

**Black Terns (*Chlidonias niger*)  
in Benin :**  
Wintering situation (February/March 2000)  
in the coastal wetlands

Mission in the framework of the support of SOVON for CEROE

Ward Hagemeijer<sup>1</sup>, Jan van der Winden<sup>2</sup>, Jacques Adjakpa<sup>3</sup> & Gilbert Boko<sup>3</sup>

<sup>1</sup> SOVON, Dutch Center for Ornithology

<sup>2</sup> Bureau Waardenburg, Consultants for environment & ecology

<sup>3</sup> Centre de Recherche Ornithologique et de l'Environnement (CEROE)

SOVON-onderzoeksrapport 2000/07

This report was made under contract of Programme d'Amenagement des Zones Humides (PAZH), Benin.



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*Authors:* Hagemeijer W., van der Winden J., Adjakpa J. & Boko G.

*Pictures:* Ward Hagemeijer

*Printed by:* Druk & Vorm, Nijmegen, The Netherlands

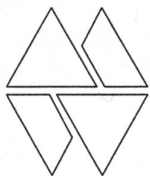
*Way of citing:*

Hagemeijer W., van der Winden J., Adjakpa J. & Boko G. 2000. Black Terns *Chlidonias niger* in Benin: Wintering situation (February/March 2000) in the coastal wetlands. Mission in the framework of the support of SOVON for CEROE. SOVON Onderzoeksrapport 2000/07. SOVON Vogelonderzoek Nederland, Beek-Ubbergen.

Contact addresses:



SOVON, Dutch Center for Ornithology,  
Rijksstraatweg 178, NL-6573 DG, Beek-Ubbergen, The Netherlands.  
Email: [info@sovon.nl](mailto:info@sovon.nl); Website : [www.sovon.nl](http://www.sovon.nl)



**Bureau Waardenburg bv**  
Consultants for environment & ecology  
P.O. Box 365, 4100 AJ Culemborg, The Netherlands  
Tel. +31 345 51 27 10, Fax +31 345 51 98 49  
E-mail [wbb@buwa.nl](mailto:wbb@buwa.nl) Website [www.buwa.nl](http://www.buwa.nl)



03 BP. 1323 Cotonou , (Rép. du Bénin)  
Tél. : (00229) 35 20 97 /35 16 39  
Fax. : (00229) 31 03 08  
E-mail : [adjakpa@svfed.bj.refer.org](mailto:adjakpa@svfed.bj.refer.org)



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## Acknowledgements

We would like to thank the people that have helped to bring this mission to a successful end. Without disqualifying contributions of others we forget to mention here, the following persons should be specifically mentioned:

PAZH, in the persons of G. Ale, L. Akambi, I. Hachimou, facilitated the work in both financial, logistic and personal sense. CEROE and all its staff members, but especially Jose Luto, Louis Lawouin and Miranda Dossouyovo should be thanked for all their work and support.

Jan Kamstra, as allways, was very positive and helpful, both during the stay as in the preparatory stages. ....provided supported us as chauffeur and with overall help. Boatsman Cristoph, navigated us at Lac Nokoue, even in very dark nights and thick fog. SOKODO provided logistic support. The people from the Direction de la Peche provided logistic support and navigated during part of the trips on Lac Nokoue and on the Aho.

Huub Ruigrok should be thanked for being the enthusiastic producer of the filmcrew consisting of Martin Gaus, Camiel van den Boogaard, Jan Olsman and Michael Ballak. They shot some nice tracks of our work. SOVON and Waardenburg facilitated the work of Ward and Jan.

Pim de Nobel, John van Betteray and Martin Poot provided comments to an earlier draft of this document.

## Summary

Because of its migratory behaviour the Black Tern constitutes a clear and direct link between The Netherlands (where it breeds) and Benin (where it winters and passes on migration). Its threatened status as a breeding bird in The Netherlands makes that there is a high interest in finding the constraints in its life cycle. The responsibility for the conservation of the species is clearly international.

The ecology of the Black Tern – and terns in general – has been studied to some extent and although many aspects remain unknown, provides a good background for understanding new observations. The species is conspicuous in the field and is a ‘flagship species’ for many wetland managers, for example in The Netherlands. Because it is a piscivorous species there is a direct link to the economical value of wetlands, e.g. to fisheries. The species, being reasonably easy to count, can indicate stock quantities of fish of certain sizes. Furthermore, in a Beninese setting, the Black Tern can serve an educational model for learning about how to perform ecological research on birds.

In February and March of the year 2000, Black Terns *Chlidonias niger* were studied in South Benin. The goal was to introduce CEROE into base-line ecological research and to investigate the possibilities to study the Black Tern as an indicator of the state of the environment, specifically in the wetland of *Lac Nokoué*. This site is known to be an important wintering site for Black Terns (supports at least 2.5 times the Ramsar 1% criterion). In March 2000 at least 2000 birds were present at *Lac Nokoué* and *Lac Ahémé*. Roosting behaviour of the terns at this lake was unknown until now.

The night roost was located and several individuals were caught and measured, giving a first indication of biometry, weight, moult stages etc. of Black Terns in South Benin in this period of the year. Foraging behaviour was observed and quantified, age ratio and plumage scores were taken. First values were obtained for parameters that allow a (rough) comparison between the amount of prey taken by Black Terns and by human fishery activities. The methods applied are promising in the Beninese context but more research effort is needed to get more reliable estimates for the parameters given above.

## 1. Introduction

Wetland sites support many values. Without intending to be complete one can easily list some of them: Large groups of people depend on their resources (economical interest), natural values are generally high, especially for birds (natural interest), they are important components in the landscape (scenic interest) and they often are crucial chains in the control of hydrology in an area (safety and economical interest).

As such the (eco-)system is usually very complex and knows many interrelations between the different aspects. The species living in these wetlands constitute the core of the system. Without knowing the ecology of these species (both resource- and other species), it is virtually impossible to manage the site in a sustainable way, safeguarding all the interests mentioned above.

On the other hand, studying the ecology of all species is too daunting a task. This is why indicator species are often used: a (group of) species that indicate the state of many of the relations, of the system in general and of other species. This way, knowledge of the ecology of one or a few species in an ecosystem, can tell a lot about all the interests of such a system. Birds are often chosen as a research subject, because of several reasons. To name just a few:

- they are conspicuous in the field;
- the knowledge of the general ecology and research methods is usually high;
- they are high up in the food chain;
- they can have a clear 'flagship function';
- The importance of these species is internationally recognized as an indicator for the value of sites and is embedded in international treaties and conventions like the Ramsar convention and the African Eurasian Waterbird Agreement (AEWA).

The Black Tern can serve as an example for this. Because of its migratory behaviour it constitutes a clear and direct link between The Netherlands (where it breeds) and Benin (where it winters and passes on migration). Its threatened status as a breeding bird in The Netherlands makes that there is a high interest in finding the constraints in its life cycle. The responsibility for the conservation of the species is clearly international.

The ecology of the Black Tern – and terns in general – has been studied to some extent and although many aspects remain unknown, provides a good background for understanding new observations. The species is conspicuous in the field and is a 'flagship species' for many wetland managers, for example in The Netherlands.

Because it is a piscivorous species there is a direct link to the economical value of wetlands, e.g. to fisheries. The species, being reasonably easy to count, can indicate stock quantities of fish of certain sizes.

Furthermore, in a Beninese setting, the Black Tern can serve an educational model for learning about how to perform ecological research on birds.

### *Short history of ornithological work in Benin*

In 1995 the initiative was taken to start ornithological work in Benin, in the framework of the preformulation of a wetland programme. A first, six-week visit was paid to the wetland zone in South Benin in February and March 1996, by SOVON (Ward Hagemeyer). Local counterparts were Patient Coubeou and Jacques Adjakpa (Hagemeyer et al 2000)

The Wetland programme was developed in the framework of the sustainable development agreement between Benin and The Netherlands and the first ornithological mission was funded by Ecooperation. One of the results was the creation of CEROE, an NGO dedicated to ornithology. The work by SOVON in Benin was continued with support of Ecooperation and

focussed on the support of CEROE. Consecutive visits were paid by SOVON in 1997 (Martin Poot) for support in monitoring and for guidance at the PAOC in Ghana and in 1998 (Ward Hagemeyer) to prepare a workplan for the cooperation between CEROE and SOVON, ranging from baseline monitoring and census to ecological research.

