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DUSK AND DAWN ASCEND OF THE SWIFT, *Apus apus L.*[1]

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Abstract

Radar observations on bird movements over The Netherlands in June and July revealed spectacular nocturnal Swift concentrations over the IJsselmeer and to a lesser extent above other waterbodies in and around The Netherlands at some kilometres from coastlines. The Swifts perform characteristic dusk and dawn ascends up to altitudes over 1800 m, while they mostly disappear from the radar screen during midnight, apparently flying below 300 m. These observations contradict the general story of Swifts sleeping on the wing high over their breeding areas. It is hypothesized that many Swifts perform feeding flights at night over open water to feed on insects with aquatic larvae. Besides that, there, they socially join typical twilight ascends for orientation purposes.

Key Words: Bird Strikes, Swift, Migration, Roosting, Dawn Ascend, Dusk Ascend, Orientation

[1] This paper was originally announced under the title: “Bird Strikes above the Boundary Layer (or How to understand the Swift)”

Introduction

Birds are truly three-dimensional creatures. The ways they exploit possibilities in altitude are often beyond human understanding. Thanks to many radar studies (Eastwood 1967) we know that migratory birds often climb to high altitudes to profit from strong tailwinds for long distance travelling. But also birds on local flights may sometimes reach high levels. An intriguing species in this respect is the Swift (***Apus apus L***.), a long distance migrant as well as an active local flyer. Although Swifts spend only three months per year in Europe, and although they are by far not the commonest bird species there, they nevertheless are highest ranking in the bird hit parade of the Royal Netherlands Air Force. Two explanations may apply here. The most obvious is that the Swift is by far the most common bird at the flight levels of aviation. The second, additional explanation might be that the bird is extra accident prone because it does not perform adequate evasive manoeuvres away from the flight path of approaching aircraft. We cannot differentiate between the two explanations as detailed species specific and quantitative descriptions of the three-dimensional bird distribution are lacking. Nevertheless, there are some intriguing observations on Swifts that stimulate further research on combinations of spatial and behavioural aspects of bird flight.

Swift strikes

Collisions between aircraft and Swifts go back to the earliest days of aviation. In his splendid monograph "Swifts in a Tower" David Lack (1959) wrote: "There is one definite observation by a French airman in the 1914-1918 war, an account which until recently was by most people dismissed as absurd. One night he was on a special operation on the Vosges front which involved climbing to 14.500 feet above the French lines and then gliding down with engines shut off over the enemy lines. "As we came to about 10.000 feet, gliding in close spirals with a light wind against us, and with a full moon, we suddenly found ourselves among a strange flight of birds which seemed to be motionless, or at least showed no noticeable reaction. They were widely scattered and only a few yards below the aircraft, showing up against a white sea of clouds underneath. None was visible above us. We were soon in the middle of the flock, in two instances birds were caught and on the following day I found one of them in the machine. It was an adult male Swift"". At least three points of this old story deserve our attention.

First of all: the collision happened at night. It is a well-known and much debated phenomenon that many Swifts spend the night in the air. Even in the breeding season many birds assemble in screaming parties before dusk, then suddenly climb to higher altitudes and disappear in the darkness. Also during migration Swifts may travel at night (Bruderer & Weitnauer 1979).

The second observation is that the birds seemed to fly motionless, or at least showed no noticeable reaction to the aircraft. To me this description comes close to what I experienced in Leshem's glider aircraft above Israel: when flying wing tip to wing tip with soaring birds, the birds seemed totally devoted to their job (soaring migration) showing no reaction to us whatsoever. This raises the question whether birds in certain stages of their flight do recognise a threat in aircraft as they do during low level flight or on the ground.

Finally, the French pilot met Swifts at 10.000 ft. By day most Swifts seem to fly much lower as indicated by diurnal collisions with aircraft above The Netherlands (fig 1). Thanks to the microscopic identification of downy feather structures and to the strong bird strike reporting discipline of the RNLAF, including the collection of the smallest bird remains down to blood smears, many Swifts were discovered that otherwise would not have been noticed (Buurma, Dekker & Brom 1986). However, the altitude distribution tells more of the aircraft movements than of those of the birds. Compared to daytime strike data of other species the Swifts’ height distribution indicates relatively high flights.

