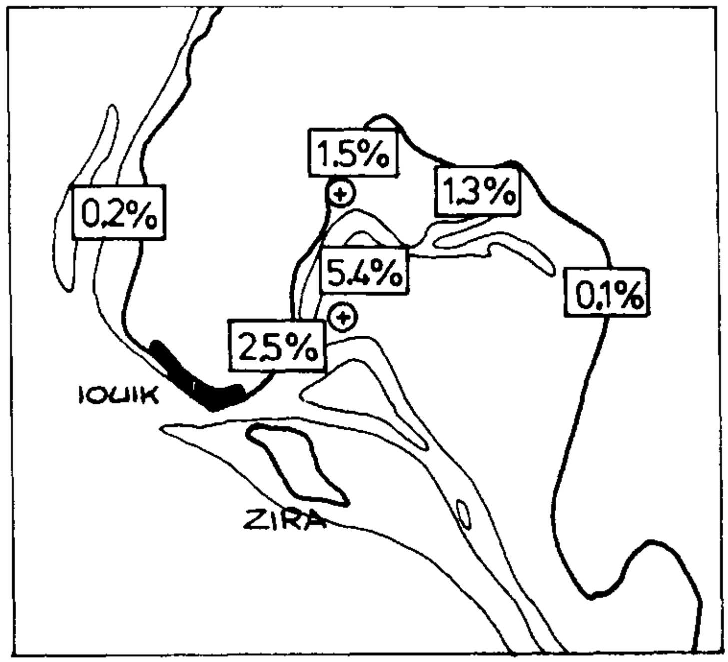


Figure 7.3. Distribution of waders marked between 22 March and 18 April 1985 on the two mist-netting sites (stars) as was apparent from resightings of birds foraging on the mudflats in the second half of April 1985. Per area, the percentage of marked birds is indicated. Sample sizes for each area are ≥ 1000 birds.

we had taken with us looked different from what he was normally working with. After some discussions a test projectile was fired with good result. However the cannons later refused at the crucial moment, so proving the powder problem was more serious than we had suspected initially. New firing tests yielded varying (good and bad) results. Mark therefore returned to Nouadhibou where he came in contact with explosive experts of a French mining company after introduction by Guy Germain. With very powerful explosives for use in mineral production and some more explosives out of a dismantled Russian dud, our driver Ely o/ Elemine safely brought back Mark after a Landrover trip through a burning hot desert. Before we started practising with these dangerous explosives some other tests were carried out with our own powder first. At last Mark got reproducible correct firings by mixing the powder with heads of the matches from our combat rations.

After this enumeration of troubles, one should not forget that we did get some birds in our hands. Although the numbers were not high these are listed in table 7.1.

Most waders in 1985 (Table 7.2) and in 1986 (all, except for the

Turnstones caught with clap nets in the village) were eventually caught with mist nets. We used 15 m long three shelf 'wader nets' and 9 m long four shelf 'songbird nets'. Lines of nets totalling between 150 and 400 m, mostly set perpendicular to the wind, were used during the catching nights (when the wind allowed us to employ the nets). Figure 7.1 gives an overview of the catching localities used in 1985 and 1986. The nets became quickly very heavy and polluted with salt and dust. In 1985 this lead us to wash the nets halfway through the study period with some (non-potable!) fresh water.

We checked the nets 3-4 times per night, carrying the birds from the nets to the boat or shore in bags. The birds were transported in plastic cages (often in the Landrover) back to camp for ringing, measuring and, in 1985, colour-dye-marking.

Captured birds were ringed and weighed. In addition lengths of wing (maximum chord; Evans 1986), bill, total head (Green 1980) and tarsus + toe (cf. Piersma 1984) were measured. Body moult was scored as absent, light, medium or heavy. The extent of summer plumage was indicated in a seven point scale ranging from 1 = full winter plumage to 7 = full summer plumage. Sexing was only possible when the birds had attained summer plumage to a sufficient degree. Ageing was according to Prater et al. (1977). All data were immediately written down on green 'computer-ready' forms, on the back side of which all administrative details were given (Fig. 7.2). The data were entered into the computer directly from the cards (kindly organised by Staatsbosbeheer, Utrecht). Most of the analyses reported on in chapter 9, were performed using the SPSS-statistical package (Nie et al. 1975).

All the biometric information on waders is presented in Appendix 1.

Table 7.4. Numbers of waders marked with leg flags and/or colour dyes near Iouik on Banc d'Arguin in March and April 1985.

		White tape[1]		White tape[2]		Yellow tape[2]		Blue tape[2]		Green tape[2]		Red tape[2]		Green Yellow tape		Dyed only	Total marked
		L	R	L	R	L	R	L	R	L	R	L	R	L	R		
Rhodamine	Ringed Plover	4	4	4	9	4	5	5	7	2	5	1	1			1	52
	Dunlin	28	70	43	64	4	8	49	88	11	13	11	16			1	406
Picric	Grey Plover	1	1		3		1		2		2	1		1[4]			12
	Knot	5	16	13	40		16	13	95[3]	2	38	2	19		1[4]	3	263
	Sanderling	2	1	1	2			2	6	1	6		2	1	8[5]		32
	Curlew Sandpiper		1	2	21		1		7		3	1	2			1	39
	Bar-tailed Godwit	4	1	1	11	2	11	3	40	1			8				82
	Redshank		10	2	9			1	1	1	2	1	1				25
	Turnstone							2[6]	6[6]								8
No dye	Turnstone			27	45			10	25			2	7	16	58		190
	Little Stint			6	24			5	94		2	1	15				147
Period (dates)		22-23 Mar		24 Mar-4 Apr		6-9 Apr (Ebelk Aisnai)		9-16 Apr		17-18 Apr (Ebelk Aisnai)		19-23 Apr		24-29 Apr. (Iouik village)		Entire period	1256

L = left, above tarsus (juvenile, 2nd c.y.); R = right, above tarsus (ad.; > 2nd c.y.)

1) dyed: on tail and rump, below tail, arm-pit; 2) dyed: on tail and rump, entire underwing and upper wing-bars;

3) one bird without dye; 4) without dye; 5) five without dye; 6) dye also below tail.

7.2 Capture totals

In 1985 when we concentrated on catching waders, we managed to capture 1433 birds (Table 7.1). In 1986 wader catching had a low priority, but still 947 waders were caught (Table 7.5). Amongst those caught in 1986 were 30 recaptures from the year before. Dunlins, Turnstones, Knots and Little Stint contributed most to the catching totals. A breakdown of numbers caught with the different types of catching gear in 1985 is presented in table 7.2. The numbers caught per day in 1985 are listed in table 7.3. In 1985 we colour-dyed the birds and also put coloured plastic tape around the ring. These activities were carried out in the context of the Wader Study Group programme on 'wader migration studies along the East Atlantic Flyway' (Piersma 1984). Table 7.4 presents the species and numbers colour-marked in different ways in different periods. No dye-marking took place in 1986, but the majority of waders received green-yellow tape around the ring.

Table 7.5. Numbers of waders captured near Iouik on the Banc d'Arguin in February-April 1986.

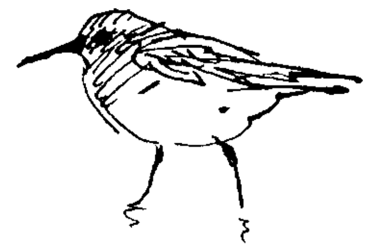
Species	Newly ringed	Recaptures within 1986	Recaptures of birds ringed in 1985	Controls	Total
Oystercatcher	10	1			11
Ringed Plover	19				19
Kentish Plover	14				14
Grey Plover	8				8
Knot	114	2			116
Sanderling	20				20
Little Stint	104				104
Curlew Sandpiper	48	1			49
Dunlin	348	5	9	3	365
Bar-tailed Godwit	30				30
Whimbrel	4				4
Redshank	16	1			17
Greenshank	1				1
Turnstone	161	5	21	2	189
Total	897	15	30	5	947

A list of the 'non-waders' caught during the two expeditions is provided by table 7.6.

Visual sampling during low tide showed that the majority of colour-marked waders stayed (foraged) very close to the catching site before departure: the percentage of marked birds of all species decreased very strongly as one moved away from the catching sites (Fig. 7.3). Observations made elsewhere on the Banc d'Arguin (e.g. Nair) in the same period yielded no marked birds either.

Table 7.6. Numbers of birds (non-waders) captured and ringed near Iouik in February-April 1985 and 1986. Only one bird, a Willow Warbler, was a control (ringed in Great Britain). The warblers and other non-waterbirds were almost all captured at the campsite with mist nets.

Species	Numbers ringed in 1985	1986
Storm Petrel _Hydrobates pelagicus_	5	-
Pintail _Anas acuta_	1	-
Kestrel _Falco tinnunculus_	3	-
Quail _Coturnix coturnix_	-	-
Grey-headed Gull _Larus cirrocephalus_	1	-
Black-headed Gull _Larus ridibundus_	-	2
Slender-billed Gull _Larus genei_	45	72
Gull-billed Tern _Gelochelidon nilotica_	1	-
Royal Tern _Sterna maxima_	2	-
Sandwich Tern _Sterna sandvicensis_	1	-
Little Tern _Sterna albifrons_	1	-
Black Tern _Chlidonias niger_	-	3
Wryneck _Junx torquilla_	1	-
Sand Martin _Riparia riparia_	1	-
Swallow _Hirundo rustica_	24	12
Red-rumped Swallow _Hirundo daurica rufula_	-	1
House Martin _Delichon urbica_	1	-
Tree Pipit _Anthus trivialis_	1	1
Yellow Wagtail _Motacilla flava_	3	-
White Wagtail _Motacilla alba_	-	1
Thrush Nightingale _Luscinia megarhynchos_	1	-
Redstart _Phoenicurus phoenicurus_	2	-
Whinchat _Saxicola rubetra_	2	-
Wheatear _Oenanthe oenanthe_	2	-
Grasshopper _Locustella naevia_	3	-
Savi's Warbler _Locustella luscinoides_	1	-
Reed Warbler _Acrocephalus scirpaceus_	1	-
Melodius Warbler _Hippolais polyglotta_	1	-
Subaline Warbler _Sylvia cantillans_	1	-
Spectacled Warbler _Sylvia conspicillata_	-	1
Common Whitethroat _Sylvia communis_	2	-
Garden Warbler _Sylvia borin_	3	-
Blackcap _Sylvia atricapilla_	5	-
Bonneli's Warbler _Phylloscopus bonelli_	2	1
Chiffchaff _Phylloscopus collybita_	9	25
Willow Warbler _Phylloscopus trochilus_	49	21
Pied Flycatcher _Ficedula hypoleuca_	1	-
Woodchat Shrike _Lanius senator_	10	-
Total	186	141



Theunis Piersma

7.3 **Resightings and recoveries**

The colour-marking programme in 1985 proved to be a great success: no less than 22 of the 1256 (1.8%) colour-marked birds were sighted later in the year (Table 7.7), thereby extensively increasing our present knowledge about migration routes and breeding destinations of waders wintering on the Banc d'Arguin (cf. Engelmoer 1982). The resightings and recoveries (Table 7.8) of Knots confirmed the existence of a stopover site in west-central France for Knots wintering in West and South Africa and breeding in Siberia (Dick et al. 1987). The resightings of Sanderlings in the Wadden Sea suggest a Siberian breeding origin. The resightings of Dunlins are consistent with the view that most Dunlins wintering on the Banc d'Arguin are of the schinzii subspecies. Apparently both birds from the main breeding population on Iceland and a smaller population on the Hebrides, Scotland, and possibly also from the very small Baltic population are involved. One Curlew Sandpiper was resighted later in spring on Malta, in the Mediterranean. This resightings suggest a trans-Saharan migration via Tunisia to the Siberian breeding grounds. One Bar-tailed Godwit was resighted only a week after capture in Denmark: this bird was certainly a very early migrant! Two other birds were resighted on a major site in the Dutch Wadden Sea (one of them only just escaped the net!). The resightings of Redshanks suggest a West European breeding origin. The three sightings of Turnstones in 1985 are remarkable since these birds were only marked with green-yellow tape (indeed, the unique colour combination made it possible to positively identify the birds as coming from Mauritania in the first place). It is striking that no Turnstones marked with green-yellow tape were sighted during the 1986 season. The recovery of a Turnstone from Greenland goes against all preconceptions: Mauritanian birds were thought to come from Northern European and Siberian breeding areas only. The recapture of a Ringed Plover during the same spring (1985) nicely illustrates the use of stop-over sites, and points to a Greenland or Canadian breeding origin.

Table 7.7. List of individual wader colour marked on the Banc d'Arguin in 1985 and resighted elsewhere later in the year.

Species	Dye-tape mark	Marking period on the Banc d'Arguin	Resighting Date	Resighting Location	Remarks
Ringed Plover	Pink under wings & sides of breast	22 March-23 April 1985	31 July 1985	Langton Herring, Fleet Dorset, U.K.	No flag seen
Knot	Yellow underwings	22 March-23 April 1985	7 May 1985	Baie de l'Aiguillon, Vendée, France	
Knot	Yellow underwings	22 March-23 April 1985	15 May 1985	Charente estuary, Vendée, France	
Knot	Yellow underwings	22 March-23 April 1985	24 May 1985	Charente estuary, Vendée, France	
Knot	Yellow underwings	22 March-23 April 1985	4 June 1985	Baie de l'Aiguillon, Vendée, France	
Knot	Yellow underwings	22 March-23 April 1985	2 June 1985	Pegwell Bay, Kent, U.K.	Recorded in flight
Sanderling	Yellow undertail + wing	22-23 March 1985	5+6 May 1985	Süderoog Sand, Schleswig-Holstein, W. Germany	
Sanderling	Yellow-orange underwing	22 March-23 April 1985	11 June 1985	Engelsmanplaat, Wadden Sea The Netherlands	Sitting in roosting flock
Dunlin	Pink underwings	24 March-23 April 1985	19 May 1985	Baie de Bourgneuf, Vendée, France	
Dunlin	Pink underwings	22 March-23 April 1985	19 May 1985	Cherry Cobb Sands, North Humberside, U.K.	
Dunlin	Pink under + upper tail	22-23 March 1985	20 May 1985	Mandø, Wadden Sea Denmark	No flag

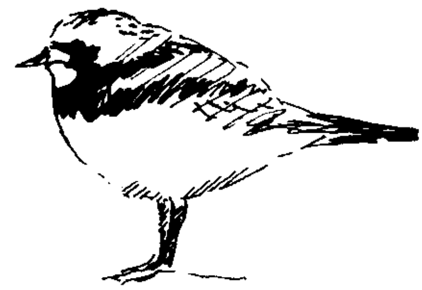
Redshank	Yellow underwings	22 March-23 April 1985	June 1985	Pellworm, Schlesw.-Holstein, W. Germany	Breeding bird
Redshank	Yellow underwings + tail	22 March-23 April 1985	28 June 1985	Marais d'Olonne sur Mer, Vendée France, (46°32'N, 1°47'W)	
Turnstone	Yellow-green tape	24-29 April 1985	21 May 1985	South Gare Sand, Teesmouth, U.K. (54°38'N, 01°08'W)	Tape around right leg=adult, vis. sexed as female at Teesm.
Turnstone	Yellow-green tape	24-29 April 1985	28 May 1985	Ile de Ré, Vendée, France	
Turnstone	Yellow-green tape	24-29 April 1985	3 August 1985	Loix en Ré, Charente, Maritime France (46°14'N, 1°24'W)	Seen in flock of 80 Turnstones of which 12 carried metal rings
Dunlin	Pink underwing	22 March-23 April 1985	20 April 1985	Süderhafen, Nordstrand, Schlesw.-Holstein, W. Germany	Seen in flight
Dunlin	Pink tail + underwing	22 March -23 April 1985	16 July 1985	Skjotjörn, Kjosasysla, Iceland (64°05'N, 22°01'W)	No flag
Curlew Sand-piper	Yellow underwings	22 March-23 April 1985	19 May 1985	Chadira, Malta (35°58'N, 14°21'E)	
Bar-tailed Godwit	Yellow underwings	22 March-23 April 1985	9 May 1985	Paesenser Polder, Friesland The Netherlands	Identified in flight as a male
Bar-tailed Godwit	Yellow underwings	22 March-23 April 1985	18 May 1985	Paesenser Polder, Friesland, The Netherlands	

Table 7.8. List of waders controlled on the Banc d'Arguin in 1985 and 1986, or ringed on the Banc d'Arguin and controlled or recovered elsewhere.

Species	Ring Number	Age	Ringing Date	Ringing Location	Recovery Date	Recovery Location	Remarks
Avocet	Arnhem 3 334 937	> 2nd c.y.	19 May 1984	Holwerd, Friesland The Netherlands	29 March 1986	Baie d'Aouatif, Banc d'Arguin, Mauritania	Bird wearing colour rings, observed back in The Netherlands (Lauwersmeer) on 19 April 1986
Avocet	Arnhem 3 374 260	> 2nd	8 May 1984	Holwerd, Friesland The Netherlands	29 March 1986	idem	Bird with colour rings, back near Holwerd, 19 Apr. 1986
Ringed Plover	Paris SA 747 322	> 2nd	8 April 1985	Iouik, Banc d'Arg. Mauritania (19°52'N, 16°18'W)	5 May 1985	Ynyslas, Berth, Dyfed, U.K. (52°31'N, 4°03'W)	Control, wing=133 mm, weight=57 g
Ringed Plover	Paris SA 747 614	> 2nd	8 Febr. 1985	Iouik, Banc d'Arg.	10 Aug. 1986	Les Hemmes-de-Marck Pas-de-Calais, France (50°59'N, 1°58'E)	Found dead
Knot	Paris GE 6338	> 3rd	7 May 1978	Triaize, Vendée, France, (46°23'N, 1°12'W)	16 April 1985	Iouik, Banc d'Arg. Mauritania	Control
Knot	Paris GE 16 837	> 2nd	26 Mar. 1985	Iouik, Banc d'Arg. Mauritania	15 Aug. 1986	Vistula mouth, Swibne Gdansk, Poland (54°20'N, 18°56'E)	Control
Curlew Sandpiper	Paris SA 543 768	1st ?	22 Nov. 1973	Cap Timiris, Banc d'Arg., Mauritania (19°23'N, 16°32'W)	16 Aug. 1985	Morsumkliff, Sylt Schlesw.-Holstein W. Germany (54°53'N, 8°28'E)	Found dead, late recovery made avail. by WJA Dick

Little Stint	Stavanger 9 288 300	1st c.y.	12 Aug. 1974	Makkevikka, Gikse M. og Romsdal, Norway (62°30'N, 6°02'E)	11 April 1985	Iouik, Banc d'Arg. Mauritania	Control, but accidently killed
Dunlin	London NS 05 982	> 2nd	8 May 1982	Waterfoot, Annan, Dumfries & Gallway U.K. (54°58'N, 3°16'W)	1 April 1985	Iouik, Banc d'Arg. Mauritania	Control
Dunlin	Paris SA 747 448	> 2nd	16 Apr. 1985	Iouik, Banc d'Arg. Mauritania	20 July 1985	Fort Mahon, Baie d'Authie, Sud Somme France (50°21'N, 1°34'E)	Killed by hunter
Dunlin	Paris SA 747 545	> 2nd	18 Apr. 1985	Iouik, Banc d'Arg. Mauritania	19 May 1987	Shannon Airport Lagoon, Clare, Ireland (52°42'N, 8°55'W)	Controlled and ring replaced by London NS 96 461
Dunlin	Paris SA 747 785	2nd?	4 Apr. 1986	Iouik, Banc d'Arg. Mauritania	23 July 1986	Farlington Marsh, Portsmouth, Hampsh. U.K. (50°50'N, 1°02'N)	Control; recaptured again at same site (Farlington Marsh, on 12 July 1987
Dunlin	Paris SA 747 473	> 2nd	15 Apr. 1985	Iouik, Banc d'Arg. Mauritania	9 Aug. 1987	Terrington Kings Lynn, Norfolk, U.K. (52°48'N, 0°18'E)	Control; ring repaced by London NS 47 170
Dunlin	London BX 64 712	> 1st	11 Aug. 1975	Terrington, Kings Lynn, Norfolk, U.K. (52°48'N, 0°18'E)	4 April 1986	Iouik, Banc d'Arg. Mauritania	Control
Dunlin	London NS 17 195	> 2nd?	5 May 1985	Biggar, Walney Isl. Umbrica, U.K. (54°05'N, 3°15'W)	6 March 1986	Iouik, Banc d'Arg. Mauritania	Control

Dunlin	London NS 74 305	pullus	1 June 1986	West Gerinish, Machair East Western Isles, Scotland, U.K. (57°21'N, 7°[illegible]3'W)	4 April 1986	Iouik, Banc d'Arg. Mauritania	Control
Turnstone	London CK 90 211	> 1st	18 Aug. 1977	Biggar, Walney Isl. Cumbria, U.K. (54°05', 3°1[illegible]'W)	26 March 1985	Iouik Banc d'Arg. Mauritania	Control
Turnstone	Stockholm 4 152 246	pullus	1 July 1983	Arholma, Uppland Sweden (59°53'N, 19°05'E)	29 March 1985	Iouik, Banc d'Arg. Mauritania	Control
Turnstone	Paris M 5042	> 2nd c.y	26 Mar 1985	Iouik, Banc d'Arg. Mauritania	16 Aug. 1985	Wevers Inlaag Zeeland, Netherl. (51°41'N, 3°50'E)	Accidently killed during cannon nett. Still wearing white tape around ring.
Turnstone	Paris M 5170	> 2nd c.y.	24 Apr. 1985	Iouik, Banc d'Arg. Mauritania	28 May 1986	Augpilagtoq, Upernavik, Greenl. (72°55'N, 55°35'W)	Shot
Turnstone	Arnhem K 571 481	> 2nd	4 May 1984	Holwerd, Friesland The Netherlands (53°22'N, 5°54'E)	26 Feb. 1986	Iouik, Banc d'Arg. Mauritania	Control
Turnstone	Helsinki AT 040 242	> 1st	15 July 1978	Närpi, Vaasan Lääni Finland (62°17'N, 21°17'E)	13 Mar. 1986	Iouik, Banc d'Arg. Mauritania	Control, ring replaced by Paris M 5353
Turnstone	London CE 81002	?	16 Aug. 1981	South Walney, Barron Cumbria, U.K. (54°03'N, 3°10'W)	18 April 1986	Iouik, Banc d'Arg. Mauritania	Found dead; prey remains of raptor
Willow Warbler	London 2H5 437	> 1st c.y.	21 Apr. 1984	Bardsey Island, Gwynedd, Wales, U.K. (52°46'N, 4°48'W)	31 Mar. 1985	Iouik, Banc d'Arg. Mauritania	Control



8. BODY COMPOSITION ANALYSIS

Nelly E. van Brederode

8.1 Introduction

Of 85 waders, the unavoidable casualties of our mist-netting and cannon-netting activities in 1985, it was possible to make a body composition analysis. Twelve species were involved (Table 8.1).

Table 8.1. Species and numbers of waders caught at Iouik, Mauritania, and used for body composition analysis.

Species	Number
Ringed Plover	4
Kentish Plover	1
Grey Plover	1
Knot	23
Sanderling	1
Little Stint	13
Curlew Sandpiper	2
Dunlin	29
Bar-tailed Godwit	4
Whimbrel	3
Redshank	1
Turnstone	3

8.2 Methods

Fresh weights (in grams) were recorded as well as wing-, bill-, total head- and tarsus + toe lengths (in mm). The pectoral muscles of the right side were completely removed and their fresh weight was taken. Sternum measurements were made according to Piersma et al. (1984). The latter data together with the breast muscle weight can be used to calculate the standard muscle volume index; an index of the protein reserves. Age and sex were determined by dissection. The carcasses and the pectoral muscles were dried in a field oven at c. 60°C for 2-4 days depending on the size of the bird. After drying they were preserved one by one in tightly closed plastic bags filled with silica-gel. After transportation to the Netherlands they were dried again at the laboratory and the dry weight was recorded. For the extraction of lipids petroleum ether was used in a Soxhlet apparatus. The residual weight of the carcass and the pectoral muscles after further drying was taken to be the fat-free dry weight (= lean dry weight). The weight of the fat was obtained by subtracting the lean dry weight from the dry weight. Lean fresh weight was obtained by substracting the weight to the fat from the fresh weight.

8.3 **Results**

8.3.1 Water percentage

The percentage of water of the lean fresh weight shows considerable variation among and between the species (Table 8.2).

Table 8.2. Mean water percentage of lean fresh weight, standard deviation and range for Little Stints, Dunlin and Knot.

Species	Mean water % of lean weight	S.D.	Range
Little Stint (13)	65.3	5.0	53.1-69.2
Dunlin (28)	67.5	3.3	56.9-73.5
Knot (23)	68.8	3.1	58.9-71.8

The smaller the species the lower the mean water percentage (Little Stint vs. Knot, $t=2.36$, $p<0.05$, two sided Student's t-test) and the bigger the standard deviation. This is in contrast with winter figures from the Netherlands and Northeast Britain which show a rather constant water percentage among the birds (Piersma 1984, Davidson 1981). The cause of this variation among birds in Mauritania is not known. It might have something to do with the procedures (e.g. the time it took between death of the bird and analyses; dehydration).

One way of telling whether dehydration after capture is of importance, is by looking at the relation between water percentage and the time between capture and taking the weight (Figs. 8.1, 8.2 and 8.3). The correlations are low (Table 8.3), but in two cases significant, so it is

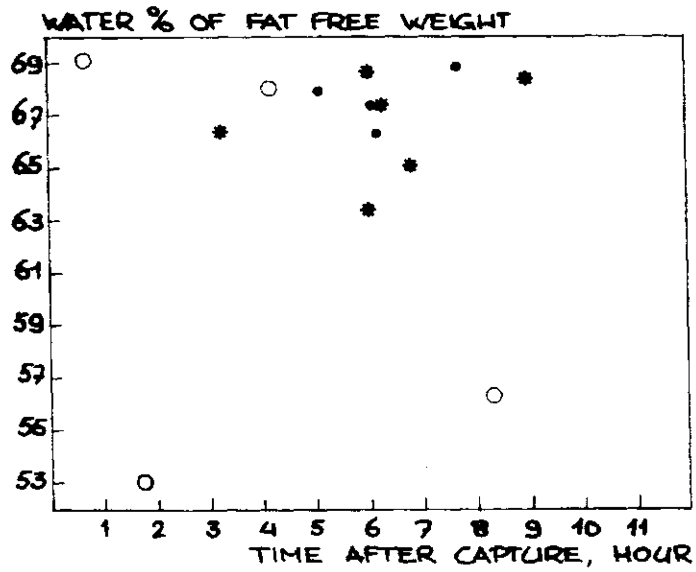


Figure 8.1. The water percentage of fat-free weight of 2nd c.y. (●), adult male (*) and adult female (o) Little Stints in March and April in Mauritania.

possible to estimate the mean water percentage at time of capture and make a correction for birds with a low water percentage.
A way of telling whether migration influences the water percentage is by looking at the relation between the water percentage and the amount of

Table 8.3. Linear regressions of water percentage of lean fresh weight (y, ing) on time between capture and taking the weight (x, also ing) for Little Stints, Dunlins and Knots. For Little Stints r is not significantly different from zero, for Dunlins and Knots r=0.05.

Species		Intercept	Slope	r	r^2
Little Stint	(n=13)	64.1	0.228	0.11	0.01
Dunlin	(n=29)	70.0	-0.613	-0.36	0.13
Knot	(n=21)	70.3	-0.405	-0.35	0.12

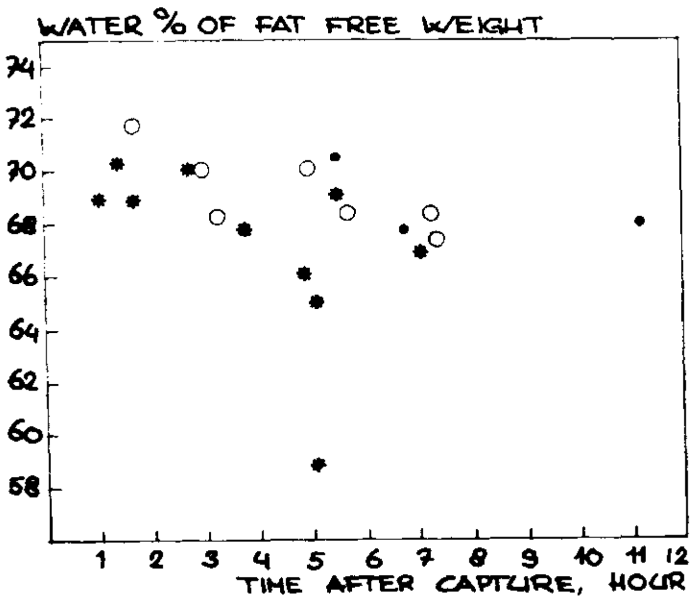


Figure 8.2. The water percentage of fat-free weight of 2nd c.y. (●), adult male (*) and adult female (o) Knots in March and April in Mauritania.

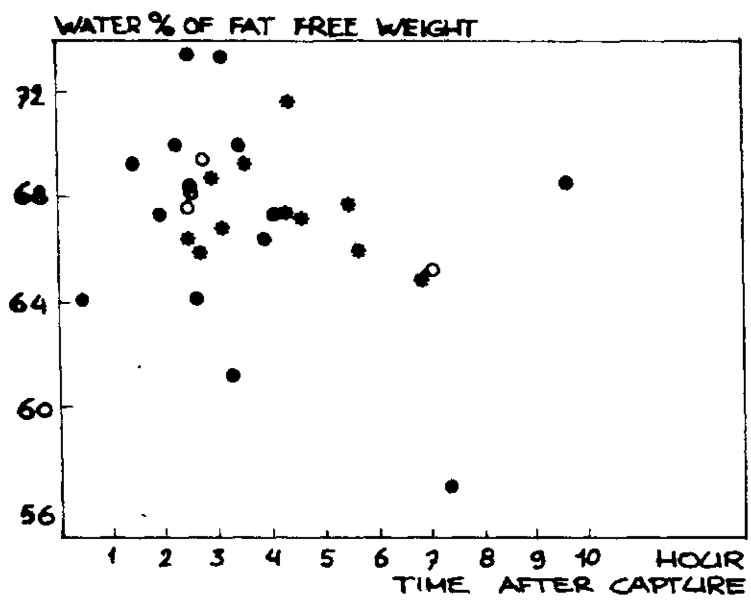


Figure 8.3. The water percentage of fat-free weight of 2nd c.y. (●), adult male (*) and adult female (o) Dunlins in March and April in Mauritania.

fat. Recently arrived birds, birds in a bad condition, as well as birds which are about to leave (premigratory dehydration) might have a low water percentage. Although birds with a low water percentage are among those with a high amount of fat, there is no trend (Figs. 8.4, 8.5 and 8.6). To get around the possible complication of dehydration the water percentages were assumed to be 65% for Little Stints, 66% for Dunlins and 67% for Knots.

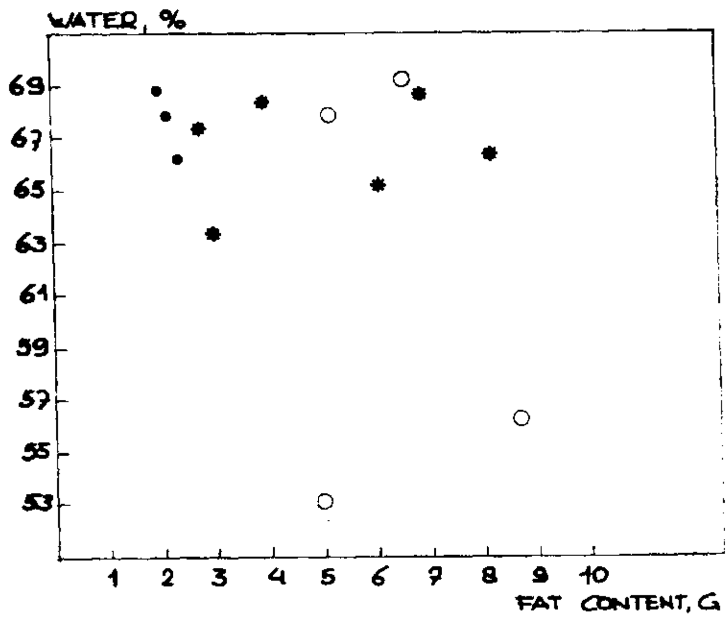


Figure 8.4. The relationship between the water percentage of fat-free weight and the fat content in 2nd c.y. (●), adult male (*) and adult female (o) Little Stints.

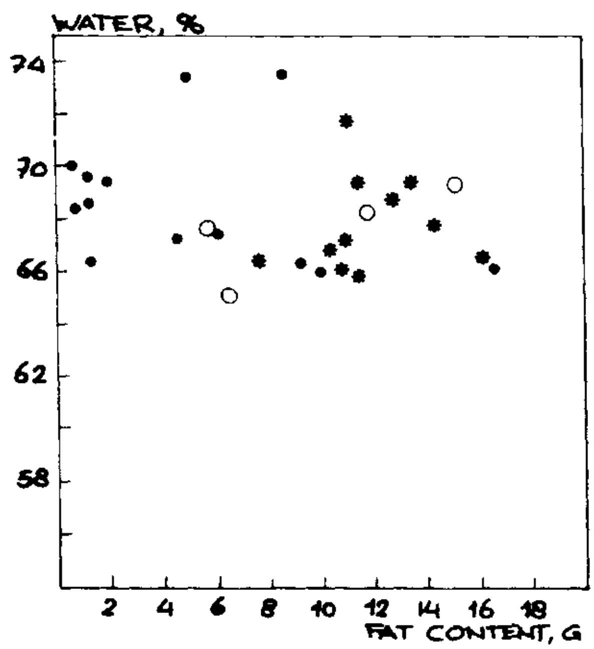


Figure 8.5. The relationship between the water percentage of fat-free weight and the fat content in 2nd c.y. (●), adult male (*) and adult female (o) Dunlins.

8.3.2. Regressions for estimating fat reserves

The regressions for estimating the fat content by using the fresh weight, and thus the lean fresh weight, are given in table 8.4. In Little Stints the correlation is high. For the second calendar year (2nd c.y.) birds however it is negative, but there are only three birds and they have very

Table 8.4. Linear regressions of fat content (y) on fresh weight (x). Where $n \geq 10$, the correlation coefficients are significantly different from zero ($p<0.05$).

Species		Intercept	Slope	r	r^2
Little Stint	all birds (13)	- 9.5	0.58	0.92	0.85
	adults (10)	- 8.9	0.56	0.90	0.81
	2nd c.y. (3)	5.2	-0.14	-0.97	0.93
Dunlin	all birds (28)	-14.7	0.48	0.84	0.71
	adults (15)	- 8.5	0.38	0.69	0.47
	2nd c.y. (13)	-13.2	0.41	0.87	0.76
Knot	all birds (23)	-57.8	0.55	0.88	0.77
	adults (18)	-53.0	0.52	0.68	0.47
	2nd c.y. (5)	- 5.4	0.08	0.77	0.59

Table 8.5. Mean values and standard deviations (in mm) of wing length, bill length, total head length, and tarsus + toe length for adult males, adult females and second calendar year birds.

Species	Wing length	S.D.	Bill length	S.D.	Total head length	S.D.	Tars. + toe length	S.D.
Little Stint								
adult females (4)	97.8	3.5	18.3	1.0	39.1	1.4	40.3	2.1
adult males (6)	96.3	2.2	17.8	0.7	38.4	1.3	40.0	1.7
Dunlin								
adult females (4)	117.3	2.2	31.9	1.9	55.5	1.5	46.8	1.7
adult males (11)	112.2	2.7	27.6	1.4	50.8	1.6	45.6	1.8
2nd c.y. (13)	115.8	3.0	30.6	2.4	53.6	2.7	46.6	1.5
Knot								
adult females (7)	170.3	3.0	35.0	1.4	63.7	1.9	58.1	1.4
adult males (11)	168.1	3.2	35.0	1.3	62.6	3.4	59.0	1.3
2nd c.y. (5)	164.8	7.2	34.5	1.4	63.1	1.9	58.4	1.5

Table 8.6. Coefficient of variation (CV) of wing, bill, total head and tarsus + toe length for Dunlins and Knots (CV=S.D./mean).

Species		CV Wing l.	CV Bill l.	CV Total head l.	CV Tarsus + toe l.
Dunlin	all birds	0.029	0.087	0.051	0.035
	adults	0.030	0.089	0.050	0.039
	2nd c.y.	0.026	0.078	0.050	0.032
Knot	all birds	0.027	0.047	0.041	0.022
	adults	0.019	0.037	0.046	0.022
	2nd c.y.	0.043	0.040	0.030	0.026

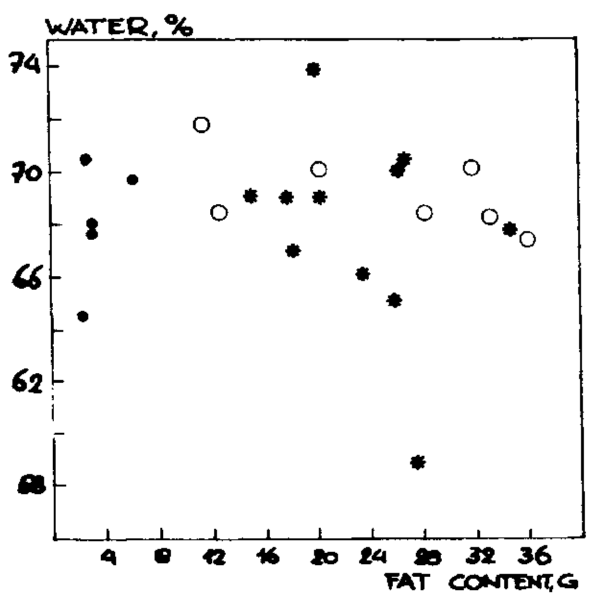


Figure 8.6. The relationship between the water percentage of fat-free weight and the fat content in 2nd c.y. (●), adult male (*) and adult female (o) Knots.

little fat (Fig. 8.7). In Knots and Dunlins this correlation is much lower, especially for the adults. For Dunlins this can be explained by the variation in size between the sexes (Table 8.5). In Knots however there is not such a big difference in measurements between the sexes and the coefficient of variation for bill length is much lower than in Dunlins (Table 8.6). Second year Knots like second year Little Stints have very little fat. The regression is again not very useful. In second

Table 8.7. Linear regressions of fat-free fresh weight (Y) on measurements (x). Where r≥0.5, the correlation coefficients are statistically different from zero (p<0.05).

		Wing length			Bill length		
		Intercept	Slope	r	Intercept	Slope	r
Little Stint	all	29.2	-0.10	-0.14	35.0	-0.85	-0.36
	adults	35.6	-0.16	-0.26	40.8	-1.15	-0.57
Dunlin	all	- 48.0	0.77	0.48	- 0.7	1.38	0.66
	adults	- 42.2	0.73	0.58	2.5	1.32	0.75
	2nd c.y.	-106.0	1.26	0.58	- 25.1	2.11	0.78
Knot	all	78.3	0.25	0.12	57.7	1.81	0.25
	adults	195.3	-0.42	-0.19	102.8	0.60	0.11
		Total head length			**Tarsus + toe length**		
		Intercept	Slope	r	Intercept	Slope	r
Little Stint	all	24.2	-0.12	-0.08	19.7	0	0
	adults	38.2	-0.47	-0.36	25.1	-0.12	-0.13
Dunlin	all	- 30.6	1.34	0.69	- 41.7	1.77	0.55
	adults	- 25.5	1.27	0.77	- 19.2	1.30	0.53
	2nd c.y.	- 58.1	1.82	0.77	- 97.1	2.93	0.68
Knot	all	68.9	0.82	0.23	175.4	-0.93	-0.13
	adults	81.7	0.67	0.27	222.5	-1.68	-0.31

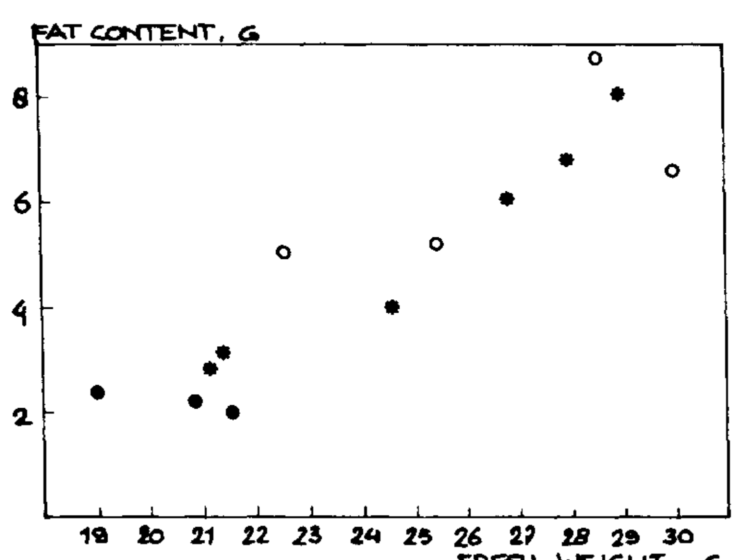


Figure 8.7. The relationship between the fat content and the fresh weight in 2nd c.y. (●), adult male (*) and adult female (o) Little Stints in March and April in Mauritania.

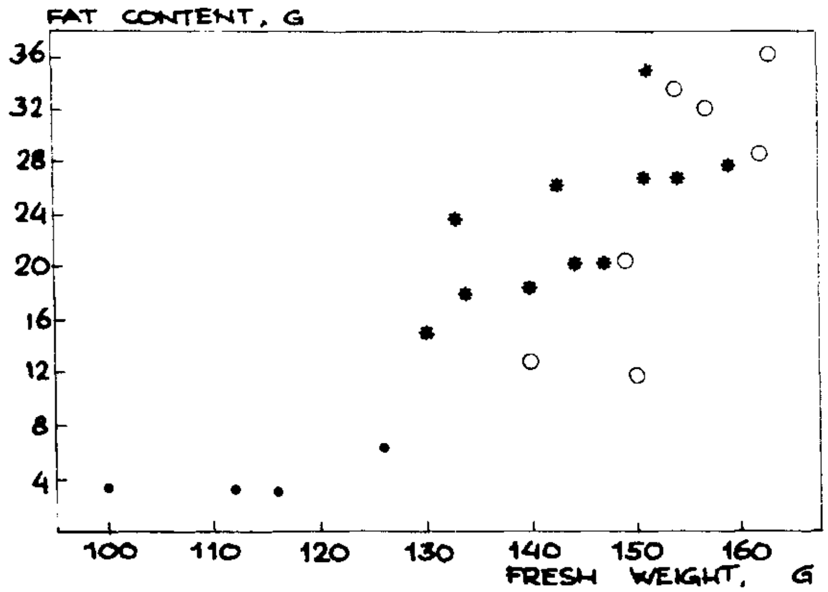


Figure 8.8. The relationship between the fat content and the fresh weight in 2nd c.y. ( ), adult male (*) and adult female (o) Knots in March and April in Mauritania.

Table 8.8. Lean fresh weight of individual birds and species in which no regression was performed.

Species	Age	Sex	Weight
Charadrius hiaticula	adult	male	43.8
	adult	male	50.9
	adult	male	43.4
	2nd c.y.	female	43.4
Pluvialis squatarola	adult	male	175.1
Calidris alba	adult	female	49.7
Calidris ferruginea	2nd c.y.	male	46.3
	adult	male	52.6
Limosa lapponica	adult	male	211.9
	adult	male	265.1
	adult	male	248.7
	adult	male	227.7
Tringa totanus	adult	female	111.1
Arenaria interpres	adult	male	96.8
	unknown	female	95.3
	adult	female	103.1

calendar year Dunlins the increase in fat and weight has the same pattern as in adults.

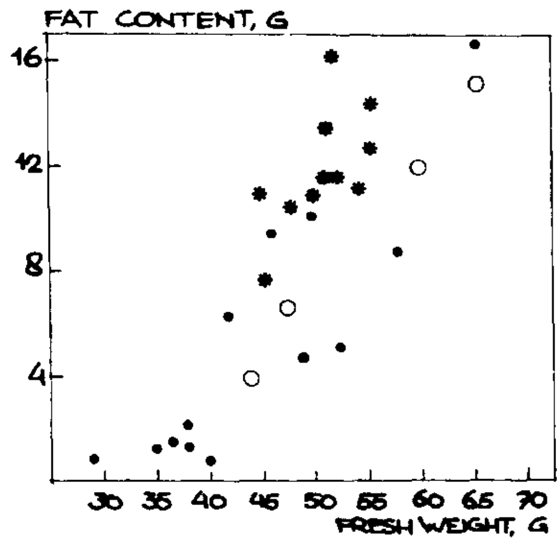


Figure 8.9. The relationship between the fat content and the fresh weight in 2nd c.y. (●), adult male (*) and adult female (o) Dunlins in March and April in Mauritania.

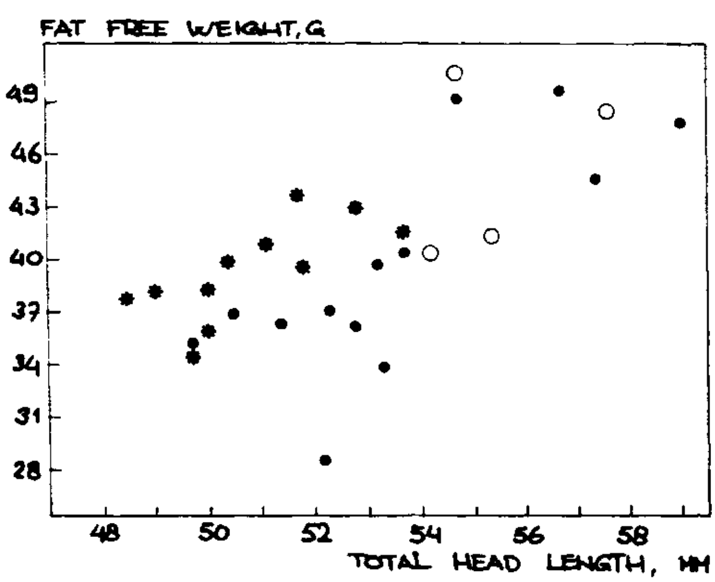


Figure 8.10. The relationship between the fat-free weight and the total head length in 2nd c.y. (●), adult male (*) and adult female (o) Dunlins.

Table 8.9. The mean lean fresh weight of Little Stints, Dunlins and Knots. For Dunlins and Knots the lean fresh weights corrected for weight loss after capture (cf. Table 8.3) are used.

Species		Mean lean fresh weight (g)
Little Stint	(13)	19.7 ± 1.8
Dunlin	(29)	39.9 ± 5.3
Knot	(23)	119.7 ± 11.5

Both for Knots and for Little Stints it is not possible to improve the estimation of lean fresh weight by using other body measurements (Table 8.7). As could be expected this can be done for adult Dunlins, especially using bill- or total head length (Table 8.7, Fig. 8.10).

Table 8.8 shows the lean fresh weight of individual birds of those species of which sample sizes are small. Table 8.9 shows the mean lean fresh weight of Little Stints, Dunlins and Knots.

8.4 Conclusions

For all three species, Little Stint, Dunlin and Knot, for which regressions were possible, the best estimates of the amount of fat in living birds can be calculated from the fresh weight. For Dunlins a better estimation is possible for adults using bill length or total head length.

9. NOTE ON GULLS AND TERNS

Mark R. Fletcher

9.1 Introduction

During the stay at Iouik several gulls and terns were caught incidentally in wader catches. Although many species of tern were present and migrating through only four species were caught and only two species of gull were caught. Numbers of individuals caught were only one or two for all species with the exception of Slender-billed Gull (Larus genei). Of this species over a hundred individuals were caught and it was possible to examine the biometric data collected for this species. Some observations of communal feeding were made for Slender-billed Gulls.

9.2 Methods

Whilst catching waders in the village of Iouik using a clap net several of the gulls were caught incidentally usually attracted to the catching area by bait laid out. This bait was rubbish from the village and bits of fish thrown away by the fishermen when preparing the fish they had caught for drying. Other birds principally terns were caught at night in mist nets over the mud flats. One tern was caught by cannon net as it roosted at high-tide with waders.

All gulls and terns caught were ringed and biometrics were recorded. The state of moult and plumage were recorded.

9.3 Terns

As many as eight species of terns were observed and counted. Several terns were observed obviously migrating in a steady stream and several birds were known to breed in the area, in particular Gull-billed Terns (Gelochelidon nilotica), Caspian Terns (Sterna caspia), Royal Terns (Sterna maxima), Common Terns (Sterna hirundo) and Bridled Terns (Sterna anaethetus) (Trotignon 1976). On several occasions mixed flocks of terns were observed feeding on fish shoals either out on the open sea or in pools at or near Iouik which were flooded at high tide.

9.3.1 Gull-billed Tern (Gelochelidon nilotica)

Individuals and parties of this species were to be seen at several locations over the mud flats often feeding on Fiddler Crabs (Uca tangeri). The maximum number counted at high tide in the Baie d'Aouatif was 191 in late April 1985. This reflected a steady build up from none counted in late March. Altenburg et al. (1982) counted eight birds in this area. Several birds were observed courting.

One bird was caught (18 April 1985) and was not aged. No moult was observed. The tip of the upper mandible of this bird was distinctly yellow in colour contrasting with the black of the rest of the bill. No broad patches were present.

Measurements made were wing (334 mm) and weight (238 g). From the biometrics given by Cramp & Simmons (1983) it would seem that this bird was probably an adult male.

9.3.2 Caspian Tern (Sterna caspia)

This species was observed migrating northwards during the duration of the study. However there is a local breeding colony on Kiaone (Altenburg et al. 1982). The numbers recorded in 1980 at this colony was 100-150 pairs. The maximum count for this species was 234 in late April in the Baie d'Aouatif area. Altenburg et al. (1982) had a count of 391 in January 1980. Dick (1975) suggested an exodus in late October and the late April count may indicate birds returning. No individuals of this species were caught.

9.3.3 Royal Tern (Sterna maxima)

With breeding colonies around the area of Baie d'Aouatif fairly large numbers of this species were observed. The highest count was in mid April with 734 individuals counted at high tide. Dick (1975) suggested that birds may winter to the south and the number counted by Altenburg et al. (1982) in mid January 1980 gave a number of 114 for the area much lower than the 360 counted some two months later.

Two birds were caught together (11 April 1985) in mist nets. Both were aged as adults and neither were showing wing or body moult. Dick (1975) had some 88 out of 117 showing moult in October and November. It was assumed that these birds were of the subspecies S. maxima albidedorsalis. The biometrics were as follows: wing 374 mm/362 mm, bill 64.1 mm/67.0 mm, tarsus 32.0 mm/30.8 mm and weight 410 g/390 g. The larger wing length is more the size of the nominate subspecies S. maxima maxima and is outside the range recorded for albidedorsalis (Cramp & Simmons 1983). The weights were at the higher end of the recorded range for albidedorsalis but this may reflect the fact that these birds were perhaps a breeding pair in breeding condition.

9.3.4. Sandwich Tern (Sterna sandvicensis)

Dick (1975) suggested that a wintering population may be established in the Banc d'Arguin. Certainly roosts have been recorded by Trotignon et al. (1980) and Altenburg et al. (1982) along the coast of Mauritania. By mid-March, no large numbers of Sandwich Terns were observed although there was a continuous movement of birds apparently migrating northwards to the North Sea coasts. No large numbers were counted at the high tides. Individuals of this species were often observed sitting amongst roosting waders.

The one bird that was caught by cannon net (9 April 1985) was caught with waders at one of these roosts. This bird was aged as an adult. It showed active primary moult similar to that found in October and November 1973 by Dick (1975). The primary moult of this bird showed two waves and expressed in the usual way was $N^{2}3^{1}4^{1}N^{2}4^{1}0^{3}$. There was also medium body moult. With a wing length of 305 mm, bill of 55.1 mm and tarsus of 28.2 mm it would seen that this bird was probably a male (Cramp & Simmons 1983). The weight was 242 g.

9.3.5 Common Tern (Sterna hirundo)

As with the Sandwich Tern these birds were observed apparantly migrating through the area. Trotignon et al. (1980) reported large numbers for Cap Blanc but Altenburg et al. (1982) counted some at the region of this study. The maximum number counted in the Baie d'Aouatif was mid April with 162 counted at high tide. When weather conditions were favourable these birds were often seen feeding in the shallows and pools as they made their way northwards. It is possible that Arctic Terns (Sterna paradisaea) were counted with the Common Terns. No Common or Arctic Tern were caught.

9.3.6. Little Tern (Sterna albifrons)

These birds were observed apparantly migrating northwards often in association with Common and Sandwich Terns. The largest numbers recorded at high tide in the Baie d'Aouatif was 62 in late April. One bird was caught and it was aged as an adult. No moult was recorded. The biometrics were wing 172 mm, bill 29.4 mm and weight 45.4 g.

9.3.7 Other terns

Black Terns (Chlidonias niger) and to a lesser extent Bridled Terns (Sterna anaethetus) were observed flying through the area in ones or twos. No larger number were recorded during the high tide counts. The Black Terns were caught in 1986, all were aged as adults. Biometrics were taken and were as follows, all were males:

wing (mm)	216	221	223
bill (mm)	27.3	28.0	27.3
tarsus (mm)	16.7	18.4	17.5
total head (mm)	60.3	61.2	58.8
weight (g)	61	61	72

No moult was recorded. All of these biometrics were similar to those reported by Cramp & Simmons (1983).

9.4 Gulls

Principally four species of gulls were observed and counted in the area of Baie d'Aouatif and Iouik. The majority of the gulls were found in the region of the village attracted by the fish offal and rubbish found at the water's edge and nearby. As in Europe the gulls readily consumed offal and rubbish when it became available and waited around feeding only for short times rather than continuously. However some active fishing was observed and also piracy of other species of gull and of waders was recorded. Some of the species of gull are obviously migrants and colonies of other species were found in the area.

9.4.1 Black-headed Gull (Larus ridibundus)

Very small numbers of this species were observed in the area of the study as were found by Dick (1975) and Altenburg et al. (1983). This area is much at the southern limit of the range of this species. In 1986 two birds were captured, both were juveniles, in their first year. The biometrics recorded are shown below and are within the limits as shown by Cramp & Simmons (1983).

wing (mm)	296	285
bill (mm)	34.5	32.4
tarsus (mm)	44.7	43.3
total head (mm)	80.3	76.6
weight (g)	252	229

9.4.2 Grey-headed Gull (<u>Larus cirrocephalus</u>)

This species is resident in the area although no evidence of local breeding was found. These birds were often seen sitting and feeding with other gull species at the village of Iouik. The largest number counted was 82 in mid April and the lowest 22 in late March. It would seen that the local population was probably below the hundred. In the same area in January Altenburg et al. (1982) counted 45: Most birds observed were coming into summer plumage and it would seen logical to think there was some breeding in the area.

One birds was caught (28 April 1985). From the biometrics it would seen that this bird was a female coming into full breeding plumage with about three quarters summer plumage, there being light body moult. Measurements were wing 286 mm, bill 32.2 mm, tarsus 45.2 mm and a weight of 260 g.

9.4.3 Lesser Black-backed Gull (<u>Larus fuscus</u>)

Large numbers of this species were counted in January 1980 by Altenburg et al. (1982). In the area of Iouik and Baie d'Aouatif 814 of these gulls were recorded. The largest number counted during this study was 25 in late March. The drop in the numbers may be due to birds returning to resting sites in Europe before the March count was made. However since 1980 and to some extent before this time Lesser Black-backed Gulls have less and less been migrating southwards, particularly in Britain (Cramp & Simmons 1985). In surveys carried out in England and Wales every ten years from 1953 to 1983 for comparable areas the number of Lesser Black-backed Gulls in winter has risen from 165 in 1953, 6960 in 1963, 25,057 in 1973 and 44,546 in 1983 (Hickling 1954, 1967 and 1977; Bowes et al. 1984). It is possible that the numbers of this species wintering in Africa has fallen as these birds have not moved southwards. Nearly all the Lesser Black-backed Gulls observed were not full adult, many being juveniles. None of this species were caught.

9.4.4 Slender-billed Gull (Larus genei)

This species is resident and comparatively large numbers were observed either feeding on shoals of fish or roosting, and feeding near the village of Iouik. The highest count made for this species was in mid April with nearly two and a half thousand counted (2435). This was more than the total count for all the Banc d'Arguin made by Altenburg et al.

Table 9.4.4.1. Mean values, standard deviations and ranges of measurements and weights of Slender-billed Gulls.

	Length in mm	S.D.	Range
Wing (n=122)	293	12.5	256 -322
Bill (n=118)	41.6	2.6	35.9- 48.3
Tarsus (n= 99)	50.0	2.8	42.7- 57.2
Total head (n= 98)	91.9	4.5	83.6-101.9
Weight in g (n=135)	286.6	38.5	205-404

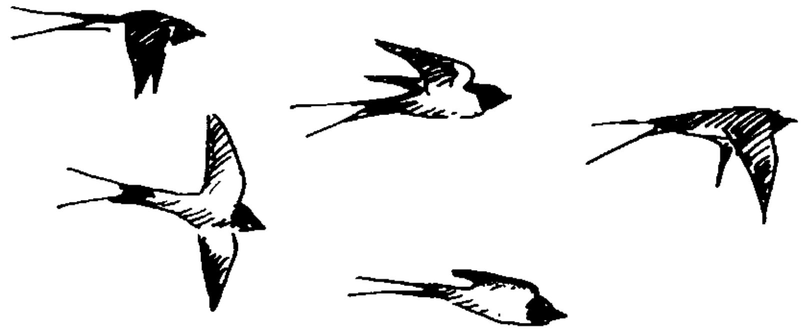
(1982) in 1980. In the area of Baie d'Aouatif and Iouik in January 1980 they counted 218. It would seem that birds probably come into the area to breed during the spring and although the count fell to 1,666 in late April this may represent breeding being under way with one of the pair being absent. The majority of the birds were counted on Zira.

A total of 51 Slender-billed Gulls were caught and measured in 1985 and a further 75 were caught in 1986 which included three birds retrapped from these caught in 1985. The majority of birds were adults. In 1985 one first year birds was caught, 1986, 14 were first year birds.

The overall mean measurements and ranges are given in table 9.4.4.1. The higher ends of the weight range are well over the published weights for the species, 350 g (Dement'ev & Gladkov 1951) but one or two of these birds were found to have brood patches and the higher weights may well have been females which were about to lay eggs.

Some observations were made on the feeding on shoals of fish by this species. Feeding by this means was mainly carried out in shallow water at high tide usually at one or two sites, the same sites being used at each successive high tide during daylight. At about two hours prior to the high tide birds would arrive in pairs and defend a space around the pair. The aggressive posture was typically neck extended as an intruding bird neared to the space around the pair. Submissive posture, neck held right down, is often given by the other of the pair when the aggressive posture is struck. Some birds would sit on the water in pairs, others on the sand often sitting right down. Preening occurs regularly and often the larger bird of the pair - possibly the male - calls, starting with the bill pointing downwards and then extenting it upwards. Both members of the pair will chase off an other bird getting too close. Pairs together on the sand often sit with their bodies touching each other.

As high tide approaches and the shoals of small fish appear the birds surround the shoal and there is a frenzied feeding action with gulls picking out the fish by plunging into the shoal or dipping to the surface and seizing the fish. These bouts of feeding lasted about 0.7-2 min, the birds usually resting on the surface of the water until the next bout started. Bouts of feeding occur about every 3-10 min. The success rate of observed gulls catching fish was about 10% of the plunging ending in a fast shallow of a fish. Some fish were collected from a captured gull which regurgitated. A total of 19 fish were counted giving a total weight of 30 g. Each fish weighed about 1.4-2.1 g. The length of the fish were all about 60 mm. The fish has not yet been identified.



10. AVIFAUNA

Cor J. Smit, Abou Gueye & Tom M. van Spanje

10.1 Introduction

This chapter summarizes all observations of birds and mammals in Mauritania during the stay of the expedition members from 10 March-5 May 1985 and from 3 February-28 April 1986. Some additional and more occasional observations of the project co-ordinator outside these periods are added as well. The location of the sites mentioned in the text can be found in appendix 2 of this report. Apart from occasional observations of the expedition members, the results of counts of the Baie d'Aouatif, Ebelk Aiznai and La Cherka, Nouadhibou for each species are added. Results for the Baie d'Aouatif include bird numbers found in Ebelk Aiznai and the area around the village of Iouik. This chapter additionally includes the biometrics of passerines captured in the expedition camp as well as biometrics of some non-passerine species captured occasionally. Fat in passerines was scored 0-5, according to the standard method described by Busse & Kania (1970). This method yields well reproduceable information on the actual fat load of passerines (Pettersson & Hasselquist 1985). More detailed accounts on the results of catches of waders, gulls and terns can be found in chapter 10 and appendix 1 of this report.

Abbreviations used in this chapter stand for:

ad. = adult(s)

camp = base camp of the expeditions, approximately 500 m east of the Biological Station near Iouik

c.y. = calendar year

imm. = immature(s)

juv. = juvenile(s)

N = North(ern)

E = East(ern)

S = South(ern)

W = West(ern)

Symbols have the following meaning:
+ 1-10
++ 11-100
+++ 101-1000
++++ 1001-10000

Systematic order, scientific nomenclature and English names for birds were taken from Voous (1973, 1977). French names were taken from Etchécopar & Hüe (1964). Names of some tropical species were taken from Lamarche (1987). Scientific and English names for mammals were taken from Rosevear (1969).

10.2 List of observed bird species

Tachybaptus ruficollis Little Grebe Grèbe castagneux

The N subspecies, T.r. ruficollis, is an occasional visitor to the N part of Mauritania, the S subspecies, T.r. capensis, is occurring in small numbers in the extreme S part of the country (Brown et al. 1982, Lamarche 1987). Considering the time of the year and the location of the sighting it is most probable our observation concerns T.r. ruficollis. Altenburg et al. (1982) observed 3 Little Grebes at the Banc d'Arguin during the 1980 expedition.

10/2/86 6 N part Baie d'Aouatif

Podiceps nigricollis Black-necked Grebe Grèbe à cou noir

Occasional visitor to Mauritania (Lamarche 1987).

15/3/86 3 near camp (in intermediate plumage)

Oceanites oceanicus Wilson's Storm Petrel Pétrel océanite

Visitor in small numbers to Mauritania, occurring throughout the year (Lamarche 1987).

5/2/86 more than 100 N of Cap Tafarit

Hydrobates pelagicus Storm Petrel Pétrel tempête

Frequently observed in Mauritanian coastal waters, mostly from March-August (Lamarche 1987).

20/3/85 About 10 Baie de Lévrier; about 15 near Cap Tafarit

5/2/86 ++ between Nouadhibou and Iouik

24/4/86 ++ between Iouik and Ile d'Arguin

Table 10.1 Weight (g) and biometrical data (mm) of Storm Petrels captured in mistnets in the Baie d'Aouatif

date	weight	age	wing	bill	tarsus
23/3/85	230	2nd c.y.	119	12.6	22.5
1/4/85	222	2nd c.y.	123		
3/4/85	255	2nd c.y.	119	12.0	22.9
15/4/85	274	2nd c.y.	121	12.4	24.6
16/4/85	239	2nd c.y.	120	11.8	22.0

Sula bassana Gannet Fou de bassan

Common visitor to Mauritanian coastal waters, locally in large flocks, most numerous from December-February. Juvenile percentage generally 50-80% (Lamarche 1987). Altenburg et al. (1982) observed 30 Gannets in the Baie de Lévrier on 8 March 1980.

10/3/85 3 over sea near Cansado

20/3/85 ++ Baie de Lévrier, approx. 25% adults

13/3/85 about 50 near Cap Blanc, nearly all imm.

2/5/85 2 Baie de Lévrier

5/2/86 200-300 during crossing of Baie de Lévrier. In the N part mainly adults, in the S part mainly 2nd c.y. and imm. In a sample of 21 birds 6 ad., 1 4-5th c.y., 3 4th c.y., 5 3rd c.y. and 6 2nd c.y..

25/4/86 ++ between Ile d'Arguin and Nouadhibou, especially in the W part of the Baie de Lévrier, 80-90% imm.

Phalacrocorax carbo lucidus Cormorant Grand cormoran

The W African subspecies of the Cormorant is a common visitor and breeding bird in Mauritanian coastal waters and the Sénégal delta (Lamarche 1987). Altenburg et al. (1982) counted 9395 Cormorants at the Banc d'Arguin during the 1980 expedition. It is breeding at the Banc d'Arguin in 3 colonies (4260 pairs in 1984-85) from September-March (Campredon 1987).

11-13/3/85 2-5 La Cherka, Nouadhibou

15/3/85 7 La Cherka, Nouadhibou and 23 along beach N of Nouadhibou

20/3/85 ++ area around Cap Tafarit

24/3/85 308 Baie d'Aouatif

20-22/4/85 ++ resting Nair during high tide
16/4/85 158 Baie d'Aouatif
23/4/85 + S part of Niroumi
24/3-7/5/86 16-90 Ebelk Aiznai
24/4/85 287 Baie d'Aouatif
2/5/85 25 Cap St. Anne
5/5/85 3 La Cherka, Nouadhibou
22/1-3/2/86 2-3 La Cherka, Nouadhibou
8/2-22/2/86 70-104 Ebelk Aiznai
24/4/86 ++ Kiaone
25/4/86 50 W part Ile d'Arguin; 30 La Cherka, Nouadhibou

Table 10.2 Weight (g) and biometrical data (mm) of a Cormorant captured in mistnets in the W part of the Baie d'Aouatif

date	weight	wing	bill	tarsus
26/3/86	1156	314	63.5	67.2

Phalacrocorax africanus Reed Cormorant Cormoran africain
Common visitor and breeding bird in Mauritanian coastal waters and inland habitats along the Sénégal river (Lamarche 1987). Altenburg et al. (1982) counted 7787 Reed Cormorants at the Banc d'Arguin during the 1980 expedition. The species is breeding at the Banc d'Arguin in 2 colonies (2460 pairs in 1984-85) from May-October (Campredon 1987).
21/3/85 5 Ten Alloul
24/3/85 920 Baie d'Aouatif
5/4/85 500 Ebelk Aiznai
12/4/85 more than 150 from Ebelk Aiznai flying towards Zira
14/4/85 119 Ebelk Aiznai
16/4/85 158 Baie d'Aouatif
21/4/85 4 Nair
22/4/85 95 Ebelk Aiznai
23/4/85 +++ Niroumi
24/4/85 287 Baie d'Aouatif
27/4/85 40 Ebelk Aiznai
8/2/86 280 Ebelk Aiznai

13/2/86 203 Ebelk Aiznai
22/2/86 372 Ebelk Aiznai

Pelecanus onocrotalus White Pelican Pélican blanc

Common visitor and breeding bird in Mauritanian coastal waters and inland habitats along the Sénégal river (Lamarche 1987). Altenburg et al. (1982) counted 611 adult White Pelicans and 300 fledglings at the Banc d'Arguin during the 1980 expedition. Breeding at the Banc d'Arguin in 1 large colony at Arel (3080 pairs in 1984-85) from September-March (Campredon 1987).

24-25/3/85 1 Baie d'Aouatif
3/4/85 1 ad. Iouik
4/4/85 1 ad. Ebelk Aiznai
5/4/85 3 Baie d'Aouatif, S of catching site 5
8/4/85 15 flying S over Ebelk Aiznai
11/4/85 48 (out of which 5 imm.) passing Iouik
14/4/85 1 swimming under mistnets Baie d'Aouatif, site 5
15/4/85 1 feeding on the emerged mudflats and seagrass beds in the N part of the Baie d'Aouatif, eating large preys
16/4/85 6 Baie d'Aouatif; 1 under the mistnets by night, Baie d'Aouatif site 5
18/4/85 2 near camp
20/3-22/3/85 up to 5 resting during high tide at Nair
24/5/85 13 Baie d'Aouatif
30/4/85 1 near camp

February-April 1986 frequently 1-3 near the camp and elsewhere in the Baie d'Aouatif. Additional observations:

16/2/86 5 SE corner Baie d'Aouatif, 2 in the central part
18/2/86 10 S of Zira
19/2/86 ++ near camp, migrating S
22/2/86 ++ Serini; +++ SE part Tidra
24/2/86 5 Serini
25/2/86 100 S tip Tila penisula
2/3/86 10 near camp, flying S
20/3/86 50 circling high over Iouik, descending into the Baie d'Aouatif
23-25/3/86 20-30 between Iouik and Rgueïba
1/4/86 4 Zira; 3 Serini
2/4/86 1 N part Tidra

8/4/86 9 near camp, 1 Zira
12/4/86 4 migrating S Ebelk Aiznai
24/4/86 40 surroundings Iouik

Nycticorax nycticorax Night Heron Héron bihoreau
Locally breeding and wintering along the Sénégal river and in other freshwater wetlands in S Mauritania. Passing through in autumn and spring and in these situations also observed along the coast (Lamarche 1987). Altenburg et al. (1982) observed 2 Night Herons in Nouadhibou during the 1980 expedition.
11/3/85 1 imm. in ship wreckage La Cherka, Nouadhibou
2/4/85 1 ad. beach Iouik
3/4/85 flying over 10 Baie St. Jean
5/4/85 3 Nair
23/4/85 1 ad. Niroumi
13/4/86 4 ad. Nair

Bubulcus ibis Cattle Egret Héron garde-boeufs
Locally a common visitor to the S part of Mauritania, generally not coming N of the 17th degree of latitude. Small numbers are observed in the N part of the country, generally from October-May (Lamarche 1987). Altenburg et al. (1982) frequently observed some tens in Nouadhibou during the 1980 expedition.
11/3/85 about 10 La Cherka, Nouadhibou
15/3/85 30 S part Presqu'Ile de Cap Blanc
1/4/85 1 near camp
15/4/85 1 Baie d'Aouatif, site 1 flying N
3-5/5/85 1 La Cherka, Nouadhibou
22/1/86 1 La Cherka, Nouadhibou
3/2/86 25 La Cherka, Nouadhibou
3/3/86 over 100 La Cherka, Nouadhibou

Egretta gularis Western Reef Heron Aigrette des recifs
The systematic position of Egretta gularis and E. garzetta still is somewhat obscure. Cramp & Simmons (1977) obviously distinguish two species, both having a dark and a white morph. Hancock (1984) distinguishes three subspecies of E. garzetta, including E.g. garzetta and E.g. gularis, white or nearly white birds being 'very rare' on

West-African coasts. Brown et al. (1982) again separate E. gularis and E. garzetta as separate species, both of these occurring along the Mauritanian coast. In the field a distinction between the two 'species' is very difficult to make. For practical reasons all dark coloured egrets were considered to be E. gularis, all white birds to be E. garzetta. This may have lead to a underestimation of the numbers of E. gularis. The 'species' is breeding at the Banc d'Arguin in 8 colonies (745 pairs in 1984-85, 55 of these at Zira) from April-November (Campredon 1987). Altenburg et al. (1982) counted 2899 dark herons at the Banc d'Arguin during the 1980 expedition.

