

TEN YEARS OF BIRDSTRIKES IN THE ISRAELI AIR FORCE**Oded Ovadia, Maj.**Birdstrike prevention section, Control units Head Quarter, IAF
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Tel: 972-3-6067007, Fax: 972-3-6067589, Email: air91@idf.gov.il**Abstract**

Over the past ten years, the Israeli Air Force (IAF) had lost two pilots and two fighters in severe air collisions with birds. During these years there have been 2330 birdstrikes, which 200 of them ended with damage (accidents). The unique location of Israel as a junction of three continents causes hundreds of millions migrating birds to cross its airspace during spring and autumn, especially soaring birds that create a significant risk for low-level flights. In 1983, BPZ (Bird Plagued Zones) regulations were implemented so that low-level flight activity of jet planes were separated from the migrating birds temporally and physically. This led to a dramatic decrease in the number of accidents.

Since the early eighties, the relative number of birdstrikes on route is gradually decreasing, but the migration is still the dominant cause for the number and severity of birdstrikes over Israel. Most of the birdstrikes occur during spring (March-May) and Autumn (September-November), mainly with low-level flights of helicopters and transporters.

970 feathers were identified in the last 10 years from 110 different species (20% of all the known species in Israel). The most frequent species involved in birdstrikes are the Stone Curlew (*Burhinus oedicephalus*), Feral Pigeon (*Columba livia*) and Spur Winged Plover (*Vanellus spinosus*). The White Stork (*Ciconia ciconia*) and Honey Buzzard (*Pernis apivorus*) caused the most severe accidents. Hundred of thousands from these two species cross over Israel during few weeks in spring and autumn and their rate of accidents is very high (43% and 60% respectively).

The IAF suffered a yearly damage of less than 100,000\$ in the last two years. The intensive birdstrike prevention activity in the airbases together with the development of real time warning system for migrating birds are the main projects for near future. This activity will help to minimize the number of accidents and the damage for IAF training in low altitude over large areas around Israel.

1. Introduction

The Unique location of Israel as a junction of three continents brings about exclusive numbers of birds and a diversity of species. The high density of migrating and local birds creates a significant risk to the Israeli Air Force (IAF) pilots and planes. Soaring birds, which hundred of thousands of them cross Israel during the spring and autumn migration, are of a special risk (Leshem, 1994). In 1982, after Sinai was returned to Egypt, all IAF training missions were transferred to a very limited area. During these years the IAF has suffered more than 100 accidents per year due to air collisions with birds (Figure 1). After a Honey Buzzard penetrated the canopy of an A-4 (Skyhawk) and the pilot was severely injured, a joint research of Tel-Aviv University, the Society for the Protection of Nature in Israel (SPNI) and IAF was initiated. Its aim was to examine the soaring birds migration and its characteristics and to reduce their risk for low-level flights. After less than a year since the research has begun, its primary conclusions were put into practice: Soaring bird routes were mapped and Bird Plagued Zones (BPZ) regulations for low-level flights were operated for jet planes in order to temporally and physically separate flight activity from migrating birds. As can be seen in Figure 1, two dramatic results have followed: The number of accidents dramatically decreased and the number of reports on bird strikes without damage increased. During the ten years following the implementation of the BPZ regulations, there was no additional decline in the average number of bird strikes and accidents.

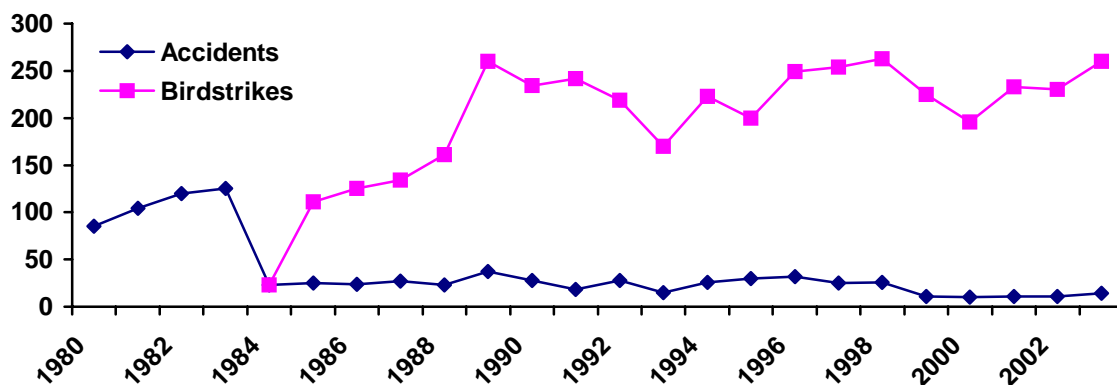


Figure 1: Number of accidents and total number of birdstrikes occurred in the IAF between 1980 - 2003

