The Second Meeting of the Asia-Pacific Wildlife Hazard Management Working Group (AP–WHM WG/2)

Virtual Meeting, 27 to 29 May 2020

Agenda Item 3: Global, Regional and National Guidance/Best Practices on Wildlife Hazard Management

CHALLENGES OF WILDLIFE HAZARD MANAGEMENT AT KIAB – 12-YEAR ENGAGEMENT OF BEST PRACTICES AND PROGRESS ON WILDLIFE HAZARD MANAGEMENT

(Presented by India)

SUMMARY

This information paper presents wildlife hazard management practices engaged to control the bird/wildlife hazards, posing threats to aircraft operating from the Garden city of India and efforts undertaken to reduce the hazards in order to provide a safe flying environment at Kempegowda International Airport, Bangalore (KIAB).

1. INTRODUCTION

1.1 Wildlife/bird strikes pose significant economic and safety consequences to flight operations. In the early days, collisions between aircraft and wildlife/birds were infrequent due to low speeds and smaller size of aircraft. In the 1990s, with major expansions in commercial aviation and population of birds and other wildlife species, it became hazardous to aviation. This resulted in millions of crores of annual loss to the aviation industry and posed a significant threat to passenger/crew. Indian Aviation is the fastest-growing aviation industry in the world as per IATA. The hub of the nation's aviation manufacturing industry, with 65% market share, is in Bangalore. Directorate General of Civil Aviation (DGCA) under the Ministry of Civil Aviation and National Civil Aviation Policy 2016 set broad goals for safety and operations which covers all the relevant aspects of ICAO Airport Services Manual Part 3 – Wildlife Control & Reduction and relevant DGCA CARs. All measures are subjected to periodical audit by DGCA.

1.2 KIA'B is located in Bangalore which has over 400 native species of birds and over 13,000 migratory birds. Bangalore has about 90 live lakes which shelter water birds moving around for livelihood. The migrant swallows also pose a threat to aircraft safety as they follow their route from Himalayas to Sri Lanka in winter and return to Himalayas during mid Mar to Apr, crossing over BIAL airport. A majority (83%) of the birds, with a body weight >700 grams, visiting the airport are hazardous and they constitute about 30% of the reported bird strikes from Airport opening date – May 2008 till 2016. These species approach our airport for thermals, gaming and training of juveniles as they require open space and easy localization. Owing to the above situations, bird/wildlife hazard has been a challenge for the airport operator over 12 years of operations. However, timely assessment and mitigation measures have helped minimize the conflict at KIAB by regular review of the Bird/wildlife hazard management program

2. DISCUSSION

Steps for Development of Wildlife Hazard Management Program for an Airport

2.1 Airport Topography & Wildlife Hazard Assessment Survey

KIAB is in the outskirts of Bangalore City, also known as the Garden City due to its vast areas of lush green cover and availability of many shallow lakes. Apart from these, there are many wildlife conservation hot spots around Bangalore, within 150 kms radius, which makes Bangalore an attractive destination for a variety of migratory and resident birds. Bangalore has about 90 live lakes around the city and has over 400 species of resident birds found throughout the year. These water sources attract birds and they keep moving from one area to another to avoid predators, environmental issues etc. To assess the bird population and the potential source of attraction, periodical wildlife hazard assessment surveys are conducted 13 kms around the airport. Wildlife hazard management plans are formulated based on the outcome of such surveys.

2.1.1. The details of a pre-2016 survey is as appended below:

a. The fauna:

147 species of Birds in & around BIAL
4 species of Mammals in critical areas (incl 3 types of bats)
11 species of Snakes (4 venomous)
6 species of Lizards
7 species of Toads
42 types of Butterflies
3 species of Moths
3 species of Bees

b. Potential sources of attraction:

Refuse dumps
Landfills
Fish breeding centers
Butcheries
Lakes with water birds
Sericulture
Poultries
Undisturbed forest land
Bat colonies
Mango/Grape/Guava gardens
Mulberry gardens

2.1.2 Based on the above potential hazards the area of 13 kms is divided into 4 zones for effective implementation of wildlife hazard management.

1. Primary Hazard Zone - The airside area of the airport
2. Secondary Hazard Zone - Area within Airport premises
3. Tertiary Hazard zone - Approach funnel
4. Low Hazard Zone - Other areas beyond the above zones, within 13 kms around Airport