11/3/85 about 10 La Cherka, Nouadhibou
15/3/85 1 La Cherka, Nouadhibou
24/3/85 53 Baie d'Aouatif
4/4/85 20 Ebelk Aiznai
7-8/4/85 1-2 Ebelk Aiznai
12/4/85 6 flying N and 3 foraging Iouik
13/4/85 22 flying N and 3 foraging Iouik
14/4/85 20 in mixed flock with E. garzetta passing camp flying N; in the evening 31 flying S towards communal nocturnal roost
16/4/85 75 Baie d'Aouatif
20-22/4/85 about 20 at high tide roost, Nair
22/4/85 ++ Iouik
23/4/85 ++ Niroumi
24/4/85 217 Baie d'Aouatif
1/5/85 + Ile d'Arguin
3/5/85 1 Presqu'Ile de Cap Blanc
5/5/85 1 La Cherka, Nouadhibou
7/5/85 2 Ebelk Aiznai
10/5/85 2 La Cherka, Nouadhibou
22/1-3/2/86 2-4 La Cherka, Nouadhibou
8-22/2/86 9-21 Ebelk Aiznai
3/3/86 15-20 La Cherka, Nouadhibou
24/3/86 ++ between Iouik and Kiji
25/3/86 5-10 between Rgueïba and Serini
5/4/86 7 in a flock, possibly migrants, N part Baie d'Aouatif
24/4/86 2 La Cherka, Nouadhibou

Egretta garzetta Little Egret Aigrette garzette

Since a distinction between Egretta garzetta and E. gularis is very difficult to make all dark coloured egrets were considered to be E. gularis, all white birds E. garzetta. This may have lead to an overestimation of the real number of Little Egrets. Twenty white Egrets in La Cherka, Nouadhibou, which were carefully studied on 2/3/86, all showed typical characteristics of Reef Herons like dull yellow feet. Also at the Banc d'Arguin this may have been the case. Only one bird in Iouik showed clear yellow feet. For further comments see under E. gularis. Altenburg et al. (1982) counted 2711 white herons at the Banc d'Arguin during the 1980 expedition.

11/3/85 about 10 La Cherka, Nouadhibou
15/3/85 13 S part Presqu'Ile de Cap Blanc
5/4/85 1 Ebelk Aiznai; 1 near camp
10/3/85 1 flying N, Iouik
24/3/85 11 Baie d'Aouatif
13/4/85 flock of 62 leaving the Baie d'Aouatif in N direction
14/4/85 50 in N part of Baie d'Aouatif, 10 in mixed flock with E. gularis flying in N direction; 55 leaving the N part of the Baie d'Aouatif in NNW direction at 7.35 p.m.
22/4/85 2 flying N over sea near Iouik
23/4/85 + Niroumi
1/5/85 + Ile d'Arguin
3/5/85 10 Presqu'Ile de Cap Blanc
5-10/5/85 3-6 La Cherka, Nouadhibou
3/2/86 3 La Cherka, Nouadhibou
8/2/86 5 Ebelk Aiznai
10-11/2/86 5-6 Baie d'Aouatif
13/2/86 16 Ebelk Aiznai
18/2/86 7 Baie d'Aouatif
22/2/86 2 Ebelk Aiznai
24/2/86 1 Iouik
3/3/86 ++ La Cherka, Nouadhibou
18/3/86 1 Baie d'Aouatif, site 1, attacked by a Marsh Harrier. One other corpse found, apparently killed by a predator.
24/3/86 ++ between Iouik and Kiji
25/3/86 5-10 between Rgueïba and Serini

Ardea cinerea Grey Heron Héron cendrée

At the Banc d'Arguin 2 subspecies are observed. The N subspecies 'cinerea' is a rather common winter visitor from September-April in coastal and freshwater habitats all over Mauritania, the endemic subspecies 'monicae' is restricted as a breeding bird to the Banc d'Arguin but may also be seen as a migrant in the Sénégal delta (Lamarche 1987). The latter subspecies is breeding at the Banc d'Arguin in colonies at Kiaone and Arel (2400 pairs in 1984-85) from April-January (Campredon 1987). Most observations concern the subspecies "monicae", though locally (and more often than indicated here) also the subspecies "cinerea" was observed. Altenburg et al. (1982) counted 3076 Grey Herons at the Banc d'Arguin during the 1980 expedition.

11/3/85 ++ La Cherka, Nouadhibou
15/3/85 42 S part Presqu'Ile de Cap Blanc
24/3/85 172 Baie d'Aouatif
14/4/85 12 Ebelk Aiznai
16/4/85 104 Baie d'Aouatif
20/4-22/4/85 about 10 Nair
22/4/85 ++ Ebelk Aiznai
23/4/85 +++ Niroumi, among which also A.c. cinerea
24/4/86 83 Baie d'Aouatif
27/4/85 14 Ebelk Aiznai
1/5/85 ++ Ile d'Arguin
3/5/85 28 S part Presqu'Ile de Cap Blanc
7/5/85 4 Ebelk Aiznai
10/5/85 12 La Cherka, Nouadhibou
22/1/86 3 La Cherka, Nouadhibou
3/2/86 20 La Cherka, Nouadhibou
8/2/86 7 N part Baie d'Aouatif; 20 Ebelk Aiznai
10-22/2/86 24-25 Ebelk Aiznai
23/2/86 120 S tip Tidra
25/2/86 50 at high tide roost S tip Tila peninsula
3/3/86 10 La Cherka, Nouadhibou
18/3/86 1 Ebelk Aiznai, positively A.c. cinerea
21/3/86 18 Baie d'Aouatif, site 1 migrating S
23/3/86 2 "cinerea" Baie d'Aouatif
24/3/86 2 "cinerea" between Iouik and Kiji
25/3/86 tens between Rgueïba and Serini

26/4/86 + La Cherka, Nouadhibou

Ardea purpurea Purple Heron Héron pourpré

Migrant in rather small numbers (September-November and April-June) and winter visitor, especially in inland wetlands in S Mauritania. Few observations from the coast (Lamarche 1987).

1/4/85 1 Niroumi
5/4/85 14 Zira
23/4/85 5 Niroumi
22/2/86 2 Ebelk Aiznai
18/3/86 1 Ebelk Aiznai
20/3/86 5 in mangroves W of Tidra
13/4/86 2 juv. and 4 ad. mangroves W of Tidra

Ciconia ciconia White Stork Cigogne blanche

Winter visitor in small flocks in wetlands in S Mauritania. Irregular passage over the Sahara in a broad front, notably from August-November and in March-April, somewhat more numerous in the W part of the country (Lamarche 1987).

10/3/85 1 La Cherka, Nouadhibou, 2 circling over Nouadhibou
12/3/85 2 La Cherka, Nouadhibou
15/3/85 2 along the beach N of Nouadhibou; 4 imm. N of Nouadhibou airport
28/4/85 2 ad. on rubbish tip near Cap Blanc
25/1/86 2 circling over La Cherka, Nouadhibou in N direction

Platalea leucorodia Spoonbill Spatule blanche

Two subspecies can be noted at the Banc d'Arguin. P.l. leucorodia is a migrant and winter visitor in small numbers, on the coast as well as in inland wetlands in Mauritania, arriving from August to November and leaving from February to May. The subspecies "balsaci" is endemic for the Banc d'Arguin. Birds of the latter subspecies are leaving the breeding grounds from October-November and return from February-March (Lamarche 1987). P.l. balsaci is breeding at the Banc d'Arguin in 6 colonies (1610 pairs in 1984-85, 450 of these at Zira) from March-November (Campredon 1987). Both subspecies partly can be separated in the field. During the 1985/86 expeditions, however, no attempts have been made to really do so. Altenburg et al. (1982) counted 8991 Spoonbills at the Banc d'Arguin during the 1980 expedition.

10/3/85 1 La Cherka, Nouadhibou

13/3/85 1 circling over Nouadhibou, 2 in lagoon N of Nouadhibou

14/3/85 6 La Cherka, Nouadhibou

15/3/85 29 S part Presqu'Ile de Cap Blanc

21/3/85 5 Ten Alloul

23/3/85 1 found dead 100 m E of Iouik

24/3/85 1043 Baie d'Aouatif, two of these carrying Dutch rings but not identifiable

1/4/85 24 N part Baie d'Aouatif, migrating NNW (7.10 p.m.)

4/4/85 46 Ebelk Aiznai

5/4/85 40-50 Ebelk Aiznai

7/4/85 36 flying towards the emerging mudflats, Zira

16/4/85 843 Baie d'Aouatif

20-22/4/85 colony settling down on NW part Nair. On 21/4 930 sitting, fighting, copulating and nesting birds and about 600 spectators. Among the latter birds 1 or 2 carrying Dutch rings.

22/4/85 9 flying N and leaving the Baie d'Aouatif around 19.30 h, site 1; 7 foraging there already; no larger flocks present any more in the Baie d'Aouatif

23/4/85 +++ Niroumi

24/4/85 9 N part Baie d'Aouatif, migrating NNW (7.30 p.m.)

27/4/85 34 Ebelk Aiznai

3/5/85 16 Presqu'Ile de Cap Blanc

7/5/85 25 Ebelk Aiznai

10/5/85 8 La Cherka, Nouadhibou

22/1-3/2/86 1 La Cherka, Nouadhibou

February and March 1986 frequent observations of small flocks (up to 35) in many places in the Baie d'Aouatif.

8/2-13/2/86 5-7 Ebelk Aiznai

9/2/86 20 on high tide roost Ebelk Aiznai

10/2/86 9 migrating N in NW part Baie d'Aouatif

14-19/2/86 200 Zira

16/2/86 150 SE part Baie d'Aouatif

19/2/86 200 on Zira; another 100 Iouik

21/2/86 200 S Foum Al Trique

23/2/86 150 S tip Tidra

24/2/86 50 S tip Ajoueïr

25/2/86 200-300 SE part Baie d'Aouatif; 250 at roost S tip Tila penisula

28/2-1/4/86 300-400 Zira

3/3/86 1 ad. and 5 imm. La Cherka, Nouadhibou

18/3/86 20 Ebelk Aiznai

24/3/86 some hundreds between Iouik and Kiji

25/3/86 ++ between Rgueïba and Serini

7/4/86 about 500 at and around Arel

9/4/86 200-300 on high tide roost NW part Tidra

11/4/86 +++ around Arel; +++ Nair; 300 Gibene

16/4/86 25 Kiaone

20/4/86 135 N of Serini, at least 2 of these carrying Dutch rings; 29 NW part Baie d'Aouatif, among which 5 with colour rings

21/4/86 15 NW part Baie d'Aouatif, none with rings

24-25/4/86 + Ile d'Arguin

Phoenicopterus ruber Greater Flamingo Flamant rose

Present as a breeding bird as well as numerous migrant. The Banc d'Arguin is the most important wintering site in Mauritania, sometimes 2-5000 are wintering in the Sénégal delta (Lamarche 1987). Breeding in 1 very large colony in the Baie d'Arguin (12940 pairs in 1984-85) from April-September (Campredon 1987). Flamingos were relatively rare in the Baie d'Aouatif in the 1986 season. In other parts of the Banc d'Arguin, for instance near Arel, large numbers were recorded. The occurrence of small numbers in the Baie d'Aouatif therefore will have been a local phenomenon. Altenburg et al. (1982) counted 60,000-80,000 Greater Flamingos at the Banc d'Arguin during the 1980 expedition.

10/3/85 14 imm. and 1 ad. La Cherka, Nouadhibou

11/3/85 46 La Cherka, Nouadhibou, among which 1 colour-ringed (probably the same bird as on 5/5/85).

15/3/85 31 (all imm.) S part Presqu'Ile de Cap Blanc

24/3/85 480 Baie d'Aouatif

4/4/85 42 Ebelk Aiznai, 1 colour-ringed (probably the same bird as on 15/4/85).

12/4/85 about 50 site 1, 15 others flying over in N direction

13/4/85 88 Zira; 26 leaving NW part Baie d'Aouatif in NNW direction (7.35 p.m.)

14/4/85 14 leaving NW part Baie d'Aouatif in NNW direction (7.40 p.m.)

15/4/85 39 during high tide Ebelk Aiznai, 1 of these colour-ringed. This bird was ringed in the Camargue on 27 July 1982 and resighted afterwards in Cadiz, Spain on 31 October 1982 and in S France from May 1986 onwards (Alan Johnson, in litt.).

16/4/85 843 Baie d'Aouatif

20-23/4/85 up to 100 foraging around Nair

23/4/85 ++ Niroumi

24/4/85 491 Baie d'Aouatif

27/4/85 73 Ebelk Aiznai

1/5/85 1700 in NE part Ile d'Arguin

3/5/85 66 Presqu'Ile de Cap Blanc

5/5/85 ++ La Cherka, Nouadhibou one of these colour-ringed as a pullus in the Camargue in 1984 (Alan Johnsson in litt.)

7/5/85 167 Ebelk Aiznai

8-20/2/86 13 Baie d'Aouatif

11/2/86 250 counted from plane between Iouik and Ile d'Arguin

14-21/2/86 5-7 Zira

22/2/86 1 Ebelk Aiznai

23/2/86 40 Ebelk Aiznai, migrating N; 19 Baie d'Aouatif

24/2-17/3/86 about 10 N part Baie d'Aouatif

13-14/3/86 6-7 Zira

18/3/86 3 Ebelk Aiznai

21/2/86 320 SW part Serini

22/2/86 +++ between Tidra and Ajoueïr; 100 E Ajoueïr

23/3/86 100 Baie d'Aouatif; 150 S tip Tidra

24/3/86 many thousands between Iouik and Kiji

25/3/86 ++ between Rgueïba and Serini

27/3-3/4/86 3-19 in Baie d'Aouatif and around Zira

4/4/86 200 between Arel and Niroumi

5/4/86 26 NW part Baie d'Aouatif

6/4/86 40 Tivide

7/4/86 2000 NW Arel

9/4/86 20 NW part Tidra

10/4/86 60 Baie d'Aouatif, 46 migrating N (5.00 p.m.)

11/4/86 11 Ebelk Aiznai; 15 Baie d'Aouatif; +++ Arel

12/4/86 38 NW part Baie d'Aouatif

13/4/86 200 Niroumi; 500 W part of Tidra

14/4/86 50 Baie d'Aouatif

16/4/86 11 Ebelk Aiznai; 47 Baie d'Aouatif; 11 Iouik migrating N

17-18/4/86 39-47 NW part Baie d'Aouatif

22-23/4/86 56-63 NW part Baie d'Aouatif
24-25/4/86 +++ surroundings of Ile d'Arguin

Phoenicopterus minor Lesser Flamingo Petit Flamant
A rare migrant from Afro-tropical regions, generally only recorded S of Tidra (Lamarche 1987).
31/3/85 2 ad. Baie d'Aouatif
1/4/85 1 ad. Baie d'Aouatif

Anas acuta Pintail Canard pilet
Varying numbers winter in the Sénégal delta, numbers ranging from 1000 up to 40,000. Migrating along the coast from October-December and January-March (Lamarche 1987). Altenburg et al. (1982) observed up to 25 Pintails in several places at the Banc d'Arguin during the 1980 expedition.
22/3/85 6 Baie d'Aouatif
25/3/85 6 flying N over Iouik
17/2/86 13 males and 2 females N part Baie d'Aouatif
18/2/86 22 flying S near camp
25/2/86 9 males and 4 females flying NW N part Baie d'Aouatif

Table 10.3 Weight (g) and biometrical data (mm) of a female Pintail captured in a mistnet in the Baie d'Aouatif, site 1

date	weight	wing	tarsus
26/3/85	660	248	38.5

Anas crecca Teal Sarcelle d'hiver
Wintering in small numbers in the Sénégal delta. Migration along the coast in October-November and February-March (Lamarche 1987). Altenburg et al. (1982) found 1 dead Teal at Tidra during the 1980 expedition.

Table 10.4 Weight (g) and biometrical data (mm) of a male Teal captured in a mistnet in the W part of the Baie d'Aouatif.

date	weight	wing
17/3/86	395	189

Anas querquedula Garganey Sarcelle d'été

Wintering in large numbers in the Sénégal delta (on average 100,000). Migration along the coast noted from September-November and in February and March (Lamarche 1987). Altenburg et al. (1982) observed up to 23 Gargeneys in several places at the Banc d'Arguin during the 1980 expedition.

24/3/85 3 males and 3 females Baie d'Aouatif, flying SW

13/3/86 14 flying SW near camp

Anas clypeata Shoveler Canard souchet

Wintering in rather small numbers in the Sénégal delta and inland wetlands in S Mauritania. Migration noted from October-December and in January and February (Lamarche 1987). Altenburg et al. (1982) observed up to 60 Shovelers in several places at the Banc d'Arguin during the 1980 expedition.

22/3/85 2 males and 6 females flying NE over camp

24/3/85 1 male N of Iouik

26/3/85 26 (about 50% males, 50% females) leaving the Baie d'Aouatif in N direction

13/4/85 2 females Baie d'Aouatif, site 2

25/2/86 2 males and 2 females N part Baie d'Aouatif

7/4/86 corpse of female found Tidra

Milvus migrans Black Kite Milan noir

Two subspecies may be observed in Mauritania. M.m. migrans probably is the only subspecies the expedition encountered, M.m. parasiticus, an Afro-tropical subspecies, has its N range around the 17th degree of latitude. "Migrans" is an rather common migrant in August and September and February and March (Lamarche 1987). Altenburg et al. (1982) observed 16 Black Kites at the Banc d'Arguin on 7 March 1980.

1/4/85 1 near camp
2/4/85 1 near camp, exhausted, missing 1 leg, in active wing moult
4/4/85 1 near camp
6/4/85 1 Baie d'Aouatif site 6, different from the one on 2/4/85
8-12/4/85 1 near camp
28/4/85 8 on dead camel, rubbish tip Cap Blanc
5/5/85 6 La Cherka, Nouadhibou
21/3/86 25 circling over camp
22/3/86 up to 70, present all over in the surroundings of Iouik
23/3/86 1 circling over camp
30-31/3/86 1 circling over camp
2/4/86 8 over camp in N direction

Neophron percnopterus Egyptian vulture Percnoptère d'Egypte
Small numbers are recorded throughout the year. Can be recorded on migration, as a wintering guest as well as a breeding bird, most of these in the E part of the country (Lamarche 1987).
28/4/85 10 on rubbish tip Cap Blanc

Gyps fulvus Griffon Vulture Vautour fauve
Small numbers are recorded on passage in coastal regions of the country, most of these in autumn (Lamarche 1987).
14/3/85 1 on rubbish tip La Cherka, Nouadhibou
mni15/3/85 3 on beach N Nouadhibou
11/4/85 1 Iouik
25/1/86 2 circling over La Cherka, Nouadhibou in N direction

Circus aeruginosus Marsh Harrier Busard des roseaux
Numerous on passage as well as a wintering guest, especially in coastal regions. Recorded on migration from August-October and February-May (Lamarche 1987). Altenburg et al. (1982) counted 62 Marsh Harriers at the Banc d'Arguin during the 1980 expedition.
15/3/85 1 male La Cherka, Nouadhibou; 1 male along beach N Nouadhibou
24/3/85 1 Baie d'Aouatif, disturbing high tide roosts
25/3/85 1 E part Baie d'Aouatif
27/3/85 1 near camp
29/3/85 1 near Iouik; 1 Baie d'Aouatif, site 3
30/3/85 1 ad.male Tivide; 1 male and 1 female Ebelk Aiznai; 1 female camp

31/3/85 1 Iouik flying S; 1 ad. male Ebelk Aiznai
2/4/85 1 W part Baie d'Aouatif; 1 female Nair; 1 ad. male Ebelk Aiznai
3-4/4/85 1 female Ebelk Aiznai
5/4/85 1 ad. male Iouik; 2 Ebelk Aiznai
6/4/85 8 Ebelk Aiznai
7-14/4/85 1-2 Ebelk Aiznai
9/4/85 1 male and 1 female Ebelk Aiznai; 1 male near camp; 1 female flying N over camp
12-21/4/85 1 W part Baie d'Aouatif
25/4/85 1 female Ebelk Aiznai
8-22/2/86 1 Ebelk Aiznai
8/2-18/3/86 1-2 W part Baie d'Aouatif
20/2/86 3 Ebelk Aiznai
21/2/86 1 female E coast Tidra
24/2/86 1 Serini
20-22/3/86 3-6 W part Baie d'Aouatif
23-24/3/86 1-3 Baie d'Aouatif, site 3
24/3/86 3 between Iouik and Kiji
25/3/86 1 Ajoueïr
25/3/-11/4/86 frequently 1-2 Baie d'Aouatif
9/4/86 1 NW part Baie d'Aouatif
20/4/86 1 Tivide
25/4/86 1 Ile d'Arguin

Circus cyaneus Hen Harrier Busard Saint-Martin
Occasional visitor to Mauritania, most frequently observed in September, October and March (Lamarche 1987).
15/3/86 1 ad. male Baie d'Aouatif, site 1
21/3/86 1 ad. male W part Baie d'Aouatif
22/23/3/86 1 imm. male W part Baie d'Aouatif
24/3/86 1 female Nair
31/3/86 1 female Baie d'Aouatif, site 1

Circus pygargus Montagu's Harrier Busard cendré
Rather small numbers are recorded as a wintering guest in the S part of the country as well as during migration, especially in September and in March-April (Lamarche 1987).
4/4/85 1 male near camp

5/4/85 1 female and 3 males Ebelk Aiznai; 1 male and 1 female Iouik
6/4/85 2 males and 2 females Baie d'Aouatif, site 6
7/4/85 1 female near camp
8/4/85 2 females near camp
9/4/85 1 female and 2 males Ebelk Aiznai
11/4/85 1 male Iouik
13/4/85 1 male near camp
12/4/86 2 males and 1 female Ebelk Aiznai

Pandion haliaetus Osprey Balbuzard pêcheur
Locally a rather common winter visitor and migrant, predominantly along the coast. Migrating individuals most frequently observed from October-December and in March-April (Lamarche 1987). Altenburg et al. (1982) counted 92 Ospreys at the Banc d'Arguin during the 1980 expedition.

13/3/85 1 Cap Blanc
14-15/3/85 1 La Cherka, Nouadhibou
23/3-18/4/85 1-2 W part Baie d'Aouatif
7/4/85 1 Ebelk Aiznai
13/4/85 1 Zira
28/4/85 1 fishing Cap Blanc
3/2/86 1 La Cherka, Nouadhibou
5/2/86 2 Kiaone
7-12/2/86 3 W part Baie d'Aouatif
13/2-12/3/86 1-2 W part Baie d'Aouatif
17-18/2/86 1 Zira
21/2/86 1 S Foum Al Trique
22/2/86 1 SE part Tidra
23/2/86 1 Ajoueïr; 1 S tip Tidra
25/2/86 3 E part Baie d'Aouatif
2/3/86 1 La Cherka, Nouadhibou
13/3/86 1 Zira
14/3/86 3 W part Baie d'Aouatif
16/3-3/4/86 1-2 W part Baie d'Aouatif
18/3/86 1 NW part Baie d'Aouatif; 1 Ebelk Aiznai
23/3/86 3 W part Baie d'Aouatif
24/3/86 2 Niroumi; 1 Kiji
1-2/4/86 1 Zira

4/4/86 1 N of Nair

5-6/4/86 1-2 NW part Baie d'Aouatif

7/4/86 1 Arel

20/4/86 2 between Tivide and Serini

21/4/86 1 NW part Baie d'Aouatif

Falco tinnunculus Kestrel Faucon crécerelle

Two subspecies are found in Mauritania, only the nominate occuring in the W part of the country. Common winter visitor to the S part of the country. On migration most frequently found along the coast in October-November and March-May (Lamarche 1987).

13/3/85 2 corpses found Cap Blanc

18/3/85 1 in garden Nouadhibou

1/4/85 1 corpse found Nair

2/4/85 1 Baie d'Aouatif, site 5

3/4/85 1 flying N over camp; 1 Iouik

4/4/85 1 near camp; 2 in the desert between Ebelk Aiznai and camp

5/4/85 1 male Ebelk Aiznai; 1 female camp catching a Phylloscopus

6/4/85 4 W part Baie d'Aouatif

7-9/4/85 1 near camp

11/4/85 1 Iouik

4/5/85 1 city centre Nouadhibou

19/1-2/2-86 1 female Sabah hotel, Nouadhibou

19/3/86 1 female Baie d'Aouatif, site 1, showing active wing moult

21/3/86 1 male near camp

22/3/86 4 Baie d'Aouatif, site 1; 1 camp

23/3/86 5-10 W part Baie d'Aouatif

24/3/86 5 Baie d'Aouatif, site 1; 5 Niroumi; 10 Kiji

25/3/86 3 between Rgueïba and Zira; 1 Baie d'Aouatif, site 1; 1 camp

27/2/86 1 between Teïchot and Rgueïba

31/3/86 7 W part Baie d'Aouatif

1/4/86 1 Baie d'Aouatif, site 1; 5 Nouadhibou

2-4/4/86 1-2 camp

5/4/86 1 N NW part Baie d'Aouatif

16/6/86 1 camp

26/4/86 1 La Cherka, Nouadhibou

27/4/86 1 Cansado

Table 10.5 Weight (g) and biometrical data (mm) of Kestrels captured in mistnets near the camp

date	weight	wing	bill	age
6/4/85	182	230	15.6	2nd c.y.
6/4/85	177	247	15.6	2nd c.y.
8/4/85	139	248	14.4	ad.

Falco biarmicus Lanner Faucon lanier

The subspecies F.b. erlangeri is found as a breeding bird in the NW, W and S part of the country (Brown et al. 1982) but is equally observed as a winter visitor as well as during migration, especially from August-October and in April-May (Lamarche 1987). Altenburg et al. (1982) counted 15 Lanners at the Banc d'Arguin during the 1980 expedition.

11/3/85 1 chasing Little Gull La Cherka, Nouadhibou
12/3/85 1 eating a tern La Cherka, Nouadhibou
13/3/85 2 on the beach N Nouadhibou
15/3/85 1 rubbish tip La Cherka, Nouadhibou, 1 N Nouadhibou Airport
21/3/85 pair Iouik, female catching a Dunlin
23/3/85 1 near camp, catching a Ringed Plover
24/3/85 1 NE part Baie d'Aouatif
27/3/85 1 near camp
3/4/85 1 in the desert between Ebelk Aiznai and camp
6/4/85 1 Ebelk Aiznai
14/4/85 1 10 km NE Iouik
17/4/85 1 W part Baie d'Aouatif
20/4/85 1 near Biological Station Iouik
22/4/85 1 hill N of Ebelk Aiznai
25/4/85 pair Baie d'Aouatif, site 3, one of these eating small wader
26/4/85 2 flying over mudflats opposite camp
30/4/85 1 camp
1/5/85 2 Ile d'Arguin
5/5/85 1 La Cherka, Nouadhibou
22/1/86 1 La Cherka, Nouadhibou, carrying a wader as prey
3/2/86 1 La Cherka, Nouadhibou
6/2-19/4/86 1-2 frequently observed W part Baie d'Aouatif, sometimes

displaying.
8/2/86 1 near airstrip Baie d'Aouatif, chasing a Redshank into the water; 1 Ebelk Aiznai catching a Ringed Plover
11/2/86 1 chasing waders, giving special notice to a Redshank
22-24/2/86 1 Ebelk Aiznai. It is uncertain whether this bird was one of the two frequently observed in the Baie d'Aouatif
18/3/86 1 Ebelk Aiznai
20/3/86 2 mangroves W of Tidra
24/3/86 pair eating a Knot, Baie d'Aouatif, site 1
11/4/86 1 male W part Baie d'Aouatif, eating a Knot
12/4/86 1 Ebelk Aiznai
20/4/86 3 Tivide
24/4/86 1 Kiaone

Fulica atra Coot Foulque macroule
Irregular winter visitor to Mauritania, the presence of which quite often is only noted through the finding of corpses (Lamarche 1987).
15/3/85 1 dead bird found in lagoon N airport Nouadhibou

Coturnix coturnix Common Quail Caille des blés
Rather small numbers are present in Mauritania as a winter vistor. Small numbers are seen during migration, mainly along the coast, from September-November and in February-March (Lamarche 1987).
16/2/86 1 female captured near the camp; weight 112 g
27/4/86 1 corpse, dead for several months, Biological Station Iouik

Porphyrio porphyrio Purple Coot Poule sultane
The subspecies "madagascariensis" is found throughout the year in the S part of the country though numbers are highly variable (Lamarche 1987).

Table 10.6 Biometrical data (mm) of 2 corpses of Purple Coots found at the N part of Tidra, both "madagascariensis", dead for approx. 2-3 months

date	wing	bill	tarsus	age
14/4/86	240	37.2	85.2	3rd c.y.
14/4/86	246	36.6	88.2	2nd c.y.

Haematopus ostralegus Oystercatcher Huitrier pie

Numbers counted in winter at the Banc d'Arguin vary from 6000 (Trotignon et al. 1980) to 9200 (Altenburg et al. 1982). Some thousands winter further S in Sénégambia and Guinea Bissau (Smit & Piersma in prep.). For further details see Appendix 1.

11/3/85 31 La Cherka, Nouadhibou
15/3/85 94 S part Presqu'Ile de Cap Blanc
24/3/85 1065 Baie d'Aouatif
3/4/85 116 Ebelk Aiznai
13-14/4/85 5-8 Iouik
15/4/85 123 Ebelk Aiznai
16-24/4/85 34-45 Ebelk Aiznai
17/4/85 275 Baie d'Aouatif
21/4/85 4 (all with collars) on high tide roost Nair
22/4/85 130 Baie d'Aouatif
23/4/85 1 Niroumi
25/4/85 393 Baie d'Aouatif
27/4/85 75 Ebelk Aiznai; 31 between Iouik and Ebelk Aiznai
3/5/85 33 S part Presqu'Ile de Cap Blanc
10/5/85 11 La Cherka, Nouadhibou
3/2/86 30 La Cherka, Nouadhibou
7/5/85 109 Ebelk Aiznai
8/2/86 300 Baie d'Aouatif; 220 Ebelk Aiznai
13-22/2/86 210-287 Ebelk Aiznai
12-19/3/86 140-250 Baie d'Aouatif, sites 1 and 3
20/3/86 310 NW part Baie d'Aouatif
29/3/86 373 NW part Baie d'Aouatif, at least 156 of these leaving in N direction
11/4/86 1 Arel
14/4/86 only 13 still present in NW part Baie d'Aouatif
20/4/86 30 between Tivide and Serini, 11 of these 2nd c.y. birds
24/4/86 4 migrating N Ile d'Arguin

Himantopus himantopus Black-winged Stilt Echasse blanche

Wintering in small numbers in S Mauritania (Lamarche 1987). Some thousands have been counted as a winter visitor in Sénégambia (Smit & Piersma in prep.). Passage in Mauritania is noted especially in September-October and March-April, along the coast as well as inland

(Lamarche 1987). Altenburg et al. (1982) did not observe the species at the Banc d'Arguin during the 1980 expedition.

7/4/85 35 Ebelk Aiznai

25/2/86 1 in mangroves N Timiris

30/3/86 40 NW part Baie d'Aouatif

Recurvirostra avosetta Avocet Avocette

Some hundreds are wintering in the S part of Mauritania (Lamarche 1987), some thousands winter further S in Sénégambia and Guinea Bissau (Smit & Piersma in prep.). Passage in Mauritania is noted from August-October and in March, especially along the coast (Lamarche 1987). Altenburg et al. (1982) did not observe the species at the Banc d'Arguin during the 1980 expedition. For further details see Appendix 1.

13/3/85 + roosting N part Baie d'Aouatif

28-29/3/85 9 Baie d'Aouatif, site 3

30/3/85 42 roosting Baie d'Aouatif, site 3

31/3/85 4 Baie d'Aouatif, site 5

14/4/85 15 departing from N part Baie d'Aouatif

17/4/85 4 N part Baie d'Aouatif

18/4/85 4 on high tide roost Ebelk Aiznai

14/3/86 4 Baie d'Aouatif, site 1

28/3/86 11 Baie d'Aouatif, site 1

29/3/86 287 departing from N part Baie d'Aouatif, 2 colour-ringed

4/4/86 7 N of Niroumi

8/4/86 86 NW part Baie d'Aouatif

11-18/4/86 13 NW part Baie d'Aouatif

16/4/86 62 N part Baie d'Aouatif

21/4/86 65 NW part Baie d'Aouatif, none of these being colour-ringed

22/4/86 34 NW part Baie d'Aouatif, 6 leaving in N direction; 28 Ebelk Aiznai

Burhinus oedicnemus Stone Curlew Oedicnème criard

Mainly seen in small flocks (some individuals) on migration, inland as well as along the coast, from September-December and from January-March (Lamarche 1987).

11-12/3/85 38-45 La Cherka, Nouadhibou

15/3/85 20 La Cherka, Nouadhibou

22/1/86 10 La Cherka, Nouadhibou

31/1/86 12 La Cherka, Nouadhibou
3/2/86 5 La Cherka, Nouadhibou
3/3/86 25 La Cherka, Nouadhibou
25/3/86 some calls heard Rgueïba
26/4/86 call heard over Nouadhibou

Cursorius cursor Cream-coloured Courser Courvite isabelle
Present as a breeding bird and as a winter visitor throughout the country. Seen on migration from August-December and March-April (Lamarche 1987).
13/3/85 2 Cap Blanc
January 1986 Some hundreds rubbish tip Cap Blanc (comm. Pierre Campredon)
22/1/86 1 flying over Sabah hotel, Nouadhibou; 2 rubbish tip La Cherka, Nouadhibou

Glareola pratincola Pratincole Glaréole à collier
Common winter visitor in the S part of the country. Autumn (September-November) and spring (March-April) migration is mainly noted in the interior part of the country (Lamarche 1987).
5/4/85 1 Baie d'Aouatif, site 6

Charadrius dubius Little Ringed Plover Petit Gravelot
Wintering along wetlands in S Mauritania. Small numbers are seen on migration, mainly in August-September and March-June (Lamarche 1987). Altenburg et al. (1982) observed 1 Little Ringed Plover at the Banc d'Arguin and 1 in Nouadhibou during the 1980 expedition.
12/3/85 15 La Cherka, Nouadhibou and nearby rubbish tip
15/3/85 5 S part Presqu'Ile de Cap Blanc
22/3/86 1 near camp; 1 NW part Baie d'Aouatif migrating N (7.00 p.m.)
23/3/86 1 Baie d'Aouatif, site 1
29/3/86 1 Baie d'Aouatif, site 1; 1 near camp
3/5/85 10 S part Presqu'Ile de Cap Blanc
10/5/85 2 La Cherka, Nouadhibou

Charadrius hiaticula Ringed Plover Grand Gravelot
Numbers counted in winter at the Banc d'Arguin vary from 98,000 (Altenburg et al. 1982) to 136.500 (Trotignon et al. 1980). As much as 57,000 are believed to winter in Guinea Bissau (Zwarts 1988), 5000-15,000

are estimated to winter on the Mauritanian coast and in the Sénégal delta. Passage in Mauritania is mainly noted in August-October and March-June (Lamarche 1987). For further details see Appendix 1.

14/3/85 300 La Cherka, Nouadhibou and on nearby rubbish tip
15/5/85 371 S part Presqu'Ile de Cap Blanc
24/3/85 4522 Baie d'Aouatif
3-16/4/85 264-344 Ebelk Aiznai
17/4/85 3555 Baie d'Aouatif
20-22/4/85 about 100 S part Niroumi
24/4/85 180 Ebelk Aiznai
25/4/85 2928 Baie d'Aouatif
27/4/85 400 Ebelk Aiznai
3/5/85 110 S part Presqu'Ile de Cap Blanc
7/5/85 330 Ebelk Aiznai
10/5/85 75 La Cherka, Nouadhibou
22/1-3/2/86 +++ La Cherka, Nouadhibou
8-22/2/86 485-700 Ebelk Aiznai

Charadrius alexandrinus Kentish Plover Gravelot à collier interrompu

Numbers counted in winter at the Banc d'Arguin vary from 6500 (Trotignon et al. 1980) to 18,000 (Altenburg et al. 1982). Some 20,000 winter further S in Sénégambia and Guinea Bissau (Smit & Piersma in prep.). Breeding along the coast from the Banc d'Arguin to S Mauritania. Passage noted from September-October and March-April (Lamarche 1987). For further details see Appendix 1.

15/3/85 113 S part Presqu'Ile de Cap Blanc
24/3/85 1383 Baie d'Aouatif
3-16/4/85 264-344 Ebelk Aiznai
17/4/85 850 Baie d'Aouatif
21/4/85 2 Nair
24/4/85 60 Ebelk Aiznai
25/4/85 456 Baie d'Aouatif
27/4/85 5 Ebelk Aiznai
3/5/85 128 S part Presqu'Ile de Cap Blanc
7/5/85 102 Ebelk Aiznai
10/5/85 17 La Cherka, Nouadhibou
22/1/86 50-100 La Cherka, Nouadhibou
13-22/2/86 21-30 Ebelk Aiznai

Pluvialis squatarola Grey Plover Pluvier argenté

Numbers counted in winter at the Banc d'Arguin vary from 14,200 (Trotignon et al. 1980) to 24,000 (Altenburg et al. 1982). Some 60,000 winter further S in Sénégambia and Guinea Bissau (Smit & Piersma in prep.), 1500-2000 are estimated to winter along the Mauritanian coast. Passage noted from August-November and March-May (Lamarche 1987). For further details see Appendix 1.

10-11/3/85 1-3 La Cherka, Nouadhibou
13/3/85 3 Cap Blanc
15/3/85 180 S part Presqu'Ile de Cap Blanc
24/3/85 1253 Baie d'Aouatif
3/4/85 127 Ebelk Aiznai
16/4/85 400 Ebelk Aiznai
17/4/85 1921 Baie d'Aouatif
20-22/4/85 800 at high tide roost Nair
22/4/85 646 Ebelk Aiznai
24/4/85 385 Ebelk Aiznai
25/4/85 1702 Baie d'Aouatif
27/4/85 232 Ebelk Aiznai
3/5/85 114 Ebelk Aiznai
7/5/85 321 Ebelk Aiznai
10/5/85 8 La Cherka, Nouadhibou
22/1/86 50-100 La Cherka, Nouadhibou
3/2/86 200 La Cherka, Nouadhibou
8/2/86 267 Ebelk Aiznai
13/2/86 642 Ebelk Aiznai
22/2/86 115 Ebelk Aiznai
24/4/86 15 migrating N Ile d'Arguin
26/4/86 + La Cherka, Nouadhibou

Calidris canutus Knot Bécasseau maubèche

Numbers counted in winter at the Banc d'Arguin vary from 334,000 (Trotignon et al. 1980) to 367,000 (Altenburg et al. 1982). Large numbers (144,000) winter further S in Guinea Bissau (Zwarts 1988). In Mauritania passage is noted from September-October and March-April (Lamarche 1987). For further details see Appendix 1.

11/3/85 200 La Cherka, Nouadhibou

14/3/85 70 La Cherka, Nouadhibou

15/3/85 292 S part Presqu'Ile de Cap Blanc

24/3/85 45513 Baie d'Aouatif

3-16/4/85 8383-9080 Ebelk Aiznai

17/4/85 40754 Baie d'Aouatif

20-22/4/85 ++++ Nair

22/4/85 6326 Ebelk Aiznai

25/4/85 19028 Baie d'Aouatif

27/4/85 3500 Ebelk Aiznai

1/5/85 10000 NE part Ile d'Arguin; 17.25 100 leaving in N direction

3/5/85 251 S part Presqu'Ile de Cap Blanc

7/5/85 3191 Ebelk Aiznai

10/5/85 142 La Cherka, Nouadhibou

22/1/86 50-100 La Cherka, Nouadhibou

3/2/86 50 La Cherka, Nouadhibou

8-22/2/86 2750-5600 Ebelk Aiznai

26/4/86 + La Cherka, Nouadhibou

Calidris alba Sanderling Bécasseau sanderling

Numbers counted in winter at the Banc d'Arguin vary from 6600 (Trotignon et al. 1980) to 34,000 (Altenburg et al. 1982), 7000 are estimated to winter on the Mauritanian coast itself (Lamarche 1987). Many thousands are known to winter further S along the W African coast, even S to the Rep. S Africa (Smit & Piersma in prep.). Passage in Mauritania is noted from September-November and in March-April (Lamarche 1987). For further details see Appendix 1.

11-12/3/85 + La Cherka, Nouadhibou and nearby rubbish tip

13/3/85 100 Cap Blanc

15/3/85 2059 S part Presqu'Ile de Cap Blanc

24/3/85 479 Baie d'Aouatif

3/4/85 50 Ebelk Aiznai

16/4/85 104 Ebelk Aiznai

17/3/85 520 Baie d'Aouatif

20-22/4/85 max. 20 Nair

22/4/85 495 Ebelk Aiznai

25/4/85 938 Baie d'Aouatif

27/4/85 322 Baie d'Aouatif

3/5/85 1257 S part Presqu'Ile de Cap Blanc

7/5/85 160 Ebelk Aiznai
10/5/85 215 La Cherka, Nouadhibou
22/1-3/2/86 200-300 La Cherka, Nouadhibou
8-22/2/86 189-289 Ebelk Aiznai
20/4/86 20-30 between Serini and Tivide
26/4/86 ++ La Cherka, Nouadhibou

Calidris minuta Little Stint Bécasseau minute

Numbers counted in winter at the Banc d'Arguin vary from 1000 (Trotignon et al. 1980) to 44,000 (Altenburg et al. 1982). As much as 123,000 are known to winter in Guinea Bissau alone (Zwarts 1988), many thousands are known to winter elsewhere in W Africa (Smit & Piersma in prep.). Passage in Mauritania is noted in September-November and in March-April (Lamarche 1987). For further details see Appendix 1.

12-13/3/85 1-2 La Cherka, Nouadhibou and nearby rubbish tip
15/3/85 25 S part Presqu'Ile de Cap Blanc
24/3/85 3122 Baie d'Aouatif
3/4/85 60 Ebelk Aiznai
16-27/4/85 315-375 Ebelk Aiznai
17/4/85 5052 Baie d'Aouatif
20-22/4/85 + Nair
22/4/85 700 Ebelk Aiznai
25/4/85 4345 Baie d'Aouatif
3/5/85 32 S part Presqu'Ile de Cap Blanc
5/5/85 at least 10 La Cherka, Nouadhibou
7/5/85 140 Ebelk Aiznai
10/5/85 5 La Cherka, Nouadhibou
13/2/86 300 Ebelk Aiznai
22/2/86 164 Ebelk Aiznai
26/4/86 + La Cherka, Nouadhibou

Calidris ferruginea Curlew Sandpiper Bécasseau cocorli

Numbers counted in winter at the Banc d'Arguin vary from 129,000 (Trotignon et al. 1980) to 174,000 (Altenburg et al. 1982). Approximately 250,000 are known to winter in Guinea Bissau (Zwarts 1988). Approximately 20,000 are estimated to winter on the Mauritanian coast, most of these in the S part of the country. Passage in Mauritania is noted in September-November and in March-April (Lamarche 1987). For further details see Appendix 1.

14/3/85 1 rubbish tip near La Cherka, Nouadhibou

15/3/85 2 S part Presqu'Ile de Cap Blanc

24/3/85 4412 Baie d'Aouatif

3/4/85 195 Ebelk Aiznai

16/4/85 3210 Ebelk Aiznai

17/4/85 13633 Baie d'Aouatif

20-22/4/85 at least 80 on high tide roost Nair

22-27/4/85 608-700 Ebelk Aiznai

25/4/85 5164 Baie d'Aouatif

3/5/85 1 S part Presqu'Ile de Cap Blanc

7/5/85 1082 Ebelk Aiznai

3/2/86 3 La Cherka, Nouadhibou

8-22/2/86 440-520 Ebelk Aiznai

Calidris maritima Purple Sandpiper Bécasseau violet

A straggler to Mauritania, not included in the list by Lamarche 1987.

5/4/85 1 Ebelk Aiznai

Calidris alpina Dunlin Bécasseau variable

Numbers counted in winter at the Banc d'Arguin vary from 705,000 (Trotignon et al. 1980) to 818,000 (Altenburg et al. 1982). Some thousands winter further S in Sénégambia and Guinea Bissau (Smit & Piersma in prep.). Up to 30,000 are estimated to winter in S Mauritania and the Sénégal delta. Passage in Mauritania is noted in October-November and March-April (Lamarche 1987). For further details see Appendix 1.

11/3/85 100 La Cherka, Nouadhibou

15/3/85 661 S part Presqu'Ile de Cap Blanc

24/3/85 56,085 Baie d'Aouatif

3/4/85 3220 Ebelk Aiznai

16-27/4/85 2200-2560 Ebelk Aiznai

17/4/85 22,163 Baie d'Aouatif

20-22/4/85 +++ on high tide roost Nair

25/4/85 31,845 Baie d'Aouatif

1/5/85 25 leaving Ile d'Arguin in N direction (5.25 p.m.); 380 (5.30 p.m.)

3/5/85 128 S part Presqu'Ile de Cap Blanc

7/5/85 1437 Ebelk Aiznai

10/5/85 12 La Cherka, Nouadhibou
22/1/86 50-100 La Cherka, Nouadhibou
8/2/86 4025 Ebelk Aiznai
12/2/86 1 albino Baie d'Aouatif
13/2/86 1950 Ebelk Aiznai
22/2/86 4600 Ebelk Aiznai
18/4/86 1 albino Niroumi
26/4/86 ++ La Cherka, Nouadhibou

Limicola falcinellus Broad-billed Sandpiper Bécasseau falcinelle
A straggler to Mauritania, not included in the list by Lamarche 1987.
22/3/85 1 W part Baie d'Aouatif, winter plumage moulting towards summer plumage
25-26/4/85 1 Baie d'Aouatif, site 1

Philomachus pugnax Ruff Chevallier combattant
Known to winter in large numbers in freshwater wetlands in W Africa (Smit & Piersma in prep.). Common winter visitor to Mauritania, especially in the S part of the country. Passage is noted in September-November and in February-April (Lamarche 1987). Altenburg et al. (1982) observed up to 15 Ruff at the Banc d'Arguin during the 1980 expedition.
1/3/85 1 female on rubbish tip near La Cherka, Nouadhibou
15/3/85 1 S part Presqu'Ile de Cap Blanc
24/2/86 3 migrating N in NW part Baie d'Aouatif

Limosa limosa Black-tailed Godwit Barge à queue noire
Wintering in large numbers in freshwater wetlands and ricefields in W Africa. Approximately 110,000-120,000 are known to winter in Guinea Bissau (Altenburg & van der Kamp 1985). Passage in Mauritania is noted in September-November and in March-April (Lamarche 1987). Altenburg et al. (1982) observed up to 25 Black-tailed Godwits at the Banc d'Arguin during the 1980 expedition.
12-15/3/85 1 La Cherka, Nouadhibou
3/3/86 1 La Cherka, Nouadhibou
23/3/86 50 NW part Baie d'Aouatif, leaving in two flocks in N direction

Limosa lapponica Bar-tailed Godwit Barge rousse
Numbers counted in winter at the Banc d'Arguin vary from 538,000

(Trotignon et al. 1980) to 543,000 (Altenburg et al. 1982). Over 150,000 are known to winter in Guinea Bissau (Zwarts 1988), 30,000-40,000 are estimated to winter on the Mauritanian coast itself. Passage in Mauritania is noted in September-October and March-April (Lamarche 1987). For further details see Appendix 1.

14/3/85 100 La Cherka, Nouadhibou
15/3/85 475 S part Presqu'Ile de Cap Blanc
24/3/85 18,518 Baie d'Aouatif
3-16/4/85 2275-2507 Ebelk Aiznai
17/4/85 14,578 Baie d'Aouatif
20-22/4/85 12,000 at high tide roost Nair
22-24/4/85 1410-1525 Ebelk Aiznai
25/4/85 13,312 Baie d'Aouatif
27/4/85 822 Ebelk Aiznai
3/5/85 222 S part Presqu'Ile de Cap Blanc
7/5/85 760 Ebelk Aiznai
10/5/85 83 La Cherka, Nouadhibou
22/1/86 50-100 La Cherka, Nouadhibou
3/2/86 100 La Cherka, Nouadhibou
8/2/86 4100 Ebelk Aiznai
13/2/86 2190 Ebelk Aiznai
24/4/86 100 Zira migrating in N direction (12.45 a.m.)
26/4/86 ++ La Cherka, Nouadhibou

Numenius phaeopus Whimbrel Courlis corlieu

Numbers counted in winter at the Banc d'Arguin vary from 10,500 (Trotignon et al. 1980) to 15,600 (Altenburg et al. 1982). Over 40,000 winter further S in Guinea Bissau (Zwarts 1988), 2000-6000 are thought to winter on the Mauritanian coast itself. Passage in Mauritania is noted in September-October and March-April (Lamarche 1987). For further details see Appendix 1.

10/3/85 + La Cherka, Nouadhibou
15/3/85 61 S part Presqu'Ile de Cap Blanc
24/3/85 245 Baie d'Aouatif
16/4/85 271 Ebelk Aiznai
17/4/85 476 Baie d'Aouatif
20-22/4/85 1500 on high tide roost Nair
22/4/85 210 Ebelk Aiznai

23/4/85 +++ in mangrove area S part Niroumi
24/4/85 34 Ebelk Aiznai
25/4/85 244 Baie d'Aouatif
27/4/85 190 Ebelk Aiznai
3/5/85 53 S part Presqu'Ile de Cap Blanc
7/5/85 129 Ebelk Aiznai
10/5/85 8 La Cherka, Nouadhibou
22/1/86 5-10 La Cherka, Nouadhibou
3/2/86 10 La Cherka, Nouadhibou
8/2/86 110 Baie d'Aouatif; 400 Ebelk Aiznai
13/2/86 8 Ebelk Aiznai
22/2/86 511 Ebelk Aiznai
24/4/86 22 S Ile d'Arguin, migrating N (7.00 p.m.)
26/4/86 ++ La Cherka, Nouadhibou

Numenius arquata Curlew Courlis cendré

Numbers counted in winter at the Banc d'Arguin vary from 10,500 (Trotignon et al. 1980) to 14,200 (Altenburg et al. 1982). Several thousands winter further S in Sénégambia and Guinea Bissau (Smit & Piersma in prep.), 1500-3000 are estimated to winter on the Mauritanian coast itself. Passage in Mauritania is noted in September-November and in February-May (Lamarche 1987).

11/3/85 7 La Cherka, Nouadhibou
12/3/85 20 La Cherka, Nouadhibou
15/3/85 17 S part Presqu'Ile de Cap Blanc
17/3/85 52 Baie d'Aouatif
24/3/85 320 Baie d'Aouatif
3-15/4/85 1-8 Ebelk Aiznai
18/4/85 1 on high tide roost Ebelk Aiznai
21/4/85 1 on high tide roost Nair
22/4/85 3 Ebelk Aiznai
23/4/85 ++ S part Niroumi
3/5/85 6 S part Presqu'Ile de Cap Blanc
4-10/5/85 1-3 La Cherka, Nouadhibou
21/1-3/2/86 10-11 La Cherka, Nouadhibou
8-22/2/86 42-80 Ebelk Aiznai
11/4/86 3 Iouik migrating N (7.30 p.m.)
21/4/86 2 migrating E Baie d'Aouatif

Tringa erythropus Spotted Redshank Chevalier arlequin

Wintering throughout W Africa, mainly in freshwater wetlands. Small numbers are wintering in Mauritania, especially in the S part of the country. Passage is noted in September-October and February-March (Lamarche 1987). Altenburg et al. (1982) did not observe the species at the Banc d'Arguin during the 1980 expedition.

21/3/85 1 La Cherka, Nouadhibou
30/3/85 1 Baie d'Aouatif, site 3
7/4/85 1 near camp
12/4/85 1 Baie d'Aouatif, site 1
20/4/85 1 Baie d'Aouatif, site 1
21/4/85 1 along the coast N of Iouik
11/3/86 1 Baie d'Aouatif, site 5
17/3/86 1 near camp
22/3/86 1 Baie d'Aouatif, site 1
25/3/86 5 Baie d'Aouatif, site 5
30/3/86 3 near camp
31/3/86 2 near camp; 1 NW part Baie d'Aouatif
1/4/86 1 Baie d'Aouatif, site 1; 2 La Cherka, Nouadhibou
4/4/86 1 Baie d'Aouatif, site 1

Tringa totanus Redshank Chevalier gambette

Numbers counted in winter at the Banc d'Arguin vary from 31,000 (Trotignon et al. 1980) to 70,000 (Altenburg et al. 1982). Over 80,000 are known to winter in Guinea Bissau (Zwarts 1988). A variable number is wintering in S Mauritania, especially in the Sénégal delta (Lamarche 1987). Passage in Mauritania is noted in September-October and in March-April (Lamarche 1987). For further details see Appendix 1.

10-14/3/85 1-3 La Cherka, Nouadhibou
15/3/85 61 S part Presqu'Ile de Cap Blanc
24/3/85 2978 Baie d'Aouatif
3-16/4/85 191-200 Ebelk Aiznai
17/4/85 965 Baie d'Aouatif
20-22/4/85 ++ on high tide roost Nair
22/4/85 14 Ebelk Aiznai
23/4/85 +++ in mangroves S part Niroumi
25/4/85 699 Baie d'Aouatif
27/4/85 68 Ebelk Aiznai

3/5/85 33 S part Presqu'Ile de Cap Blanc
7/5/85 55 Ebelk Aiznai
3/2/86 2 La Cherka, Nouadhibou
8/2/86 490 Ebelk Aiznai
13-22/2/86 41-67 Ebelk Aiznai
29/3/86 278 NW part Baie d'Aouatif migrating N
26/4/86 + La Cherka, Nouadhibou

Tringa stagnatilis Marsh Sandpiper Chevalier stagnatile
Small numbers are recorded in winter as well as on on passage, mainly in August-September and March-April. Single individuals are known to winter on the Banc d'Arguin (Lamarche 1987).
2/4/86 1 N part Baie d'Aouatif

Tringa nebularia Greenshank Chevalier aboyeur
Numbers counted in winter at the Banc d'Arguin vary from 850 (Trotignon et al. 1980) to 1500 (Altenburg et al. 1982). Some thousands winter further S in Sénégambia and Guinea Bissau (Smit & Piersma in prep.), some hundreds have been found to winter in S Mauritania. Small numbers of migrating individuals are recorded in August-November and March-May (Lamarche 1987).
12-14/3/85 15-20 La Cherka, Nouadhibou
15/3/85 22 S part Presqu'Ile de Cap Blanc
24/3/85 54 Baie d'Aouatif
3/4/85 10 Ebelk Aiznai
9/4/85 75 Ebelk Aiznai
17/4/85 148 Baie d'Aouatif
18/4/85 flock (size unknown) leaving Baie d'Aouatif
23/4/85 ++ in mangrove area S part Niroumi
25/4/85 237 Baie d'Aouatif
27/4/85 60 Ebelk Aiznai
7/5/85 181 Ebelk Aiznai
22/1/86 5-10 La Cherka, Nouadhibou
3/2/86 10 La Cherka, Nouadhibou
8-13/2/86 7-13 Ebelk Aiznai
22/2/86 1 Ebelk Aiznai
3-15/4/86 50 W part Baie d'Aouatif
26/4/86 18 La Cherka, Nouadhibou

Table 10.7. Weight (g) and biometrical data (mm) of a Greenshank captured in a mistnet W part Baie d'Aouatif

date	weight	wing	bill	tarsus+toe	age
6/3/86	163	198	49.4	99	>2nd c.y.

Tringa ochropus Green Sandpiper Chevalier cul-blanc

A common wintering guest in S Mauritania, mainly in the W part of the country, but rare on the Banc d'Arguin. Passage is noted in August-October and in February-April (Lamarche 1987).

20/3/86 1 W part Baie d'Aouatif

15/4/86 1 near camp

Tringa glareola Wood Sandpiper Chevalier sylvain

Small numbers are wintering in Mauritania, more frequently observed during migration. Main passage is noted in August-September and March-April (Lamarche 1987). Altenburg et al. (1982) did not observe the species at the Banc d'Arguin during the 1980 expedition.

15/3/85 2 lagoon N of airport Nouadhibou

3/4/85 1 tidal flats opposite camp

5/4/85 1 near camp

Actitis hypoleucos Common Sandpiper Chevalier guignette

Small numbers are wintering in Mauritania, more frequently observed during migration. Main passage is noted in August-September and in February-April (Lamarche 1987). Altenburg et al. (1982) observed 5-10 Common Sandpipers in La Cherka, Nouadhibou in January and March 1980 and 5 at Kiaone during the 1980 expedition.

10/3/85 2 La Cherka, Nouadhibou; 1 Cansado

15/3/85 10 S part Presqu'Ile de Cap Blanc

30/3/85 1 Iouik

5/4/85 1 near camp

6/4/85 1 near camp; 1 Ebelk Aiznai

7-14/4/85 1 Ebelk Aiznai

23/4/85 5 S part Niroumi

25/4/85 17 Baie d'Aouatif

3/5/85 8 S part Presqu'Ile de Cap Blanc
7/5/85 3 Ebelk Aiznai
22/1-3/2/86 1 La Cherka, Nouadhibou
4/2/86 1 new harbour Nouadhibou
16/2/86 1 near camp
3/3/86 25-30 La Cherka, Nouadhibou
31/3/86 1 near camp; 1 NW part Baie d'Aouatif; 1 N part Baie d'Aouatif migrating N
1/4/86 2 Baie d'Aouatif; 1 La Cherka, Nouadhibou
2/4/86 10 Zira
13/4/86 3 mangroves Tidra; 1 Niroumi
16/4/86 1 Kiaone
16-21/4/86 1 near camp
19/4/86 1 NW part Baie d'Aouatif
26/4/86 5-10 La Cherka, Nouadhibou

Arenaria interpres Turnstone Tournepierre
Numbers counted in winter at the Banc d'Arguin vary from 6000 (Trotignon et al. 1980) to 17,000 (Altenburg et al. 1982). Approximately 5000 are estimated to winter between Chott'Boul and Cap Timirist (Lamarche 1987). Many thousands winter in Sénégambia and Guinea Bissau (Smit & Piersma in prep.). Passage in Mauritania is noted from September-November and in March-April (Lamarche 1987). For further details see Appendix 1.
10/3/85 30 Cansado
11/3/85 250 La Cherka, Nouadhibou
15/3/85 221 S part Presqu'Ile de Cap Blanc
24/3/85 640 Baie d'Aouatif
3/4/85 24 Ebelk Aiznai
16/4/85 193 Ebelk Aiznai
17/4/85 1016 Baie d'Aouatif
20-22/4/85 1500 at high tide roost Nair
22/4-3/5/85 158-201 Ebelk Aiznai
25/4/85 758 Baie d'Aouatif
7/5/85 63 Ebelk Aiznai
10/5/85 50 La Cherka, Nouadhibou
22/1/86 50-100 La Cherka, Nouadhibou
12/2/86 148 Ebelk Aiznai
13-22/2/86 57-69 Ebelk Aiznai

11/3/86 500-600 roosting Iouik, probably coming from tidal flats W Iouik
15/3/86 at least 400 roosting Iouik
17/3/86 740 Iouik
26/4/86 ++ La Cherka, Nouadhibou

Stercorarius parasiticus Arctic Skua Labbe parasite
Small numbers are wintering in Mauritanian coastal waters, generally 50-70 are wintering at the Banc d'Arguin. Present from September-April (Lamarche 1987).
13/3/85 10-15 Cap Blanc

Stercorarius skua Great Skua Grand Labbe
Small numbers are wintering in Mauritanian coastal waters, about 50 are wintering at the Banc d'Arguin. Present from September-March (Lamarche 1987). Altenburg et al. (1982) observed 1 Great Skua in the Baie de Lévrier during the 1980 expedition.
5/2/86 20-30 Baie de Lévrier

Larus minutus Little Gull Mouette pygmée
Frequently observed at the Banc d'Arguin from November-March, though always in small numbers (Lamarche 1987). Altenburg et al. (1982) observed one juvenile Little Gull in Nouadhibou during the 1980 expedition.
11/3/85 1 juv. La Cherka, Nouadhibou
25/3/85 1 Iouik
5/5/85 2 second c.y. and 1 third c.y. La Cherka, Nouadhibou

Larus melonocephalus Mediterranean Gull Mouette mélanocéphale
Small numbers, mainly immature individuals, are wintering in Mauritanian coastal waters. Present from September-April (Lamarche 1987). Altenburg et al. (1982) observed up to 5 Mediterranean Gulls in Nouadhibou during the 1980 expedition.
22/1/86 1 imm. La Cherka, Nouadhibou
18/3/86 2 third c.y. and 1 second c.y. NW part Baie d'Aouatif
1/4/86 3 La Cherka, Nouadhibou
9/4/86 2 imm. NW part Baie d'Aouatif

Larus ridibundus Black-headed Gull Mouette rieuse
About 400-500 are wintering at the Banc d'Arguin, another 300-400 are

wintering in the Sénégal delta. Present from September-May (Lamarche 1987). Altenburg et al. (1982) counted 115 Black-headed Gulls at the Banc d'Arguin during the 1980 expedition. For further details see chapter 9.4.1.

11/3/85 +++ La Cherka, Nouadhibou
15/3/85 120 S part Presqu'Ile de Cap Blanc
24/3/85 6 Baie d'Aouatif
25/3/85 1 Iouik
26/3/85 4 ad. and 2 imm. Iouik
29/3/85 10 Ebelk Aiznai
31/3/85 10 Iouik, 1 of these in complete winter plumage
3/4/85 + Iouik
12-22/4/85 1-6 Iouik
25/4/85 1 ad. Baie d'Aouatif
10/5/85 15 La Cherka, Nouadhibou
3/2/86 ++ La Cherka, Nouadhibou
8/2/86 2 Ebelk Aiznai

February 1986: frequent observations of up to 5 Black-headed Gulls at several places in the Baie d'Aouatif, most of these around Iouik and Zira. Numbers dropping in the course of April.

18/2/86 6 ad. and 8 imm. leaving the Baie d'Aouatif
22/2/86 7 Ebelk Aiznai
2/3/86 200 La Cherka, Nouadhibou
15/3/86 7 between camp and site 1
17/3/86 28 ad. and 5 imm. NW part Baie d'Aouatif
18/3/86 12 ad., 1 second c.y. and 1 third c.y. NW part Baie d'Aouatif
24/3/86 5-10 between Iouik and Kiji
25/3/86 5-10 between Rgueïba and Zira
26/3/86 6 ad. and 3 imm. resting Baie d'Aouatif, site 1
29/3/86 4 NW part Baie d'Aouatif
3/4/86 4 ad. and 9 imm. between Baie d'Aouatif, site 1 and Iouik; 2 Gibene
7/4/86 at least 1 ad. and 1 imm. Iouik
8/4/86 13 NW part Baie d'Aouatif, 3 of these in summer plumage, 2 in half completed, 2 in 1/4 completed summer plumage, 6 in winter plumage
9/4/86 2 Tivide
12/4/86 2 N Tidra
20/4/86 2 migrating N in NW part Baie d'Aouatif

26/4/86 4 La Cherka, Nouadhibou

Larus cirrocephalus Grey-headed Gull Goéland à tête grise

Present throughout the year, wintering as well as breeding in Mauritania. Rarely found inland (Lamarche 1987). Altenburg et al. (1982) counted 81 Grey-headed Gulls at the Banc d'Arguin during the 1980 expedition. Breeding at the Banc d'Arguin in 2 small colonies at Zira and Kiaone (15 pairs in 1984-85) from May-July (Campredon 1987). Surprisingly few sightings from Nouadhibou and surroundings. For further details see chapter 9.4.2.

21/3/85 4 Ten Alloul
22/3/85 21 along the water's edge near the camp to S
24/3/85 22 Baie d'Aouatif
26-30/3/85 10 Iouik
31/3/85 4 Ebelk Aiznai; 1 Iouik
8-9/4/85 2 Ebelk Aiznai
9/4/85 6 Iouik
17/4/85 82 Baie d'Aouatif
22/4/85 1 Ebelk Aiznai
25/4/85 26 Baie d'Aouatif

1986: Numbers appear to increase slightly in the course of February.

7/2/86 2 ad. and 1 imm. Ebelk Aiznai
8/2/86 1 Ebelk Aiznai
9-14/2/86 1-5 around Zira and Iouik
15/2/86 10 Iouik
22/2/86 8 Ebelk Aiznai; 2 near camp
24/2-3/3/86 5-10 Iouik
3/3/86 1 ad. La Cherka, Nouadhibou
10-13/3/86 10-20 Iouik
18/3/86 1 Ebelk Aiznai
22/3/86 1 ad. and 1 imm. in wing moult near the camp
24/3/86 5-10 between Nair and Rgueïba
25/3/86 5-10 between Rgueïba and Serini
1-3/4/86 about 20 Iouik
7/4/86 ++ Arel
13/4/86 5 Niroumi; 1 Tidra

Larus genei Slender-billed Gull Goéland railleur

Present as a wintering guest, as a breeding bird and as a migrant. Occasionally found inland. Passage is noted in October and February-March (Lamarche 1987). Altenburg et al. (1982) counted 2462 Slender-billed Gulls at the Banc d'Arguin during the 1980 expedition. Breeding at the Banc d'Arguin in 6 colonies (1610 pairs in 1984-85, 1010 of these at Zira) from April-July (Campredon 1987). For further details see chapter 9.4.4.

11/3/85 100 La Cherka, Nouadhibou
15/3/85 315 S part Presqu'Ile de Cap Blanc
23/3/85 23 ad. none in full summer plumage, feeding in the channel near the camp on small fish by plunging for 3.5 hrs.
24/3/85 713 Baie d'Aouatif
26/3-23/4/85 20-100 frequently observed in Iouik and near the camp
13/4/85 +++ Ebelk Aiznai, arriving from Zira
16/4-7/5/85 20-31 Ebelk Aiznai
17/4/85 2435 Baie d'Aouatif
18/4/85 135 flying N near camp
20-22/4/85 only small numbers at Nair
23/4/85 small numbers everywhere between Iouik and Niroumi
25/4/85 1666 Baie d'Aouatif, 150 of these near camp
27/4/85 200 Iouik, remarkably many as compared to previous days
28/4/85 200 Iouik, arriving from Zira, mainly present during low tide
1/5/85 +++ NE part of Ile d'Arguin; +++ between Iouik and Ile d'Arguin
2/5/85 +++ Baie de Lévrier
3/5/85 60 S part Presqu'Ile de Cap Blanc
10/5/86 13 La Cherka, Nouadhibou
3/2/86 + La Cherka, Nouadhibou
1986: numbers around Iouik increasing in the course of February and March
8/2/86 50 Ebelk Aiznai
13/2/86 20 Ebelk Aiznai
14/2/86 40 around Iouik
15/2/86 13 near camp; 50 Iouik
16/2/86 43 feeding socially NW part Baie d'Aouatif
21/2/86 30 Iouik
22/2/86 29 Ebelk Aiznai
24-26/2/86 40-60 Iouik
24/3/86 ++ between Iouik and Kiji

25/3/86 ++ between Rgueïba and Zira

1/4/86 150 Iouik

9-14/4/86 25-100 frequently feeding socially near camp

26/4/86 + La Cherka, Nouadhibou

Larus audouinii Audouin's Gull Goéland d'Audouin

Small numbers of individual birds and some occasional small flocks are found along the coast as a wintering guest from November-May (Lamarche 1987).

20/3/85 1 ad. Baie de Lévrier

3/2/86 2 La Cherka, Nouadhibou

31/-1/43/86 5 ad. and 10 imm. La Cherka, Nouadhibou, one of these colour-ringed, possibly in Spain.

Larus fuscus Lesser Black-backed Gull Goéland brun

In theory we may expect both L.f. fuscus and L.f. graellsii in Mauritania but also Larus argentatus michahellis (Urban et al 1986). Especially L.f. graellsii and L.a. michahellis are difficult to distinguish in the field. During the 1985 and 1986 expeditions no serious attempts were made to do so. For this reason all observations of Lesser Black-backed Gull-like birds have been lumped to L. fuscus. Our observations suggest a decrease in numbers in the course of March and April. For further details see chapter 9.4.3. Altenburg et al. (1982) counted 7468 "Lesser Black-backed Gulls" at the Banc d'Arguin during the 1980 expedition.

10/3/85 +++ La Cherka, Nouadhibou

13/3/85 +++ Cap Blanc

15/3/85 120 S part Presqu'Ile de Cap Blanc

24/3/85 2 ad. and 23 imm. Baie d'Aouatif

26/3/85 30 Iouik

31/3/85 1 ad. and 6 imm. Iouik

8/4/85 30 Ebelk Aiznai

12/4/85 5 ad. and 1 imm. Iouik

13/4/85 1 ad. and 4 imm. Iouik

17/4/86 8 Baie d'Aouatif

18/4/85 2 ad. and 3 imm. Iouik

22/4/85 1 imm. Iouik

25/4/85 4 Baie d'Aouatif

27/4/85 1 Ebelk Aiznai; 1 imm. Iouik

28/4/85 89 Baie d'Aouatif probably migrating in NW direction
2/5/85 ++ between Iouik and Ile d'Arguin
3/5/85 685 S part Presqu'Ile de Cap Blanc
10/5/85 130 La Cherka, Nouadhibou
3/2/86 +++ La Cherka, Nouadhibou
8/2/86 100 Baie d'Aouatif; 40 Ebelk Aiznai
13-22/2/86 130-220 Ebelk Aiznai
14-24/2/86 50 Iouik
24/3/86 ++ between Nair and Rgueïba, possibly migrating N
25/3/86 ++ between Rgueïba and Zira, possibly migrating N
1/4/86 10 Iouik; 5-10 Serini
2/4/86 20-30 Gibene
7/4/86 ++ Arel
13/4/86 19 between Niroumi and Tinimorgawoi
14/4/86 28 migrating N NW part Baie d'Aouatif
20/4/86 1 imm. between Serini and Tivide
24/4/86 + between Iouik and Ile d'Arguin
25/4/86 ++ Baie de Lévrier
26/4/86 ++ La Cherka, Nouadhibou

Gelochelidon nilotica Gull-billed Tern Sterne hansel

Present as a wintering guest, as a breeding bird and as a migrant, mainly from August-May. Rarely found inland (Lamarche 1987). Altenburg et al. (1982) counted 110 Gull-billed Terns at the Banc d'Arguin during the 1980 expedition. Breeding on the Banc d'Arguin in 8 colonies (1180 pairs in 1984-85, 450 of these at Zira), mainly on sandy islands, from May-August (Campredon 1987). Counts of the Baie d'Aouatif show a considerable increase in the course of April. For further details see chapter 9.3.7.

