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BIRD STRIKE INCIDENCE AT ADDIS ABABA BOLE INTERNATIONAL AIRPORT

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ABSTRACT: The time and rate of bird strike incidences, species composition and number of birds involved in strikes, and the behaviour of birds were recorded at Bole International Airport from December 1994 to December 1995. The gut contents of the birds struck by aircraft were analyzed. A total of 33 bird strikes were recorded during the study period. Fifteen species of birds were involved in the strikes. Pigeons (Speckled pigeons, White-collard pigeons and Red eyed doves together), Black kites and Eurasian bee-eaters were responsible for 33, 24 and 18% of all the strikes recorded, respectively. Most bird strikes took place between September and October while the number of bird strikes between May and June were the least. Most of the bird strikes occurred in the early mornings when most flights leave or arrive. In 69% of the gut analysis carried out, the stomachs or crops were found empty mainly because strikes occurred in early mornings before the birds had fed. The bird strike prevention measures suggested include biological and physical methods.

Key words/phrases: Airport, behaviour, bird strike, Bole

INTRODUCTION

Bird strike, the collision between birds and aircraft, may result in deaths, injuries and damages to properties (Blockpoel, 1976). Thorpe (1994) has summarized bird strike data in major airports of the world for the years between 1986 and 1990. The data show that 1,310 engines were damaged and three airplanes were totally destroyed during the period considered. In addition to loss

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of human lives, there has been high cost of repairs of aircraft bodies and engines (Hild, 1983a; 1983b; Smith, 1986; Harrison, 1987).

Delays or cancellations of flights due to bird strike have involved additional cost to feed and lodge passengers, and payment of alternative transportation and/or rescheduling. In most cases, a damaged aircraft would be sent to the manufacturer or other more capable and less costly centres for repair. Besides, grounded aircraft incur operation costs such as salaries for crew and parking fee.

The geographical location and the high diversity of flora and fauna of Ethiopia (Pichi-Sermolli, 1957; Urban and Brown, 1971), appear to have contributed to the high incidences of birds on the runways and airstrips. The incidence in Bahirdar (northern Ethiopia) in 1988 where a 737 Boeing encountered a flock of Speckled pigeons (*Columbia guinea*) during take off is one of the major bird strike accidents recorded in Ethiopia. The aircraft was completely destroyed by 15 Pigeons ingested in the engine resulting in the death of 35 people (Lewis, 1995). Records of the Ethiopian Civil Aviation Authority (ECAA) indicate that the Ethiopian Airlines loses more than 2.5 million dollars every year to maintain equipment damaged by bird strikes.

Trees and shrubs, wetlands and grasslands and the numerous abattoirs and garbage dumps in and around the Airport harbour large numbers of different species of birds. Disturbance from predators and humans is less in the grassland on either side of the runway. As a result, birds may occur frequently in those airports where such habitats are available.

Many airports in different parts of the world have employed various techniques to scare away or reduce bird populations in their environs with the aim of minimizing bird strike incidences. The efficacy of these techniques have been tested in many countries under locally prevailing conditions (Blockpoel, 1976; Hild, 1983a; 1983b; 1985; Max, 1989; Spence, 1990; Anderson and Ordinol, 1991; Chamero and Clavero, 1994; Dolbeer and Bucknall, 1994; Hores and Milo, 1994; Lischak, 1994; Stenman, 1994). The serious drawback of these methods, however, is that birds get used to them and the methods become ineffective shortly after their introduction.