2. Materials and Methods

2.1 Bird Remains Identification

The IAF is conducting systematic identification of feather remains since 1991. In 1993 the Bird Remains Identification System (BRIS) was established and remains are identified with the help of both microscopic examination and macroscopic comparison of bird skins at the zoological museum in Tel-Aviv university. During the first 10 years of the systematic identification, remains were collected from 35% of all bird strikes. Since the establishment of the IAF's Birdstrike Prevention Section in 2002, more than 60% of birdstrikes have been fully investigated.

2.2 Bird Strike Database

The IAF bird strike database contains information about 4158 bird strikes that took place between 1983 and the end of 2003. Remains from 110 different species were identified for a total of 1154 bird strikes that remains were collected. The database includes detailed information from each bird strike: Date, time, place of collision, aircraft type, unit, flight phase, aircraft part that was struck, altitude, velocity, weather, light conditions, damage, number and types of birds involved. In the past 10 years 970 feathers were identified from 2330 birdstrikes occurred, 83% were identified to the exact specie, 5% were identified to the level of genus, 2% to the level of family and 10%, to the level of order.

3. Results

3.1 Severe Accidents

During the last 10 years, 200 accidents occurred as a result of bird collisions, out of which 8 were severe accidents, and 49 moderate accidents. One fatal accident occurred in August 10, 1995 in which 2 pilots were killed when F-15, flying at low altitude and high speed, hit a small group of storks. Two White Storks were ingested to the left engine (Picture 1) and the plane crashed after 2 seconds. The accident occurred at the beginning of the White Stork migration season, only one week before the operation of BPZ regulations. Another crash occurred on September 7, 1997 while a Honey Buzzard penetrated the canopy of F-16 during the peak of the migration season. The accident occurred in a specific place where the migration route crosses the corner of a firing zone. At this specific location, the BPZ regulations were not valid. The two pilots abandoned the plane while the young pilot in the front seat lost a leg and the back seat pilot was hit in his face. The third severe accident occurred in May 11 2000, when F-16 took off at night and hit a few White Storks well beyond V1. The engine was damaged seriously and the pilot aborted takeoff although he was in very high speed. The plane split the two cables and the net at the end of the runway and stopped in the field beyond the overrun. The accident resulted in a damage of 1.25 million dollar with no injuries (Picture 2). Six more severe accidents occurred during the last 10 years: An accident with a nesting Griffon Vulture (*Gyps fulvus*), an accident with a Stone Curlew during takeoff, and four accidents with large migrating species on route (Three White Storks and one Crane). During this period, the IAF had suffered a damage of 66.5 million dollars, which are more than 6.5 million dollars every year.



Picture 1 (left): Remains of the F-15 crashed after colliding White Storks, 10/8/95
 Picture 2 (right): F-16 after colliding White Storks during takeoff, 11/5/00.

3.2 Bird strikes in the Bases and on Route

In civil flights, about 85% of the strikes happen in the airport area. In military flights, however, the proportion of birdstrikes on route is higher (Thorpe, 1999). Because a significant migration takes place in Israel, the proportion of air collisions on route is equally divided by collisions during take off and landing (Figure 2). The majority of birdstrikes occur during the two migration periods: Spring migration (March-May) and autumn migration (August-November). Although the total number of birdstrikes per year was generally stable in the last ten years, it is interesting to look at the gradual change in relation between birdstrikes on route and birdstrikes in the air bases area (Figure 3).

Ten years ago there were many more birdstrikes on route than in air bases and last year the reverse pattern was true. The reason for the reduction in birdstrikes on route relatively to air bases is the expansion of BPZ regulations following the two severe accidents in the nineties and a better separation between flight activities and soaring birds on route during migration. On the other hand, the number of birdstrikes in the airbase areas is increasing, mainly with local birds. Growing levels of awareness and reporting, as part of new bird control programs in IAF air bases are also responsible for the higher number of birdstrikes reported in the air bases.