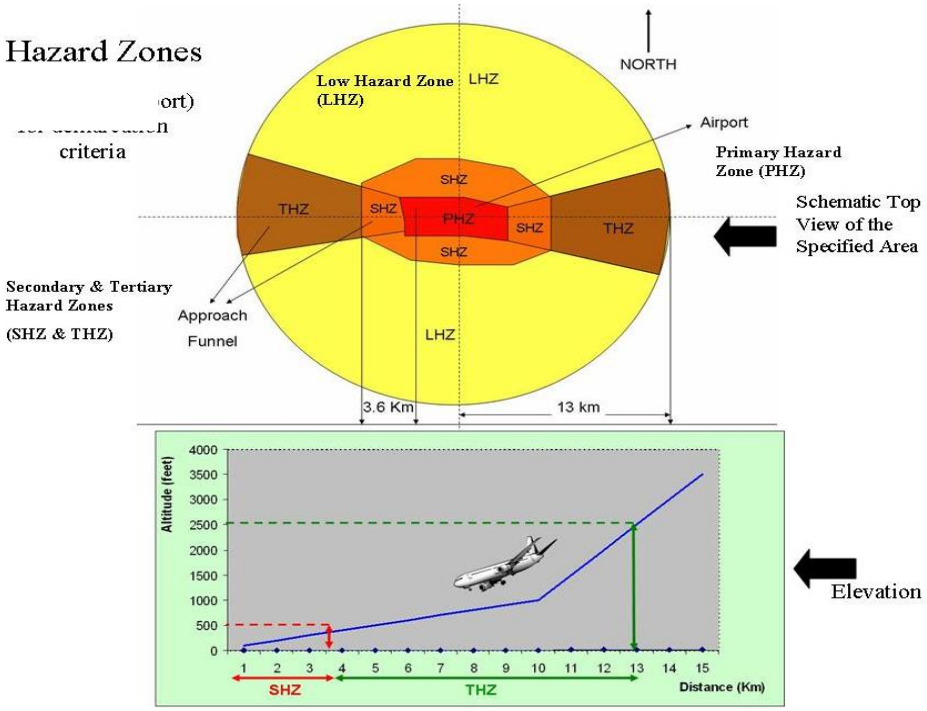

Figure 1. Hazard Zones

2.2 Bird movement mapping

2.2.1 Bird movements are manually recorded meticulously during the day over the airside area and transferred to a digital database for analysis, such as species, time zone and movement pattern etc. It was found that the airport is a transit (cross over) area for many species (Scavengers/Raptors – large sized birds having body weight > 700gms) from their roosting site to feeding site to countryside towards the north of the airport. There are about 400 bird crossings sighted regularly over the airport in the morning and they go back to their roosting sites in the evening following the same path. Potential hot spots over airports are identified and a robust management plan is implemented along with the Operating Manual and procedures.

2.3 Designing of a Management Plan

2.3.1 Based on the bird movement data, critical hot spots (conflict zones) are identified at the airside and bird/wildlife hazard management plans are developed for the airport. A bird hazard management team consisting of 3 bird watchers, 12 bird chasers along with one supervisor and a helper are deployed daily from dawn to dusk, manning these critical areas with bird hazing kits (species-based scaring measures). One staff is deployed for the night before the start of Operations. The entire airside area has been cordoned off with measures to prevent animal entry such as drainage outlet grills, entry gates, crash gates etc. A workflow chart for reporting has been prepared with an SOP and all the staff are trained to use RT sets to communicate with the Operations team to report real time incidents for support/action.

2.4 Preparation of Wildlife Hazard Management Manual/Policy with SOPs

2.4.1 A wildlife hazard management plan, covering all the relevant aspects of ICAO/DGCA standards, has been prepared with 28 SOPs along with a maintenance plan for wildlife hazard equipment. A vegetation management requirement for the airside of the airport has been prepared including grass height maintenance and insecticide application and shared with the landscape team of the airport. However, due to vastness of area the grass land management has been restricted to 400 acres of critical area out of 1600 acres.

2.5 Review of Management Plan

2.5.1 The total airside area of the airport is divided into 6 zones each for south and north runway separately for effective bird hazard movement mapping and accordingly the bird movement patterns are identified for revision of deployment on a weekly basis.

a. Bird monitoring Zones for North runway (NA TO NF) & South runway (SA to SF)

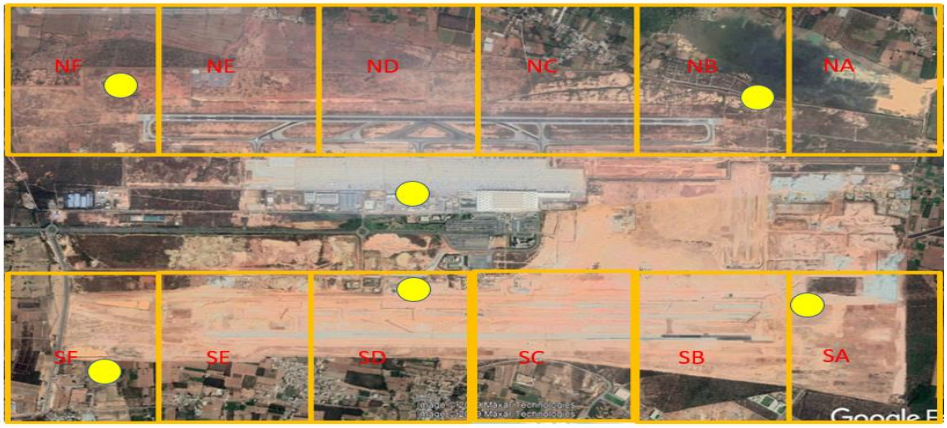

Fig 2, Bird monitoring zones

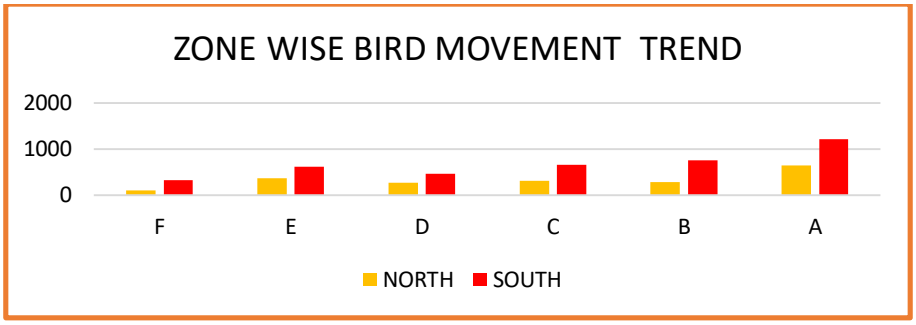

Fig 3, Bird movement trend zone wise

b. Weekly Bird movement pattern – Zone

BIRD MOVEMENT PATTERN DATA ANALYSIS							
RUNWAY		**F**	**E**	**D**	**C**	**B**	**A**
WEEK 17 (20 - 26 Apr)	NORTH	116	606	934	347	386	557
	SOUTH	133	471	666	406	329	456
WEEK 18 (27 - 03 May	NORTH	96	361	269	306	279	638
	SOUTH	317	614	459	660	754	1216
Variance between week	NORTH	-21%	-60%	-71%	-12%	-28%	15%
	SOUTH	58%	24%	-45%	39%	57%	63%

Fig 4, Bird movement pattern – Zone wise

2.6 Integrated Wildlife Hazard Management Plan

2.6.1 An integrated wildlife hazard management program is devised by forming a team of personnel from different departments (Maintenance team consisting of Civil, Horticulture, Waste Management, Water and wastewater, Environment department and Operations department of BIAL). This team also conducts monthly inspections on the airside to identify potential bird/wildlife attractants and initiate suitable mitigation actions. Also, all the works planned at the airport area are controlled by permit. Works are permitted only on assurance of bird/wildlife control measures being in place while executing the project.