The managements of many airports have, therefore, chosen environmental measures to make airports less attractive to birds. At Gatwick, Manchester and London Heathrow (Ferns *et al.*, 1994), Amsterdam Schiphol (Schiphol Airport Authority, 1991), Helsinki and Copenhagen (Stenman, 1994), Switzerland Zurich (Bruderer, 1978) and John F. Kennedy airports (Caccamise *et al.*, 1994), environmental measures are used against gulls. At John F. Kennedy (Burger, 1985), Singapore-Changi and Jakarta-Cengkoreng (Hild, 1985) airports, measures to deprive birds off living space have been employed. Similar measures have also been tested at Nairobi, Dakar, Bangkok, South Africa and other countries. Some of these airports have significantly reduced the frequency of bird strikes within one year by implementing the recommended environmental measures (Gwahaba, 1985a; 1985b; Anderson and Ordinol, 1991; Transport Air Canada (TAC), 1994a; 1994b). None of the above preventive methods have been applied at Bole International Airport. The only measure currently being applied consistently at Bole Airport is a long row of human bird-scarers chasing away birds during take off and landing of aircraft.

The objective of the present study was to collect relevant data on bird species composition, the time and rate of bird strikes incidences and behaviour of birds at Addis Ababa Bole International Airport with the aim of suggesting integrated environmental methods of reducing bird strikes.

MATERIALS AND METHODS

The time and rate of bird strikes incidences and bird species involved were recorded along the runway on alternate days from 0700 to 1800 hrs local time from December 1994 to December 1995. The behaviour of birds as they approached the Airport was noted using binoculars. Carcasses of the birds hit by aircraft were collected and identified following Mackworth-Praed and Grant (1957a; 1957b). In most cases, only feathers were used for identification. In other cases, particularly with Black kites, the whole body of the bird sucked and ingested by the aircraft engines was retrieved. The gut contents of the birds struck by aircraft were analyzed, unless the carcasses were torn to pieces. The physical, biological and environmental factors that could possibly attract birds to the Airport were noted. Multiple regression analysis was performed between

number of strikes as a dependent variable, number of flights and time as independent variables. The Map of Addis Ababa and location of Bole International Airport and other important features that attract birds are shown in Figure 1.

