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BIRD STRIKES STATISTICS IN ESTONIA 1951 - 1988

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SUMMARY

About 270 birdstrikes reported with 12 types of aircraft of Estonian Civil Aviation Department between 1951 and 1988 have been analysed. The analysis includes strike rate for aircraft types and airports (partly based on aircraft movements), bird species and weight, part of aircraft struck, effect of strike.

The paper shows that gulls were involved in 61.1 % of the incidents where the bird species was known, and that only 3 % of bird strikes involves birds of over 4 kg. The major effects have been damage to 20 engines, 2 precautionary stops and 1 forced landings.

INTRODUCTION

The general aviation-ornithological characteristic of the Soviet Baltic region with respect to others regions of the USSR was shown in article of Drs. A.I. Rogachev and V.V. Khodchenko (Rogachev, Khodchenko, 1983). Analogous characteristic of Estonia with respect to Latvia and Lithuania was shown by author at the conference "Baltic Birds - V" in Riga in 1987 (Shergalin, in press). In this report detailed analysis of collisions between birds and aircraft of the Estonian Civil Aviation Department (ECAD) is given.

Data for analysis has been kindly placed for my disposal for 1951-1970 years by Dr. V.E. Jacoby, for 1971-1982 - by Dr. A.I. Rogachev, and for 1982-1988, gathered by author, who began his work as aviational ornithologist in ECAD in 1982 and continues nowedays. I am very thankful to Drs. V.E. Jacoby and A.I. Rogachev for this information.

In Estonia total strike rate per 10 000 movements in 1986 was 10,2; in 1987 - 7,5; in 1988 - 9,1; in average for period 1986-1988 - 9,0. So high indices ranks Estonia among such countries with traditionally high danger for aviation from birds: Switzerland, Germany, Netherlands (Thorpe, 1984).

DISTRIBUTION OF BIRD STRIKES DURING STUDY PERIOD TABEL 1

Year	Number of strikes	Year	Number of strikes	Year	Number of strikes	Year	Number of strikes
1951	1	1966	9	1974	2	1982	9
57	1	67	6	75	5	83	20
58	2	68	24	76	7	84	22
59	1	69	12	77	11	85	25
60	4	70	17	78	7	86	37
62	2	71	5	79	8	87	33
64	1	72	4	80	13	88	42
65	4	73	2	81	11	Total*	350

* Table does not include 21 Strikes, when year of Strike was defined unexactly.

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BIRD

Month

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May
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November
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Table 1 includes not only bird strikes, reported by pilots and ground personal (1951-1988), but also remains, which were founded on runway or it's surroundings (1983--1988). Relation between number of reported birds strikes and founded remains of birds on runway during last years was next:

NUMBER OF REPORTED BIRD STRIKES AND REMAINS TABL. 2

	1986	1987	1988	Total	%
remains	9	7	9	25	22,3
reported	37	33	42	112	100,0

BIRD STRIKES ACCORDING TO SEASON TABL. 3

Month	Pentades						Pentade unknown	Total	%	Long-term %
	I	II	III	IV	V	VI				
January		1						1	0,3	2
February										3
March	1		1					2	0,6	5
April	1			2	5	4	12	24	7,4	9
May	4	3	4	6	9	2	9	37	11,4	10
June	4	2	5	5	7	7	16	46	14,2	11
July	9	15	19	7	8	12	19	89	27,4	13
August	10	7	11	6	9	2	10	55	16,6	14
September	3	4	5	2	2	4	10	30	11,1	12
October	2	3	3	2	6	2	5	23	7,1	10
November			4		2	3		9	2,8	4
December		1			2	1		4	1,2	3
Total	34	36	52	30	50	37	87	326	100	100

* Here and further data, concerned "Aeroflot" are taken from manual Rogachev A.I., Nebedev A.M. "Ornithological flight security." Moscow, "Transport", 1984. 126 p.

Time	Number of strikes	% from 327	Time	Number of strikes	% from 327
1.01-01.00	1	0,3	12.01-13.00	13	5,9
-02.00	2	0,7	-14.00	12	5,5
-03.00	3	1,4	-15.00	13	5,9
-04.00	0	0	-16.00	12	5,5
-05.00	3	1,4	-17.00	7	3,2
-06.00	2	0,9	-18.00	7	3,2
-07.00	2	0,9	-19.00	16	7,3
-08.00	12	5,5	-20.00	6	2,7
-09.00	23	10,5	-21.00	6	2,6
-10.00	21	9,6	-22.00	10	4,6
-11.00	13	5,9	-23.00	7	3,2
-12.00	13	5,9	-24.00	6	2,7

In the daytime 257 collisions occured, at night - 46, at dawn - 2, at dusk - 11.