In 1999 initiatives were taken to enter the next phase (demography and ecological research) of cooperation, by supporting CEROE to start ecological research into a species as an indicator for sustainable management of wetland sites. The example of the Black Tern was chosen. The project was realized in the beginning of 2000 and carried out by SOVON (Ward Hagemeyer). Jan van der Winden (Bureau Waardenburg) was invited to take part in the mission because of his specific expertise with Black Terns.

*SOVON*, Dutch Centre for Ornithology, is a Dutch NGO, founded in 1974. It focusses on ornithological research to gather information to further the conservation of birds and their environment and for science. In the beginning the focus was on atlas work (mapping distributions of birds). Later the working field became broader and monitoring and research into causes of changes and relations with ecology of birds became important aspects. An important characteristic of the work of SOVON is that the participation of as many volunteers as possible in the projects is stimulated, especially in monitoring and atlas work. This results in 'the SOVON network' of thousands of volunteers. This way, SOVON represents a broad base within Dutch society.

Nowadays SOVON counts 35-50 staff. International work is based at the department of Research and International Affairs.

*Bureau Waardenburg*, Consultants for environment & ecology, provides research and consultancy services within the fields of ecology and environmental science; a broad area encompassing the relationships between people, animals, plants and the environment. Founded in 1979, the practice initially concentrated on aquatic research, but the scope of its activities has since rapidly expanded to include terrestrial environment. The research staff of 25 persons have built up a thorough knowledge base and can draw upon extensive experience in diverse topics, allowing to take on a wide range of projects. Bureau Waardenburg has organised its projects within three sections: Nature and Landscape, Aquatic Ecology and Bird Ecology. The 8 persons staff of Bird Ecology have a broad international experience in bird research projects as well as in consultancy services. Topics of bird-related projects include feeding ecology, effects of chemical pollution, effects of wind turbines, air ports and other man-induced developments, birds and flight safety for airplanes, nature development projects, counts and censuses. In The Netherlands, Bureau Waardenburg is involved in Black Tern projects as well: habitat restoration projects for Black Terns, including breeding success studies to monitor effects of habitat changes.

*CEROE*, *Centre de Recherche Ornithologique et de l'Environnement*, is a Beninese NGO, founded in 1996. It has gone through a remarkable development, increasing its activities from waterbird counts (what it all started with) to a wide range of projects, including educational and research aspects. The objectives of CEROE are 1) to promote Ornithology in Benin and to contribute to the preservation of birds and to the sustainable development of their habitat; 2) to constitute a database on birds found in Benin; 3) to educate people about Biodiversity preservation and 4) to develop regional and international co-operation.

In 1998, in the framework of the bilateral agreement between Benin and The Netherlands, a mission was organised to develop a cooperation agreement between CEROE and SOVON and to write up a project plan for the future.



Summarizing the cooperation would focus on

1. the continuation and improvement of the counting and monitoring
2. the development of research into reproduction and survival of birds as crucial ecological factors in understanding changes in numbers
3. the development of research into the ecology of species as indicators for sustainable management and – use of (wetland) ecosystems.

Cooperation was intended to exist of

- support missions of SOVON to CEROE in order to help with the above aspects
- visits of CEROE to SOVON to learn about - and to be trained in, specific aspects of the workfield above

*Goals of the mission in February and March 2000.*

Within the framework of the support for CEROE the goals of the mission were:

1. Explore possibilities and initiate ecological research on Black Terns in the wetlands in South Benin, also as a learning model for CEROE;
2. To facilitate the shooting of film images on the research of Black Terns in Benin as a contribution to a Wetland documentary and a contribution about Black Terns in a WWF documentary for Dutch television;
3. Support CEROE in the counting of waterbirds, with a focus on improving the quality of counts and introducing new methodological aspects;
4. Support CEROE in setting up relational databases storing the data gathered by the counts;
5. To give a lecture at the university of Benin, recognizing the need to build ornithological capacity at the scientific level as well.



Fig 1.1. Black Tern *Chlidonias niger*, full winter plumage, in flight.

**2.**

## 2. Study Area

The study area is located in South-Benin between 6°15' and 7°00' Northern Latitude. It is composed of several wetland ecosystems ranging from the mouth of the River Mono at the Togolese border in the West to the marshes of Adjarra-Avrankou at the Nigerian border in the East. This region includes the departments of Mono, Atlantique, Ouémé and part of Zou.

For details concerning climate, hydrology, relief and soils, vegetation and human population we refer to Hagemeyer et al (2000).