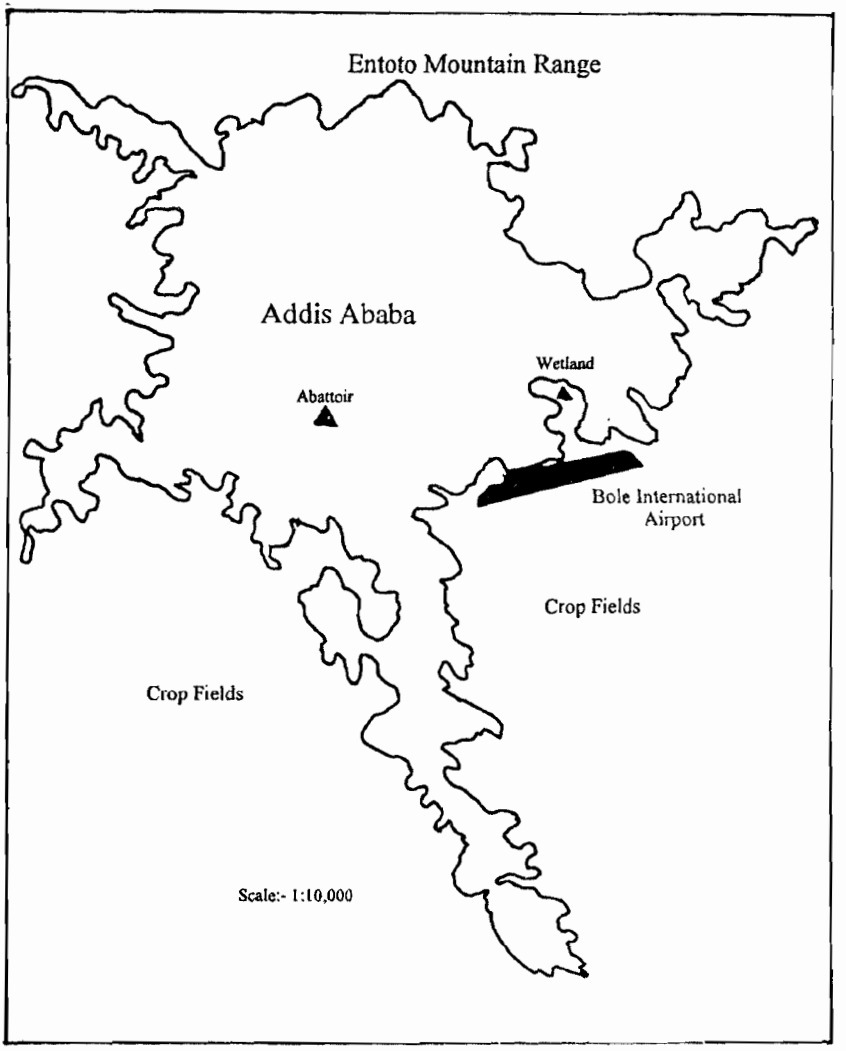

Fig. 1. Map of Addis Ababa.

RESULTS AND DISCUSSIONS

Bird strike incidences

Bird strike incidences observed during the study period are given in Table 1. A total of 77 birds were killed in 33 strikes. Fifteen species of birds were involved in these strikes. Pigeons (Speckled pigeons, White-collared pigeons and Red-eyed doves), Black kites and Eurasian bee-eaters caused 33, 24 and 18% of the strikes registered in the study period, respectively.

Table 1. Bird strike incidence records at Bole International Airport from December 1994 to December 1995.

Date	Time	Species	Count	Gut Analysis
12/07/94	1400 hr	Marsh Sandpiper	1	--
12/07/94	0700 hr	Button Quail	1	--
12/09/94	0830 hr	Speckled Pigeon	1	--
12/19/94	0930 hr	Red-eyed Dove	1	Empty
12/23/94	1600 hr	Speckled Pigeon	1	Wheat
02/03/95	0800 hr	White-collared Pigeon	1	Empty
02/11/95	1000 hr	Egyptian Goose	1	--
02/13/95	1100 hr	Black Kite	1	Empty
03/15/95	1100 hr	Black Kite	1	Empty
04/08/95	1200 hr	Black Kite	2	Empty
04/10/95	1200 hr	Black Kite	1	Empty
04/13/95	--	Black Kite	2	Empty
07/17/95	1200 hr	Yellow-shouldered Widowbird	1	Empty
08/16/95	1300 hr	European Bee-eater	1	Empty
09/06/95	0900 hr	Yellow-shouldered Widow bird	1	--
09/15/95	0700 hr	White-collared Pigeon	1	--
09/25/95	0700 hr	White-collared Pigeon	1	--
09/26/95	1000 hr	European Bee-eater	26	--
09/27/95	0700 hr	Lesser Flamingo	1	--
09/27/95	1000 hr	European Bee-eater	16	--
09/29/95	0900 hr	European Bee-eater	3	Empty
10/04/95	0800 hr	Speckled Pigeon	1	--
10/04/95	0900 hr	European Bee-eater	1	--
10/10/95	0900 hr	European Bee-eater	1	--

Table 1. (Contd.)

Date	Time	Species	Count	Gut Analysis
10/14/95	1000 hr	Swallow	1	Empty
10/18/95	1600 hr	Red-eyed Dove	1	Empty
10/22/95	1600 hr	Red-eyed Dove	1	Wheat
10/22/95	1600 hr	Swift	1	--
10/22/95	1520 hr	White-backed Vulture*		--
11/05/95	0900 hr	Speckled Pigeon	1	Empty
11/08/95	1200 hr	Speckled Pigeon	1	Wheat
12/20/95	1800 hr	Black-shouldered Kite	1	Empty
01/02/95	1200 hr	Black Kite	1	--
01/02/95	--	Verreaux's Eagle-owl	1	--

*, Out side the airport

During the study period, there were an average of 12 flights per day. The highest number of strikes was recorded in September and October (Fig. 2). A total of 56 birds were involved in the strikes in September and October only. Forty-seven (84%) of these were the migratory Eurasian bee-eaters. Pigeons were responsible for 29% of the strikes in September and 43% of the strikes in October. Pigeons were involved in all the strikes in November. All strike incidences in April were due to Black kites. There was no bird strike incidence in May and June.