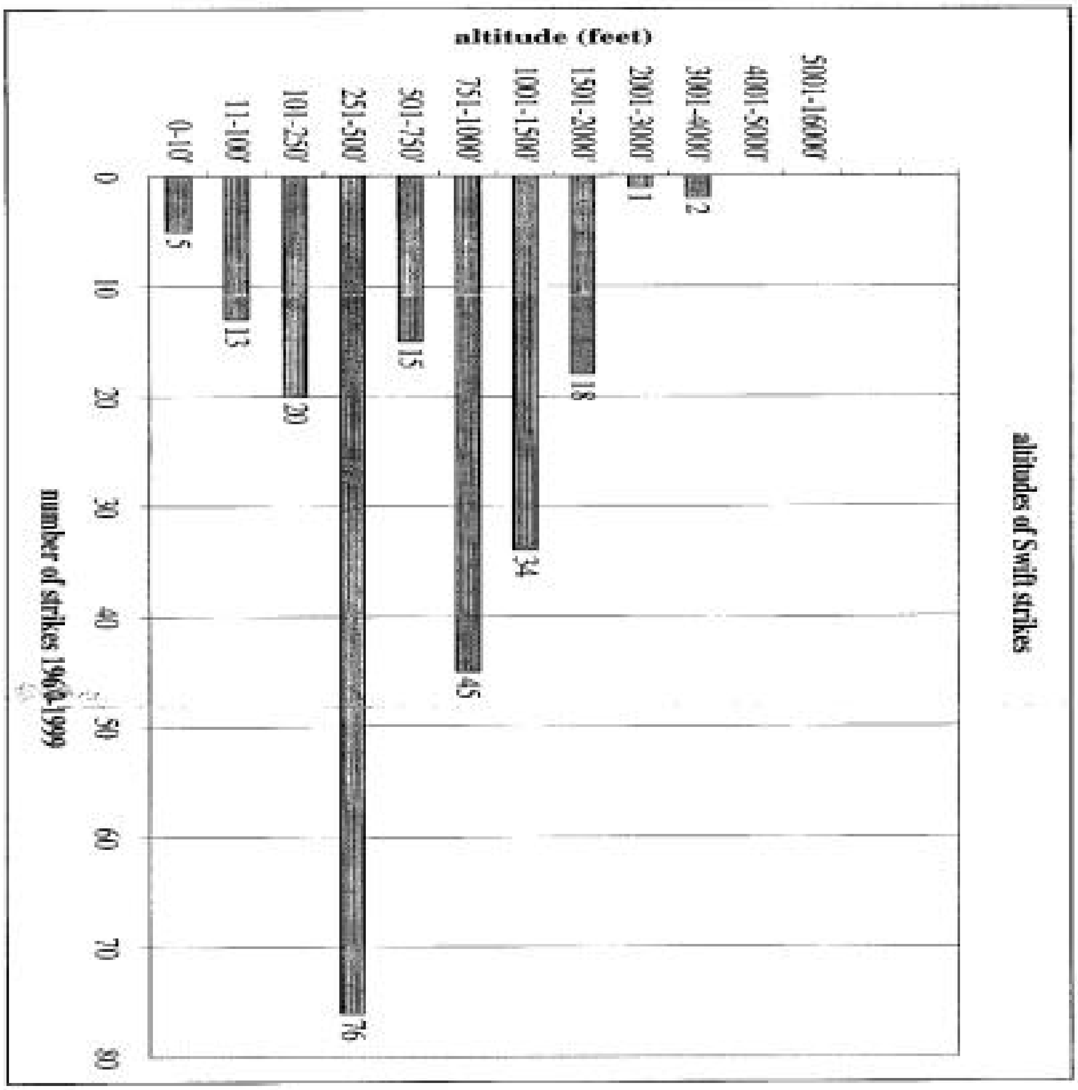

Figure 1: Altitude distribution of Swift strikes between 1960 and 1999 according to the database of the Zoological Museum of Amsterdam. The great majority of the bird strikes came from the Royal Netherlands Air Force and occurred during the day.