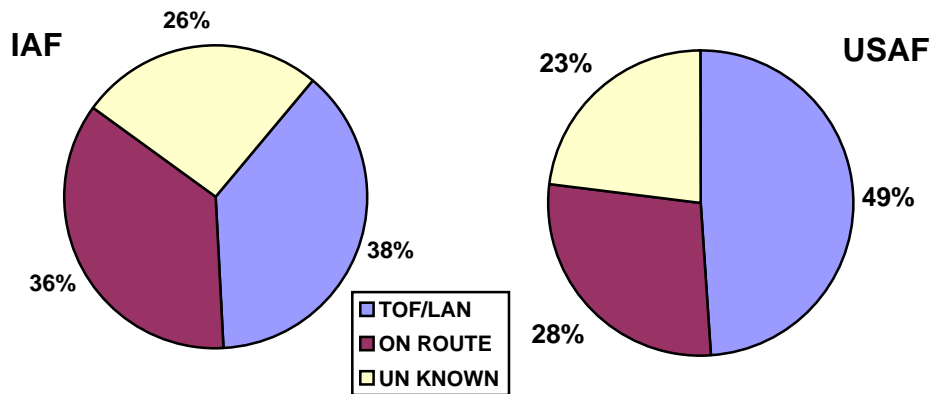


Figure 2: Distribution of birdstrikes by flight phase. On the left, birdstrikes in the IAF Between 1994-2003. On the right, birdstrikes in the USAF between 1985 - 2001, (USAF data was presented in the ATASC 8 seminar, 2002).

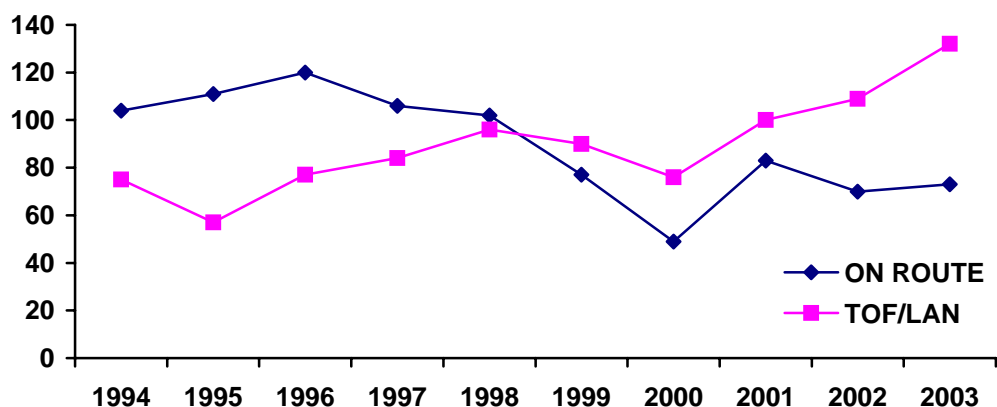


Figure 3: Number of birdstrikes on route and in the IAF airbases in the last 10 years.

3.3 Species Involved in Birdstrikes

As shown in Table 1, the most frequent species involved in birdstrikes during the last 10 years are the Stone Curlew (*Burhinus oedicanus*), Feral Pigeon (*Columba livia*), Spur Winged Plover (*Vanellus spinosus*), Skylark (*Alauda arvensis*) and Common Swift (*Apus apus*). Specifically, during the last three years, the number of birdstrikes with Curlews, Plovers, and Kestrels (*Falco tinnunculus*) has significantly increased. It is quite difficult to say whether this pattern is real or an artifact due to the fact that more feathers were identified in the past two years. Nevertheless, it is clear that the large populations of these three species, which dominate the open fields around the runways, have to be dealt with.

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	Specie	Number of strikes	Rate of accidents (%)
1	Stone Curlew (<i>Burhinus oedicanus</i>)	117	8
2	Feral Pigeon (<i>Columba livia</i>)	90	16.6
3	Spur Winged Plover (<i>Vanellus spinosus</i>)	69	0
4	Skylark (<i>Alauda arvensis</i>)	62	1.6
5	Common Swift (<i>Apus apus</i>)	44	13.6
6	Kestrel (<i>Falco tinnunculus</i>)	36	5.6
7	Chukar (<i>Alectoris chukar</i>)	32	9.4
8	White Stork (<i>Ciconia ciconia</i>)	27	44.4
9	Hooded Crow (<i>Corvus corone cornis</i>)	22	4.5
10	Alpine Swift (<i>Apus melba</i>)	16	6.3