Thirty three per cent of the strikes recorded during the study period were due to collisions with birds of prey. Black kites caused 67% of these strikes. Flights have been delayed several times as a result of Black kites flocking on the runway.

Eighteen per cent of the strikes during the study period were caused by Bee-eaters. In 60% of these strikes, more than one bird was involved. Some of these birds were killed by the engine blast only, without any visible damage to the body of the bird. It is important to remark here that the bigger the flock size, the greater is the risk associated with it. In this respect, Swifts and Swallows should be considered hazardous mainly because they flock in large numbers.

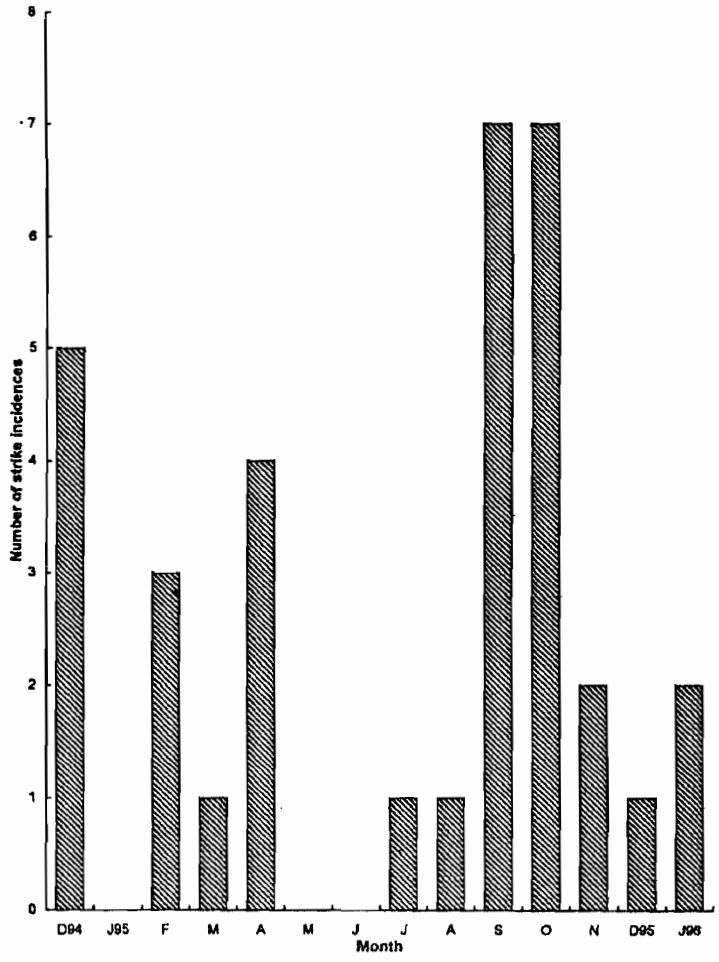

Fig. 2. Bird strike incidence at Bole International Airport in each month of the year.

Time of strikes

Most of the bird strikes occur in the early mornings and late afternoons. The timing of flights in the airport and of the strike incidents are shown in Figures 3 and 4, respectively. Fifty-eight per cent of the strikes occurred before noon. Pigeons caused 29% of the strikes in the morning and 33% in the afternoon while black kites caused 67% of the strikes at noon. These observations are

similar to that of Gwahaba (1985a; 1985b). He reported that the highest number of strikes at Entebbe Airport, Uganda, occurred in early mornings and late afternoons.