Swift radar pictures

When I restarted radar observations for flight safety purposes in The Netherlands in 1979 I directly noticed the massive bird echo's above water in the IJsselmeer (Lake IJssel) area in June and July (fig 2). In the continuous time lapse film recordings a clear rhythm of birds apparently ascending into the radarbeam shortly after sunset and again shortly before sunrise showed up day after day. Field observations on 11 July 1979 from the Oostvaardersdijk (West coast of the South Flevopolder - locations indicated in fig 3) clearly pointed in the direction of the Swift as the only possible source of these echo's. Between 21.00 and 22.00 Local Time mass numbers were seen leaving Amsterdam and the old land around the city towards the Markermeer and the South Flevopolder, where they collectively fed on massive swarms of "IJsselmeer midges" (***Chironomus spp***). Shortly after 22.00 the birds changed behaviour: from low level flight in loose swarms 2 to 30 m high above lake, dyke and polder, the birds concentrated in several dense circling parties, screaming loudly while climbing slowly. At 22.15 no birds were flying below 100-200 m. All birds visible circled in a few extreme dense flocks of up to several hundreds of birds each. Within 5 minutes all climbing birds were out of sight, while in the twilight at 22.20 no cries could be heard anymore either. Observations were repeated in later summers, also along the coast of SW Friesland, always resulting in Swifts flying in the direction of the IJsselmeer.

Reading popular literature on Swifts at night, the general story is that the birds do not return to their nests (or nestboxes) and stay high up in the air above the breeding area the whole night, apparently sleeping on the wing. The clear picture from a full season (June, July) radar filming is that the birds above the IJsselmeer ascend twice. In between, in full darkness, the birds disappear from the radarscreen, apparently flying at low level (below the radarbeam) above the lake, where they, strange enough, never have been noticed so far.

The observations were repeated in 1980 resulting in the same picture. After 1989 we got the possibility to electronically collect radar pictures via a dedicated bird echo extractor and a direct datalink between the large military air defence radar in the North of Friesland and our office in The Hague (ROBIN system: see Buurma 1996; see also Buurma 1994 for the first published image of a Swift concentration above Markermeer and IJsselmeer). Fig 3 and 4 are examples of these electronic time exposure pictures. Fig 3 indicates that the birds keep a certain distance from the coastlines when they ascend. Fig 4 not only shows a very dense and long (dark blue) flock above the IJsselmeer, but also Swift-type echofields above the Waddensea (Balgzand, Eastern Waddensea, Dollard) and along the West coast of The Netherlands. Fig 4 was taken during a night when we had a Flycatcher tracking radar placed at the tip of the South Pier of IJmuiden, 3 km out of the Dutch West coast (Van Belle et al, 2000). According to wingbeat patterns (see

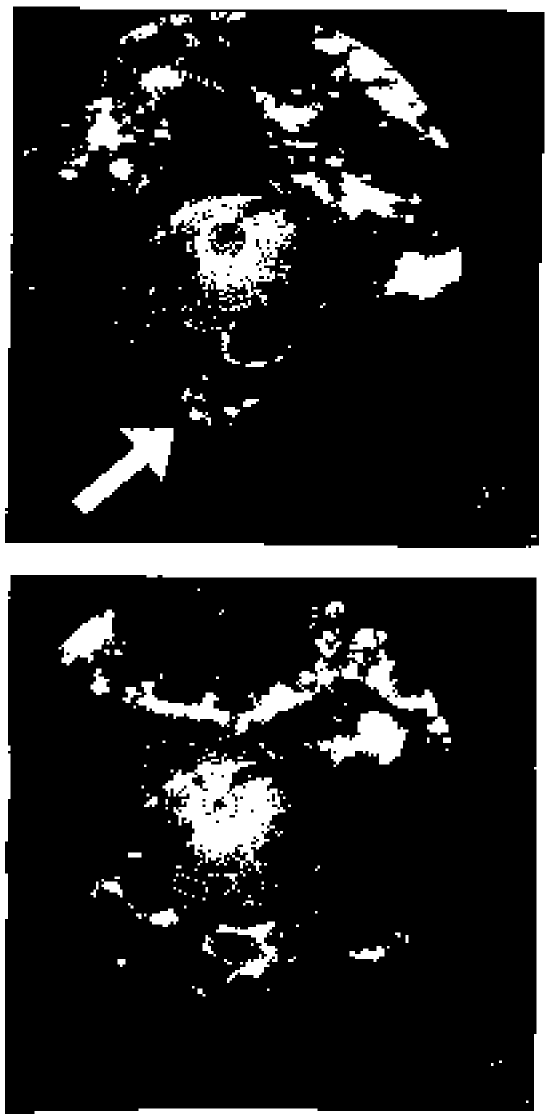

Figure 2: Two single frames (one antenna rotation) of the time lapse film recordings of the plan position indicator of RNLAF Radar Post North. Ground returns around the centre indicate the province of Friesland and the wadden islands Vlieland, Terschelling and Ameland. The large echoes in the northern half of the image are rain clouds. Due south of the radar the lakes around the Flevopolders are indicated by echoes of big Swift concentrations at dusk (22.40 LT – upper picture) and at dawn (04.58 LT – lower picture) (19/20 July 1979).

example in fig 5) Swifts were the dominant species that night. We cannot say for sure that the many bird echo's in the SE quadrant of fig 4 were also mainly Swifts but films from 1979 and 1980 indicate (according to echo type, speeds, locations of departure and time of the year) that Swifts must be the most important candidate.