Fig. 2.1 and 2.2 present some information about the geography of South Benin

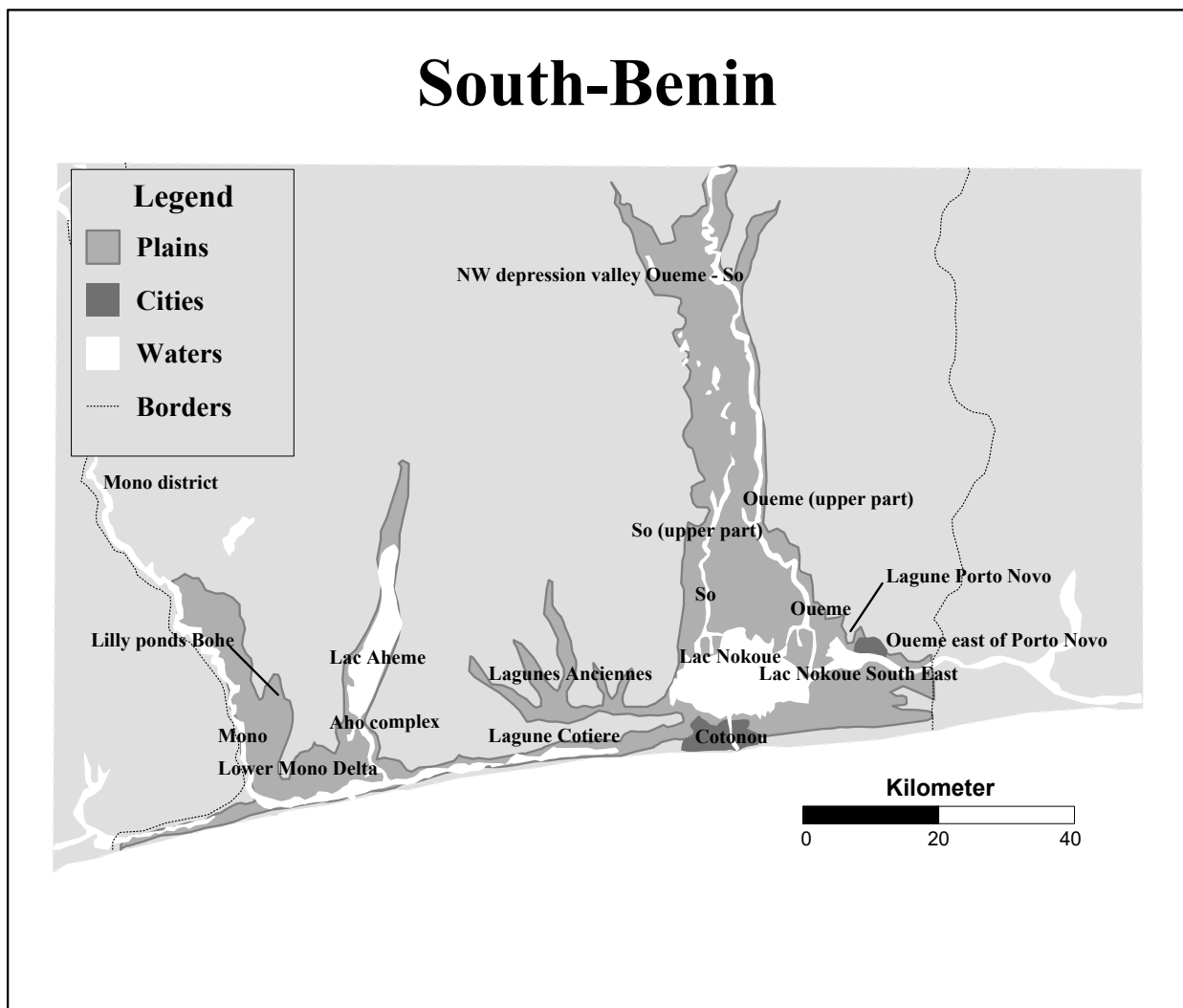


Fig. 2.1: Map of Southern Benin, showing some important toponyms

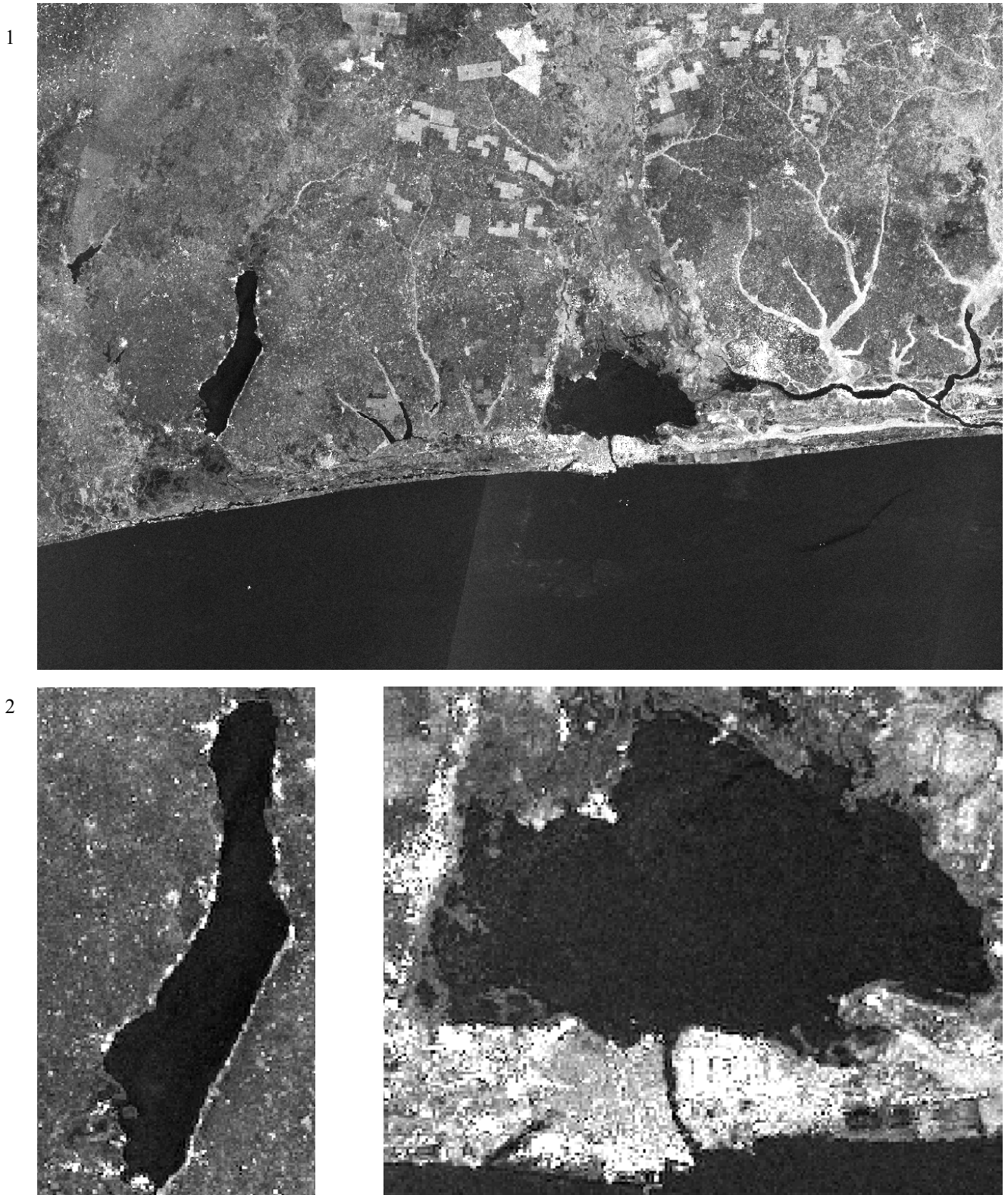


Fig 2.2: Satellite (radar) images of South Benin showing:

1. Total coastline from Togo to Nigeria. Lac Ahémé, Lac Nokoue, Lagune de Porto Novo, Anciennes Lagunes and Lagune Cotiere are clearly visible
2. Detail showing Lac Ahémé, with Guezin in the south.
3. Detail showing Lac Nokoue with Cotonou to the south.

Source: Landsat TM scenes from the NASA Scientific Databuy program, mosaic compiled by Earthsat

### 3. Itinerary

Monday, February 21

Arrival Ward Hagemeyer (WHa) and Jan van der Winden (JvdW) in Cotonou (18.30). First meeting later that evening with representatives for PAZH (G. Ale, A. Akambi and I. Hachimou) and the members of the filmcrew of *Small World* and *Dierenmanieren op reis* (Jan Kamstra, Huub Ruigrok, Martin Gaus, Jan Olsman, Michael Ballak, Camiel van den Boogaard).

Tuesday, February 22

Visit to CEROE to meet the team and see their new headquarters. Discussion about the workplan for the mission with Jacques Adjakpa, president of CEROE.

Next a visit to PAZH, meeting Mr. Iro Hachimou, '*Chargé de Programme Biodiversité et Recherche Scientifique*' and Dr. Liamidi Akambi.

In the afternoon the first visit to the terrain, with members of CEROE (Gilbert, Jose Luto), to inspect a potential night-roost of Black Terns, previously identified by CEROE.

Wednesday, February 23

Visit to the *Lac Ahémé* and *Bouche du Roi*, taking the boat near Guezin en descending the Aho to join the *Lagune Cotiere*, arriving to the *Bouche* later. Visit to the daytime roost of terns on the sandbank in the river mouth.

An attempt to visit a comparable river mouth just over the border with Togo fails because WHa and JvdW are not allowed into Togo without visa.

On our return in Grand Popo we explore the rich avifauna of this region, before continuing to *Lac Ahémé* (by car) to check for Black Terns and to find indications for their roosting behaviour at that site.

Thursday, February 24

Early morning departure from *Direction de la Pêche*, Cotonou, to visit *Lac Nokoué* by boat.

After reaching the centre of the lake we take the boat towards Gbakpodji (SE), return to Ouédo Gbadji, So Tchanhoué, So Zounko, Ganvie and Abomey Calavi. From there we head back to the centre of the lake to look for roosting behaviour and to try and find the roost, in which we succeed.

Friday, February 25

In the morning some deskwork is done and preparations are made to capture terns. In the afternoon we visit *Lac Nokoué* by boat to try and capture Black Terns at the roost. WHa has to explain the activities to the owner of the *akadja* in Ouédo Gbadji, arriving back just in time for the dusk and the terns to arrive. Capturing activities continue into the night.

Saturday, February 26

Second day of capturing at the roost, now with the film crew. They shoot the preparations, take interviews and shoot the netting and handling of one Black Tern. We continue our efforts to capture terns until 01.00 in the night, before returning to Cotonou.

Sunday, February 27

Visit to *Lac Ahémé* (Guezin) and later to Gbehoue (SW of Come) with the film crew to take interviews with CEROE and to shoot aspects of the work of SOVON with CEROE.

Later in the afternoon we visit *Lac Ahémé* (Adjatokpa) to record the migration of Black Terns towards the roosts, until darkness.

Monday, February 28

Visit to *Lac Nokoué* to study ecological aspects of Black Terns. Towards the evening new catching attempts are made at the roost.

Tuesday, February 29

Visit to the *Lagune de Porto Novo* in the morning, for support in counting methodology. A visit was planned in the afternoon to *Lac Ahémé* to finally locate the roost there, but a boat could not be arranged. Instead, the afternoon is used for a visit to CEROE and to prepare the lecture that will be given the next day at the university (CPU).

Wednesday, March 1

Lecture at the UNB, CPU. WHa teaches an audience of 150 students and other university staff about biodiversity, conventions, conservation and the link to the ecology (of birds). JvdW illustrates this with the example of the Black Tern.

The afternoon was spent at the office of CEROE, working on the wetland counts and the reporting of the results. In addition, visits were paid to PAZH and to the Royal Dutch Embassy (Franke Toornstra) and to CBDD (Gaetan Agbangla).

Tuesday, March 2

WHa joins CEROE at their office and helps setting up a relational database for the wetland counts.

JvdW, together with Gilbert and Jose Luto once more visits *Lac Nokoué* to record some more ecological aspects of Black Terns

Friday, March 3

In the morning debriefing at PAZH. Over lunch a meeting is arranged with several people from CBDD. In the afternoon some deskwork is done and preparations are made for departure of WHa and JvdW in the evening.