Table 1: Number of birdstrikes and rate of accidents with main species in the IAF (1994-2003)

Stone Curlews – Are involved in more birdstrikes than any other bird in Israel. Most birdstrikes happen during nesting seasons (Figure 4), when the Curlews nest on the runways' shoulders, and during nighttime (Figure 5a). The Stone Curlew is active at night, foraging for

earthworms, soil-surface arthropods and mollusks (Green et. al, 2000). In some of the IAF airbases we found traditional aggregation sites of wintering Stone Curlews populations. Amazingly we counted more than 100 Curlews standing close together without movement during daytime in specific locations near the runways. These wintering populations are “responsible” for the second minor peak of birdstrikes with Curlews during the winter (Figure 4). The high frequency of birdstrikes with Curlews can be explained by their freezing strategy when a predator (or a plane) approaches, their heavy flight when they escape, and their motivation to protect their nests that are located so close to the runways.

Feral Pigeons – Create a safety problem in the airbases and environmental and health hazards in the airbases hangars. Big flocks of pigeons come to eat seeds in the agricultural open fields near the runways. A daily movement of Pigeons, crossing the runways in dense flocks flying from their roosting sites in the big cities to the foraging sites and back, are of a special risk. It has been suggested that the bases and runways are navigation points on the pigeon’s route. Birdstrikes with Pigeons occur all year long, mainly following mowing (July-September) and sidling activities (December). 16.6% of the 90 birdstrikes with pigeons ended with damage (Table 1).

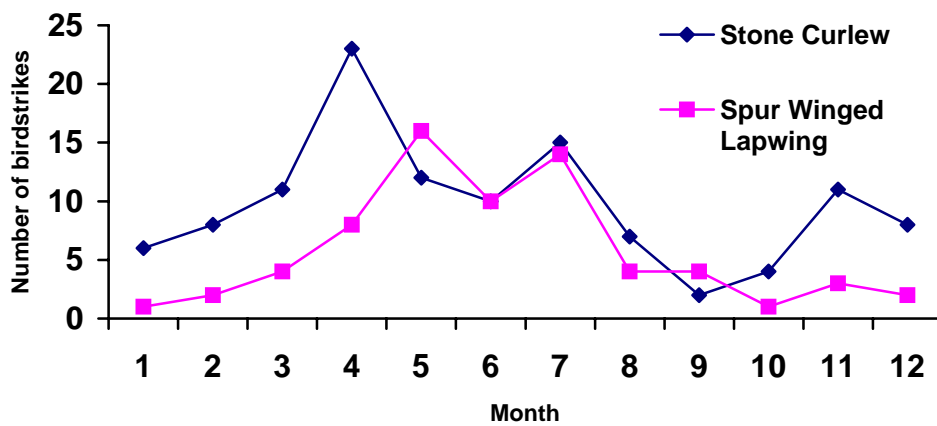


Figure 4: Number of birdstrikes with the two main ground nesting species.

Spur Winged Plover – This is another ground nesting specie that collides with takeoff and landing planes. Like the Stone Curlew, the Plover builds its nest near the runways but prefers the rubble surface in the overruns to the runway shoulders. The Plover also eats insects. Although it is known as diurnal specie, more than 60% of birdstrikes with this specie occur during nighttime (Figure 5b). Most of the birdstrikes with the Plover are during nesting season between April and July (Figure 4). Contrary to the Curlew, the Spur Winged Plover is very aggressive and maneuverable. Although it was involved in 69 birdstrikes, none of them has ended with damage (Table 1).

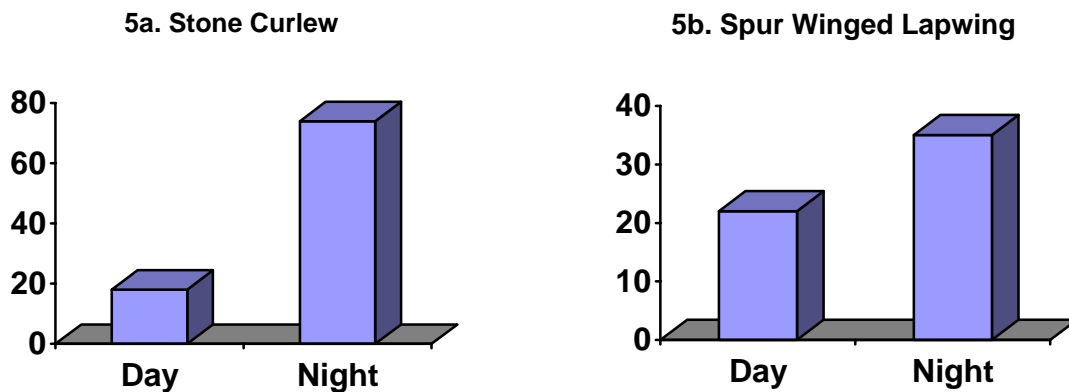


Figure 5: Number of birdstrikes with Stone Curlews (Nocturnal specie) and Spur Winged Plover (Diurnal specie) during daytime and nighttime.