DISTRIBUTION OF STRIKES BY AIRCRAFT TYPE TABLE 5

Aircraft type	Number of Strikes	% Based on 327	Aircraft type	Number of Strikes	% Based on 327
Tu-134	90	26,9	Yak - 8	4	1,2
An - 2	86	26,3	Yak - 12	2	0,6
Yak - 40	59	18,0	Super-aero 45	2	0,6
Tu - 16	47	14,4	An - 26	1	0,3
Tu - 104	31	9,5	An - 28	1	0,3
Tu - 24	5	1,5	Mi - 8	1	0,3

DISTRIBUTION OF STRIKES BY AIRCRAFT TYPE TABLE 6

Aircraft type	Number of strikes	% based on 327	Aircraft type	Number of strikes	% based on 327
Turbojet	178	54,4	Piston	141	43,1
Turboprop	7	2,1	Helicopters	1	0,3

In average strike rate per 10 000 movements during 1977-[illegible] and 1986-88 for aircraft Tu-134 was 16,6, for [illegible]-40 - 3,7, for An-2 - 9,9. In last case true index must be less than 9,9, because total number of strikes with this aircraft type was taken into consideration, while number of movements during aviational-chemical works (ACW) was not included.

THE BIRD SPECIES THAT COLLIDED WITH AIRCRAFTS IN DIFFERENT AIRPORTS TABLE 7

Bird Groups Names	Tallinn	Kuressaare	Pärdi	Tartu	Pärnu	Viljandi-chemical works
Pigeons and Doves	2	0	0	2	1	0
Gulls	124	31	12	3	1	10
Waterfowl (ducks, geese)	5	2	3	0	1	1
Small passeriformes (Starlings, Skylarks, Swallows)	26	2	2	1	1	17
Birds of prey	4	1	0	1	0	0
Corvidae (Crows, Rooks, Jackdows)	6	1	1	0	0	0
Swifts	6	0	0	0	0	0
Owls	2	0	0	0	0	0
Lapwing	7	2	2	1	2	0
Partridge	4	1	0	1	0	0
Black Grouse	0	0	0	0	0	0
Total	186	40	20	9	9	19

[illegible] 369 strikes are analysed, including 311 collisions on the territory of Estonia. 279 strikes or 7[illegible] % occurred in airports, [illegible] or 7,[illegible] % near airports, [illegible] or 12,[illegible] % outside of airports and [illegible] or [illegible] % occurred in unknown places.

STRIKE RATE IN DIFFERENT AIRPORTS TABLE 8

Airport	Number of movements					Number of strikes				
	77-82	86-88	1986	1987	1988	77-82	86-88	1986	1987	88
Tallinn	103570	60984	17242	17636	26106	32	65	25	19	21
Kuressaare	16532	8710	2994	2892	2824	9	5	2	-	3
Kärdla	9736	4972	[illegible]	1526	1576	5	11	1	1	9

Airport	Strike rate per 10 000 movements					
	66-69*	77-82	86-88	1986	1987	1988
Tallinn	4-6	3,4	10,7	14,5	10,8	8,1
Kuressaare	34-42	5,5	5,3	6,7	-	10,7
Kärdla	-	5,2	22,0	5,6	6,3	57,1

*Jacoby, V.E. Bird strikes in the USSR - Proc. World Conf. Bird Hazards to Aircraft, Kingston, Ontario, 2-5 Sept. 1969. National Research Council of Canada, Ottawa, pp. 101-109.

During study period the greatest index was in Kärdla airport in 1988 - 57,1 strikes per 10000 movements. As far as we know, this airport may be considered the most dangerous airport in respect of birds worldwide.

BIRD STRIKES ACCORDING TO ICAO CATEGORIES TABLE 9

ICAO Category	Number of Strikes	% from 369
A	79	21,4
B	279	75,6
C	11	3,0
D	-	-

BIRD S[…]

Bird Groups
Doves and P[…]
Gulls
Waterfowl (d[…]
Small passe[…] (Starlings, […]
Birds of pr[…]
Corvidae (Crows, Roo[…]
Swifts
Owls
Storks and […]
Others
Total

BIRD STRIKES ACCORDING TO SPECIES — TABLE 10

Bird Groups Names	Number of Strikes	% from 349	% APPROACH
Doves and Pigeons	10	3	25
Gulls	214	61	18
Waterfowl (ducks, geese)	20	6	14
Small passeriformes (Starlings, Skylarks, Swallows)	68	19	14
Birds of prey	9	3	11
Corvidae (Crows, Rooks, Jackdaws)	10	3	6
Swifts	5	1	3
Owls	2	1	3
Storks and Herons	1	0	2
Others	11	3	3
Total	349	100	100