Saturday, March 4

Arrival WHa and JvdW at Schiphol. Journey home.

## 4. Black Terns wintering in Benin

### General introduction

Black Terns *Chlidonias niger niger* breed throughout Europe and western Asia (e.g. Hagemeyer & Blair 1997). The preferred breeding habitat is inland freshwater marshlands and eggs are laid on floating water vegetation especially Water Soldier *Stratiotes aloides*. The birds arrive in Europe in spring from half April onwards and they stay until early September. Just before the migration towards Africa, Black Terns use large wetlands to stopover for their initial moult and for storing fat reserves for their long distance flight to West-Africa.

After departure from Europe in autumn, Black Terns likely fly non-stop to the Banc D'Arguin in Mauritania, where more than 100,000 birds concentrate in September-October (Meininger 1988). From September onwards high numbers (tens of thousands) are reported from the Gulf of Guinea, feeding on coastal upwellings and coastal lagoons (e.g. Grimes 1977, Piersma & Yaa Ntiamo-Baidu 1995). During the period November–March the numbers along the coasts of West Africa are lower, when birds are probably feeding on upwellings far from the coast and more spread along the southern African coasts (e.g. Urban et al. 1986). Black Terns forage offshore and in coastal lagoons mainly feeding on small fish and shrimps.

The occurrence of “Dutch” Black Terns in Benin was proven by a recovery of a bird, ringed in Noorden, The Netherlands. This bird was found at Ovagblo in Benin (Haverschmidt 1978).

### Wintering numbers in Benin

Records of Black Terns from the censuses in 1996 and 1997 are shown in fig 4.1, indicating important sites for Black Terns.

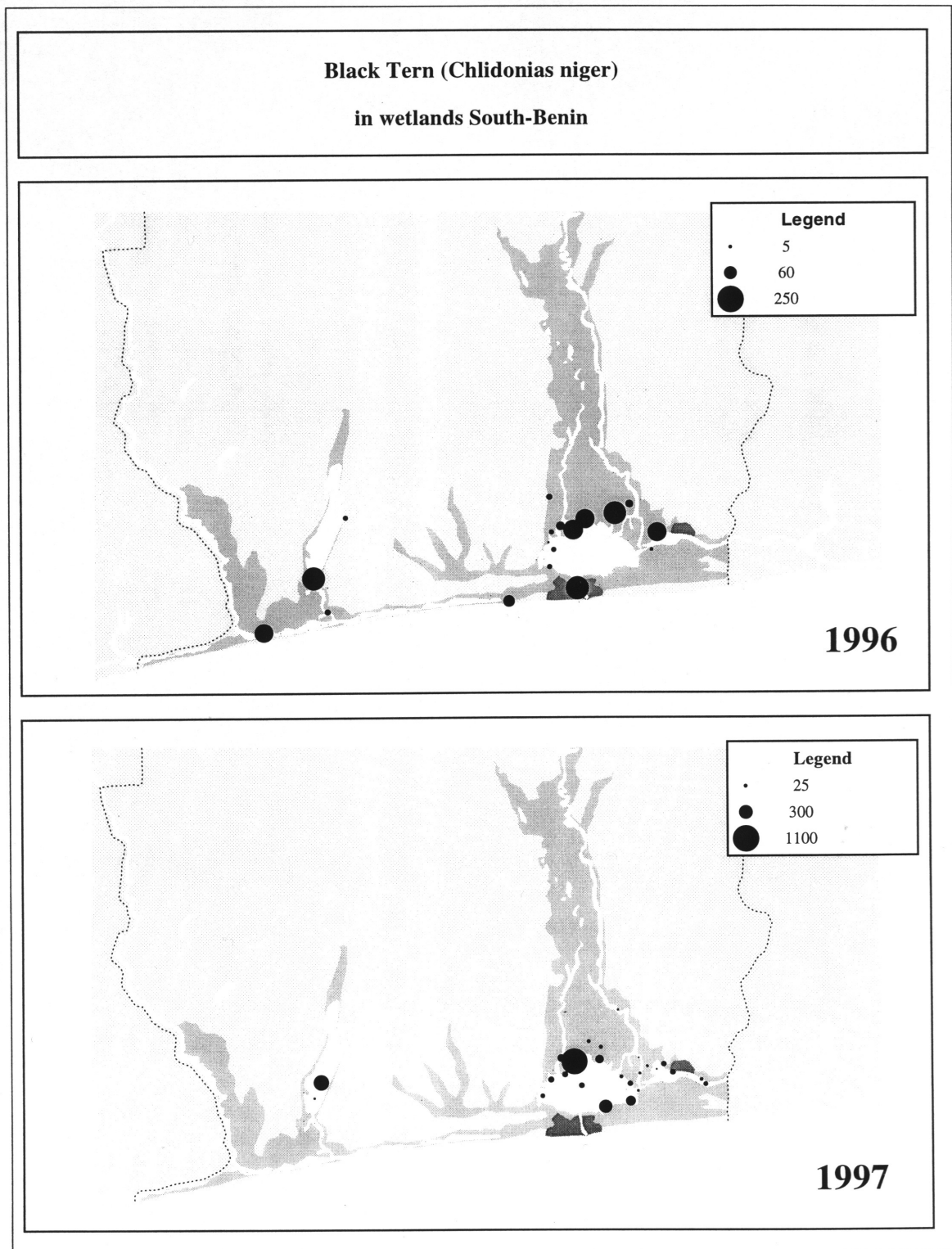
From March 1998 onward monthly counts of waterbirds including terns have been executed by CEROE in all coastal wetlands in Benin. The counts are conducted during daytime by means of small boats. Terns are counted from these boats as completely as possible. The aim is a complete coverage of all waterbodies in the wetlands of southern Benin in order to arrive at the most reliable estimate of the total population present.

The numbers of Black Terns fluctuate substantially throughout the year (fig. 4.2). Peak numbers are present in the period January-March. More than 5000 birds have been counted in this period at one moment, which is 2.5 times the international important 1% level (Rose & Scott 1997). Clearly the Benin wetlands are of international importance for Black Terns.

In the period with highest numbers especially *Lac Nokoué* and *Lac Ahémé* are of importance for Black Terns (fig 4.1). In general more than 75% of all Black Terns is present on these two lakes with *Lac Nokoué* being the most important of both lakes. In the period September-October, however most birds are present in the lower Mono delta, near the *Bouche du Roi*. Other areas including the rivers may hold up to a few hundred birds especially in March-April. The relatively high numbers in September-October at the *Bouche du Roi*, suggest that these birds feed at sea. This corresponds very well with the peak in numbers in Ghana in this period, where birds feed in upwellings that are close to the West-African coast in this time of the year (Grimes 1977). Later in the season birds no longer occur at these coastal sites and coastal lagoons are preferred.

It seems that there is a clear migration peak in March-April, in Benin as well as in other parts of West Africa, likely of adult birds on their way towards the European breeding areas. The Benin coastal lagoons may be used as an important stopover area to finish moult and to gain fat reserves for migration. From half April onwards adult birds leave West Africa for their breeding areas which is reflected by the decrease in numbers in this period (fig. 4.2). The coastal wetlands are used by subadult Black Terns from April to August as a non-

breeding area.