3.5 Species Involved in Severe Accidents

The two species that are most frequently involved in severe accidents are the White Stork and the Honey Buzzard. They are the most dominant soaring bird species that migrate through Israel during spring and autumn. These species are big and heavy and their rate of accidents is 43% and 60% respectively.

White Storks – Were involved in 12 accidents during the last ten years out of 27 birdstrikes (Table 1). Seven accidents were severe or moderate. Although there are hundred of thousands white Storks during both migration seasons (Leshem & Yom-Tov, 1998), most accidents and birdstrikes occur during spring migration (Figure 6), in the vicinity of two southern airbases located in a semi-arid region. It is interesting to see that the BPZ regulations solved most of the risks in collisions with white storks on route. The main problem remaining with storks exists in the southern bases, where the exhausted storks find a shelter with plenty of food after they have crossed the wide desert strip (Sahara and Sinai).

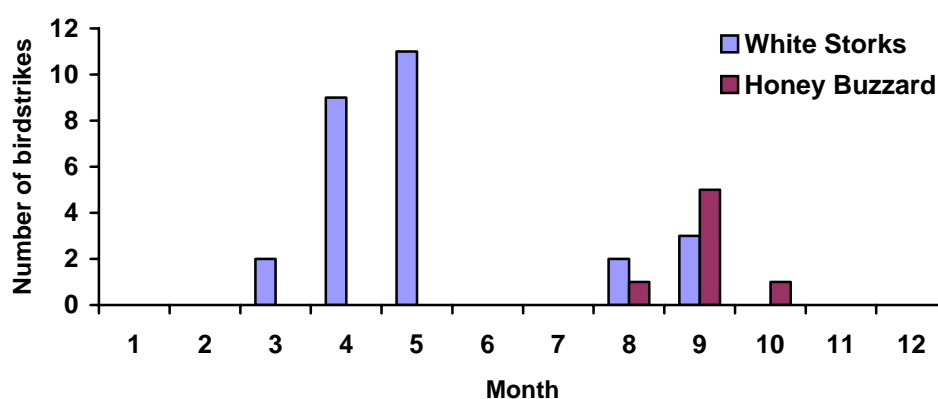


Figure 5: Birdstrikes with White Storks and Honey Buzzard during the last ten years.

Honey Buzzards – This specie was involved in 4 accidents during the past ten years, out of 7 birdstrikes. During autumn migration, 90% of the 300,000 Honey Buzzards cross Israel from August 30th to September 14th. (Leshem & Yom-Tov, 1996) During spring migration, the Honey Buzzards cross the gulf of Elat on their way north, and turn northeast towards their nesting sites (Leshem & Yom-Tov, 1998). Most of them cross Israel in a very short period during the first week of May (Leshem & Yom-Tov, 1996). Contrary to the White Storks that mostly collided with airplanes during spring migration, the Honey Buzzard collided with IAF planes only during autumn migration (Figure 5) and only on route or in the circles but not during takeoff or landing.

4. Discussion

The number of accidents caused by collisions with birds is gradually decreasing in the last 10 years, especially on route. Since the severe accidents usually occur on route, there is also a decrease in the yearly total damage. The conduction of bird control programs in the IAF airbases contributed to this trend and lowered the number of accidents in the vicinity of the airbases together with a dramatic increase in both awareness and reports of birdstrikes. The detailed database includes important information about the birdstrikes and analyzing the data helps us to focus on the problematic species in the specific time they create the greatest risk. Separating flight activity from soaring birds led to a significant reduction in the conflict between IAF flights and migrating birds. However, this has its cost - training missions of jet planes on low-level flights are limited during seven months every year. The main project in the coming future is to complete the establishment of a real time warning system. This system will be based on bird radars that will enable us to keep the high level of flight safety and to minimize damages to the IAF low-level flights in our limited space.

5. Acknowledgments

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6. References

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