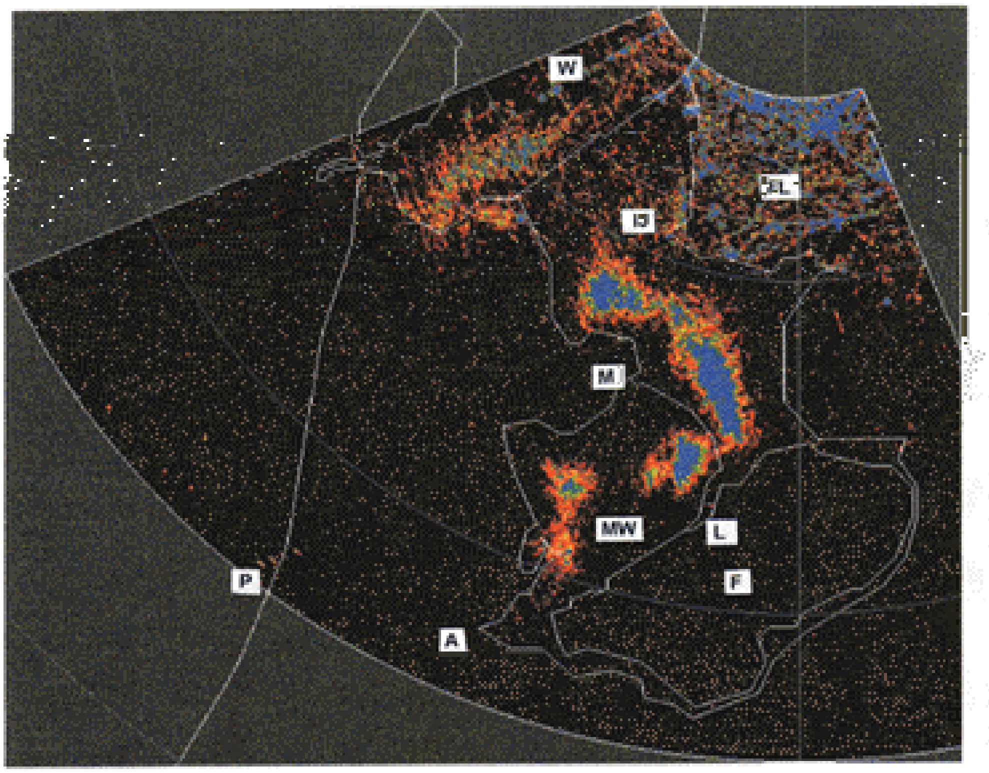

Figure 3: Electronic time exposure radar picture (1 minute, 6 antenna rotations, 13 June 1996 04.15 LT) showing mass movements of Swifts (depicted by echo fields - increasing reflectivity: red, yellow, green, blue) above the lakes IJsselmeer (IJ) and Markerwaard (MW). Other locations mentioned in the text: A = Amsterdam, F = East and South Flevopolder, FL = Friesland, L = Lelystad, M = Medemblik, P = Piers of IJmuiden, W = Waddensea.