**Fig.4.1:** Sites of observations of Black Terns *C.niger* in the winter (Feb.) of 1996 and 1997 in the South of Benin (Hagemeijer *et al.* 2000)

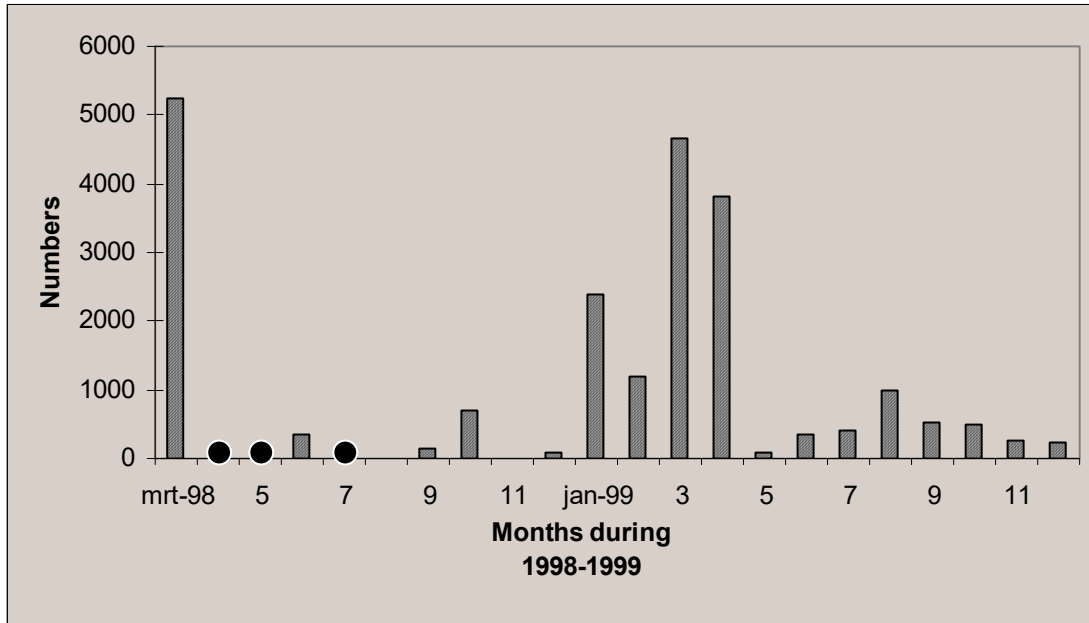


Fig. 4.2: Black Tern numbers in Benin in the period 1998-1999 (data CEROE). • : no counts available.

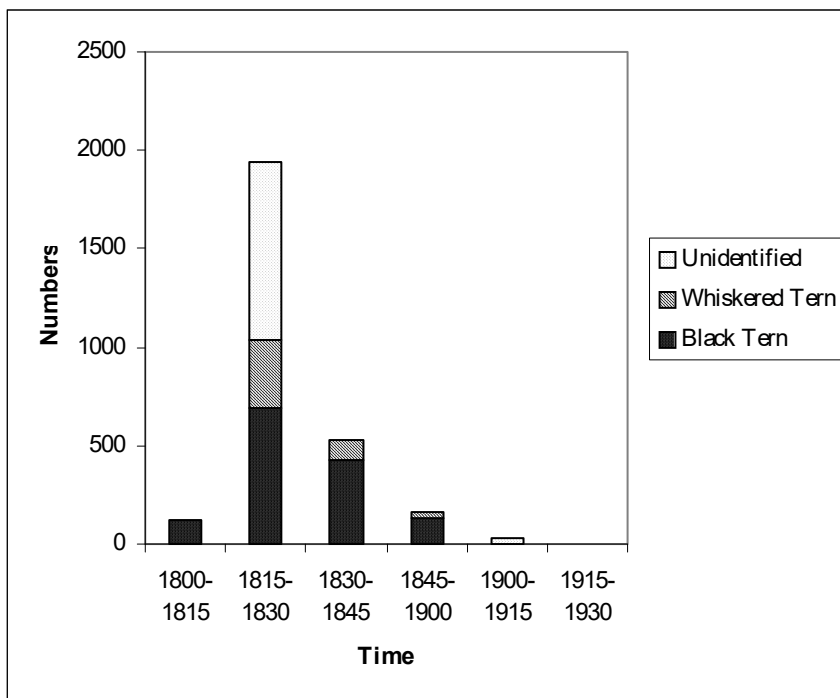


Fig. 4.3: Marsh tern numbers (*Chlidonias niger*, *C. hybridus*, *C. leucopterus*) arriving at the night roost at Lac Nokoué on 25 February 2000. Presented are the numbers per 15 min. Sunset was at 19.00 hr. About 19.30 hr it was more or less dark. In total 2790 marsh terns arrived of which at least 1380 Black Terns. Whiskered Tern *C. hybridus* was the second most numerous species, 480 being positively identified as such. White-winged Tern *C. leucopterus* occurred in low numbers (not more than 10 having been identified as such).



### *Behaviour and ecology of Black Terns in Benin wetlands*

Black Terns were observed throughout the day on the open waters of the coastal lagoons *Lac Nokoué* and *Lac Ahémé*. Birds were mainly feeding on shrimps, but also on small fish. The areas where birds were feeding on shrimps were clearly separated from those where birds were feeding on fish. Shrimps were caught on the central open parts of the lake, while birds feeding on fish were observed only at the fringes near or in outlets of rivers. In the evening birds moved to night roosts in akadja in the centre of *Lac Nokoué*. On *Lac Nokoué* all birds moved to an area with several akadja parcels to roost together with Whiskered Terns *C. hybridus*. From 18:00 until 19:00 hour birds arrived on the roost. All birds were present before darkness. This provided an excellent opportunity to count arriving terns on 25 February (fig. 4.3). Altogether 2790 marsh terns were counted with 1380 Black Terns, 480 Whiskered terns and 930 unidentified marsh terns. All birds arrived before dusk.

At 23 February about 500 Black Terns were present on *Lac Ahémé*. This brings the estimated total for Benin in February/March to at least 2000.

During the study in February-March 2000, no marsh terns were observed at sea nor at the tern roost at the *Bouche du Roi* where only Royal Tern *Sterna maxima* and Sandwich terns *S. sandvicensis* were present.

### *Catching activities*

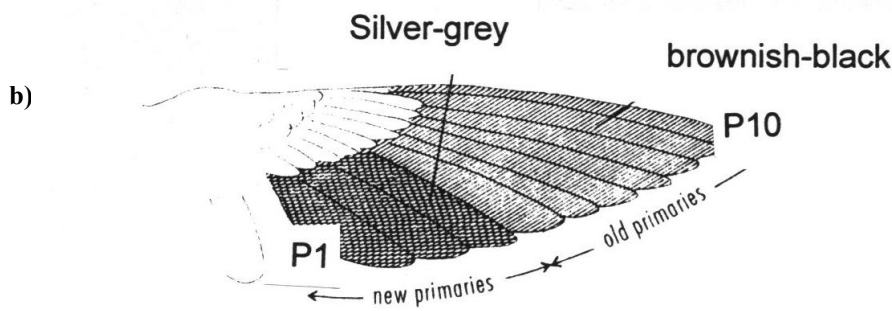
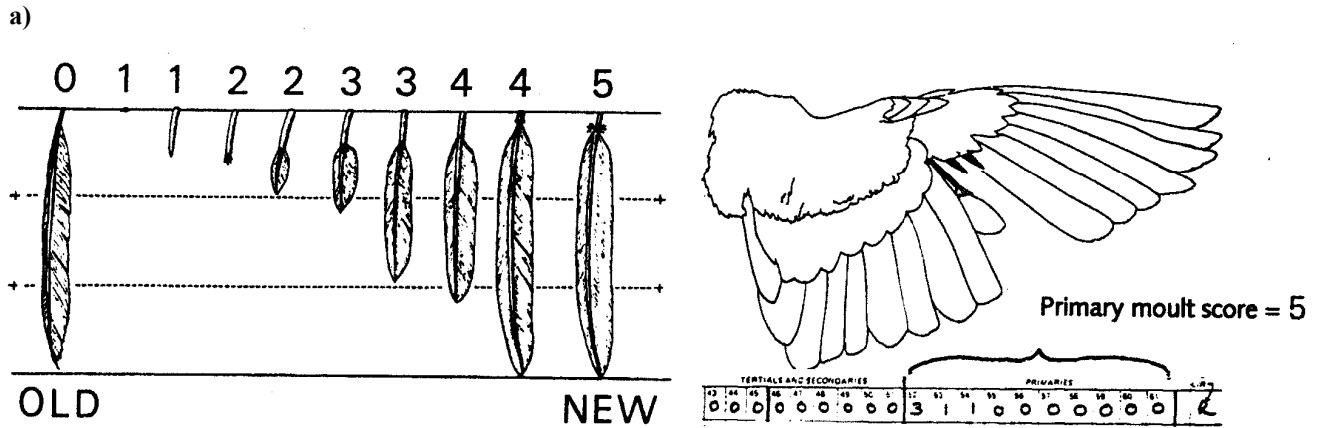
At the night roost of *Lac Nokoué*, mist nets were placed during three nights (25/2, 26/2 and 28/2). Because the water depth was about 1.60 m, it was very difficult to place these nets. At one net birds were tape-lured, which turned out to be the most effective catching location. During the catching nights respectively two, four and three nets were placed. This relatively low catching effort was due to the difficult circumstances. In total 7 birds were captured (table 1). Of all birds capture time, weight, wing length, bill length, bill height, total head length, and moult scores were taken. A picture was taken of the open wing.