10/3/85 1 La Cherka, Nouadhibou
24/3/85 1 E part Baie d'Aouatif
27-30/3/85 2-3 ad. in summer plumage Baie d'Aouatif
31/3/85 4 between camp, Iouik and Ebelk Aiznai
1-10/4/85 about 10 along the whole W shoreline of the Baie d'Aouatif
9/4/85 1 Ebelk Aiznai
12/4/85 5 Baie d'Aouatif, site 1; + Iouik
13/4/85 + between camp, Iouik and Ebelk Aiznai
14/4/85 10 Ebelk Aiznai
17/4/85 107 Baie d'Aouatif

18/4/85 roost of 10 during high tide Baie d'Aouatif, site 1
20-22/4/85 40 Nair, frequently displaying
22/4/85 4 Ebelk Aiznai; 9 Baie d'Aouatif, site 1 feeding on Fiddler Crabs
23/4/85 small numbers everywhere between Iouik and Niroumi
25/4/85 191 Baie d'Aouatif
1/5/85 ++ NE part Ile d'Arguin; + between Iouik and Ile d'Arguin
7/5/85 21 Ebelk Aiznai
10/5/85 1 La Cherka, Nouadhibou
6/2-1/4/86 about 10 along the whole W shoreline of Baie d'Aouatif
8/2/86 10 Tivide
18-22/2/86 2-3 Ebelk Aiznai
7/4/86 17 Arel
8/4/86 8 NW part Baie d'Aouatif; 5 NE Arel
9/4/86 20 NW Tidra; 10 NW part Baie d'Aouatif
11/4/86 4 Ebelk Aiznai; 5 Arel; 5 Baie d'Aouatif, site 1; 5 near camp
12/4/86 12 Ebelk Aiznai
13/4/86 ++ between Tidra and Niroumi; + surroundings of Nair
20/4/86 20-30 between Serini and Tivide
21-22/4/86 15-20 NW part Baie d'Aouatif

Sterna caspia Caspian Tern Sterne caspienne

Present as a wintering guest, as a breeding bird and as a migrant, mainly from August-April. About 1500-2000 are estimated to winter at the Banc d'Arguin, another 400-500 along the Mauritanian coast. Rarely found inland (Lamarche 1987). Altenburg et al. (1982) counted 2435 Caspian Terns at the Banc d'Arguin during the 1980 expedition. Breeding at the Banc d'Arguin in 5 colonies (2575 pairs in 1984-85, 230 of these at Zira) from February-November (Campredon 1987). Counts and occasional observations show that part of the birds at the Banc d'Arguin is resident, part is leaving the area in the course of March-April. For further details see chapter 9.3.2.
10/3/85 3 Cansado
11/3/85 60 La Cherka, Nouadhibou
13/3/85 ++ Cap Blanc
15/3/85 139 S part Presqu'Ile de Cap Blanc
20/3/85 ++ between Nouadhibou and Ten Alloul
22-30/3/85 1-2 Ebelk Aiznai
24/3/85 10 Baie d'Aouatif

25/3/85 1 ad. and 1 fullgrown chick, begging for prey, Baie d'Aouatif

6/4/85 10 Baie d'Aouatif, site 6

7/4/85 20 Cap Tafarit

15/4/85 40 on high tide roost Ebelk Aiznai

17/4/85 5 Baie d'Aouatif

20/4/85 3 Nair

23/4/85 1 Niroumi

25/4/85 234 Baie d'Aouatif

1/5/85 ++ between Iouik and Ile d'Arguin; + Ile d'Arguin

2/5/85 ++ between Baie de Lévrier

3/5/85 64 S part Presqu'Ile de Cap Blanc

7/5/85 6 Ebelk Aiznai

10/5/85 La Cherka, Nouadhibou

3/2/86 100 La Cherka, Nouadhibou

8/2/86 67 Ebelk Aiznai

9/2/86 500 on high tide roost Ebelk Aiznai; ++ surroundings of Zira

12/2-21/3/86 about 10 along W shoreline Baie d'Aouatif

13/2/86 245 Ebelk Aiznai

22/2/86 100 Ebelk Aiznai

25/2/86 15 Tivide

26/2/86 2 NW part Baie d'Aouatif, eating fishes of 15-20 cm

28/2/86 at least 100 Zira

2-3/3/86 150-200 La Cherka, Nouadhibou

24/3/86 ++ between Iouik and Rgueïba

25/3/86 ++ between Rgueïba and Zira

16/4/86 250 pairs Kiaone

20/4/86 5 between Serini and Tivide

24/4/86 ++ between Iouik and Ile d'Arguin

25/4/86 ++ Baie de Lévrier

26/4/86 + La Cherka, Nouadhibou

Sterna maxima Royal Tern Sterne royale

Present as a wintering guest, as a breeding bird and as a migrant, though numbers in winter are lower than in other seasons. Passage, mainly along the coast, is noted in September-October and March-April (Lamarche 1987). Altenburg et al. (1982) counted 3339 Royal Terns at the Banc d'Arguin during the 1980 expedition. Breeding on the Banc d'Arguin in 4 colonies (5630 pairs in 1984-85, 330 of these at Zira) from April-July (Campredon

1987). For further details see chapter 9.3.3.

12/3/85 7 La Cherka, Nouadhibou

13/3/85 15 Cap Blanc

15/3/85 24 S part Presqu'Ile de Cap Blanc

16/3/85 10 Iouik

20/3/85 ++ between Nouadhibou and Ten Alloul

24/3/85 360 Baie d'Aouatif

29/3/85 20 Iouik

30/3/85 100 ad. Ebelk Aiznai, all displaying

7/4/85 300 Cap Tafarit

16/4/85 204 Ebelk Aiznai

17/4/85 734 Baie d'Aouatif

21/4/85 2 Nair

22/4/85 28 Ebelk Aiznai; ++ Iouik

25/4/85 258 Baie d'Aouatif

27/4-7/5/85 32-40 Ebelk Aiznai

1/5/85 ++ between Iouik and Ile d'Arguin; + NE part Ile d'Arguin

2/5/85 ++ Baie de Lévrier

3/5/85 28 S part Presqu'Ile de Cap Blanc

5/5/85 1 La Cherka, Nouadhibou

10/5/85 23 La Cherka, Nouadhibou

8-22/2/86 10-30 Ebelk Aiznai

14/2/86 1 Zira

24/2/86 1 Serini

3/3/86 1 La Cherka, Nouadhibou

24/3/86 ++ between Iouik and Rgueïba

25/3/86 ++ between Rgueïba and Zira

2/4/86 ++ Zira; 10 La Cherka, Nouadhibou

7/4/86 +++ Arel

24/4/86 ++ Baie de Lévrier, more numerous than Caspian Tern

25/4/86 ++ between Ile d'Arguin and Nouadhibou

26/4/86 1 imm. La Cherka, Nouadhibou

Sterna sandvicensis Sandwich Tern Sterne caugek

Wintering at the Banc d'Arguin in large numbers (29,000) as well as along the coast (5000). Migration observed from August-October and in March-April (Lamarche 1987). Altenburg et al. (1982) counted 250 Sandwich Terns at the Banc d'Arguin during the 1980 expedition. Numbers obviously decrease in the course of March-April. For further details see chapter 9.3.4.

10/3/85 1 Cansado
12/3/85 20 La Cherka, Nouadhibou
13/3/85 ++++ Cap Blanc
15/3/85 101 S part Presqu'Ile de Cap Blanc
30/3/85 10 imm. and 20 ad. Ebelk Aiznai
9/4/85 15 Ebelk Aiznai
14/4/85 4 Ebelk Aiznai
15/4/85 29 on high tide roost Ebelk Aiznai
16/4/86 6 Ebelk Aiznai
17/4/85 8 Baie d'Aouatif
18/4/85 10 Iouik, feeding
25/4/85 1 Baie d'Aouatif
27/4/85 3 Ebelk Aiznai
3/5/85 148 S part Presqu'Ile de Cap Blanc
7/5/85 17 Ebelk Aiznai
10/5/85 16 La Cherka, Nouadhibou
3/2/86 50 La Cherka, Nouadhibou
8/2/86 265 Ebelk Aiznai
11-28/2/86 ++ Baie d'Aouatif
13-23/2/86 200-260 Ebelk Aiznai
22/2/86 5 SE part Tidra
2/3/86 3 La Cherka, Nouadhibou
1-15/3/86 + Baie d'Aouatif
24/3/86 ++ between Iouik and Rgueïba
25/3/86 ++ between Rgueïba and Zira
31/3/86 2 NW part Baie d'Aouatif
3/4/86 3 Gibene
9/4/86 2 NE Arel; 1 between Arel and Iouik
13/4/86 10 surroundings of Niroumi
26/4/86 1 La Cherka, Nouadhibou

Sterna hirundo Common Tern Sterne pierregarin

Present as a wintering guest, as a breeding bird and as a migrant, mainly from September-April, inland as well as along the coast (Lamarche 1987). Altenburg et al. (1982) observed only small numbers at the Banc d'Arguin during the 1980 expedition. They were not able to visit the important roost at Cap Blanc. The species is breeding at the Banc d'Arguin in 5 small colonies (98 pairs in 1984-85, 50 of these at Zira) from May-July (Campredon 1987). Locally numerous as early as February and March but at the Banc d'Arguin increasing in numbers in the course of March-April. Frequently seen migrating N in March-April. For further details see chapter 9.3.5.

11/3/85 ++ La Cherka, Nouadhibou

13/3/85 ++++ Cap Blanc

15/3/85 10 S part Presqu'Ile de Cap Blanc

17/3/85 1 La Cherka, Nouadhibou

24/4/85 30 Baie d'Aouatif

30/3/85 30 Ebelk Aiznai

3/4/85 200 Ebelk Aiznai, half of these in summer plumage, some displaying; 2 Iouik

15/4/85 40 Ebelk Aiznai

16/4/85 130 Ebelk Aiznai

18/4/85 20 Iouik

20/4/85 ++ migrating N along the camp

20-22/4/85 30 Nair, among which displaying couples

21/4/85 10 ad. and 10 imm. Iouik; 1 imm. moulting 9th primary

22/4/85 120 Ebelk Aiznai; 10 ad. and 15 imm. Iouik

27/4/85 6 Ebelk Aiznai; ++ Iouik

1/5/85 ++ between Iouik and Ile d'Arguin

2/5/85 ++ between Ile d'Arguin and Nouadhibou

3/5/85 425 S part Presqu'Ile de Cap Blanc

7/5/85 70 Ebelk Aiznai

10/5/85 53 La Cherka, Nouadhibou

8-13/2/86 1 Ebelk Aiznai

16/2/86 1 Baie d'Aouatif

22/2/86 2 Ebelk Aiznai

6-23/2/86 1 W part Baie d'Aouatif

24/3/86 20 Nair; 10 Kiji

25/3/86 5-10 between Rgueïba and Zira

28/3/86 10 near camp

29/3-22/4/86 approx. 10-20 W part Baie d'Aouatif

1/4/86 30 La Cherka, Nouadhibou

12/4/86 25 Ebelk Aiznai

13/4/86 20 Nair

16/4/86 8 Ebelk Aiznai
17/4/86 5 E Arel
24/4/86 ++ between Iouik and Ile d'Arguin
25/4/86 +++ Baie de Lévrier
26/4/86 20 La Cherka, Nouadhibou

Sterna paradisaea Arctic Tern Sterne arctique
Rather common migrant, mainly in September-October and in March-April, almost exclusively along the coast (Lamarche 1987). Altenburg et al. (1982) observed 5-10 Arctic Terns in Nouadhibou during the 1980 expedition. Probably more numerous but not always distinguished from Common Terns. For further details see chapter 9.3.7.
27/4/85 1 Iouik
25/3/86 2 Baie d'Aouatif
12/4/86 15 Ebelk Aiznai

Sterna anaethetus Bridled Tern Sterne bridée
Locally a common breeding bird, present in the breeding colonies from April-October. Exclusively found along the coast. No sightings of wintering individuals (Lamarche 1987). Breeding at the Banc d'Arguin in 4 colonies (440 pairs in 1984-85, 80 of these at Zira) from May-July, apparently seriously declining (Campredon 1987). Arriving in the course of April.
19/4/85 15 near Zira
22/4/85 15 in pairs flying N near Zira
23/4/85 3 NE Zira
25/4/85 10 near Iouik, coming from Zira
4/4/86 3 W Zira
7/4/86 20 around Arel
9/4/86 5 N of Tidra; 1 between Tidra and Arel; 3 Arel

Sterna albifrons Little Tern Sterne naine
About 300-400 Little Terns are wintering at the Banc d'Arguin, small numbers are found elsewhere along the coast. Passage is noted in September-October and in April-May (Lamarche 1987). Altenburg et al. (1982) counted 371 Little Terns at the Banc d'Arguin during the 1980 expedition. Breeding on the Banc d'Arguin in 4 small colonies (29 pairs in 1984-85, 5 of these at Zira) from May-July (Campredon 1987). Only very

small numbers in early February, getting more numerous from mid-February onwards. For further details see chapter 9.3.6.

26/3/85 1 Iouik

27/3/85 3 near camp

29/3/85 4 over the tidal flats opposite camp

30/3/85 2 ad. Ebelk Aiznai; 3 ad. near camp

31/3/85 4 ad. Iouik; 4 ad. near camp

2/4/85 14 Ebelk Aiznai

3/4/85 50 on high tide roost Ebelk Aiznai; + Iouik; 2 near camp

5-6/4/85 52-53 Baie d'Aouatif, site 6

9/4/85 8 Ebelk Aiznai

14/4/85 at least 22 Ebelk Aiznai

16/4-17/5/85 39-52 Ebelk Aiznai

17/4/85 43 Baie d'Aouatif

20-22/4/85 6 Nair

22/4/85 10 Iouik

25/4/85 62 Baie d'Aouatif

27/4/85 + Iouik

1/5/85 ++ surroundings of Iouik

3/5/85 48 Presqu'Ile de Cap Blanc

10/5/85 7 La Cherka, Nouadhibou

7/2/86 at least 2 Ebelk Aiznai

8/2/86 2 Ebelk Aiznai; 1 between Iouik and Ebelk Aiznai

10-15/2/86 + W part Baie d'Aouatif

13/2/86 2 Ebelk Aiznai

15-28/2/86 10-20 W part Baie d'Aouatif

19/2/86 6 Ebelk Aiznai

28/2/86 10 Iouik

1-30/3/86 10-20 W part Baie d'Aouatif, frequently 1-5 near the camp

18/3/86 1 Ebelk Aiznai

24/3/86 ++ between Iouik and Kiji

25/3/86 ++ between Rgueïba and Zira

1-24/4/86 ++ Baie d'Aouatif

3/4/86 20 Gibene

7/4/86 + Arel

12/4/86 15 Ebelk Aiznai

13/4/86 at least 100 Nair

16/4/86 20 Ebelk Aiznai

25/4/86 ++ Baie de Lévrier

Chlidonias nigra Black Tern Guifette noir

Present throughout the year, mainly along the coast. Migrating birds are observed in September-October and the end of April-July (Lamarche 1987). Altenburg et al. (1982) did not observe the species at the Banc d'Arguin during the 1980 expedition. For further details see chapter 9.3.1.

11/3/85 ++ La Cherka, Nouadhibou
15/3/85 10 Presqu'Ile de Cap Blanc
17/3/85 1 La Cherka, Nouadhibou
12/4/85 30 N of Tidra
17/4/85 2 Baie d'Aouatif, both of these in Ebelk Aiznai
18/4/85 1 Ebelk Aiznai; 18 migrating N Iouik; 1 Iouik
19/4/85 2 Iouik; 2 near camp
21/4/85 1 Iouik
22/4/85 8 Iouik
23/4/85 5 near camp; 1 NE Zira
26/4/85 1 near camp
27-28/4/85 3 Iouik
1/5/85 1 between Iouik and Ile d'Arguin
2/5/85 about 600 Baie de Lévrier
3/5/85 44 Presqu'Ile de Cap Blanc
5/5/85 15 La Cherka, Nouadhibou
7/5/85 31 Ebelk Aiznai
10/5/85 15 La Cherka, Nouadhibou
7/4/86 25 Arel
13/4/86 1 N Tidra; 2 Zira
23/4/86 3 near camp
24/4/86 + between Iouik and Ile d'Arguin
25/4/86 100-200 Baie de Lévrier, most of these flying towards night roosts near Nouadhibou
26/4/86 5-10 La Cherka, Nouadhibou

Chlidonias leucoptera White-winged Black Tern Guifette leucoptère

Rather common during autumn and spring migration but in some areas infrequently observed. No observations from the Banc d'Arguin (Lamarche 1987).

4-5/5/85 2 ad. and 1 imm. La Cherka, Nouadhibou

26/4/86 2 ad. La Cherka, Nouadhibou

Streptopelia turtur Turtle Dove Tourterelle des bois

Two subspecies occur in Mauritania, the nominate being the only one to be observed in the W part of the country. Ten thousands of S.t. turtur are wintering in the S part of the country. Passage noted in August-October and in April-May (Lamarche 1987).

5/4/85 2 Nair

8/4/85 1 Ebelk Aiznai

3/5/85 1 near Sabah hotel, Nouadhibou, Nouadhibou

4/5/85 2 in garden Nouadhibou

5/5/85 2 near Sabah hotel, Nouadhibou, Nouadhibou

2/3/86 1 corpse found Tanoudert, wing 172 mm.

22/3/86 1 near camp

27/3/86 1 dead bird beached near camp

1/4/86 1 garden Nouadhibou

17/4/86 1 Biological Station

Otus scops Scops Owl Hibou petit duc

Two subspecies occur in Mauritania, the nominate being the only one occurring as far N as Nouadhibou. O.s. scops is a wintering guest in small numbers, along the coast as well as inland. Passage is noted mainly from September-December and in April and May (Lamarche 1987).

28/4/85 1 corpse found Cap Blanc

Asio flammeus Short-eared Owl Hibou brachyote

Rather small numbers are wintering along the coast as well as in the S part of Mauritania. Passage is noted in October-November and in March (Lamarche 1987). Altenburg et al. (1982) observed 1 individual near Ten Alloul and 3 at the Banc d'Arguin during the 1980 expedition.

28-29/3/85 1 along the shoreline near Iouik, flying up with prey

7/4/85 2 Cap Tafarit

Apus apus Swift Martinet noir

Small numbers are found wintering, mainly in the S part of the country. Passage is noted in August-September and February-June (Lamarche 1987). Altenburg et al. (1982) did not observe the species at the Banc d'Arguin during the 1980 expedition.

26-29/3/85 1-2 Iouik and W part Baie d'Aouatif
31/3/85 1 near camp; 1 (A. apus?) Ebelk Aiznai
2-5/4/85 1-2 near camp and W part Baie d'Aouatif, some migrating N
6/4/85 2 near camp; 1 Baie d'Aouatif, site 6
12/4/85 1 Baie d'Aouatif, site 1
18-20/4/85 2-3 W part Baie d'Aouatif
22/1/86 1 over Sabah hotel, Nouadhibou
6/3/86 1 NW part Baie d'Aouatif
23/3/86 13 near camp but number changing throughout the day; 9 migrating NE in NW part Baie d'Aouatif
24/3/86 50-100 migrating N between Iouik and Kiji; 1 near camp
25/3/86 10-20 between Rgueïba and Zira
3/4/86 2 Gibene
8/4/86 2 near camp, migrating N
19/4/86 2 near camp, migrating N
21/4/86 3 near camp
25/4/86 15 near Ile d'Arguin over sea

Apus pallidus Pallid Swift Martinet pâle

Present as a breeding bird and as a migrant, mainly in September-October and in February-May. Breeding at Cap Tafarit and at Kiaone but subspecies of the latter birds obscure (Lamarche 1987). Altenburg et al. (1982) observed hundreds in Iouik on 3 March 1980 and only small numbers elsewhere at the Banc d'Arguin during the 1980 expedition.
3/4/85 1 Iouik
25/4/85 2 Baie d'Aouatif, site 3

Apus melba Alpine Swift Martinet alpin

Observed in small numbers during migration, mainly in September-October and March-June (Lamarche 1987).
23/3/86 13 NW part Baie d'Aouatif, migrating W at high altitude

Apus affinis House Swift Martinet à croupion blanc

Two subspecies are present. A.a. affinus is a rather common breeding bird, found all over the country and breeding among others at Kiaone and Cap Tafarit. A.a. galilejensis is a migrant, found in small flocks along the coast as well as inland, mainly in September-October and in February-March (Lamarche 1987). Altenburg et al. (1982) observed some

hundreds in Iouik on 3 March 1980 and some tens elsewhere in the same period during the 1980 expedition.
24/3/85 1 N part Baie d'Aouatif flying NW
18/4/85 1 Baie d'Aouatif, site 3 flying N
28/2/86 1 Ebelk Aiznai, flying N
23/3/86 1 Baie d'Aouatif, site 1
24/3/86 4 Baie d'Aouatif, site 1

Merops apiaster Bee-eater Guêpier d'Europe
Numerous as a wintering guest in the Casamanche (Sénégal). Migrating individuals are seen from August-December and in March-June, though spring migration is rather inconspicuous (Lamarche 1987).
29/3/85 1 Iouik
6/4/85 10 Baie d'Aouatif, site 5; 8 site 6
12/4/85 call heard when unknown number was flying over camp
18/4/85 8 Baie d'Aouatif, site 3
23/3/86 41 on the sebka, Baie d'Aouatif, site 1 (10.45 a.m.); 20 males and 16 females migrating E near camp (6.15 p.m.)
24/3/86 32 Baie d'Aouatif, site 1, migrating N
25/3/86 call heard and 1 seen near camp
31/3-1/4/86 ++ Nouadhibou
23/4/86 call heard when unknown number was flying over camp
27/4/86 call heard Nouadhibou

Coracias garrulus Roller Rollier d'Europe
In the W part of Mauritania only autumn passage is observed (August-September) (Lamarche 1987). Altenburg et al. (1982) observed 1 individual in Nouadhibou during the 1980 expedition.
6/4/86 old corpse, probably dating from 1985, found NE part Tidra

Upupa epops Hoopoe Huppe fasciée
Two subspecies are present in the country, which cannot be separated in the field. In the NW part of the country probably only the nominate subspecies is present. It is only seen as a rather common migrant from August-October and January-May (Lamarche 1987). Altenburg et al. (1982) observed 1-3 individuals in the first part of February during the 1980 expedition.
10/3/85 + Nouadhibou

11-12/3/85 ++ migrating through Nouadhibou
13/3/85 only small numbers left in Nouadhibou
31/3/85 3 along the beach near Iouik; 1 near camp
2/4/85 1 near camp
3-4/4/85 1 Iouik
5/4/85 1 Baie d'Aouatif, site 6; 1 on airstrip near camp
6/4/85 1 Baie d'Aouatif, site 6; 1 Nair
7/4/85 1 Ebelk Aiznai; 1 Cap Tafarit
12/4/85 1 Iouik
4/5/85 1 on rubbish tip near La Cherka, Nouadhibou
22/1/86 1 beach near La Cherka, Nouadhibou; 2 Sabah hotel, Nouadhibou
9/2/86 1 near camp
15/2/86 1 near camp
13/3/86 1 Baie d'Aouatif migrating SE
22-23/3/86 1 near camp; 1 N part Baie d'Aouatif
27-31/3/86 1 near camp or around Iouik
2/4/86 1 Nouadhibou Airport
3/4/86 1 Iouik
12/4/86 1 Ebelk Aiznai

Jynx torquilla Wryneck Torcol fourmilier
Wintering near wetlands in the S part of Mauritania. Passage is noted in September-October and March-April. In Nouakchott autumn migration is far more conspicuous than spring migration (Lamarche 1987).
15/3/85 1 Nouadhibou in top of a telephone pole
6/4/85 1 near camp

Lybius vielloti Vieillot's Barbet Barbu de vieillot
Resident in the S part of the country, in rainy seasons coming N up to the 17th degree of latitude (Lamarche 1987).
Early April 1986 1 near camp

Ammomanes cincturus Bar-tailed Desert Lark Ammomane élégante
Occurring as a breeding bird in small numbers all over the country (Lamarche 1987).
17/4/85 2 seen and several heard in desert S of Baie d'Aouatif
25/2/86 1 SE Tivide
2/3/86 8 in Acacia forest N Tanoudert

12/4/86 3 Ebelk Aiznai

13/4/86 6 Tidra

Aleamon alaudipes Hoopoe Lark Sirli du dèsert

Occuring as a common breeding bird all over the country, but rare or absent in the SE (Lamarche 1987). Altenburg et al. (1982) observed 1-2 in the Baie d'Aouatif area in January 1980 and 1 near Cap Tafarit in March 1980. Frequently 1-2 in Ebelk Aiznai and in the dunes in the NE part of the Baie d'Aouatif. According to our occasional observations relatively numerous around the Baie d'Aouatif but less so further away from the coast.

25/3/85 2 N Iouik

30/3/85 2 N Iouik; 1 near camp

31/3/85 1 in desert near camp

17/4/85 2 between camp and Ebelk Aiznai; 1 in SE part Baie d'Aouatif

28/4/85 1 Iouik

8/2/86 2 Tivide

17/2/86 1 near camp

24/2/86 1 Foum Al Trique

25/2/86 4 displaying Tivide

2/3/86 1 between Tanoudert and Nouadhibou

6/3/86 1 near camp

9/4/86 1 N part Tidra

13/4/86 1 Tidra

Calandrella cinerea Red-capped Lark Alouette calandrelle

Found as a breeding bird in the N part of the country. Noted on passage in September-Ocober and March-April, locally in large flocks. Wintering in the N as well as in the S part of the country. Premigratory flocks may hold thousands of birds (Lamarche 1987). Altenburg et al. (1982) observed 1 individual near Cap Timirist during the 1980 expedition.

14/3/85 1 on rubbish tip near La Cherka, Nouadhibou

1/4/85 1 Niroumi

14/4/85 1 Ebelk Aiznai

24/2/86 3 Foum Al Trique

21/3/86 5 near camp migrating N

22/3/86 2 NW part Baie d'Aouatif

30/3/86 2 near camp

5/4/86 1 near camp
9/4/86 1 N part Tidra
20/4/86 1 along the coast at 10 km S of Tivide
23/4/86 3 in dunes near camp

Riparia paludicola Brown-throated Sand Martin Hirondelle de Mauritanie
Present as a wintering guest in small numbers in the S part of the country from November-March. Status largely unknown (Lamarche 1987). Altenburg et al. (1982) occasionally observed 2-3 individuals near Cap Timirist and Tanoudert during the 1980 expedition.
5/4/85 at least 1 near camp
6/4/85 2 near camp

Riparia riparia Sand Martin Hirondelle de rivage
Wintering in rather small numbers near wetlands in the S part of the country. On migration, mainly noted in September and from February-May, occasionally in large groups, sometimes up to 30,000 individuals (Lamarche 1987).
26/3/85 1 Baie d'Aouatif, site 1
30/3/85 3 near camp; ++ in other places Baie d'Aouatif
31/3/85 3 Iouik
1/4/85 4 near camp
2/4/85 50-100 Baie d'Aouatif, site 1
3-4/4/85 + near camp; + Iouik
5-6/4/85 ++ Baie d'Aouatif, site 6 and camp
7/4/85 + Baie d'Aouatif, site 6
8-9/4/85 + near camp
17/4/85 ++ Baie d'Aouatif migrating N
19/4/85 2 over sea near Iouik
20/4/85 1 Iouik
22/4/85 + Ebelk Aiznai
24/4/85 1 Iouik
16/2/86 1 near camp migrating N
14-15/3/86 1-2 near camp migrating N
20/3/86 5 in E part Baie d'Aouatif; 1 corpse found, dead for approx. 5 days, wing 105 mm
21-24/3/86 every day 3-10 near camp, most of these migrating N
24-25/3/86 5-10 between Iouik and Kiji

30/3/86 ++ along W shoreline Baie d'Aouatif

31/3-3/4/86 + near camp

7/4/86 1 Iouik

20/4/86 3 between Serini and Tivide

21-23/4/86 2-5 near camp

26/4/86 + La Cherka, Nouadhibou

27/4/86 + Nouadhibou

Table 10.8. Weight (g) and biometrical data (mm) of a Sand Martin captured in mistnets in the Baie d'Aouatif, site 5.

date	weight	wing	age
3/4/85	220	102	ad

Hirundo rustica Swallow Hirondelle de cheminée

Only wintering in small numbers in the S part of the country. Large numbers are seen on migration, mainly from August-November and January-July, sometimes assembling in very large flocks (Lamarche 1987). Altenburg et al. (1982) observed an increased Swallow migration at the Banc d'Arguin in the course of February and March 1980.

10/3/85 + Cansado

11/3/85 + Nouadhibou

14/3/85 32 Nouadhibou

15/3/85 2 in lagoon N airport Nouadhibou

20/3/85 2 near Cap Tafarit

21/3/85 2 Ten Alloul

24/3/85 3 near camp; 60 in the Baie d'Aouatif; in the afternoon 15 Baie d'Aouatif migrating N; 1 Ebelk Aiznai

25/3/85 3 near camp; 11 Iouik

28/3/85 10 Baie d'Aouatif

29/3/85 18 Ebelk Aiznai

30/3/85 30 migrating N Iouik; +++ Baie d'Aouatif

31/3/85 400 foraging Baie d'Aouatif, site 3, gradually migrating N

1/4/85 ++ near camp

2/4/85 300 Baie d'Aouatif, site 1

3-4/4/85 + Iouik; ++ near camp; everywhere in the Sahara between

Nouadhibou and Iouik

5/4/85 +++ strong migration N everywhere in Baie d'Aouatif

6/4/85 200 around camp

7-10/4/85 ++ near camp

11-13/4/85 10 between camp and Iouik

14/4/85 3 Chamie; ++ Ebelk Aiznai; 10-20 near camp

17/4/85 + W part Baie d'Aouatif

18/4/85 + camp; 80 in one flock NE part Baie d'Aouatif

20/4/85 1 Iouik; + between camp and site 1

22/4/85 65 Ebelk Aiznai

23/4/85 5 Niroumi

25/4/85 ++ E part Baie d'Aouatif

27/4/85 + Iouik

1/5/85 + Ile d'Arguin

4-5/5/85 +++ Nouadhibou

22/1/86 10 Sabah hotel, Nouadhibou

7/2/86 5 near camp

8-22/2/86 up to 10 near camp, frequently seen migrating N

19/2/86 3 Ebelk Aiznai

23/2-12/3/86 up to 5 along the W shoreline of the Baie d'Aouatif

13-15/3/86 ++ near camp migrating N

14/3/86 +++ near camp migrating N, spending the night in expedition tents

16-17/3/86 numbers near camp decreasing as compared to previous days

18-19/3/86 + near camp; + along W part Baie d'Aouatif; 1 Tivide

20/3/86 ++ near camp migrating N

21-23/3/86 +++ near camp migrating N

24/3/86 100-200 between Iouik and Kiji migrating N

25/3/86 10-50 between Rgueïba and Zira migrating N

26/3-1/4/86 ++ near camp

2/4/86 +++ between Iouik and Tidra

3-19/4/86 ++ camp

7/4/86 1 Arel

8/4/86 4 NE Arel

13/4/86 15 N part Tidra; 1 Niroumi

20/4/86 100 Serini; 50 Tivide; 30 NW part Baie d'Aouatif

21/4/86 +++ along shoreline W part Baie d'Aouatif

22-23/4/86 50-100 along shoreline W part Baie d'Aouatif

25/4/86 + Ile d'Arguin

26/4/86 +++ Nouadhibou

Table 10.9. Weight (g) and biometrical data (mm) of Swallows captured in mistnets near the camp or by hand in the camp itself

date	weight	wing	sex	age	fat score
31/3/85	130	121	male	ad.	0
31/3/85	180	122	male	ad.	0
1/4/85	205	117	female	ad.	0
1/4/85	173	117	female	ad.	0
2/4/85	150	120	female	ad.	0
3/4/85	193	125	male	ad.	4
8/4/85	138	119	female	2nd c.y.	0
14/3/86	157	121	male		2
14/3/86	157	120	female	ad.	3
14/3/86	130	122	male	ad.	0
18/3/86	139	120	female	ad.	0
21/3/86	150	119		ad.	0
21/3/86	163	123	male	ad.	0
21/3/86	159	122		ad.	0
21/3/86	162	124	male	ad.	0
21/3/86	161	123	female	ad.	0
22/3/86	164	119	female	ad.	3
22/3/86	148	122	female		0
31/3/86	116	117	female	ad.	0

Table 10.10. Biometrical data (mm) of Swallows found dead in and around the camp, the Biological Station and in Iouik

date	wing	sex	age	fat score
11/4/85	126	male		0
11/4/85		female	2nd c.y.	0
11/4/85		female	2nd c.y.	0
12/4/85	123	male	ad.	
16/4/85	130	male		0
19/4/86	125	male	ad.	0
19/4/86	120	male		
21/4/86	118	female	ad.	
21/4/86	120	female	ad.	
21/4/86	121	male	ad.	0
21/4/86	123	female	2nd c.y.	0
21/4/86	125	female	2nd c.y.	0
21/4/86	123	male	ad.	0
21/4/86	123	female	ad.	0
21/4/86	124	male	ad.	
21/4/86	125	male	ad.	
21/4/86	122	male	ad.	
21/4/86	119	male	2nd c.y.	
21/4/86	121	male	2nd c.y.	0

Hirundo daurica Red-rumped Swallow Hirondelle rousseline

Two subspecies are present in the country, one of these being rare and only occurring in the extreme S of the country. H.d. rufula is a migrant, seen in rather small numbers, in October-November and March-June (Lamarche 1987). Altenburg et al. (1982) observed 1 individual near Cap Tafarit (5/3/80) during the 1980 expedition.

10/3/85 1 Cansado

13/3/85 20 Cap Blanc

5/4/85 1-2 airstrip W part Baie d'Aouatif

6/4/85 10 near camp; 3 Baie d'Aouatif, site 6

13/3/86 1 Baie d'Aouatif, site 5

22-23/3/86 9-10 near camp

24/3/86 1 near camp

31/3/86 1 near camp

2-3/4/86 2 near camp

12/4/86 1 Ebelk Aiznai

21/4/86 1 corpse found near Biological Station, dead for about 2 weeks, wing 119 mm

Table 10.11. Weight (g) and biometrical data (mm) of a Red-rumped Swallow captured in a mistnet near the camp

date	weight	wing	age	fat score
22/3/86	182	119	2nd c.y.	2

Delichon urbica House Martin Hirondelle de fenêtre

Wintering in very small numbers in the S part of the country. Autumn passage (October) is not very conspicuous. Numbers seen during spring passage (February-June) are somewhat larger. Most birds seem to use a route through the interior part of the country (Lamarche 1987). Altenburg et al. (1982) only observed 2 individuals at the Banc d'Arguin during the 1980 expedition.

10/3/85 + Cansado

13/3/85 1 Cap Blanc

29/3/85 1 Iouik

31/3/85 7 near camp; 3 Iouik

1/4/85 2 near camp

2/4/85 10 Baie d'Aouatif, site 1

3/4/85 + Iouik; + near camp; at least 10 Nouadhibou

5-6/4/85 ++ camp; ++ Iouik

7/4/85 + near camp

11/4/85 1 near Biological Station Iouik

14-18/4/85 up to 5 migrating N near camp

4/5/85 1 Nouadhibou

3/2/86 1 Nouadhibou

7/2/86 1 Ebelk Aiznai

15/2/86 3 near camp, migrating N

14/15/3/86 1-2 near camp

20/3/86 3 along W part Baie d'Aouatif
21-25/3/86 5-10 near camp, migrating N
24-25/3/86 + between Iouik and Kiji
30/3/86 ++ N part Baie d'Aouatif
3/4/86 1 near camp
7/4/86 1 female found in sea near Cap Tafarit, wing 106 mm
8/4/86 1 near camp
20/4/86 1 at 20 km S Tivide; 1 NW part Baie d'Aouatif
21-22/4/86 2 near camp; 2 NW part Banc d'Arguin
26/4/86 ++ Nouadhibou

Anthus campestris Tawny Pipit Pipit rousseline

Present in most of the country throughout the year. Breeding possible but not yet certain. Passage in September-October and March-May (Lamarche 1987).

14/3/85 2 La Cherka, Nouadhibou; 6 on nearby rubbish tip
30-31/3/85 1-2 Ebelk Aiznai
1/4/85 1 Niroumi
6/4/85 1 Baie d'Aouatif, site 6
9/4/85 1 Ebelk Aiznai
14/4/85 1 Ebelk Aiznai
23/3/86 2 Baie d'Aouatif, site 2
3/4/86 2 Baie d'Aouatif, site 5
9/4/86 1 N part Tidra
13/4/86 2 W part Tidra
20/4/86 3 between Serini and Tivide
23/4/86 1 near camp

Anthus trivialis Tree Pipit Pipit des arbres

Wintering in rather small numbers in the S part of the country. A rather common migrant, seen mainly from September-November and March-June (Lamarche 1987).

10/3/85 1 garden Nouadhibou
12/3/85 1 La Cherka, Nouadhibou
14/3/85 5 garden around Sabah hotel, Nouadhibou
15/3/85 15 La Cherka, Nouadhibou
30/3/85 1 Iouik
31/3/85 1 Iouik; 5 Ebelk Aiznai

1/4/85 1 Niroumi
2-5/4/85 1-2 near camp
3/4/85 2 Iouik
11-13/4/85 1 Iouik
17/4/85 2 W part Baie d'Aouatif
14/3/86 1 near camp; 2 Baie d'Aouatif, site 1
25/3/86 2 Rgueïba, migrating N
1/4/86 1 near camp
2/4/86 3 near camp; 2 NW part Baie d'Aouatif
5/4/86 1 near camp
9/4/86 2 N part Tidra
26/4/86 + La Cherka, Nouadhibou

Table 10.12. Weight (g) and biometrical data (mm) of Tree Pipits captured in mistnets near the camp

date	weight	wing	age	fat score
16/3/85	26.5	90		4
28/3/86	15.0	87	ad.	0

Anthus pratensis Meadow Pipit Pipit farlouse
Small numbers are wintering in Mauritania, rarely in the E part of the country. Passage is noted from September-November and in February-March (Lamarche 1987).
31/1/86 1 La Cherka, Nouadhibou
9/4/86 1 N part Tidra

Anthus cervinus Red-throated Pipit Pipit à gorge rousse
Wintering in vegetated parts of the country, mainly S of the 21st degree of latitude. Passage from September-November and March-May, in autumn mainly in the E part of the country, in spring mainly in the W part (Lamarche 1987). Altenburg et al. (1982) once (7/3/80) observed 5 Red-throated Pipits near Cansado during the 1980 expedition.
11/3/85 20 La Cherka, Nouadhibou
14/3/85 15 on rubbish tip near La Cherka, Nouadhibou
30/3/85 1 Ebelk Aiznai

8/4/85 2 Ebelk Aiznai
11/4/85 1 Iouik
27/4/85 1 in summer plumage Ebelk Aiznai
4/5/85 1 in garden Nouadhibou
5/5/85 1 La Cherka, Nouadhibou
22/1/86 6 Beach near La Cherka, Nouadhibou
31/1/86 5 Beach near La Cherka, Nouadhibou
16-17/4/86 1 near camp
21/4/86 1 near camp; 1 in NW part Baie d'Aouatif
24/4/86 1 near camp
27/4/86 3 La Cherka, Nouadhibou

Motacilla flava Yellow Wagtail Bergeronnette printanière

Six subspecies may be met in Mauritania, M.f. flava being the most numerous. Thousands of Yellow Wagtails are wintering in the S part of the country, but wintering individuals may also be found along the coast and in Nouakchott. The subspecies composition in the wintering areas, however, still is poorly known. All subspecies are observed on migration, M.f. flava in August-September and March-April, "flavissima" (rather common) from August-October and in March, "iberiae" (small numbers) in August-September and February-March (also present as a breeding bird), "cinereocapilla" (small numbers) from August-October and March-April, "thunbergi" (very small numbers) in September-October and April and "feldegg" (rare) in October and March (Lamarche 1987). Altenburg et al. (1982) observed up to 30 (mainly from early January to mid February) Yellow Wagtails at the Banc d'Arguin during the 1980 expedition.
11/3/85 + on several places Nouadhibou
12/3/85 1 La Cherka, Nouadhibou, probably "iberiae"
14/3/85 1 male "flavissima" on rubbish tip near La Cherka, Nouadhibou; also present here: + "iberiae" and 5 M. flava sp.,
15/3/85 2 La Cherka, Nouadhibou
22/3/85 1 male and 1 female? along beach in E part Baie d'Aouatif
28-29/3/85 1 Iouik; 1 along the beach near Iouik
30/3/85 1 male and 3 males "flava" near camp; 10 near camp migrating N
31/3/85 12 Ebelk Aiznai
1/4/85 4 near camp, among which 1 "flavissima"
2/4/85 2 Nair
3/4/85 10 Iouik; 8 Ebelk Aiznai

5/4/85 ++ near camp, among which "flava"

6/4/85 at least 6 "flavissima" Baie d'Aouatif, site 6; 1 M. flava sp. near camp

7/4/85 ++ near camp

8/4/85 5 Ebelk Aiznai; 4 near camp

9-22/4/85 at least 2 Ebelk Aiznai

12/4/85 1 male "flavissima" Iouik

13/4/85 3 near camp; + Iouik

14/4/85 4 Ebelk Aiznai; 1 "flava" W part Baie d'Aouatif

18-22/4/85 2 near camp; 1 Iouik

19-23/4/85 3 Nair

23/4/85 ++ Niroumi, all males "flava"

25/3/85 + E part Baie d'Aouatif

27/4/85 1 Ebelk Aiznai

1/5/85 + NE part Ile d'Arguin

15-19/2/86 1 near camp

22/2/86 1 male "iberiae" Ebelk Aiznai; 1 flava sp. near camp

25/2/86 1 near camp

28/2/86 3 "iberiae" Ebelk Aiznai

8-12/3/86 1-2 near camp

14/3/86 10 "iberiae", 10 "flava" and 1 "flavissima" near camp

15/3/86 3 near camp; 2 Iouik

20/3/86 1 near camp; 1 along W part Baie d'Aouatif

22/2/86 2 Ajoueïr

22-23/3/86 10-20 near camp, among which 1 "iberiae"

24/3/86 25-50 between Iouik and Kiji, among which "flavissima"

25/3/86 10-50 between Rgueïba and Zira

26-29/3/86 1-3 near camp; 1 "thunbergi" Iouik

30/3/86 15 "iberiae" and "thunbergi" near Biological Station

31/3/86 about 100 Baie d'Aouatif, site 1

1/4/86 10-20 migrating along camp, among which 1 "flava" and 2 "thunbergi"

2/4/86 2 "flavissima" along W part Baie d'Aouatif

3/4/86 4 near camp; 2 Iouik; 1 Tidra

4-27/4/86 up to 5 near camp

6/4/86 1 "thunbergi" Iouik

9/4/86 20 N part Tidra

20/4/86 1 between Serini and Tivide

26-27/4/86 + La Cherka, Nouadhibou, among which 1 "thunbergi"

Table 10.13. Weight (g) and biometrical data (mm) of a Yellow Wagtail captured in a mistnet near the camp

date	weight	wing	age	fat score
4/4/86	17.2	78	2nd c.y.?	3

Motacilla cinerea Grey Wagtail Bergeronnette des ruisseaux

Small numbers are wintering near wetlands in the S part of the country. Passage from August-October and April-May (Lamarche 1987).

12/3/85 1 La Cherka, Nouadhibou

16/2/86 1 near camp

26/4/86 14 La Cherka, Nouadhibou

Motacilla alba White Wagtail Bergeronnette grise

Large numbers are wintering along the coast (1000 at the Banc d'Arguin), in the Sénégal delta and elsewhere in the S part of the country. Passage from September-November and in February-March (Lamarche 1987). Altenburg et al. (1982) observed some tens foraging in Nouadhibou in mid-January, up to 2 in Iouik in the course of January-February and up to 5 elsewhere at the Banc d'Arguin during the 1980 expedition. Observations in 1985/86 at the Banc d'Arguin become less numerous in the course of April. All sightings refer to the subspecies M.a. alba, except for those indicated subspecifically.

10-20/3/85 ++ Nouadhibou

25/3/85 1 Iouik

31/3-3/4/85 2 Iouik

5-6/4/85 1 Baie d'Aouatif, site 6

7/4/85 1 near camp

8/4/85 1 Ebelk Aiznai

11-13/4/85 2 Iouik

14/4/85 1 near camp; 1 Iouik

19-20/4/85 1 Iouik; 4 near camp

21/4/85 1 near camp

22/1/86 20 Nouadhibou

2-4/2/86 ++ Nouadhibou, several places
6-7/2/86 1 near camp
8/2-7/3/86 2-5 near camp; + Ebelk Aiznai; 0-1 Iouik
16/2/86 ++ near camp
24-25/2/86 1 Teïchot
3/3/86 10 La Cherka, Nouadhibou
8-9/3/86 1 near camp
10/3-2/4/86 generally 2, occasionally up to 5 near camp; 0-4 Iouik
24-25/3/86 5-10 between Iouik and Kiji
2/4/86 6 La Cherka, Nouadhibou
2-14/4/86 1-2 near camp
3/4/86 2 very dark Wagtails near camp, possibly M.a. subpersonata; 1 M.a. alba Iouik
9/4/86 10 N part Tidra
16/4/86 1 Iouik
20/4/86 1 Tivide
21/4/86 1 Iouik

Table 10.14. Weight (g) and biometrical data (mm) of a White Wagtail captured in a mistnet near the camp

date	weight	wing	sex	age	fat score
15/4/86	15.6	83	male	2nd c.y.	0

Luscinia megarhynchos Nightingale Rossignol philomèle
Probably not present as a wintering guest. Passage, mainly in the W part of the country, from August-October and February-April (Lamarche 1987).
31/3/85 2 in camp Iouik
1/4/85 1 in camp (in tent)
17/4/85 1 near camp
9/4/86 1 N part Tidra
17/4/86 1 corpse, dead for several weeks, Biological Station

Luscinia svecica Bluethroat Gorge bleue
Small numbers are wintering in the Sénégal delta and elsewhere in wetlands in the S part of the country. Passage from September-November

and March-April (Lamarche 1987).
10/3/85 1 female La Cherka, Nouadhibou
21/3/85 1 male along the beach Ten Alloul
4/4/85 1 whitebreasted Ebelk Aiznai

Phoenicurus ochruros Black Redstart Rouge-queue noir
Occasional visitor to Mauritania (Lamarche 1987).
5/4/85 1 near camp; ++ Nair
7/4/85 2 males and 1 female Cap Tafarit
22/1/86 1 male Sabah hotel, Nouadhibou
28/3/86 1 female near camp

Phoenicurus phoenicurus Redstart Rouge-queue à front blanc
A common wintering guest along the Sénégal river. Passage is noted throughout the country, mainly from August-November and February-June (Lamarche 1987).
30/3/85 1 female catching flies in house Iouik
31/3/85 2 males and 1 female near camp
3/4/85 1 male Iouik
4-6/4/85 1 male near camp
1/4/86 1 Nouadhibou

Table 10.15. Weight (g) and biometrical data (mm) of a Redstart captured in a mistnet near the camp

date	weight	wing	sex	age	fat score
31/3/85	11.1	69	male	2nd c.y.	2

Saxicola rubetra Whinchat Traquet tarier
Rather small numbers are wintering along the Sénégal river, most birds present here in autumn migrating further S. Passage from August-November and April-May (Lamarche 1987).
3/4/85 1 Ebelk Aiznai
4-5/4/85 1-2 near camp
17/4/85 1 near camp
20/4/86 1 ad. male NW part Baie d'Aouatif

26/4/86 1 male La Cherka, Nouadhibou

Table 10.16. Weight (g) and biometrical data (mm) of a Whinchat captured in a mistnet near the camp

date	weight	wing	age	fat score
4/4/85	14.0	73	ad.	2

Saxicola torquata Stonechat Traquet patre

Rare as a wintering guest as well as during migration, numbers varying strongly from year to year (Lamarche 1987).

5/4/85 1 male Baie d'Aouatif, site 6

23/1/86 1 male Sabah hotel, Nouadhibou

Oenanthe oenanthe Wheatear Traquet motteux

Four subspecies may be encountered in Mauritania, O.o. oenanthe being the most numerous. Birds wintering in the country probably mostly are O.o. seebohmi and possibly O.o. libanotica. O.o. oenanthe is observed as a migrant from September-November and February-March, "leucorhoa" is relatively scarce from September-November and in March. "Seebohmi" is noted on passage in November and in February-March, "libanotica" is mostly seen in October and November and possibly in February (Lamarche 1987). Altenburg et al. (1982) observed 1 Wheatear in Cansado in March during the 1980 expedition.

11/3/85 3 Nouadhibou

12-15/3/85 1-2 La Cherka, Nouadhibou

21/3/85 1 Ten Alloul

30/3/85 2 males Iouik; 1 male near camp; 1 male Ebelk Aiznai; 1 female (probably O.o leucorrhoa) Baie d'Aouatif; 1 male Baie d'Aouatif, site 3

31/3/85 2 Ebelk Aiznai

3/4/85 1 male and 1 female Iouik; 1 male near camp

5/4/85 at least 5, out of which 3 males, Baie d'Aouatif, site 6

6/4/85 1 male Baie d'Aouatif, site 6; 10 near camp

7/4/85 1 female Ebelk Aiznai; 1 female near camp

8/4/85 2 males Ebelk Aiznai

14/4/85 3 Ebelk Aiznai out of which 2 males O.o. seebohmi

19/4/85 1 male near camp

31/1-3/2/86 1 rubbish tip near La Cherka, Nouadhibou

23/3/86 1 male and 1 female airstrip W part Baie d'Aouatif

24/3/86 2 females Kiji

25/3/86 1 male Baie d'Aouatif, site 1

31/3/86 1 near camp

1/4/86 1 Iouik; 1 Nouadhibou

2-3/4/86 1 male O.o. seebohmi Iouik

2/4/86 2 La Cherka, Nouadhibou

4-5/4/86 1 female near camp

5/4/86 1 male Iouik

7-11/4/86 1 female Iouik

17/4/86 1 female Biological Station

Oenanthe hispanica Black-eared Wheatear Traquet oreillard

Two subspecies are present in Maurutania. O.h. hispanica is a common wintering guest in the S part of the country and seen on passage from September-November and in February-March. O.h. melanoleuca is passing through in very small numbers in October-November and in April (Lamarche 1987).

5/4/85 1 male Baie d'Aouatif, site 6

14/3/86 2 males near camp

18/3/86 1 male Baie d'Aouatif, site 3

21/3/86 1 male near camp

22/3/86 1 male Biological Station; 3 near airstrip W part Baie d'Aouatif

Oenanthe deserti Desert Wheatear Traquet du desert

Wintering guest and breeding bird in Mauritania, present throughout the country. Observed at the Banc d'Arguin from September-November and in March-April (Lamarche 1987), but during the 1986 expedition also observed as a wintering guest in Nouadhibou and at the Banc d'Arguin. Altenburg et al. (1982) observed 3 Desert Wheatears in Nouadhibou in January 1980, some tens in the desert between Nouadhibou and the Banc d'Arguin and 1 in Iouik in January 1980.

22/1/86 3 singing males rubbish tip near La Cherka, Nouadhibou

3/2/86 1 male La Cherka, Nouadhibou

7-13/2/86 1 male near camp

8/2/86 1 female Tivide; 1 female Ebelk Aiznai; 1 female NW part Baie

d'Aouatif
14/2-13/3/86 1 male Iouik
18/2/86 1 Tivide
22/2/86 1 female Ebelk Aiznai
3/3/86 1 male La Cherka, Nouadhibou
8/3/86 1 male near camp

Oenanthe leucopyga White-crowned Black Wheatear Traquet à tête blanche
Occurring throughout the Sahel and Sahara, generally N of the 18th degree of latitude (Lamarche 1987).
23/2/86 1 S tip Tidra

Monticola saxatilis Rock Thrush Merle de roche
A rare guest to Mauritania, mainly from September-April (Lamarche 1987).
5/4/85 1 ad. male sebka near Iouik

Turdus philomelos Song Thrush Grive musicienne
A rare guest to Mauritania, mainly from November-February (Lamarche 1987).
14/3/85 1 in bushes near Sabah hotel, Nouadhibou
30-31/1/86 1 in garden Sabah hotel, Nouadhibou

Locustella naevia Grasshopper Warbler Locustelle tachetée
Locally common as a wintering guest, mainly between Nouakchott and the Chott'Boul and along the coast. Passage from August-October and in February-March. Spring migration is very inconspicuous (Lamarche 1987).
4/4/85 1 garden Nouadhibou
5/4/85 + near camp; 1 Ebelk Aiznai
7/4/85 feather remains of eaten bird Ten Alloul
10/4/85 1 in house Iouik
14/4/85 1 near camp
23/1/86 1 garden Sabah hotel, Nouadhibou

Acrocephalus schoenobaenus Sedge Warbler Phragmite des joncs
Wintering in small numbers in the Sénégal delta and wetlands elsewhere in the S part of the country. Passage in September-October and from February-June (Lamarche 1987).
22/1/86 1 in garden Sabah hotel, Nouadhibou

Locustella luscinioides Savi's Warbler Locustelle luscinioide

Small numbers sometimes are wintering along wetlands in the S part of the country. Autumn migration is noted in September-October, spring migration is very inconspicuous (Lamarche 1987).

6/4/85 1 near camp

Hippolais polyglotta Melodious Warbler Hypolais polyglotte

Uncertain whether the species is wintering in S Mauritania. Passage, mainly observed in the coastal region, from August-October and March-April

6/4/85 3 Nair

21-23/4/86 1 near camp

Table 10.17. Weight (g) and biometrical data (mm) of a Melodious Warbler captured near the camp

date	weight	wing	age	fat score
4/4/85	10.7	70	ad.	0

Sylvia conspicillata Spectacled Warbler Fauvette â lunettes

Common as a wintering guest along the coast, S of the $18^{o}30$ degree of latitude. Small numbers are wintering inland, throughout the country. Passage from August-October and in March (Lamarche 1987).

22/1/86 1 male and 2 females Nouadhibou

Table 10.18. Weight (g) and biometrical data (mm) of a Spectacled Warbler captured in a mistnet in the camp

date	weight	wing	age	fat score
8/4/86	7.7	55	ad.	1

Sylvia cantillans Subalpine Warbler Fauvette passerinette

Wintering in rather small numbers, mainly in the S part of the country.

Passage in September-October and in March (Lamarche 1987). Altenburg et al. (1982) observed single individuals at the Banc d'Arguin on two days in February during the 1980 expedition.

6/4/85 1 near camp

4/5/85 1 in garden Nouadhibou

20/2/86 1 near camp

Table 10.19. Weight (g) and biometrical data (mm) of a Subalpine Warbler captured in mistnets near the camp

date	weight	wing	age	fat score
4/4/85	8.8	56	2nd c.y.	3

Sylvia melanocephala Sardinian Warbler Fauvette mélanocéphale

Wintering in rather small numbers, mainly in the S part of the country. Rare in the E. Passage in September-November and from February-April (Lamarche 1987).

22/1/86 1 male and 2 females Nouadhibou

2/3/86 pair in Acacia forest N Tanoudert

Sylvia communis Common Whitethroat Fauvette grisette

A rather common wintering guest, mainly in the S part of the country. Passage in August-October and in April-May (Lamarche 1987).

8/4/86 1 Baie d'Aouatif, site 1

Table 10.20. Weight (g) and biometrical data (mm) of a Common Whitethroat captured in mistnets near the camp

date	weight	wing	sex	age	fat score
3/4/85	11.4	74	female?	ad.	0

Sylvia borin Garden Warbler Fauvette des jardins

Wintering in rather small numbers, mainly in the central part of the country, absent in the S part. Passage in August-November and from

March-May (Lamarche 1987).
8/4/85 1 near camp
16/4/85 1 near camp
16/4/86 1 near camp; 1 Iouik

Table 10.21. Weight (g) and biometrical data (mm) of a Garden Warbler captured in mistnets near the camp

date	weight	wing	age	fat score
4/4/85	24.6	79	ad.	4

Sylvia atricapilla Blackcap Fauvette à tête noire
Small numbers are wintering in wooded or shrub areas in the central and S part of the country and along wetlands in the Sahel zone. Common on passage in October-November and from February-June (Lamarche 1987).
4-5/4/85 1 male near camp
6/4/85 1 female near camp; 1 female eaten by Kestrel
7/4/85 1 male in tent in camp
14/4/85 1 male Ebelk Aiznai
16/4/85 1 near camp
22/1/86 1 male garden Sabah hotel, Nouadhibou
2/3/86 1 male garden Sabah hotel, Nouadhibou
23/3/86 1 male Baie d'Aouatif, site 6
24/3/86 1 male near camp
31/3/86 1 female near camp
3/4/86 1 female near camp
7/4/86 1 male Baie d'Aouatif, site 1
16/4/86 1 male near camp; 1 male Baie d'Aouatif, site 5; 1 female Iouik
17/4/86 1 male near camp; 1 female Niroumi
21-22/4/86 1 female near camp; 1 female Iouik
27/4/86 1 female garden Nouadhibou

Table 10.22. Weight (g) and biometrical data (mm) of a Blackcap captured in mistnets near the camp

date	weight	wing	sex	age	fat score
3/4/85	24.5	73	male	ad.	5

Phylloscopus bonelli Bonelli's Warbler Pouillot de Bonelli
Small numbers are wintering S of the 17th degree of latitude. Passage from August-October and February-April (Lamarche 1987).
5-6/4/85 1 near camp
18/4/85 1 near camp
14-15/3/86 1 near camp
26/4/86 1 La Cherka, Nouadhibou

Table 10.23. Weight (g) and biometrical data (mm) of a Bonelli's Warbler captured in mistnets near the camp

date	weight	wing	age	fat score
14/3/86	8.1	66	ad.	3

Phylloscopus collybita Chiffchaff Pouillot vèloce
Common winter visitor in areas more or less close to the water. Passage in October-November and January-June (Lamarche 1987). Altenburg et al. (1982) observed 1 singing Chiffchaff in Nouadhibou in March 1980.
10/3/85 1 in garden Nouadhibou
11/3/85 ++ on several places Nouadhibou
13/3/85 1 in garden Nouadhibou
29/3/85 2 Iouik
30/3/85 1 Ebelk Aiznai
2-5/4/85 ++ near camp
18/1/86 5 in garden Sabah hotel, Nouadhibou
3/2/86 ++ in gardens Nouadhibou
8/2/86 1 Tivide
10/2-19/3/86 + near camp

22/2/86 5 Ebelk Aiznai

25/2/86 1 Tivide

26/2-15/3/86 + Iouik

22-23/3/86 50-100 near camp

29/3-6/4/86 1-5 near camp

Table 10.24. Weight (g) and biometrical data (mm) of Chiffchaffs captured in mistnets near the camp

date	weight	wing	age	fat score
13/3/85	8.8	55		4
13/3/85	11.0	63		3
1/4/85	6.0	58	ad.	0
2/4/85	7.4	56	ad.	3
4/4/85	5.9	55	ad.	0
4/4/85	6.9	56	ad.	3
6/4/85	5.6	63		0
10/2/86	6.5	59	ad.	3
11/2/86	7.2	63		0
16/2/86	8.0	63	ad.	3
21/3/86	5.5	58	ad.	0
23/2/86	7.1	62	ad.	0
14/3/86	7.1	54	ad.	5
14/3/86	6.6	57	ad.	2
15/3/86	5.8	56	ad.	0
15/3/86	5.7	56	ad.	0
15/3/86	6.8	63	ad.	0
21/3/86	7.2	56	ad.	4
22/3/86	5.5	56	ad.	0
22/3/86	5.5	55		1
22/3/86	5.9	58	ad.	0
22/3/86	7.5	61	ad.	3
22/3/86	5.7	56	ad.	0
23/3/86	5.7	55	ad.	0
23/3/86	6.5	54		0
24/3/86	5.4	55		0
29/3/86	6.1	56	ad.	2
30/3/86	7.8	69	ad.	0
30/3/86	6.2	65	ad.	0
31/3/86	6.9	57	ad.	0
31/3/86	5.0	56	ad.	
5/4/86	5.7	58	ad.	0

Phylloscopus trochilus Willow Warbler Pouillot fitis

Rather common winter visitor near wetlands all over the country. Passage from August-November and in January-February (Lamarche 1987).

13-15/3/85 ++ gardens and La Cherka, Nouadhibou
30/3/85 1 Iouik; 1 Ebelk Aiznai
31/3/85 1 captured, ringed 21/4/84 Bardsey Isl., Wales; 3 Iouik
1/4/85 at least 4 around camp
5-6/4/85 +++ everywhere around the camp, frequently feeding in tents
7/4/85 4 near camp; 1 Ebelk Aiznai
18/4/85 1 Baie d'Aouatif, site 5
23/4/85 2 Niroumi
1/5/85 1 Ile d'Arguin
22/1/86 10 garden Sabah hotel, Nouadhibou
14-20/3/86 + near camp
22-23/3/86 50-100 near camp
24/3/86 30 S part Kiji
24-26/3/86 3-5 near camp
29/3-3/4/86 1-3 near camp
13/4/86 2 N part Tidra
20/4/86 3 between Serini and Tivide, foraging along the shoreline
21-22/4/86 1 near camp

Table 10.25. Weight (g) and biometrical data (mm) of Willow Warblers captured in mistnets near the camp

date	weight	wing	sex	age	fat score
12/3/85	10.3	66			4
31/3/85	7.2	63			0
1/4/85	6.2	62		ad.	0
1/4/85	6.8	62		ad.	1
3/4/85	7.3	64		ad.	1
3/4/85	8.1	71		ad.	3
3/4/85	8.7	63		ad.	4
3/4/85	7.2	68		ad.	0
3/4/85	9.5	70		ad.	3
4/4/85	8.3	64		2nd c.y.	3
4/4/85	7.6	63		ad.	2

4/4/85	7.1	64		ad.	0
4/4/85	9.8	65		ad.	4
4/4/85	8.8	61		ad.	4
4/4/85	9.3	68		ad.	2
4/4/85	10.5	65		ad.	0
4/4/85	9.7	70		2nd c.y.	4
4/4/85	8.5	65		ad.	3
5/4/85	6.8	64	female	ad.	0
6/4/85	5.9	68		ad.	0
6/4/85		70	male	ad.	0
14/3/86	8.2	69			3
15/3/86	7.5	72		ad.	0
15/3/86	9.4	68		ad.	0
20/3/86	12.3	67		ad.	5
21/3/86	7.3	68		ad.	0
21/3/86	6.6	69		ad.	0
21/3/86	7.3	69		ad.	0
22/3/86	6.8	71		ad.	0
22/3/86	6.8	68		ad.	0
22/3/86	7.9	68		ad.	3
23/3/86	6.2	63			0
23/3/86	6.6	70		ad.	0
24/3/86	6.9	62			0
26/3/86	7.0	70		ad.	0
29/3/86	7.2	71		ad.	0
30/3/86	6.4	68		ad.	0
30/3/86	7.4	69		ad.	0
30/3/86	6.1	71		ad.	0
31/3/86	7.1	69		ad.	0
2/4/86	6.1	70		ad.	0
3/4/86	6.3	63		ad.	0

Muscicapa striata Spotted Flycatcher Gobe-mouches gris

Wintering in rather large numbers, mainly in the S part of the country. Passage from August-October and April-May (Lamarche 1987).

11/4/86 1 Iouik

Ficedula hypoleuca Pied Flycatcher Gobe-mouches noir

Wintering in rather small numbers in the S part of the country. Much more numerous during passage, mainly from August-November and in April (Lamarche 1987).

6/4/85 1 male Baie d'Aouatif, site 6

Table 10.26. Weight (g) and biometrical data (mm) of a Pied Flycatcher captured in mistnets near the camp

date	weight	wing	sex	age	fat score
15/4/85	8.2	80	male	2nd c.y.?	0

Lanius excubitor Great Grey Shrike Pie grièche grise

Three subspecies may be encountered in Mauritania, L.e. elegans and L.e. leucopygos being the most numerous. All subspecies are breeding in the country as well. "Elegans" is mainly to be found in the N part, thoughout the year, and may be seen on passage from August-November and February-April. "Leucopygos" is a rather common resident breeding bird from the S part of the country, though some N-S movements have been recorded. The status of "dodsoni" still is somewhat obscure. Possibly it is a rare breeding bird from the Adrar region in the central part of the country (Lamarche 1987). Observations of the 1985/86 expeditions probably refer to "elegans". Altenburg et al. (1982) observed 1 Great Grey Shrike in Nouadhibou in January 1980.

4/4/85 1 in garden Nouadhibou

22/1/86 1 singing garden Nouadhibou; 1 La Cherka, Nouadhibou

4/2/86 1 city centre Nouadhibou

20/4/86 1 between Serini and Tivide

Lanius senator Woodchat Shrike Pie grièche à tête rousse

A rather common wintering guest, occurring near wetlands in the S part of the country. Passage from July-October and March-June (Lamarche 1987).

31/3/85 1 Ebelk Aiznai; 1 near camp

1/4/85 1 ad. male Niroumi

2/4/85 2 Ebelk Aiznai

3/4/85 1 Iouik

4/4/85 + near camp; 2 in garden Nouadhibou
5/4/85 + near camp; 3 Baie d'Aouatif, site 6; 2 on airsprip W part Baie d'Aouatif. One male catching small Fiddler Crabs (less than 1 cm) along the shoreline
6/4/85 1 on airstrip W part Baie d'Aouatif
11/4/85 1 Iouik
2/3/86 old corpse found Tanoudert, wing 89 mm
24/3/86 1 Nair migrating NE
16-17/4/86 1 near camp

Table 10.27. Weight (g) and biometrical data (mm) of Woodchat Shrikes captured in mistnets near the camp

date	weight	wing	sex	age	fat score
4/4/85	293	94	male	2nd c.y.	0
4/4/85	253	95	female	ad.	0
4/4/85	237	95	male	2nd c.y.	0
4/4/85	227	92	male	2nd c.y.	0
5/4/85	195	90	female	ad.	0

Corvus monedula Jackdaw Choucas des tours
Only one observation (25/10/85) from Nouadhibou (Lamarche 1987).
10/3/85 2 La Cherka, Nouadhibou
16/3/85 2 La Cherka, Nouadhibou
5/5/85 2 La Cherka, Nouadhibou
3/2/86 5 La Cherka, Nouadhibou

Corvus ruficollis Brown-necked Raven Corbeau brun
Common breeding bird in the N part of the country, N of the 17th degree of latitude, frequenting all kinds of habitats (Lamarche 1987). Altenburg et al. (1982) observed 5-10 individuals in Nouadhibou in January 1980 and some single individuals between Nouadhibou and Iouik during the 1980 expedition.
10/3/85 2 Nouadhibou
13/3/85 1 Cap Blanc
15/3/85 1 lagoon N airport Nouadhibou; 5 along the beach N Nouadhibou

14/4/85 5 Chami

28/4/85 1 near camp

1/5/85 4 NE part Ile d'Arguin

3-4/5/85 2-4 La Cherka, Nouadhibou

5/5/85 2 near Sabah hotel, Nouadhibou; 2 La Cherka, Nouadhibou

20/2/86 1 near camp

25/2/86 1 Aouguît

2/3/86 6 between Tanoudert and Baie de Lévrier

13-14/3/86 2 Baie d'Aouatif, site 1, watching Fiddler Crab burrows

25/4/86 3 Ile d'Arguin

Passer simplex Desert Sparrow Moineau blanc

Small numbers are found as a breeding bird in the N part of the country (Lamarche 1987).

14/4/85 12 Chami

2/3/86 10-15 Acacia woods N Tanoudert

7/3/86 8 among which 3 males, near camp

13/3/86 1 in camp

21/3/86 pair near camp

23/4/896 12 near camp

Passer luteus Sudan Golden Sparrow Moineau doré

Common breeding bird, mainly between the Sénégal river and the 18th degree of latitude, getting rarer N of this latitude (Lamarche 1987). Altenburg et al. (1982) observed hundreds in Cansado in March 1980.

18/3/85 ++ Cansado

Carduelis chloris Greenfinch Verdier

Rare visitor to Mauritania, only few sightings from Nouadhibou and Nouakchott (Lamarche 1987).

22-25/1/86 4 garden Sabah hotel, Nouadhibou

2/3/86 5 garden Sabah hotel, Nouadhibou

Rhodopechys githagenea Sahara Trumpeter Bullfinch Bouvreil githagine

Rather common and widespread as a breeding bird throughout the country, but only occurring in places where fresh water is available (Lamarche 1987).

22/3/86 1 imm. male near camp

Emberiza hortulana Ortolan bunting Bruant ortolan

A frequently observed migrant, occurring in very small numbers from September-November and in April (Lamarche 1987).

6/4/85 1 male on the beach near camp

10.3 List of observed mammal species

Jaculus jaculus Lesser Egyptian Gerboa

30/3-2/4/85 1 in camp

21/4/85 1 near kitchen tent

8-24/2/86 1 in kitchen tent

2/3/86 1 in tent of general coordinator, eating peanuts and raisins

13-15/3/86 1 in laboratory tent

28/3/86 1 captured in kitchen tent

2-10/4/86 1 in laboratory tent

14-23/4/86 3 in several places in the camp

16/4/86 the first juvenile!