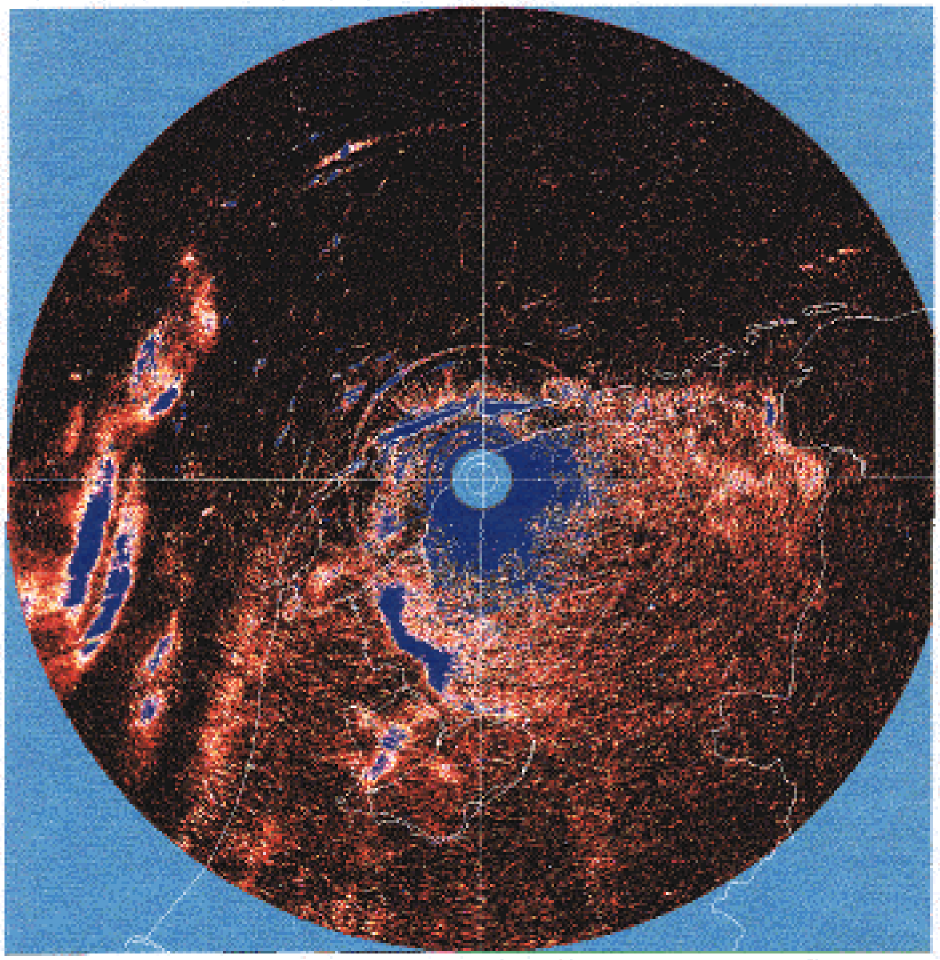

Figure 4: Electronic time exposure radar picture (10 minutes, 60 antenna rotations, 15 June 1999 23.08 LT) with rain clouds above the North Sea and Swift concentrations above IJsselmeer, Markerwaard, along the West coast over the North sea and over the Waddensea. See further in the text.