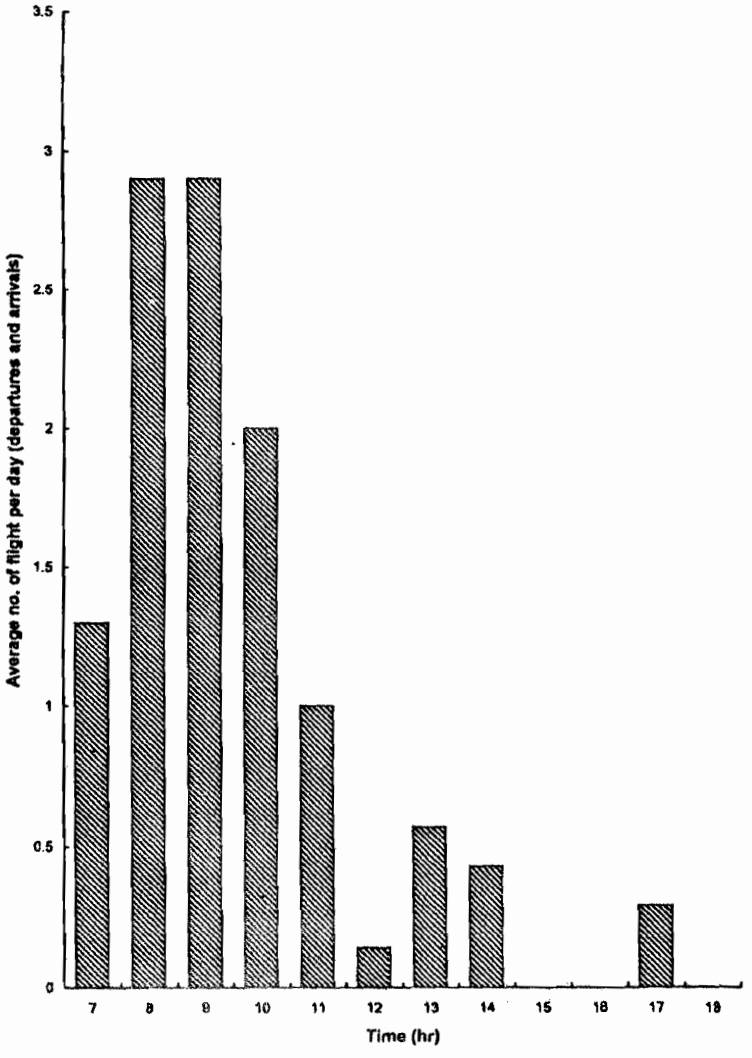

Fig. 3. Frequency of flight at Bole International Airport in the hours of the day (departures and arrivals averaged over a week).