Meriones crassus Jird

11/3/86 1 (probably this species) captured in food storage tent, dyed and released in the dunes far from the camp

23/3/86 dyed individual recaptured close to the food storage tent, kept in a cage afterwards and released on 23/4/86

Rattus norvegicus Brown Rat Surmulot

26/4/86 1 harbour Nouadhibou

Western Ground Squirrel Xerus erythropus

26/2-24/4/86 dens in the low dunes close to the waters edge, near camp as well as in Ebelk Aiznai, occasionally seen

Canis aureus Common Jackal Chacal commun

23/3-25/4/85 Now and then seen or heard in the surroundings of the camp

31/3/85 1 Ebelk Aiznai

24/3/85 1 Tivide

1/4/85 1 Niroumi

6/4/85 1 Ebelk Aiznai

7/4/85 1 Cap Tafarit

17/4/85 2 Ebelk Aiznai

25/4/85 1 Ebelk Aiznai

12/2-24/4/86 seen or heard very frequently in or close to the camp

12/2/86 2 on tidal flats NW part Baie d'Arguin

24/2/86 traces found at Foum Al Trique

25/2/86 2 NW part Baie d'Arguin

5/3/86 1 feeding along the edge of the tidal flats NW part Baie d'Arguin

20/3/86 1 piste Teichot-Iouik, close to Serini

23-26/3/86 1 feeding at night Baie d'Arguin, site 1

25/3/86 den found Ebelk Aiznai with small and large traces nearby

1/4/86 traces found Serini

2/4/86 traces found Gibene

3/4/86 many traces found Tidra

6/4/86 1 at 12 m distance from observer, NW part Baie d'Aouatif

9/4/86 many traces as well as dens found Tidra

12/4/86 1 W part Baie d'Arguin; 1 Ebelk Aiznai

13/4/86 traces found at Tidra and Niroumi

16/4/86 1 following the waters edge near the camp; 1 Ebelk Aiznai

17/4/86 1 Baie d'Arguin, site 3 walking in direction Ebelk Aiznai

20/4/86 1 sleeping Tivide

21/4/86 1 NW part Baie d'Arguin

24/4/86 1 Ebelk Aiznai

Felis sylvestris sarda African wild cat Chat sauvage d'Afrique

19/4/85 1 close to the mist nets Ebelk Aiznai

1/5/85 1 Ile d'Arguin

Gazella dorcas Dorcas Gazelle Gazelle dorcas

25/2/86 traces found Tivide

13/4/86 1 male and 1 female Tivide

20/4/86 2 males found dead S of Tivide

Tursiops truncatus Bottlenose Dolphin Grand Dauphin

20/3/85 20-30 during crossing Baie de Lévrier

2/5/85 10-20 during crossing Baie de Lévrier

5/2/86 some tens during crossing Baie de Lévrier

2/3/86 1 in channel next to the camp

4/3/86 1 in channel next to the camp

18/3/86 1 in channel next to the camp

18/3/86 1 found dead Tivide, measuring 299 cm, 43 cm from eye-breathing hole, 22 teeth in upper jaw and 21 in lower jaw

4/4/86 1 NE Arel

9/4/86 1 Arel

13/4/86 1 between Nair and Tidra

24/4/86 10-20 area around Cap Tafarit, 5 Ile d'Arguin

25/4/86 5 Baie de Lévrier

Sousa teuszi Camerun River Dolphin Dauphin Guinée

5/4/85 1 in the channel next to the camp

30/3/85 1 landed at Iouik, captured by Sénégalese fishermen, length 269 cm, 30 teeth in upper and 28 in lower jaw (many more measures taken)

1/4/85 1 Arel

26/4/85 1 in the channel next to the camp

8-9/2/86 1-2 central part Baie d'Arguin

15/2/86 10-15 passing twice in channel next to the camp, swimming up and down

25/2/86 1 in channel next to the camp

3/3/86 1 in channel next to the camp

15/3/86 1 in channel next to the camp

17/3/86 1 S of Iouik

20/3/86 1 in channel next to the camp; 21 near Kiji, swimming in NW direction

22/3/86 2 in channel next to the camp

24/3/86 20-30 NW Kiji

25/3/86 1 beached Reguïba, length 282 cm, tail width 59 cm, 29 teeth in upper and 28 in lower jaw

2/4/86 1 Tivide; 1 Gibene

4/4/86 1-2 N Niroumi

6/4/86 1 between Timye and Tenvaddir

8/4/86 5-10 NE Arel

9/4/86 3 Arel; 1 found dead (for several months) N part Tidra, lenght 219 cm, tail width 56 cm, 30 teeth in upper and 28 in lower jaw

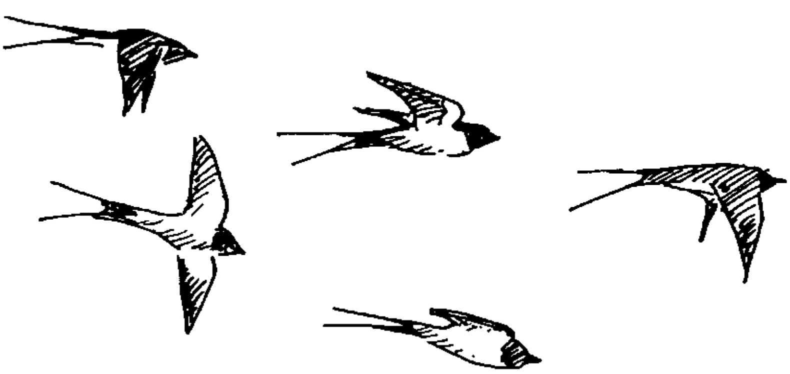
11/4/86 1 NW Arel; 5 E Arel

13/4/86 2 W Arel

17/4/86 2 W Nair

17/4/86 10 near Nair swimming in direction Arel

19/4/86 1 in channel next to the camp



11. TIME BUDGET OF WADERS

Anne-Marie Blomert and Roelof Hupkes

11.1 Introduction

Before waders wintering on the Banc d'Arguin can migrate to their northern breeding grounds, they have to increase in weight. The extra energy can be gained in three ways:

1. Increase in total foraging time.
2. Increase in the intake rate during foraging.
3. Decrease in the overall expenditure of energy.

It is hard to imagine a way in which the waders could achieve the last possibility. There are two routes to the second option. Either the waders work harder to obtain more food per unit feeding time, as shown for oystercatcher when feeding time was experimentally limited (Swennen et al., in prep.), or the availability of the food increases in the course of the season (chapter 14). Here we investigate the possibility that the waders increase the time spent on foraging.

11.2 Methods

In 1985 a pilot study was undertaken on the mudflat just opposite the camp site. A hide was erected on 2 m of scaffolding. Five sites measuring 50 by 50 m^2 and as 'homogeneous' as possible were pegged out with stakes. Observations were carried out on 1, 8, 14, 22 and 26 April during daylight. Every half hour all birds feeding in the sites were counted and their activity scored as foraging, sleeping or preening. When time allowed the data were supplemented by recording the activity of as many birds as possible outside the study area. For species with a well defined summer plumage it was noted how far body moult had progressed.

In 1986 two hides were erected to the north of the camp site. The first overlooked a marked area of 5 ha. From 14 February to 21 April observations took place almost daily, following the same methodology as in 1985. The other hide was occupied once a week during two consecutive low-tide periods. One week a complete daytime low-water period was followed by a complete nighttime low-water period, while the other week a half light, half dark period was followed by a half dark, half light period. In daytime an area of 6.7 ha was covered, compared to an area of 2.5 ha during the night, due to the limited visual range of the infrared night-scope.

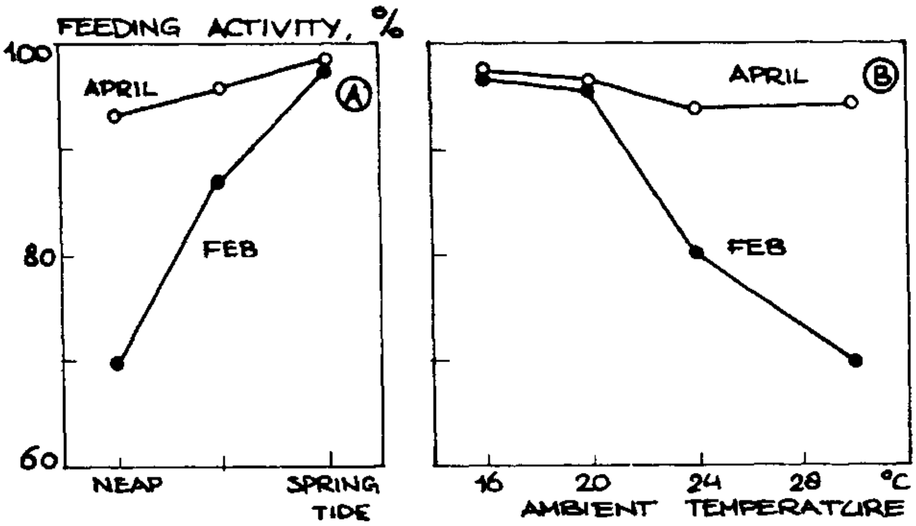


Figure 11.1. a Average feeding activity of Dunlin during neap and spring tides and intermediate tides in February and April 1986; b Average feeding activity of Dunlin at different temperatures given apart for February and April.

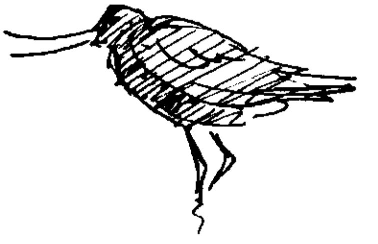
11.3 **Results and conclusions**

Daytime feeding activities were high in 1985 and 1986 and comparable to January 1980 (Altenburg et al. 1982). Waders in moult spent more time on feeding than individuals in winter plumage. This could be due to the fact that many juveniles neither moult to summer plumage nor build up large fat reserves for migration, or do so rather late in the season (chapter 9). Large flocks of preening and sleeping birds were seen outside the counting areas during neap tides in February and March: hence the feeding activity was much lower on neap tides compared to other tides in the same period, the absence of such flocks in April suggests an increase in overall feeding time (Fig. 11.1a). Increased feeding activity in the course of the season was also suggested by an increased density of waders in the counting area.

Not all waders present in daytime showed up at night. The presence of some species was closely correlated with the intensity of moonlight. During the night feeding activity was always close to 100%. However, the density of feeding birds increased notably in the course of the season (Fig. 11.2). Probably, the increase in nighttime feeding contributed more to the increase in overall feeding time than the slight increase in daytime feeding.

On hot days feeding activity was lowered, but this effect disappears in the course of the season (Fig. 11.1b).

Theoretically it should be possible to combine the data on gross energy intake (chapter 13 and 14) and the data on extra energy needed to gain weight (chapter 12) to calculate whether the weight increase in spring (appendix) corresponds to the observed increase in foraging time. As the data stands, there are too many complications to make the calculation feasible.

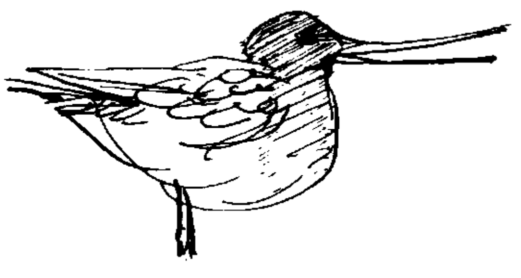


12. WADER ENERGETICS

Marcel Klaassen

12.1 Heat stress on the roost

During the 1986-expedition the possible load of heat stress on roosting waders was investigated. Experiments with a Bar-tailed Godwit mount and behavioural observations on Bar-tailed Godwits, Dunlins and Kentish Plovers, were conducted at the high water roosts. The mount experiments showed that laying birds encounter higher environmental temperatures than standing birds. Heat stress cannot be an acute problem on the high water roosts as many birds were found laying, or standing on one leg with tucked bills. The finding that roosting birds are not suffering from heat stress, cannot implicitly be extrapolated to foraging waders.



12.2 Is salt stress a problem for waders wintering on the Banc d'Arguin?

Many wader species have to deal with great environmental changes during their annual cycle. They breed in the arctic and sub-arctic while they spend the winter under the tropical sun. For many of them it is also the time of the year in which they are completely restricted to salt water. The salt loads upon the waders may possibly limit their energy expenditure. A possible consequence of such a limit, would be a reduced speed of food gathering and consequent reduction in the rate of weight gain for migration. Heat stressed birds need increasing amounts of water for evaporative heat loss. It is therefore conceivable that in warm and salt environments the combination of salt and heat loads increasingly stress the birds.

During the 1986-expedition the possible load of salt upon some wintering waders, was investigated. Knots and Sanderlings were used in cage experiments in which water and food consumption were measured under different salt regimes. Food consumption decreased and water consumption increased after changing the water provided from fresh to salt. Experiments in which salt water was provided to Knots over a longer time scale revealed that Knots have a very high tolerance and capability of adaption to salt water. It is calculated that at a maximum food intake level of isotonic prey items, the Knot may not have great difficulties with the salt load. The situation may be wholly different for species which are physiologically less well adapted, like the Sanderling. Evaporative cooling in heat stressed birds might increase salt stress. A negative correlation between ambient temperature and food consumption was found when salt water was provided. However, this relation found is probably due to the increased salinity of the drinking water at high ambient temperatures, and not to increased water demand for evaporative cooling. The birds also did not avoid the extra endogenous heat production associated with food intake during the warmest parts of the day. Nevertheless, field observations suggest some heat and/or salt stress in foraging waders at days with high ambient temperatures. However, during fat deposition, necessitating a higher foraging intensity, the maximum temperatures at the Banc d'Arguin are generally moderate.

12.3 **Energetic cost of weight gain**

To evaluate the extent to which the premigratory weight gain forms a heavy burden for the waders preparing to migrate from the Banc d'Arguin in spring, cage experiments were conducted to measure the extra food needed to gain weight. In 1985 seven Turnstones were kept in captivity from 30 March to 30 April. In 1986 twelve Knots and five Sanderlings were kept in captivity from 7 March to 22 April. All birds were provided with fresh water ad libitum and a commercial feeder. At regular intervals (varying from 2 to 5 days depending on the species) all birds were weighed and food consumption over the interval was measured. These data allowed a plot relating daily food consumption to daily weight change. As

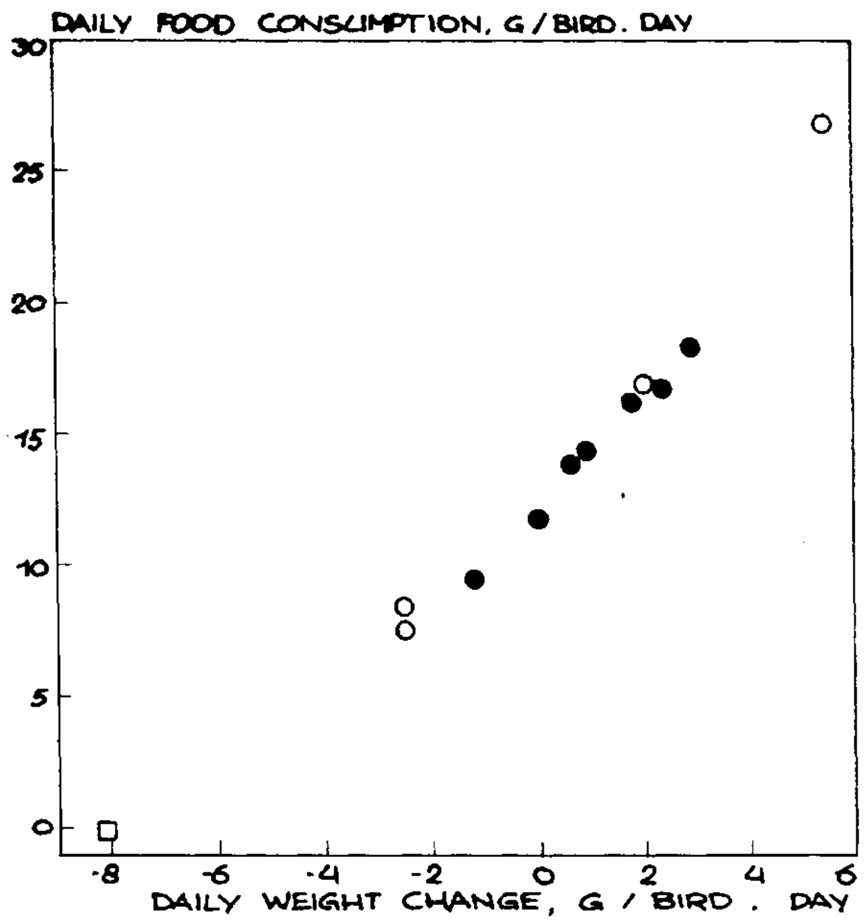
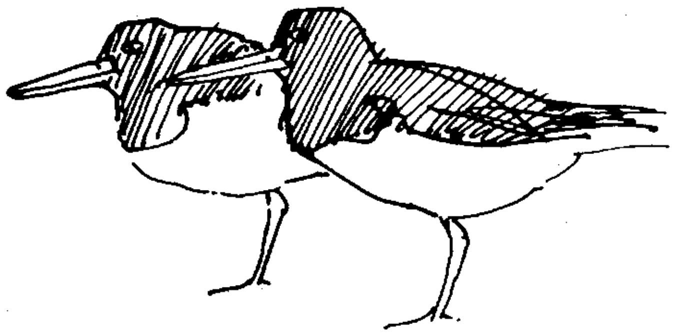


Figure 12.3.1 Daily food consumption (gram pelsifood per Turnstone per day) as a function of daily weight change (gram body weight per Turnstone per day). Closed dots refer to group means, and the open dots to data points for individuals when food was provided ad libitum. The open square reports the average weight loss when the food was taken away for a day.

an example the data for Turnstones are shown in figure 12.3.1. The intercept of the line can be interpreted as the energy needed to stay alive in the cage (MMR=Maintenance Metabolic Rate), whereas the slope presents a measure of the food needed to gain 1 gram in weight. To convert these gross intake rates into assimilated energy, assimilation efficiences have to be known, which were only measured in 1986 using chromium oxide as a marker in the food and excreta (Table 12.3.1). Assimilation efficiences reported from studies on waders in temperate climates on the same diet as used in the Turnstone experiments tend to vary around 85% (Kersten & Piersma 1987). Estimates for the cost of gaining weight under temperate conditions range between 25 and 51 kJ per gram body weight (calculated from table 4 in Kersten & Piersma (1987). The estimates of our experiments are of the same magnitude (Table 12.3.1). Cost of gaining weight is highest for Turnstones. They were also the only species that reached departure weights during experiments. At least in Knots rapid accumulation of fat (the most costly in terms of energy needed to gain 1 gram in body weight) seems to start only beyond a specific body weight before which only water-rich (70%) protein is stored (chapter 8). Hence the insert data on Turnstone probably provide the best estimate for the cost of gaining weight. The Banc d'Arguin maybe a good place to accumulate fat reserves for migration due to the low energy costs for thermoregulation, although salt stress might cause problems (see chapter 12.2.). Clearly, more data are needed on the relationship between assimilation efficiency and ambient temperature and experiments should be carried out for more natural conditions (salt water and natural food).

Table 12.3.1. Assimilation efficiences (not measured in Turnstones: two assumed values are presented), mean metabolic rates (MMR in kJ per bird per day) and energetic cost of weight gain (ew in kJ per gram body weight) for captive Sanderlings, Knots and Turnstones.

	Assimilation efficiences	MMR	ew	
Sanderling	0.62 (n= 1)	89	21.5	(r=0.921, n=15)
Knot	0.70 (n=12)	181	25.6	(r=0.869, n=76)
Turnstone	0.85 (-)	235	40.7	(r=0.996, n= 7)



13. FORAGING OYSTERCATCHERS ON THE BANC D'ARGUIN

C. Swennen

All data for this study were collected from 7 to 28 February 1986. Flocks of Oystercatchers Haematopus o. ostralegus were only seen foraging on beds of the Bloody Cockle Anadara senilis that were present on intertidal flats in and around the Baie d'Aouatif (Banc d'Arguin). A few single birds, that were probably ill, were observed at other sites (beach of Iouik, harbour of Nouadhibou).

Although some Oystercatchers flew from their high water roosts to the emerging tidal flats at the same time as the other waders, the majority departed later in the tidal cycle. In contrast with what was observed in most other waders present, the Oystercatcher show no intensified feeding in the beginning and at the end of the low tide period.

Detailed feeding observations were conducted from an elevated hide on an intertidal flat at the Baie d'Aouatif. It could be established that adults fed on A. senilis. Juveniles appeared to be less specialized and took other prey species as well.

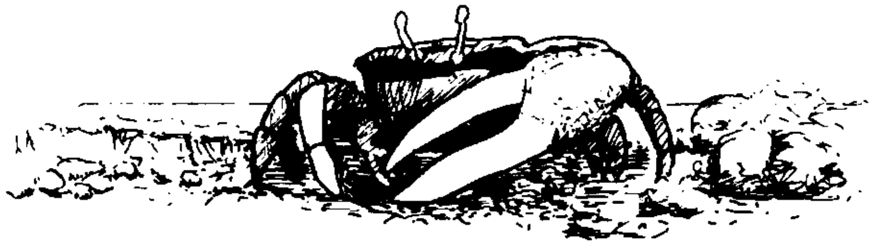
Oystercatchers obviously located most of their prey by eye while walking slowly. They always opened the bivalve by stabbing. Stabbing movements seemed to be directed to the frontal-ventral side, which is rather deep in the sediment. Undisturbed handling times were about 3.5 min on average. The first part of a handling episode from having located the prey to swallowing the first parcel of flesh, took on average 69 sec, and the last part 143 sec. The maximum undisturbed handling time lasted 570 sec (9.5 min). It did not become clear how the birds were able to open shells without damaging their bill. The handling could not be imitated by the author with living individuals of A. senilis. The metal bill-model was always trapped between the very solid valves of the animals within 20 sec from the moment that the flesh was touched between somewhat gaping valves.

On average the Oystercatchers opened 1.6 A. senilis per hour. This represents 5.3 g ash-free dry weight (ADW) of flesh. Because of kleptoparasitism, the real consumption was estimated at only 2.9 g ADW of flesh per hour. No differences were found between number of cockles opened per hour during low water in day time and low water during nights with moonlight. Total real consumption could be estimated at 19.2 g ADW of flesh per low water period at daytime.

The main kleptoparasites were: Lesser Black-backed Gulls Larus fuscus and Slender-billed Gulls Larus genei. Usually after the bivalve had been abandoned by the Oystercatcher or a kleptoparasite, a Turnstone Arenaria interpres or a Curlew Sandpiper Calidris ferruginea came to inspect the area for pieces that might have been lost by the larger birds. During diurnal low water some Grey Plover Pluvialis squatarola behaved as Turnstones, being satellites of some feeding Oystercatchers, without really kleptoparasitizing (i.e. overtaking the whole prey). During the night, however, Grey Plovers behaved successfully as kleptoparasites. The gulls were also present on the flat at night, but remained rather inactive.

The mean density of foraging Oystercatchers on the studied flat was about 4.9 per ha. Bloody Cockle densities varied between 5 and 48 cockles per m^2, with shells varying in length between 50 and 91 mm. The emptied shells of freshly eaten cockles were easy to locate. It appeared that the Oystercatcher did not select for shell size when feeding.

The gulls and the other waders were unable to open an A. senilis by themselves. Even when an Oystercatcher had opened an Anadara, they usually had to wait until the Oystercatcher had taken a piece of flesh in its bill. The narrow slit between the valves could not be opened wide and therefore the bills of gulls and small waders were usually unable to reach the flesh of the mollusc. The cockles eaten by the Oystercatchers in Mauritania must be the largest prey taken by any wader in the world: the total fresh weight of the bivalves varied between 150 and 509 g. The largest shells had about the same weight as the birds! Due to the heavy kleptoparasitism, Oystercatchers had to open about twice as much shells than they needed for their own food.



14. FEEDING BEHAVIOUR OF WHIMBREL AND ANTI-PREDATOR BEHAVIOUR OF ITS MAIN PREY, THE FIDDLER CRAB UCA TANGERI

Leo Zwarts and Sjoerd Dirksen

14.1 Introduction

The primary aim of this part of the project was to arrive at an estimate of the daily gross energy intake of at least one wader species under the tropical conditions of the Banc d'Arguin. Through extrapolation the result could then be used to estimate the food consumption of other wader species. A pilot study in 1985 revealed that Whimbrel preying on fiddler crabs are not only well suited to make field estimates of food intake, but also extremely well suited to make a much more fundamental investigation of the relationship between predator and prey.

14.2 Methods

A continuous record of the feeding behaviour of one Whimbrel was made (when possible throughout the whole tidal cycle) from a hide on top of 5 m of scaffolding located in the NW-corner of the Baie d'Aouatif. A total of 200 hours of observations were collected on three individuals defending a territory on the beach and adjacent muddy Zostera flats.

The surface activity of Uca was measured in three ways:

- regular counts with a telescope of Uca present in 13 plots of 4 m^2.
- counts of burrows in 76 plots of 1 or 4 m^2; the burrow diameters were measured to estimate the size frequency distribution (Zwarts 1985).
- recording the activity of Uca with a film and photo camera mounted on a tripod; pictures were made at regular intervals during the entire low water period.

14.3 Prey choice Whimbrel

Whimbrels on the Banc d'Arguin selected three prey species: Uca, 'Pilumnus' and Callinectes (all crabs). A total of 934 crabs were taken by the three individuals studied: 83.4% Uca, 15.6% 'Pilumnus' and 0.7% Callinectes.

Whimbrels fed on the beach if Uca were present there, but switched to the Zostera area to search for 'Pilumnus' if no or only a few Uca were found on the beach.

Small Uca were ignored, even though they were very common. Most Uca taken had a carapax width of 15-20 mm. The selection for a large prey was less pronounced in 'Pilumnus': 58% of these prey had a carapax width of less than 10 mm.

Uca of 15-20 mm live in burrows that are too deep for a probing Whimbrel. Therefore, all Uca were taken when present on the surface or when leaving their burrows.

14.4 Total food intake Whimbrel

The density of Uca on the surface had a large effect on the food intake of a Whimbrel. The intake on the beach was maximal if the Uca density was high and minimal if most Uca remained in their burrow. Only then the Whimbrel switched to the Zostera area, where food intake was low too.

When Uca were present on the beach the maximal food intake was not limited apparently, by the numerical density of Uca. After eating 3-5 large crabs, the bird always took a pause, suggesting a digestive bottleneck. Thus the total food intake mainly depended on the presence or absence of Uca on the surface.

The surface activity of Uca seemed to be determined by the following variables:

- time within the tidal cycle: no Uca was ever observed outside its burrows during the 5 hours around high water.
- temperature: no Uca appeared on the surface when air temperature was 17°C or less.
- water level at previous high tide. The effect was limited for the small Uca living on the lower part of the beach, but very pronounced for the large Uca having their burrows high up on the beach. These large Uca appeared on the surface during spring tide low water periods only.

Besides high water, all cold periods (the greater part of the nights and early mornings) and neap tides were times when the Whimbrels could obtain little food. Despite a large variation in the food intake from one low water period to the next, a gradual increase from February to April was apparent. This was due to temperatures of 17°C and less, occurring less often late in the season. The premigratory weight increase of the Whimbrel may thus be attributed to the effect of temperature on the availability of its main prey.

14.5 Prey availability

It would be too simple to equate 'prey availability' to 'density of Uca on the surface'. Special attention was paid therefore to the way Uca minimize the risk of being taken by a bird:

- how far do foraging Uca move from their safe burrows?
- what is its burst speed when taking flight to its burrows? The positive correlation between burst speed and temperature may explain why Uca do not leave their burrows at low temperature.
- at what distances from an approaching predator start the escape?
- how long do Uca remain in their burrows following a disturbance?

When the escape behaviour of Uca is compared to the feeding capabilities of Whimbrel (like its maximal running speed) it is clear that Whimbrel have to work hard to find enough prey if the Uca remain in their burrowing zone. The situation is completely different if the crabs leave their burrowing zone in very large herds to feed elsewhere. This occurred during 1 to 4 low water periods per fortnight.

Thus to understand the availability of Uca we must understand their willingness to take risks. It remains to be shown that Uca only accept high risks when potential benefits are high too.

15. LIST OF MARINE PHANEROGAMS, MOLLUSCS, POLYCHAETES AND CRUSTACEA OBSERVED ALIVE AT THE BANC D'ARGUIN IN 1985 AND/OR 1986

Wim J. Wolff

15.1 Aquatic phanerogams

The following species of aquatic phanerogams (identifications Prof. Dr. C. den Hartog) were observed at the Banc d'Arguin during our studies:

Zostera noltii;

Cymodocea nodosa;

Halodule wrightii.

15.2 Molluscs

Only species observed alive or recently dead have been listed below. Nomenclature is in most cases according to Nordsieck (1968, 1969), but the names used by Nicklès (1950) are given in brackets if different. The numbers denote our sampling sites (Fig. 21.1).

Jujubinus striatus (Linné) (Calliostoma striatum).
Samples: 52, 109
Beach of Iouik

Gibbula candei (d'Orbigny) (Gibbula umbilicalis)
Samples: 68, 151, 170. Near samples: 84, 93, 176, 178.

Monodonta lineata (da Costa) (Monodonta colubrina)
Living in the tidal zone of the rocky shore of Kiaone.
Altenburg et al. (1982) record Monodonta lineata and M. cf. articulata Lam. from Kiaone.

Tricolia pullus (Linné)
Samples: 53, 69, 192.
Beach of Iouik

Peringia ulvae (Pennant) (Hydrobia ulvae)
Samples: 11, 31, 49, 69, 90, 115, 126, 152, 154, 187, 194, 226.
Beach of Iouik.
Altenburg et al. (1982) found the species near Arel, Iouik and Kiji.

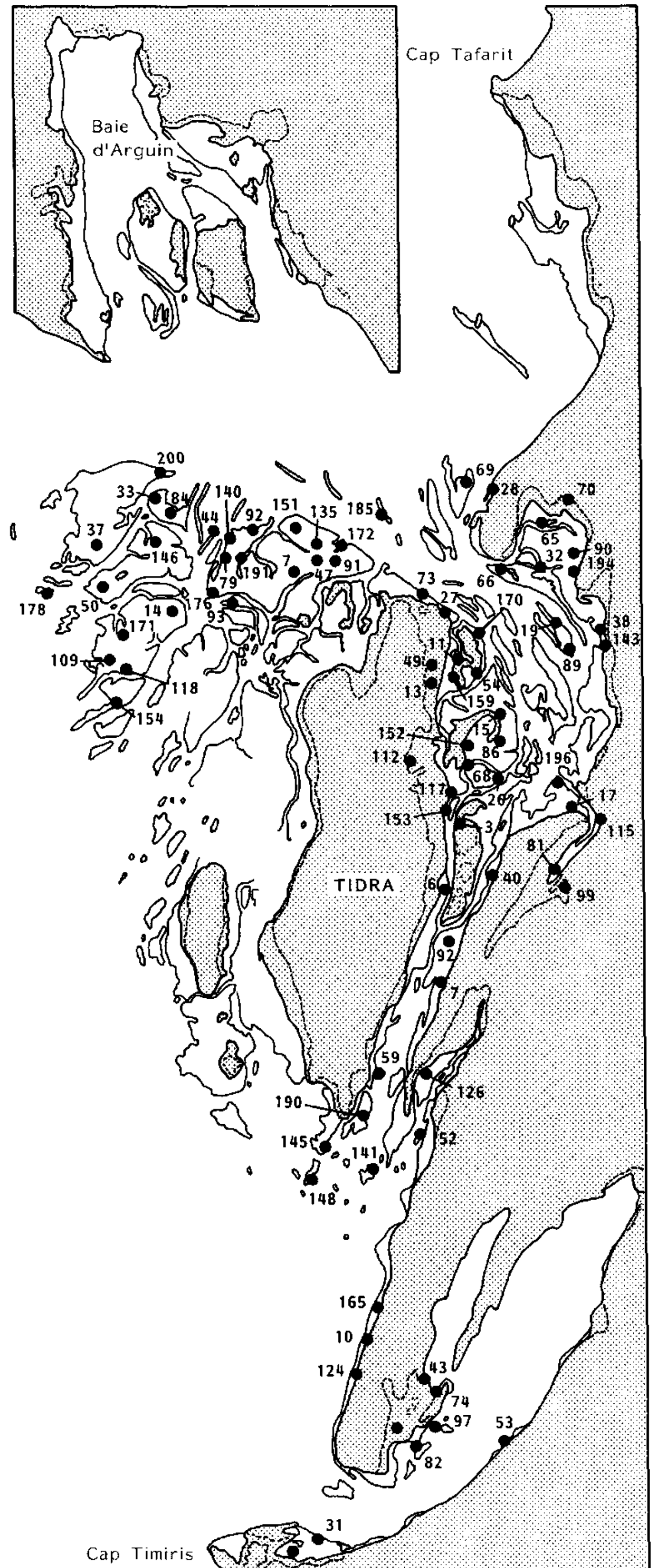


Fig. 21.1. Localities at the tidal flats where bentic fauna sampels were taken in 1986.

Mesalia brevialis (Lamarck) (Turritella torulosa)
Samples: 13, 31, 36, 40, 53, 82, 126, 153, 170, 194, 226.
Common on tidal flats.

Bittium reticulatum (da Costa)
Samples: 28, 69, 148, 185
Altenburg et al. (1982) found Bittium near Iouik and Arel.

Calyptraea chinensis (Linné)
Samples: 53
Beach of Iouik

Crepidula porcellana Lamarck
Samples: 37, 47, 54, 79, 84, 93, 109, 118, 135, 146, 148, 170.
Beach of Iouik.
Common on shells of Anadara senilis and epibenthic gastropods. Altenburg et al. (1982) found the species near Iouik and Kiji (as C. goreensis)

Nacca fulminea (Gmelin) (Natica fulminea)
Baie d'Aouatif; Beach of Iouik.
Altenburg et al. (1982) found the species at the beach of Iouik.

Murex cornutus Linné
In the main channel of the Baie d'Aouatif.

Columbella rustica (Linné)
Samples: 47, 52, 57, 79, 84, 109, 118, 141, 146, 171, 176.
Beach of Iouik.

Cantharus dorbignyi (Payraudeau) (Pisania d'orbignyi)
Samples: 118, 140, 141, 148.

Semifusus morio (Linné)
Near samples 69, 185, 200.

Hinia miga (Bruguière) (Nassa miga)
Samples: 3, 36, 40, 52, 57, 69, 79, 109, 118, 148, 190.
Beach of Iouik

Amyclina pfeifferi Philippi
Samples: 13, 27, 93, 126, 226.
Beach of Iouik
Altenburg et al. (1982) found *A. pfeifferi* near Chikchitt, Cheddid and South Tidra

Cymbium cymbium (Linné)
Altenburg et al. (1982) record *Cymbium cymbium* (Linné) near Iouik and Nair.
We observed it at several places in the vicinity of Iouik and in the Baie d'Aouatif.

Persicula cingulata (Dillwyn)
Samples: 37, 90
Beach of Iouik

Persicula chudeaui Bavay
Samples: 28, 109

Prunum amygdalum (Kiener) (Marginella amygdala)
Samples: 14, 27, 28, 31, 79, 146, 151, 159, 170, 185, 192.
Beach of Iouik.
Altenburg et al. (1982) found *Prunum amygdalum* near Chikchitt and Cheddid

Clavatula bimarginata (Lamarck)
Samples: 37, 52, 57, 79, 82, 90, 93, 109, 118, 146, 151, 166, 171, 172, 176.
Beach of Iouik
Altenburg et al. (1982): near Chikchitt and South Tidra.

Conus papilionaceus Bruguière (Conus papilionaceus Hwass)
Near samples 84, 93, 175, 176, 185.
Altenburg et al. (1982) record *Conus pulcher papilionaceus* Hwass from the mudflats near Arel, Iouik, Kiji and S. Tidra

Conus genuanus Hwass
Samples: 26, 52, 118, 135, 146, 170
Altenburg et al. (1982) record apparently the same species as *Conus*

guinaicus Hwass from the mudflats near Arel, Iouik, Kiji and Cheddid.

Bullaria adansoni Philippi
Samples: 166, 170, 172
Beach of Iouik

Haminea elegans
Samples: 118

Haminea orbignyana Férussac
Samples: 11, 28, 36, 89, 135, 178, 191.
Beach of Iouik. Altenburg et al. (1982) record Haminea cf. orbignyana from between eelgrass near Chikchitt and South Tidra.

Cylichna grimaldi Dautzenberg
Beach of Iouik

Dentalium senegalense Dautzenberg
Beach of Iouik

Nucula turgida (Winckworth) (Nucula nitida)
Samples: 68
Beach of Iouik

Arca afra Gmelin
Samples: 6, 143

Anadara senilis (Linné)
Samples: 6, 11, 17, 19, 26, 32, 36, 47, 54, 81, 135, 143, 159, 166, 170.
Very common at the nearshore tidal flats of the Banc d'Arguin, where Altenburg et al. (1982) also found it plentiful.

Crenella decussata dollfusi Dautzenberg (Crenella dollfusi)
Samples: 6, 40, 159.
Beach of Iouik

Linga columbella (Lamarck) (Phacoides adansoni d'Orbigny)
Beach of Iouik

Altenburg et al. (1982) found Linga adansoni (d'Orbigny) alive near Arel.

Loripes lacteus (Linné)
Samples: 3, 14, 17, 19, 26, 27, 28, 31, 33, 36, 37, 40, 47, 50, 52, 53, 57, 59, 69, 79, 81, 82, 89, 90, 93, 109, 118, 135, 141, 143, 145, 146, 147, 148, 151, 154, 166, 170, 171, 172, 176, 178, 190, 191, 192.
Very common in all tidal flats. Also Altenburg et al. (1982) found this species living at all sites apart from Chikchitt.

Pythina mactroides Hanley
Samples: 6

Cerastoderma edule (Linné)
Samples: 31, 53, 126.

Dosinia lupinus (Poli)
Samples: 126
Beach of Iouik?

Venus verrucosa Linné
Near samples: 44, 200

Tagelus angulatus (Sowerby)
Baie d'Aouatif; Beach of Iouik.
Altenburg et al. (1982) mention T. angulatus from the Baie d'Aouatif; freshly dead specimens near Iouik.

Abra tenuis (Montagu)
Samples: 13, 17, 19, 27, 53, 57, 68, 79, 81, 82, 84, 92, 126, 135, 140, 148, 152, 154, 166, 171, 176, 178, 190, 192, 196, 226.
Common at all sites according to Altenburg et al. (1982)

Gastrana matadoa (Gmelin)
Baie d'Aouatif; recently dead.

Solen marginatus (Pennant)
Beach d'Iouik

Aloides laticosta (Ed. Lamy)
Samples: 6, 159.

Other species recorded by Altenburg et al. (1982) and Piersma & Molenbeek (1982) are: Smaragdia viridis, Truncatella subcyclindrica, Rissoa cf. membranacea, Terebra senegalensis, Strigatella zebrina, Bursatella leachi, Siphonaria pectinata, Solemya togata, and Dosinia hepatica, Of these Smaragdia, Truncatella, Rissoa and Siphonaria originated from rocky shores, a biotope hardly investigated by us, whereas Solemya was found in the stomach of a fish.

15.3 Polychaetes and Oligochaetes

Eteone longa (Fabricius)
Beach of Iouik

Anaitides mucosa (Oersted)
Samples: 36

Eumida sanguinea (Oersted)
Samples: 47, 118, 166, 170

Typosyllis armillaris (O.F. Müller)
Samples: 3, 6, 26, 59, 69, 143, 150, 159, 191, 192, 194, 225, 226

Exogone verugera (Claparède)
Samples: 68

Perinereis cultrifera (Grube)
Samples: 6, 14, 33, 36, 37, 44, 47, 53, 73, 81, 90, 93, 118, 135, 191, 194, 196, 200, 226

Nereis falsa
Samples: 53, 68, 73

Nereis caudata (Delle Chiaje)
Samples: 44, 49, 50, 52, 54, 90, 135, 170, 196, 226

Nereis spec.
Samples: 13, 14, 26, 27, 36, 37, 90, 140, 146, 151, 154, 159, 170, 175

Nephtys spec.
Samples: 32

Glycera alba (O.F. Müller)
Samples: 28, 185

Glycera rouxi (Audouin & Milne-Edwards)
Samples: 28, 69, 151

Glycinde nordmanni (Malmgren)
Beach of Iouik

Onuphis eremita
Samples: 28

Diopatra neapolitana
Samples: 3, 6, 11, 17, 31, 36, 73, 79, 90, 135, 143, 145, 150, 153, 159, 175, 191, 192, 194, 200, 226

Marphysa sanguinea (Montagu)
Samples: 6, 11, 14, 17, 19, 26, 28, 32, 33, 36, 50, 59, 90, 93, 118, 140, 141, 143, 145, 146, 151, 166, 170, 176, 190, 192, 194, 196

Nematonereis unicornis
Samples: 6, 73

Lumbrineris spec.
Samples: 33, 40, 73, 140, 143, 151, 172, 178, 191, 192, 194

Arabella mutans
Samples: 6, 31, 32, 44, 146, 175, 178, 191, 192, 200

Driloneris filum (Claparède)
Samples: 3

Naineris laevigata

Samples: 3, 6, 11, 14, 17, 26, 28, 36, 43, 47, 54, 59, 65, 69, 81, 82, 84, 90, 93, 118, 135, 140, 143, 145, 153, 166, 170, 171, 175, 176, 178, 185, 190, 191, 192, 196

Scoloplos capensis

Samples: 6, 11, 17, 26, 28, 31, 32, 36, 50, 53, 82, 118, 145, 147, 153, 159, 176, 185, 194, 226

Scoloplos chevallieri

Samples: 6, 11, 26, 31, 36, 53, 82, 90, 135, 145, 146, 159, 166, 175, 192, 226

Polydora antennata (Claparède)

Samples: 6, 26, 27, 49, 68, 140, 226

Prionospio malmgreni (Claparède)

Samples: 28

Aricidea fauveli

Samples: 6, 36, 73, 79, 90, 153, 175

Aricidea longobranchiata

Samples: 73, 89, 185

Cirriformia tentaculata (Montagu)

Samples: 3, 26, 32, 47, 49, 57, 59, 69, 79, 81, 109, 140, 143, 145, 171, 172, 176, 185, 192, 226

Scolelepis squamata (Müller)

Samples: 28

Tharyx marioni (Saint-Joseph)

Samples: 6, 28, 89, 90, 145, 153, 154, 159

Armandia intermedia

Samples: 36, 73, 153, 191

Capitellidae spec.
Samples: 17

Capitella capitata (Fabricius)
Samples: 3, 6, 13, 26, 27, 31, 32, 49, 53, 68, 79, 81, 90, 109, 115, 118, 124, 126, 143, 145, 147, 152, 154, 159, 165, 171, 175, 178, 190, 226

Heteromastus filiformis (Claparède)
Samples: 6, 11, 19, 27, 47, 49, 68, 69, 79, 90, 92, 93, 135, 140, 141, 145, 146, 148, 153, 154, 159, 166, 172, 185, 191, 192

Arenicolidae spec.
Samples: 109

Euclymene oerstedi (Claparède)
Samples: 3, 6, 11, 13, 14, 17, 26, 28, 31, 32, 36, 37, 40, 47, 49, 50, 52, 53, 54, 65, 69, 73, 82, 90, 93, 109, 118, 135, 140, 141, 145, 147, 148, 151, 153, 154, 159, 166, 170, 171, 175, 176, 185, 192, 194, 196, 200, 226

Petaloproctus terricola
Samples: 6, 11, 13, 14, 17, 32, 36, 40, 47, 65, 73, 82, 90, 140, 143, 145, 146, 159, 191, 192, 194, 196, 200

Isolda whydahaensis
Samples: 28

Pista spec. cf. cristata (O.F. Müller)
Samples: 90, 140, 151, 200

Terebella lapidaria
11, 36, 59, 65, 82, 90, 153, 154, 194, 196, 200

Polycirrus aurantiacus (Grube)
Samples: 3, 11, 59, 69, 82, 89, 118, 145, 192

Hypsicomus spec.
Samples: 11, 36, 143

Sabellidae spec.
Beach of Iouik

Bhawania goodei
Samples: 159

Polynoinae spec.
Samples: 59

Jasmineira elegans (Saint-Joseph)
Samples: 79, 153

Fabricia sabella (Ehrenberg)
Samples: 147, 176

Oligochaeta spec.
Samples: 6, 13, 26, 27, 37, 49, 68, 79, 82, 109, 140, 147, 152, 154, 175, 196, 226

Pontodrilus litoralis
Samples: 10

Polychaeten ondetermineerbaar
Samples: 17, 19, 31, 36, 47, 52, 54, 59, 69, 89, 90, 126, 135, 141, 143, 145, 170, 176, 190, 194, 226.

Sipinculida spec.
Samples: 6, 11, 26, 33, 40, 90, 140, 153, 159, 170, 176, 194, 200

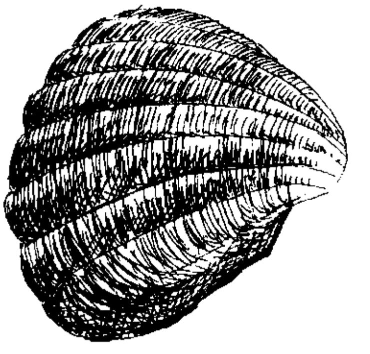
Nemertinea spec.
Samples: 28, 44, 147, 154, 185

Nematoda spec.
Samples: 73, 147

Other species recorded by Altenburg et al. (1982) are:

Ehlersia cornuta	)
Spionidae spec.	) found in samples from muddy *Zostera*
Clymeninae spec.	)

Perinereis oliveira	)
Scolaricia typica	) found in samples from sandy biotopes like
Scoloplos madagascariensis	) beaches



16. DISTRIBUTION, BIOMASS, RECRUITMENT AND PRODUCTIVITY OF ANADARA SENILIS

Wim J. Wolff, Abou Gueye, André Meijboom, Theunis Piersma
and Mamadou Alassane Sall

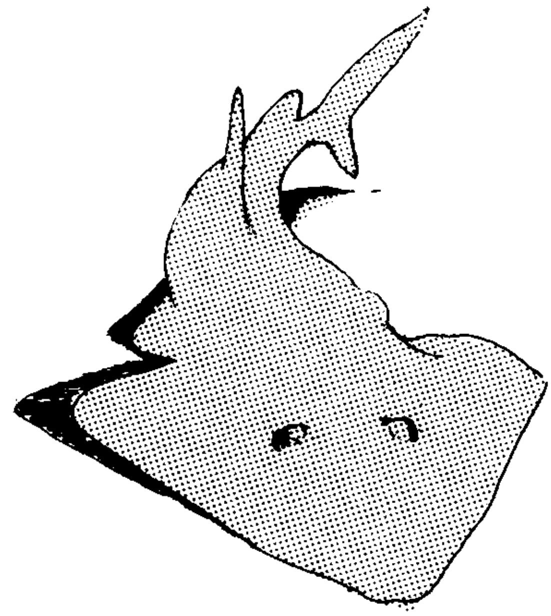
The West African bloody cockle Anadara senilis (L.) (also known as Arca senilis) occurs from the former Rio de Oro in the north to Angola in the south (Nicklès 1950). Little is known about its ecology. Yonge (1955) presents a short account of its habits. Yoloye (1976) gives data on distribution and ecology of the species in Ghana and Nigeria. Gjangmah et al. (1979) give some physiological data on tolerance of low salinities.

Altenburg et al. (1982) encountered the species in large numbers on the tidal flats of the Banc d'Arguin in Mauritania. In their samples from different localities on the Banc d'Arguin A. senilis had an average biomass of 4.7 g ash-free dry weight per m^2, thus accounting for about 60% of the total biomass of all macrobenthis animals living on the tidal flats.

Hence we paid special attention to this species during the project Banc d'Arguin 1985-86.

Data on distribution, ecology, biomass, recruitment, growth, mortality and productivity of the West African bloody cockle Anadara senilis were collected at the Banc d'Arguin, Mauritania, in early 1985 and 1986. Ash-free dry weight appeared to be correlated best with shell height. A. senilis was abundant on the tidal flats of landlocked coastal bays, but nearly absent on the tidal flats bordering the open sea. The average biomass for the entire area of tidal flats was estimated at 5.5 $g.m^{-2}$ ash-free dry weight. The *A. senilis* population appeared to consist mainly of 10 to 20-year-old individuals, showing a very slow growth and a production : biomass ratio of about 0.02 y^{-1}. Recruitment appeared negligible and mortality was estimated to be about 10% per year. Oystercatchers (*Haematopus ostralegus*), the gastropod (*Cymbium cymbium*) and unknown fish species were reponsible for a large share of this. The distinction of annual growth marks permitted the assessment of year-class strength, which appeared to be correlated with the average discharge of the river Senegal. This may be explained by assuming that year-class strength and river discharge both are correlated with rainfall at the Banc d'Arguin.

A detailed account of this study is given in the Netherlands Journal of Sea Research 21: 243-253.



17. FISHES AND SHRIMPS ON THE TIDAL FLATS

Pierre Campredon and Ben Schrieken

As stated in the introduction of this report it is possible that small fish and invertebrates migrating with the tides between the tidal channels and the tidal flats constitute an additional source of food for waders. To test this hypothesis we have made a few hauls with a small trawl in March 1986. These data are insufficient for any conclusions. However the latter author had started a series of similar hauls in December 1984, which were continued in 1985 by the former author. Together we have data available from 20 hauls between December 1984 and December 1985 and from 5 additional hauls in March 1986.

All samples were taken with a small (2 m) beam trawl with a counter. The first 20 hauls have sampled 4578 m. In these samples we caught 2266 fish of 19 different species and 9244 prawns of 10 different species (Table 17.1). 7455 Prawns belonged to the species Palaemon elegans. Furthermore we caught small numbers of crabs, amphipods and isopods.

A small number of species have been found exclusively in the seagrass beds, viz. the fishes E. guttiferum, S. spengleri, T. guineensis (??), C. bailloni and L. nuchipinnis and the prawns P. adspersus. S. typhle and S. hispidus also preferred seagrass beds, but the flatfish species C. stampflii, D. azevia and D. cuneata were caught over sand bottoms.

In summer the numbers of some species increase, especially for the fish species P. microps/marmoratus, S. typhle, E. guttiferum and S. hispidus, and for the prawns P. kerathurus, P. adspersus, and especially

Table 17.1. List of species of fish, prawns and crabs caught.

Pisces (fishes)

Gynglymostoma cirratum (Bonnaterre 1788)
Atherina cf. loperiana Rossignol & Blache 1961 [1)]
Syngnathus typhle Linnaeus 1758
Syngnathus cf. abaster Risso 1826
Ephinephelus aenaeus (Geoffroy Saint Hilaire 1817)
Ephinephelus guaza (Linnaeus 1758)
Dicentrarchus punctatus (Bloch 1792)
Tilapia guineensis (Bleeker 1862) - identification not certain
Diplodus sargus Linnaeus 1758
Pomadasys incisus (Bowdich 1825)
Sparus caeruleostictus (Valenciennes 1830)
Crenilabrus bailloni Valenciennes 1839
Labrisomus nuchipinnis (Quoy & Gaimard 1824)
Pomatoschistus marmoratus / microps [2)]
Gobius niger Linnaeus 1758
Gobius paganellus Linnaeus 1758
Bathygobius casamancus
Citharichthys stampflii (Steindachter 1894)
Dicologlossa azevia Capello 1867
Dicologlossa cuneata (Moreau 1881)
Stephanolepis hispidus (Linnaeus 1766)
Ephippion guttiferum (Bennett 1831)
Sphaeroides spengleri (Bloch 1782)
Lagocephalus laevigatus (Linnaeus 1766)

Crustacea Decapoda

Penaeaidea (prawns)

Gennadas spec.
Penaeus notialis Perez Farfante 1967
Penaeus kerathurus (Forskal 1775)
Sicyonia carinata (Brünnich 1768)

Caridea (prawns)

Leander tenuicornis (Say 1818)
Palaemon adspersus Rathke
Palaemon elegans Rathke
Hippolyte longirostris (Czerniavsky)
Latreutes fucorum Fabricius 1798
Pontophilus fasciatus (Risso 1816)

Brachyura (crabs)

Callinectes marginatus A. Milne-Edwards 1863

Microcassiope minor Dana 1852

Macropodia spec.

Pseudopagurus granulimanus

---

1) Our specimens have not been identified to species level, but Sevrin-Reyssac & Richter found this species.
2) Without males in breeding conditions further identification is not possible.

P. elegans.

Shrimps of the genus Panaeus live offshore as adults and reproduce in Mauritanian waters from May till August. The larvae are found in inshore waters; they migrate to tidal flats during nightly high tides. Palaemon adspersus reproduces offshore in summer; afterwards adults and larvae migrate shoreward. P. elegans is an estuarine species which is able to produce several batches of eggs a year. We found individuals with eggs between May and December. In November 50% of the specimens carried eggs.

Table 17.2. Numbers of specimens of fish and crustaceans obtained in trawl hauls over sandy bottoms.

Year	1984		1985							1986				
Date	12/8	12/8	5/5	5/5	10/22	10/22	11/22	11/22	12/8	3/15	3/17	3/17	3/17	3/25
Atherina sp.	-	-	1	-	-	-	1	-	-	-	-	-	-	-
S. typhle	-	-	2	-	-	-	-	-	1	1	-	-	-	-
Carangidae	-	-	-	18	-	-	2	2	-	-	-	-	-	-
E. aenaus	-	-	-	-	-	-	-	-	-	-	-	-	-	1
D. sargus	-	-	-	-	23	1	-	-	50	-	2	1	-	3
L. nuchipinnis	-	-	-	-	-	-	-	-	-	-	-	-	-	1
P. marmoratus/microps	34	35	110	30	95	51	21	23	7	-	-	+	+	-
G. niger	5	2	-	4	1	-	-	-	1	-	-	-	-	-
C. stampflii	-	-	-	-	-	-	1	-	-	-	-	-	-	-
D. azevia	1	-	3	6	-	1	1	-	1	-	-	-	-	-
D. cuneata	-	-	-	-	-	-	-	-	-	-	-	1	-	-
S. hispidus	-	-	-	-	1	1	-	1	1	-	-	-	-	1
S. spengleri	-	-	-	-	-	-	-	-	-	-	1	-	-	-
P. kerathurus	8	14	-	-	) 35	) 14	30	) 19	) 4	-	-	-	-	-
P. nothialis	-	-	-	-	)	)	-	)	)	1	-	-	-	-
P. adspersus	-	-	-	-	-	-	-	-	-	1	-	-	-	-
P. elegans	-	-	24	9	46	1	2	36	2	-	-	-	-	-
other shrimps	-	-	4	-	+	-	-	-	2	-	-	-	-	-
C. marginatus	-	-	-	-	-	-	1	-	-	-	-	1	-	-
M. minor	-	-	-	-	-	-	-	-	-	-	1	1	-	-

Table 17.3. Numbers of specimens of fish and crustaceans obtained in trawl hauls over seagrass beds.

Year	1984		1985								
Date	12/8	12/8	6/17	6/17	10/21	10/21	11/22	11/22	11/22	12/8	12/8
G. cirratum	-	-	-	-	-	1	-	-	-	-	-
Atherina sp.	-	-	-	-	-	-	30	-	-	-	-
S. typhle	10	7	34	46	35	20	24	20	14	6	12
Ephinephelus sp.	-	-	-	-	13	8	-	14	4	-	3
T. guineensis (??)	1	21	-	-	-	2	-	1	-	-	10
D. sargus	-	1	86	139	-	-	5	-	-	-	-
C. bailloni	-	-	3	11	-	-	-	-	-	7	-
L. nuchipinnis	3	-	-	-	-	-	1	-	-	-	-
P. marmoratus/microps	26	52	282	105	9	-	185	39	12	1	-
G. niger	22	27	30	30	12	-	18	6	1	-	12
C. stampflii	-	-	-	-	-	-	2	-	-	-	-
D. azevia	-	1	-	1	-	-	-	-	-	-	-
S. hispidus	4	-	-	-	53	37	-	7	3	13	7
E. guttiferum	1	-	-	-	13	18	-	21	47	1	1
S. spengleri	-	-	-	-	-	-	-	1	-	2	-
P. kerathurus	2	3	-	-	-	-	-	) 25	-	-	) 71
P. nothialis	3	14	-	-	275	260	-	)	18	18	)
P. adspersus	12	13	few	-	1288	700	1400	-	-	13	873
P. elegans	13	760	1200	880	-	400	-	1000	955	137	+
L. tenuicornis	2	-	-	-	-	-	-	-	-	)	)
L. fucorum	3	-	-	-	-	-	-	-	-	) 7	) 4
P. fasciatus	-	-	3	-	-	-	-	-	-	)	)
H. longirostis	-	4	30	86	-	-	-	176	32	)	)
C. marginatus	-	-	-	-	-	1	-	-	-	-	-
M. minor	-	-	-	-	-	2	-	-	-	-	-
Macropodia	-	-	-	-	-	-	1	-	-	-	-

Table 17.4. Numerical densities of fish and shrimps over the tidal flats of the Baie d'Aouatif at high tide.

Month	J	F	M	A	M	J	J	A	S	O	N	D
Sand												
No hauls					2	-				2	2	3
Total length hauls					392	-				420	413	770
No fish/m^2					0.43	-				0.43	0.12	0.17
No gobies/m^2					0.35	-				0.34	0.10	0.10
No shrimps/m^2					0.09	-				0.22	0.21	0.00
No P. elegans/m^2					0.08	-				0.11	0.09	0.00
Seagrass												
No hauls					-	2				2	3	4
Total length hauls					-	483				420	658	1022
No fish/m^2					-	1.58				0.62	0.68	0.24
No gobies/m^2					-	0.80				0.02	0.35	0.07
No shrimps/m^2					-	4.54				7.78	5.31	1.88
No P. elegans/m^2					-	4.36				6.58	5.28	0.89

18. RECOMMENDATIONS FOR THE MANAGEMENT OF THE PARC NATIONAL DU BANC D'ARGUIN

Although the Mauritanian authorities are well aware of the importance of the Parc National du Banc d'Arguin and have developed a well designed set of management regulations some of our observations might be useful for the daily management of the Parc.

Permanence of foot prints and human trails on the tidal flats

On different occasions we have made observations on the time required to remove by natural processes foot prints and human trails on the tidal flats.

On sandy shores the impact of people walking over the flats was very slight and the traces left had disappeared after one or two tides.

On muddy shores the impact of walking people was much greater and traces were visible longer. On the very muddy shores (where people sink knee-deep in the mud when they try to walk) the traces lasted at least two months. On the other hand we revisited one of our very muddy 1985 sites in February 1986. In April 1985 this site had been marked by small sticks and in order to peg out these sticks people had walked around the entire perimeter of the site. At that time their traces were very deep. On February 1986, after about 10 months, these traces could not be found back in the field although the sticks were still in place. At one spot only small depressions, 2-3 cm deep, occurred, possibly representing the remnants of a knee-deep human trail in 1985.

We concluded that human trails from the tidal flats will disappear again due to the actions of the tides; on sandy flats this will happen within a few tides, but on very muddy flats this may take about one year.

Protection of turtles

Turtles are caught regularly by the Imraguen. The worldwide endangered state of these animals leads to the suggestion to apply protection measures.

A possibility would be that the Parc National buys the turtles and sets them free again. This could be financed by WWF.

19. REFERENCES

Altenburg, W., M. Engelmoer, R. Mes & T. Piersma 1982. Wintering waders on the Banc d'Arguin, Mauritania. Report of the Netherlands Ornithological Mauritania Expedition 1980. Comm. nr. 6, Wadden Sea Working Group, Stichting Veth tot Steun aan Waddenonderzoek, Leiden.

Altenburg W., M. Engelmoer, R. Mes & T. Piersma 1983. Recensement des Limicoles et autres oiseaux aquatiques au Banc d'Arguin, Mauritanie. Gerfaut 73: 243-264.

Bowes, A., P.C. Lack & M.R. Fletcher 1984. Wintering gulls in Britain, January 1983. Bird Study 31: 161-170.

Brederode, N.E. van, M. Kersten, T. Piersma & P. Zegers 1982. Netherlands wader expedition to Morocco 1982 - some preliminary results. Wader Study Bull. 36: 12-14.

Brown, L.H., E.K. Urban & K. Newman 1982. The Birds of Africa, Vol. 1. Acad. Press, London.

Bub, H. 1969. Vogelfang und Vogelberingung. Vol. 4, Neue Brehm Bücherei, Wittenberg Lutherstadt.

Busse, P. & W. Kania 1970. Operation Baltic 1961-1967 working methods. Acta Orn. 12: 231-267.

Cramp, S. & K.E.L. Simmons (eds.) 1977. The Birds of the Western Palearctic, Vol. 1. Oxford University Press, Oxford.

Cramp, S. & K.E.L. Simmons (eds.) 1983. The Birds of the Western Palearctic, Vol. 3. Oxford University Press, Oxford.

Campredon, P. 1987. La reproduction des oiseaux d'eau sur le Parc National du Banc d'Arguin (Mauritanie) en 1984-1985. Alanda 55: 187-210.

Davidson N.C. 1981. Seasonal changes in the nutritional condition of shore birds during non-breeding seasons. Ph.D. Thesis, University of Durham.

Davidson, D.C. 1983. Formulae for estimating the lean weights and fat reserves of live shorebirds. Ring. & Migr. 4: 159-166

Davidson N.C. 1984a. How valid are flight range estimates for waders. Ring. & Migr. 5: 49-64.

Davidson, N.C. 1984b. Changes in the condition of Dunlins and Knots during short-term captivity. Com. J. Zool. 62: 1724-1731.

Dement'ev, G.P. & N.A. Gladkov 1954. Birds of the Soviet Union, Vol. 5, Moskva.

Dick, W.J.A. (ed.) 1975. Oxford and Cambridge Mauritania expedition 1973 Report. Unpublished report, Cambridge.

Dick, W.A., M.W. Pienkowski, M. Walter & C.D.T. Minton 1976. Distribution and geographical origins of Knot Calidris canutus wintering in Europe and Africa. Ardea 64: 22-47

Dick, W.J.A., T. Piersma, P. Prokosch 1987. Spring migration of the Siberian Knots Calidris canutus canutus: results of a co-operative Wader Study Group project. Ornis Scand. 18: 5-16.

Djangmah, J.S., S.E. Shumway & J. Davenport 1979. Effects of fluctuating salinity on the behaviour of the West African blood clam Anadara senilis and on the osmotic pressure and ionic concentrations of the haemolymph. Mar. Biol 50: 209-213.

Dowsett, R.J. 1971. Suspended wing-moult in migrants. Bird Study 18: 53-54.

Dowsett, R.J. & C.H. Fry 1971. Weight losses of trans-Saharan migrants. Ibis 113: 531-533.

Dijk, A.J. van, K. van Dijk, L.J. Dijksen, T.M. van Spanje & E. Wymenga 1986. Wintering waders and waterfowl in the Gulf of Gabès, Tunisia, January-March 1984. WIWO-report 11, Zeist.

Elliott, C.C.H., H. Waltner, L.G. Underhill, J.S. Pringle & W.J.A. Dick 1976. The migration system of the Curlew Sandpiper Calidris ferruginea in Africa. Ostrich 47: 191-213.

Engelmoer, M. 1982. The importance of the Banc d'Arguin for wintering waders. In: W. Altenburg, M. Engelmoer, R. Mes & T. Piersma. Wintering waders on the Banc d'Arguin, Mauritania. Stichting Veth tot Steun aan Waddenonderzoek, Leiden: p. 91-100.

Engelmoer, M. 1984. Analyses van biometrische gegevens van 12 soorten holarctische steltlopers. Report, Staatsbosbeheer, Utrecht.

Engelmoer, M., K. Roselaar, G.C. Boere and E. Nieboer 1983. Post-mortem changes in measurements of some waders. Ring. & Migr. 4: 245-248.

Etchécopar, R.D. & F. Hüe 1964. Les Oiseaux du nord de l'Afrique, de la Mer Rouge, aux Canaries. Boubée, Paris.

Etheridge, B. 1971. Weights and measurements of waders wintering in the Trucial States, Arabia. Wader Study Group Bull. 3: 5-7.

Evans, P.R. 1986. Correct measurement of the wing-length of waders. Wader Study Group Bull. 48: 1-11

Ferns, P.N. 1980. The spring migration of Ringed Plovers through Britain. Wader Study Group Bull. 29: 10-13.

Ferns, P.N. & G.H. Green 1979. Observations on the breeding plumage and prenuptial moult of Dunlins Calidris alpina captured in Britain. Gerfaut 69: 287-303.

Glutz von Blotzheim, U.N., K.M. Bauer & E. Bezzel 1975. Handbuch der Vögel Mitteleuropas, Band 6. Akademische Verlagsgesellschaft, Wiesbaden.

Glutz von Blotzheim, U.N., K.M. Bauer & E. Bezzel 1977. Handbuch der Vögel Mitteleuropas, Band 7. Akademische Verlagsgesellschaft, Wiesbaden.

Goede, A.A. & E. Nieboer 1983. Weight variations of Dunlins Calidris alpina during post-nuptial moult, after application of weight data transformations. Bird Study 30: 157-163.

Green, G.H. 1980. Total head length. Wader Study Group Bull. 29: 1-18.

Griffith, J. 1968. Multi-modal frequency distribution in bird populations. Bird Stduy 15: 29-32

Hancock, J. 1984. Field identification of West Palearctic white herons and egrets. British Birds 77: 451-457.

Hickling, R.A.O. 1954. The wintering gulls in Britain. Bird Study 1: 129-148.

Hickling, R.A.O. 1967. The inland wintering gulls in England. Bird Study 14: 104-113.

Hickling, R.A.O. 1977. Inland wintering gulls in England and Wales. Bird Study 24: 79-88.

Johnson, C. 1985. Patterns of seasonal weight variations in waders on the Wash. Ring. & Migr. 6: 19-32.

Kersten M. & T. Piersma 1983. Wader studies. In: M. Kersten, T. Piersma, C. Smit & P. Zegers (eds.). Wader migration along the Atlantic coast of Morocco, March 1981. RIN-report 83/20, Rijksinstituut voor Natuurbeheer Texel: 47-117.

Kersten, M. T. Piersma, C. Smit & P. Zegers 1983. Wader migration along the Atlantic coast of Morocco, March 1981. RIN-report 83/20, Rijksinstituut voor Natuurbeheer, Texel.

Kersten M. & T. Piersma 1987. High levels of energy expenditure in shorebirds; metabolic adaptions to an energetically expensive way of life. Ardea 75: 175-187.

Knight, P.J. & W.J.A. Dick 1975. Recensement de Limicoles au Banc d'Arguin (Mauritanie). Alanda 43: 363-389.

Lamarche, B. 1987. Liste commentée des oiseaux de Mauritanie. Unpubl.

report, Nouakchott.

McNeil, R. & F. Cadieuz 1972. Numerical formulae to estimate flight range of some North American shorebirds from fresh weight and wing length. Bird Banding 43: 107-113.

Moser, M.E. (ed.) 1980. Shorebird studies in North West Morocco. Report Department of Zoology, Durham.

Nicklès, M. 1950. Mollusques testacés marins de la côte occidental d'Afrique. Manuels ouest-africains. Paul Lechevalier, Paris: 1-269.

Nie, N.H., C.H. Hull, J.G. Jenkins, K. Steinbrenner & D.H. Bent 1975. SPSS Statistical Package for the Social Sciences, second edition. McGraw-Hill, New York.

Pearson, D.J. 1984. The moult of the Little Stint Calidris minuta in the Kenyan rift valley. Ibis 126: 1-15.

Petterson, J. & D. Hasselquist 1985. Fat deposition and migration capacity of Robins Erithacus rubecula and Goldcrest Regulus regulus at Ottenby, Sweden. Ringing & Migration 6: 66-76.

Pienkowski, M.W. (ed.) 1972. University of East Anglia Expedition to Morocco 1971 Report. Unpublished report, Norwich.

Pienkowski, M.W. 1980. A new WSG data form and prospects for analyses. Wader Study Group Bull. 28: 11-14.

Pienkowski, M.W. & W.J.A. Dick 1975. The migration and wintering of Dunlin Calidris alpina in North West Africa. Ornis Scand. 6: 151-167.

Pienkowski, M.W., P.J. Knight, D.J. Stanyard & F.B. Argyle 1976. The primary moult of waders on the Atlantic coast of Morocco. Ibis 118: 347-365.

Pienkowski, M.W. & P.R. Evans 1984. Migratory behaviour of shorebirds in the Western Palearctic. In: J. Burger & B.L. Olla (eds.). Shorebirds, migration and foraging behaviour. Behaviour of estuarine animals, Vol. 6. Plenum New York: 73-123.

Piersma, T. 1982. Foraging of Bar-tailed Godwits. In: W. Altenburg, M. Engelmoer, R. Mes & T. Piersma. Wintering waders on the Banc d'Arguin, Mauritania. Stichting Veth tot Steun aan Waddenonderzoek, Leiden: p. 135-148.

Piersma, T. 1984. Estimating energy reserves of Great Crested Grebes Podiceps cristatus on the basis of body dimensions. Ardea 72: 119-126.

Piersma, T. 1984. International wader migration studies along the East Atlantic Flyway spring 1985. Final announcement of a Wader Study Group project. Wader Study Group Bull. 42: 5-9.

Piersma, T., N.C. Davidson & P.R. Evans 1984. Estimation of the protein reserves of waders: the use and misuse of Standard Muscle Volume. Wader Study Group Bull. 42: 19-22.

Piersma T., 1986. Breeding waders in Europe. A review of population size estimates and a bibliography of information sources. Wader Study Group Bull. 48, Suppl.: 1-116.

Piersma, T., A.J. Beintema, N.C. Davidson, OAG Münster & M.W. Pienkowski 1987. Wader migration systems in the East Atlantic. Wader Study Group Bull. 49, Suppl./IWRB Special Publ. 7: 35-56.

Portenko, L.A. 1959. Studien an einigen seltenen Limicolen aus dem nördlichen und östlichen Sibirien. Der Sichelstrandläufer Erolia ferruginea. J. Orn. 100: 141-172.

Prater, A.J., J.H. Marchant & J. Vuorinen 1977. Guide to the indentification and ageing of holarctic waders. BTO Guide 17, Tring.

Rappoldt, C., M. Kersten & C. Smit 1985. Errors in large-scale shorebird counts. Ardea 73: 13-24.

Reyssac, J. 1977. Hydrologie, phytoplancton et production primaire de la Baie du Lévrier et du Banc d'Arguin. Bull. IFAN (Dakar) 39A: 487-550.

Rosevear, D.R. 1969. The rodents of West Africa. British Museum, London: 604 p.

Salomonsen, F. 1955. The evolutionary significance of bird migration. Dan. Biol. Mead. 22 (6): 1-62.

Schick, C.T. 1983. Weight loss in Sanderlings Calidris alba after capture. Wader Study Group Bull. 38: 33-34.

Schütz, E., P. Berthold, E. Gwinner & H. Oelke 1971. Grundriss der Vogelzugskunde. Parey, Berlin: 390 p.

Sevrin-Reyssac, J. 1980. Chlorophylle A et production primaire dans les eaux de la Baie du Lévrier et du Parc National du Banc d'Arguin (septembre-octobre 1980). Bull. Cent. Nat. Rech. Océanogr. Pêches, Nouadhibou 9: 56-65.

Sevrin-Reyssac, J. 1981. Caracteristiques du phytoplancton de la région de l'île Tidra (Mauritanie) en septembre et octobre 1980. Bull. Nat. Rech. Océanogr. Pêches, Nouadhibou (sous presse).

Smet, K. de & J. van Gompel 1979. Wader counts at the Senegalese coast in winter 1978-79. Wader Study Group Bull. 27: 30.

Smit, H. 1987. Vogeltellingen op de Engelsmanplaat. Limosa 60: 111-118.

Speakman, J.R. 1987. Apparent absorption efficiences for Redshank (Tringa totanus L.) and Oystercatcher (Haematopus ostralegus L.): implications for the predictions of optimal foraging models. Am. Nat. 130: 677-691.

Spencer, R. & R. Hudson 1978. Report on bird ringing for 1977. Ringing & Migration 2: 57-104.

Stanyard, D.J. 1974. A note on the primary moult of Calidris minuta Little Stint in Botswana. Wader Study Group Bull. 12: 13-14.

Summers, R.W., L.G. Underhill, M. Waltner & D.A. Whitelaw 1987. Population, biometrics and movements of the Sanderling Calidris alba in Southern Africa. Ostrich 58: 24-39.

Swennen, C. 1984. Differences in mean quality between roosting flocks of Oystercatchers Haematopus ostralegus. In: P.R. Evans, J.D. Goss-Custard & W.J. Hale. Coastal waders and wildfowl in winter. Cambridge University Press, Cambridge.

Swennen, C., L.L.M. de Bruijn, P. Duiven, M.F. Leopold & E.C.L. Martijn 1983. Differences in bill form of the Oystercatcher Haematopus ostralegus: a dynamic adaptation to specific foraging techniques. Neth. J. Sea Res. 17: 57-83.