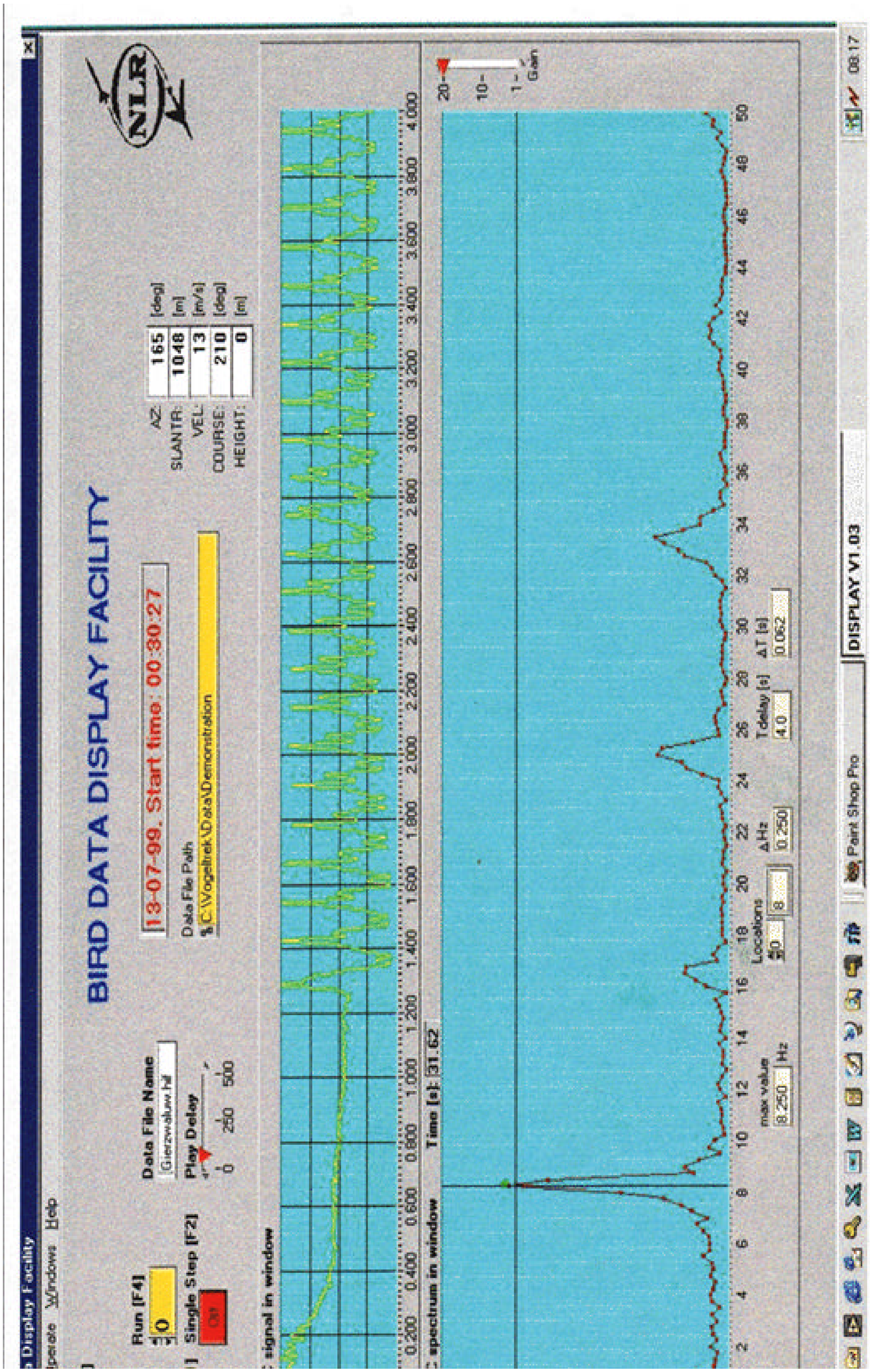
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Figure 5: Example of a wingbeat pattern frequently observed in June and July, most probably belonging to the Swift. The birds were tracked by a Flycatcher X-band tracking radar from the tip of the South Pier of IJmuiden.

Swift density measurements

In order to prove and quantify the ascend behaviour we took, during seven nights in June 1996, series of 300 square km samples around the dyke between Lelystad and Medemblik from the Frysian radar. As the radar is a stacked beam system we could select the lowest two beams and could compare the amount of reflection caused by Swifts (“massa”) in those beams: fig 7. Fig 6 shows the so-called vertical coverage diagram of both beams and illustrates the amount of airspace missed due to the curvature of the earth. As the air volume sampled is at 70 km from the radar, the birds could only be “seen” by the high beam when flying above 1800 m. At the same distance from the radar the low beam detects Swifts between ca. 300 and 1600 m.

