Visual Lapwing Counts Versus Aircraft-Lapwing Strikes

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VISUAL LAPWING COUNTS VERSUS AIRCRAFT-LAPWING STRIKES

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SUMMARY

Using very frequent birdcounts, from 6 RNLAF airfields during the years 1982-1987 the pattern of presence of the Lapwing (Vanellus vanellus) during the year was defined. Differences between the 6 airfields can be explained geographical location (surroundings) and the agricultural management of the airfield and surroundings. Comparison with quantitative information on the autumn presence of the Lapwing in the Netherlands reveals that the "bird unfriendly" management of the airfields does pay off in the sense that numbers of the Lapwing on the airfields are relatively low. The distribution of Lapwing strikes over the year shows distinct peaks in early spring, mid summer and especially in autumn (october). The high number of strikes in autumn appears to be caused mainly by local strikes. However, the relation between the presence of Lapwings on the airfields and the number of local Lapwing strikes is poor and certainly not a simple one. The chance on a collision is not determined by the actual number of Lapwings on an airfield but by the flying activity of Lapwings around and over airfields. Effective countermeasures include the removal of flocks and the adaptation of aircraft movements.

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INTRODUCTION

At the bird hit parede from civil as well as military bird strike statistics the Lapwing (Vanellus vanellus) has since long scored in the upper regions. From 7381 registered birdstrikes with European registered civil aircraft during the period 1976-1984, the Lapwing was involved in 923 cases (12.5%)(refs.1,2,3). In the incomplete military statistics over the period 1977-1984 (mainly involving data from RAF; GAF; SAF; RDAF) out of 3956 birdstrikes 366 times (9.3%) the Lapwing turns out to be the victim (refs.4,5,6,7,8,). In the RNLAF bird strike data over the period 1977-1987 the Lapwing is also well represented. In 89 out of 1837 cases (4.9%) this species was involved.

In order to assess wether prevention of Lapwing strikes is feasable and what kind of prevention is likely to be most succesful it is nessecary to know where, when and why Lapwings do form a threat to flight safety. We use weekly bird surveys at all Dutch fighter bases to study the potential danger of the species, and check this with the Lapwing strikes that actually occured.

2. MATERIAL AND METHODS

2.1. The Lapwing in Europe in a broader perspective.

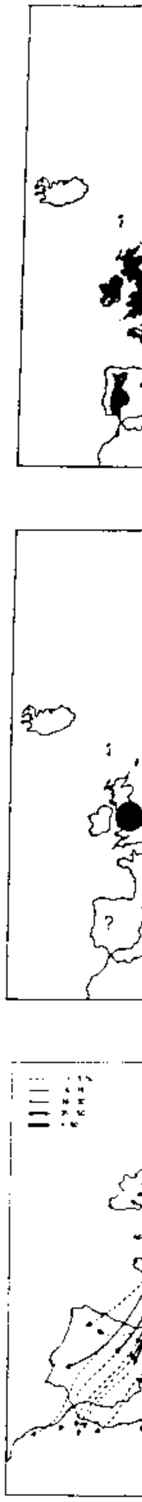
The Lapwing is a bird typical for open, more or less flat terrain on an altitude which normally does not exceed 1000 m. The distribution over Europe is given in figure 1a (ref.9). This map just gives the pattern of presence but no quantitative information. The highest densities of breeding birds are found in the North German and Dutch lowlands and especially in the grassland areas of NW-Netherlands. The total number of breeding Lapwings in NW Europe (excluding UK and Ireland) is estimated at 500 to 800 thousand pairs. Of these, over 200 thousand breed in the Netherlands (refs.9,10). Adding information about the number of breeding pairs to fig. 1a leads to fig 1b. Here the mere presence of the species as given in figure 1a is set in the perspective of numbers.

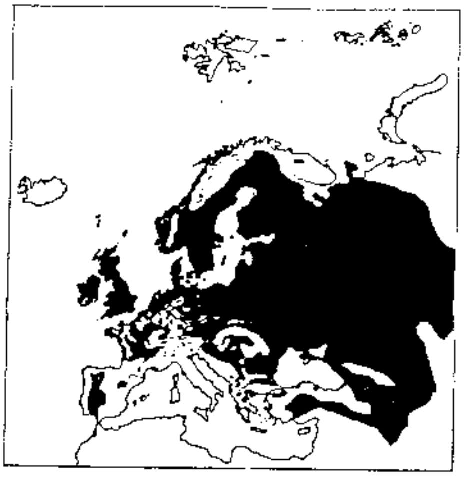
Predominantly living of soil invertebrates, the Lapwing probes the top layer of the soil in order to catch prey which is located by sight and sound. For the majority of the birds this way of feeding makes it impossible to stay in the breeding area all year round. So migration takes place on a rather large scale.
The first migrants, together with dispersing young birds are responsible for the complex movements of Lapwings over Europe which do start immediately after the breeding season. Without going into detail these movements result in a general move in South-Westerly directions as is shown in figure 1c in which the the migration routes of Lapwings from different populations is shown (ref.11).

In addition it is neccesary to know that autumn migration does not take place in one rush but results in accumulating numbers of Lapwings in the North German and Dutch lowlands. These birds generally do not leave before frost and snow make it impossible to feed. This behaviour is responsible for the so called hard-weather movements, sometimes involving huge numbers of birds.

From figures 1b and 1c it is clear that the North German and Dutch lowlands are used for a longer or shorter period of time by the majority of the NW European populations of the Lapwing.

There are indications that some behavioural aspects of the Lapwing have changed over the last 10 to 20 years. These changes are supposed to be the result of adaptations to the radically changed agricultural landuse. In the Netherlands for instance breeding on ploughed fields now is a common phenomenon (ref.12) whereas in earlier times breeding was restricted to grassland. Not only breeding habitat but also breeding season has changed. Ringing data of chicks suggest that breeding starts about a week earlier (ref.13).