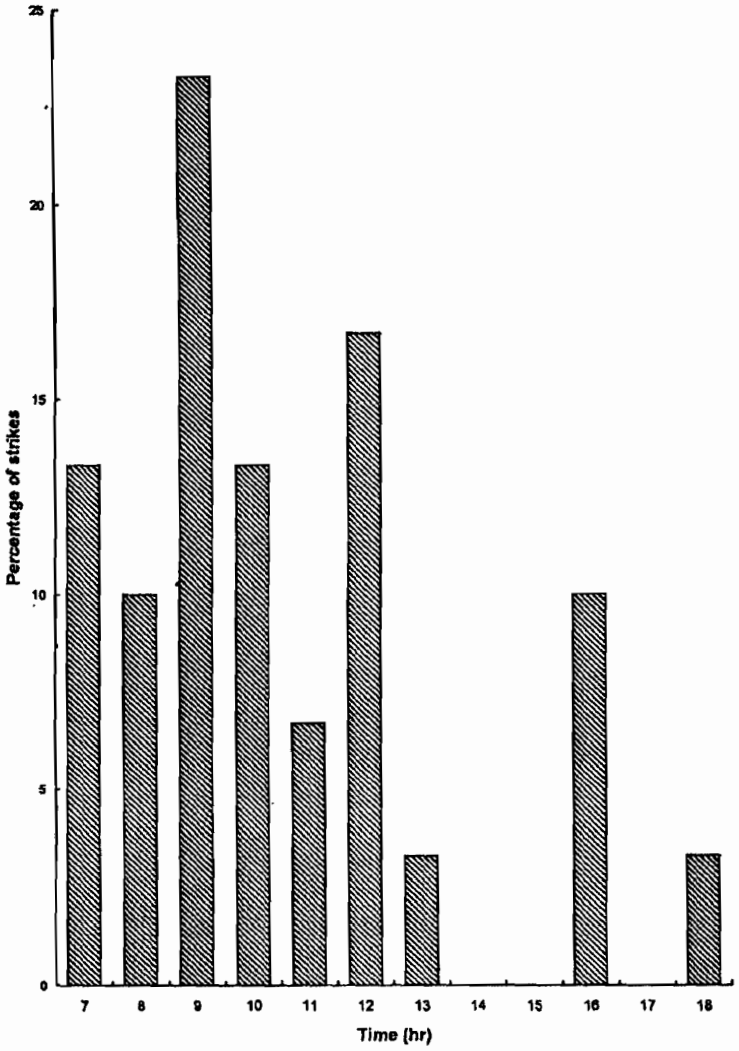

Fig. 4. Bird strike incidence at Bole International Airport in the hours of the day.

Result of the multiple regression analysis showed that number of strikes was significantly related ($P = 0.042$) to number and time of flights. The correlation between number of strikes and number of flights is 0.67 indicating that inci-

dence of strike increases with number of flights. Hence it is misleading to suggest a time free of bird strike incidents. Nevertheless, observations on activities of some birds (*e.g.*, Pigeons) may suggest that the time between 1300 and 1600 hrs might appear to have few or no bird strike incidents at Bole. This may be due to the less traffic density and low bird activity at these hours of the day.

Gut analysis

Fifty nine per cent of the birds struck by aircraft were shuttered to pieces making gut content analysis practically impossible. In those cases where gut analyses were possible, the crops were empty in 82% of the gut analyses carried out. This can be attributed to the fact that 58% of the strikes took place in the early mornings before the birds had fed. The stomachs of all the pigeons that were struck in the afternoons contained wheat grain indicating that the strikes occurred after the birds had fed.

Behaviour

Pigeons and doves crossed the Airport in early mornings while they flew to their feeding areas, which are the farmlands south and southeast of Addis Ababa. In late afternoons, they flew in the directions to the range of mountains north of Addis Ababa. Pigeons and Doves generally crossed the runway at about 35 to 40 metres above the ground. On cool and cloudy days, these birds travelled to the feeding areas late in the mornings and returned to the roosting sites much earlier than usual. Large number of pigeons also roosted in the hangar of the Airport at night.

In November, when the harvest outside the Airport is ready, Speckled and White collared pigeons and Red-eyed doves visited the farmlands in flocks and roosted in the Airport hangars, inside roofs of buildings in the airport and grounded old airplanes. In this month, they flew at a relatively lower height while approaching the runway and stayed long in the farmlands close to the Airport. They flew in either directions of the runway restlessly when farmers scared them. These had made the pigeons and doves highly vulnerable to strikes. Pigeons and doves accounted for all the strikes recorded in November.

Pigeons and doves flew unusually very high in February when the harvest outside the Airport has already been collected. Nevertheless, small flocks were observed feeding in the vegetation inside the Airport. They also fed on caterpillars, earthworms and termites on the runway. While passing to their feeding or roosting areas, pigeons and doves sometimes made a stop over at the Airport. When disturbed by bird scarers or by aircraft landing and taking off, pigeons circled around before they settled again or flew away. This behaviour made them vulnerable to frequent strikes.

Open garbage dumps in and around the Airport attracted many kites. Kites were also observed feeding on insects, earthworms, grasshoppers, lizards, snakes and small mammals in the Airport. Kites were bold and fearless and scaring them away from the runway had sometimes been very difficult. This fearless behaviour made kites highly vulnerable to strikes. In most of the strikes observed, the whole body of the Black kites were sucked into the engines.