Fig 5. Integrated Wildlife Hazard Management

2.7 Review of Management Plan - 2013-2016

2.7.1 Despite implementation of various measures, a spike in bird strikes was observed from the year 2013 onwards. This necessitated conducting another survey to identify the possible causes for the increase in bird strikes. The following aspects were examined:

a. Assessment of factors contributing to hazard

- Species of birds involved with bird strike
- Contributing factor for birds at airside
- 400 acres out of 1600 acres of airside habitat was maintained
- Insufficiency of pesticide application
- Loss of green cover and development of bald patches lead to visibility of ground mammals to birds (animals give priority to their instinct before safety)
- Conducive habitat for birds/animals in airside beyond the critical area

b. Results

- Nocturnal birds consist of owl's strike were on the rise with small ground birds during day
- Airport expansion project earth excavation resulted in migration of rodents to airside which is attracted by owls for their feed

- Bald patches on runway strips resulting easy hunting on rodents by owls
- The grass species (Kikuyu – Bermuda 60:40 combination) planted during the project stage has been invaded by natural species resulting into a conducive habitat for ground birds. The reason for this was due to application of insecticide during dry days resulting in decease of grass cover.
- Soil erosion/termite outbreak

c. Measures taken up for effective management

- Engagement of active control
- Engagement of passive control
- Suggested review of habitat management plan by taking over the responsibilities of Habitat management under wildlife hazard division
- Monthly AEMC survey around the airport
- Quarterly AEMC subcommittee meeting
- Purchased cut & collect machines capable of cutting wildlife vegetation with capacity to cover > 766 Cubic meter area and collect organic waste.
- Grass study conducted to identity the airport suitable grass species
- Weekly night surveys for wildlife/bird's assessment and treatment action

BIRD STRIKE TREND - PHASE OF THE DAY																								
YEAR	2008		2009		2010		2011		2012		2013		2014		2015		2016		2017		2018		2019	
Phaase of day	DAY	NIGHT	DAY	NIGHT	DAY	NIGHT	DAY	NIGHT	DAY	NIGHT	DAY	NIGHT	DAY	NIGHT	DAY	NIGHT	DAY	NIGHT	DAY	NIGHT	DAY	NIGHT	DAY	NIGHT
BIRD STRIKE	13	1	14	2	10	0	7	3	8	2	12	20	13	13	7	14	25	26	9	21	11	26	7	3
TOTAL	15		16		10		10		10		32		21		19		43		30		34		22	

Fig 6. Bird strike trend

2.8 Challenges in the year 2016 - Review of departmental responsibilities as well as inclusion of habitat Management aspect with Wildlife/Bird hazard control team.

2.8.1 The responsibilities of Habitat Management were taken over by the Wildlife Hazard Management team. BASHM team conducted a major habitat modification initiative at the airport airside area, covering an area of 1600 acres, resulting in the removal of wild vegetation, trees, levelling and grading etc. Further, the following new measures were added into the Wildlife Hazard Management Plan:

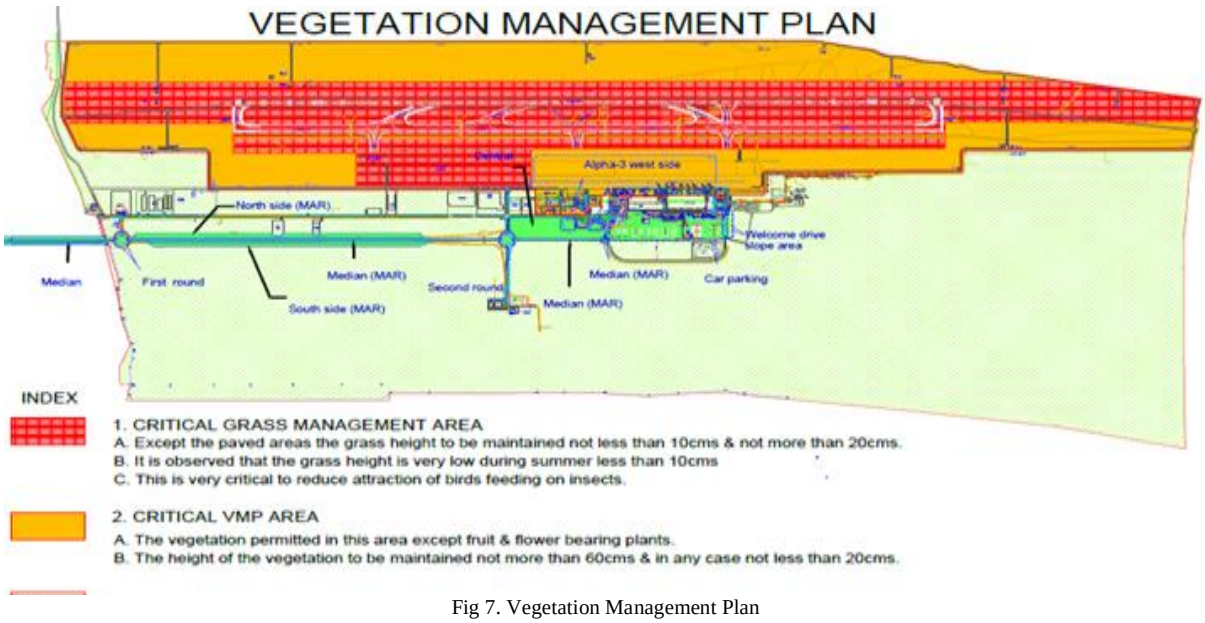

Fig 7. Vegetation Management Plan

2.8.2 Grass Study of KIAB

Fig 8. Grass study graph

a. Recommendations and action taken

- Developed a Vegetation Management Plan for the airside
- Conducted a grass and soil study for the airside
- Mapped the airside area for fauna
- Conducted hazard ranking of species
- Categorized most hazardous and least hazardous species
- Engaged species-specific treatment actions
- Replaced the green cover on the runway strip (110 meters from runway edge) of the runway
- Installed irrigation systems for runway strips
- The entire airside area of 1,300 acres has been maintained free from birds/wildlife and its attractants
- Mapping of nocturnal bird movement by Camera trap and passive control initiated to keep them away from critical areas