Taylor, R.C. 1980. Migration of the Ringed Plover Charadrius hiaticula. Ornis Scand. 11: 30-42.

Trotignon, J. 1976. La nidification sur le Banc d'Arguin (Mauritanie) au printemps 1974. Alauda 44: 119-133.

Trotignon, E., J.M. Bailoon, J.F. Dejonghe, D. Duhantos & M. Lecompte 1980. Recensement hivernal des limicoles et autres oiseaux aquatiques sur le Banc d'Arguin (Mauritanie) (Hiver 1978/1979). L'Oiseaux et R.F.O. 50: 323-343.

Tye, A. & H. Tye 1987. The importance of Sierra Leone for wintering waders. Wader Study Group Bull. 49, Suppl./IWRB Special Publ. 7: 71-75.

Urban, E.K., C.H. Fry & S. Keith 1986. The birds of Africa, Vol. II. Acad. Press, London.

Voons, K.H. 1973. List of recent holarctic bird species, non-passerines. Ibis 115: 612-638.

Voons, K.H. 1977. List of recent holarctic bird species, passerines. Ibis 119: 223-250, 376-406.

Wilson, J.R., M.A. Czajkowski & M.W. Pienkowski 1980. The migration through Europe and wintering in West Africa of Curlew Sandpipers. Wildfowl 31: 107-122.

Yoloye, L. 1976. The ecology of the West African bloody cockle Anadara (Senilia) senilis (L.). Bull. Inst. Français d'Afrique Noire, Dakar

38: 25-56.

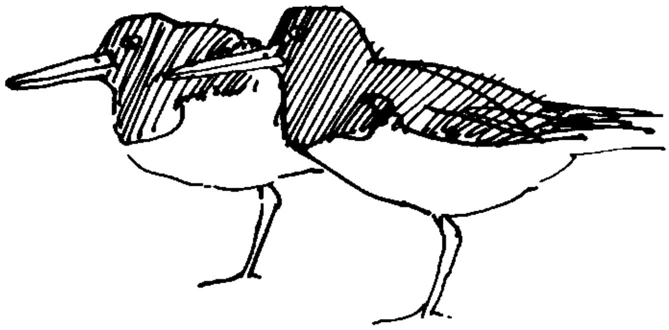
Yonge, C.M. 1955. A note on Arca (Senilia) senilis Lamarck. Proc. malacol. Soc. London 31: 202-208.

Zwarts, L. 1984. Wading birds in Guinea-Bissau, winter 1982/83. Wader Study Group Bull. 40: 36.

Zwarts, L. 1986. The winter exploration of fiddler crabs Uca tangeri by waders in Guinea-Bissau. Ardea 73: 3-12.

Zwarts, L. 1988. Numbers and distribution of coastal waders in Guinea Bissau. Ardea, in prep.

APPENDIX I



WADER BIOMETRICS

Piet Duiven

1 Oystercatcher (Haematopus ostralegus)

1.1 Catches

1985. When we arrived in the 'Parc' most of the Oystercatchers had left the study area and were migrating towards their breeding grounds, or did already arrive there. By the time we actually could start catching, only small numbers of Oystercatchers were still using the high tide roosts in the Baie d'Aouatif and at Ebelk Aiznay (Northwest Bay). As observed earlier (Theunis Piersma, pers. comm.) the birds were found very shy. And the only two birds we eventually laid hands on, were caught on 16 April 1985 and 29 April 1985, an after third calendar year and a third calendar year bird respectively.

1986. During our second stay nine Oystercatchers were caught near the camp site on various dates between early February and mid April. One of the birds was retrapped in the same period. More measurements were obtained from the remains of dead Oystercatchers. One was found at Ebelk Aiznay and two at Tidra.

1.2 Biometrics

All birds belonged to the race ostralegus. Sex was not determined. Measurements and weights were combined in tables 1.1 and 1.2.
On average weights were low in all age classes if compared with the weights of Oystercatchers from the western Wadden Sea in early spring (Glutz et al. 1975). However one has to bear in mind that the majority of Oystercatchers had already left the area and most of the stragglers probably were not in optimal condition. Of the second calendar year birds with a low body weight two were in full winter plumage at the end of the first decade of April. The other one was just half way towards summer

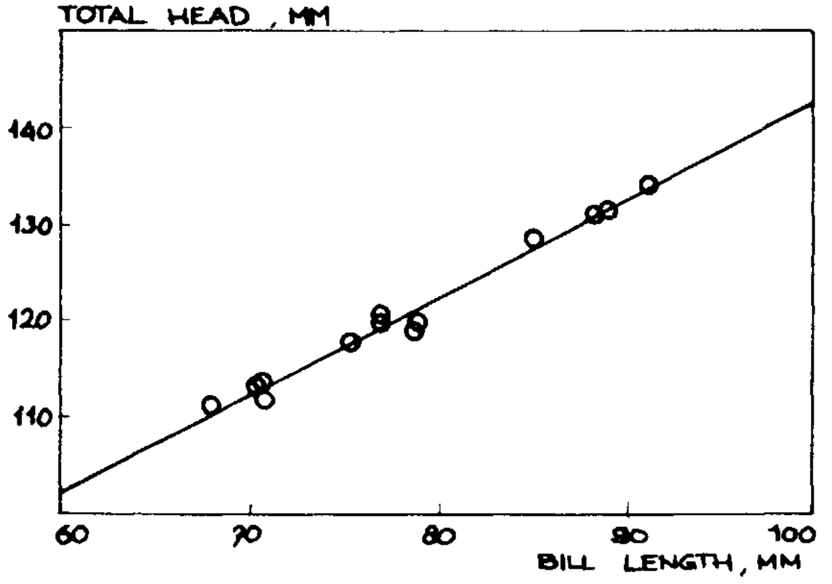


Figure 1.1. The relationship between bill length and total head of Oystercatchers at the Banc d'Arguin, Mauritania. $Y = 41.3766 + 1.01383\ x$, $r=0.992039$.

plumage. The after third calendar year bird, weighing 480 g, was in full winter plumage too. Another after third calendar year bird only weighed 384 g. One of the legs of this bird was missing from the intertarsal joint and besides that, it was still in winter plumage and two of the primaries were not moulted. It was found earlier that the enumerated aberrations are indications for a poor physical condition (Swennen 1984).

Though the available sample is small (n=10) a close relationship has been found between bill length and total head (Fig. 1.1).

Table 1.1. Weights (in gram) of Oystercatchers at the Banc d'Arguin, Mauritania.

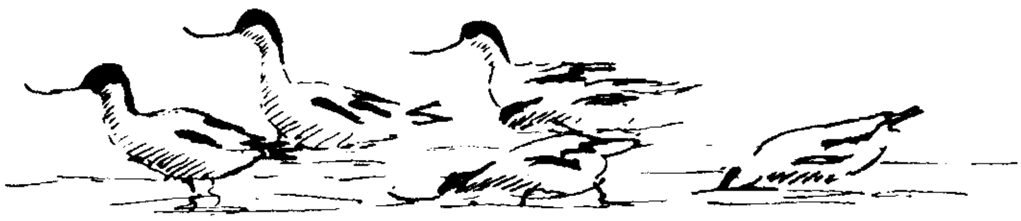
	February		March		April	
	1-14	15-28	1-15	16-31	1-15	16-30
2nd c.y.					364	
					372	
					370	
> 2nd c.y.			503			
3rd c.y.			513			423
			375			
> 3rd c.y.	480	384	592			550

Table 1.2. Wing length, bill length, total head (= tohe) and tarsus + toe (= tato) (in mm) of Oystercatchers at the Banc d'Arguin, Mauritania.

	2nd c.y.			3rd c.y.		> 3rd c.y.				
Wing	235	247	252	247	257	258	259	259	259	266
Bill	70.7	76.9	76.9	78.8	68.0	78.7	75.3	88.2	89.0	70.7
Tohe	112.0	119.7	120.5	119.9	111.2	118.9	117.7	131.1	131.5	113.7
Tato	90	95	100	95	97	97	85	99	98	96

1.3 Bill morphology and foraging

Seven bill tips (= 50% of the trapped birds and the remains of the dead ones) were chisel shaped, two had a pointed bill, four were intermediate between pointed and chisel shaped and one was intermediate between chisel and hammer. The bill shapes can be related to foraging techniques (Swennen et al. 1983). Oystercatchers with chisel shaped bills were eating molluscs. In both years principally the bivalve Anadara (Arca) senilis was fed upon. In 1986 the foraging behaviour of Oystercatchers was studied in detail (Swennen, chapter 13). Birds with pointed bills foraged on worms. On the tidal flats they specially were feeding on the larger polychaetes, probably Nereis falsa and Marphysa sanguinea. In certain areas along the mainland coastline Oystercatchers (and Bar-tailed Godwits) were observed foraging very actively. In bottom samples was under some cm of sand a layer of 5-10 cm of Zostera wrack. In the rotting Zostera high densities of the marine oligochaete Pontodrilus litoralis were found. After high tide the Oystercatchers followed the falling tide and north of Ebelk Aiznay they were able to come to an estimated food intake between 11 and 18 g ash-free dry weight within one and a half hour.



Theunis Piersma

2 Avocet (Recurvirosta avosetta)

Much to our surprise we found Avocets in our mist nets on the evening of 25 March 1985 (more individuals than we had seen up till then!). The measurements made on these birds (both > second calendar year birds) are listed in table 2.1. Two Avocets with colour rings were sighted on 29 March 1986. Both were ringed in May 1984 near Holwerd, Friesland, The Netherlands, as breeding adults. One was sighted later in spring (on 19 April 1986) in the Lauwersmeer, The Netherlands, and the second was resighted on 15 April 1986 near Holwerd (M. Engelmoer, pers. comm.). It took them therefore a maximum of two weeks to fly from the Banc d'Arguin to the Dutch Wadden Sea.

Tabel 2.1. Measurements of two adult Avocets on 15 March 1985 near Iouik on the Banc d'Arguin.

	Bird 1 (ring FT 92008)	Bird 2 (ring FT 92009)
Wing length (mm)	223	217
Bill length (mm)	84.2	70.9
Total head length (mm)	127.2	119.1
Tarsus + toe length (mm)	133	125
Body weight (g)	261	275
Colour of iris	brown (female?)	reddish brown (male?)

3 **Ringed Plover**

Cor J. Smit

3.1 Introduction

The number of wintering Ringed Plovers on the Banc d'Arguin amounts to about 100,000 (Altenburg et al. 1982), which is somewhat more than 4% of the total wader number. The species therefore is ranked at the fifth place, after Dunlin, Bar-tailed Godwit, Knot and Curlew Sandpiper. During low tide Ringed Plovers are most numerous on barren sandflats (about 4 birds per hectare). Numbers on muddy and sandy seagrass flats and muddy Arca-flats are in the order of 1-2 birds/ha (Altenburg et al. 1982). Ringed Plover numbers in the Baie d'Aouatif on 24 March 1985 amounted to somewhat over 4500 birds, which was less than half the number counted in January 1980. This suggests that by the end of March a considerable proportion of the wintering number of Ringed Plovers already has left. Numbers decline further in the course of April. On 25 April 1985 3000 Ringed Plovers were counted in the Baie d'Aouatif. Numbers in Ebelk Aiznai varied from 180 to 540 and did not show a systematic trend.

3.2 Catches

The total number of captured Ringed Plovers amounted to 78, 24 of these being second calendar year birds. One bird could not be aged successfully. All but 9 birds were captured in mist nets at various places in the Baie d'Aouatif. The 9 were part of a cannon net catch on 8 April 1985. Dick (1975) found considerable differences in the number of juvenile Ringed Plovers in the 1973 catches, the percentage of juveniles gradually dropping from early October to mid-November, possibly due to passage of juveniles to wintering areas further south. Recent counts (Zwarts 1988) show that some 57,000 Ringed Plovers are wintering in Guinea Bissau, whereas another 25,000 may be expected to winter in Sierra Leone (figure calculated from data in Tye & Tye 1987). In our catches the percentage of second calendar year birds dit not change in the course of the season, being 31 and 30% in March and April, respectively. Juveniles could not be sexed successfully. Among the adults 23 could be sexed as male, 3 as female. Another 27 could not be sexed successfully. It should be kept in mind, however, that males can more easily be sexed (Prater et al. 1977). There were 4 retraps, the biometrical data of these are given in table 3.1.

Table 3.1. Biometrical data of 4 Ringed Plovers captured twice.

Ring	Date	Age	Corrected weight	Wing	Bill	Total head	Tarsus + toe
SA 747096	25/3/85	6	51	136	14.1	41.8	47
	10/4/85	6	53	137	14.3	41.5	48
SA 747334	10/4/85	6	56	136	15.0	40.6	46
	9/3/86	6	51	134	13.9	40.5	46
SA 747336	11/4/85	6	52	131	15.0	42.0	46
	9/3/86	6	49	132	14.9	41.9	46
SA 747554	19/4/85	6	62	130	13.8	39.7	44
	22/4/85	6	57	131	14.2	40.2	44

3.3 Biometrics

Body measurements of Ringed Plovers captured in 1985 and 1986 are given in table 3.2. There are significant differences in wing length ($t = 5.44$, $p < 0.001$), bill length ($t = 2.99$, $P < 0.01$) and total head length ($t = 2.08$, $P < 0.05$) between second calendar year and adult birds. Juvenile bill lengths are somewhat smaller as compared to measures taken in 1973 ($t = 2.49$, $P < 0.05$). Adult bill lengths are exactly the same. Juvenile wing lengths in autumn 1973 were significantly larger ($t = 3.08$, $P < 0.01$) as compared to winter 1985/1986. This may be a result of feather abrasion in the course of autumn and winter, though it may also be due to the fact that different populations are involved. Adult wing lengths do not differ significantly.

A frequency distribution of bill, wing and tarsus plus toe lengths (Fig. 3.1) demonstrates two distinct and one minor peaks in bill lengths, suggesting that within the catches two or three populations can be distinguished. This may partly be explained by differences between sexes, but also indicates that at least two populations of different origin are present. Table 3.3 shows that, as in Kentish Plover, few biometrical parameters are significantly correlated.

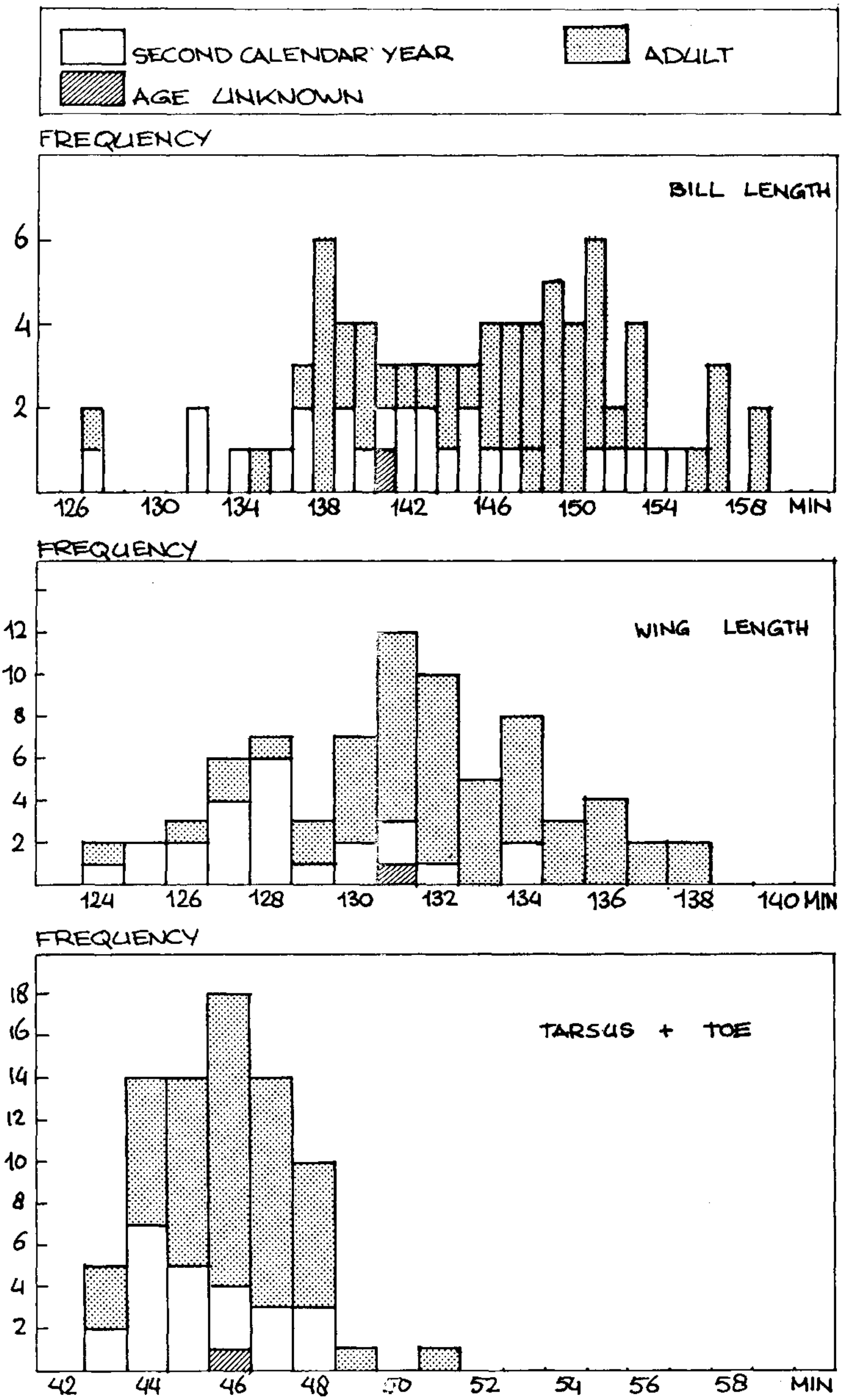


Figure 3.1. Frequency distribution of bill, wing and tarsus + toe lengths of Ringed Plovers captured at the Banc d'Arguin in 1985/1986.

Table 3.2. Body measurements (in mm) of Ringed Plovers at the Banc d'Arguin in February-April 1985 and 1986.

	2nd c.y. average ± S.D. range, number	Adult average ± S.D. range, number	All birds average ± S.D. range, number
Wing length	128.2 ± 2.8 123-134; n=24	132.2 ± 3.0 124-138; n=52	130.9 ± 3.4 123-138; n=77
Bill length	14.1 ± 0.6 12.7-15.3; n=24	14.6 ± 0.7 12.7-15.9; n=53	14.5 ± 7.0 12.7-15.9; n=28
Total head length	40.7 ± 0.7 38.8-42.0; n=24	41.1 ± 0.8 38.9-42.6; n=53	41.0 ± 0.8 38.8-42.6; n=28
Tarsus + toe	45.3 ± 1.5 43-48; n=23	46.0 ± 1.6 43-51; n=53	45.8 ± 1.6 43-51; n=77

Table 3.3. Correlation coefficients of corrected weight and biometrics of Ringed Plovers (all age classes), n=78. Coefficients significant at the 0.05 level are marked with *, those at the 0.01 level with ** and those at the 0.001 level with ***.

	Weight	Wing length	Bill length	Total head length
Wing length	0.3007*			
Bill length	0.0189	0.1448		
Total head length	0.0550	0.1459	0.5602***	
Tarsus + toe	0.1911	0.0371	- 0.1641	- 0.0667

Table 3.4. Corrected mean weights (grams) of second calendar year and adult Ringed Plovers captured at the Banc d'Arguin in February-April 1985/1986.

Month	2nd c.y. average ± S.D. range, number	Adult average ± S.D. range, number
February	43 (n=1)	54 (n=1)
March	47.1 ± 2.2 43-50; n=9	49.4 ± 4.2 43-57; n=20
April	49.8 ± 4.1 42-56; n=15	56.9 ± 5.1 46-70; n=31

3.4 Weights

Weights used in this chapter have been corrected for weight loss between catching and weighing. All together 25 measures were available, time intervals between successive weighing ranging from 1.7-13.2 hours (mean 7.3 ± S.D. 3.5). Mean weight loss amounted to 0.43 g/hour (± S.D. 0.37). On average Ringed Plovers were kept 3.50 hours (± S.D. 2.03, n = 74) between catching and weighing. Corrected mean weights are presented in table 3.4. The data show a weight increase both for second calendar year and adult birds, the increase being much more obvious for adults. Weight increase is also depicted in figure 3.2., showing the same pattern. Weights in March are very much the same as compared to those found on the Banc d'Arguin in September-November 1973 (Dick 1975). The latter author found juveniles measuring 48.5 g ± S.E. 1.5 (n=22), adults 50.6 g ± S.E. 0.46 (n=49). Spring weights in Morocco were 50.1 g (± S.D. 4.5; n=29) for juveniles and 54.5 g (± 5.0; n=4) for adults (Kersten et al. 1983). Once again, these weights are extremely low as compared to spring weights of Ringed Plovers in western Europe. In April/May mean weights in the Wash were around 70 g, the few birds captured in June even weighing 10 g more

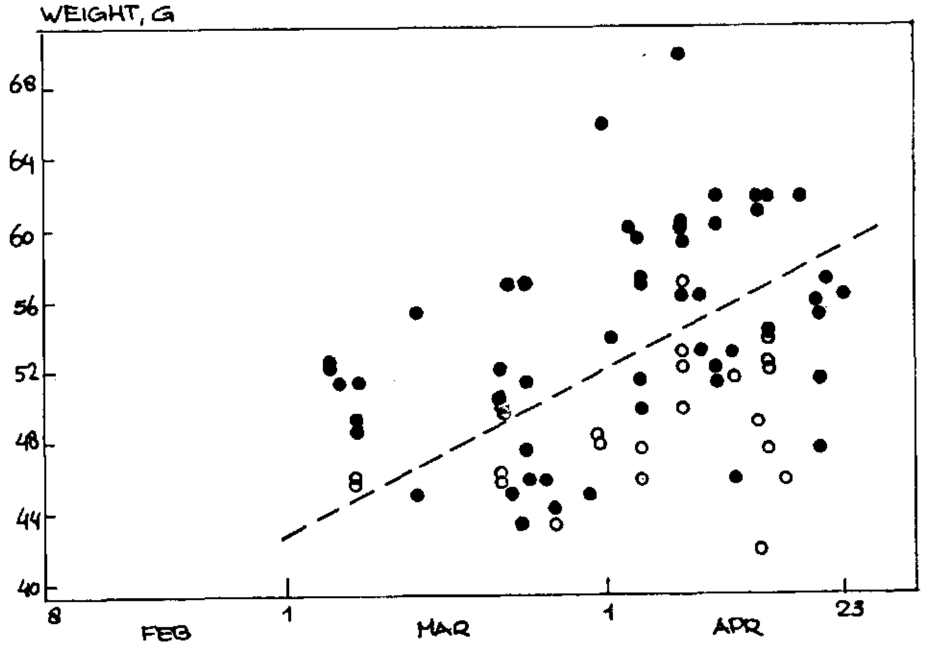


Figure 3.2. Weights (grams) of Ringed Plovers, captured at the Banc d'Arguin in February-April 1985/1986. Open circles refer to second calendar year birds, dots to adults. Weights have been corrected for weight loss between catching and weighing.

(Johnson 1985). Figure 3.2 shows that weight increase of Ringed Plovers at the Banc d'Arguin starts from mid-March onwards. The same figure suggests a separation in two groups of birds, according to the dotted line. A comparison of wing- and bill lengths of those two groups does not show any differences. We may therefore not conclude that different populations are involved. Neither there is any indication that this separation is the result of differences between sexes.

The fact that Ringed Plover numbers on 24 March already were half of those counted in January indicates that a considerable proportion of these birds which are leaving the Banc d'Arguin do so at relatively low weights. Assuming that the population of birds captured in our mist nets is a representative sample of the population present at the Banc d'Arguin, the birds leaving the area do so at weights of approximately 50 g! The lean weight of a Ringed Plover may be estimated at 45.4 g (McNeil & Cadieux 1972). Birds leaving in March therefore would only carry about 5 g of fat, allowing them to fly somewhat over 500 kilometers (calculated from equations in Davidson 1984). This would only bring them as far as the Bay of Dakhla or coastal areas elsewhere in the Republic of Western Sahara. The heaviest birds in mid-April are approximately 10 g heavier as compared to those in March. This fat load allows them to fly about 1500 km, as a result of which they would be able to reach central Morocco.

There are two possible explanations for the extremely low fat loads found in March. Firstly we may not have captured relatively heavy birds in March. This is well possible since the number of Ringed Plover catches from the first part of March, is extremely limited. The second explanation may be that Ringed Plovers leaving in March do not prepare for long distance flights but are capable of foraging along sandy or rocky coasts along the West African coast north of the Banc d'Arguin. Quite considerable numbers have been found on rocky coasts in Morocco indeed (Kersten et al. 1983) where they appeared to be the most numerous wader species. On 13 March 1984 75 Ringed Plovers were counted on a stretch of 10 km between Cap Blanc and El Jadida.

3.5 Plumage

From early March onwards Ringed Plovers start coming into summer plumage (Fig. 3.3). Especially adult birds appear to do so. The number of second calendar year birds in intermediate or summer plumage is extremely small.

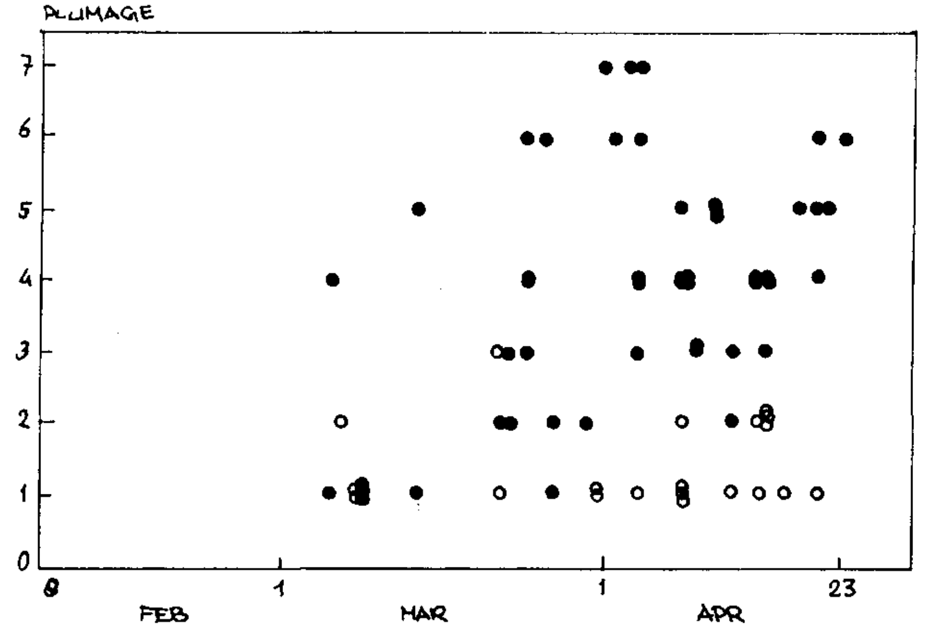


Figure 3.3. Plumage of Ringed Plovers at the Banc d'Arguin in February-April 1985/1986. Open circles refer to second calendar year birds, dots to adults.

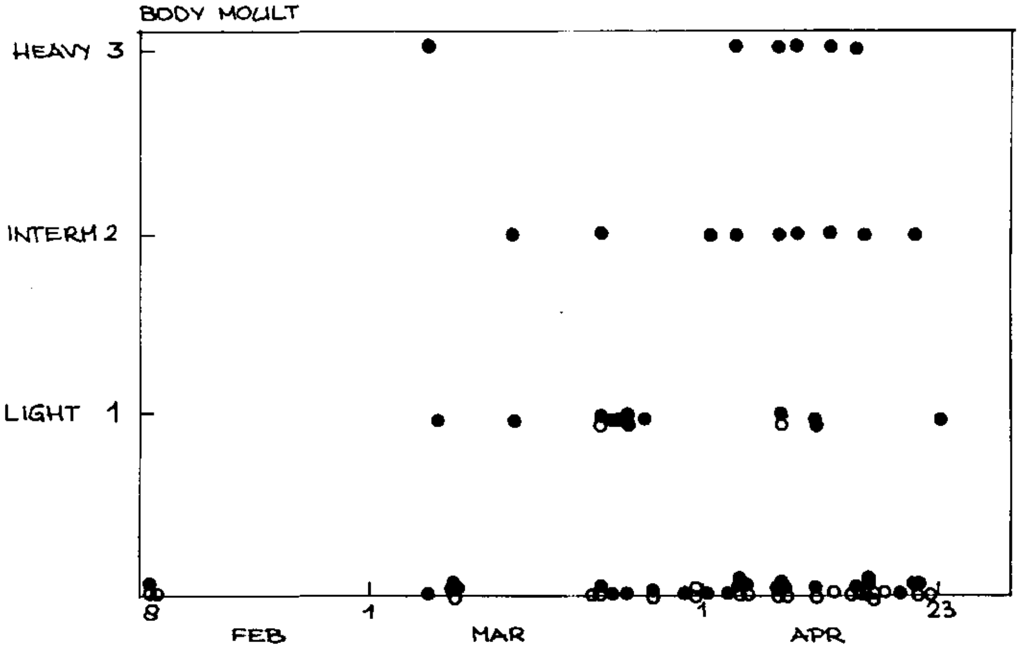


Figure 3.4. Body moult of Ringed Plovers in the course of spring at the Banc d'Arguin. Open circles refer to second calendar year birds, dots to adults.

Only one bird was found to be in intermediate plumage. Adult birds come into full summer plumage by the end of March. By the end of April adult Ringed Plovers display a blend of intermediate and full summer plumages. Relatively few birds have been found to be in heavy body moult (Fig. 3.4). Most adult birds are in intermediate or light body moult and the number of birds not moulting at all is relatively large, even in the second part of March and in April. The number of juveniles found moulting amounted to 5, which equals about 20% of the total number captured. For the adults no relation could be found between moulting stage and weight. This finding is in contrast to data from Morocco 1981, where moulting birds tended to be heavier as compared to non-moulting individuals (Kersten et al. 1983). Two birds, both juveniles, were in active wing moult. One, captured on 15 April 1985, weighing 42 g showed following characteristics: 5555530000. The second bird, captured 9 March 1986 weighing 46 g showed 5550000000. None of the birds showed signs of tail feather moult.

3.6 Geographical variation and migration

Ringed Plovers have often been regarded as one of the typical species showing leap-frog migration (Salomonsen 1955, Parey et al. 1971). This means that the northernmost breeding populations are wintering farthest south, those breeding further south progressively migrating over shorter distances. As a result the southernmost breeding population (Britain) is almost resident and is wintering farthest north. Breeding populations from elsewhere in Northwest Europe have been found wintering south to North Africa. Those breeding in Iceland and Greenland 'probably' winter in West Africa whereas birds from northern Scandinavia and northern USSR winter in West Africa (Pienkowski & Evans 1984). West Europe is situated on a crossroad of migration routes from Nearctic and Palearctic breeding grounds, probably ending up in the Gulf of Guinea and possibly even further south. There are recoveries of Ringed Plovers, captured in the Wash on the English east coast, from Morocco, Sénégal and Bénin (Branson 1987). Nearctic and North Palearctic populations do mix in African winter quarters whereas considerable numbers (mainly the North Palearctic 'tundrae' population) winter inland in Africa, south of the 15th degree of latitude, along large rivers and lakes (Pienkowski in Cramp and Simmons 1983). A recent analysis of ring recoveries (Taylor 1980) shows that the leap-frog concept does exist but is less distinct than assumed

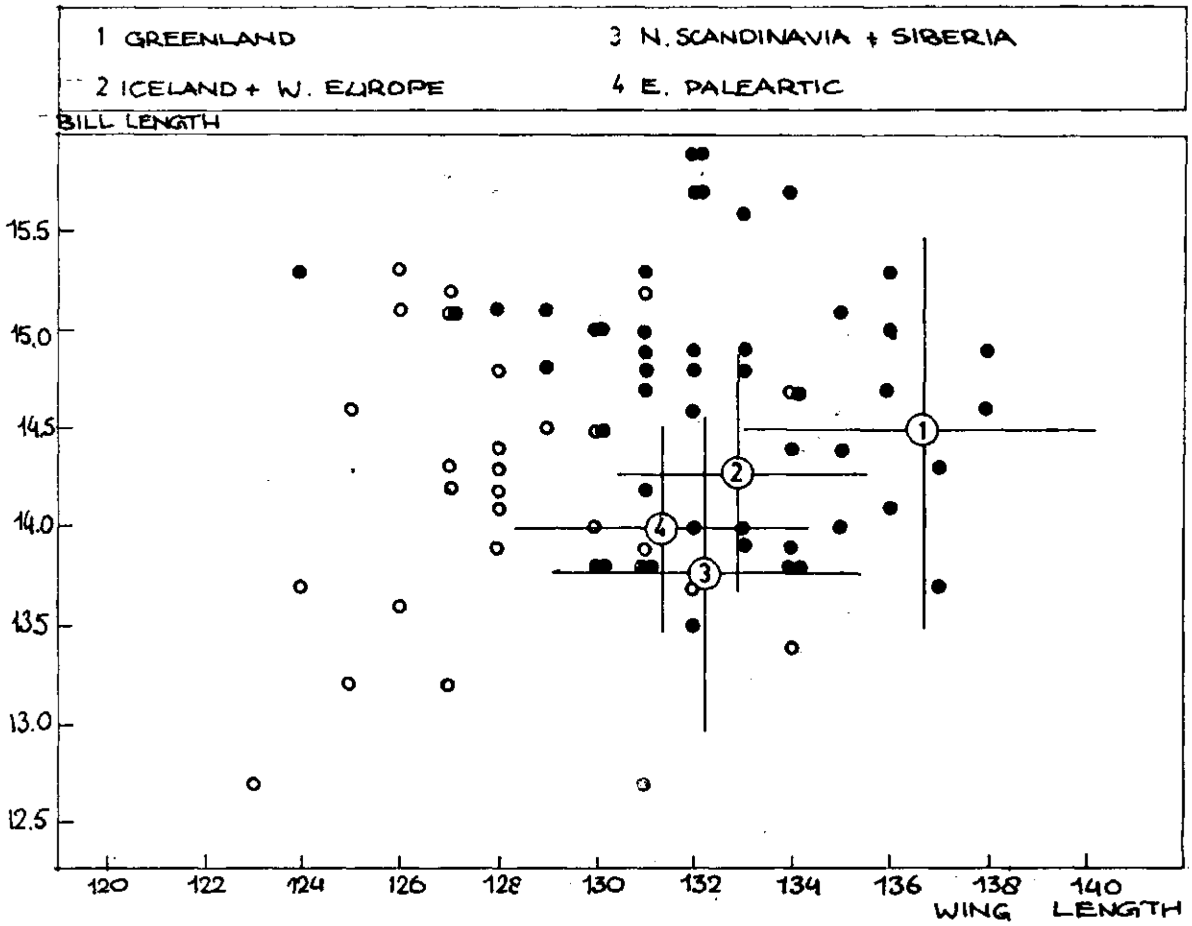


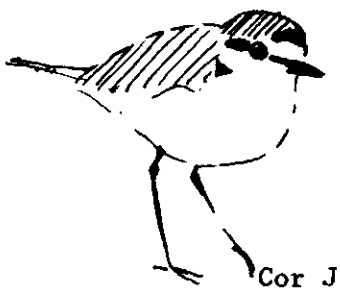
Figure 3.5. Wing length-bill length relation of Ringed Plovers captured at the Banc d'Arguin and mean lengths and standard deviations of Ringed Plover populations elsewhere (based on museum skins, corrected for shrinkage; Engelmoer 1984). Open circles refer to second calendar year birds, dots to adults.

by Salomonsen (1955). Figure 3.5 shows the results of the wing length-bill length relation of Ringed Plovers captured at the Banc d'Arguin in 1985/1986. This graph also shows the mean and standard deviations of four populations of Ringed Plovers based on data supplied by Engelmoer (1984). Based on the results of discriminant analysis he is able to separate the following Ringed Plover populations:

1) a long winged and relatively long billed population of birds from Iceland and West Europe;

2) three populations which are not separatable using discriminant analysis, breeding in Greenland, northern Scandinavia and northern USSR and the East Palearctic. These three populations are characterized by shorter wings and shorter bills, as compared to the first one.

Obviously part of the Mauritanian measures coincides with the measures of the four populations from figure 3.5. However, quite a lot of measures do not fit well into these four populations. These remaining birds are especially charcterized by relatively long bills and shorter wings. The same relatively long bills and short wings have been found by the Oxford and Cambridge expedition in autumn 1973 (Dick 1975). In fact their adult bill and wing lengths did not differ significantly from values found in 1985/1986. There are two recoveries of birds ringed at the Banc d'Arguin in 1985/1986. The first, an adult ringed on 8 April 1985, was controlled in Wales (52°31'N, 04°03'W) on 5 May in the same year. The second, an adult ringed on 8 February 1986, was found dead on the French channel coast (50°59'N, 01°56'E) on 10 August 1986. The 1973 expedition yielded recoveries from Iceland, the Baltic and Morocco (Altenburg et al. 1982). These recoveries strongly suggest (cf. Ferns 1980) that at least part of the birds wintering in or passing through the Banc d'Arguin, is of Icelandic or Nearctic origin. The Baltic recovery suggests that also populations from northern Scandinavia or the USSR are involved. The origin of the long billed birds, however, for the moment remains obscure. Even more is uncertain regarding the juvenile birds. Autumn catches at Cap Timiris (Dick 1975) suggest an exodus of Ringed Plovers, particularly juveniles, to wintering quarters further south.



4 **Kentish Plover**

Cor J. Smit

4.1 Introduction

Kentish Plovers are relatively uncommon at the Banc d'Arguin. Altenburg et al. (1982) arrived at somewhat over 17,000 birds for the whole area, which is 0.8% of the total number of waders wintering in the area. These birds are mainly feeding on mudding and sandy seagrass and muddy Arca flats. In the best areas densities at low tide are up to 2 birds per ha. (Altenburg et al. 1982). Numbers counted in the Baie d'Aouatif showed a steady decline, from 1400 on 24 March 1985 to 450 on 25 April. Numbers in Ebelk Aiznai were rather small and do not allow any conclusions (cf. Rappoldt et al. 1985) on changes in numbers.

Table 4.1. Body measurements (in mm) of Kentish Plovers captured at the Banc d'Arguin in February-April 1985 and 1986.

	2nd c.y. average ± S.D. range, number	Adult average ± S.D. range, number	All birds average ± S.D. range, number
Wing length	112.5 ± 3.7 107-119; n=13	111.9 ± 3.4 105-116; n=9	112.1 ± 4.2 102-119; n=24
Bill length	15.7 ± 1.0 14.2-17.3; n=13	15.6 ± 0.4 14.8-16.2; n=9	15.8 ± 0.9 14.2-17.3; n=24
Total head length	42.9 ± 1.3 40.8-45.5; n=13	42.4 ± 0.6 41.6-43.3; n=9	42.8 ± 1.2 40.8-45.5; n=24
Tarsus + toe	48.5 ± 1.6 46-51; n=13	48.1 ± 2.2 43-51; n=9	48.3 ± 1.8 43-51; n=24

4.2 Catches

All but one bird were captured in mist nets on various catching sites. The total number of Kentish Plovers captured in 1985 and 1986 amounts to 24 birds, 59% of these being second calendar year birds. This figure is quite close to the 65% found by Dick (1975) at the Banc d'Arguin in 1973 and by Van Dijk et al. (1986) in the Gulf of Gabès, Tunisia. Nine birds were sexed as males, one as a female but it should be kept in mind that males can be more easily sexed (Prater et al. 1977). Two birds could not be aged successfully. All birds were newly ringed. No retraps (own birds) or controls (foreign birds) were obtained.

4.3 Biometrics

Body measurements of Kentish Plover captured in 1985 and 1986 are given

Table 4.2. Biometrics (x ± S.D.) of juvenile and second calendar year and adult Kentish Plovers along the north and west African coast. Data were taken from Dick (1975) (5), Pienkowski (1975) (1), Moser (1981) (2), Kersten et al. (1983) (3), Van Dijk et al. (1986) (4) and this study (6).

Origin	Wing length (mm)		Bill length (mm)	
	juveniles + 2nd c.y.	adults	juveniles + 2nd c.y.	adults
1 Morocco autumn 1972	110.7 ± 3.1 (n=15)	109.3 ± 2.9 (n=34)	14.9 ± 0.8 (n=17)	14.9 ± 3.3 (n=69)
2 Sidi Moussa, Morocco autumn 1980	109.9 ± 3.8 (n=29)	110.4 ± 3.0 (n=14)	14.7 ± 0.6 (n=35)	15.1 ± 1.1 (n=29)
3 Sidi Moussa, Morocco spring 1981	112.0 ± 2.5 (n=6)	114.8 ± 1.6 (n=7)	15.5 ± 0.5 (n=6)	15.4 ± 0.7 (n=7)
4 Gulf of Gabès, Tunisia winter 1984	113.8 ± 2.8 (n=33)	113.8 ± 2.5 (n=11)	16.0 ± 0.8 (n=33)	15.7 ± 0.6 (n=11)
5 Banc d'Arguin autumn 1973	110.8 ± 2.7 (n=11)	110.8 ± 0.6 (n=6)	15.5 ± 0.8 (n=11)	15.3 ± 1.2 (n=6)
6 Banc d'Arguin spring 1985, 1986	112.5 ± 3.7 (n=13)	111.9 ± 3.4 (n=9)	15.7 ± 1.0 (n=13)	15.6 ± 0.4 (n=9)

in table 4.1. Wing and bill lengths of both second calendar year and adult birds are somewhat larger as compared to 1973 values (Table 4.2) but sample sizes are small and none of these differences is statistically significant. Table 4.3 shows that only few biometrical parameters are significantly correlated. There appears to be a strong correlation ($p<0.001$) for bill and total head length. In general correlations are much lower as compared to the surprisingly high ones found in, for instance, Sanderling and Turnstone.

4.4 Weights

Hardly no information was collected on weight loss between catching and weighing. Therefore results of the Sidi Moussa 1981 expedition (Kersten et al. 1983) were used showing that the average weight loss of four (!)

Table 4.3. Correlation coefficients of corrected weight and biometrics of Kentish Plovers (all age classes), n=24. Coefficients significant at the 0.05 level are marked with *, those at the 0.01 level with ** and those at the 0.001 level with ***

	Weight	Wing length	Bill length	Total head length
Wing length	0.5149**			
Bill length	0.0718	0.2618		
Total head length	0.2984	0.4355*	0.7459***	
Tarsus + toe	0.1004	0.0575	0.2379	0.2337

Table 4.4. Corrected mean weights (grams) of second calendar year and adult Kentish Plovers captured at the Banc d'Arguin in February-April 1985/86.

Month	2nd c.y. average ± S.D. range, number	Adult average ± S.D. range, number
February	34 (n=1)	38 (n=1)
March	41.4 ± 8.0 35-38; n=7	42.0 ± 4.9 36-46; n=4
April	40.8 ± 7.5 33-51; n=4	43.0 ± 2.6 40-46; n=4

Kentish Plovers amounted to 0.3 g/h. The results presented here have been corrected accordingly. On average Kentish Plovers were kept 3.22 h ± S.D. 1.82 (n=23) between catching and weighing. The results of our measurements are shown in table 4.4. Adult weights tend to increase very slightly in the course of the season but this does not apply for young birds. The limited amount of data, however, does not allow any further analyses. Both second calendar year and adult weights are slightly exceeding the levels found by Dick (1975). The latter data (September-November 1973) show a mean juvenile weight of 36.5 g ± S.E. 1.2 (n=11) and a mean adult weight of 38.7 g ± S.E. 1.8 (n=6). Second calendar year and adult Tunisian captured birds (January-March 1984) weighed 41.3 g on average (Van Dijk et al. 1986), Moroccan birds (March 1981) were lighter (36.5 g and 37.3 g resp.) (Kersten et al. 1983). This indicates that although own Mauritanian spring weights were low, there is a certain tendency to fatten up. Figure 9.4.1, however, shows that no obvious weight increase in the course of the spring can be detected. This applies both for young and for adult birds. Only two birds out of 22 used for data analysis, weighing 51 g and 58 g respectively, were obviously heavier as compared to the rest. Assuming a lean weight of 40 g the heaviest bird carried 18 g fat. Applying the equation given by Davidson (1983) this bird would be capable of covering a non-stop flight of somewhat less than 2000 km.

Kentish Plovers leave their wintering quarters rather early in the season. Breeding sites in southern Morocco are reoccupied from the end of February onwards (Robin in Glutz von Blotzheim et. al 1975). Further north (Bretagne) Kentish Plovers arrive relatively early as well, i.e. from early March on. The majority of the population in this area arrives in the second part of March and in the course of April. Territories in countries bordering the North Sea are reoccupied from the end of March until mid-April (Glutz von Blotzheim et al. 1975). Numbers along the Moroccan coast (Sidi Moussa) decreased in the early part of March and were rather stable in the following weeks (Kersten et al. 1983). Considering these data and keeping in mind that only few adult Kentish Plovers were relatively heavy we must conclude that most of the captured birds probably were not preparing a long distance flight towards breeding areas in Europe or northern Africa. Unfortunately only very few Kentish Plovers were captured in the course of February and March. The few data available for this period do not allow any speculations on departure weights and migration strategies.

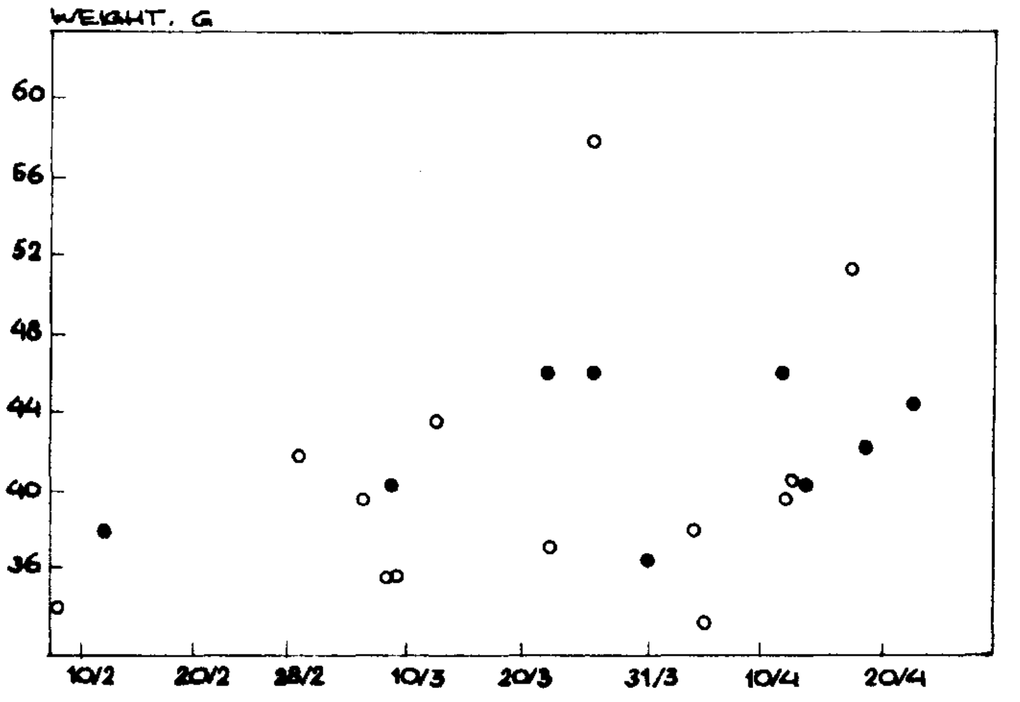


Figure 4.1. Weights (grams) of Kentish Plovers, captured at the Banc d'Arguin in February-April 1985/86. Open circles refer to second calendar year birds, dots to adults. Weights have been corrected for weight loss between catching and weighing.

4.5 Plumage

Adult Kentish Plovers captured at the Banc d'Arguin tended have an intermediate plumage in March. By April all captured birds were in summer plumage but the number of birds this applies for is limited. According to Cramp & Simmons (1983) adult Kentish Plovers come into breeding plumage from November to early December onwards, or even earlier than that. Full breeding plumage is attained by January-early March.

Second calendar year Kentish Plovers tend to get into summer plumage from early March onwards but by mid-April, when several birds are in full summer plumage, some others still carry almost complete winter plumage. Possibly part of the latter birds remain in the area to spend the summer. There is no obvious correlation between the amount of summer plumage and the presence of body moult. Birds in full winter plumage could be in moult or show no sign of body moult at all, the same applied for intermediate plumages. Most birds showing body moult, adults as well as younger ones, did so at a rather low level. None of them was in full body moult or showed primary moult.

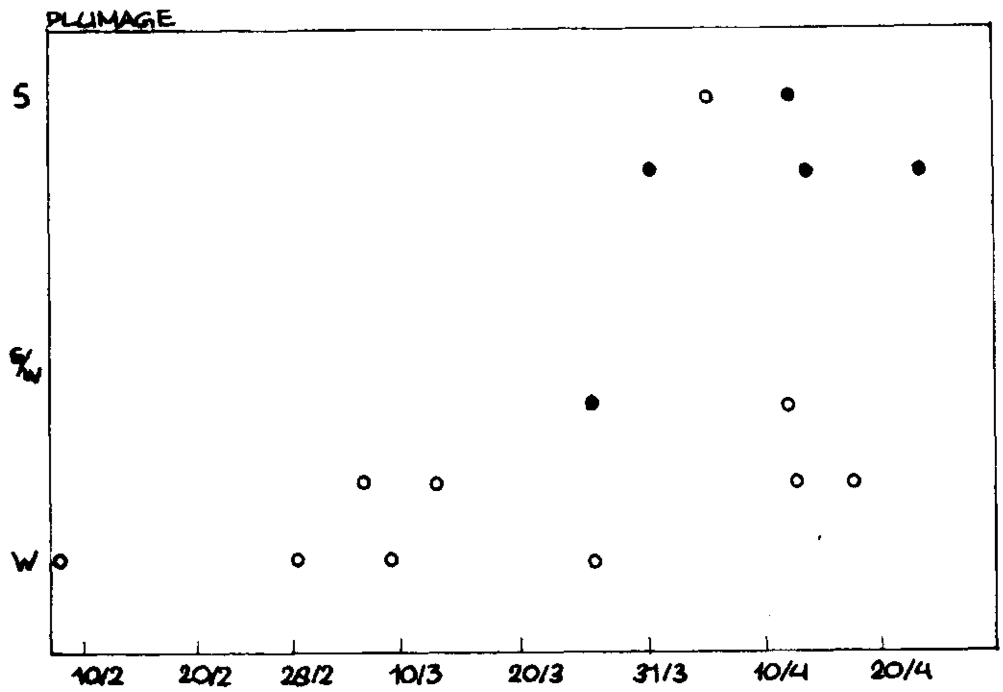
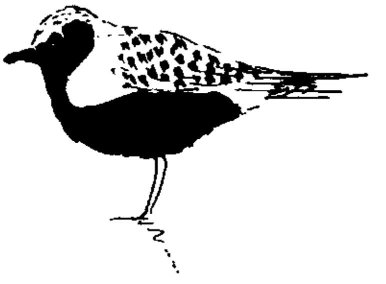


Figure . 4.2. Plumage of Kentish Plover at the Banc d'Arguin in February-April 1985/86. Open circles refer to second calendar year birds, dots to adults.

4.6 Geographical origin and migration

Though rather few data are available, the frequency distribution of bill lengths of Mauritanian captured Kentish Plovers has a single peaked shape. Most bills measured between 15-16 mm. This is in contrast with data from Tunisia. Van Dijk et al. (1986) found a bimodal distribution with peaks in the 15-16 mm and 17-18 mm range. Wing lengths at the Banc d'Arguin showed a tendency towards two peaks, one between 105-110 cm, and one between 112-117 cm. In Tunisia more or less the same distribution was found. Using the PCF-method outlined by Griffiths (1968), 60% of the Tunisian birds appeared to be small-winged (mean 111.7 mm ± 1.7), 40% was larger-winged (mean 116.3 mm ± 0.9). Part of the Tunisian population is thought to be residental, another part is believed to originate from southern France and possibly from Italy and the central part of Europe. According to Cramp & Simmons (1983) northwest European Kentish Plovers have wings of 113 mm (males) to 114 mm (females) (mean data corrected for shrinkage, Engelmoer et al. 1983), those of the Canary Islands and Maghreb countries being approximately 1 mm smaller. Measurements of wing, tail and toe apparently decrease gradually from western to southern Europe whereas males of southern breeding populations more often tend to have a bright cinnamon coloured crown. The latter phenomenon definitely has been found in our catches. Measurements of Banc d'Arguin captured Kentish Plovers are in rather good agreement with the longer-winged bird in northwest Europe but do not give an obvious clue on the origin of the few short-winged birds. Neither do the relatively long-winged Tunisian birds fit into this picture. Short-winged Kentish Plovers have also been found in Morocco in autumn (Table 4.2). During spring migration, however, the mean wing length appeared to be 4 mm larger. Part of this difference may be explained by feather abrasion of adult birds which had not moulted yet in autumn, but it is unlikely that this explains all of the difference. Possibly different populations of different breeding areas are involved. Corresponding to the Moroccan autumn catches mean wing lengths at the Banc d'Arguin are somewhat smaller as compared to western European breeding birds. Part of the explanation for this phenomenon may be that the breeding population, which is supposed to winter in Mauritania, largely consists of southern European birds. Piersma (1986) estimates the European population of Kentish Plovers at 6400-9600 pairs. Most of these are breeding in Spain (2000-3000) and Portugal (1500-3000). Smaller numbers are found further north, France and the Wadden Sea countries holding a population of 2650-3100 pairs. The size of the Moroccan breeding population is not known, the one from the Banc d'Arguin itself is thought to amount to only 30 pairs (Trotignon in Cramp & Simmons 1983). The European/North African breeding population is believed to distribute over the East Atlantic coast and western part of the Mediterranean (Cramp & Simmons 1983, Smit & Piersma, in prep.). These data lead to the conclusion that Mauritanian captured Kentish Plovers are a mixture of western, southern Europe and probably Northwest African breeding places, probably migrating in distinct waves. The origin of the small (105-110 mm) winged birds remains obscure.



5 Grey Plover

Cor J. Smit

5.1 Introduction

As compared to some other wader species Grey Plovers are rather scarce at the Banc d'Arguin. Altenburg et al. (1982) arrived at 23,500 birds for the whole area, about 10% of these wintering in the Baie d'Aouatif. The number of Grey Plovers in the whole area corresponds to about 1% of the total number of waders. Grey Plovers can be found in several habitat types feeding in densities ranging from less than 1 up to 3 birds/ha (Altenburg et al. 1982). Numbers in the Baie d'Aouatif in 1985 varied between 1253 and 1921 birds, showing no obvious trend to decrease or to increase. The same applied for numbers counted in Ebelk Aiznai.

5.2 Catches

The total number of Grey Plovers captured in 1985 and 1986 amounts to 22 birds; five birds were captured using a clap net, one using a cannon net, the remaining 16 in mist nets at various places in the Baie d'Aouatif. All birds could be aged successfully. Exactly half the number were second calendar year birds. This is considerably more than the 19% found by Dick (1975). It should be kept in mind, however, that the number of birds captured in 1973 was small too and amounted to only 21 birds. All but one bird, captured in 1985/86, were newly ringed. One second calendar year bird, captured on 22 March 1985, was retrapped as an adult on 1 March 1986. Biometrics of the latter bird are shown in table 5.1.

Table 5.1. Biometrical data of a Grey Plover (FT 92002) captured both in 1985 and 1986.

Date	Age	Corrected weight	Wing	Bill	Total head	Tarsus + toe
22 March 1985	2nd c.y.	203	203	319	691	83
1 March 1986	adult	201	209	323	705	82

5.3 Biometrics

Body measurements of Grey Plovers captured in 1985 and 1986 are given in table 5.2. Wing and bill lengths of juveniles cannot be compared with results from 1973 because in the latter year only 4 juvenile birds were captured. The same applies for adult wing lengths, which had to be splitted up in 1973 because some birds carried old and abrased primaries whereas others had new ones. Bill lengths of adult Grey Plovers in 1973 were significantly longer as compared to 1985/86 ($t=2.64$, $p<0.01$). Further details on this matter can be found in chapter 5.6. Table 5.3. shows that especially total head and bill lengths of Grey Plovers are highly correlated. The same applies for correlations of tarsus + toe with bill and total head length.

Table 5.2. Body measurements (mm) of Grey Plovers captured at the Banc d'Arguin in February-April 1985 and 1986.

	2nd c.y. Average ± S.D. range, number	Adult Average ± S.D. range, number	All birds Average ± S.D. range, number
Wing length	197.3 ± 3.7 192-203, n=11	202.4 ± 5.1 195-210, n=11	199.8 ± 5.1 192-210, n=22
Bill length	30.6 ± 0.8 29.3-31.9, n=11	29.8 ± 1.8 26.7-32.3, n=11	30.2 ± 1.4 26.7-32.3, n=22
Total head length	68.4 ± 0.9 67.1-70.5, n=11	67.8 ± 2.2 64.0-71.0, n=11	68.1 ± 1.7 64.0-71.0, n=22
Tarsus + toe	82.4 ± 1.0 81-85, n=11	81.1 ± 3.6 75-87, n=11	81.7 ± 2.7 75-87, n=22

Table 5.3. Correlation coefficients of corrected weight and biometrics of Grey Plovers (all age classes), n=22. Coefficients significant at the 0.05 level are marked with *, those at the 0.01 level with ** and those at the 0.001 level with ***.

	Weight	Wing length	Bill length	Total head length
Wing length	0.4142*			
Bill length	0.0788	0.3232		
Total head length	0.0801	0.4263*	0.8213***	
Tarsus + toe	-0.0136	0.3238	0.5615**	0.5922**

5.4 Weights

No information was collected on weight loss between catching and weighing. Based on the results of the 1981 Sidi Moussa expedition (Kersten et al. 1983) weight loss was assumed to amount to be 1.5 g/h. The results presented here have been corrected for accordingly. Grey Plovers were kept 2.77 h ± S.D. 2.20 (n=22) on average between catching

Table 5.4. Corrected mean weights (grams) of second calendar year and adult Grey Plovers captured at the Banc d'Arguin in February-April 1985 and 1986.

Month	2nd c.y. Average ± S.D. range, number	Adult Average ± S.D. range, number
February	187 (n=1)	
March	184.7 ± 16.2 164-207, n=7	202.2 ± 12.0 188-221, n=5
April	185.3 ± 12.9 176-200, n=3	209.8 ± 29.3 163-238, n=6

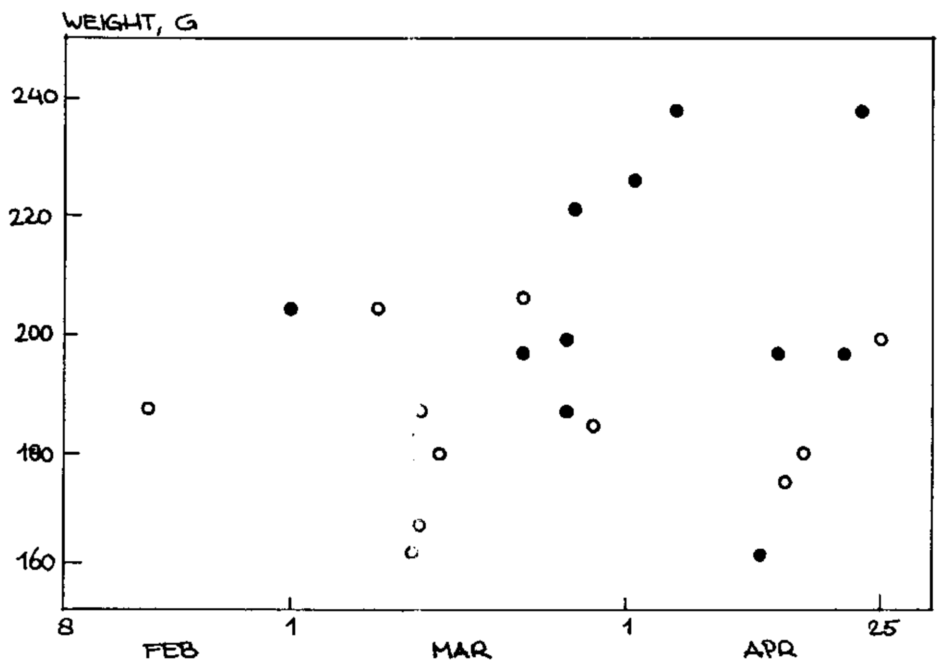


Figure 5.1. Weights (grams) of Grey Plovers captured at the Banc d'Arguin in February-April 1985/86. Open circles refer to second calendar year birds, dots to adults. Weights have been corrected for weight loss between catching and weighing.

and weighing. The results of weight measurements are presented in table 5.4. These results do not show a weight increase for juvenile birds and a rather slight one for adult birds. Figure 5.1 shows that from mid-March onwards some adults increase in weight whereas others do not show any sign at all. The heaviest bird measured had a weight of 238 g on 23 April, which is very low as compared to May weights on the Wash (mean 316.9 g; Johnson 1985). Assuming a lean weight of 196 g (calculated from equations in Davidson 1983), a 42 g fat load would carry migrating Grey Plovers as far as over 2000 km (Davidson 1984). This would bring them as far north as the Moroccan coast, a distance comparable to the one found in some other species.

5.5 Plumage

Only half of the Grey Plovers captured at the Banc d'Arguin showed signs of summer plumage. From early March onwards especially adult birds start coming into summer plumage (Fig. 5.2), though not all of them really do so. Funny enough figure 5.3 shows that most Grey Plovers start their active body moult as late as the end of March. Since some birds by this time already carry a plumage intermediate to summer and winter plumage, body moult must have started earlier than suggested by figure 5.2. There

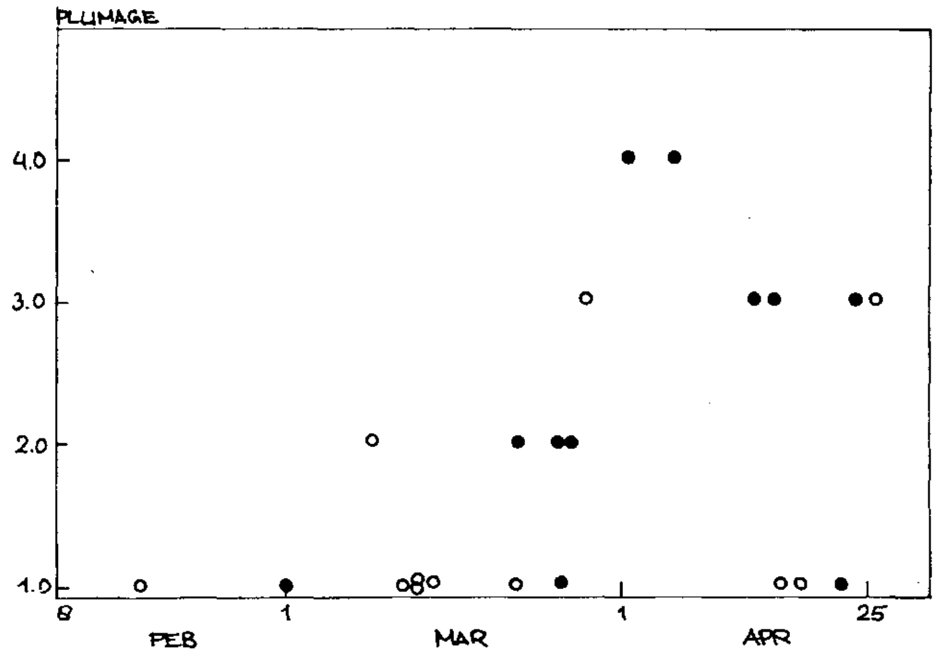


Figure 5.2. Plumage of Grey Plovers at the Banc d'Arguin in February-April 1985/86. Open circles refer to second calendar year birds, dots to adults.

have been no captures of birds in plumage stages 5-7, i.e. close to complete summer plumage. Field observations, however, showed that some birds apparently do come into full summer plumage at the Banc d'Arguin. By mid-April most Grey Plovers, both adult and second calendar year birds, have been found in intermediate or heavy body moult. This finding suggest that most Grey Plovers continue their body moult while on migration towards the breeding areas.

Grey Plovers at the Banc d'Arguin showed no signs of primary or secondary moult. This finding is in strong contrast with observations in Tunesia where in March 1984 9 out of 40 Grey Plovers showed primary moult and 22 out of 40 showed secondary moult (Van Dijk et al. 1986).

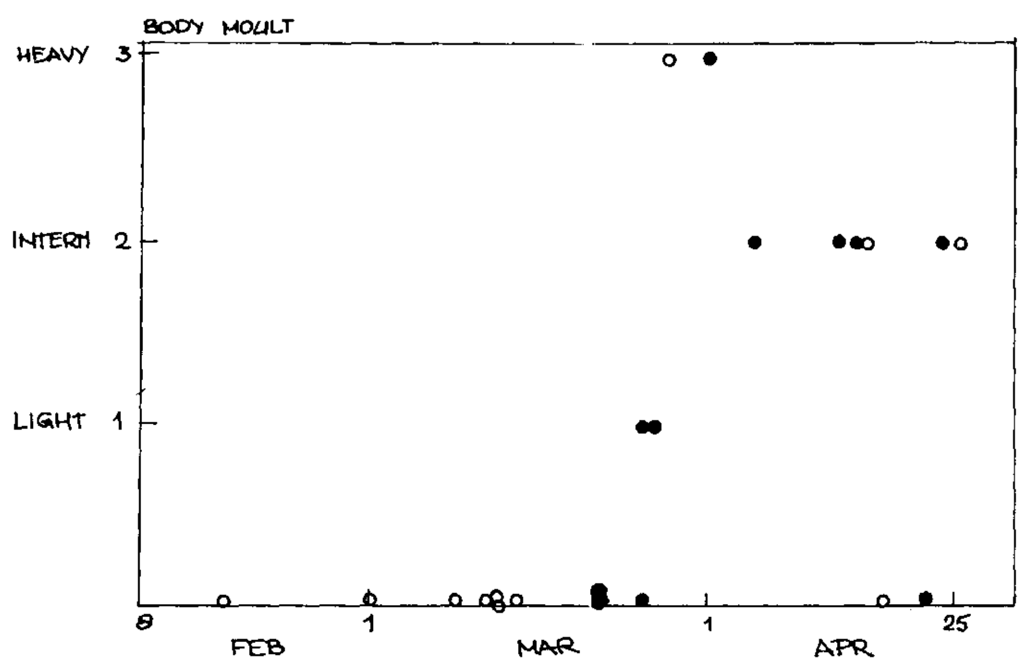


Figure 5.3. Body moult of Grey Plovers in the course of spring at the Banc d'Arguin. Open circles refer to second calendar year birds, dots to adults.

5.6 Geographical origin and migration

Grey Plovers migrating through Northwest-Europe are believed to originate from the West-Siberian population, though a recovery from the Taymyr peninsula indicates that also Central-Siberian birds are present (Cramp & Simmons 1983). Recoveries from Great Britain show that the winter quarters of birds passing through Northwest-Europe are situated as far south as Ghana (Spencer & Hudson 1978). Figure 5.4 shows the results of the wing length-bill length relation of Grey Plovers captured at the Banc d'Arguin in 1985-86. This graph also shows the means and standard deviations of three populations of Grey Plovers, based on data supplied by Engelmoer (1984). Using discriminant analyses he concludes that the following populations of Grey Plovers can be distinguished:

1. a short-winged population breeding in the Northeast of Canada, which also has been found on migration in Greenland;
2. a short-billed and long-winged population breeding in West-Siberia which also has been found on migration in North-Europe;
3. a long-billed and long-winged population breeding in Central and East-Siberia and Alaska.

According to Engelmoer (1984) all three populations are present in Northwest-Europe, 76% of the birds belonging to the Westpalearctic population, 14% to the Eastpalearctic population and 10% to the Canadian population. Though the number of captures is small the Mauritanian findings point in the same direction, most of the birds having intermediate wing and bill lengths, some extremes being on the edge of

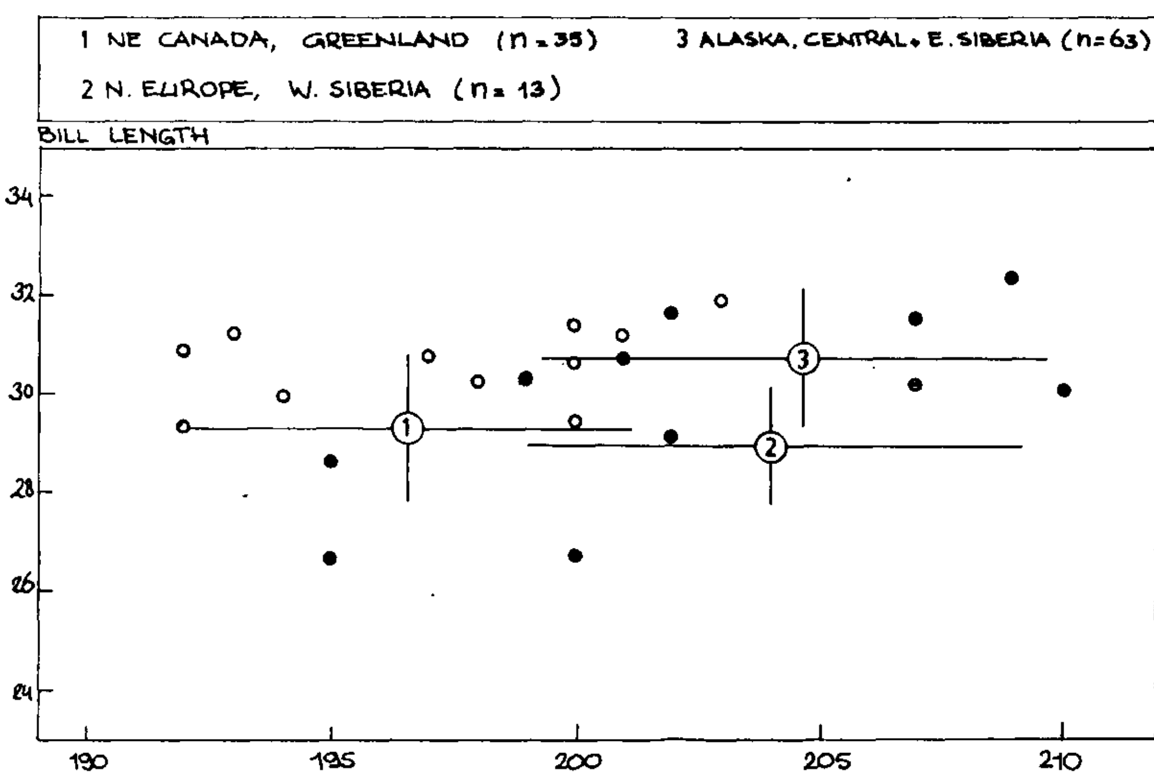
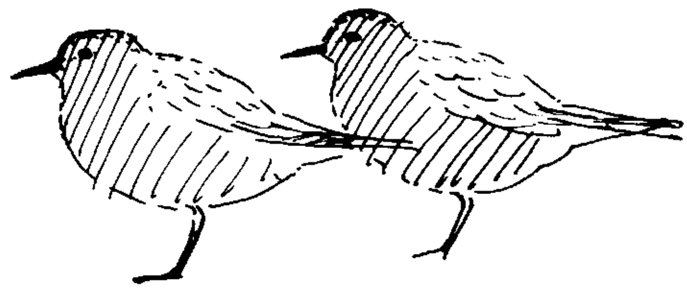


Figure 5.4. Wing length - bill length relation of Grey Plovers captured at the Banc d'Arguin and mean lengths and standard deviations of Grey Plovers populations elsewhere (based on museum skins, corrected from shrinkage; Engelmoer et al. 1983). Open circles refer to second calendar birds, dots to adults.

what has been measured on Westsiberian birds. The latter measurements, especially some very long-winged and long-billed birds, suggest that at least some birds from eastern Palearctic populations are present at the Banc d'Arguin and possibly also birds from the Nearctic population (the presence of the latter population, however, has not yet been confirmed through ring recoveries in western Europe or western Africa). The fact that autumn catches (Dick 1975) yielded even longer-billed birds (chapter 5.3) suggests that these birds are even more numerous in this season. A possible explanation may be that the relatively high number of Grey Plovers which has been found to winter in Guinea Bissau (57,000; Zwarts 1988) and further south along the Gulf of Guinea consists of a relatively high proportion of eastern Palearctic birds. An analyses of biometrics of Grey Plovers captured in Guinea Bissau shows that a high proportion actually does consist of large billed Eastern Palearctic birds (Altenburg et al., in prep.).