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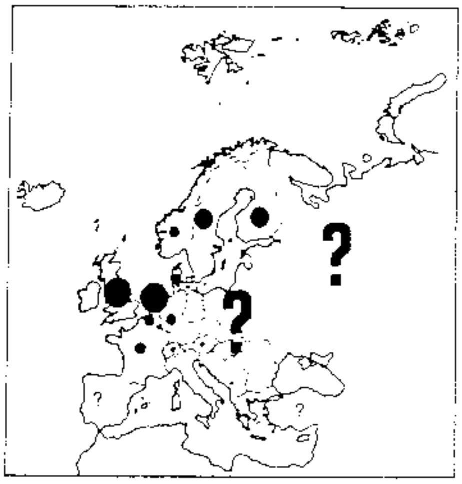

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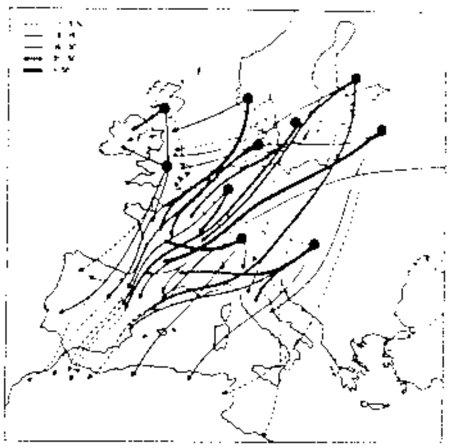

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Figure 1:

a. Breeding distribution of the Lapwing.
b. Number of breeding pairs of Lapwing per country.
   - < 10,000 pairs
   - 10,000-100,000 pairs
   - 100,00-200,000 pairs
   - > 200,000 pairs
c. Autumn migration routes of different populations of European Lapwing.

Data from refs 9 and 11.

2.2. The presence of Lapwings on RNLAF-airfields

One of the standard daily activities of Bird Control Units (BCU's) is the early morning survey, which is done before the start of flight operations (ref.14). Once a week but in later years often more frequently, this quick survey is extended to a standard count of all birds present per airfield section.

BCU personnel is well trained for this task because detailed instructions are given and regular evaluations are made. Therefore we believe the collected data are very reliable. On average such an extended survey takes about 45 min. to complete. Simulation experiments with data collected on a nearly daily base learned that the minimum counting frequency providing reliable patterns is once in a week.

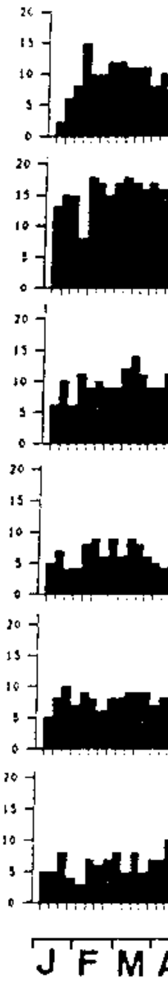
The patterns of presence during the years 1982-1987 were established for 6 airfields. The charactaristic yearly pattern for each airfield was then obtained by calculating the (three week) running weekly mean for these six years. The total number of counts during the 6 year period on the 6 airfields is 2380.
The breakdown over the years and airfields is given in tabel 1 while the number of counts per week and per airfield is visualized in fig. 2.

Tabel 1. The number of bird counts per airfield and per year.

YEAR / AIRFIELD	1982	1983	1984	1985	1986	1987	TOTAL
Leewarden	69	44	56	49	45	149	412
Twenthe	63	144	175	76	97	83	638
Soesterberg	90	82	45	46	42	72	377
Volkel	34	39	34	41	39	73	260
Eindhoven	44	87	68	46	43	84	372
Gilze-Rijen	82	44	28	42	43	82	321
TOTAL	382	440	406	300	309	543	2380

2.3. The Lapwing in the RNLAF bird strike statistics.

Since the introduction of jet engines, the bird strike risk in military operations has increased significantly. This lead to more emphasis on collecting proper statistics of bird strikes. Hence, reliable data are available from 1960 onwards. Determination of the bird species involved was done by the zoological museum of the University of Amsterdam. From 1977 onward the microscopical method of determination has greatly improved the quality and the number of succesfull determinations of bird remains (ref.15). For this analysis we selected all "Lapwing strikes" with jets from 1960 up to and including 1987.



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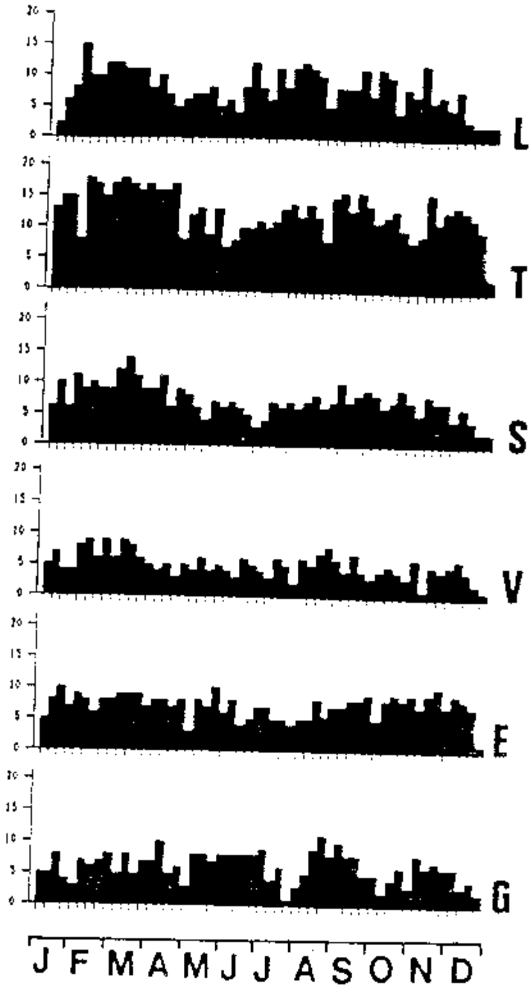


Figure 2:

Number of available counts per week during the period 1982-1987 for 6 RNLAF airbases.