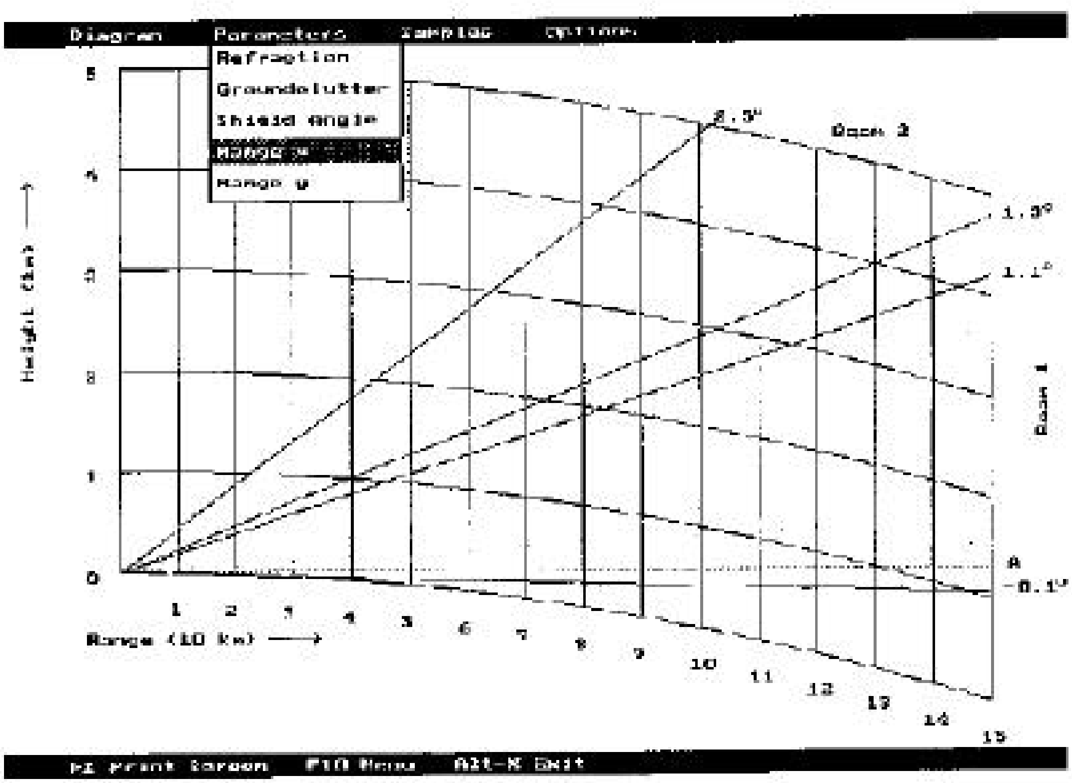

Figure 6: Vertical coverage diagram showing altitude against distance for straight lines representing radar radiation. The elevation of the lower and

upper side of the two lowest radar beams is indicated to the right. The visual horizon is given by A.