Black Naped Hares

Fig 9. Camera trap images – Black Naped hare

Wildcats

Fig 10. Camera trap images- Wildcat

- Passive control activities have been increased. Attended 60 rodent burrows per week in critical area (during maintenance slot)
- Shut down approximately 60 makeshift fish breeding ponds in the vicinity of the airport with the help of the State Department

b. Results

- Bird strikes involving large birds and nocturnal/day birds reduced
- Green cover on runway strips maintained resulting in fewer ground birds at airside
- Termite attacks on grass and critical area reduced
- Reduction in snake and rodent menace resulting in eradication of Owl hazard

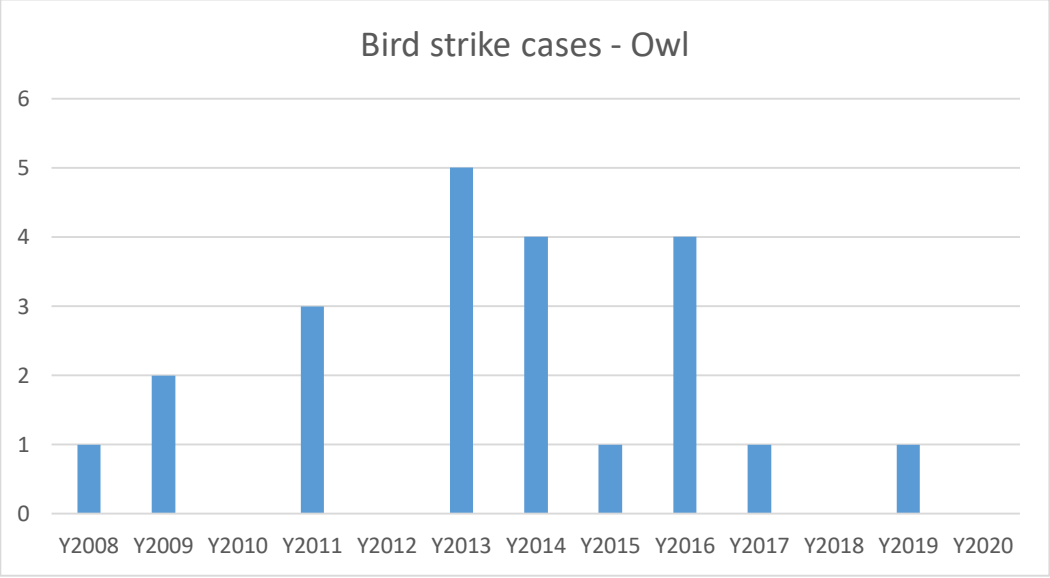

Fig 11. Bird strike graph - Owl

HAZARD RANKING FOR BIAL PROBLEM SPECIES									
SL .No	Species of Wildlife	Mass (In Grams)	Ranking based on Mass	Average movement in airside PHZ	Ranking based on movement at airside	Average Group Size if there is a flocking behaviour	Ranking based on average group size	Sum of Ranking (SUM of R)	Hazard Ranking
			R		R		R		
1	Jungle cat	7000	1	1	13	1	18	32	14
2	Black naped hare	3000	2	1	12	1	17	31	12
3	Tawny Eagle	2800	3	2	9	1	16	28	9
4	Grey Heron	2200	4	5	6	5	7	17	2
5	Mongoose	2000	5	1	15	1	15	35	16
6	Fruit Bat	1600	6	1	11	5	8	25	8
7	Duck	1500	7	5	6	5	9	22	6
8	Eagle Owl	1100	8	1	10	1	13	31	11
9	Pariah Kite	850	9	222	1	15	3	13	1
10	Brahminy kite	670	10	6	7	2	12	29	10
11	Marsh harrier	670	11	1	12	1	14	37	17
12	Jungle crow	650	12	34	3	10	5	20	4
13	Cattle Egret	512	13	11	4	20	1	18	3
14	Dove	380	14	8	5	20	2	21	5
15	Kestrel	250	15	1	14	3	11	40	18
16	Myna	130	16	4	8	5	9	33	15
17	Parakeet	120	17	50	2	10	4	23	7
18	Swift	50	18	6	7	10	6	31	13
19	Lark	22	19	1	16	5	10	45	19

Fig 12. Hazard Ranking

2.9 Challenge in the year 2017- Migratory Route of Swallows

2.9.1 Migratory swallows were found crossing over our airport from mid Sep every year, since 2017. Through our observations and study, it was found that these birds move towards Sri Lanka from the Himalayas during the winter migration and return to the Himalayas between mid Feb and mid May. These birds are tiny creatures with a body weight <10 gms with swift movements, which are difficult to spot from a distance. We are still working on certain habitat management measures to alter their path over our airport.

2.9.2 Migratory route map – Swallows

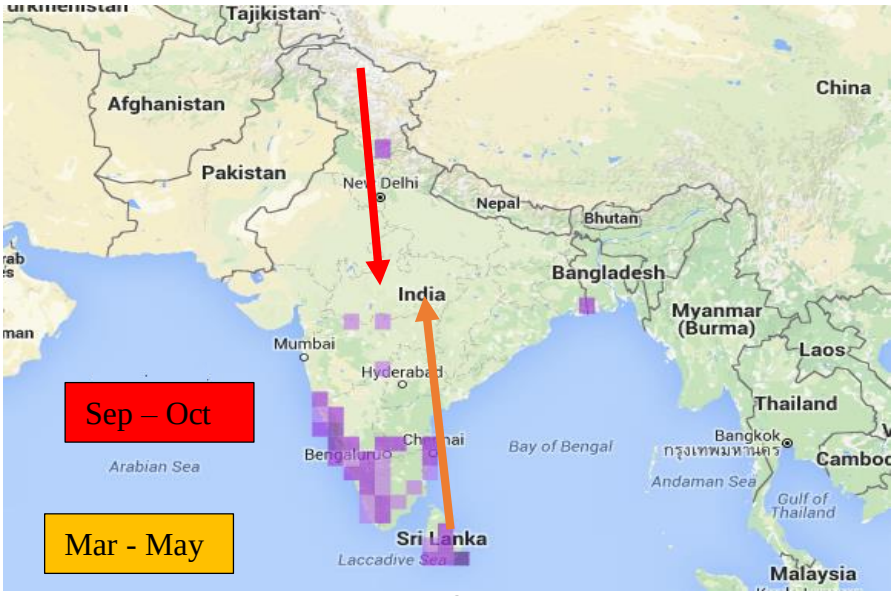

Fig 13. Migratory route

2.10 Challenge 2018 -2019 -Fruit bat management project

2.10.1 We have recorded increased wildlife strike incidents with bats, especially fruit bats during 2017-18 and to address and control this menace, the Wildlife hazard team carried out a survey. On review of data it was observed that two different types of bats were involved in the reported bird strike cases.