### *Body and primary moult*

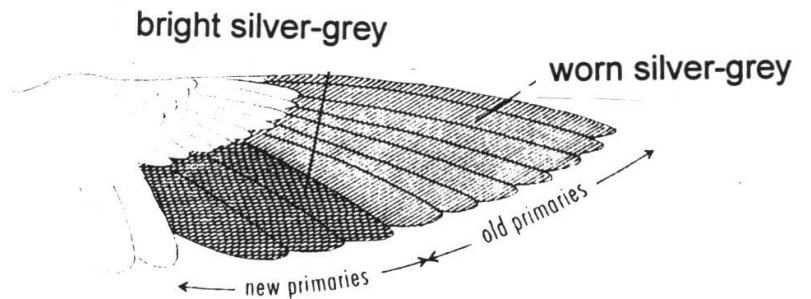
*Primary moult* - Terns moult their primaries from the inner one towards the outer one (fig. 4.4). The moult was scored according to Ginn & Melville (1983) with adaptations for later moult shifts according to Underhill & Prys-Jones 1986 and Van der Winden & Nesterenko (in prep.).

Throughout the season at least two moult series can be recognized. Adults start moulting their first primary (P1) in July-August. In February-March all primaries are replaced for the first time. The new primaries of this period are coded '5'. From November onwards a second series starts at P1 for which the new ones are coded '6'. Some birds might perform a third series in February-April starting at P1 again, for which the new feathers are coded '7'. Juveniles start later with primary moult and for these birds all new feathers are coded '5'.

*Body moult* - The white feathers of the underparts (non-breeding plumage) are replaced by the black breeding plumage from March onwards. The progress of this change is recorded in five categories (fig. 4.5). The first few black spots are marked as 5a and if birds have only one or two white feathers left they are called 1a (Schouten 1982, Van der Winden & Nesterenko in prep.)



Typical first winter bird in February-March



Typical adult bird in February-March

**Fig. 4.4.** Primary moult registration. In the upper figure (a) primary moult score is demonstrated (after Ginn & Melville 1983). The figure is adapted to show the principle for birds with 10 primaries (like Black Terns).

- 0 Old feather remaining
- 1 Old feather missing or new feather completely in pin
- 2 New feather just emerging from the sheath up to one third grown
- 3 New feather between one third and two thirds grown
- 4 New feather more than two thirds grown and with remains of waxy sheath at its base
- 5 New feather fully developed with no trace of waxy sheath remaining at base

In the lower figure (b) tern moult progress (starting at P1, moving outwards) is demonstrated (after Baker 1993) and differences between adult and juvenile (first winter) birds are indicated. See also text. See appendix 3 for pictures of the wings of the Black Terns caught.

**Table 4.1.** Biometrics of Black Terns *Chlidonias niger* captured *Lac Nokoué* Benin 2000.

Date	ring number	age	weight (g)	primary moult score	body plumage
25/2	SA895301	juv	67	5555310000	5
25/2	SA895302	ad.	61	6664115555	5
25/2	SA895303	ad.	62	6641555555	5a
25/2	SA895304	juv.	58	555541000	5
26/2	SA895305	ad.	64	1666645555	4
28/2	SA895306	ad.	63	6666455555	5a
28/2	SA895307	ad.	59	6666555555	3

*Population characteristics*

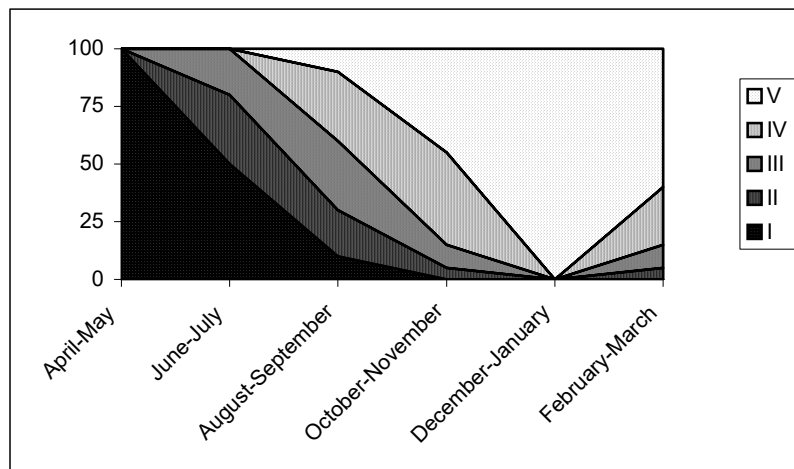
On subsequent days in February-March small flocks of Black Terns were examined for their age composition. In flight, juveniles can be recognized by their different primary moult pattern.

Although difficult, it is possible for experienced observers to age most birds in good light conditions. In total 194 birds were checked with 33,5% juveniles present. This is relative high compared to other post-breeding areas in Europe and Africa. It is likely therefore, that a high proportion of juveniles uses Benin wetlands in winter time.

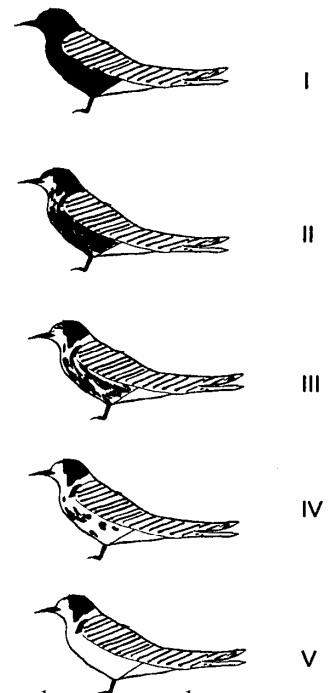
Progress of body moult was studied by checking, resting birds for the amount of black/white at the underparts at two dates (table 4.2). At the first day, most birds were in full non-breeding plumage (complete white underparts), but within one week there was a shift notable towards a higher proportion of birds with at least part of their underparts with black feathers. This might be caused by a quick moult progress in local birds, or by an influx of new birds with more advanced moult stages.

**Table 4.2.** Breeding plumage scores (in %) of Black Terns in Benin, *Lac Nokoué*, 2000 (for plumage categories see fig.4.5).

	I	II	III	IV	Va	V	n
24 Feb	0	0	0	8,6	5,7	85,7	35
2 March	0	0	2,7	13,5	8,1	75,7	37



**Fig 4.6** Schematic impression of the shift in body moult progress of stages presented in figure 4.5.



**Fig 4.5.** Body moult patterns and stages.

### Feeding ecology

Black Terns were feeding on *Lac Nokoué* and Ahémé on shrimps as well as fish. However, the majority of the terns was feeding on shrimps at the open parts of the lakes. The most important species is *Penaeus notialis* (Akambi 1988). The birds were feeding in loose flocks at 2-3 m height above the water. Shrimps were picked up from the water surface without diving (surface picking). Near outlets of rivers, small flocks of terns were feeding on small fish mostly diving in the water with head and part of the body submerged (partially diving).

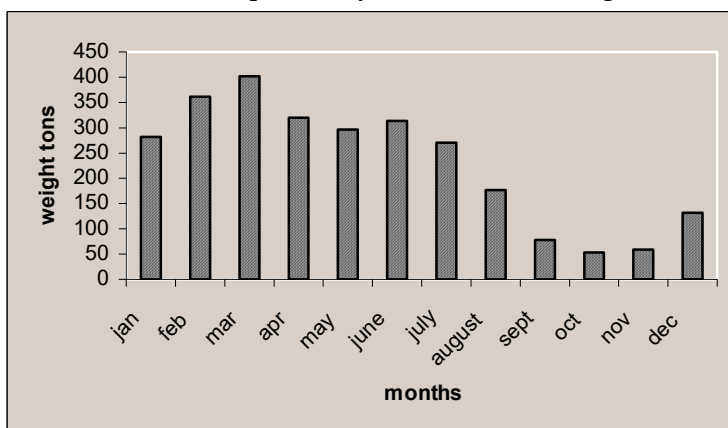
In order to get an impression of the number of shrimps that the terns catch, intake rates were established by following a tern as long as possible and counting the number of times a prey item was taken within a certain period (table 4.3).