L = Leeuwarden
T = Twenthe
S = Soesterberg
V = Volkel
E = Eindhoven
G = Gilze-Rijen

Where nessecary a distinction was made between "local" bird strikes and strikes "en-route". The main criterium to assign the bird strikes to the appropiate category is speed in combination with altitude (ref.16). All strikes which took place at speeds lower than 300 kts and not exceeding a height of 500 ft were allocated to the group of local strikes. A small number of strikes cannot, on the base of this criterium, be said to be local or en-route and strictly speaking should be called "unknown". However, charactaristics of these strikes (% damage, distribution over the year, parts struck etc. etc.) give good cause to consider them as "en-route". So, all strikes that could not said to be "local" were assigned to the "en-route" group.

3. RESULTS

3.1. The number of Lapwings on RNLAF airfields.

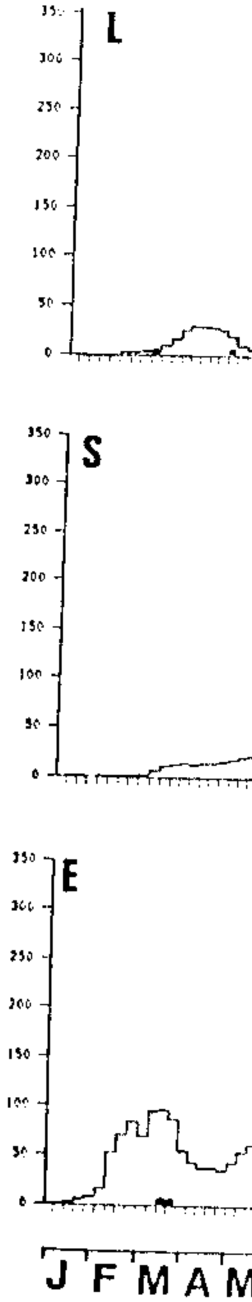
For each airfield the mean pattern of presence of Lapwing through the year is given in figure 3. The area covered by the counts is roughly the same for all airfields. It is clearly shown that there are distinct differences between the airfields, both in absolute numbers and in the temporal pattern. Except for Eindhoven, where staging Lapwing during spring are mainly responsible for the high numbers, spring migration does not result in considerable numbers on RNLAF airfields. Instead, spring numbers more or less represent the arrival of the breeding populations of the airfields.

The influence of the surrounding landscape on Lapwing numbers is clearly shown in the case of Soesterberg. Although fully covered with grass, surrounding woods and urban areas transform the airfield into a relatively small secluded island of grass. Apperently this is not the kind a situation preferred by Lapwings.

It is not clear why summerpeaks of any significance are only registered on Leeuwarden and Eindhoven. The explanation might be found in the geographical location of these airfields in relation to the migration route of certain Lapwing populations.
Autumn migration does result in an increase in numbers on all airfields. However, there are considerable differences.

3.2. Lapwing strikes in the RNLAF.

Using ratio's (number of Lapwing strikes per 10,000 flying hours) comparison of Lapwing strikes through the years is possible. From 1960 onwards the ratio of RNLAF Lapwing strikes is given in figure 4. The graph does show a pattern of ups and downs. More striking though is the general upward trend and especially the higher level since the mid seventies. To what extend this increase reflects an increase in Lapwing numbers is difficult to asses. Introduction of Bird Control Units in 1976 (ref.14) meant a better reporting standard. A better method of identification probably also is responsible for part of the increase. On the other hand, more scaring activity should have reduced the Lapwing numbers on the airfields. However, apart from the methodological biases there are indications that from a Lapwings point of view the attraction of the Netherlands as an area to stay after the breeding season did increase. This implies that despite all preventive efforts the increase of the strike ratio most probably is real.