Theunis Piersma

6 **Knot (Calidris canutus)**

6.1 Age ratio

The ratio between Knots in the catches aged as juveniles or as adults, appeared to vary considerably, both within and between the years 1985 and 1986 (Table 6.1). In both years there is a trend of the juvenile percentages becoming smaller in the course of the spring season. The percentage of juveniles was generally higher in 1986 than in 1985. Catching studies in autumn 1973 by Dick (1975) have indicated that juveniles are more likely to be caught in mist nets than adults, compared to cannon net catches. This means that the percentages of juveniles in our (mist net) catches may overestimate the real juvenile percentages.

Table 6.1. Juvenile adult ratios of Knots captured on the Banc d'Arguin in the springs of 1985 and 1986.

Period	Spring season 1985			Spring season 1986		
	n juv.	n ad.	% juv.	n juv.	n ad.	% juv.
8-28 February	-	-	-	36	5	88
1-15 March	-	-	-	23	6	79
16-31 March	12	25	32	-	-	-
1-14 April	11	106	9	18	2-	43
15-25 April	16	116	12	-	-	-

6.2 Biometrics

Table 6.2. shows the averages of the body measurements of Knots. Juveniles have shorter wings and lower body masses than adults, but the other body dimensions were slightly larger in juveniles.
The average adult bill length of 35.1 mm indicates that we are dealing with birds of the Siberian breeding population Calidris canutus canutus

Table 9 6.2. Body measurements of Knots captured on the Banc d'Arguin in February-April 1985/86. Body mass was corrected for loss after capture. The number of juveniles in the sample is 116, the number of adults 278 (wing, tarsus + toe), or 281 (rest).

Measurements		Juveniles		Adults	
		Average	S.D.	Average	S.D.
Wing length	(mm)	163.89	4.13	169.71	3.90
Bill length	(mm)	35.62	1.82	35.12	1.78
Total head length	(mm)	64.32	2.04	64.00	1.96
Tarsus + toe length	(mm)	59.36	1.86	58.95	1.81
Body mass	(g)	119.20	10.03	144.2	15.42

(Dick et al. 1976, 1987). The linear body measurements of Knots correlate strongly (Table 6.3). It comes as no surprise that total head length and bill length show the strongest correlation with each other.

6.3 Body mass changes

Body mass is a complicated measure because it is so variable. It depends on water and food intake and excretion, so that birds loose mass after capture. We therefore have to transform body masses taken at various intervals after capture to the time of capture, taking into account the post-capture loss in body mass (Goede & Nieboer 1983, Davidson 1984a). Figure 6.1 shows that Knots lost on average 0.8 g/h between first and second weighing, i.e. after the period of rapid mass loss in the first few hours after capture. Figure 6.1 also shows that 'our' Knots were weighed between 1 and 8 hours after capture. In this study all body mass

Table 9.6.3. Pearson correlation coefficients between different body measurements of adult Knots on the Banc d'Arguin in 1985 and 1986. All correlation coefficients are significantly different from zero at the 0.1% level.

	Bill	Total head	Tarsus + toe
Wing	0.334	0.356	0.390
Bill		0.821	0.334
Total head			0.337

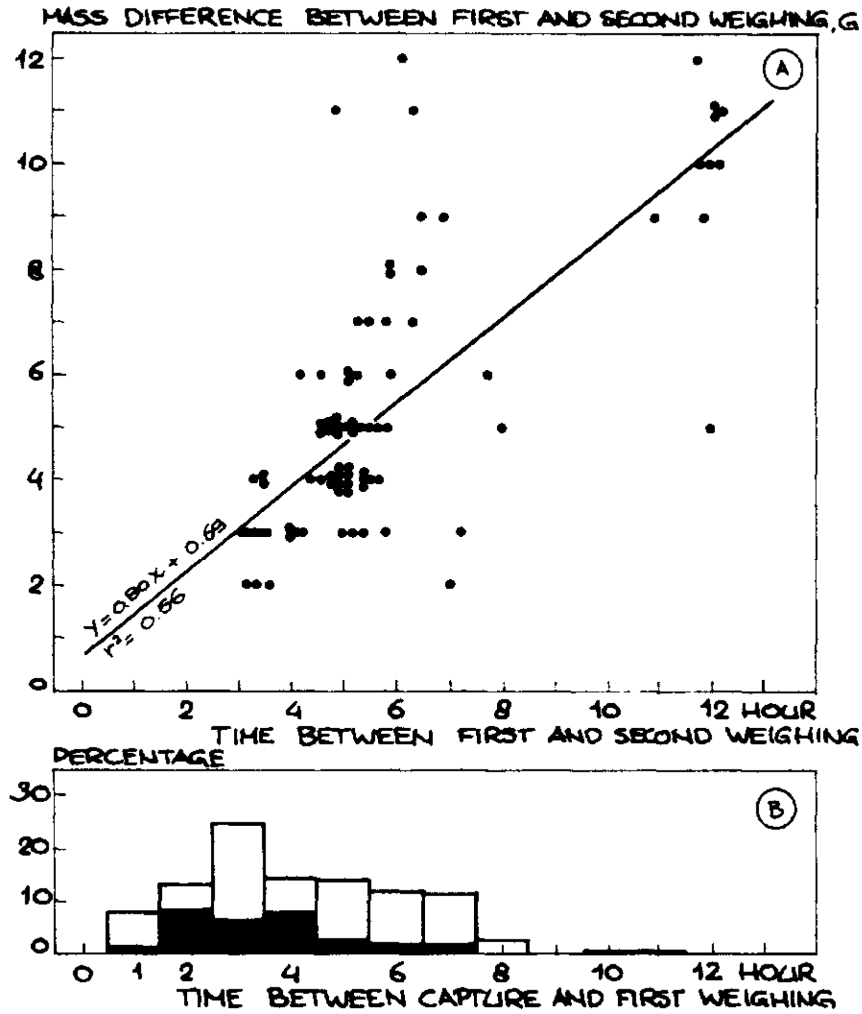


Figure 6.1. Mass loss after capture by Knots on the Banc d'Arguin in 1985 and 1986, and weighed twice after capture (A). B shows how long it took between capture and first weighing for all captured Knots: black indicates juveniles, white indicates adults (n = 395).

values have therefore been corrected to represent the (theoretical) body mass at the time of capture (adding 0.8 g/h).

6.3.1 Juveniles. Since there were no obvious differences between the body masses of juvenile birds caught in 1985 and 1986, the data from the two springs were taken together. Table 6.4. presents the average body masses of juveniles in the course of the spring, as derived from the complete data set, which is shown in figure 6.2. The tendency of average body mass to decrease in the course of spring is due to the absence of any heavy (135-160 g) juveniles after 10 April. The decreasing percentages of juveniles during spring (Table 6.1) and the absence of

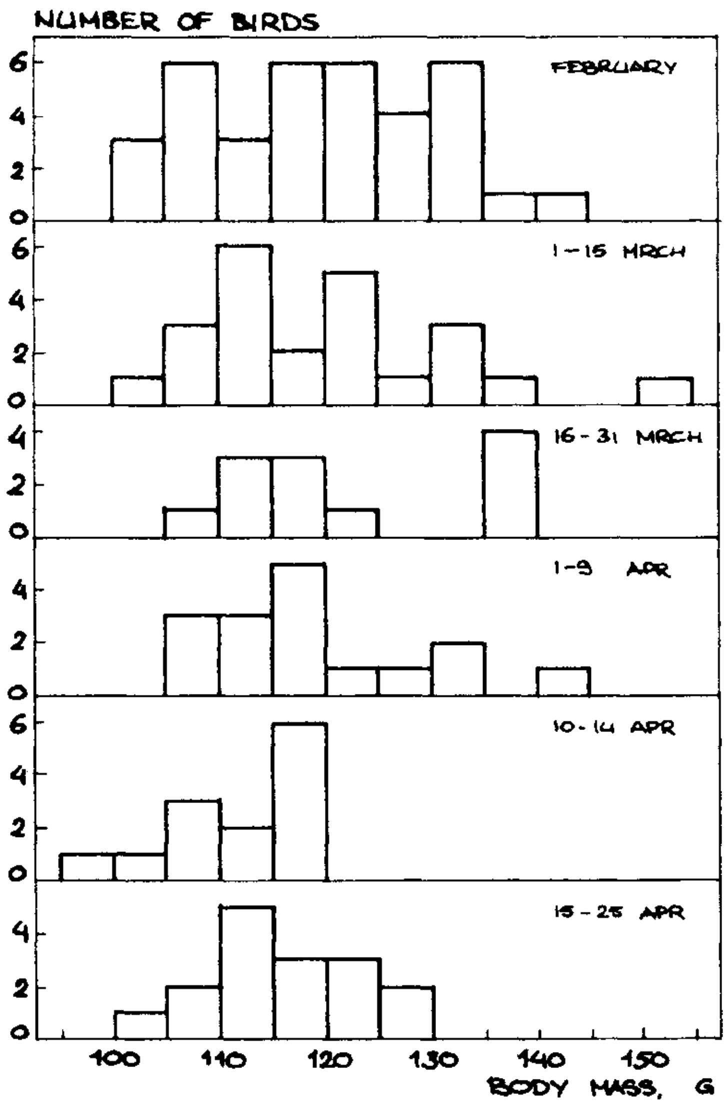


Figure 6.2. Variation in body mass of juvenile Knots on the Banc d'Arguin in February-April 1985/86.

juveniles heavier than 130 g after 10 April may indicate an early departure of Knots from the Banc d'Arguin. Since it is clear that second calendar year birds do not put on fat in April to depart with the adults to the north in late April/early May, it is possible that there are early leaving juveniles who go southwards e.g. to possible summering areas in Guinea-Bissau. This hypothesis clearly needs testing.

6.3.2 Adults. Body masses of adult Knots show a large variation, even within periods and especially from April onwards (Fig. 6.3). Part of this variation may be due to variations in structural size, as is indicated by the positive correlations between mass and various body dimensions, especially bill and total head length (Table 6.5). There were no

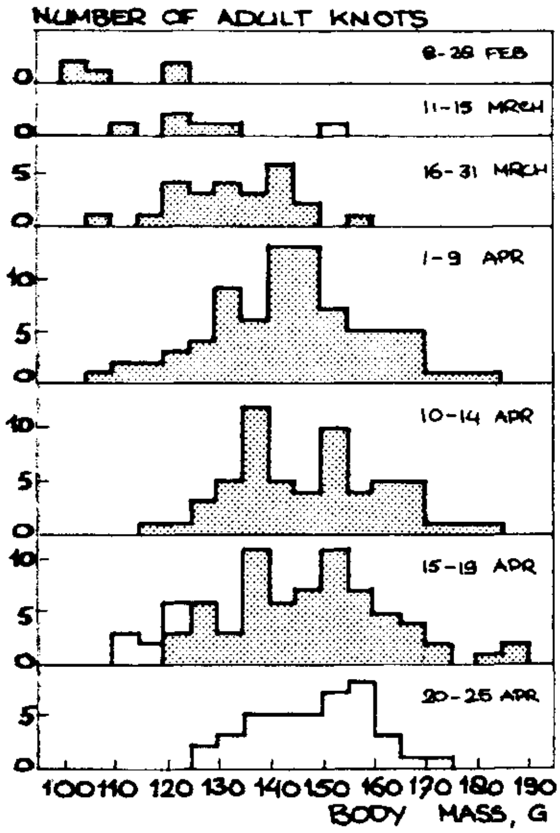


Figure 6.3. Body mass changes of adult Knots on the Banc d'Arguin in the springs of 1985/86. The shading refers to birds presumed to belong to one 'migratory cohort'. Open areas indicate a group which may include lighter and later arriving birds, and excludes some early leaving, heavy ones.

Table 6.4. Body mass (g) of juvenile (second calendar-year) Knots on the Banc d'Arguin in the springs of 1985 and 1986. Since there were no detectable differences between the two years, the data were taken together. Body mass was corrected for loss after capture.

Period	Average	S.D.	(n)	Minimum	Maximum
8-18 February	120.5	10.4	(36)	102.2	117.0
1-15 March	120.1	11.5	(23)	103.6	150.6
16-31 March	123.0	10.7	(12)	108.2	138.0
1- 9 April	119.8	10.0	(16)	106.1	142.2
10-14 April	112.3	6.1	(13)	98.5	118.8
15-19 April	117.6	6.3	(14)	109.0	129.4
20-25 April	113.5	13.3	(2)	104.1	123.0
Total	119.2	10.0	(116)		

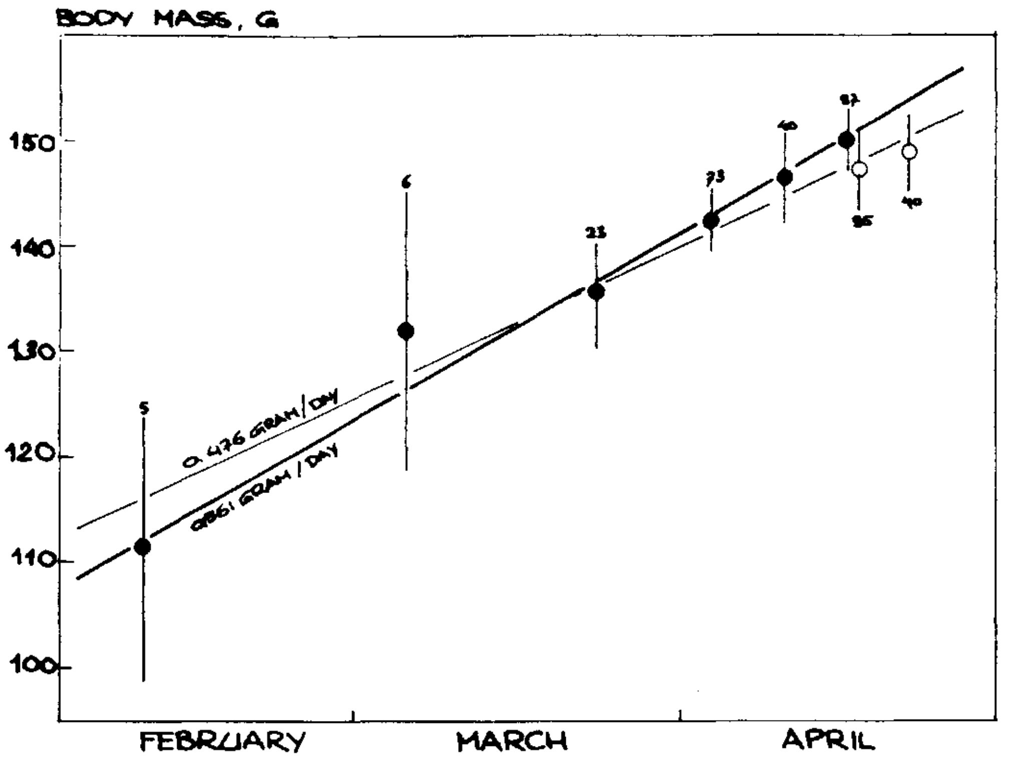


Figure 6.4. Average increase in body mass of adult Knots on the Banc d'Arguin in the springs of 1985/86. The thin line describes the linear regression through all data points (r^2=0.43) and the thick line (r^2=0.21) excludes the data from the last period and the birds with low body masses from the period 15-19 April (white area in figure 9.6.3). The dots give averages ± 95% confidence intervals.

Table 6.5. Pearson correlation coefficients between different structural size variables and body mass of adult Knots on the Banc d'Arguin in different periods in the springs of 1985 and 1986. Single underlined values are significant at the 5% level and bold typed values at the 0.5% level. The remaining correlation coefficients are not statistically significantly different from zero.

	8-28 Feb (n=5)	1-15 Mar (n=6)	16 Mar-9 Apr (n=94-96)	10-19 Apr (n=131-132)	20-25 Apr (n=40)
Wing	0.378	0.281	**0.303**	**0.457**	**0.594**
Bill	-0.491	<u>0.776</u>	**0.372**	**0.512**	**0.406**
Total head	-0.525	0.700	**0.350**	**0.519**	**0.427**
Tarsus + toe	0.557	0.537	<u>0.251</u>	**0.375**	<u>0.323</u>

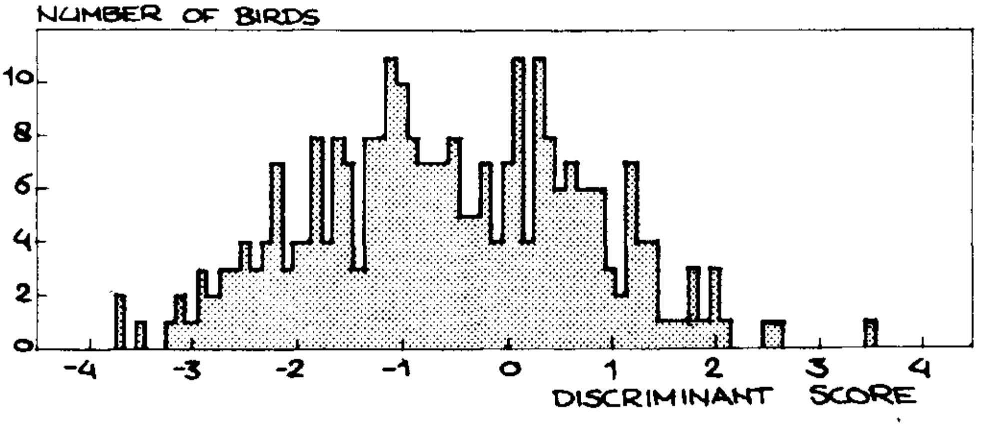


Figure 6.5. Discriminant scores of adults Knots caught on the Banc d'Arguin in the springs of 1985/86, based on the discriminant formula derived by M. Engelmoer from measurements of sexed museum skins of Siberian Knots: Discriminant Score = (0.1851333 * WING) + (0.4909321 * BILL) - 49.21633. Wing and bill in mm.

differences between the two years. Average body mass increased linearly from February onwards, but showed a small decline in late April. This decline is likely to be due to the arrival of light birds on passage, probably coming from the south, and by departure of some of the heaviest birds. This is indicated by the 'new' light birds which show up in the overall diagram for the period 15-19 April and the obvious loss of many of the heaviest birds (Fig. 6.3). This coincides with a decrease in the extent of summer plumage of adults birds caught in the last two periods (below, Fig. 6.8.). A linear regression line through all available data points yields an estimated body mass increase of 0.476 g/day (Fig. 6.4.). If we leave out the lightest birds from the period 15-19 April and all data points from 20-25 April (Fig. 6.3: the unshaded part), we arrive at an estimated average body mass increase of 0.561 g/day (Fig. 6.4.).

The positive correlations between body mass and linear measurements (Table 6.4) indicates that part of the body mass variations may be due to the sexual dimorphism (females are larger than males). Figure 6.5 shows a diagram of the discriminant values of our birds from a function to distinguish between males and females (kindly provided by Meinte Engelmoer). Birds with discriminant scores smaller than 0 should be males, and with scores larger than 0 females. Figure 6.6 shows the body mass increases for the two sex-groups. Females show a linear body mass increase of 0.56 g/day and males of 0.52 g/day. If we do the calculations with a somewhat safer sexing criterium (e.g. discriminant scores smaller

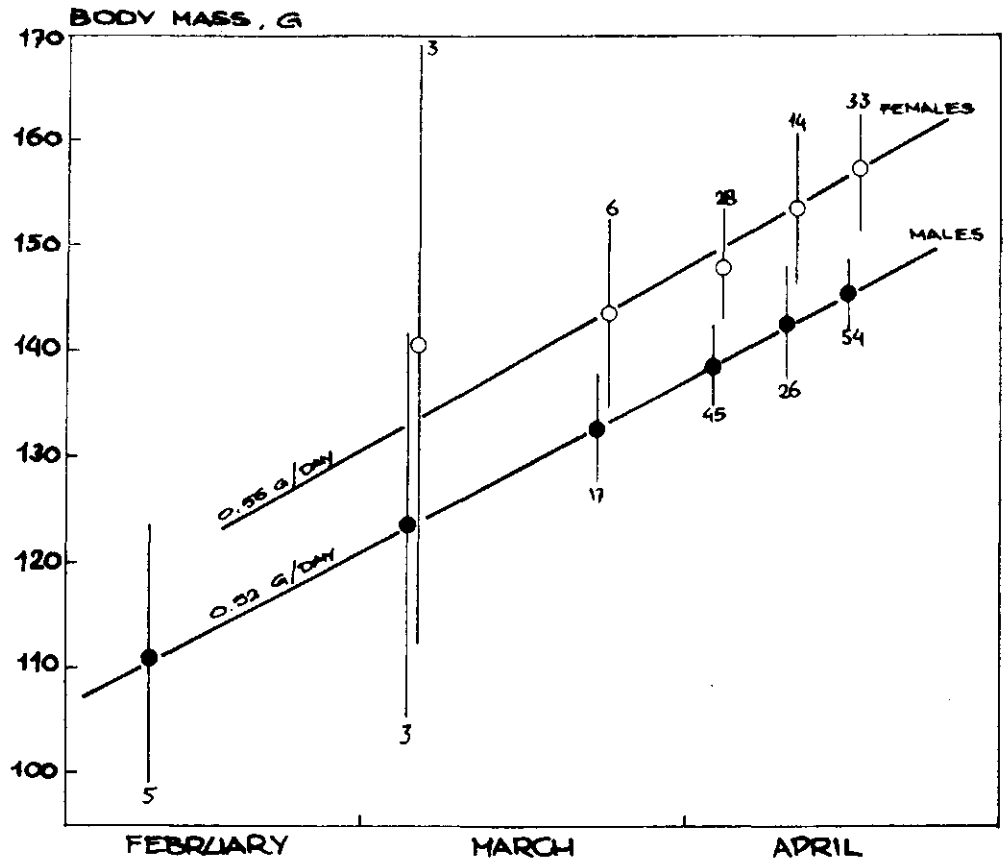


Figure 9.6.6. Body mass increases of adult female and male Siberian Knots caught on the Banc d'Arguin in 1985/86, excluding the light birds and those from the last catching period (cf. Fig. 9.6.3). The birds were sexed according to the discriminant function presented in figure 9.6.5. The dots give averages ± 95% confidence intervals.

or larger than 0.8), the results are the same, although the explained variances are somewhat lower.

Arrival times in West Europe (Piersma, Bredin & Prokosch in prep.) indicate that the Knots should be leaving the Banc d'Arguin during the first few days of May. An extrapolation of the average body mass increase (Fig. 6.4), suggests that the average departure mass would be about 160 g. This is 20 g less than the predicted departure mass on the Banc d'Arguin, as estimated by Dick et al. (1987: Fig. 9) from arrival masses in Schleswig-Holstein (the inferred next stopover site) and the flight range formula of Davidson (1984a). Note, however, that the 'disappearance' of birds weighing 170-190 g between 15-19 and 20-25 April (Fig. 6.3) indicates that some birds may leave with predicted body masses. The average mass increase of 0.56 g/day on the Banc d'Arguin is far less than the average mass increase of 3/day measured at Langebaan Lagoon in South Africa and 4 g/day in the Wadden Sea (Dick et al. 1987).

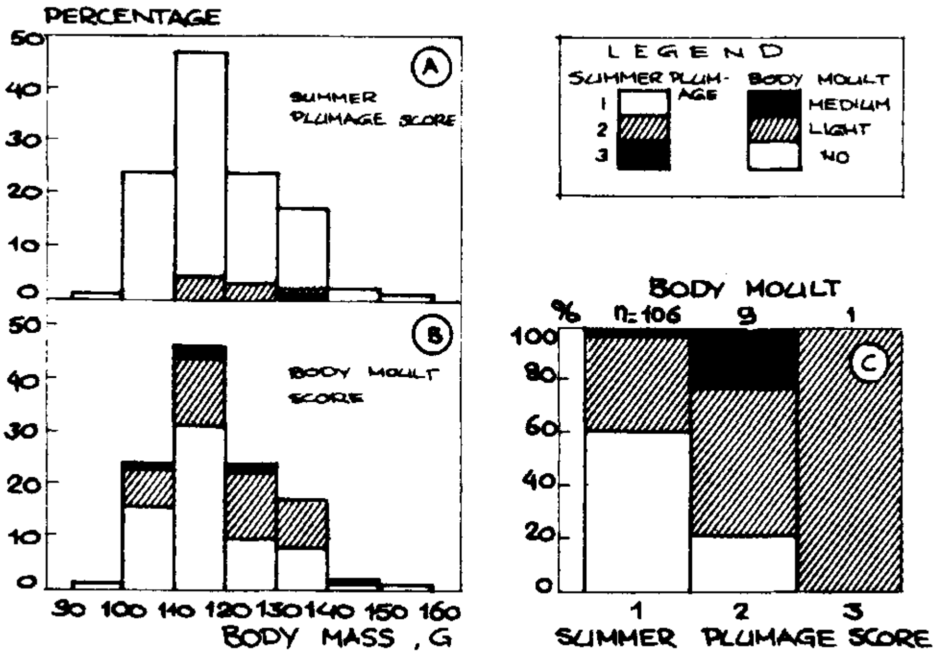


Figure 6.7. Summer plumage and body moult scores in relation to body mass of juvenile Knots caught on the Banc d'Arguin in the springs of 1985/86 (A,B) and the interrelation between the extent of summer plumage and body moult score (C). A plumage score of 1 stands for full winter plumage, 2 for trace of summer plumage and 3 for a quarter summer plumage.

6.4 Body moult and the acquirement of summer plumage

6.4.1 Juveniles. The great majority of captured juvenile Knots showed no body moult and no change from winter to summer plumage. There was no obvious relation with body mass (Figure 6.7 A,B). Juvenile birds with more summer plumage incidentally showed a higher intensity of body moult (Fig. 6.7 C). The general lack of formation of summer plumage supports the interpretation based on (the lack of) body mass changes, that the great majority of juvenile Knots remains at least one summer on their wintering grounds.

6.4.2 Adults. Data on the extent of summer plumage of adult Knots (Fig. 6.8), show that the birds produce a summer plumage in the period early March-late April. Body moult is most intense in late March-early April. A comparison between the data collected from 16 March to 19 April in the two years, gives some suggestion that the Knots may have been slightly more advanced in 1986, or that in 1985 there were more birds which lagged behind as far as the development of summer plumage was concerned. Although this is not clear from an examination of the averages (Fig. 6.9), the suggestion is supported by measurements of the extent of

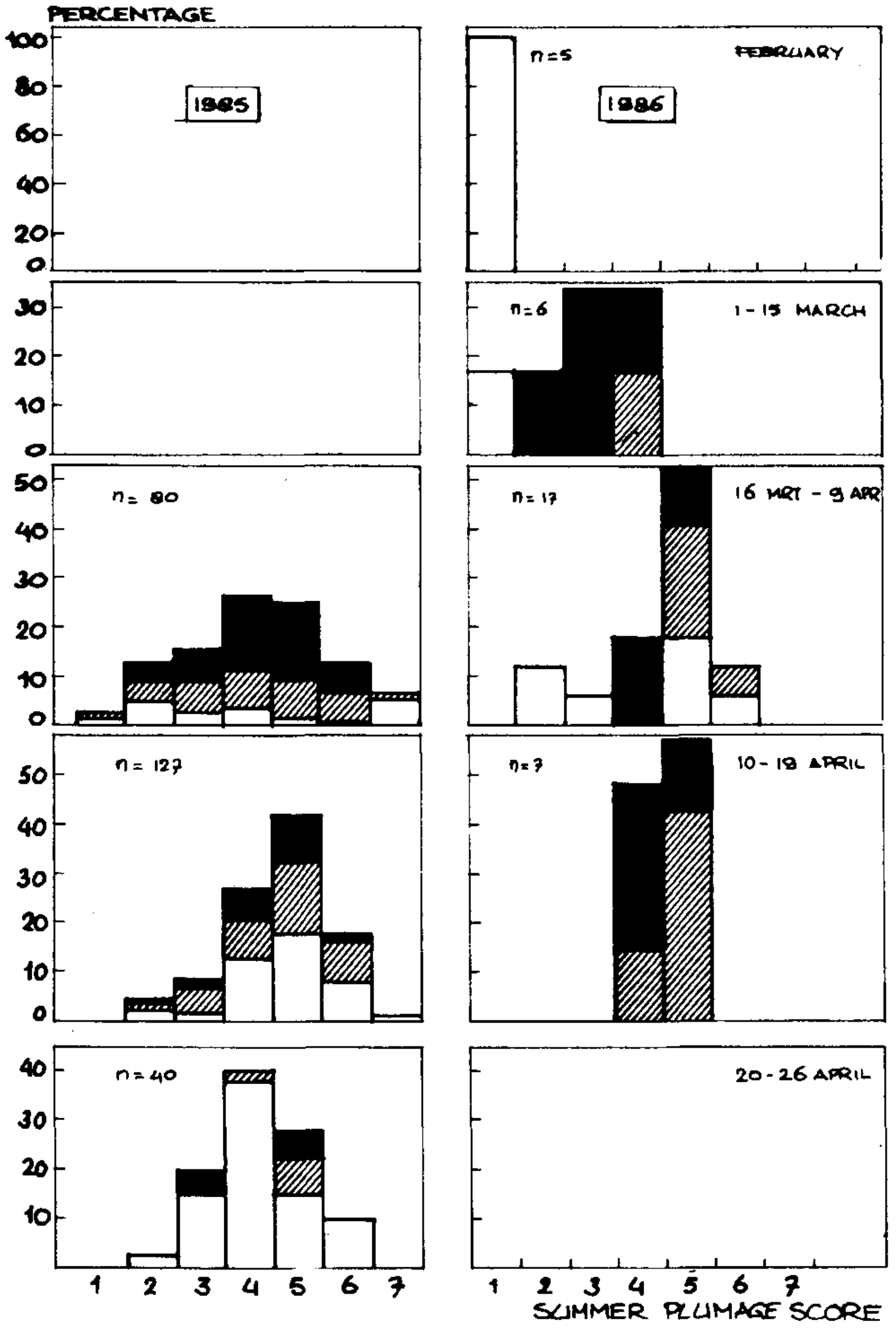


Figure 6.8. Development of the summer plumage of adult Knots on the Banc d'Arguin in the period February-April in 1985 and 1986, in relation to body moult. Heavy shading refers to birds in medium or heavy body moult, light shading to birds in light body moult and no shading to birds without body moult. A summer plumage score of 4 stands for half summer plumage, 5 for 3/4 summer plumage, 6 for trace of winter plumage and 7 for full summer plumage.

summer plumage at West European stopover sites (Piersma, Bredin & Prokosch, in prep.): they show that in the same time of the year Knots had a more fully developed summer plumage in 1986.

Figure 6.10 shows two things: birds with a more advanced summer

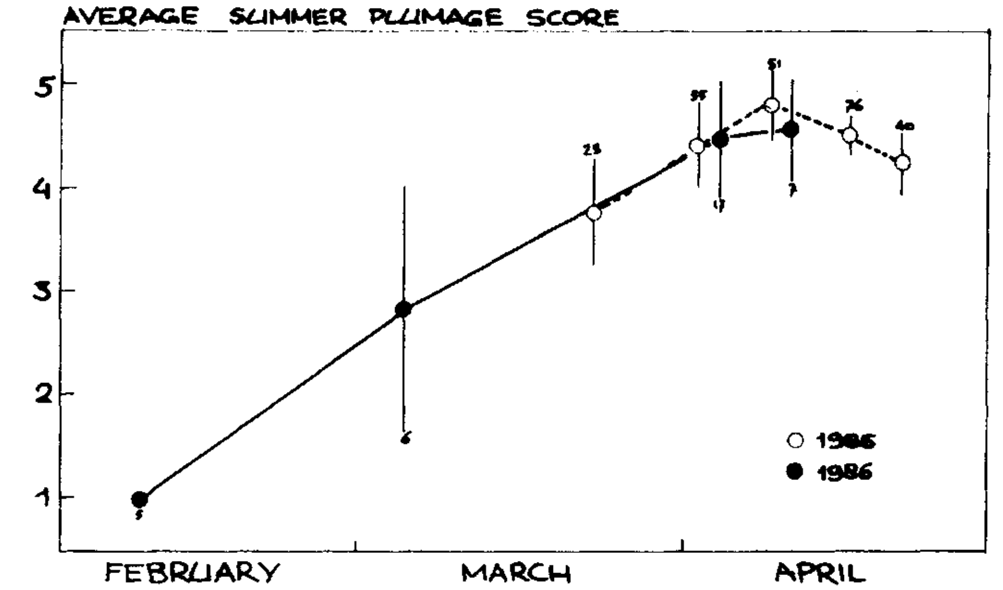


Figure 6.9. Changes in the average summer plumage score of adult Knots on the Banc d'Arguin in the course of spring (1985/86). Averages ± 95% confidence intervals are given.

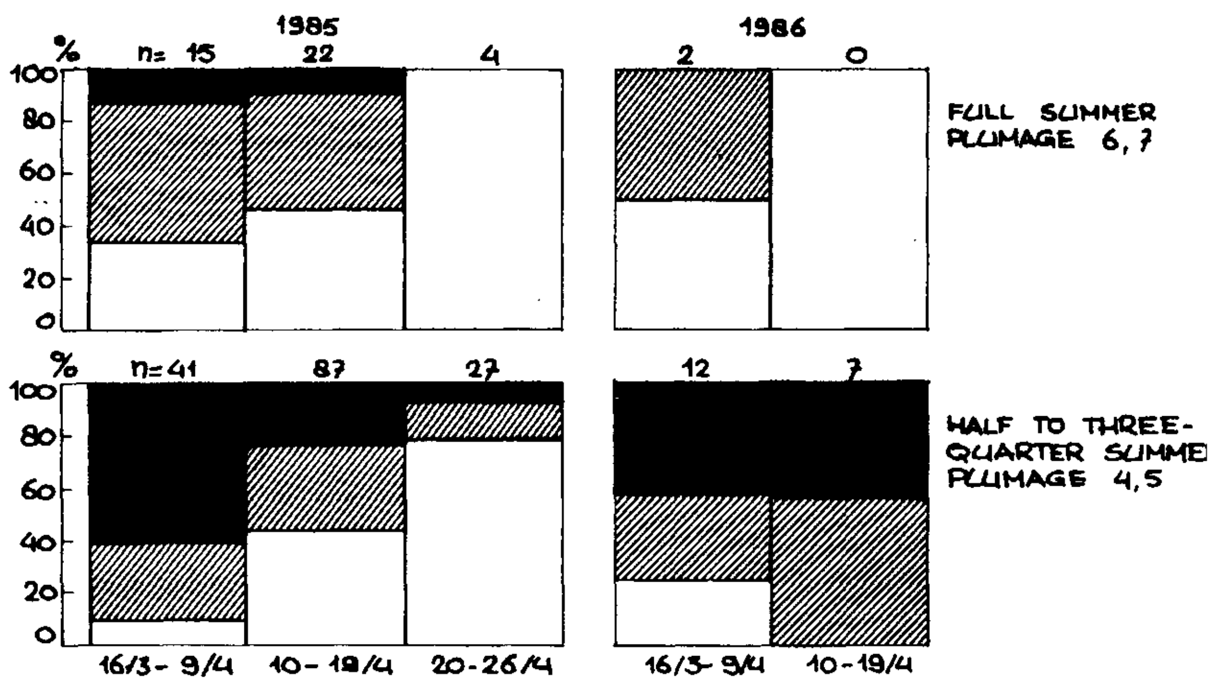


Figure 6.10. Interrelations between the extent of summer plumage and body moult intensity of adult Knots during the springs of 1985/86 on the Banc d'Arguin. Heavy shading refers to birds with medium or heavy body moult, light shading to birds with light body moult and no shading to birds without any traces of growing belly and breast feathers.

plumage show smaller body moult intensities, and: later in spring birds with a more, but also with a less advanced summer plumage, show little or no body moult. This strongly suggest that before departing to the north birds stop body moult. This is even the case when the summer plumage is not yet fully completed: the 'decision rule' whether to finish summer plumage, or to stop body moult and leave summer plumage incomplete as to be able to migrate, appears to change in the course of the spring season.

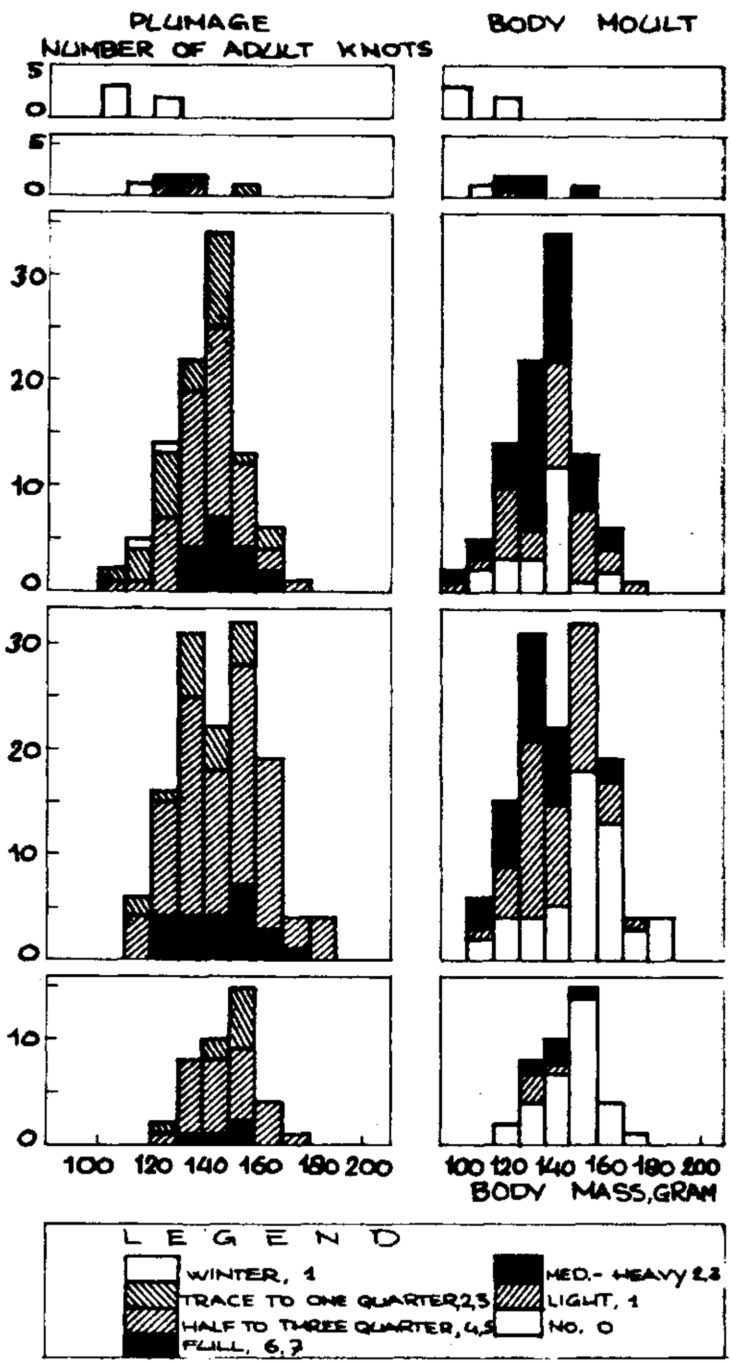


Figure 6.11. The development of summer plumage and the intensity of body moult in relation to body mass and the time of the year in adult Knots on the Banc d'Arguin (1985/86).

7 **Sanderling (Calidris alba)**

Cor J. Smit & Tom M. van Spanje

7.1 Introduction

As compared to other wader species Sanderlings are relatively uncommon on the Banc d'Arguin. Altenburg et al. (1982) counted almost 34,000, which amounts to only 1.5% of the total number of waders wintering in the area. Numbers in the Baie d'Aouatif varied from 479 to 938, those in Ebelk Aiznai (Northwest Bay) ranged from 30 to 495. These data however, do not show a consistent pattern. Numbers went up from 30 to 495 from 24 March to 22 April, and down, up and down again during the following counts. These fluctuations may be a result of migration, though the possibility of changing populations using Ebelk Aiznai as a high tide roost should not be excluded.

During low tide Sanderlings are most numerous on barren sandflats (mean 16 birds/ha). In low densities (1-2 birds/ha) they are also found on sandy Arca and sandy seagrass flats (Altenburg et al. 1982) as well as along the edges of the larger channels. During high tide they are also seen feeding on dried fish and human food waste in the village of Iouik. Occasionally they were also seen feeding in the camp.

7.2 Catches

Adding up the results of both study years a total number of 54 Sanderlings was caught at the Banc d'Arguin. One other bird was found alive in Nouadhibou, caught by children in a snare. It was ringed and released. Most Sanderlings (28) were captured during high tide in the village of Iouik, the great majority of these in clap nets after attracting the birds with dried fish or fish waste. Another 16 birds were mist-netted on the Arca flats on the opposite side of the camp (site 5, Fig. 7.1). Using the methods outlined by Prater et al. (1977) 22 birds were aged as second calendar year birds, 31 as adults. Two other birds could not be aged successfully. There is a striking difference in age composition between catches, the number of second calendar year birds dominating in February (10 second calendar year birds and 2 adults in February 1986), the number of adults dominating in April (5 second calendar year birds and 26 adults in April 1985). During the Oxford and Cambridge Mauritanian expedition in September-November 1973 (Dick 1985) 110 Sanderlings were caught, 29% of these being juvenile birds. For the moment sample sizes still are too small to speculate on the background of these differences.

Table 7.1. Body measurements (in mm) of Sanderlings captured at the Banc d'Arguin in February-April 1985 and 1986.

	2nd c.y. average ± S.D. range, number	Adult average ± S.D. range, number	All birds average ± S.D. range, number
Wing length	123.3 ± 2.9 117-131; n=21	126.8 ± 3.7 118-133; n=31	125.4 ± 3.8 117-133; n=54
Bill length	24.8 ± 1.3 21.7-27.6; n=22	24.6 ± 1.9 20.9-27.9; n=31	24.7 ± 1.6 20.9-27.9; n=55
Total head length	50.0 ± 2.0 46.8-57.3; n=22	50.0 ± 1.8 45.5-53.1; n=31	50.0 ± 1.9 45.5-57.3; n=55
Tarsus plus toe	44.1 ± 1.4 41-47; n-21	45.0 ± 1.3 43-47; n=31	44.6 ± 1.4 41-47; n=54

All 1985/86 captured birds were newly ringed. No retraps (own birds) or controls (foreign birds) were obtained. Eight birds out of the 1986 catch were used for cage experiments.

7.3 Biometrics

Body measurements of Sanderlings captured in 1985 and 1986 are given in Table 7.1. Adult wing lengths are very similar to values found by Dick in 1973 (mean 126.6 ± S.E. 0.31 for new primaries). Wing lengths of juvenile birds caught by the 1973 expedition were somewhat longer (mean 124.8 ± S.E. 0.35), but this difference is not significant ($p>0.05$, t-test). The same has been found in other species, e.g. for Little Stint, and could be a result of feather abrasion in autumn and winter. There is no difference in bill lengths between second calendar year birds and adult birds. This applies both for the 1973 data as well as for those from 1985/86. Mean bill lengths of both age classes, however, were about 0.5 mm shorter in 1985/86 as compared to Dick's values. Again this difference is not significant.

Table 7.2 shows that biometric parameters and weight are highly correlated. A very high correlation was found for bill length and total head length.

Table 7.2. Correlation coefficients of weight and biometrics of Sanderlings (all age classes), n=55. Coefficients significant at the 0.05 level are marked with *, those at the 0.01 level with ** and those at the 0.001 level with ***.

	Weight	Wing length	Bill length	Total head length
Wing length	0.5826***			
Bill length	0.5047***	0.4417**		
Total head length	0.4075**	0.4368**	0.7924***	
Tarsus plus toe	0.3811**	0.4713***	0.3148*	0.3556**

7.4 Weights

Weights used in this chapter have been corrected for weight loss between catching and weighing. Data of only 6 birds were available for correction. Assuming weight loss is linear the following equation was found:

$$\text{corrected weight} = \text{uncorrected weight} + (0.52\ T_{dif} - 0.41)$$

where T_{dif} = time in hours between first and second weight. Application of this equation leads to an approximate weight loss of 0.5 g/h. Despite the small number of birds this figure is based upon, it is in rather good agreement with earlier findings. Schick (1983) found that Sanderlings lost 1.2 g of their initial weight in their first hour of captivity. In the following hours weight loss dropped to 0.4 g/h, again later to 0.3 g/h. At the Banc d'Arguin Sanderlings were kept 4.04 hours $\pm$ S.D. 2.47 (n=50) on average between catching and weighing.

Corrected weights of second calendar and adult Sanderlings are given in table 7.3. Dick (1975) found 43.9 $\pm$ S.E. 0.57 g for juveniles and 45.4

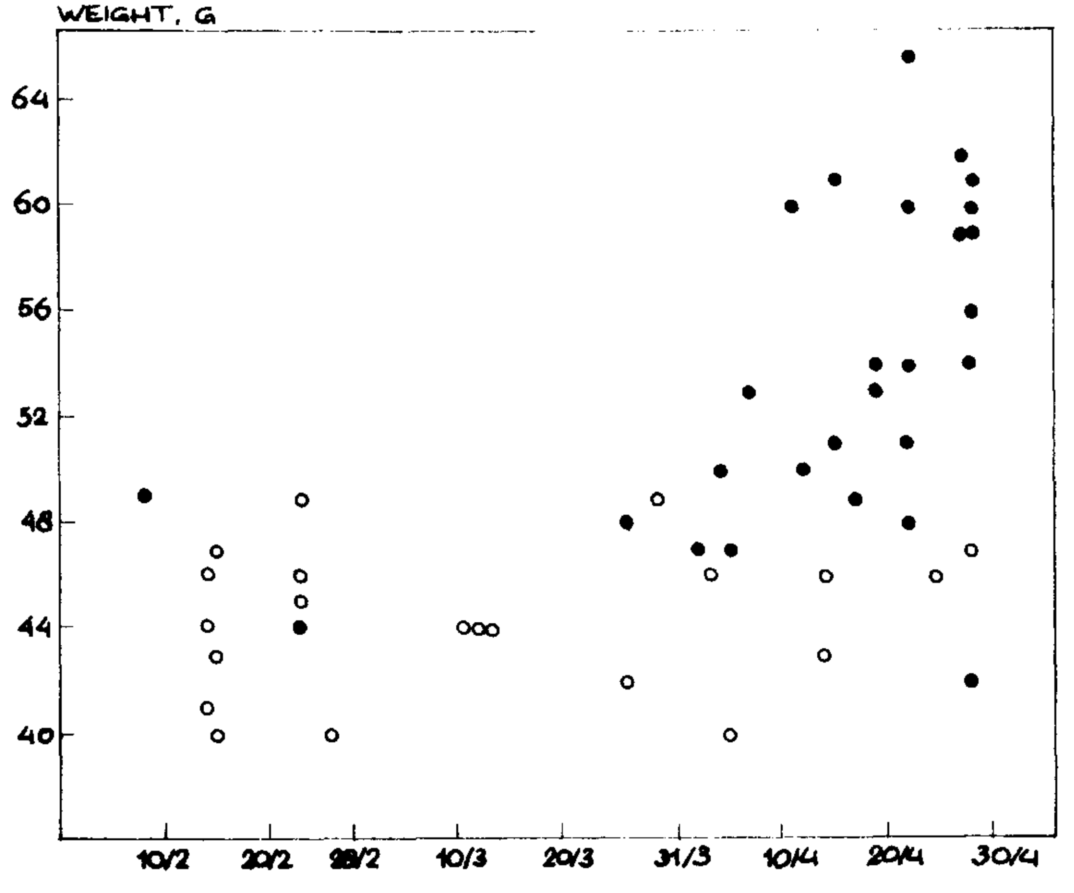


Figure 7.1. Weights (grams) of Sanderlings, captured at the Banc d'Arguin in February-April 1985/86. OPen circles refer to second calendar year birds, dots to adults. Weights have been corrected for weight loss between catching and weighing.

± S.E. 0.39 for adults in September-November 1973. Though the sample size of our February catches is small, weights may be considered comparable to those found in 1973. Once again (following Dick 1975) we may conclude that Sanderling weights in Mauritania in winter are the lowest found anywhere.

Three birds, died during capture or during their stay in the cages, were analysed on fat content afterwards. Results of this analysis and biometric data are given in table 7.4. Lean weight figures are considerably below the 55 g we arrive at when applying the lean weight equation given by McNeil & Cadieux (1972).

Weights, especially of adult birds, increase in the course of time. Figure 7.1 demonstrates that adult weight increase probably starts around mid March. Because very little information is available for February and March it is impossible to be more explicit about the start of the fattening up. More or less the same applies for the fattening up of

Table 7.3. Corrected mean weights (grams) of second calendar year and adult Sanderlings captured at the Banc d'Arguin in February-April 1985/1986.

Month	2nd c.y. average ± S.D. range, number	Adult average ± S.D. range number
February	44.1 ± 3.1 40-49; n=10	46.5 ± 3.5 44-49; n=2
March	44.6 ± 2.6 42-49; n=5	48.5 ± 0.7 48-49; n=2
April	44.7 ± 2.7 40-47; n=6	54.5 ± 6.0 42-66; n=24

second calendar year birds. The few young birds captured in April do not show a very obvious weight increase, suggesting that they summer at the Banc d'Arguin or leave later as compared to the adults. A linear regression of adult weight increase over April yields 0.36 g/day, which is high as compared to Redshank (same increase but a larger bird), but somewhat lower as compared to Dunlin. Migrant individual Dunlins, retrapped while depositing fat in Great Britain, increased in weight at mean rates of 0.7-1.0 g/day. In Sweden Dunlins even gained 1-3 g of weight per day (Pienkowski & Evans 1984). Maximum weights of Sanderlings at the Banc d'Arguin by the end of April amounted to 59-66 g. This is low as compared to spring weights from Britain (mean weights from June 74.0 g, n=234; Johnson 1985) and South Africa (departing weights estimated at 95 g; Summers et al. 1987). Assuming a flight speed of 65 km/h (McNeil & Cadieux 1972) and a lean weight of 46 g, Sanderlings of 59-66 g have a

Table 7.4. Biometrical data (mm) and weights of three Sanderlinsg analysed on fat content (data by Nelly van Brederode).

Date	Age	Fresh weight	Wing length	Bill length	Total head	Tato	Lean weight
13 April 1985	ad.	56	125	25.5	51.5	44	49.7
14 Feb. 1986	2nd c.y.	44	120	25.3	49.6	44	39.6
15 Feb. 1986	2nd c.y.	47	124	25.3	50.7	46	40.3

potential flight range if 1,500-2,300 km (Davidson 1984). This fat load will bring them to the Moroccan coast, and it means that their flight range is only half the size, or less, as compared to Sanderlings from Britain and South Africa. This may implicate that Sanderlings captured at the Banc d'Arguin either were still in the process of fattening up, or that flight ranges of birds leaving the Banc d'Arguin simply are rather small. According to Dick (1975) Sanderlings are numerous along the Mauritanian mainland coast between Cap Timiris and Nouakchott. The same applies for the Sénégalese coast where De Smet & Van Gompel (1979)

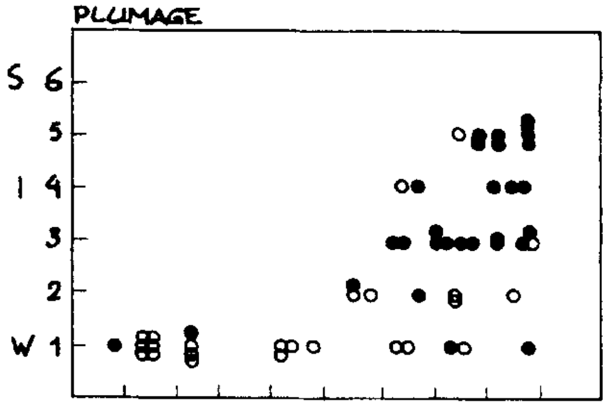


Figure 7.2. Plumage of Sanderlings at the Banc d'Arguin in February-April 1985/86. Open circles refer to second calendar year birds, dots to adults.

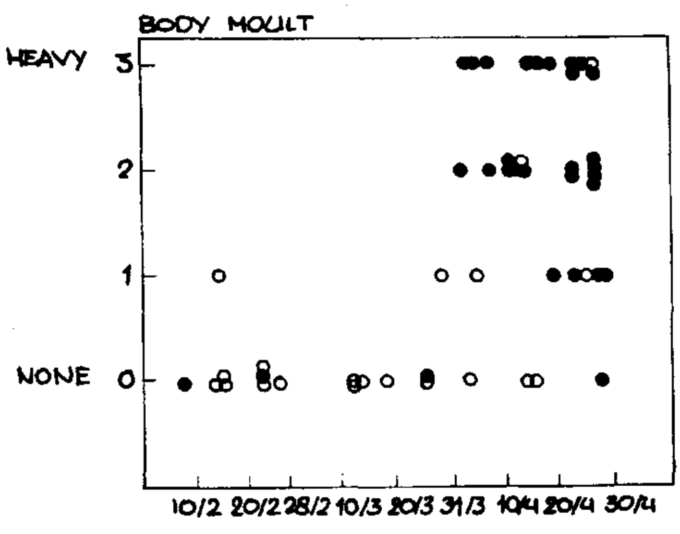


Figure 7.3. Body moult of Sanderlings in the course of spring at the Banc d'Arguin. Open circles refer to second calendar year birds, dots to adults.

counted over 6,000, being the most numerous wader species. The same may apply for sand beaches further north along the African coast. A possible explanation for the rather low weights at the Banc d'Arguin therefore may be that the birds do not migrate over large distances. Since we have no records of visible migration and counts only yielded varying numbers, the first explanation (birds still were in the process of fattening up by the time the expedition left the Banc d'Arguin) still remains open. In western Europe high numbers of Sanderlings are recorded in the third May decade (Smit 1987). This may imply that departure from the Banc d'Arguin occurs relatively late.

7.5 Plumage

From the end of March onwards, Sanderlings start coming into summer plumage by moulting body feathers (Figures 7.2 and 7.3). The start of body moult lags behind about 1-2 weeks after Sanderlings start building up fat reserves for migration. It is striking that by the end of April no birds at all have attained full summer plumage, though they are in heavy body moult. This means that Sanderlings either continue their body moult while on migration or do not leave yet until plumage moult has been partly or fully completed. Our findings corresponds with literature

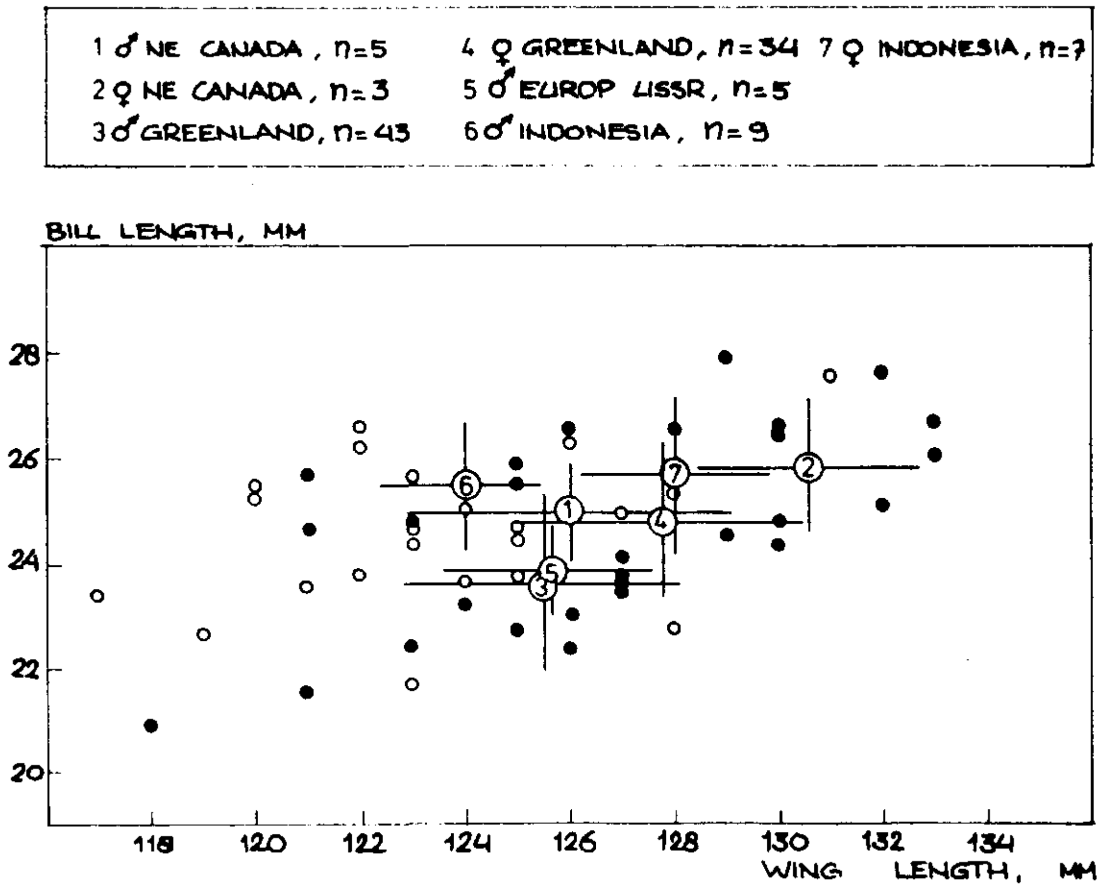
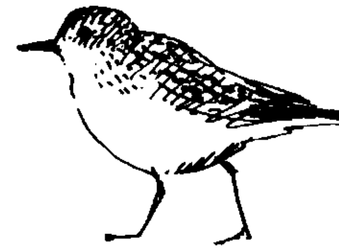


Figure 7.4. Wing length - bill length relation of Sanderlings captured at the Banc d'Arguin and mean lengths and standard deviations of Sanderlings populations elsewhere (based on museum skins, corrected from shrinkage). Open circles refer to second calendar birds, dots to adults.

information. According to Cramp & Simmons (1983) adult Sanderlings moult part of their body feathers in the second part of April and in May, some feathers even being replaced as late as mid-July. Some second calendar year birds also show body moult and also attain some summer plumage. They do, however, lag behind the adults. Again this is in agreement with literature. According to Cramp & Simmons (1983) spring body moult in juveniles is highly variable and mainly takes place in May-June. One bird of unknown age, weighing 47 grams, captured on 28 April 1985 was in active wing moult in its outer two primaries (5555555543).

7.6 Geographical origin and migration

An analysis of the wing length-bill length relation of birds caught in Mauritania in 1985/86, together with biometric data from breeding areas in the nearctic and some stop-over and wintering sites in the Palearctic (Fig. 7.4) yields no information on the possible origin of the Mauritanian birds. There is a considerable overlap in sizes between Nearctic and Palearctic breeding populations and the pattern is even more obscured by the size difference between sexes. Birds caught in Mauritania much variation, both in wing length and in bill length. It is striking that some relativly small-winged and small-billed birds have been caught, both second year birds and adults. These measurements point towards West Siberian birds. Uspenski (1969) gives wing lengths of 115-124 mm (mean 118.6) for 30 females from Siberia (exact location unknown) and 115-126.5 mm (mean 121.9) for 30 females. Bill lengths of this population are 20.8-26.0 for males and 20.2-27.6 for females. The lower part of the range of measurements of birds encountered in Mauritania is below the one found in Nearctic birds (Cramp & Simmons 1983, Engelmoer 1984). These measurements however do coincide with small-winged and small-billed birds captured in South Africa (Summers et al. 1987). of the latter population have been recorded in Siberian breeding sites and stop-over areas along the Black Sea, Caspian Sea and Mediterranean, the latter areas also pointing to migration towards Siberian breeding areas. Additionally there is one May-resighting of a 1985 dyed Sanderling from the Schleswig-Holstein west coast, also pointing towards migration to Siberia. On the other hand there are three spring recoveries of Mauritanian ringed Sanderlings from the English west coast, birds probably belonging to the Greenland breeding population (Dick 1975). These data clearly suggest that Sanderlings of both Nearctic and Palearctic origin are wintering at the Banc d'Arguin.



Mark R. Fletcher

8 Little Stint (*Calidris minuta*)

8.1 Introduction

Little Stints are very common and fairly numerous over most parts of the area of the Banc d'Arguin and Iouik. These birds were observed feeding over the muddy arca areas of the mudflats at any time this was exposed and, to a lesser extent, feeding occurred at the waters edge.

8.2 Ringing studies

A total of 274 individuals were caught, all in mist nets. The majority were caught either at the line of nets near the airstrip and on the mudflats opposite the camp site. Some birds were even caught during daylight. The birds were netted in the Northwest Bay. Four birds were retrapped, one of which was retrapped twice. A single bird was controlled which had been ringed in Norway (see Table 7.8). Full biometrics were taken on all birds caught. The majority of birds caught were aged as adult (216, 78.8%) and fifty birds were aged as juveniles. There were eight birds that were not aged. The ageing technique used was that outlined by Prater et al. (1977). The juveniles were caught throughout the study period (8 February-22 April), with a larger proportion, about 25% of the population, at the first part of the study (8 February-5 April). The proportion dropped to about 7% in the remaining time. This contrasted with results obtained by Knight & Dick (1975) who found on the Banc d'Arguin 86% juveniles at the beginning of October, 82% at the end of October and 60% in mid-November.

8.3 Biometrics

The mean wing length of all birds caught which had wings that could be measured, i.e. outer primaries were not in moult, was 97.9 mm (S.E. $\pm$ 0.20). The range was 91-106 mm (n=231). Juvenile wing lengths had a mean of 97.4 mm (S.E. $\pm$ 0.62), range 92-103 (n=34) and adults 98.0 mm (S.E. $\pm$ 0.22), range 91-106 (n=189). Female Little Stints have longer wing lengths than males and the range throughout the period of the study suggested that both female and male birds were present at all times. The wing lengths however were on average longer than those found by Etheridge (1971) in the Trucial States in late December (mean 95.5 mm, range 93-99 (n=7)). The adult wing lengths were very similar to those found by Dick (1975) mean 98.4 mm but the juvenile wing lengths found by Dick were on average longer 99.7 mm (n=46). Wing lengths at the lower end of the range in the study were smaller than those published in 'The Birds of the Western Palearctic' (Cramp & Simmons 1983).

The mean bill length of all birds (n=244) was 18.7 mm (S.E. ± 0.06) with a range of 15.1-21.1 mm. For juvenile birds, mean bill length was similar to those of adults. The distribution of wing length is shown in figure 9.8.1.

Cramp & Simmons (1982) give a range for bill length of 16.7-19.9 mm for museum specimens. Seven birds were found to have bill lengths shorter than this range, with one bird very much shorter 15.1 mm. In addition

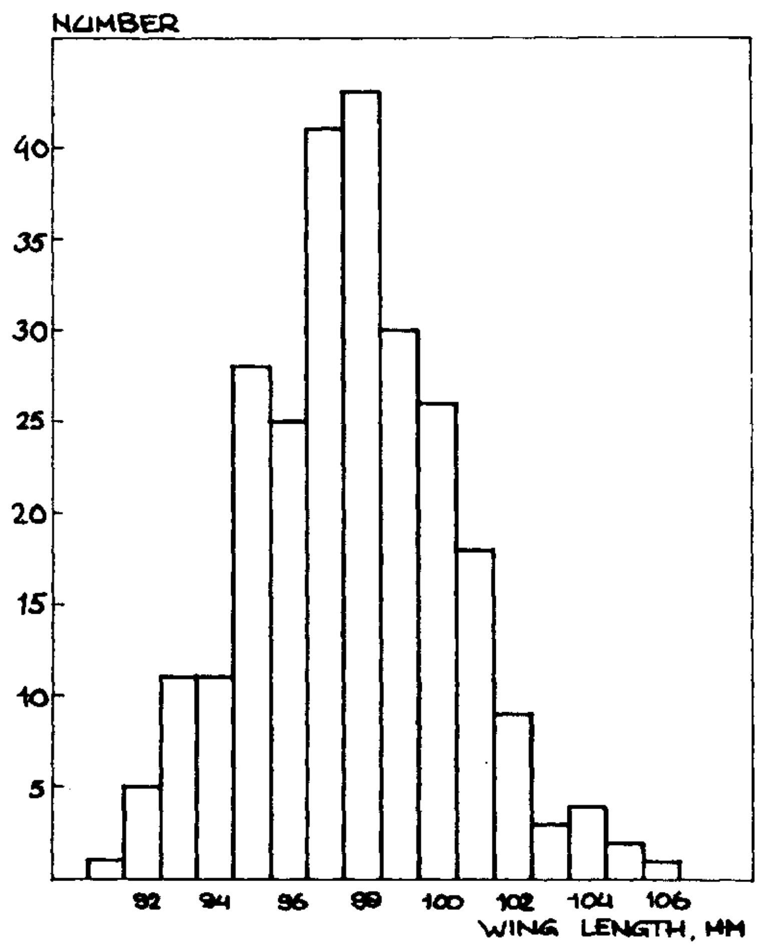


Figure 8.1. Distribution of wing lengths of Little Stints caught on the Banc d'Arguin in 1985/86.

nine birds had bills longer than the quoted range with one at 21.1 mm. In general the bill lengths were similar to those found by Dick (1975) in Mauritania and Etheridge (1971) in the Trucial States.

Other biometrics taken (other than weight, see below) included total head measurements, giving an overall mean of 38.7 mm (S.E. ± 0.07) and a range of 32.5-41.9 mm (n=244). The smaller billed birds also gave smaller head measurements giving confidence that recording errors were probably not made when measuring these smaller bills. There was no difference in the total head measurements of adults and juvenile birds.

The difference between sexes is significant for bill in Little Stints, male 18.1 mm (range 16.7-19.2 mm), female 18.5 mm (range 17.5-19.9 mm) as outlined by Cramp & Simmons (1983).

Also recorded was the combined tarsus + toe measurement. The average of this measurement was 39.7 mm (S.E. ± 0.1), range 36.0-47.0 mm (n=243).

There was no difference in the tarsus + toe measurements between juveniles and adults.

8.4 Weights

The mean weight for all Little Stints was 23.8 g (S.E. ± 0.2) with a range of 17.0-35.0 g (n=241). Juvenile mean weight was 21.4 g (S.E. ± 0.37), range 18.0-30.5 g (n=38) and adults 24.3 g (S.E. ± 0.23), range 17.0-35.0 g (n=195). These weights were taken throughout the study from 8 February to 22 April. Over this period the mean weight increased particularly for adult birds (Table 8.1).

Table 8.1. Mean weights (in gram) of Little Stints in three periods between 8 February and 22 April (1985 and 1986).

	8-13 Feb	1-9 Mar	13-16 Mar
All birds	20.8 g (n=11)	21.2 g (n=20)	21.5 g (n= 8)
Juveniles	23.0 g (n= 1)	20.3 g (n=10)	19.0 g (n= 2)
Adults	20.1 g (n= 9)	22.1 g (n=10)	22.6 g (n= 5)
	22 Mar-5 Apr	**10-16 Apr**	**17-22 Apr**
All birds	22.4 g (n=95)	25.0 g (n=122)	25.6 g (n=18)
Juveniles	20.9 g (n=23)	22.4 g (n= 10)	22.3 g (n= 1)
Adults	23.1 g (n=66)	25.3 g (n=112)	25.8 g (n=17)

However, often weights were recorded some time after the bird was captured and weight losses are known to occur with time. In several cases a second weight was taken after a known period of time in an attempt to assess this weight loss with time.

If it is assumed that this weight loss is linear, the following equation can be applied:

$$WDif = - 0.249 + 0.341\ TDif\ (r^2=0.54)$$

where WDif = difference in grams between first and second weight, and TDif = time in hours between the two weights.

This gives a weight loss of 0.3 g/h. It is probable that the weight loss in the first hour is greater than this, with a lower decrease in weight as time progresses. Because the time of capture was approximately known and the time of weighing was recorded, it is possible to correct the weights of the birds using the above equation. This was then used to give a mean corrected weight for all birds of 25.3 g and a range of 17.9-36.5 g. Juvenile mean weight was 25.5 g, range 17.9-36.5 g. Corrected mean weights over the the period of the study are shown in table 8.2.

Table 8.2. Corrected mean weights of Little Stints in time periods between 8 February and 22 April (1985 and 1986).

	8-13 Feb	1-9 Mar	13-16 Mar
All birds	21.4 g	21.6 g	21.8 g
Juveniles	23.7 g	20.7 g	19.1 g
Adults	20.7 g	22.5 g	22.9 g
	22 Mar-5 Apr	10-16 Apr	17-22 Apr
All birds	23.4 g	26.9 g	27.1 g
Juveniles	22.0 g	23.5 g	24.1 g
Adults	23.9 g	26.4 g	27.3 g

The weight increase with time is still present with the adult birds and this may show a pre-migratory increase at the Banc d'Arguin prior to departure northwards. Because this increase is not so apparent in juvenile birds it is possible that some may be passing through and feeding further north prior to migration or have increased their weights further south and are over-flying the Baie d'Aouatif. However care must be taken in interpreting the weights of the juveniles as the sample was small.

Dowsett & Fry (1971) showed spring weights of Little Stints at Lake Chad in 1967 to have a mean of 22.9 g with a range of 19.9-27.5 g (n=7) and in spring 1968 23.3 g, range 18.4-30.2 g (n=44), values lower than those found in April 1985.