**Table 4.3.** Intake rates of Black Terns feeding at fish or shrimps at *Lac Nokoué*, February-March 2000. Presented is the total observation time, the number of individual birds followed and the average number of prey captured per minute.

date	observation time	prey type	birds	prey/min
24 Feb	59.65 min	shrimp	8	0.168
28 Feb	9.22 min	fish	9	0.542
2 Mar	115.8 min	shrimp	15	0.190

### *How many shrimps are eaten by terns compared to human fishery activities?*

The coastal lagoons are used by fishermen for catching shrimps. The shrimps are caught by installing approximately 5000 catching cages in the evening in the lake which are harvested early in the morning (PAZH *pers. comm.*). On a yearly basis between 2000 and 3500 tons of shrimps are harvested in *Lac Nokoué* (*Direction des Peches unpubl. data*). The main harvesting period is between January and August (fig. 4.7). This is related to the life cycle of the shrimps which occur in highest numbers of large sizes in this period. It is interesting to find out how many shrimps are eaten by terns and to see if sustainable use of wetland resources is possible for men and birds in co-existence in the Beninese wetlands. The figure shows a remarkable pattern which can be recognized in tern numbers as well (fig. 4.2). The highest tern numbers occur from January onwards, the period with highest numbers of shrimps. From April onwards numbers of terns decrease because of their return to the European breeding areas. These figures show clearly that information on bird counts can contribute significantly to knowledge about wetland ecosystems. The period with high abundance of shrimps clearly coincides with high numbers of Black Terns.



**Fig 4.7** Average shrimp catches by fishermen per month over the period 1987-1995 at *Lac Nokoué*, Benin.

On average 0.179 shrimps are eaten per minute by a single Black Tern (compare Table 4.3). Based on observations of feeding and resting terns it was estimated that about 50% of the period available for foraging was effectively used for feeding. Feeding birds were followed until they went to the resting place and a few resting birds were observed until they started feeding again. In addition to this the proportions of resting birds and feeding birds were established by regularly counting all birds at a feeding site. The foraging period lasted from 07.00-18.00 hr, so an estimated total of 5.5 hours was used for feeding. This means an estimated number of 59 shrimps per tern per day.

Of 18 shrimps that were caught by terns, the size was estimated in comparison with the size of the bill or head of the Black Tern that caught it. This is a field estimation sensitive to under or overestimation, but in general this estimation gives an impression of the overall size classes eaten by terns. This showed a size range of 4.5 to 9.0 cm of shrimps caught by terns (6.1 cm on average). Akambi (1988) provided good data on shrimp size and the relation between size and fresh weight. Shrimps of about 6 cm on average weigh 2.22 g. This figure is rounded to 2.5 gram as prey sizes are in general underestimated in the field. So one tern consumes about 147.5 g shrimps per day (fresh weight).

For 1999 monthly counts of Black Terns are available (fig. 4.2 show totals for South Benin as a whole. Numbers for *Lac Nokoué* shown in table 4.4). Based on these data the average number of shrimp weight eaten by Black Terns per month can be calculated for *Lac Nokoué*. In these calculations it is assumed that all terns present eat shrimps which is certainly not the case since part of the birds eat fish and possibly prey choice differs between seasons. With these assumptions the total estimated shrimp consumption in 1999 equals about 53.5 tons (table 4.4). Although these calculations are rough and sensitive to mistakes due to several assumptions, one can get a general impression of shrimps eaten by the terns present. Even if twice as many shrimps are eaten, the total quantity is relative low compared to the amount caught by fishermen.

**Table 4.4** Estimated shrimp consumption by Black Terns at *Lac Nokoué* in 1999, based on tern counts executed by CEROE and estimated prey intake rates (see text).

Month	Count Black Tern <i>Lac Nokoué</i>	Consumed shrimp weight (tons)
January	2395	11.0
February	137	0.6
March	3956	18.1
April	3281	14.5
May	29	0.1
June	218	1.0
July	308	1.4
August	720	3.3
September	167	0.7
October	161	0.7
November	255	1.1
December	222	1.0
Total 1999		53.5

The average yearly shrimp catch over the period 1987-1995 by fishermen was 2762.1 tons. This means that fishermen catch 52 times more shrimps than the Black Terns do. If there are

about 5000 catching cages available, one can estimate that the yield of 95 cages equals more or less the prey-amount of the Black Terns. In this light it is clear that terns only take a minor part of the available food resources in the lake. At this moment it is likely that the terns can co-exist with the human use of the area without major conflicts. On the contrary, tern numbers and possible changes in numbers might indicate changes in food availability and these bird numbers therefore might be an indication of available changes in food resources for men as well as birds.

### **Summary of results**

- Black Terns occur in international important numbers in Benin
- Black in February-March Terns feed mainly on shrimps at coastal lagoons during the day.
- Black Terns sleep at night at akadja at *Lac Nokoué*, the night roost at *Lac Ahémé* remains unknown
- Basis biometric data of a few Black Terns were gathered
- Black Terns were moulting flight and body feathers in Benin
- Black Terns were eating on average 59 shrimps per tern per day
- The total Black Tern population in 1999 caught an estimated 53.5 tons of shrimps which is 1.9% of the average yearly catch of fishermen
- Black Terns at the moment can co-exist with human use of wetlands and are good indicators for changes in (sustainability of) use of wetlands, and can indicate problems like overexploitation of coastal wetlands by men
- The applied methods provide good possibilities for further work in Benin.

## 5. Overview of other activities during visit to Benin

Next to the work on Black Terns, which is described in the previous chapter, the following activities were undertaken :

### Support to CEROE

WHa and JvdW were introduced to the staff, building and programmes of CEROE. The progress that had been made since the foundation in 1996 is impressive. It can be concluded that CEROE has grown a lot, both in size and content and that the support that SOVON has been giving throughout the years has been very effective.

During this mission the support to CEROE took the form of

- i. Introduction and guidance about research on Black Tern
- ii. Recording other observations regarding birds e.g. age of Purple Herons and colonies of fish-eating birds (e.g. herons)
- iii. Improvement of counting/monitoring
- iv. Discussion about introduction of new methodologies
- v. Help in initiating and setting up relational database to store counting data
- vi. Transfer of material for monitoring and research
- vii. Discussion about future cooperation

The above aspects are being elaborated below:

- i. (see chapter 4)
- ii. Simple observations can bring forward a lot of information. As an example the age (ad/juv) of all observed Purple Herons *Ardea purpurea* was recorded (if visible) to show how easily this could be done, still yielding usefull information if enough records are gathered. During the short period of our stay only few observations were made. The results are given in appendix 2.  
In the framework of researching the reproductive success of fish-eating birds, a day roost annex breeding colony was found of Night Heron *Nycticorax nycticorax*. Some remains of nests were found. The site was recorded (GPS 6.451136; 2.563033; 29-FEB-00 10:04) for possible later visits during the breeding season.
- iii. During a visit to the counting site Lagune de Porto Novo possible improvements of the quality of the counts were discussed. These included further standardisation of counting routes, species identification, travel speed, active searching vs. more passive recording. Some aspects were practiced during this trip.
- iv. The possibility and desirability of introducing additional transect counts was discussed. Several species remain undetected by 'just' navigating along the shores of lakes/lagunes/channels. In some habitats species hide very effectively, resulting in severe underestimation of numbers or even presence. Snipe *Gallinago gallinago* and Wood Sandpiper *Tringa glareola* are examples of those. Transect on land perpendicular to the shoreline might make a large difference in the accuracy of recording these (and other) species.
- v. During one day a relational database programme (Paradox) was installed at CEROE and a file structure was built to store the data of the counts that had been made so far. A

start was made of entering all data into the relational database. WHa has contacted Tim Dodman of Wetlands International to find out more about the central database structure of WI, requesting count data for Benin to be fed back to CEROE and to inform about possibilities with WI to support the formation of database skills at CEROE. Because WI is transferring all her databases at the moment (to Access) no help was currently available. Also the feed back of data was delayed but was announced for the end of 2000.

vi. Transfer of material to CEROE:

- Database software (Paradox, french version)
- Rings from France (CRBPO) (including list of provided rings)
- 7 mistnets for waders/terns (no 8, two shelf wader mistnets)
- Callipers
- 3 pesolas (100, 300, 600 gram)
- Tongs for ringing (red)
- Handcounter
- Boxes, including foldable ones
- Sony cassette player
- Gas Lamp (Camping Gaz)
- 7 fieldguides for wader and waterbirds of West Africa (in French) (ONC)
- Various materials for fieldwork (cords, bags for birds etc)
- 2 GPS: Garmin 12 (two pieces)
- GPS connection cable (one)
- GPS cases (two)
- Slides of most aspects of the work done during the mission

vii Future cooperation

Some open ends were discussed and plans for the future were reinforced:

Finalisation of report on counts 1996-1997. The translation into French was made by CEROE and will be send to SOVON in March 2000. WHa will then combine the english and french version into one report and have it published. The database with all the countdata needs to be analysed, to find pattern in time and space and to facilitate for example the process of selecting IBA's

The workplan for the future is roughly still the same as discussed in 1998. Some new elements have been discussed. In discussion with PAZH during the debriefing on 3 March it was agreed that CEROE (Jacques Adjakpa) would make a new version of the plans for 2000-2001 and send this to SOVON and PAZH for comments. The plan would then be finalised and put forward to PAZH and other parties for funding. This plan would include for 2000 (amongst other things):

1. continuation of work on Black Terns (november)
2. work on colony-breeding and fish-eating birds
3. participation of SOVON in Wetlands International training course, to be hosted by CEROE in November 2000.
4. Possibility of lectures given at the UNB by WHa/JvdW during November 2000.
5. Possibility to organize a national bird day (biodiversity day?)