2.10.2 Pipistrelle Bat

- The Common pipistrelle is a very small species of bat.
- Its forearm is 27.7–32.2 mm (1.09–1.27 in) long. The body mass can range from 3.5 to 8.5 gm, with the wingspan ranging from 18 to 25 cm (7.1 to 9.8 in).
- It is insectivorous, preying on flies, caddisflies, lacewings, and mayflies. Mosquitoes, midges, and gnats are particularly favored prey items.
- Very swift moving species hunts on moving insects generally disturbed due to aircraft movement during flare off.

a. Observation

- Most of the carcass retrieved from the runway were during night inspection, which were not reported by any source
- No wildlife strike reports were received from aircraft operating crew
- No visible injuries observed during carcass examination
- Carcass retrieved were mostly in stiff condition, indicating that the cause of death was due to jet blast and not direct impact with the aircraft

b. Findings and recommendations

- Insects were the main cause of attraction for these species
- Insects were attracted due to illumination of lining-up aircraft
- There is a need to map areas beyond the maneuvering areas and other areas of airport

c. Measures adopted

- Insecticide application on runway strip
- Mapped & identified high activity area away from critical area
- Created a conducive area for their feeding needs, where the grass height is maintained higher thus attracting the insects
- Mixing of insecticides through irrigation system to runway in use area to keep the effectiveness of the application (generally the effectiveness remain for 3-4 days subject to climatic conditions

d. Results

- Less activity noticed in the critical area
- Bats remain active at location away from critical area
- Eco friendly insect management
- Reduced cases of bird strikes involving Pipistrelle Bat

2.10.3 Fruit Bat

2.10.3.1 Indian Fruit Bats also known as Flying Fox are the largest bats in the world weighing up to 1.6 kg (3.5 lb.), its body mass ranges from 0.6–1.6 kg, and males are generally larger than females.

The wingspan ranges from 1.2–1.5 m (3 ft. 11 in–4 ft. 11 in) and body length averages 15.5–22.0 cm (6.1–8.7 in). Wildlife/hazard team took up this challenge by conducting a study on this.

a. Assessment with available data

- Zones where the carcass were retrieved
- Bird strike reporting time from aircraft
- Carcass removal time by Follow-Me
- Nocturnal activity
- Not easily noticeable with naked eye
- No measures available with us to map the movement

b. Survey method

- Study the behavior of the species
- Data analysis to identify the movement path
- Time zone in which the strike occurred

c. Time Zone Strike Analysis

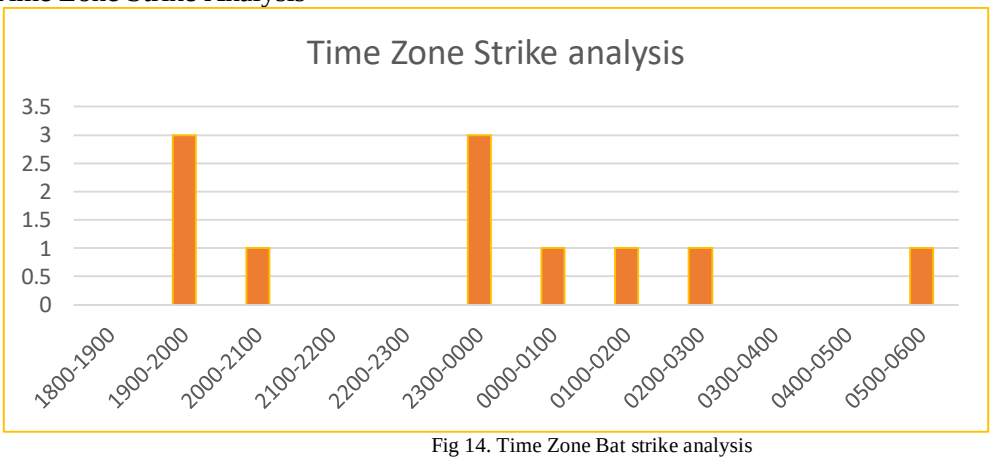

Fig 14. Time Zone Bat strike analysis

d. Bat Strike incidents – Zone A-F

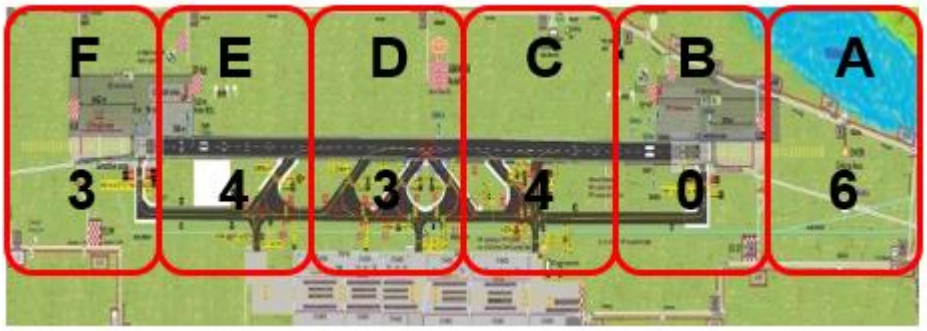

Fig 15. Bird strike incidents zone wise analysis

e. Findings

- Identified that the birds move out of their roosting site immediately after sunset
- Strike patten revealed that one set of strike occurred immediately after sunset and one set post-midnight
- Bats move towards feeding opportunity areas soon after sunset
- Conducted full moon survey on the strike zone to identify the movement pattern