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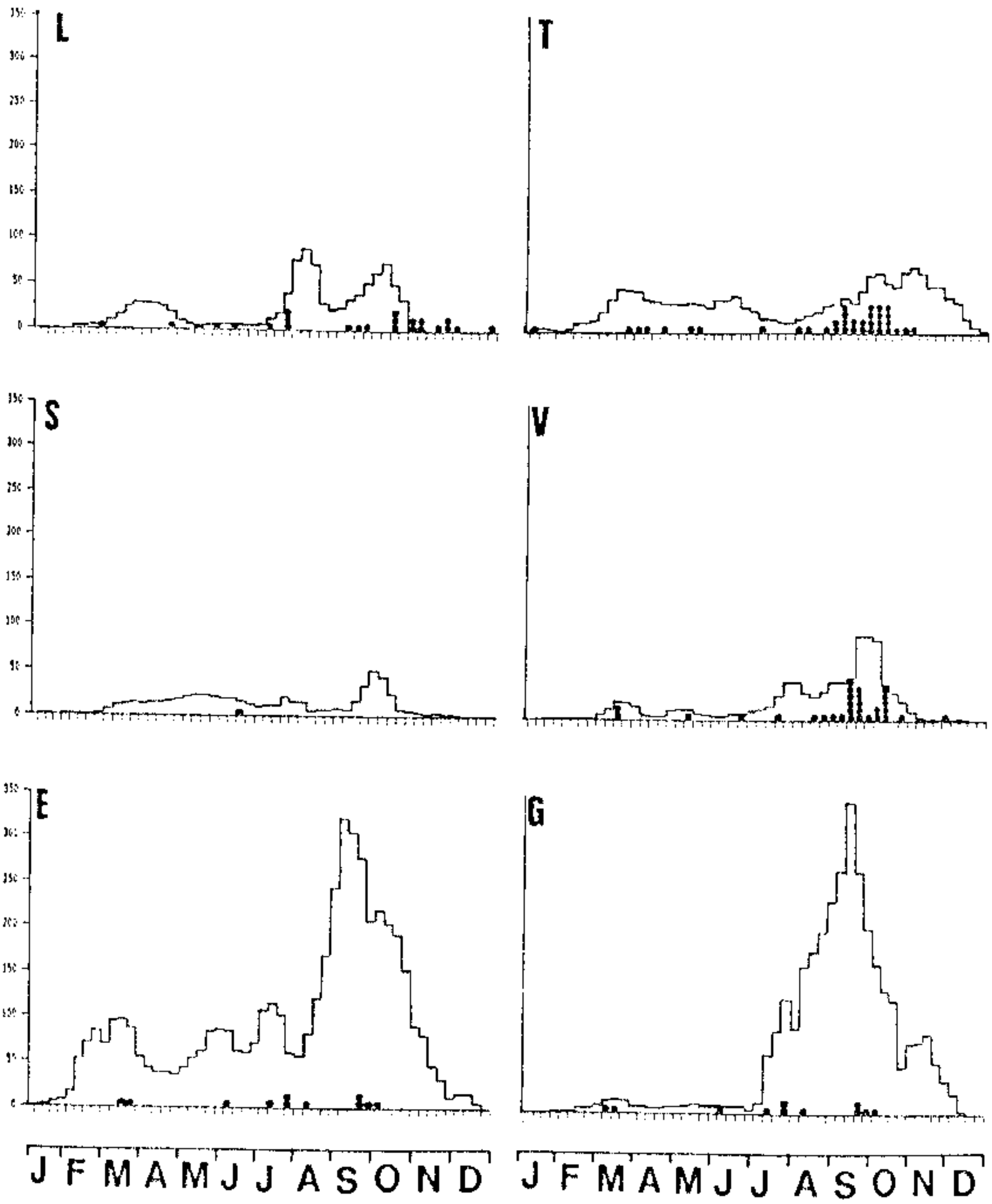


Figure 3: Running weekly mean number of Lapwings during the years 1982-1987 for 6 RNLAF airbases.
Local Lapwing sstrikes with RNLAF jets during the period 1960-1987 for each airbase are marked with dots.
For legenda of airbase names see fig.2.

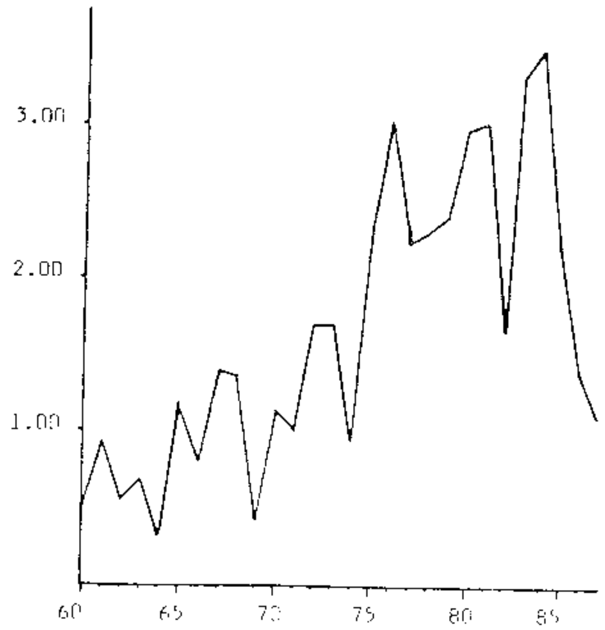
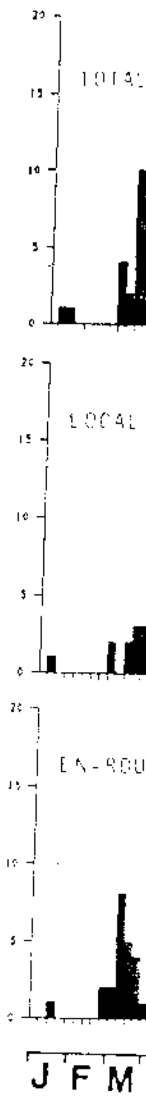


Figure 4:

Ratio of Lapwing strikes with RNLAF jets (per 10,000 flying hours) in the period 1960-1987.

The pattern of Lapwing strikes through the year is given in figure 5a. In order to interpret the three clear peaks in a justified way it is nessecary to make a distinction between "local" strikes and strikes that happened "en-route". Year patterns for local and for en-route Lapwing strikes are given in figures 5b and 5c.
It is now clear that the overall pattern of figure 5a is the result of two totally different patterns. Surprisingly, the autumn peak is dominated by strikes on and near the airfield while the spring and summer peak are mainly caused by "en-route" strikes. For the spring situation this can be explained by the altitude at which aircraft and Lapwings fly. Prevailing Southwesterly winds cause spring migration to take place at a higher altitude than in autumn. This means that in spring Lapwings and aircraft are competing for space in the same height band whilst in autumn the majority of migrating Lapwings fly at lower altitudes than aircraft en-route.