## 6. Conclusions and Recommendations

### *General conclusions*

1. Possibilities have been proven to exist for doing research on Black Tern in Benin. Especially *Lac Nokoué* offers possibilities, but potentially also *Lac Ahémé*
2. This research allows to correlate the use by local human population for fisheries with the numbers and food intake (and other ecological aspects) of Black Terns. Understanding these relations is crucial for being able to develop sustainable management.
3. In statistical terms the catches are not yet strong enough, but additional numbers can be caught if more time and effort would be invested. This would require at least 2 foreign specialists to work for two weeks.
4. CEROE has become familiar with methods used in ecological research. Further training is needed for members of CEROE to be able to perform these techniques on their own.
5. The lectures at the UNB were received with great interest. They can be combined with missions as the one performed now. This adds considerable value to the visit.
6. The organisation of a training course of Wetlands International in Benin in November 2000, hosted by CEROE, offers to possibility to transfer knowledge and expertise to a big group of national coordinators of Wetlands International, representing all the countries in Africa.
7. Sites have been found where fish-eating colony breeding birds reproduce. This offers the possibility to start working on the ecology of these species, thus shedding light on the relationship between these species and their ecology and fisheries.



**Fig 6.1** Black Tern *Chlidonias niger* , full winter plumage, in flight.

### Recommendations

In the coming years, priority should be given to two aspects of research:

- a. continuation and improvement of counts and
- b. continuation of recording of basic ecological observation as done during this mission, and extending the research into Black Tern ecology.

To achieve this:

- Research on Black Terns should be continued and intensified. Black Terns are good indicators for changes in human use of coastal wetlands and for the health of the wetland system in general. Counts of birds at the night roost of *Lac Nokoué* are the best method for establishing total numbers because daytime counts of the vast lagoons may cause underestimates of the total population present, due to difficulties in covering all suitable habitat. The night roost at *Lac Ahémé* should be localized in order to get an impression of its type and to provide a suitable site for counts in this area.

An increase of the number of captures is needed to give more information about the importance of the coastal wetlands for the Black Tern population. E.g. it is unclear whether the same birds use the wetlands throughout the year, or whether different parts of the total population use Benin as stopover site. If this is the case, the importance of Benin for the total Black Tern population is higher than now presumed because more birds use the wetlands throughout the year. Moreover bird ringing increases the recapture possibilities of ringed birds abroad which will give more information about the relations between Benin and other countries in the life cycle of Black Terns.

Apart from this, research activities should be executed in other periods of the year in order to get an impression of the importance of different areas in subsequent months for Black Terns.

Until the moment that CEROE can do this autonomically, at least two foreign specialists are required for two weeks (only devoted to catching terns) to do this successfully. CEROE needs more intensive training in basic ecological research techniques. Partly this can be done in Benin, but it would be advisable to have members of CEROE run a course in The Netherlands to become more acquainted with the techniques and to learn the work in practice.

- Setting up general ringing work in the form of Constant Effort Site (CES) mistnetting offers a good possibility to acquire expertise in handling and ringing birds, before making the step to more difficult birds like terns. CES should be set up in Benin as soon as possible.
- Future visits to Benin should be combined with giving lectures at the UNB.
- A mission should be organised to find more colonies of fish-eating birds. This could easily be done for the south of Benin. For the north of Benin this could be combined with a mission to study the relative values of (wetland)sites for birds.
- Set up a pilot for transect counting of birds in 'difficult' habitats.

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## Appendix

### 1. Waypoint (GPS) Coordinates of sites mentioned in this report

<i>Name of Site</i>	<i>° North</i>	<i>° East</i>	<i>Date</i>	<i>Time</i>
ADJATOPA	6.434689	1.966419	27-FEB-00	16:50
AHÉMÉ-O	6.410844	1.960925	23-FEB-00	16:39
DOGLOBOUE	6.301115	1.958007	23-FEB-00	09:08
DORTOIRE	6.460090	2.449656	28-FEB-00	15:58
FOURAGE	6.449903	2.514002	28-FEB-00	12:13
GANVIE	6.462820	2.394006	24-FEB-00	13:24
GRST	6.456597	2.454822	28-FEB-00	11:24
GRST2	6.456989	2.493719	28-FEB-00	11:26
NIGHT HERON	6.451136	2.563033	29-FEB-00	10:04
EAST BANK	6.458405	2.518857	28-FEB-00	11:48
OUEDO GBADJI	6.491316	2.450117	24-FEB-00	12:58
FAECES1	6.407610	2.427115	24-FEB-00	07:48
FAECES2	6.451496	2.512071	28-FEB-00	12:26
ST.CECILE	6.387901	2.420742	22-FEB-00	15:58
STERN BOUCHE	6.294034	1.913955	23-FEB-00	10:59
VANG1	6.412126	2.428842	24-FEB-00	09:18

## 2. Other observations

During the Black Tern research some ecological observations on other bird species were made. Of all well visible Purple Herons *Ardea purpurea*, individuals were aged in two classes: 'juvenile' and 'adult'. Adults are greyish above while juveniles (first winter) birds are in general brownish above. In total 10 birds were aged of which 3 adults. This sample is small, but very little information is available about distribution of adult and juvenile Purple Herons in Africa, so this information contributes to the knowledge that both types winter in southern Benin. Above this, in future bird-watchers in Benin should be aware of the possibility to age Purple Herons.

### Terns

Apart from Black Terns, the species were present in Benin (table x.x). Especially of Whiskered Tern internationally important numbers are present in the area. Other tern species are relatively scarce. Whiskered Terns and White-winged Terns overlap mostly with Black Terns in Distribution although they are lacking almost completely at the centre of Lac Nokoue where Black terns are most common. The 'Sterna' species occur mostly at Bouche du Roi, while they feed at sea on fish or at the eastern part of Lac Nokoue wher Black Terns hardly occur. This indicates areas with higher densities of fish instead of shrimps.

**Table app.1.** terns species observed in Benin in February-March 2000 with their observed numbers mainly present at Lac Nokoue, Lac Aheme and Bouche du Roi.

	numbers present
Royal Tern <i>Sterna maxima</i>	500-600
Sandwich Tern <i>Sterna sandvicensis</i>	>200
Common tern <i>S. hirundo</i>	1
Little Tern <i>S. albifrons</i>	1
Whiskered Tern <i>Chlidonias hybridus</i>	>500
White-winged Tern <i>C. leucopterus</i>	<10

During all visits at Lac Nokoué, few Sandwich Terns *Sterna sandvicensis* were aged on the basis of primary moult pattern. This resulted in 46% juveniles (n=13). Of 28 birds that were checked carefully for metal rings, 18% were banded. This is a high proportion.

**3. Pictures of wing and wingmoult of Black Terns *C. niger* caught in Benin February 2000.** Birds are shown in order of ringnumber (see table 4.1). No. SA895305 was not photographed because this bird was handled during the shooting of a film and this did not allow to hold the bird any longer for taking a picture.



SA895301, Juv.; 5555310000



SASA895302, Ad.; 6664115555



SA895303, Ad.; 6641555555



SA895304, Juv.; 5555541000  
(no picture of SA895305)



SA895306, Ad.; 6666455555 (shown twice)



SA895306, Ad.; 6666455555 (outer primary hidden by hand) (shown twice)





SA895307, Ad.; 6666655555