- Water body in Zone-A north of airport and feeding areas with Guava, mango, grapes plantations
- Identified the bat movement from South to North
- Since the time zone is close to sunset it also revealed that the roost is close to airport to reach soon after sunset
- Studied the google satellite map to identify the green patch and located the villages
- Identified the bat roost with a population of >1000 resident bats

f. Bat roost close to airport (within 7 km radius on south side)

Fig 16. Bat survey – Bat colony

g. Bat movement path map

Fig 17. Bat movement map

h. Mitigation measures with state support

- Conducted awareness to villagers, who were not in support of displacing them since there are some religious connotations attached to these species.
- Case taken up with Forest department and Village Head
- Joint inspection conducted
- Mitigation measures were not agreed by the Villagers

i. Measures adopted by wildlife hazard team

- Started mapping the bird movement pattern from roost
- Two-layer protection engaged at BIAL premises with high illumination fireworks
- Bat movement from roost informed through RT to first- and second-layer protection team
- First layer team blast the fireworks towards the assumed area of crossing from our south boundary (6 km away from the strike zone)
- Continued these measures for few days
- Mapped with thermal imager to locate their movement during night
- Full-moon day survey continued for identifying their movement
- Bats diverted their movement path which is clear from BIAL airspace
- No cases of Bat strikes reported post these actions

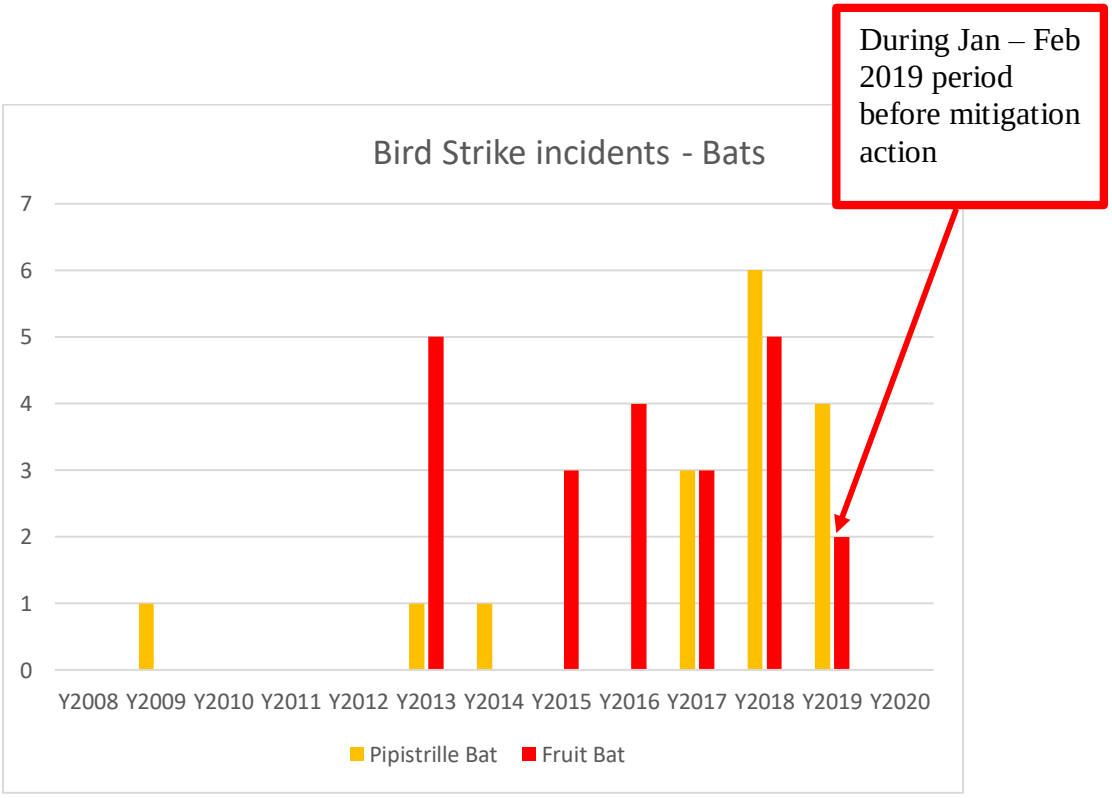

Fig 18. Bat strike graph

j. Thermal images of Bat movement

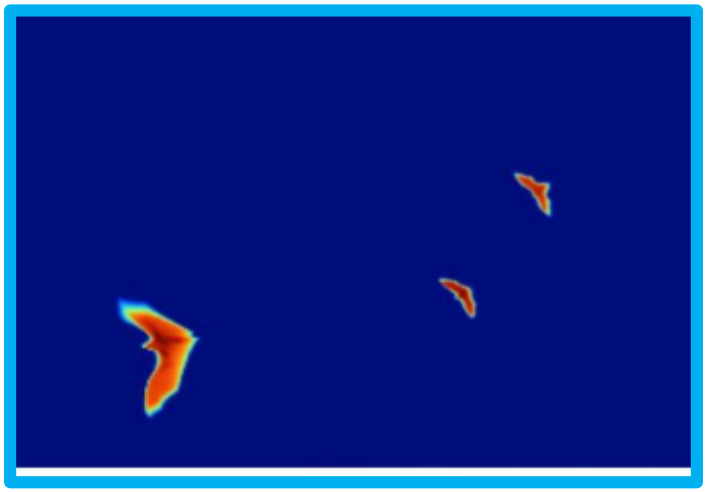

Fig 19. Bat strike graph

2.11 Database Management

2.11.1 All bird movements occurring at the airside are recorded through a tab/mobile/laptop-based application. This enhances the real time data available to all Wildlife Hazard Management staff and helps them to provide timely guidance and take action for effective avoidance of bird/wildlife conflict. Bird movement trends and data analysis are carried out to assess the threat levels posed by different species at the airport by using this application.