Because the situation with regard to bird strike prevention changed drastically thanks to the establishment of bird control units in 1976, we splitted up our data in two periods, 1960-1976 and 1977-1987. The year pattern of local Lapwing strikes for both periods is given in figure 6. Although the percentage of Lapwing strikes from januari-june is decreased from 23% to 16% there does not seem to have changed much in the overall pattern of the local situation over the year. Over the 11 years between 1977 and 1987 the mean percentage of bird strikes with RNLAF jets which occurred on or near an airfield is 27% (SD=6). For Lapwing strikes this percentage is 59% (sd=12). So the Lapwing appears to be a species which specifically forms a problem on and near airfields and to a lesser extend "en-route".



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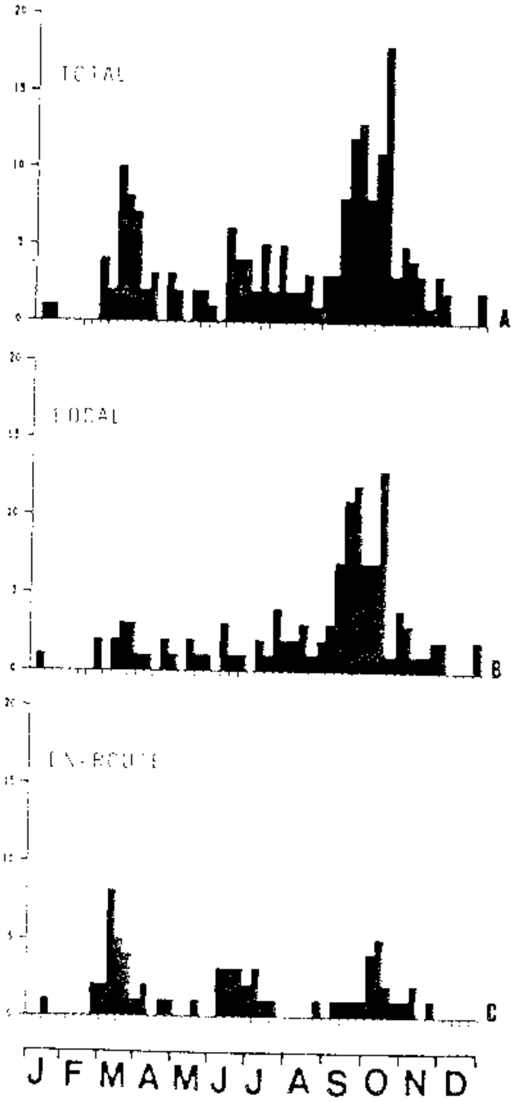


Figure 5:

Weekly distribution of Lapwing strikes in the RNLAF during the period 1960-1987.

a. top : all strikes n=183
b. middle : local strikes n=118
c. bottom : en-routestrikes n=65

However, this conclusion may overemphasize the danger of Lapwing on the airfield itself. If we exclude all "local" strikes (see 2.3.) above 100 ft. then the remaining total number of local strikes (marked black in fig.6) decreases with 20% in period I and with 40% in period II. This indicates that many strikes involve Lapwings near instead of on airfields, especially recently.

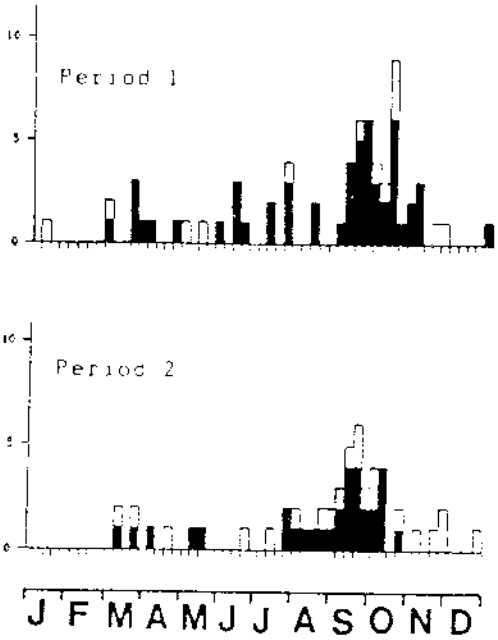


Figure 6:

Weekly distribution of local Lapwing strikes in the RNLAF during two periods.

a. period 1; 1960-1976
   n=66
b. period 2: 1977-1987
   n=52

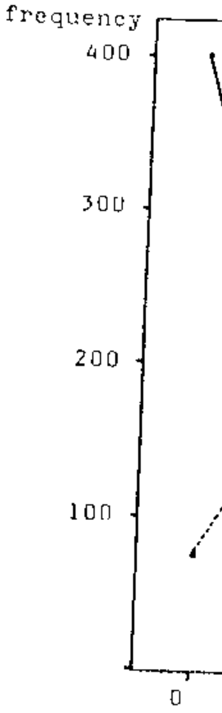
Strikes that occured below 100 ft. are marked black.

3.3. Numbers of Lapwing versus Lapwing strikes.

Apart from the average pattern of Lapwing presence over the year, in figure 3 the distribution of Lapwing strikes over the year is visualized. Assuming that the pattern of Lapwing presence roughly will have been the same in the years previous to 1982, not only the local Lapwing strikes from 1982-1987 are marked but also the ones from previous years.

The figure indicates that, if there does exist a relation between numbers of Lapwing and Lapwing strike, this will certainly not be a simple one. Seasonal patterns of strikes do not always coincide with the distribution of Lapwing presence over the year.