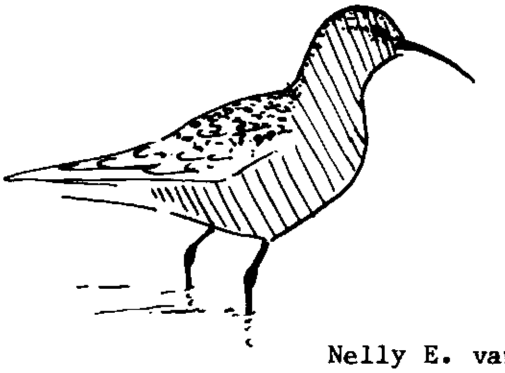
The mean weights in this study were also very much higher than those found by Dick (1975) in winter in Mauritania; juveniles mean weight 18.8 g (n=52), adults mean weight 22.0 g (n=19); and by Etheridge (1971) in late December in The Trucial States, mean weight 21.0 g (n=7).

8.5 Moult

The primary moult of Little Stints caught during the study in the Banc d'Arguin appears to be very complex. Moulting birds, both adults and juveniles were caught throughout the period of the study. In many cases the moult appeared to be complete with the apparent renewal of all primary feathers. This applied to the majority of adults (94%) and some juveniles (18%). Several birds were in the process of moulting all their primary feathers with moult scores between 22 and 49. In this category were many of the juveniles (36%) and a small number of adults (3.7%) and three unaged birds. The juveniles had a lower mean moult score of 35 compared with the adults which had a mean moult score of 46. Samples of both juveniles and adults moulting in this way were found throughout the study so they are not biased by the time of catching.

In another group of birds the moulting or remoulting of some of the outer primaries was found. There were 23 juveniles (46%) in this category. Pearson (1984) suggested when he found this in his study of Little Stints in the Rift Valley, Kenya, that these birds may have started moulting late, perhaps January-February. Five adults and two unaged birds were also moulting the outer primaries with old inner primaries. Pearson (1984) suggested for these birds that they may have moulted early the previous year and were remoulting these outer primaries. Stanyard (1974) suggested that early moulting Little Stints in Botswana were failed breeders. The number of other feathers being moulted varied considerably from very few to nearly all. There was one bird (juvenile) which showed arrested moult with a moult configuration of N^7O^3. Arrested moult in Little Stints has been recorded by Dowsett & Fry (1971) at Lake Chad, and Pienkowski et al. (1976) on the Atlantic coast of Morocco. In both these cases arrested moult was recorded in September.

Body moult was recorded in the majority of birds and there were birds caught showing full winter plumage right through various stages to full summer plumage.



Nelly E. van Brederode

9 Curlew Sandpiper (*Calidris ferruginea*)

9.1 Sex-, age-ratios and measurements

We captured 90 Curlew Sandpipers, 54 adults, 35 second calendar year birds (2nd c.y.) and one bird of unknown age. According to the discriminant function developed for adult birds by Engelmoer (1984), in which both bill and wing length are involved (y = 0.0747894 *wing length +0.4863466 *bill length -28.52034), our sample of adults comprised 23 females and 30 males. In one adult catching casualty sexing by dissection confirmes the prediction (Table 9.1). Bill length is the most discriminatory feature, so in most cases it is possible to separate males and females by using a bill length of 38.3 mm. Since bill and total head length are linearly related (r=0.96; Fig. 9.4) it is not surprising that total head length is also a sexually dimorphic feature (Fig. 9.1). Wing and bill length are not linearly related (Fig. 9.5), neither are wing and total head length (Fig. 9.6). Furthermore there is no clear bi-modality in wing length (Fig. 9.2). The only strongly sexually dimorphic feature or Curlew Sandpipers is therefore bill length (Fig. 9.3).

The mean bill length for adults (Table 9.2) does not differ significantly from those measured during two spring expeditions to Morocco (Kersten et al. 1983, T-test, df=55, t=0.69; Van Brederode et

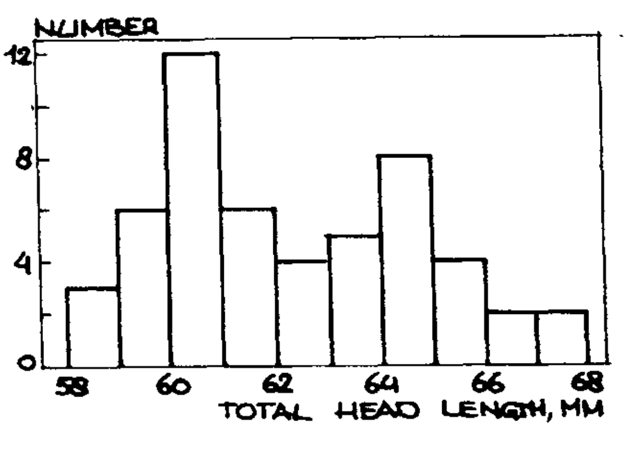


Figure 9.1. Frequency distributions of total head length of adult Curlew Sandpipers (n=52) caught at Iouik, Mauritania in 1985 and 1986.

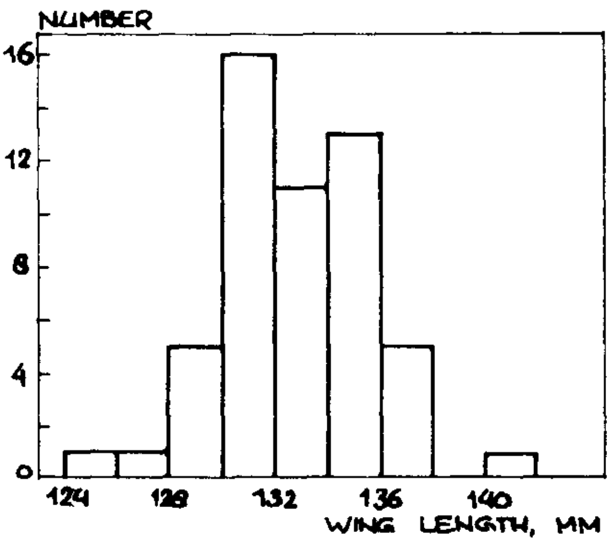


Figure 9.2. Frequency distribution of wing length of adult Curlew Sandpipers (n=53) caught at Iouik, Mauritania in 1985 and 1986.

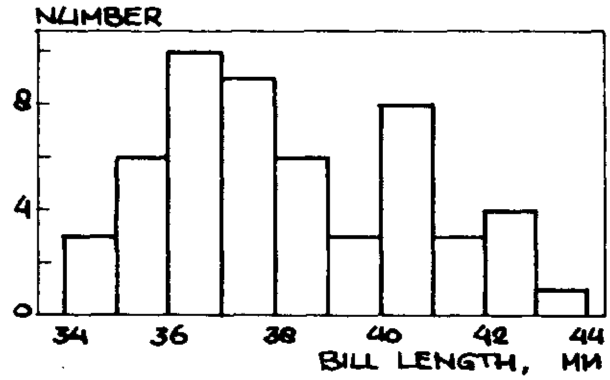


Figure 9.3. Frequency distribution of of bill length of adult Curlew Sandpipers (n=53) caught at Iouik, Mauritania in 1985 and 1986.

al., in prep., T-test, df=70, t=0.67), but does significantly differ from mean bill lengths measured during a winter expedition to Mauritania (Dick et al. 1975, T-test, df=402, t=2.35) and two autumn expeditions to Morocco (Pienkowski et al. 1972, T-test, df=63, t=5.10; Moser et al. 1980, T-test, df=87, t=2.00). The difference with the autumn figures is probably caused by the differential timing of autumn migration by males and females, the males migrating earlier and leaving to incubate and tend the young (Portenko 1959). In spring there is simultaneous northward migration (Elliott et al. 1976) and simultaneous arrival on the breeding grounds (Portenko 1959). The autumn figures from Morocco also illustrate this point: the mean bill length for adult birds caught in July and August is significantly lower than that for adult birds caught in September (Pienkowski et al. 1972; Moser et al. 1980; T-test, df=44, t=11.24). In Mauritania there is no significant difference at the 5% level between the number of adult males and females present in February compared with March (x^2=0, df=1) and in February and March compared with April (x^2=2.77, df=1).

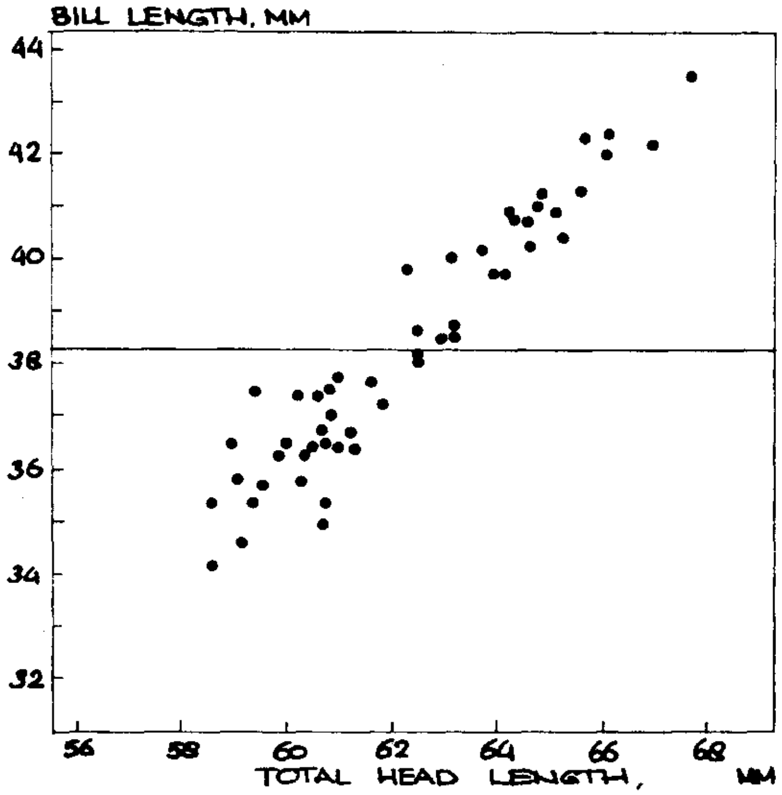


Figure 9.4. The relationship between bill and total head length in adult Curlew Sandpipers (n=52), y = -20.73 + 0.95x (r=0.96). The horizontal line divides the females (top) and males (bottom) according to the discriminant function (see text).

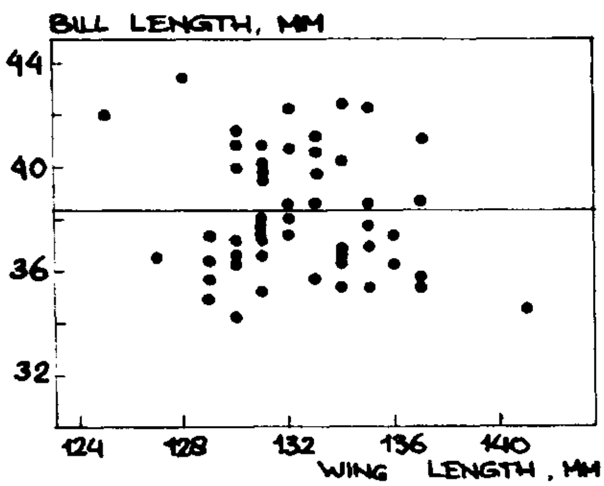


Figure 9.5. The relationship between bill and wing length in adult Curlew Sandpipers (n=52), y = 59.72 - 0.16 x (r=-0.20). The horizontal line divides the females (top) and males (bottom) according to the discriminant function (see text).

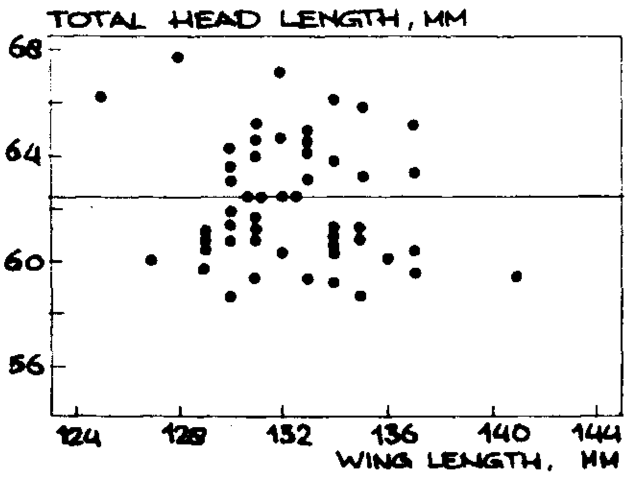


Figure 9.6. The relationship between total head and wing length in adult Curlew Sandpipers (n=51), y = 82.55 - 0.15x (r=-0.18). The horizontal line divides the females (top) and males (bottom) according to the discriminant function (see text).

In our data neither bill length (r=-0.08) nor wing length (r=-0.04) correlates well with weight during the spring period when there is no increase in weight yet (before 15 March), so these measures cannot be used as an indication for structural size.

In order to see how much weight birds might loose between time of capture and time of measurement, we measured rates of weight loss in a small sample of birds. One bird reweighed after one hour had lost 1.7 g, three birds reweighed after 4-5 hours lost on average 0.8 $\pm$ 0.4 g/h, eight birds reweighed after 10-12 hours lost on average 0.6 $\pm$ 0.06 g/h. The greatest rates of weight loss therefore occur in the first hours of captivity. The average weight loss of all 12 birds is 0.7 $\pm$ 0.4 g/h. In practice the time between capture and first weight is on average 4.4 $\pm$ 1.7 h (n=87). So our correction with 0.7 g/h is considered a minimum.

Table 9.1. The fresh and fat-free fresh weights and the sexing data (see text) of three Curlew Sandpipers caught and dissected at Iouik, Mauritania, in spring 1985 and 1986.

Age	Fresh weight (in gram)	fff-Weight (in gram)	Sexing by dissection	Sexing by discriminant function
Adult	67.8	52.6	male	male
Adult	60.1	51.1	unknown	male
2nd c.y.	56.8	48.1	male	-

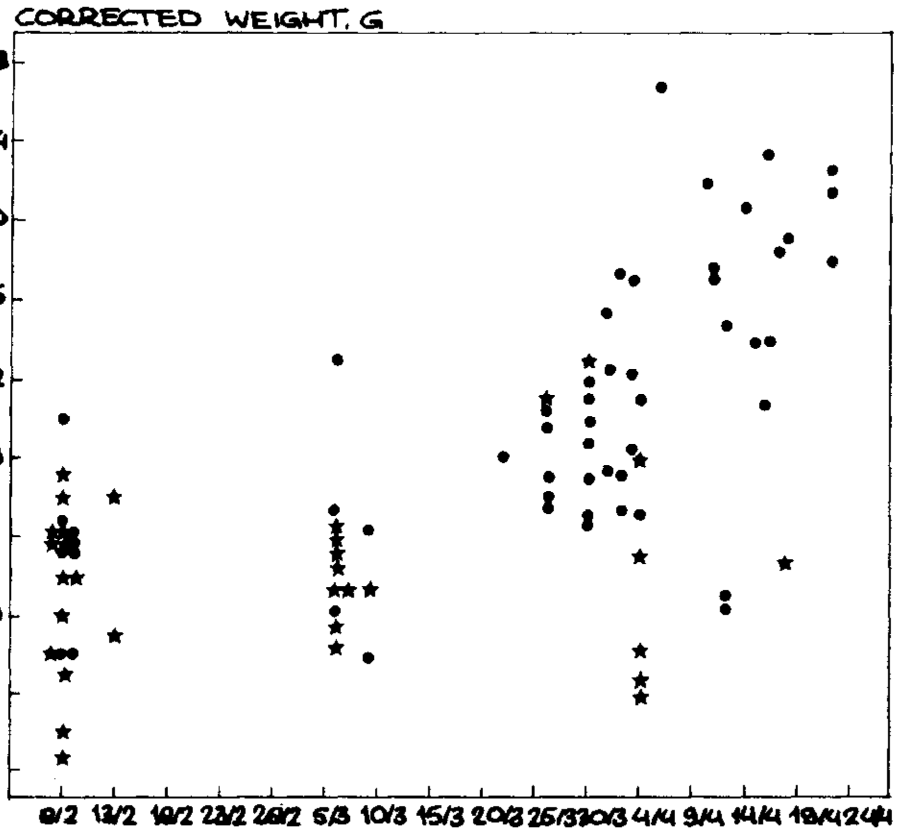


Figure 9.7. The connected weights of Curlew Sandpipers (n=87) caught at Iouik, Mauritania in 1985 and 1986 (● adult, * 2nd c.y.).

These rates of weight loss are larger than that of 0.4 g/h found in Morocco (Kersten et al. 1983), possibly because the higher air temperatures in Mauritania result in higher respiratory water loss.

The weights of adult birds vary between 47.8 g and 63.3 g in February and the first half of March (Fig. 9.7). In the second half of March and in April the weight generally increases, up to a maximum of 76.8 g. In this group (n=40) there is a linear relation between weight and time for birds which weigh more than the average fat-free fresh weight (fff-weight) for Curlew Sandpipers (see flight range; r=71, y = 55.76 + 0.48 x). This may indicate that birds are preparing for migration, gaining 0.48 g/day, and indeed our high tide counts show that there is a large rise and an equally large drop in numbers of birds in April. The increase in weight in this group is almost 1% of the fff-weight per day. The two adult birds which have been excluded from this group because they weigh less than the average fff-weight may have just arrived from the south. Further studies may show that there is indeed different timing of migration and therefore different timing of increase in weight.

The weights of second calendar year birds vary between 42.8 g and 57.1 g in February and the first half of March (Fig. 9.7). In the second half of March and in April the weight increases but not as much as for the adults. The maximum is 63.2 g. This might indicate they either migrate later in the season or that they do not migrate at all. For the birds caught before 15 March there is no significant difference in weight between adults and juveniles (T-test, df=36, t=1.81), for the birds caught after 15 March there is a significant difference (T-test, df=48, t=4.92).

Table 9.2. Measurements of Curlew Sandpiper caught at Iouik, Mauritania, in spring 1985 and 1986. There is no bird of unknown age and one adult which could not be sexed by discriminant function (see text).

	2nd c.y. (35)	Adult males (30)	Adult females (23)
Wing length (mm)	128.5 ± 3.5	132.6 ± 3.1	132.1 ± 2.8 (22)
Bill length (mm)	37.0 ± 2.2	36.5 ± 1.0	40.6 ± 1.3
Total head l. (mm)	60.6 ± 2.1	60.4 ± 1.0 (29)	64.6 ± 1.4
Tarsus + toe (mm)	53.7 ± 2.0	53.5 ± 1.4	54.7 ± 1.8
Weight (g), uncorr.	49.7 ± 4.1 (34)	58.4 ± 6.8	55.8 ± 7.7
Weight (g), corr.	51.8 ± 4.7 (34)	61.7 ± 6.8	58.3 ± 7.6

	All adults (54)	All birds (90)
Wing length (mm)	132.4 ± 2.9 (53)	130.8 ± 3.7 (89)
Bill length	38.3 ± 2.3 (53)	37.8 ± 2.4 (89)
Total head l. (mm)	62.3 ± 2.4 (52)	61.6 ± 2.4 (88)
Tarsus + toe (mm)	54.0 ± 1.7	53.9 ± 1.8
Weight (g), uncorr.	57.2 ± 7.2	54.3 ± 7.2 (89)
Weight (g), corr.	60.2 ± 7.2 (53)	56.9 ± 7.5 (88)

Two birds were recaptured, one adult caught on 2 April 1985 (57.5 g) and recaptured on 3 April 1985 had lost 3.0 g. One second calendar year bird caught on 8 February 1986 (52.0 g) and recaptured on 6 March 1986 had, even after this long period lost 1.6 g.

9.2 Flight range estimates

To estimate flight range we have used the formula of Davidson (1984): $R = 95.447 * S * (T^{0.302} - M^{0.302})$, where S = speed km/h, T = total weight at departure, M = fff-weight or total weight at arrival. M (fff-weight) was

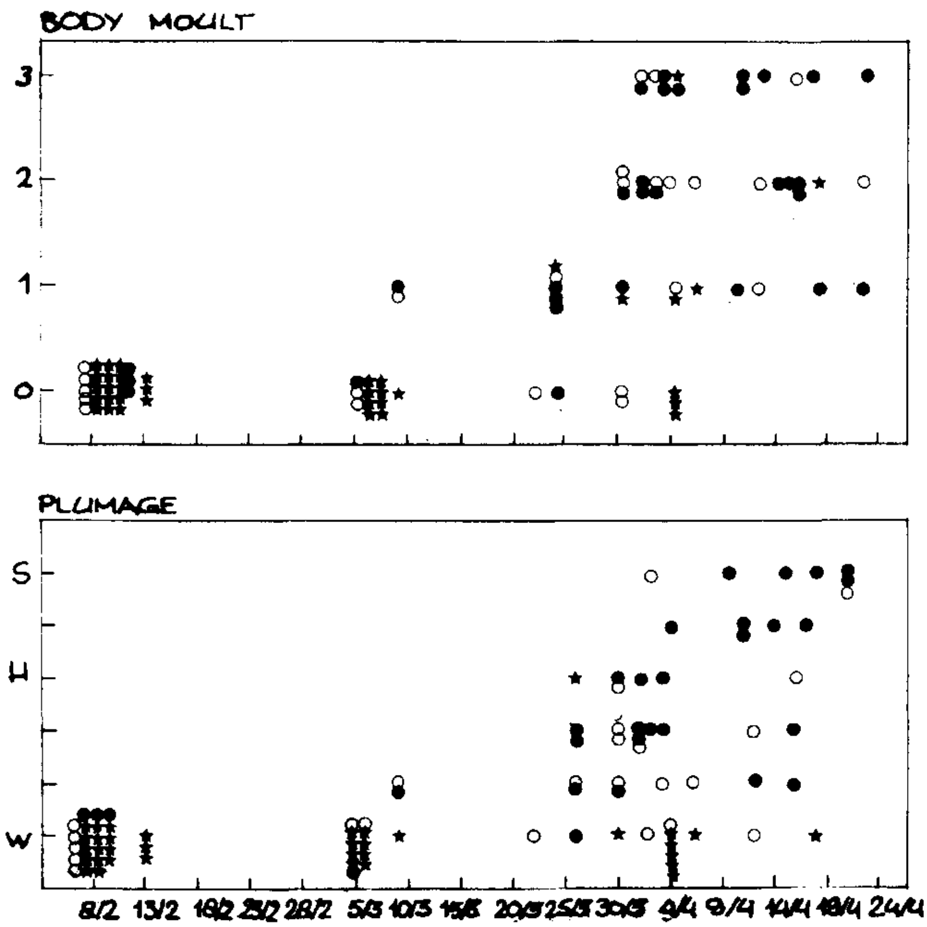


Figure 9.8. The plumage and body moult of Curlew Sandpiper caught at Iouik, Mauritania in 1985 and 1986 (n=89, o adult female, . adult male, * 2nd c.y.). The birds are provisionally sexed with discriminant function (see text).

estimated from data on birds collected in winter and spring in Mauritania (Table 9.1), Morocco (Kersten et al. 1983, Van Brederode et al. in prep.) and Tunisia (Van Dijk et al. 1986). Data from birds clearly preparing for migration (those with corrected weights > 60.0 g) are excluded in this estimation because such birds are increasing the lean component of their body weight at this time (Davidson 1983). The average lean weight of these birds is 50.8 $\pm$ 2.5 g (n=5). To estimate the total weight at departure we use the mean weight of 10% of birds preparing for migration: 73.7 g (n=4). We use the flight speed given by McNeil (1972) for Sandpipers: 80 km/h. This would give a flight range of 2902 km and would bring them from Mauritania to the northern half of the Atlantic coast of Spain, to the Mediterranean coast of Southeast Spain or three quarters the way across the Sahara to the Gulf of Gabès, Tunisia. A non-stop flight across the Sahara has been suggested by Wilson et al. (1980). A colour-marked bird caught in March or April 1985 at Iouik was seen on 19 May 1985 in Malta. The departure weight for a non-stop flight, 3800 km, would predict to be 81.7 g. It should be mentioned that Van Brederode et al. (1982) counted 4000 Curlew Sandpipers in the Merja Zerga, Morocco, on 30 April 1982, while none were present on 18 March 1982. If birds first fly to the Merja Zerga (2000 km) and then further north (to the Mediterranean) the departure weights would be 65.8 g. Several birds have a weight well above this figure and will probably not go there. It is also unknown if birds from the Banc d'Arguin go to the Merja Zerga at all, they may come from further south than the Banc d'Arguin.

9.3 Plumage and moult

Up to 20 March most birds are still in full winter plumage and very few birds show body moult (Fig. 9.8). From the end of March onwards, and with

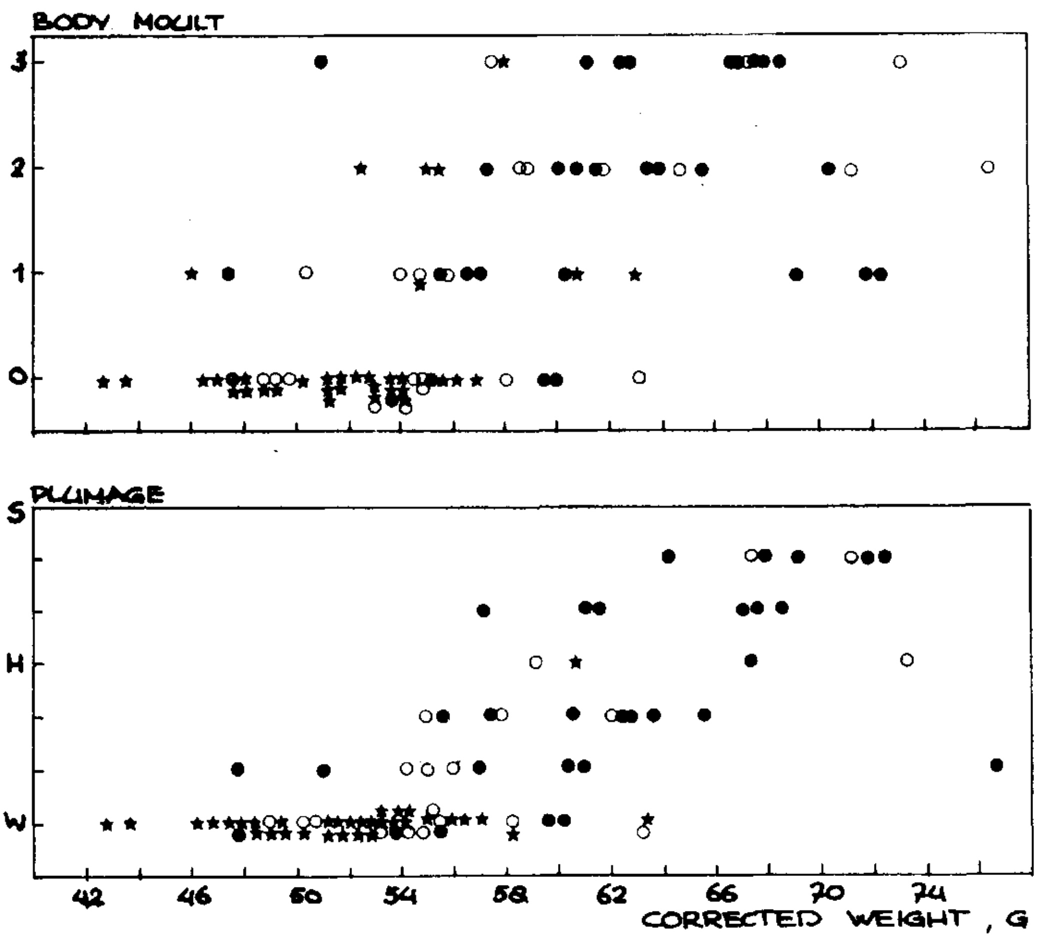


Figure 9.9. The relationship between plumage resp. body moult and corrected weight in Curlew Sandpipers caught at Iouik, Mauritania in 1985 and 1986 (n=89, o adult female, . adult male, * 2nd c.y.). The birds are provisionally sexed with discriminant function (see text).

Table 9.3. Body moult of Curlew Sandpipers caught at Iouik, Mauritania, in spring 1985 and 1986.

Body moult		2nd c.y.	Adult males	Adult females	All adults	All birds
None	(0)	29	5	10	15	44
Light	(1)	4	8	4	12	16
Moderate	(2)	1	8	7	15	17
Heavy	(3)	1	9	2	12	13
Total		35	30	23	54	90

Table 9.9.4. Plumage of Curlew Sandpipers caught at Iouik, Mauritania, in spring 1985 and 1986.

Plumage (score)	2nd c.y.	Adult males	Adult females	All adults	All birds
Full winter (1)	34	5	11	16	51
<50% summer (2/3)	-	12	8	21	21
50% summer (4)	1	3	2	5	6
>50% summer (5/6)	-	10	2	12	12
Full summer (7)	-	-	-	-	-
Total	35	30	23	54	90

increasing weight (Fig. 9.9), the adult birds start their body moult and change into summer plumage. None of the birds, however, reach what we consider a complete summer plumage (score 7). According to our high tide counts there is strong emigration in April, so birds may depart without having reached full summer plumage.

To examine the relation between plumage, body moult and weight independently of time, we divided the adult birds caught in April into a low-weight group and a high-weight group (Fig. 9.10). Neither group incorporates non-moulting birds. The low-weight group of adult birds includes a high proportion of birds in (almost) full winter plumage (scores 1 and 2) and no birds in near-complete summer plumage (score 6, Fig. 9.10). Some birds in (almost) full winter plumage have a body moult score of one, indicating that they have just started their moult. The high weight group of adult birds includes a high proportion of birds

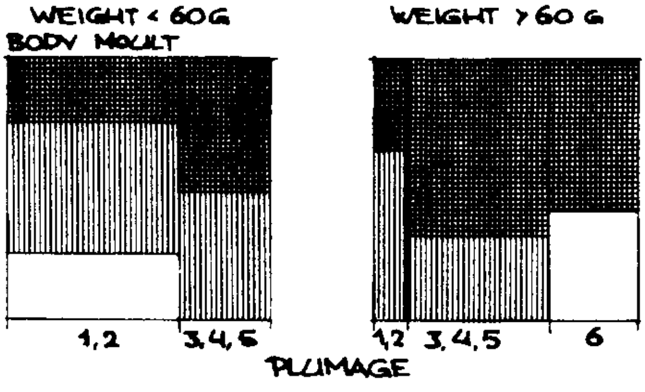
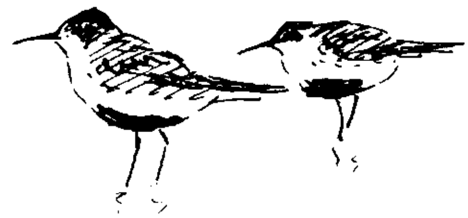


Figure 9.10. The relationship between plumage and body moult in April for adult Curlew Sandpipers with a low weight, < 60 g, (n=6) and a high weight, > 60 g, (n=22), expressed as relative surface over a body moult vs. plumage plot (BM 1 = blank, BM 2 = vertical stripes, BM 3 = vertical plus horizontal stripes).

which are halfway into summer plumage (scores 3, 4 and 5). Some of the birds in almost full summer plumage (score 6) also have a body moult score of one, indicating that they are finishing their moult. This again suggests that adult Curlew Sandpipers complete their moult into full summer plumage further north. There is no apparent difference between adult males and adult females in the timing of the acquisition of summer plumage (Fig. 9.8).

With one exception all second calendar year birds stayed in full winter plumage (Table 9.4). Of the six birds which showed light, moderate or heavy body moult (scores 1, 2 and 3) five were still in full winter plumage. It is possible, therefore, that second calendar year birds in Mauritania do not change into summer plumage until at least the end of April (Fig. 9.8).



Marcel Kersten

10 **Dunlin (Calidris alpina)**

10.1 Numbers and migration

10.1.1 High-tide counts

The data refer to 1985 only since no counts were performed in 1986. In the Baie d'Aouatif 56085 Dunlins were counted on 23 March. This is even more than the 43427 birds counted in January 1980 (Altenburg et al. 1981), suggesting that at most small numbers of Dunlins had left the area before our arrival. Numbers decreased throughout April, but the actual course of spring migration departure is obscured by the irregular pattern of roost-site occupation in the eastern part of the Baie d'Aouatif

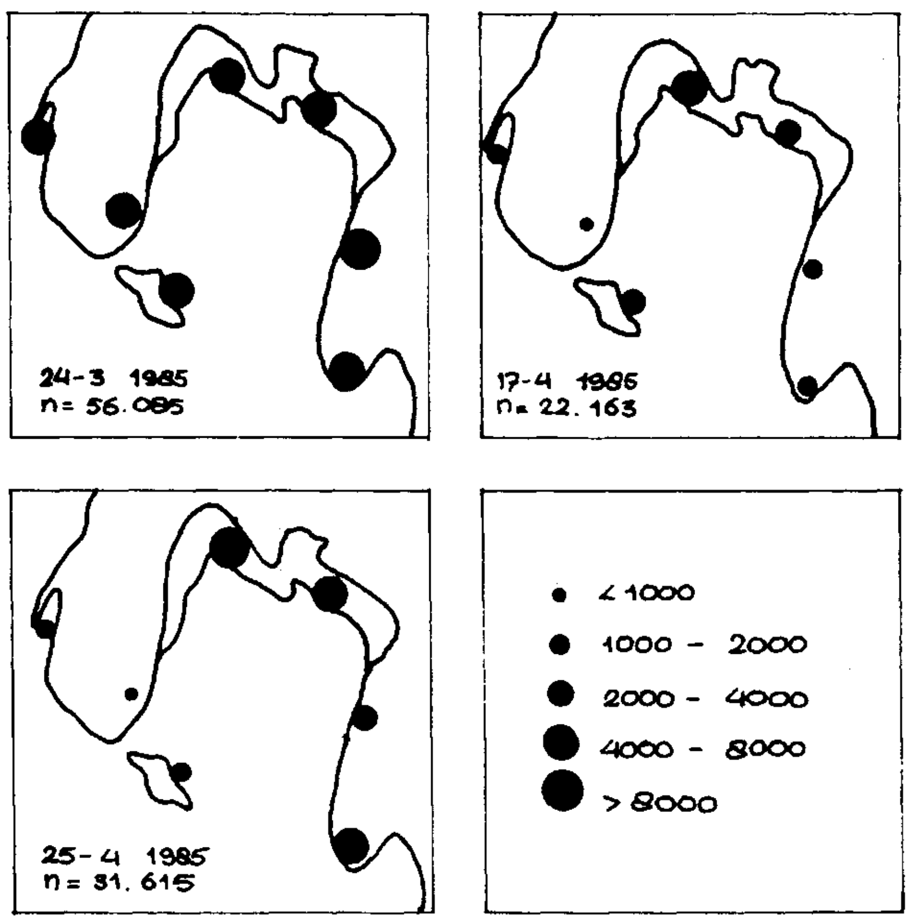


Figure 10.1. Numbers and distribution of Dunlin in the Baie d'Aouatif during high tide on three days in spring 1985.

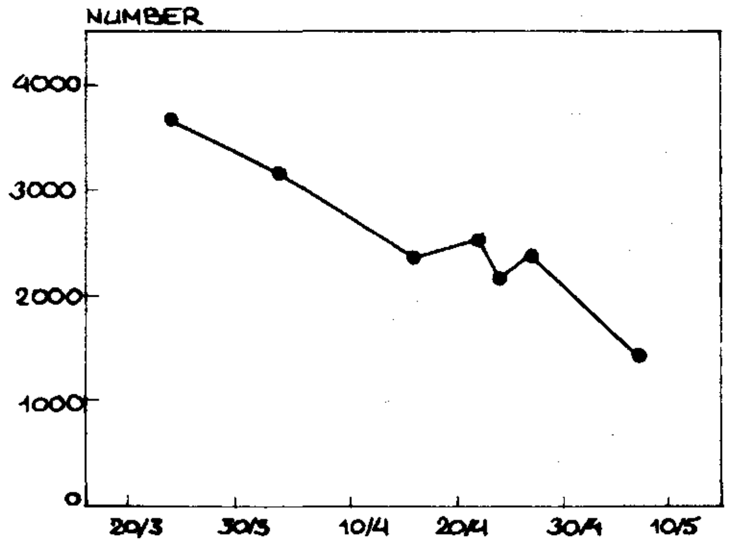


Figure 10.2. Numbers of Dunlins during high tide in the Northwest Bay in spring 1985.

(Fig. 10.1). A series of regular counts in the Northwest Bay gives a better picture of the timing of spring migration departure (Fig. 10.2). The results suggest that numbers declined steadily over the study period

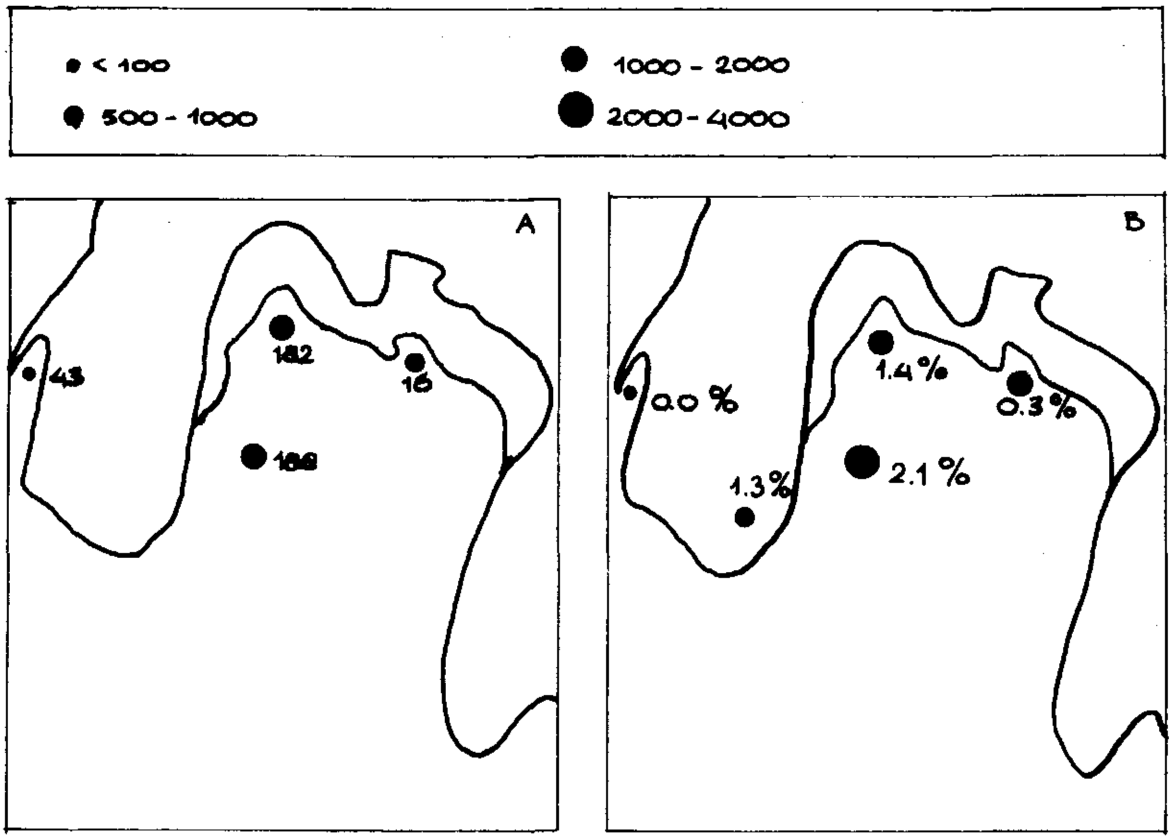


Figure 10.3. a. Numbers of Dunlins marked at different locations in the Baie d'Aouatif. b. Proportion of marked Dunlin in the population at different sites.

with an interruption during the second half of April. By the end of April 41% and 44% of the original numbers in the Northwest Bay and the Baie d'Aouatif respectively had left the area. Even on 7 May, 38% of the supposed wintering population in the Northwest Bay was still present. Considering the very long distance between the Banc d'Arguin and the arctic breeding grounds (± 5500 km to Iceland), it seems unlikely that these birds are able to arrive in time in the breeding area. This would mean that a surprisingly large proportion of the Dunlins wintering on the Banc d'Arguin will not participate in reproduction during the next breeding season.

Table 10.1. The age of Dunlins captured

Period	Adults	Juveniles	Total	% juveniles
1985				
22-27 March	87	41	128	32
30 March-6 April	63	37	100	37
10-18 April	113	66	179	37
21-23 April	10	15	25	60

	site 1			site 5		
Period	n	Juv.	% Juv.	n	Juv.	% Juv.
1986						
8 Feb.-14 March	153	74	48	72	19	26
2-12 April	18	11	61	122	47	39

Table 10.2. The proportion of juveniles in resightings of marked Dunlins in 1985.

	Marked	Observed	
Period	22 March-4 April	10-19 April	20-29 April
Number	200	40	23
% Juveniles	37	50	70

10.1.2 Catches 1985

There were strong indications that more adults than juveniles left the area during the study period. First, the proportion of juveniles in the catches increased from 33% at the end of March to 60% by the end of April (Table 10.1). Further, the proportion of juveniles in resightings of Dunlins marked with plastic tape between 22 March and 4 April increased during the season (Table 10.2). This indicates that the majority of Dunlins that stayed on the Banc d'Arguin until late in the season are

Table 10.3. Numbers of adults and juveniles that left the Baie d'Aouatif between 24 March and 25 April in 1985. * average of two estimates (18985 and 22152), see text.

	Adults	Juveniles	Total
1) N present 24 March	35334	20751	56085
2) N present 25 April	11076	20569 *	31645
3) N departed (1-2)	24258	182	24440
4) % departed (3/1)	69%	1%	44%

Table 10.4. Concentration of birds marked between 22 March and 4 April within the population close to the catching areas throughout April.

Period	sample size	number marked	% marked
8-13 April	1822	26	1.4
15-20 April	448	9	2.0
22-27 April	1043	12	1.2

Table 10.5a. Biometric data for Dunlins, 1985.

	Adults (n=273)		Juveniles (n=159)	
	mean	S.D.	mean	S.D.
Wing length (mm)	114.6	3.2	114.3	3.3
Bill length (mm)	30.9	2.7	30.4	2.6
Total head (mm)	53.2	2.8	53.4	2.7
Tarsus + toe (mm)	46.3	2.0	46.3	1.8

juveniles. It is even possible that hardly any juvenile Dunlin had left the area before the end of April. The estimated number of juveniles in the Baie d'Aouatif on 24 March is 0.37 x 56085 = 20751 birds. By the end of April the proportion of juveniles had increased to 60-70% (Tables 10.1-2). Thus their number on 25 April was somewhere between 0.6 x 31645

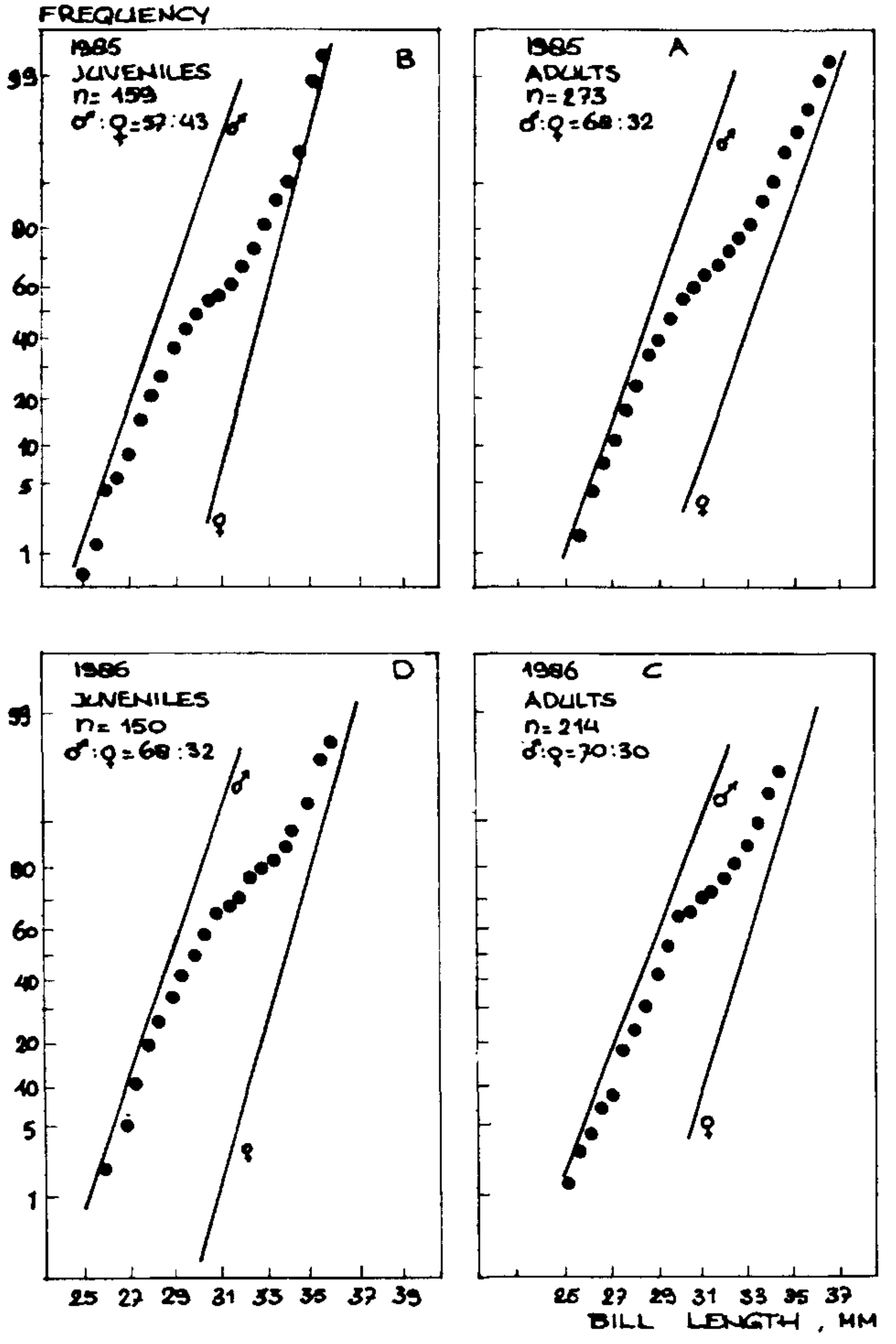


Figure 10.4. Percentage Cumulative Frequency diagram of the bill length of a. adult Dunlin in 1985, b. juvenile Dunlin in 1985, c. adult Dunlin in 1986, d. juvenile Dunlin in 1986.

Table 10.5b. Biometric data for Dunlins, 1986.

		Adults (n=215)		Juveniles (n=151)	
		mean	S.D.	mean	S.D.
Wing length	(mm)	114.4	3.2	113.9	3.7
Bill length	(mm)	29.9	2.5	30.6	2.7
Total head	(mm)	52.5	2.6	53.1	2.9
Tarsus + toe	(mm)	46.6	2.0	46.6	1.8

= 18985 and 0.7 x 31645 = 22152 birds. Based on this information, the proportion of adult Dunlins that left the study area until 25 April can be estimated at 69% (Table 10.3).

There was probably no immigration of Dunlins into the study area. Arrival of new birds would have resulted in a decrease of the proportion of marked birds of the population. There is no sign of such a drop, but the situation is a little complicated since the marked Dunlins did not disperse freely over the study area. Instead, the marked birds were concentrated close to the sites where they were captured (Fig. 10.3). When we use the resightings close to the catching sites of the 200 Dunlins marked between 22 March and 4 April it can be shown that their concentration remained more or less constant throughout the study period (Table 10.4).

10.1.3 Catches 1986

No Dunlins were marked in 1986, but the data on the proportion of juveniles among the captured birds showed the same increase as in 1985. The situation was, however, a little more complicated since the proportion of juveniles differed considerably between the two sites where Dunlins were captured in 1986 (Table 10.1).

10.2 Biometrics

Tables 10.5a and b provide a summary of the biometric data. In all measurements the Mauritanian Dunlins were appreciable smaller than those caught in Morocco in March 1981 (Kersten et al. 1983). This is not surprising since the Moroccan Dunlins belonged for about 50% to the biggest subspecies C. a. alpina, whereas the vast majority of Dunlins in Mauritania were from the much smaller subspecies C. a. schinzii (Table 10.6).

Table 10.6. Subspecific origin of Dunlins captured on the Banc d'Arguin in 1985 according to plumage characteristics (Ferns & Green 1979). Determination of subspecies was only possible in birds with summer plumage (n=267).

Subspecies	Adults number	%	Juveniles number	%
C.a. alpina	2	1	-	
C.a. schinzii	206	87	21	68
C.a. arctica	4	2	-	
Arctica or schinzii	24	10	10	32

The frequency distribution of bill-length is clearly bimodal, as is exemplified by the Percentage Cumulative Frequency (PCF) diagrams (Fig. 10.4). This bimodality arises from the fact that females have on average longer bills than males. From the point of inflexion in the PCF diagram it can be deduced that males outnumbered females. In 1985 the estimated sex ratio is 68 : 32 in adults and 57 : 43 in juveniles. In 1986 the ratios were 70 : 30 and 68 : 32 respectively.

The average bill-length of males and females estimated from the PCF diagram, are very close to published values of the Icelandic breeding

Table 10.7. Average bill lengths of male and female Dunlins captured in Mauritania compared with those of C. a. schinzii breeding in Iceland (Morrison & Wilson in Pienkowski & Dick 1975).

Origin		Bill length (mm) males mean	S.D.	females mean	S.D.
Iceland					
adults		28.4	1.3	32.8	1.1
Mauritania					
adults	1985	28.5	1.6	33.1	1.7
	1986	28.6	1.8	32.8	1.6
juveniles	1985	28.4	1.6	32.9	1.2
	1986	28.9	1.6	34.0	1.4

population of C. a. schinzii (Table 10.7). It is very convenient that there is little overlap between the bill-lengths of males and females. By allocating bill-lengths $\leq$ 30.5 mm to males and bill-lengths $\geq$ 31.5 mm to females, more than 80% of the birds captured could be assigned a sex, with only a few errors (Table 10.8).

Females do not only have longer bills than males; they are generally bigger in all measurements taken (Table 10.9).

Table 10.8. Proportion of male and female Dunlins with 'short' and 'long' bills.

Age and sex	1985 bill length (mm)		1986 bill length (mm)	
	$\leq$ 30.5	$\geq$ 31.5	$\leq$ 30.5	$\geq$ 31.5
Adults				
males	89%	3%	85%	5%
females	5%	85%	5%	83%
Juveniles				
males	90%	3%	84%	5%
females	3%	86%	0.5%	97%

Table 10.9. Average measurements of male (bill length < 30.5 mm) and female (bill length $\geq$ 31.5 mm) Dunlins.

	Adults				Juveniles			
	males		females		males		females	
	mean	S.D.	mean	S.D.	mean	S.D.	mean	S.D.
1985 (n)	(165)		(90)		(87)		(64)	
Wing length	113.1	2.8	117.0	2.6	112.7	2.5	116.4	3.0
Total head l.	51.3	1.5	56.4	1.5	51.4	1.4	56.1	1.3
Tarsus + toe	45.4	1.6	47.8	1.6	45.4	1.2	47.5	
1986 (n)	(142)		(57)		(87)		(48)	
Wing length	113.2	2.7	117.2	2.7	112.6	3.2	116.6	3.2
Total head l.	51.0	1.4	56.0	1.8	51.1	1.3	56.6	1.9
Tarsus + toe	46.0	1.9	47.9	1.6	45.8	1.5	48.0	1.6

10.3 Preparation for spring departure

10.3.1. Moult of body feathers

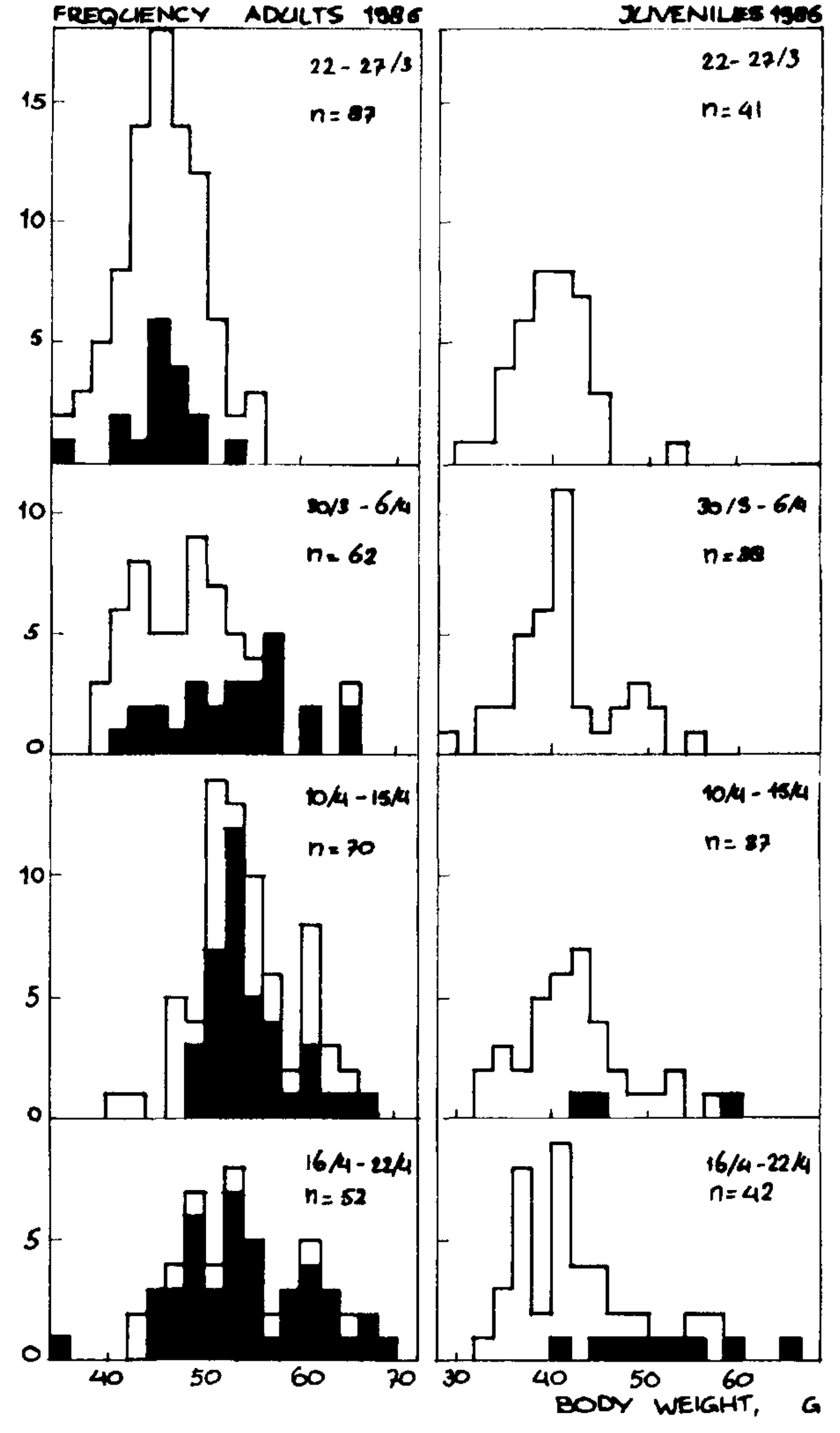
Many Dunlins were actively moulting their body feathers during the study period. By the second half of April 1985 87% of the adults and 27% of the juveniles were in full summer plumage (Fig. 10.5). This indicates that the spring moult of juveniles lays behind that of adults. In fact the first juveniles and the last adults started to moult the same moment, i.e. the end of March.

In 1985, 37 out of 41 juveniles captured between 22 and 27 March were still in winter plumage. The other 4 juveniles had some 25% summer plumage. Some 20 days later, i.e. between 10 and 15 April, the very first juveniles in full summer plumage appeared in the population. Among the adults captured between 22 and 27 March, 7 out of 87 birds (8%) were still in winter plumage. All but one of these birds had just started to moult. Between 16 and 22 April, 13% (7 out of 53 birds) had not yet completed their moult, although they were all in the final phase. Combining the information on adults and juveniles it can be deduced that the moult from winter plumage into summer plumage takes about one month in both age classes.

There was also a difference in the timing of the prenuptial moult

Table 10.10. The occurrence of males (bill length < 30.5 mm) and females (bill length ≥ 31.5 mm) among 87 adult Dunlins captured between 22 and 27 March, according to their plumage. The majority of the birds (n=64) had an intermediate plumage. * Assuming a sex-ratio of 68 : 32 (see figure 9.10.4).

Winter plumage	Males	Females
n observed	1	5
n expected *	4.08	1.92
$x^2 = 7.26$, $p > 0.01$		
Summer plumage		
n observed	14	1
n expected *	10.20	4.80
$x^2 = 4.42$, $p < 0.05$		



between adult males and females. Among the adults captured between 22 and 27 March, females dominated the birds that were still in winter plumage, whereas they were underrepresented among the birds that were already in full summer plumage (Table 10.10). This indicates that females started to moult later than males.

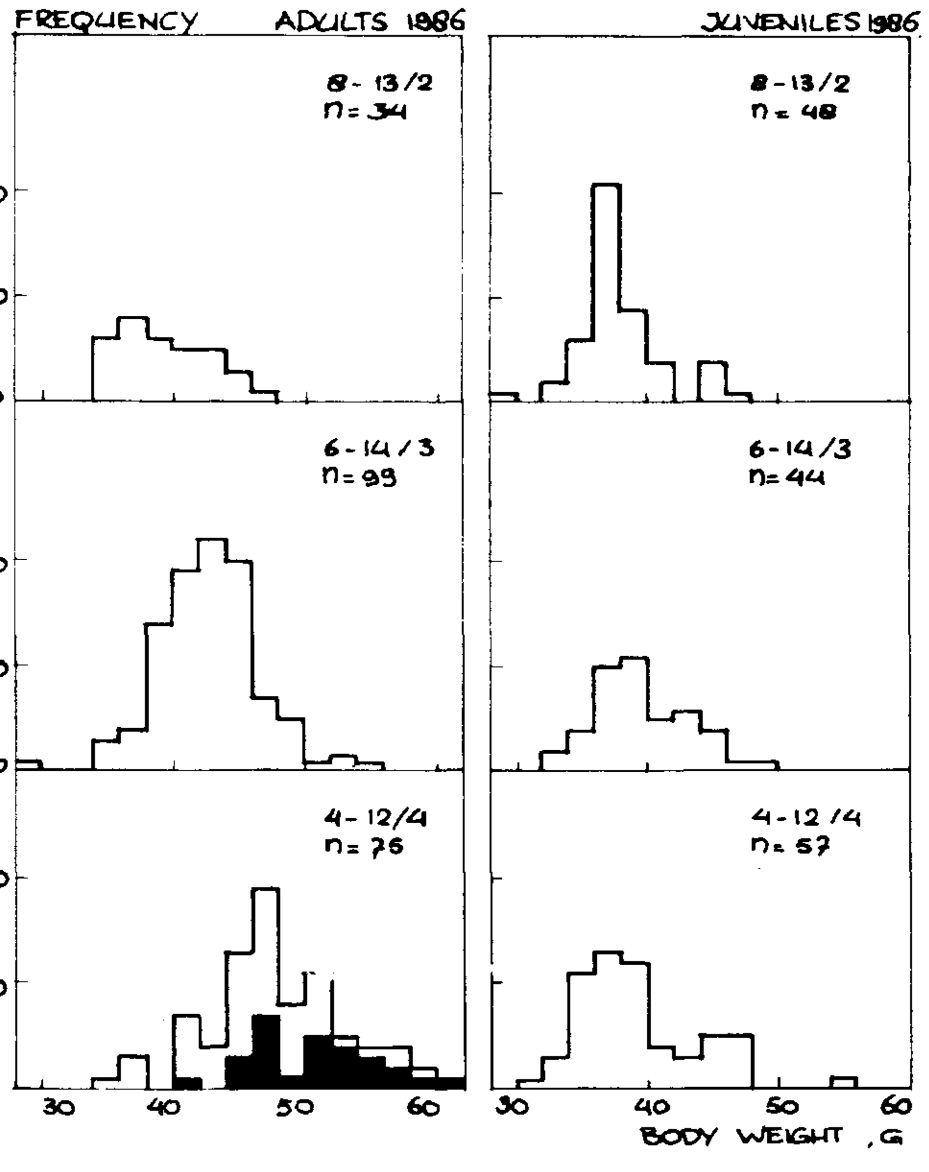


Figure 10.5. Frequency distribution of body weight for different periods for a. adult Dunlin in 1985, b. juvenile Dunlin in 1985, c. adult Dunlin in 1986, d. juvenile Dunlin in 1986. Shaded areas denote birds in full summer plumage.

10.3.2 Body weight

Figure 10.5 a to d, show the frequency distribution of body weight. In both adults and juveniles the average body weight increased, but the increase in adults was much larger (Table 10.11). This weight increase is

Table 10.11. Average body weights of adult and juvenile Dunlins in the course of spring.

	Body weight (g)					
	adults			juveniles		
	mean ±	S.D.	(n)	mean ±	S.D.	(n)
1985						
22-27 March	44.8	4.3	(87)	39.3	4.2	(41)
30 March- 6 April	48.8	6.7	(62)	40.8	5.4	(38)
10-15 April	53.9	5.3	(70)	42.3	6.2	(37)
16-22 April	53.8	7.1	(52)	43.1	7.2	(42)
1986						
8-13 Feb.	38.9	3.4	(34)	36.7	6.3	(49)
6-14 March	42.3	3.9	(99)	39.1	3.7	(44)
4-12 April	47.4	5.3	(82)	38.6	4.6	(58)

mainly due to fat deposition (see chapter 8) and illustrates that these birds are preparing themselves for a long migratory flight. The difference between adults and juveniles must be related to the fact that the juveniles did not leave the study area before the end of April, whereas many of the adults departed (Table 10.3).

10.3.3 Adults

Adults which have completed their moult are generally heavier than those which were still moulting (Table 10.12), but this does not mean that each bird delayed premigratory fattening until moult was finished. The body weight of birds with moult still in progress increased as well over the study period.

Dunlins have a very low weight before the onset of moult and there is a strong positive correlation between body weight and bill-length (Table 10.13). A rough estimate for the amount of fat that is deposited before the start of the spring migration might be derived from the difference in body weight between summer and winter plumage birds. This weight difference is in order of 10-14 grams, and there is a tendency for big birds to accumulate more reserves than small birds.

One important point remains to be made. It is not only the average body weight of adult Dunlins that increases in the course of the season,

Table 10.12. Body weights of adult Dunlins according to their stage of moult.

	Body weight (g)								
	winter plumage			intermediate plumage			summer plumage		
	mean	S.D.	(n)	mean	S.D.	(n)	mean	S.D.	(n)
1985									
22-27 March				44.9	4.3	(70)	45.4	3.9	(16)
30 March-6 April				46.1	5.6	(35)	52.5	6.5	(26)
10-15 April				52.9	6.7	(27)	53.8	3.5	(36)
16-22 April				53.0	6.5	(6)	54.0	7.1	(44)
1986									
8-13 Feb.	38.9	3.4	(34)						
6-14 March	41.2	4.1	(22)	42.6	3.8	(77)			
4-12 April				45.8	5.2	(48)	50.3	4.9	(28)

but the maximum body weights were much higher by the end of April than they were by the end of March 1985 (Fig. 10.5). This implies that, if adult Dunlins depart from the area by the end of March (as is at least suggested by figure 10.2, they do so with a much lower body weight than their conspecifics which stay until the end of April. If this weight difference, which amounts to some 10 g, is entirely due to fat, the potential flight range of birds that stayed until the end of April is in the order of 1000 km longer. Consequently, these late birds have to use fewer stopover areas during their spring migration. To some extent they may compensate this way for the time lag between them and the early departing birds.

10.3.4 Juveniles

The first juvenile Dunlins completed their moult after April.
In contrast to the adults, where males started to moult earlier than females, this sequence was reversed among juveniles (Table 10.14). Over 50% of the juvenile males had not even started to moult by April. In

Table 10.13. Linear regression equations for the relation between body weight (g) and bill length (mm) in adult Dunlins. In summer plumage birds the slope of the regression equation is significantly steeper than in winter plumage birds ($p<0.5$, Student t-test). Only one adult with winter plumage was captured in 1985.

Plumage	year	Body weight = a (bill length) + b	r^2	n	S.E. of a
Winter	1986	1.05 BL + 7.84	0.62	55	0.11
Summer	1986	1.51 BL + 5.76	0.60	28	0.24
	1985	1.61 BL + 4.19	0.39	122	0.18

Table 10.14. Proportions of male and female juvenile Dunlins captured between 10 and 22 April at different stages of moult. 3 birds could not be sexed according to their bill length.

Plumage	Males		Females	
	n	%	n	%
Winter plumage	22	51	7	21
Intermediate	15	35	20	58
Summer plumage	6	14	7	21
Total	43		34	

Table 10.15. Body weights of adult and juvenile Dunlins that had completed their body moult.
a) Juveniles captured between 10 and 22 April.
b) Adults captured between 16 and 22 April.

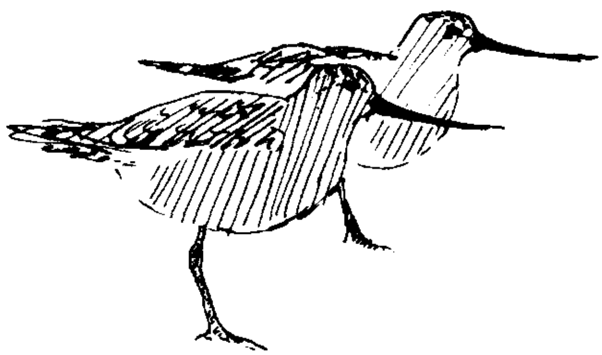
	Males	Females
	mean ± S.D. (n)	mean ± S.D. (n)
Juveniles a)	45.9 ± 4.8 (6)	54.8 ± 7.6 (6)
Adults b)	49.7 ± 5.3 (25)	59.6 ± 5.1 (18)

females this figure was only 21%. Moreover, the proportion of females that had completed their moult between 10 and 22 April was higher in females than in males.

The body weights of juveniles with completed moult was on average some 5 g below that of adults (Table 10.15). This indicates that these birds may leave the Banc d'Arguin together with the last adult females. If there really is a surplus of males in the adult population (as is suggested by the sex-ratio in our catches), the juvenile females will have a fair chance to breed during their first summer.

10.4 Conclusions

1. The majority of Dunlins that had spent the winter on the Banc d'Arguin were still present by the end of March. About one third of these birds were juveniles, the rest adults.
2. By the end of April, no juveniles and some 70% of the adults had left the study area.
3. According to their measurements and plumage characteristics, the vast majority of Dunlins on the Banc d'Arguin belonged to the subspecies *Calidris alpina schinzii*.
4. Males outnumbered females in both adults and juveniles; sex ratios were 68 : 32 and 57 : 43 respectively.
5. Moult into summer plumage took about one month in adults and juveniles, but juveniles lag about one month behind the adults.
6. Among adults, males started to moult earlier than females. In juveniles, this pattern is reversed.
7. The body weights of both adults and juveniles increased over the study period, but the increase in adults was much larger.
8. Juvenile females are more likely to participate in reproduction than juvenile males.
9. Adult Dunlins that leave the Banc d'Arguin early in spring (end of March-beginning of April) depart with a lower body weight than birds that leave by the end of April. By using fewer stopover areas during their spring migration these late birds may compensate to some extent for the time lag between them and the early departing birds.



Theunis Piersma

11 **Bar-tailed Godwit (*Limosa lapponica*)**

11.1 Biometry

Bar-tailed Godwits are a sexually very dimorphic wader species with females being larger than males (Green 1973). This is also apparent in our data on bill lengths for birds captured on the Banc d'Arguin (Fig. 11.1). We captured far less females than male Bar-tailed Godwits (27% vs. 73%), which is in accordance with an unequal sex ratio of 1:2 recorded in January/February 1980 by visual observations (Piersma 1982). Table 11.1 shows that also in other measurements males are smaller than females. Juvenile males are somewhat smaller than adult males and much lighter. The latter indicates that juvenile birds do not generally deposit fat reserves for spring migration and may therefore be expected to spend their second calendar year's summer on the Banc d'Arguin. As is apparent from table 11.2, all measurements are strongly and positively correlated

Table 11.1. Body measurements of Bar-tailed Godwits on the Bnac d'Arguin in February-April 1985/86. Males are birds with bills smaller than 89 mm. Body mass values were corrected for mass loss after capture. Linear measurements in mm, masses in gram.

	Males Juveniles (n=23) average ± S.D.		Males Adults (n=61) average ± S.D.		Females Adults (n=22) average ±S.D.	
Wing length	205.0	5.2	214.2	6.3	230.7	4.0
Bill length	78.2	3.9	78.1	3.6	99.8	4.1
Total head length	114.1	3.7	115.2	5.0	137.9	4.7
Tarsus plus toe	87.3	2.6	87.2	3.0	95.0	2.6
Body mass	204.9	22.8	294.4	41.6	355.4	45.6

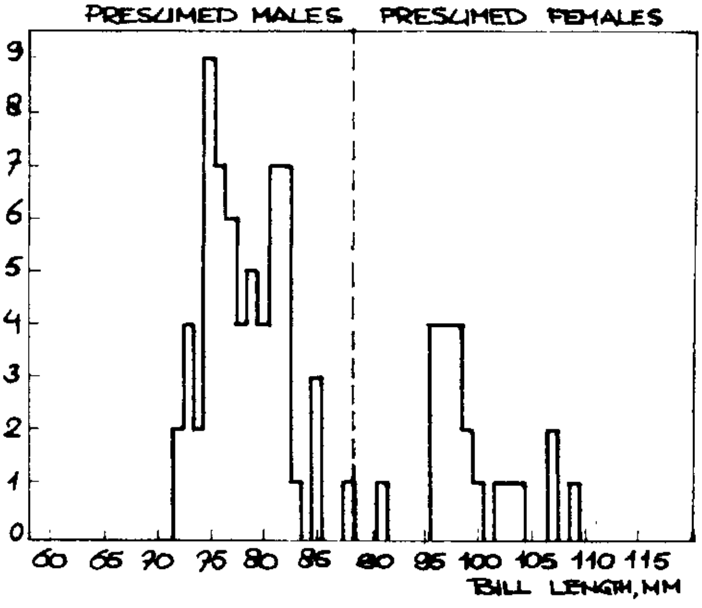


Figure 11.1. Frequency distribution of bill lengths of Bar-tailed Godwits captured on the Banc d'Arguin in 1985/86 (adult birds only).