a. Total bird movement Graph 2010 – 2020

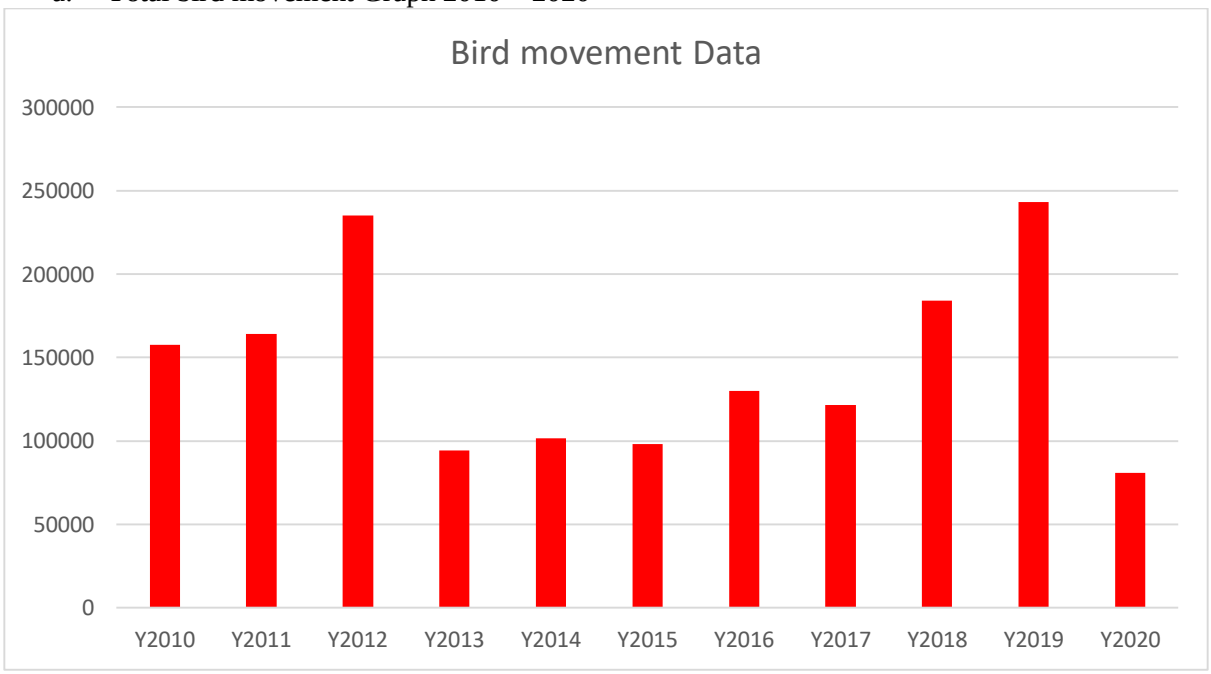

Fig 20 Bird movement data

b. Species involved with bird strikes

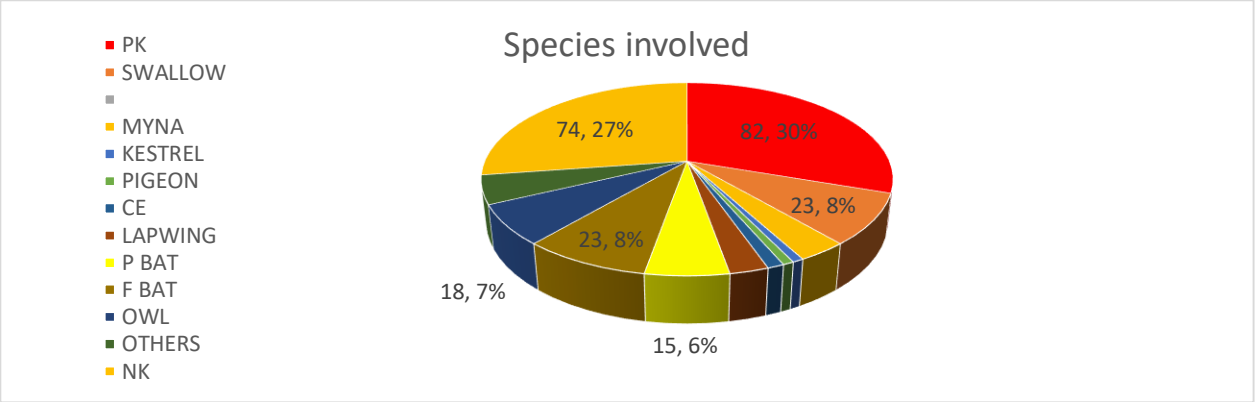

Fig 21. Bird strikes graph - Species

c. Bird Waring period assessment

BIRD STRIKE DATA - BIRD WARNING PERIOD													
Time Zone	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**Total**
0001-0200	0	0	0	0	0	4	1	0	3	2	3	1	**14**
0201-0400	0	0	0	0	0	1	2	2	1	1	6	2	**15**
0401-0600	1	0	0	0	0	2	2	1	1	1	0	0	**8**
0601-0800	7	5	4	1	1	3	4	1	2	3	0	1	**32**
0801-1000	3	6	4	0	6	6	5	1	9	0	0	1	**41**
1001-1200	3	2	0	0	0	2	1	1	7	2	5	3	**26**
1201-1400	0	1	2	0	0	1	1	2	2	1	2	3	**15**
1401-1600	0	0	0	0	0	1	0	0	0	0	1	3	**5**
1601-1800	1	0	0	0	0	0	0	0	0	0	0	1	**2**
1801-2000	0	1	0	0	1	3	2	3	5	10	5	3	**33**
2001-2200	0	0	0	1	0	5	0	4	5	5	5	1	**26**
2201-0000	0	1	0	0	1	4	1	1	7	5	6	1	**27**
TZNK	0	0	0	8	1	0	2	3	1	0	1	2	**18**
Total	15	16	10	10	10	32	21	19	43	30	34	22	**262**

Fig 22. Bird strikes graph - Species

This was prepared based on the number of hazardous species present at the airside during different time period.

Bird species data is used to identity the potential zones/attractants, seasonal patterns etc. and suitable habitat modification is carried out to reduce the bird strike incidents effectively.