For a more detailed analysis data from the years 1982-1987 were used. Using abundance classes for the Lapwing on 5 airfields, the frequency distribution is calculated for the weekly mean numbers of Lapwing per airfield and per year. For 18 Lapwing strikes during this period the accompanying mean number of Lapwings on that airfield and during that particular week were available; for those the frequency distribution over the same abunce classes was made. In figure 7 both frequency distributions are given. Although based on only 18 Lapwing strikes it is clear that two different situations do occur. As long as numbers of Lapwing stay below about 50, despite the high frequency of this situation, the chance for a strike to occur is relatively small. In the less frequent situations in which more Lapwings were present this chance is disproportionately high but not increasing when numbers grow even bigger.
Apperently, it is only to a certain extend that the number of Lapwing counted on the airfield determines the chance on a Lapwing strike.



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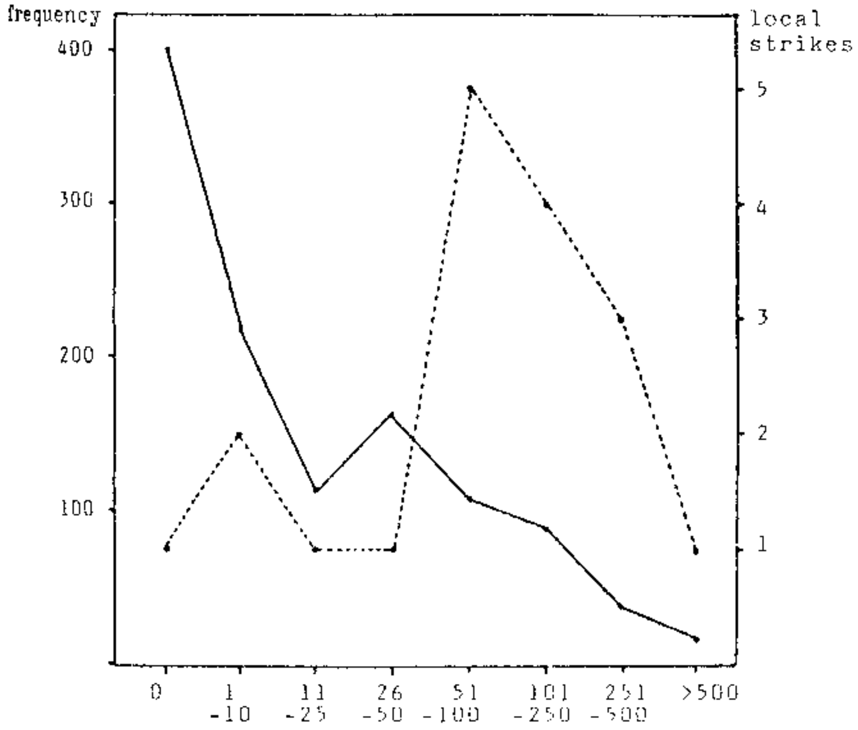

Figure 7: Frequency distribution of weekly mean numbers of Lapwing per airfield per year over 8 abundance classes. (solid line).
The number of local Lapwing strikes which coincided with each abundance class is represented with the dotted line.

4. DISCUSION.

Year patterns for different airfields at different locations, as are given in fig. 3, give a good idea about the different local situations. Nevertheless, these patterns may deviate considerable from the region wherein the airfield is situated. This means that evaluation of the registered numbers should be done in the perspective of the region the airfield is located in. To put it in an order way, we have to know how much is much.

Five years of field work, mainly carried out by amateurs and coordinated by full-time professionnel ornithologists, have recently resulted in an Atlas of Dutch Birds in which quantitative information on the presence of birds per month is given (ref.10). Concentrating on autumn, fig. 8 shows the abundance of Lapwing per 5x5 km grid. It is clear that plots in which more than 1000 Lapwings occur are quite numerous and mainly do occur in all lower parts of the country. Assuming that a RNLAF-airfield on average covers about 300 to 400 Ha of open land this means that 150 Lapwings on a dutch airfield cannot be looked upon as excessive. On most airfields not even half of these numbers are registered, not even in peak times.

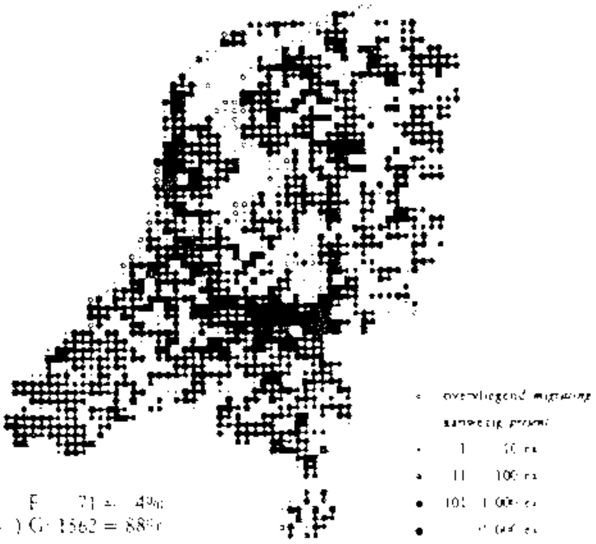

Figure 8: October distribution of the Lapwing in the Netherlands on a 5 x 5 km grid (from [illegible]).

A number of factors possibly are responsible for these low numbers. First of all the good drainage of the most airfields in relation to the surrounding certainly does play a role. Furthermore, on Leeuwarden and Twenthe the agricultural management of the grassland is extensified and no longer aimed at production. This means that application of anorganic fertilizers -and as a consequence the number of agricultural actions- is brought back to a minimum level. Although not aimed at a certain grasslength this management implies that the grass is kept at a certain minimum height. Intensifying the effort of the Bird Control Unit in 1985, by increasing the manpower, also made a contribution. The combined effect is shown in the results of Twenthe airbase. The overall picture from figure 3 over the years 1982-1987 hides the differences between the consecutive years. For 1983-1987 the seperate patterns are shown in figure 9, (1982 was left out because of insufficient data). It is clearly shown that more attention to a bird-unfriendly management did pay off in the sense that the numbers of Lapwing drastically decreased. This decrease was not a simple result of a lower number of Lapwings per sighting. As is shown in figure 10, the main way in which numbers decreased was by the absence of big flocks of over a hundred Lapwings and by the nearly complete absence of Lapwings during the second half of autumn.