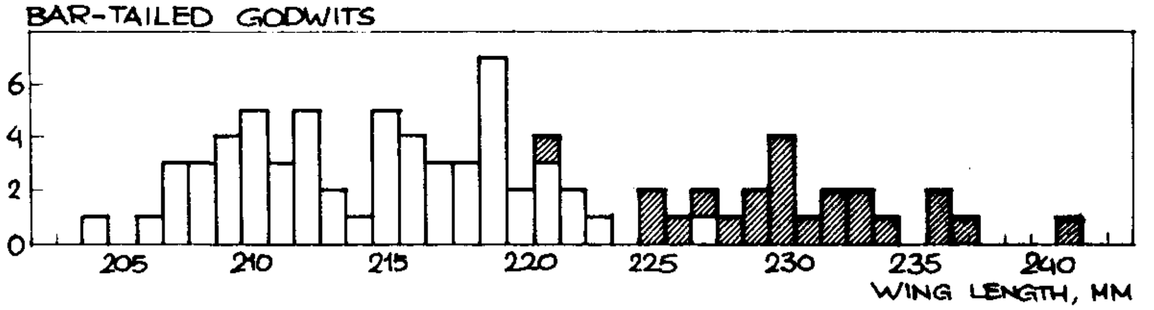


Figure 11.2. Frequency distribution of wing lengths of adult Bar-tailed Godwits captured on the Banc d'Arguin. Birds indicated with hatched bars have been categorized as females on the basis of bill length (bill $\geq$ 89, Fig. 9.11.1).

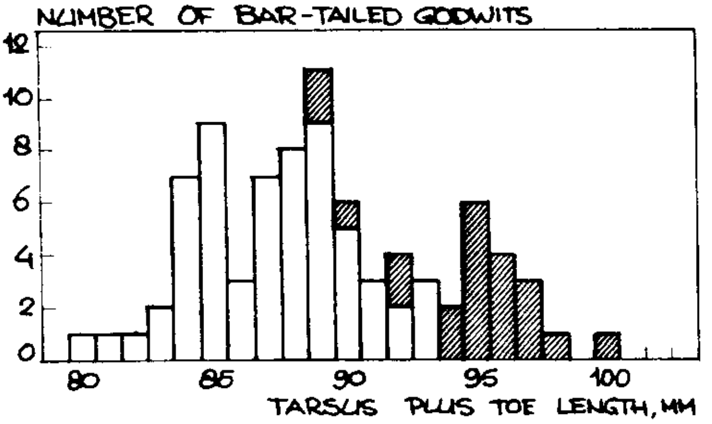


Figure 11.3. Frequency distribution of the lengths of tarsus + toe of Bar-tailed Godwits captured on the Banc d'Arguin. Birds indicated with hatching were categorized as females since their bills were larger than 89 mm (Fig. 9.11.1).

Table 11.2. Pearson correlation coefficients between different body measurements of Bar-tailed Godwits captured in March and April 1985 (sex and age classes combined) n=85. All coefficients are significant at the 0.001 level.

	Wing	Bill	Total head	Tarsus + toe
Weight	0.748	0.599	0.362	0.339
Wing		0.753	0.493	0.560
Bill			0.520	0.645
Total head				0.350

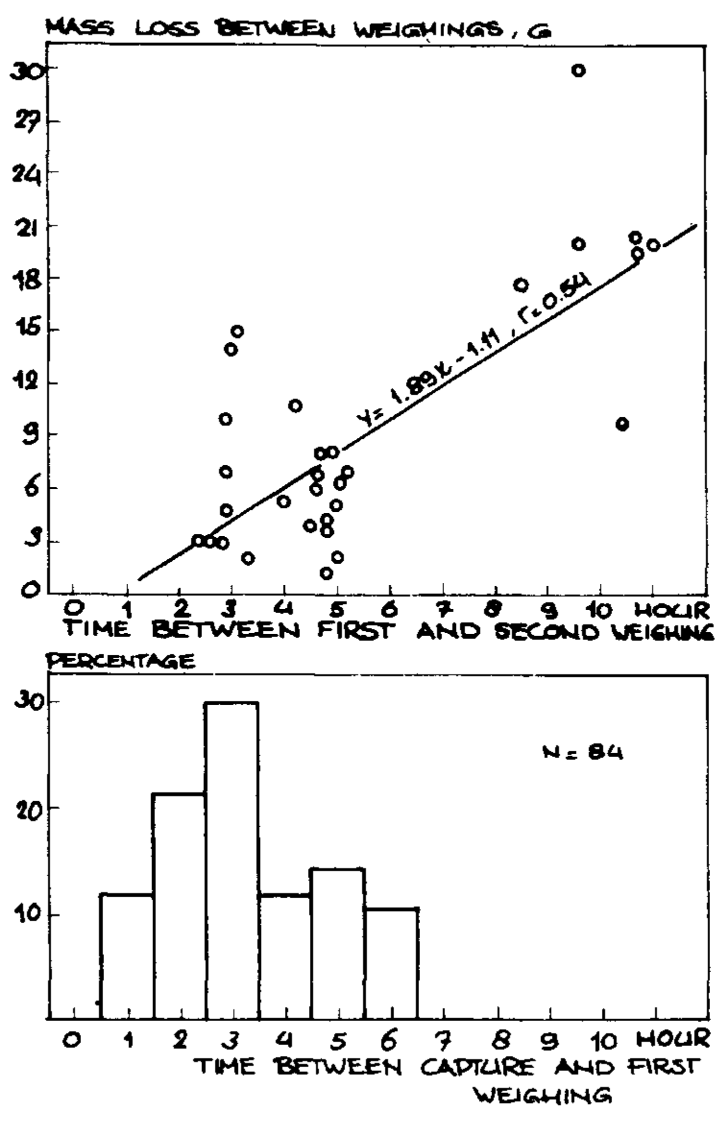


Figure 11.4. Mass loss after capture (top) and the time between capture and first weighing (bottom) of Bar-tailed Godwits on the Banc d'Arguin. Sex and age classes combined.

with each other. Despite the good correlations, the size frequency distributions of wing lengths (Fig. 11.2) and tarsus + toe lengths (Fig. 11.3) of presumed males and females show a good overlap.

11.2 Body mass changes

Mass losses after capture are shown in figure 11.4. Bar-tailed Godwits lost on average 1.9 g/h after capture, and were weighed on average 3.3 hours after capture (i.e. an average mass loss of 6.3 g). Figure 11.5 shows the transformed body masses of the captured Bar-tailed Godwits in relation to date. There is a gradual increase in body mass over the entire study period, but some very light birds were captured after 15 April. These birds could possibly represent immigrants from more southern wintering areas, such as Guinea-Bissau where some 150,000 Bar-tailed Godwits are now known to spend the winter (Zwarts 1984). Over all birds (also taking the late light ones into account), the average increase in body mass is 1.84 g/day (r^2=0.20) for males and only 0.67 g/day (r^2=0.01)

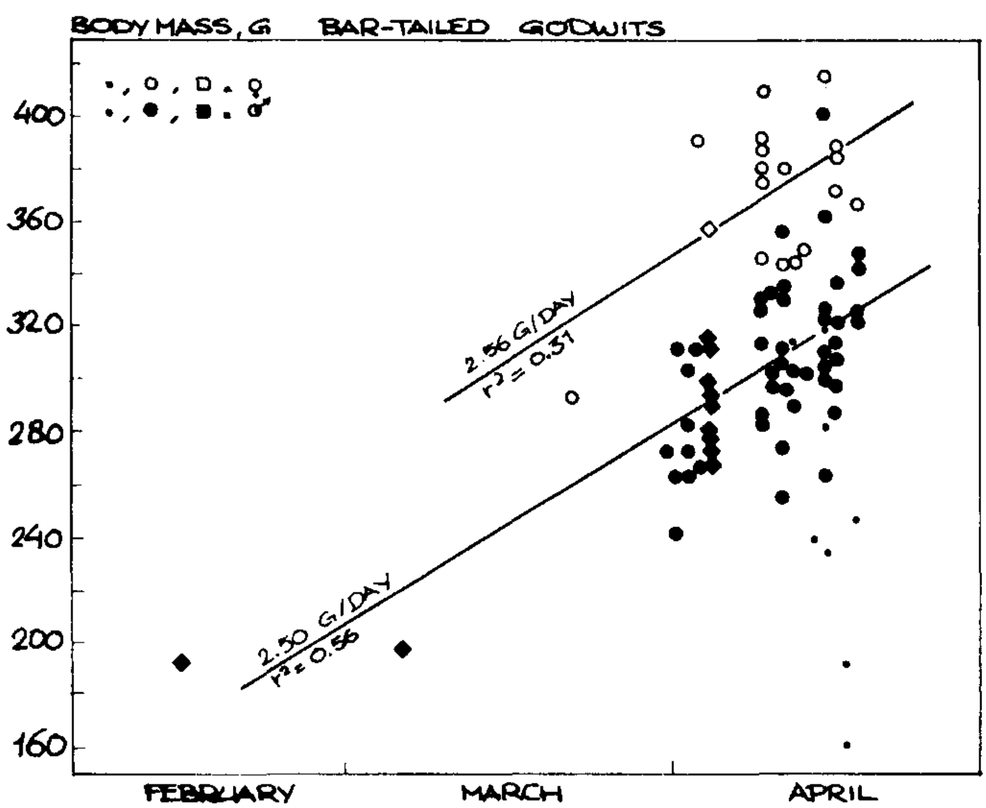


Figure 11.5. Body masses of adult Bar-tailed Godwits on the Banc d'Arguin in relation to date. Males are birds with bills < 89 mm. Dots and circles are birds caught in 1985, triangles are data excluding the birds with very low body masses captured after 15 April and indicated with small sumbols.

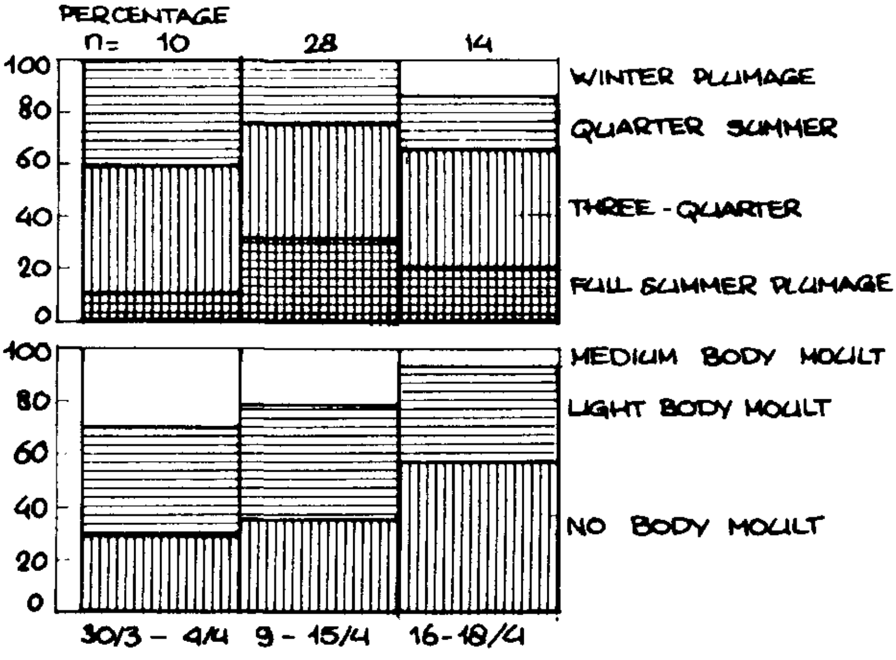
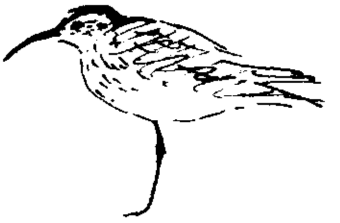


Figure 11.6. Development of summer plumage and body moult of male Bar-tailed Godwits on the Banc d'Arguin in the course of April 1985.

for females, but both values must be underestimates. If we exclude the data for the light and possibly immigrant birds (see below), males increased body mass by 2.5 g/day and females by 2.6 g/day (as indicated by the fitted linear regressions in figure 11.5). Both values are much smaller than the rate of body mass increase of 6-8 g/day in the same godwit population in Friesland, The Netherlands in May 1985-86 (Piersma & Jukema, in prep.).

11.3 Plumage and moult

Figure 11.6 shows the temporal changes in the extent of summer plumage and the intensity of body moult in male Bar-tailed Godwits in spring 1985. In the third period the proportion of birds in full summer plumage has declined and the proportion of birds in winter plumage increased. This supports the suggestion that some unmoulted birds arrived and/or that birds in full summer plumage departed from the area. The percentage of Bar-tailed Godwits without body moult steadily increased over the spring season. The data suggest that (male) Bar-tailed Godwits leave the Banc d'Arguin with a three-quarter or fully completed summer plumage and no body moult.



Piet Duiven

12 **Whimbrel (Numenius phaeopus)**

12.1 Catches

1985. In total we caught twenty-seven Whimbrels. Twenty-one birds were cannon-netted in the Northwest Bay on 9 April 1985. The other six were caught in mist nets at locations on the mudflats near the air strip and opposite the camp site on different dates in March and April. Twenty of the Whimbrels were after second calendar year birds, and seven were in their second calendar year.

1986. Four Whimbrels were caught near the camp site on various dates in March and April. The age of the birds was after second calendar year.

12.2 Biometrics

The two age classes were separated for calculations of mean, s.d. and range of the various measurements and weights (Table 12.1). Because of the overlap in the data the catching were combined.

Table 12.1. Whimbrel, Banc d'Arguin, Mauritania. Weight in g. Wing length, bill length, total head (=tohe) and tarsus + toe (=tato) in mm.

	2nd calendar year				> 2nd calendar year			
	Mean	S.D.	(n)	Range	Mean	S.D.	(n)	Range
Weight	407.0	25.56	(7)	380 -440	528.9	45.95	(20)	445 -610
Wing	253.4	6.40	(7)	245 -264	263.3	7.65	(24)	251 -283
Bill	83.96	5.23	(7)	73.8- 90.0	84.29	5.08	(24)	75.5- 93.0
Tohe	124.1	4.54	(7)	114.7-129.0	124.4	5.97	(24)	114.9-135.8
Tato	105.0	2.16	(7)	101 -108	105.5	4.46	(24)	97 -114

For comparing the weights of the two age classes only the catches of 1985 were used. Birds after their second calendar year had significantly higher weights than the second calendar year birds (Analysis of variance, F=43.78, P<0.001). The weights of the Whimbrels caught in 1986 were 369, 406, 459 and 630 g. For comparison only few data on weights from winter quarters are available. In South Africa in late March/early April two adults weighed 627

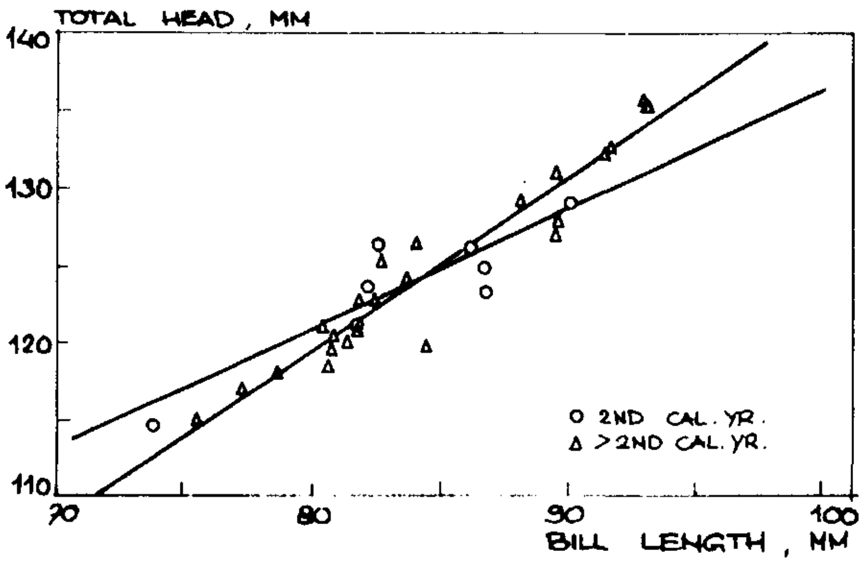


Figure 12.1. Relationship between bill length and total head of Whimbrels at the Banc d'Arguin (Mauritania). For Whimrel 2nd c.y.: y = 58.5879 + 0.779964 x, r=0.898683; for Whimbrel > 2nd c.y.: y = 29.2278 + 1.12869 x, r=0.960326.

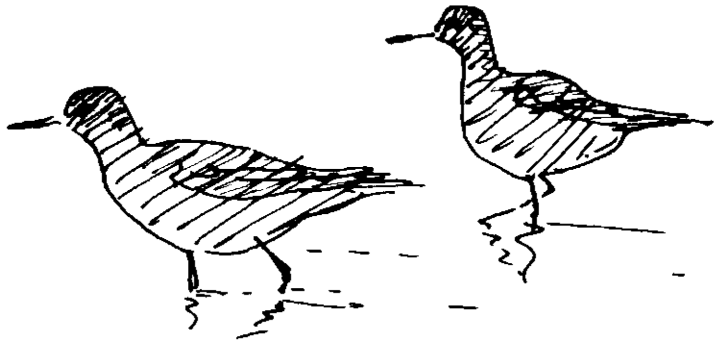
and 600+ g and a juvenile 370 g (Glutz von Blotzheim et al. 1977). Four adults birds after completion of wing moult weighed between 480 and 600 g at the Banc d'Arguin in November (Dick 1975).

The mean wing length of the birds after second calendar year is larger than that of second calendar year birds. The difference is significant (Analysis of variance, F=8.58, P<0.001). Birds in both age classes have longer wings than has been described in literature (Glutz von Blotzheim et al. 1977, Prater et al. 1977, Cramp & Simmons 1983). However measurements in these references are mostly obtained from museum specimens, and because of post-mortum shrinkage wing length in dried museum skins is significantly shorter than in freshly killed or living birds (Prater et al. 1977, Engelmoer et al. 1983). After transformation the data for shrinkage, the estimated wing lengths in our Whimbrels are still longer. The wing lengths of adults caught at the Banc d'Arguin in November were also smaller than in our birds (Dick 1975). Although wing moult was complete, the primaries possibly still were not full grown at that moment.

Though the differences are not statistically significant, bill, total head and tarus + toe tend to be larger in the birds after second calendar year.

A fairly close relationship has been found between bill length and total head. When only one of these measurements is available the second one can be estimated by comparison with figure 12.1. As we only have measurements of tarsus + toe, we unfortunately can not calculate the relationship with the single tarsus for the same purpose.

The geographical origin of the Whimbrels at the Banc d'Arguin is not clear. As far as we know the birds belonged to the nominate phaeopus, the breeding birds of Iceland - West USSR. The Islandic population of this race on average has the longest wings and may be considered for the wintering Whimbrels at the Banc d'Arguin, although there is no hard evidence yet. Greater samples and more comparative biometric data from different breeding and wintering areas will be essential for statictical analysis. Moreover ring recoveries or sightings of colour marked birds will help to clarify which breeding population is represented on the Banc d'Arguin.



Theunis Piersma

13 **Redshank (Tringa totanus)**

The spring migration (departure) of Redshanks was already in full swing by the time we started our catching activities on the Banc d'Arguin in 1985. From 24 March to 17 April 1985 Redshank numbers around Iouik dropped with 68 % from 2878 to 965 birds. Their relatively early departure may have been one of the reasons that we captured only few (29) Redshanks during this expedition. In 1986 catching activities already started in early February and so a small sample of birds was obtained from before the time of mass departure. The average measurements of Redshanks are presented in table 13.1. Apart from body mass, the biometric values (both averages and standard deviations) closely resemble those of birds caught in Morocco during spring migration (Table 13.2), suggesting that we are dealing with the same population. This is probably the population breeding in Northwest Europe (The Netherlands, West Germany, Denmark), as is supported by the sighting of a colour marked

Table 13.1. Body measurements of Redshank on the Banc d'Arguin in February-April 1985 and 1986. Body mass values are not corrected for loss after capture. Linear measurements in mm, body mass in g.

	Juveniles (n=12) average ± S.D. (min.-max.)		Adults (n=32) average ± S.D. (min.-max.)		All birds (n=45) average ± S.D.	
Wing length	157.1	3.9	161.3	3.5	160.2	4.0
	(150-164)		(154-168)			
Bill length	43.2	1.8	43.7	1.5	43.5	1.6
	(40.1-45.7)		(40.2-47.5)			
Total head length	74.9	2.5	75.6	1.7	75.4	1.9
	(71.0-79.2)		(71.9-79.4)			
Tarsus + toe	84.8	2.8	85.1	2.7	85.0	2.7
	(80-89)		(79-92)			
Body mass	100.8	18.4	129.7	18.3	122.0	22.1
	(86-150)		(95-174)			

Table 13.2. Comparison between the measurement of adult Redshanks on the the Banc d'Arguin and at Sidi Moussa, Morocco, during spring migration (February-April vs. March). The latter data were taken from Kersten & Piersma (1983).

	Banc d'Arguin Mauritania average ± S.D.		Sidi Moussa Morocco average ± S.D.	
Wing length (mm)	161.3	3.5	162.0	3.9
Bill length (mm)	43.7	1.5	43.5	1.7
Total head length (mm)	75.6	1.7	75.5	1.8
Body mass	129.7	18.3	110.2	13.7

Table 13.3. Pearson correlation coefficients between different body measurements of Redshanks (all age classes), n=30. Coefficients significant at the 0.05 level are underlined and those significant at the 0.001 level bold typed.

	Wing	Bill	Total head	Tarsus + toe
Body mass	**0.571**	0.182	<u>0.304</u>	0.222
Wing		0.181	<u>0.345</u>	<u>0.307</u>
Bill			**0.856**	**0.512**
Total head				**0.609**

Table 13.4. Incidence of body moult in juvenile (J) and adult (A). Redshanks on the Banc d'Arguin in February-April 1985 and 1986.

		February	March	April
No moult	J	80%	100%	75%
	A	50%	76%	100%
Light body moult	J	20%	-	25%
	A	50%	19%	-
Medium body moult	J	-	-	-
	A	-	5%	-
Number of birds examined	J	5	3	4
	A	4	21	7

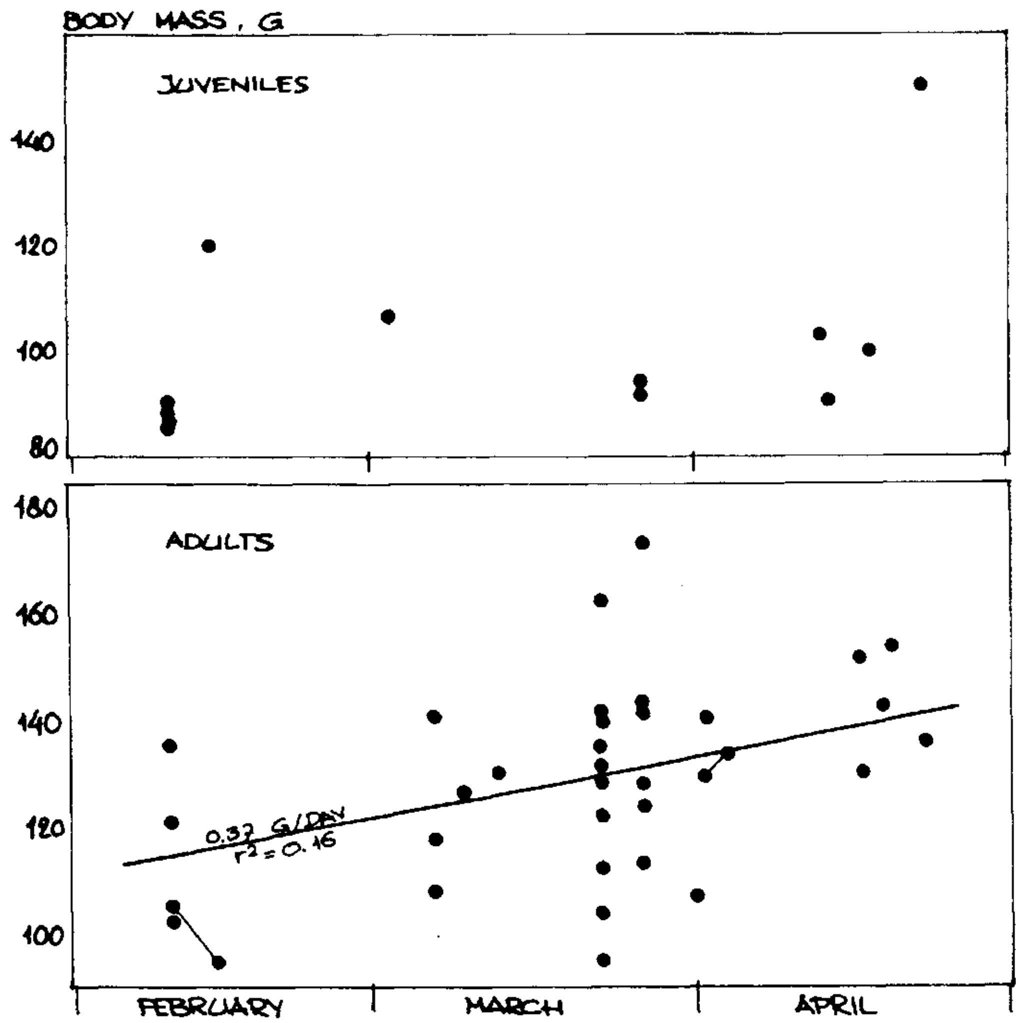


Figure 13.1. Changes in body mass of juvenile and adult Redshanks on the Banc d'Arguin in 1985 and 1986. Thin lines connect successive weighings of individual birds. The linear regression of first taken body masses against data is given for adult birds. For juveniles the positive slope (0.25 g/day) was significantly different from zero.

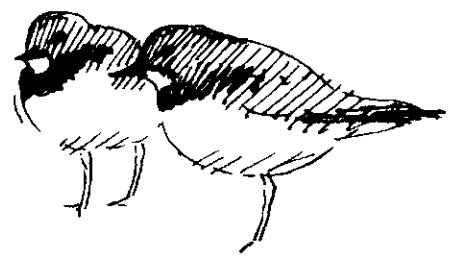
Redshank on the island of Pellworm (Wadden Sea of Schleswig-Holstein), where it was spotted as a breeding bird!

Body mass correlated best with wing length, but hardly so with the other linear dimensions (Table 13.3). Bill, total head and tarsus + toe length are strongly correlated with each other, but much less so with wing length and body mass. This may indicate that only wing length is a measure of structural size, the other dimensions probably being expressions of race, sex and age.

We made only a few measurements of mass loss after capture, and for this reason body mass was not corrected for the time between capture and first weighing. The average time between capture and first weighing was

3.26 h (S.D.=1.53; extremes 0.6-7.3). Juveniles were on average much lighter than adults suggesting that large numbers of second calendar year birds summer on the Banc d'Arguin. However, figure 13.1 shows that some juvenile birds do reach higher body masses in April, and might therefore leave the area for the north. The adults show a continuous increase in average body mass over the study period. A linear regression suggests an average body mass increase of 0.37 g/day. This estimate is not affected by (e.g. very low) body masses of birds remaining or arriving after the mass departure in early April. One individual bird recaptured after two days in the first week of April showed a 4 g increase in body mass. Another bird recaptured after four days in early February lost 10 g.

Juvenile birds showed very little body moult throughout spring (Table 13.4). Adults showed some body moult in February and March, but not in April. This indicates that the birds migrate without growing body feathers.



Bruno J. Ens

14 **Turnstone (*Arenaria interpres*)**

14.1 Materials and methods

The large majority of Turnstones were caught at high water with clap nets in the little village of Iouik, while they were feeding on drying fish and litter left on the beach. Some were caught with a cannon net in Iouik and a few into mist nets placed on the mudflat nearby.

Separating the Turnstones in adults and juveniles, using the criteria of Prater et al. (1977), was generally easy except for a few individuals. In some measurements these individuals tended more to adults, in others more to juveniles (Table 14.1), indicating they might well be immatures in their third calendar year. It was decided to restrict the analysis to the adults and juveniles.

A few times birds were reweighed after a certain time lag to estimate the weight loss incurred. Despite a large scatter (after 8 hours individuals lost from 1 to 5 g in weight), a significant non-linear

Table 14.1. Comparison of biometric data on birds of three different age classes. Means and standard deviations (in brackets) are provided, except for body moult and summer plumage score where the median value and the range (in brackets) are presented. Data for 1985 and 1986 are combined.

	Juvenile (n=113)		Age uncertain (n=13)		Adult (n=287)	
Wing length (mm)	150.9	(4.4)	156.1	(5.2)	157.6	(5.0)
Bill length (mm)	23.2	(0.9)	23.5	(1.5)	23.4	(2.0)
Total head length (mm)	51.2	(1.1)	51.5	(1.0)	51.4	(2.0)
Tarsus + toe (mm)	52.5	(1.6)	52.9	(1.5)	52.8	(1.9)
Body weight (g)	89.3	(7.0)	96.5	(9.0)	109.4	(14.5)
Body moult	0	(0-3)	0	(0-2)	1	(0-3)
Summer plumage	1.5	(1-3)	2	(1-5)	4	(1-7)

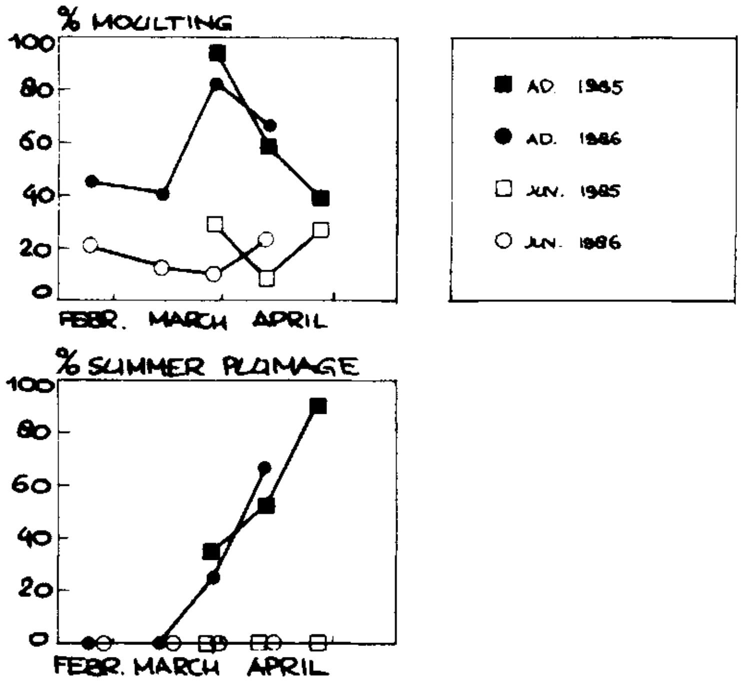


Figure 14.1. a. Proportion of adult and juvenile Turnstones caught showing body moult for five different periods in 1985 and 1986. b. Proportion of adult and juvenile Turnstones caught in summer plumage (i.e. summer plumage three quarters or more) for five different periods in 1985 and 1986).

relationship was obtained between weight loss (dw) and time lag (dt):

$$\ln (dw) = 0.339 \ln (dt) + 0.330, \; r^2=0.41, \; p<0.001, \; n=20.$$

Weight loss was not corrected for though, since most birds were weighed within 1 to 5 hours after capture, which would lead to a maximal difference in the correction term between individuals of only 1 g.

14.2 Moulting and gaining weight

Adult Turnstones started moulting to summer plumage in the first weeks of March (Fig. 14.1). At the end of April most adults had acquired three

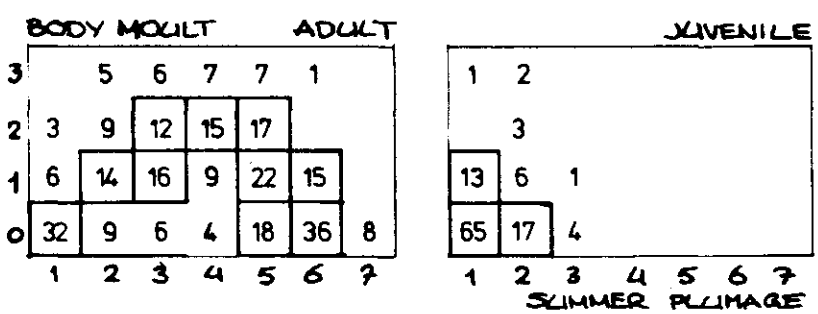


Figure 14.2. Body moult in relation to the extent of summer plumage for a. adult and b. juvenile Turnstones (data of 1985 and 1986 combined).

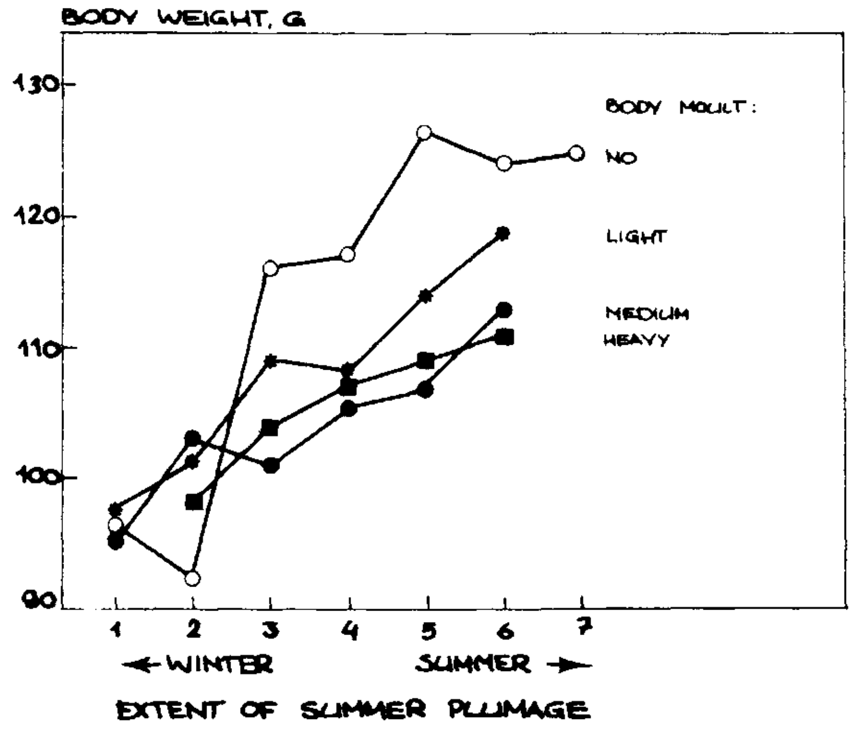


Figure 14.3. Body weight of adults in relation to the extent of summer plumage, separated for different body moult scores (data of 1985 and 1986 combined).

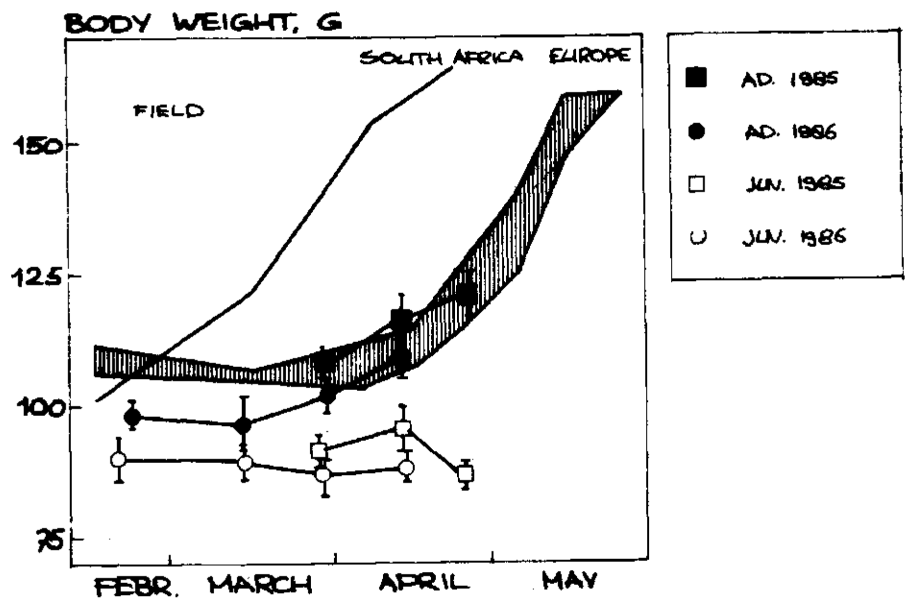


Figure 14.4. Average weight of adult and juvenile Turnstones caught in five different periods in 1985 and 1986. Bars represent 95% confidence limits. For comparison average weights of adults in South Africa (Summers & Waltner 1979). Morecambe Bay (Clapham 1979) and the Wadden Sea (Engelmoer in prep.) are also presented.

quarters or more of their summer plumage and few were still actively moulting. Surprisingly, several non-moulting adults had progressed only halfway towards completion (Fig. 14.2). Non-moulting individuals were heavier than moulting individuals when they had attained one quarter summer plumage or more (Fig. 14.3). This suggests that at least some adults temporarily suspended moulting to migrate from the Banc d'Arguin. They were caught in the first and last weeks of April.

Contrary to adults, only a minority of juveniles was caught moulting (Fig. 14.1) and no juvenile had progressed beyond one quarter summer

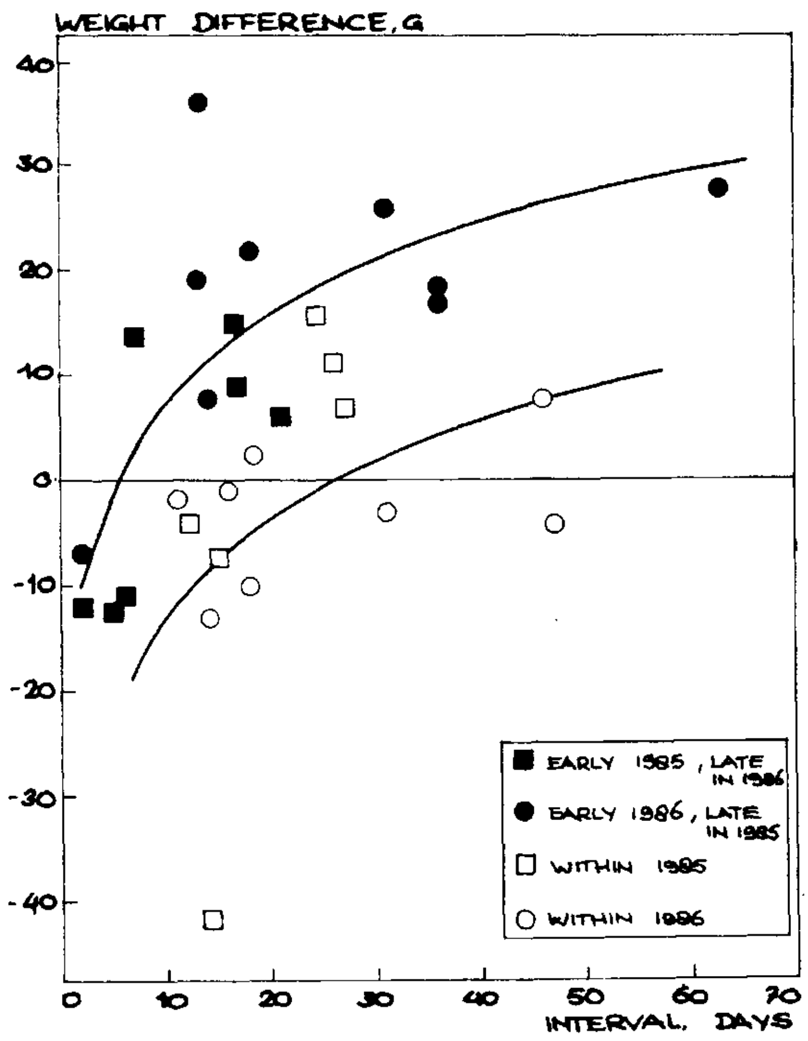


Figure 14.5. Weight difference (in g) in relation to the interval (days) between first and second capture. Each dot represents one individual (only adults). Open dots and squares refer to birds recaptured within the same year: dw = 13.55 ln (dt + 1) - 44.61, r^2=0.19, p=0.06, n=14, where dw is weight difference in gram and dt is interval in days. Closed dots and squares refer to birds caught in both 1985 and 1986: dw = 12.85 ln (dt + 1) - 23.26, r^2=0.57, $p<0.001$, n=16.

plumage (Fig. 14.2). In addition the weight of juveniles showed no tendency to increase in time (Fig. 14.4). In every period the weights of juveniles and adults were higher in 1985 than in 1986 (Fig. 14.4).

Several lines of evidence indicate that departure commences at the end of April. The pattern of the average weight gain depicted in figure 14.4 may well correspond to the pattern for individuals up to that period. Surprisingly only 5 out of 14 adults recaptured within the same year showed a positive weight change (Fig. 14.5). It is possible that due to the extreme environmental conditions the effects of catching and handling birds are more detrimental than they appear to be in temperate zones (Davidson 1984). Large weight decreases were associated with short time intervals, suggesting that the birds needed some time to recover from the negative effects of being caught (Fig. 14.5).

Assuming that individuals follow more or less the same migration program from one year to the next (Metcalfe & Furness 1985), we can meaningfully analyse the weight differences of individuals caught in different years. If the difference in weight gain between 1985 and 1986 is real, we expect that birds caught early in 1986 and late in 1985 show larger weight gains than birds caught early in 1985 and late in 1986. This may be true, but there is too much scatter in the data to make the differences significant (Fig. 14.5). By lumping the data we hope that under- and overestimates are cancelled out. The fact that weights 'gained' between years were much larger than weights gained within a year is additional evidence of a negative effect of handling. The fact that the curve levels off at long intervals may be caused by long intervals being due to birds caught in February. Fig. 14.4 shows that weights start to increase from March onwards. The rate of weight gain can be meaningfully calculated only when the time interval is sufficiently long, so intervals of less than a week were rejected.

Table 14.2 suggests that birds gained weight at a faster rate at the end of April, but it is not significant. Even so, the calculated average rate of 0.91 g/day for individual birds is much higher than the average rate of 0.5 for the population (Fig. 14.4). This indicates that some heavy individuals departed, thereby depressing the weight gain of the population. The same conclusion follows from figure 14.6: the weight distribution of the individuals 'ready to go' (no body moult and three quarters summer plumage or more) did not change from the middle of April towards the end of April.

14.3 Discussion

The rate of weight gain of adults departing from the Banc d'Arguin is low compared to adults departing from South Africa or from Europe (Fig. 14.4,

Table 14.2. Rate of 'weight gain' (g/day) for birds caught in a period in 1985 different from their capture period in 1986 (i.e. an interval of more than 7 days). Birds are grouped according to the latest capture date. A one-way analysis of variance showed the groups to be not significantly different (p=0.13).

Date of 2nd capture	Mean weight gain (g/day)	S.D.	(n)
26 March- 6 April	0.51	0.05	3
7 April-20 April	0.63	0.28	4
21 April-28 April	1.47	0.97	4
Ungrouped data	0.71	0.22	11

Table 14.2). The change in the population mean probably misrepresents the pattern for the individual due to heavy individuals 'continuously' leaving to migrate and light individuals arriving after migration. The first problem applies to all data sets. The second problem applies to Europe and perhaps to the Banc d'Arguin. Indeed the rate of weight gain estimated from between-year recaptures was twice the value estimated from changes in the population mean. However, even at this rate it would take the birds weighing 120 g at the end of April more than a month to reach weights of 160 g or more as observed in South Africa and Europe.

Could it be that the low weights measured on the Banc d'Arguin are due to our catching method biasing towards hungry birds in poor conditions?

Table 14.3. Average weight (sample size in brackets) for Turnstones caught with different catching devices. Data refer to 1985 only, since nearly all birds were caught with clap nets in 1986.

Age class	Period	Mist nets	Clap nets	Cannon nets	Results ANOVA
Juveniles	7-20 Apr	95.0 (5)	99.5 (2)	93.3 (4)	p=0.623
Adults	25 Mar-6 Apr	111.6 (5)	107.3 (56)		p=0.406
Adults	7-20 Apr	107.1 (15)	118.0 (6)	125.5 (13)	p=0.001

Table 14.3 shows that there is only one period in which the catching method had a significant effect on body weight. However, this is due to mist net birds being extremely light. Birds caught with the clap net did

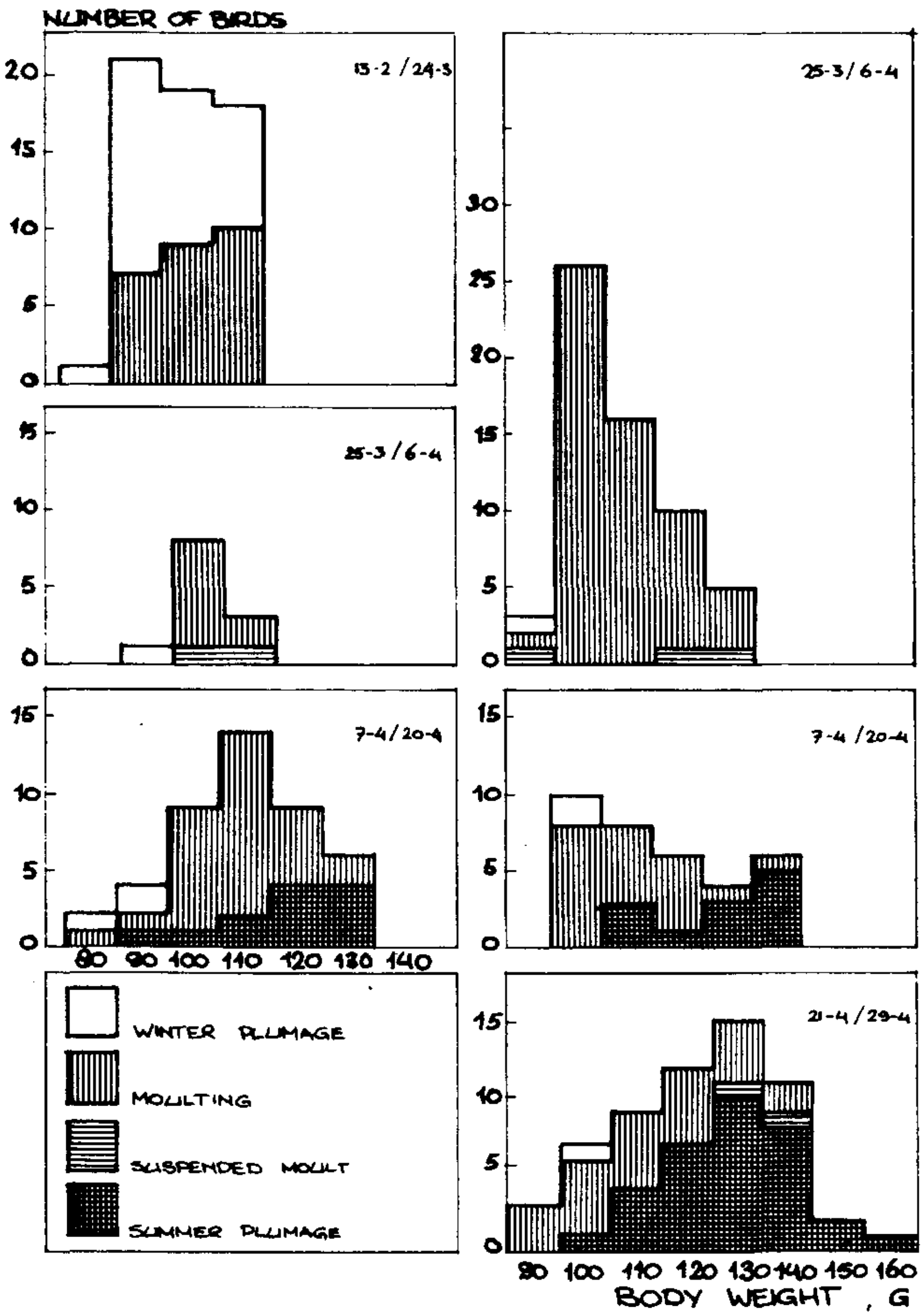
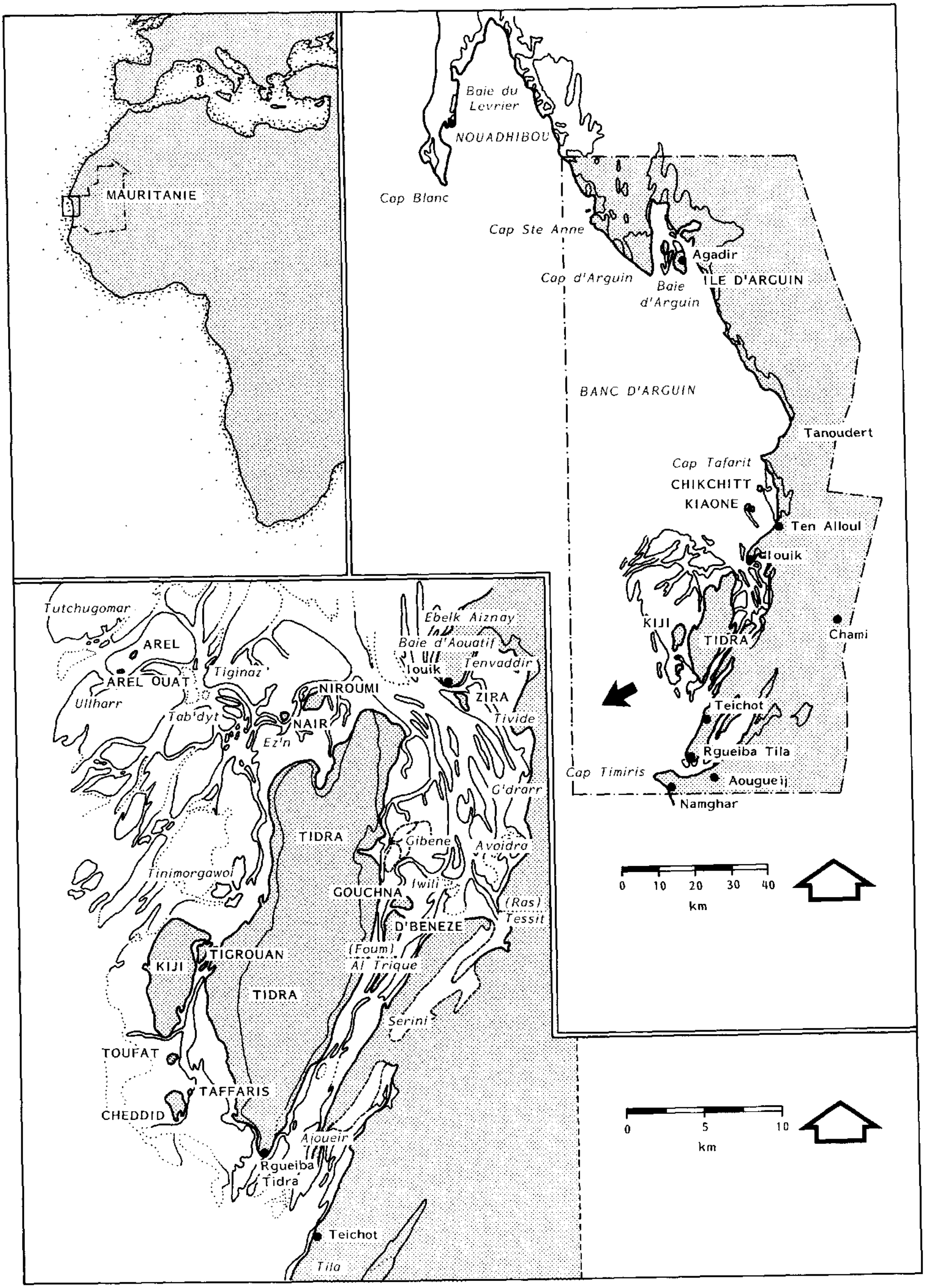


Figure 14.6. Frequency distribution of weights of adult Turnstones in four different periods in 1985 and 1986. Differences in hatching indicate: birds in winter plumage (plumage score 1 or 2), showing no body moult, all birds showing body moult, birds in summer plumage (score 5, 6 or 7) showing no body moult.

not differ much from birds caught with the cannon net. Very few birds were caught in mist nets outside the middle of April 1985. Excluding the mist net samples from the analysis would virtually eliminate the positive weight change from the middle of April towards the end of April 1985.

In all it seems safe to conclude that the birds leaving in early April did so with low body weights of around 130 g. A crude estimate yields a maximum flight distance of 2000 km (Davidson 1984), indicating Morrocco as the next stopover site.

APPENDIX II


MAURITANIE
Baie du Levrier
NOUADHIBOU
Cap Blanc
Cap Ste Anne
Agadir
Cap d'Arguin
ILE D'ARGUIN
Baie d'Arguin
BANC D'ARGUIN
Tanoudert
Cap Tafarit
CHIKCHITT
KIAONE
Ten Alloul
Iouik
KIJI
TIDRA
Chami
Teichot
Rgueiba Tila
Cap Timiris
Aougueij
Namghar
0 10 20 30 40
km
Tutchugomar
AREL
AREL OUAT
Ullharr
Tiginaz
Tab'dyt
NIROUMI
NAIR
Ez'n
Ebelk Aiznay
Baie d'Aouatif
Iouik
Tenvaddir
ZIRA
Tivide
G'drarr
TIDRA
Gibene
Avoidra
Tinimorgawoi
GOUCHNA
Iwili
D'BENEZE
(Ras) Tessit
(Foum) Al Trique
KIJI
TIGROUAN
TIDRA
Serini
TOUFAT
TAFFARIS
CHEDDID
Ajoueir
Rgueiba Tidra
Teichot
Tila
0 5 10
km

WIWO-reports available:

Altenburg,W., M.Engelmoer, R.Mes & T.Piersma 1982. Wintering waders on the Banc d'Arguin-Mauritania. Report of the Netherlands Ornithological Mauritanian Expedition 1980. Communication No. 6 Wadden Sea Working Group, Stichting Veth tot Steun aan Waddenonderzoek, Texel. 284 pp. (WIWO-report 1) Sold out.

Altenburg,W. 1987. Waterfowl in West African coastal wetlands: a summary of current knowledge. WIWO-report 15, Zeist, The Netherlands. Dfl. 10,-.

Bennet,C.A., R.G.Bijlsma & R.Stouthamer 1982. Survey of waterbirds on Egyptian wetlands, autumn 1981. WIWO-report 16, Zeist, The Netherlands. Dfl. 7,50.

Berg,A.B.van den 1988. Moroccan Slender-billed Curlew survey, winter 1987-88. Joint report of WIWO and ICBP nr. 29, Zeist, The Netherlands and Cambridge, England. Dfl. 15,-.

Berk,V.van den, R.G.Bijlsma & F.E.de Roder 1985. The importance of some wetlands in Turkey for transient and wintering birds in Turkey. WIWO-report 6, Zeist, The Netherlands. Dfl. 10,-.

Berk,V.van den, D.van Dorp, O.van Hoorn & R.Vos 1986. Cranes and waterfowl counts of some Turkish wetlands. WIWO-report 10, Zeist, The Netherlands. Dfl. 12,50.

Berk,V.van den, J.P.Cronau, T.M.van der Have & J.P.W.Letschert (eds.) 1988. Waders and waterfowl in the Gukurova Delta, Southern Turkey. spring 1987. WIWO-report 22, Zeist, The Netherlands. Price not yet known.

Bijlsma,R.G. & F.E.de Roder 1985. Waders along the coast of Thailand during November and December 1984. WIWO-report 4, Zeist, The Netherlands. Dfl. 10,-.

Bijlsma,R.G. & F.E.de Roder 1986. Notes on the birds of some wetlands in Turkey. WIWO-report 12, Zeist, The Netherlands. Sold out.

Chalabi,B., J.Harrison & G.van Dijk 1985. Les zones humides du Nord-Est Algerien en 1984. WIWO-report 8, Zeist, The Netherlands. Dfl. 10,-.

Chalabi,B. & G.van Dijk 1988. Les zones humides dans la region de Anaba et El Kala en Mai 1987. WIWO-report 24, Zeist, The Netherlands. Dfl. 7,50.

Dijk,A.J.van, K.van Dijk, L.Dijksen, T.van Spanje & E.Wymenga 1986. Wintering waders and waterfowl in the Gulf of Gabes, Tunisia, January-March 1984. WIWO-report 11, Zeist, The Netherlands. Dfl. 30,-.

Dijksen,L.J. & F.J.Koning 1986. Mid-winter waterfowl census, Turkey 1986. WIWO-report 13, Zeist, The Netherlands. Dfl. 10,-.

Dijksen,L.J. & P.van der Wolf 1987. Mid-winter waterfowl census Turkey January 1987. WIWO-report 18, Zeist, The Netherlands. Dfl. 7,50.

Dijksen,L.J. & A-M.Chr.Blomert 1988. Mid-winter waterfowl census Turkey January 1988. WIWO-report 21, Zeist, The Netherlands. Dfl. 7,50.

Ens,B. 1985. Tussen Sahara en Siberië. WIWO-report 9-N, Ewijk, The Netherlands. Dfl. 7,50.

Ens,B. 1985. Entre Sahara et Siberië. WIWO-report 9-F, Ewijk, The Netherlands. Dfl. 5,-.

Ens,B.J., T.Piersma, W.J.Wolff, L.Zwarts (eds.) 1989. Report of the Dutch-Mauritanian project Banc d'Arguin 85/86. Joint report of WIWO and RIN nr. 25, Zeist, The Netherlands. Dfl. 35,-.

Kersten,M., T.Piersma, C.Smit & P.Zegers 1983. Wader migration along the Atlantic coast of Morocco, March 1981. WIWO-report 2, Texel, The Netherlands. Dfl. 25,-.

Lensink,R. 1987. Notes on the birds of some wetlands in North-East Greece and Turkey. WIWO-report 19, Zeist, The Netherlands. Dfl. 7,50.

Marteijn,E.C.L. & P.L.Meininger (eds.) in prep. Waterbirds in Nort-East Greece spring 1987. WIWO-report 20, Zeist, The Netherlands. Price not yet known.

Philippona,J. 1985. Waterbirds at some wetlands in Turkey and Greece. WIWO-report 3, Zeist, The Netherlands. Dfl. 4,-.

Piersma,T. 1985. Wader studies and waterbirds in the Nakdong Estuary, South Korea, in September 1984. WIWO-report 7, Zeist, The Netherlands. Dfl. 12,50.

Roder,F.E.de 1985. Waterbirds on some Turkish wetlands, October/November 1983. WIWO-report 5, Zeist, The Netherlands. Dfl. 8,-.

Schekkerman,H. & J.C.J.van Wetten 1987. An ornithological winter survey of Lake Turkana, Kenya. WIWO-report 17, Zeist, The Netherlands. Dfl. 7,50.

Reports can be ordered by paying to postal giro account 2.666.009 or to ABN bank account 57.02.16.613 of Stichting WIWO, Ewijk, The Netherlands. Postage is included in the price.

De volgende RIN-rapporten kunnen besteld worden door overschrijving van het verschuldigde bedrag op giro 516 06 48 van het RIN te Leersum onder vermelding van het rapportnummer. Uw giro-overschrijving geldt als bestelformulier; toezending geschiedt franco. Gebruik **geen verzamelgiro** omdat het **adres** van de besteller niet op onze giro-bijschrijving wordt vermeld zodat het bestelde niet kan worden toegezonden.

86/7 M.Nooren, Inventarisatie van de houtwallen in het nationale park de Hoge Veluwe. 49 p. f 8,-
86/8 M.Nooren, Over het verleden van de Hoge Veluwe. 89 p. f 13,50
86/9 K.Stoker, De verspreiding van de rode bosmieren op de Hoge Veluwe. 110 p. f 15,60
86/19 B.van Noorden, Dynamiek en dichtheid van bosvogels en geïsoleerde loofbosfragmenten. 58 p. f 8,50
86/21 G.P.Gonggrijp (red.), Gea-objecten van Limburg. 287 p. f 34,-
87/1 W.O.van der Knaap & H.F.van Dobben, Veranderingen in de epifytenflora van Rijnmond sinds 1972. 36 p. f 6,-
87/2 A.van Winden et al., Ruimtelijke relaties via vogels in het Strijper-Aa-gebied gedurende broedtijd en zomer. 97 p. f 14,50
87/3 F.J.J.Niewold, De korhoenders van onze heideterreinen: verleden, heden en toekomst. 32 p. f 5,-
87/4 H.Koop, Het RIN-bosecologisch informatiesysteem; achtergronden en methoden. 47 p. f 7,50
87/5 K.Kersting, Zuurstofhuishouding van twee poldersloten in de polder Demmerik. 63 p. f 11,-
87/6 G.F.Willemsen, Bijzondere plantesoorten in het nationale park de Hoge Veluwe; voorkomen en veranderingen. 92 p. f 13,50
87/7 M.J.Nooren, Het verleden van de houtwallen in het nationale park de Hoge Veluwe. 23 p. f 5,-
87/8 G.Groot Bruinderink, D.Kloeg & J.Wolkers, Het beheer van de wilde zwijnen in het Meinweggebied (Limburg). 96 p. f 14,50
87/9 K.S.Dijkema, Selection of salt-marsh sites for the European network of biogenetic reserves. 30 p. f 5,50
87/11 G.J.Baaijens, Effecten van ontwateringswerken in de ruilverkaveling Ruinerwold-Koekange. 64 p. f 9,-
87/13 J.Weinreich & J.Oude Voshaar, Populatieontwikkeling van overwinterende vleermuizen in de mergelgroeven van Zuid-Limburg (1943-1987). 62 p. f 8,-
87/14 N.Dankers, K.S.Dijkema, G.Londo & P.A.Slim, De ecologische effecten van bodemdaling op Ameland. 90 p. f 13,50
87/15 F.Fahner & J.Wiertz, Handleiding bij het WAFLO-model. 99 p. f 14,50
87/16 J.Wiertz, Modelvorming bij de projecten van WAFLO en SWNBL. 34 p. f 6,-
87/17 W.H.Diemont & J.T.de Smidt (eds.), Heathland management in The Netherlands. 110 p. f 15,50
87/18 Effecten van de kokkelvisserij in de Waddenzee. 23 p. f 3.75
87/19 H.van Dam, Monitoring of chemistry, macrophytes, and diatoms in acidifying moorland pools. 113 p. f 16,-
87/20 R.Torenbeek, P.F.M.Verdonschot & L.W.G.Higler, Biologische gevolgen van vergroting van waterinlaat in de provincie Drenthe. 178 p. f 23,-
87/21 J.E.Winkelman & L.M.J.van den Bergh, Voorkomen van eenden, ganzen en zwanen nabij Urk (NOP) in januari-april 1987. 52 p. f 7,50
87/22 B.van Dessel, Te verwachten ecologische effecten van pekellozing in het Eems-Dollardgebied. 71 p. f 10,-
87/23 W.D.Denneman & R.Torenbeek, Nitraatemissie en Nederlandse ecosystemen: een globale risico-analyse. 164 p. f 21,-
87/24 M.Buil, Begrazing van heidevegetaties door edelhert en moeflon; een

Hoge Veluwe. 49 p. f 7,50

87/26 H.A.T.M.van Wezel, Heidefauna in het nationale park de Hoge Veluwe. 54 p. f 8,-

87/28 G.M.Dirkse, De natuur van het Nederlandse bos. 217 p. f 27,50

87/29 H.Siepel et al., Beheer van graslanden in relatie tot de ongewervelde fauna: ontwikkeling van een monitorsysteem. 127 p. f 17.95

88/30 P.F.M.Verdonschot & R.Torenbeek, Lettercodering van de Nederlandse aquatische macrofauna voor mathematische verwerking. 75 p. f 10,-

88/31 P.F.M.Verdonschot, G.Schmidt, P.H.J.van Leeuwen & J.A.Schot, Steekmuggen (Culicidae) in de Engbertsdijkvenen. 109 p. f 15,50

88/33 H.Eijsackers, C.F.van de Bund, P.Doelman & Wei-chun Ma, Fluctuerende aantallen en activiteiten van bodemorganismen. 85 p. f 13,-

88/34 Toke de Wit, De effecten van ozon op natuurlijke ecosystemen; een literatuuronderzoek. 27 p. f 5,20

88/35 A.J.de Bakker & H.F.van Dobben, Effecten van ammoniakemissie op epifytische korstmossen; een correlatief onderzoek in de Peel. 48 p. f 7,50

88/36 B.v.Dessel, Ecologische inventarisatie van het IJsselmeer. 82 p. f 12,75

88/37 A.Schotman, Tussen bos en houtwal; broedvogels in een Twents cultuurlandschap. 87 p. f 13,25

88/38 P.Opdam & H.van den Bijtel, Vogelgemeenschappen van het landgoed Noordhout. 66 p. f 10,-

88/39 P.Doelman, H.Loonen & A.Vos, Ecotoxicologisch onderzoek in met Endosulfan verontreinigde grond: toxiciteit en sanering. 34 p. f 6,-

88/40 G.P.Gonggrijp, Voorstel voor de afwerking van de groeve Belvedere als archeologisch-geologisch element. 13 p. f 3,-

88/41 J.L.Mulder (red.), De vos in het Noordhollands Duinreservaat. Deel 1: Organisatie en samenvatting. 32 p.

88/42 J.L.Mulder, idem. Deel 2: Het voedsel van de vos. 78 p.

88/43 J.L.Mulder, idem. Deel 3: De vossenpopulatie. 129 p.

88/44 J.L.Mulder, idem. Deel 4: De fazantenpopulatie. 59 p.

88/45 J.L.Mulder & A.H.Swaan, idem. Deel 5: De wulpenpopulatie. 76 p.

De rapporten 41-45 worden niet los verkocht maar als serie van vijf voor f 25.

88/46 J.E.Winkelman, Methodologische aspecten vogelonderzoek SEP-proefwindcentrale Oosterbierum (Fr.). Deel 1. 145 p. f 20,-

88/47 T.A.Renssen, De herintroductie van de raaf (Corax corax) in Nederland: een overzicht. 30 p. f 5,50

88/48 J.J.Smit, Het Eemland en de polder Arkemheen rond het begin van de twintigste eeuw. 64 p. f 9,-

88/49 G.W.Gerritsen, M.den Boer & F.J.J.Niewold, Voedselecologie van de vos in Nederland. 96 p. f 14,25

88/50 G.P.Gonggrijp, Permanente geologische ontsluitingen in de taluds van Rijksweg A 1 bij Oldenzaal. 18 p. f 3,50

88/51 P.Spaak, Een modelmatige benadering van de effecten van graslandbeheer op het populatieverloop van weidevogels. 42 p. f 7.50

88/53 L.W.G.Higler & F.F.Repko, Analyse van de macrofauna van de Hierdense Beek. 97 p. f 14,25

88/54 H.W.de Nie & A.E.Jansen, De achteruitgang van de oevervegetatie van het Tjeukemeer tussen Oosterzee (Buren) en Echten. 18 p. f 4,50

88/55 R.Torenbeek, Hydrobiologie en waterhuishouding: een beleidsvoorbereidende studie. 148 p. f 20,50

88/56 P.A.J.Frigge & C.M.van Kessel, Adder en zandhagedis op de Hoge Veluwe: biotopen en beheer. 16 p. f 3,50

88/57 A.J.de Bakker, Monitoring van epifytische korstmossen in Nederland in 1987. 35 p. f 6,-

88/59 F.J.J.Niewold & H.Nijland, De Sallandse Heuvelrug als reservaat voor het Westeuropese heidekorhoen. 102 p. f 14,50

88/63 S.E.van Wieren & J.J.Borgesius, Evaluatie van bosbegrazingsobjecten in Nederland. 133 p. f 19,-

88/64 G.P.Gonggrijp (red.), Gea-objecten van Gelderland. 342 p. f 40,-

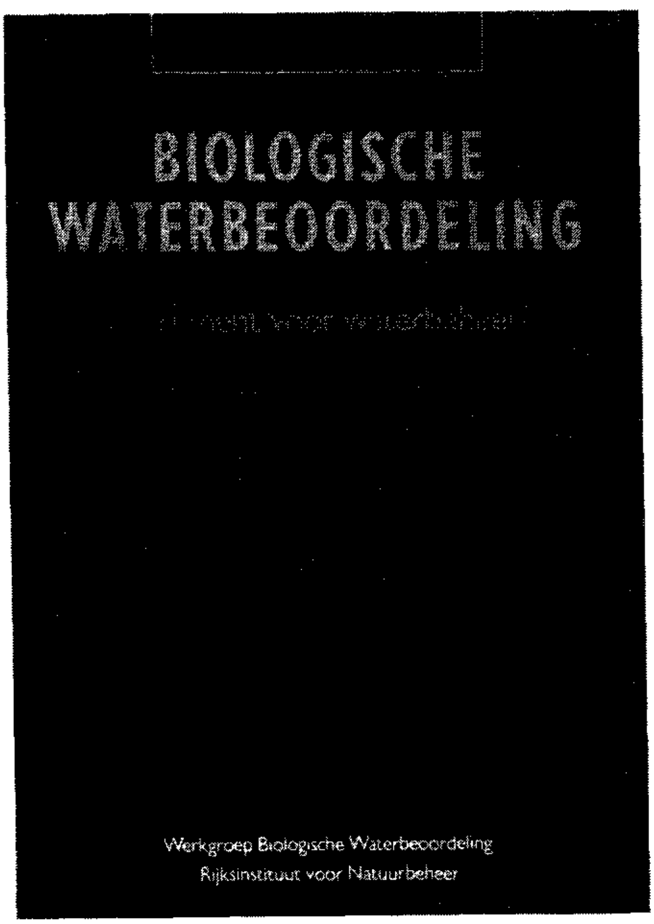
88/68 R.Noordhuis, Maatregelen ter voorkoming en beperking van schade door zilvermeeuwen. 48 p. f 7,50

89/6 B.J.Ens, T.Piersma, W.J.Wolff & L.Zwarts 1989. Report of the Dutch-Mauritanian Project Banc d'Arguin 1985-1986. WIWO-rapport 25. f 35,-

Ecologie van kleine landschapselementen

Kleine landschapselementen vormen voor veel soorten planten en dieren van het cultuurlandschap biotoop en ecologische infrastructuur. In 1986 wijdde het RIN een studiedag aan dit thema. In het verslag hiervan werd een overzicht gegeven van de stand van het onderzoek en er is ruime aandacht besteed aan praktijkproblemen van de landinrichting.

88 pagina's, geïllustreerd
prijs *f* 20,-
bestelcode: KLE



Biologische waterbeoordeling: instrument voor waterbeheer?

De Werkgroep Biologische Waterbeoordeling organiseerde in 1987 in samenwerking met het RIN een symposium waarvan de bijdragen gebundeld zijn in dit boek.

"De werkgroep heeft een rijk en plezierig geïllustreerd kader uitputtend op poten gezet. Laten we voortaan spreken van de blauwe gids en wie hem onverhoopt nog niet heeft: aanschaffen!"

Jaap Dorgelo in Hydrobiological Bulletin 22,2: 209.

184 pagina's
prijs *f* 35,-
bestelcode: BW

Beide boeken zijn te bestellen door overschrijving van het verschuldigde bedrag op giro 516 06 48 van het RIN te Leersum onder vermelding van de bestelcode. Uw giro-overschrijving geldt als bestelformulier; toezending geschiedt franco.