2.12 Current Scenario and the Results

2.12.1 The following are the results of the change management undertaken from 2016 onwards:

- Reduced number of bird strike cases involving hazardous bird species
- Reduced number of bird strike cases involving nocturnal birds
- No major bird strike incident cases reported at the airport
- Real time data is available to cross match with bird strike incidents
- Species data available for mitigation action
- Bird warning periods for the airport are circulated for ATIS publication
- Bird warning patrol started for effective bird management
- Airside has been transformed to a non-conducive habitat for wildlife/birds

- Bird hazard calendar for the airport is available which helps prepare contingency plans

a. Bird/wildlife Strike data

BIRD/WILDLIFE STRIKE DETAILS -SPECIES WISE(2007-2020)													
Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Pariah Kite	13	10	9	7	9	7	7	3	3	1	1		
Owl	1	2		3		5	4	1	4	1		1	
Fruit bat						5		3	4	3	5	4	
Black Shoulderd kite		1											1
Brahmny kite		1	1										
Jungle Cat									1				
House crow	1	1											
Black napped hare									1				
Mongoose						1	2				1		
Plower							1	2			2		
Night jar						1							
Kestrel						1	1						
Cattle Egret										1			
Lap Wing										1	1	1	
Indian Roller						1		1					
Pippet							1					1	1
Pigeon								1		1			
Sparrow/Swallows						1					6	5	2
Snake								1	1				
Pipistrelle Bat		1				1	1			3	6	2	
Not Known	0	0	0	0	1	9	4	7	29	19	12	8	7
Total	15	16	10	10	10	32	21	19	43	30	34	22	11

Fig 23. Bird strikes graph - Species

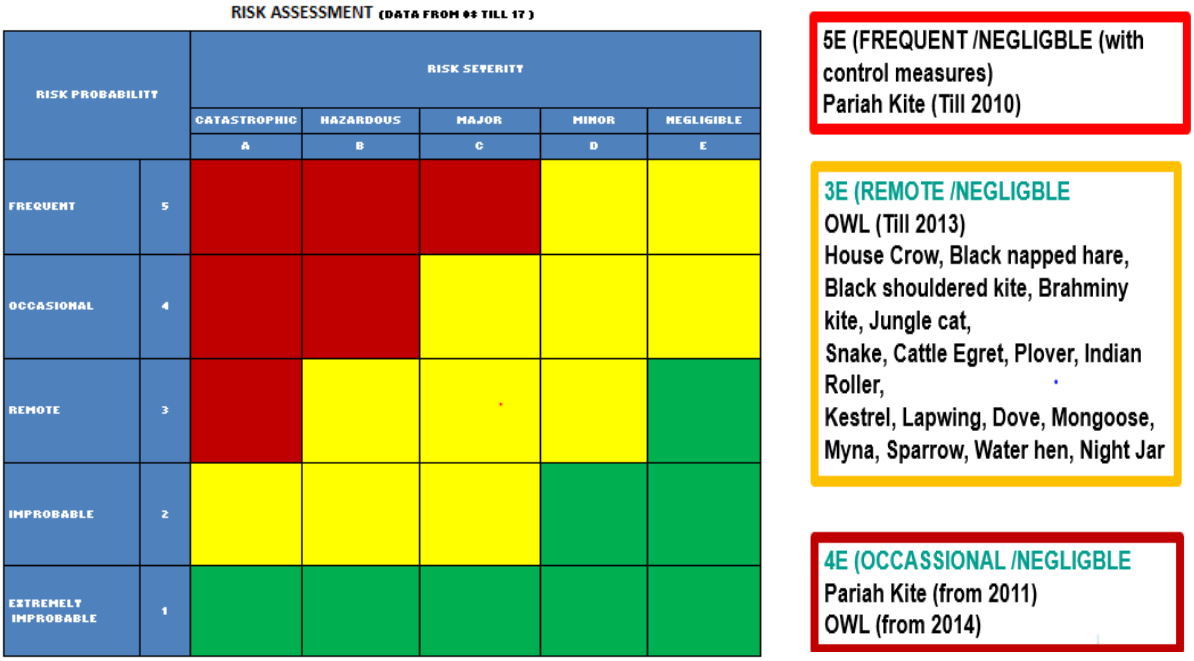

Fig 24. Risk assessment

2.13 Insects migration management – An innovative measure

Fig 24. Insect's management

2.13.1 All active airports face constrains with respect to maintenance slot to implement necessary habitat measures for insects and ground mammal management. Insecticide application to repel the insects from runway strip are effective only for 3-4 days subject to climatic conditions and hence there are chances that the insects could come back if they are disturbed from other areas of the airport while maintaining one area. Also, when the farmers apply insecticides in his fields close to airport during this period they could migrate en masse to airside. To avoid such kind of migration we started maintaining the grass land allowing the insects to remain within the area. While undertaking grass cutting at other areas of airport, grass patches were undisturbed by maintaining grass cutting in a planned pattern. This allow the insects to be retained at the same area. (Annotation. it is not viable to conduct insecticide application to the entire airside area of an airport)

2.14 **Conclusion**

2.14.1 During a survey conducted approximately 10 years ago, it was revealed that there are about 200 to 400 billion number of birds, amounting to about 40 to 60 birds per person for a population of 5 billion. With the increase in human population there is a corresponding rise in the bird population as well. Scavengers cum raptor species consisting of big sized birds like Black Kites are problematic birds for aviation since they travel along with the thermals from ground at a height up to 3,000 feet. They are highly immune to any kind of pollution. Kite population across the country has increased, especially in areas with high density of human population. These birds are known to avoid heavily forested regions. A survey in 1967 over 150 square km in New Delhi area estimated approx. 2,200 pairs or roughly 15 Kites per sq. km. A similar survey in 2013 estimated 30 per square km. State regulations do not permit any damage the ecosystem to control birds over airport, however they encourage initiatives for co-existence. Hence it is the responsibility of the airport operator to assess and review the wildlife hazard management plan periodically.

2.14.2 Effective bird/wildlife hazard management can only be achieved by a collaborative, synchronized and seamless action by all the stakeholders of the airport ecosystem.

3. ACTION BY THE MEETING

3.1 The meeting is invited to note the information contained in this paper.

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