That there is always an other side of the coin is also demonstrated in figure 9; coinciding with the decrease of the Lapwing the Kestrel (Falco tinnunculus) considerably increased in numbers. A more numerous rodent population (mice/voles) as a concequence of the extensified agricultural management is responsible for this increase.

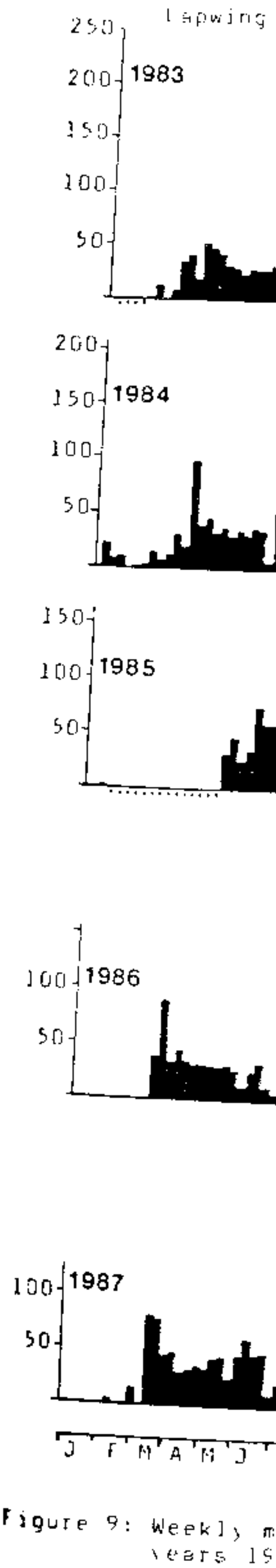

Figure 9: Weekly m
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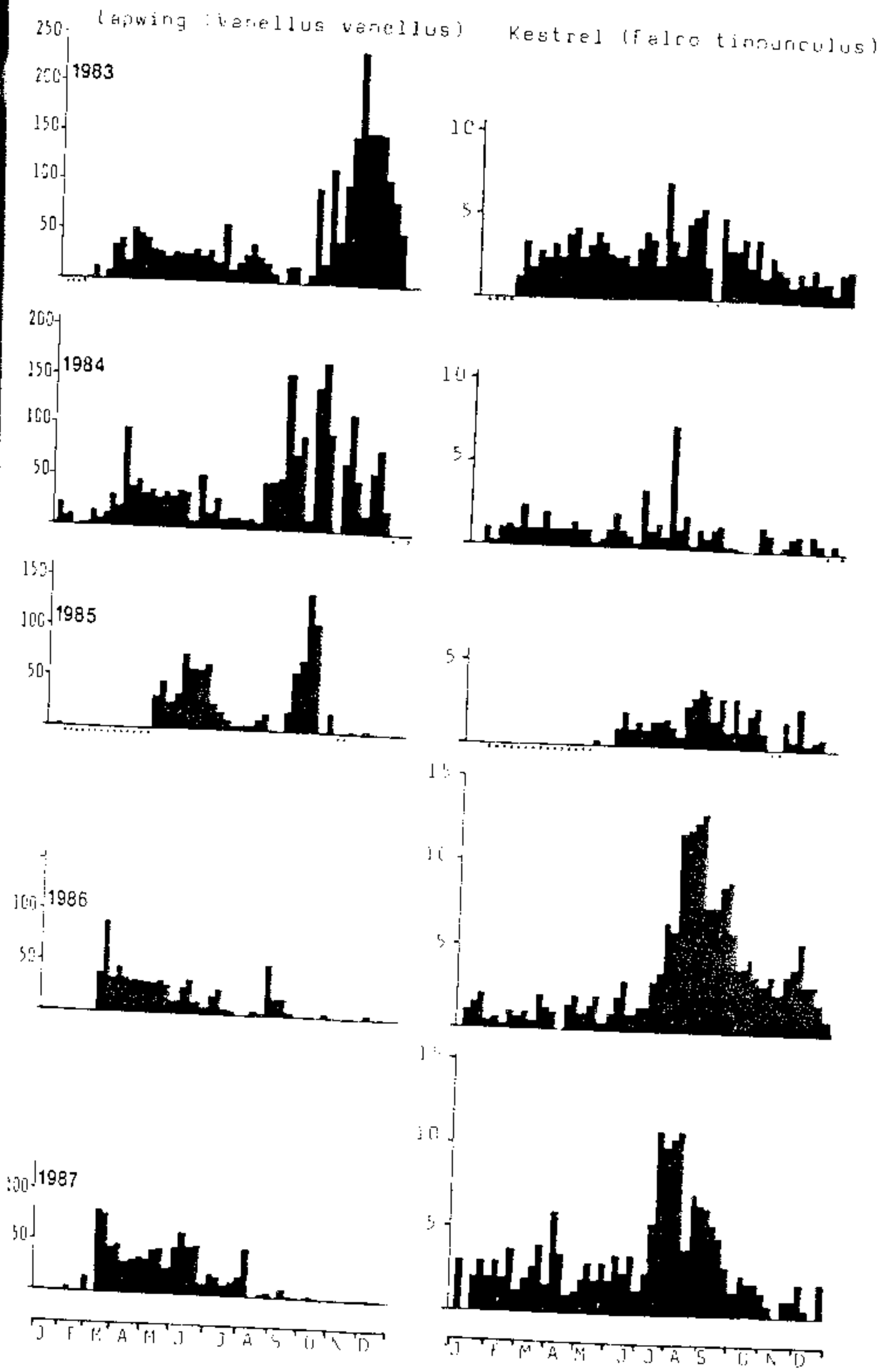

Figure 9: Weekly mean numbers on Twenthe airbase during the years 1983-1987 of Lapwing (left) and Kestrel (right). Weeks lacking any data are marked with a dot.