The Eurasian Bee-eater, a Palaearctic winter migrant to Ethiopia, visited the Airport in two occasions. According to Mackworth-Praed and Grant (1957a), these migratory birds arrive in Africa in September and October, passing on further South in November. They leave the Southern Hemisphere between February and April. Bee-eaters were highly gregarious and were attracted to the runway by bees swarming on flowers including *Bidens prestinaria* and *Bidens macroptera* in September and October. These birds were also seen in the Airport in March and April while returning northwards. During this period, bee-eaters were observed feeding on termite larvae which flourished following the small rain.

Nocturnal animals such as owls and bats were also occasionally involved in collisions with aircraft. Birds such as Flamingos and Gulls, not encountered during data collection at the airport, were also involved in the strikes. This shows that bird strike could also occur at night while nocturnal and infrequent birds are traversing the Airport

CONCLUSIONS AND RECOMMENDATIONS

Speckled and White collared pigeons and Red-eyed doves; and Black kites accounted for most of the strikes at Bole International Airport. The time between 0800 and 1200 hrs and from 1600 to 1800 hrs experienced the highest number of bird strikes. There is a clear correlation between bird strike and the behavioural pattern of birds. Moreover, the air traffic was relatively heavy in the mornings. High number of strikes occurred in September and October while none occurred in May and June. The most prevalent bird strikes occurred when insects, mainly grasshoppers and termite larvae were abundant and when the crops outside the Airport fields were ready for harvest.

Ecological measures of controlling bird strikes should focus on birds that frequently visit and/or pass across the Airport notwithstanding the fact that some infrequent birds could also be hazardous. Modification of the Airport environment with the aim of removing features that attract birds is vital. Based on this study the following recommendations can be forwarded.

Garbage dumps found within the premises of the Airport and its vicinity should be closed. Garbage barrels in the Airport should never be left open. Similarly, open and semi-closed slaughterhouses in the city and the surrounding areas should be removed. The recommendation of ICAO to remove garbage dumps and abattoirs and other bird attracting features within 13 km of the Airport should be applied.

The Ethiopian Civil Aviation Authority in collaboration with the City Council should set the necessary rules and regulations to remove all possible factors that may attract birds to and around the Airport. This may include proper use of garbage disposal systems and prohibition of agricultural activities in and around the Airport. Other agricultural activities such as livestock and bee keeping close to Airports should also be discouraged.

The bird scaring practice using bird scaring personnel could be made effective by raising the awareness of the personnel with regard to the season, abundance and behaviour of birds. Personnel of the Airport operation and pilots should be aware of bird activities in different times of the day and seasons of the year.

A trade off between grass height and the possible risk associated should be tested under the prevailing set of conditions. Hild (1983a; 1983b) has shown that most bird species involved in bird strikes prefer short grass. However, only a few small birds frequent long grass. Short grass discourages the presence of small mammals and other animals that can attract birds of prey. A serious disadvantage of short grass is that it exposes earthworms, insects, and other animals. This will in turn attract insect eating birds. Grass allowed to grow to full height develop seeds which will attract seedeaters. Hild (1983a; 1983b) recommend to maintain the grass height within 15 to 25 cm. The grass should be removed as soon as it is cut. This would otherwise harbour small mammals and insects.

Spraying the grassland on either side of the runway with insecticides can be considered to prevent the proliferation of termites and other insects.

Ditches and holes in and around the Airport retain water and encourage the presence of reptiles and amphibians, small mammals and invertebrates, which in turn may attract birds. Open holes should be plugged and the ditches or depressions should be graded to allow water to runoff as rapidly as possible.

Trees that provide protection and nesting sites to birds and serve as possible lookout perches to birds of prey should be removed. All possible perching and posting sites (including abandoned aircraft, electric and telephone poles) inside the Airport should be removed. Covering the ceiling of the hangar with wire mesh will prevent the roosting of birds in the hangar.

Continuous and detailed monitoring of the environmental conditions and bird activities at Bole International Airport should be made. Bird strike statistics and other relevant data should be made available for analysis and monitoring.

It should be noted that a new runway parallel to the old one currently under construction is likely to increase the flight frequency and may aggravate the problem of bird strike given the set of conditions at Bole remain the same.

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