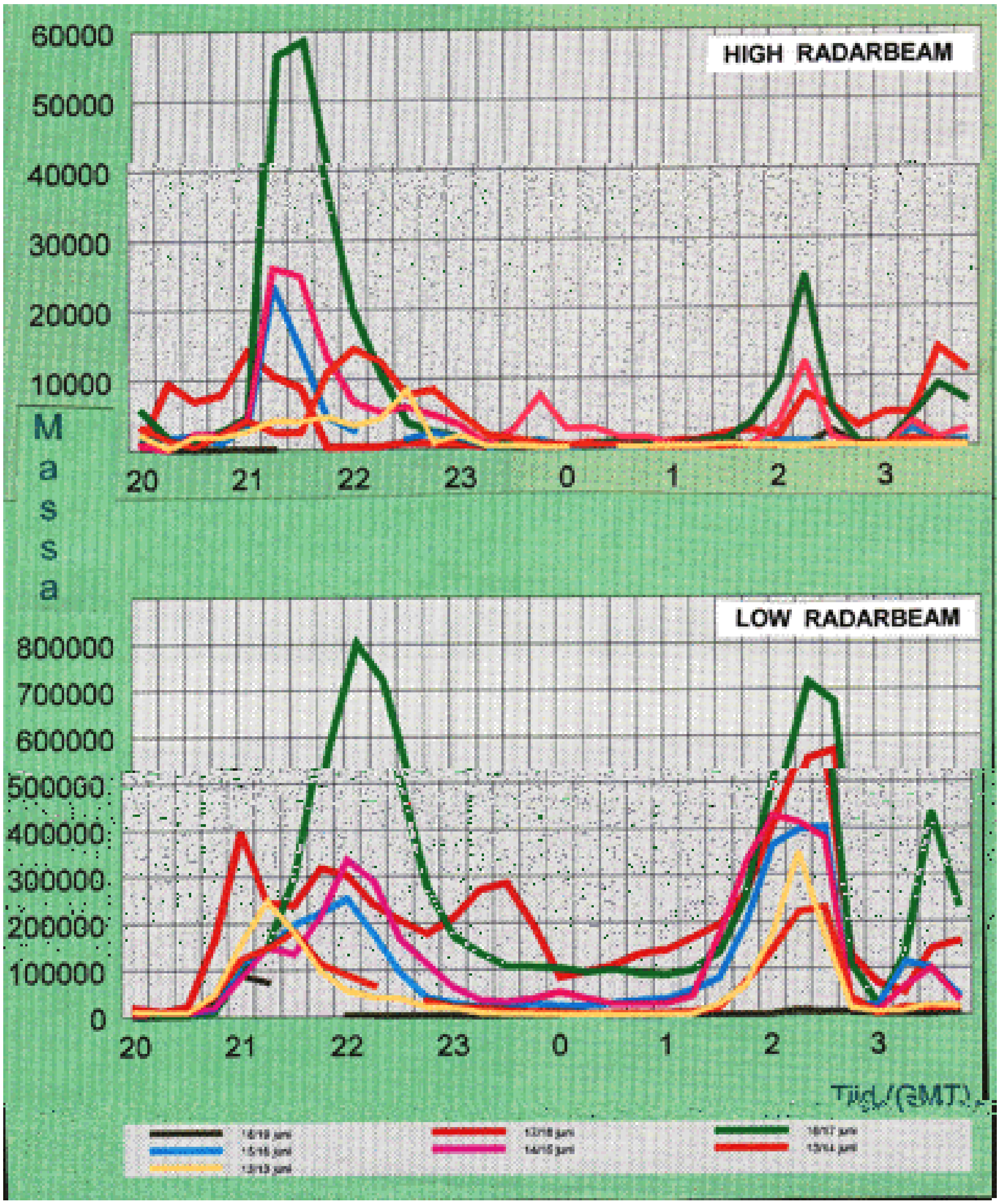

Figure 7: Mass of Swift echoes within a 300 km2 counting window around the dyke between Lelystad and Medemblik in the course of the night (one scan per 15 minutes) between 12 and 19 June 1996 (hours in Greenwich Mean

Time – Local Time is + 2 hours). The upper graph data came from the upper beam (2), the lower graph from the lower beam (1).

The amount of Swift mass is 15 times higher in the low beam than in the high beam (see values along y-axis) but a reasonable number of Swifts reached 1800 m during most nights. During the seven nights dusk and dawn ascend were clearly separated, leaving a 2 – 3 hr period in between with hardly any Swifts above 300 m. A remarkable difference between timing of dusk and dawn ascend is the day to day synchronicity. This is clearly highest during dawn. During dusk only the highest flying Swifts are also very synchronous, but at lower level they may proceed hanging around up to more than 2 hours, quite different from day to day.

Discussion

The dusk and dawn ascends of Swifts above the IJsselmeer area throw new light upon the old riddle of the Swift sleeping on the wing at night at high altitudes. Does it, energetically speaking, make sense to climb above the insect rich lowest air layers for many hours? Our radar observations indicate that Swifts at night are only flying above 300 m during several hours under good weather conditions, most probably because then also insects reach these higher flight levels. But on windy days in June and July the radar screen over land is totally empty. Already in 1959 Lack noted "that Swifts appear on large lakes particularly in windy and wet weather, when land living insects tend to stay on the ground, but some of those with aquatic larvae fly low over the water". This seems to happen at an extremely large scale in the IJsselmeer area where "IJsselmeer midges" offer excellent feeding opportunities, probably especially for non-breeding one year old Swifts. Most of this Swift activity takes place <u>below</u> 300 m by day as well as during the main part of the night. But even under the worst weather conditions there is <u>always</u> a little amount of dusk and dawn ascend albeit only in the lowest radar beam, thus maybe not high above 300 m, and only very briefly (often less than one hour). This indicates that the ascends serve another goal than feeding. I strongly believe that it relates to some sort of social orientation behaviour. Both the temporal as well as the spatial aspect might support this view. The finding that the highest ascending Swifts are most synchronised suggests that the birds collectively observe the setting and rising sun (or a related feature as polarised light) in combination with a view on the starry sky (cf. Emlen 1975). The social component might be that the birds share their sense and interpretation of celestial rotation and "average" their individual "measurements". Moreover, during the ascend the birds might be able to perfectly explore weather conditions at different altitudes. The pressure vs. wind direction gradient might tell them quite precisely the development of the weather. They can measure this gradient most precisely by flying above large bodies of water where disturbing surface effects on wind movements are much smaller than over land. Furthermore, the Swifts seem to keep a certain distance to the coastline but always have the land/water interface in sight which provides them with a good ground reference for orientation i.e. measuring airspeeds and directions more accurately. Even in dark nights coastlines and surf lines are often well visible from the air.

Understanding Swift movements at low and high level might elucidate a lot of bird flying activity as partly detectable by long range surveillance radars and partly visible to the human eye. Swifts are perfect navigators both on local as well as on migratory flights. Their dawn ascend resembles the dawn ascend of Thrushes during autumn migration in the North Sea area. A function in relation to Thrush (re)orientation has been hypothesised (Myres 1964). The dusk ascend resembles the well-known and general exodus of nocturnal migrants around sunset. In this behaviour also orientational components have been postulated (Emlen 1975). Ascending after sunset as well as before sunrise might provide the Swift with the ultimate combination of cues related to celestial rotation and the birds' position on the globe.

Acknowledgements

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