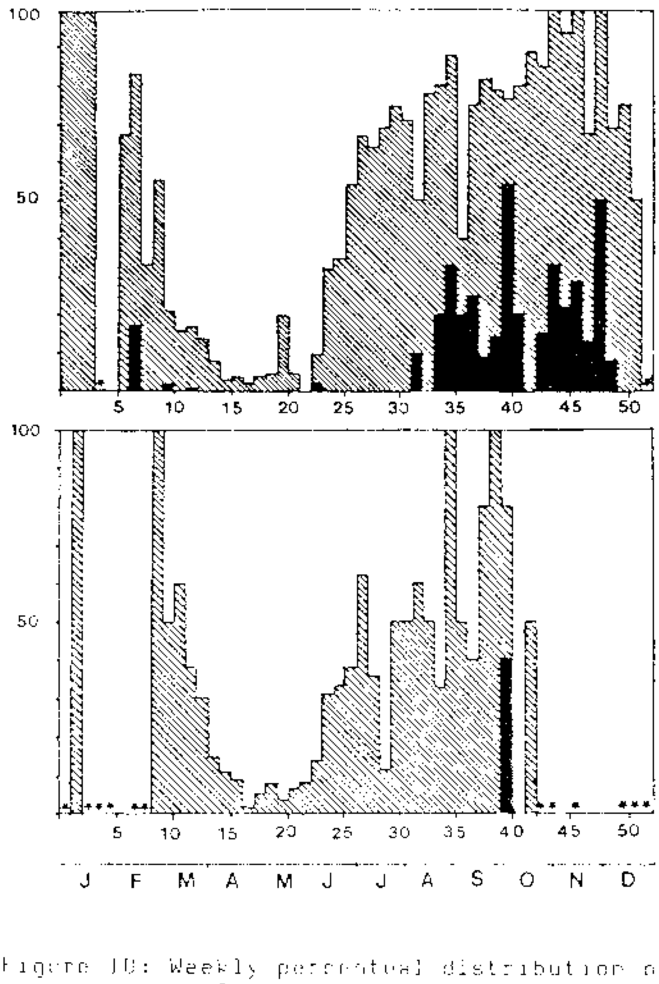

Figure 10: Weekly percentual distribution of Lapwing sightings on Twenthe airbase over the following number categories: 1-9 ex. (white)
10-99 ex. (shaded)
> 100 ex. (black)
Weeks without any Lapwing sightings are marked with an asterix.
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Bottom : 1985-1987 N= 605

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Besides the agricultural management, on Eindhoven airbase infrastructure changed drastically during the last years, works involved the relocation of the runway. As a result the numbers in autumn rose considerable and do not represent the present situation any more. Although the pattern of presence essentially stayed the same during all six years, the general level in the last two years has decreased.

In general, wintering numbers of Lapwings in the Netherlands probably have increased. However, the numbers on most RNLAF airfields do show a downward trend over the last years. This in the first place is the effect of measures taken by the RNLAF, but changing habits of Lapwing might have been helpful as well. There are indications that the presence of Lapwing is less confined to grassland areas and that arable land in later years does hold considerable numbers. Furthermore, as a concequence of intensive agricultural techniques dutch agricultural lands are more productive than ever. For some species, e.g. gulls, crows, geese, duck and probably Lapwings as well, this means that these lush and rich fields became more attractive than ever. This might have led to a change in migrating behaviour of the Lapwing in the sense that more and more Lapwing are reluctant to leave the Netherlands for their ultimate wintering areas in SW France, Iberia and the UK and do not leave the country before frost and/or snow forces them, but accumulate in the western most part of the country. Counts on Schiphol airport do support this phenomenom. During the late seventies october/november numbers averaged around 560 while an average of 3393 is scored during the years 1984-1986 (ref.17). In this respect the westerly location of Gilze-Rijen airbase may well be one of the factors responsible for the relatively high autumn numbers of Lapwing there.

At first sight the poor relation between Lapwing strikes and the number of local Lapwings present is rather surprising. In order to understand this we have to realise that, in order for a strike to occur both aircraft and birds have to be flying. In other words aircraft don´t hit birds that stay on the ground. The potential riskfull situations then, are those which involve a high number of flying activity of Lapwings. Local movements which are not necessarily related to the number of Lapwing on the airfield can be one cause (e.g. flights between roost and foraging grounds). Disturbance on the airfield of big flocks may form an other source of an excessive flying movements. Furthermore, in certain weather conditions migration sometimes takes place in high densities at such low altitudes that interference with local aircraft movement is unavoidable.

We conclude that two prevention methods could help reduce Lapwing strikes and are feasable on short term.

a.) avoiding the establishment of big (roosting) flocks on the airfield;

b.) assessing the predictability of the variation and patterns of local flights and/or monitor these movements ad hoc and adapting the flightprogram.

Long term measures such as inf' the local flight pattern of Lapwings by changing crucial of the Lapwing habitat outside the airfield usually will meet strong opposition of the public and effects are difficult to achieve. The intensity of movements of the total local bird population may in certain cases even be a consideration in the (re)allocation of an airfield.

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