Scientific Name	English Name	[illegible]	[illegible]	[illegible]	[illegible]
1	2	3	4	5	6
Anseriformes					
Anser Briss	Goose	[illegible]	[illegible]	1,[illegible]	[illegible]
Anser anser sive fabalis	Grey Lag or Bean Goose	[illegible]	1	1,[illegible]	1
Anser albifrons	White-fronted Goose	[illegible]	1	1,[illegible]	1
Anas L.	Duck	[illegible]	[illegible]	1,[illegible]	[illegible]
Anas platyrhynchos	Mallard	[illegible]	[illegible]	[illegible]	[illegible]
Anas crecca sive querquedula	Teal or Garganey	[illegible]	1	1,[illegible]	1
Somateria mollissima	Eider	[illegible]	1	1,[illegible]	1
Mergus merganser	Goosander	[illegible]	1	1,[illegible]	1
Apodiformes					
Apus apus	Swift	[illegible]	[illegible]	1,[illegible]	[illegible]
Apus apus sive hirundinidae	Swift or Swallow	[illegible]	[illegible]	1,[illegible]	
Charadriiformes					
Vanellus vanellus	Lapwing	B	1[illegible]	[illegible],1	1[illegible]
Laridae	Gull	B	9[illegible]	[illegible]	[illegible]
Larus melanocephalus	Mediterranean Black-headed Gull	B	1	1,[illegible]	1
Larus ridibundus	Black headed gull	B	74	[illegible]	[illegible]
Larus fuscus sive marinus	Lesser black-backed or Great bl.-backed Gull	B	[illegible]		
Larus argentatus	Herring gull	B	25	1,[illegible]	[illegible]
Larus marinus	Great black-backed gull	B	[illegible]	1,[illegible]	[illegible]

(continued)

1	2	3	4	5	6
Larus canus	Common gull	B	15	1,3	13
Larus canus sive argentatus	Common or Herring gull	B	2	-	-
Columbiformes					

(continued)

1	2	3	4	5	6
Larus canus	Common gull	B	15	1,2	12
Larus canus sive argentatus	Common or Herring gull	B	2	1	1
Columbiformes					
Columba L.	Pigeon	B	1		
Columba livia rustica	Racing pigeon	B	8	21,6	5
Streptopelia decaocto	Collared Turtle-Dove	B	1	1,0	1
Falconiformes					
Accipitridae		B	1	1,0	1
Milvus Lac.	Kite	B	1	1,0	1
Accipiter gentilis	Goshawk	B	1	1,0	1
Accipiter Nisus	Sparrow Hawk	B	1	1,0	1
Buteo lagopus	Rough-legged Buzzard	B	1	1,0	1
Buteo buteo		B	3	1,0	3
Falconiformes	Buzzard	B	1	1,0	1
Falco tinnunculus	Kestrel	B	1	1,0	1
Galliformes					
Lyrurus tetrix	Black grouse	B	2	1,0	2
Perdix perdix	Partridge	B	6	4,3	25
Passeriformes					
Passeriformes excludia					
Corvidae		B	1	1,0	1
Hirundo rustica	Swallow	B	1	2,0	1
Delichon urbica	House martin	B	1	1,0	1
Alauda arvensis	Skylark	B	7	1,3	9
Hirundo rustica sive	Swallow or				
Delichon urbica	House martin		20	1,0	10

(continued)

1		2	3	4	5
Motacilla alba	White Wagtail	1	1	1,0	1
Lanius excubitor	Great Grey Shrike	1	1	1,0	1
Sturnus vulgaris	Starling	1	1		
Corvidae sive Corvus sp.	Crow	1	1		
Pica pica	Magpie	2	1	1,0	1
Corvus monedula sive	Jackdaw or				
cor. cornix	Hooded Crow	8	1	1,0	1
Corvus frugeligus	Rook	1	1	1,0	1
Corvus corone cornix	Hooded crow	3	3	1,0	
Oenanthe oenanthe	Wheatear	1	1	1,0	1
Turdus L.	Thrush	1	1	1,0	1
Ploceidae	Passer	1	1		
Fringillidae		1	1		
Acanthis flammea	Mealy Redpoll	1	1	1,0	1
Emberiza citrinella	Yellow Hammer	1	1	1,0	1
Strigiformes					
Strigidae L.	Owl	6	1	1,0	1
Asio flammeus	Short-eared Owl	3	1	1,0	1
Strix aluco	Tawny Owl	3	1	1,0	1

Bird species was exactly identified in 203 collisions (60,5 %). Victims of strikes were identified to genus in 15 cases (4,5 %), to family - 97 (29,0 %), order - 20 (6,0 %). Determination of the bird species involved in difficult cases was done in the Estonian Nature Museum.

Age of birds was identified in 166 cases. In 110 collisions adult birds took part, and in 56 collisions - young birds or 33,7 % from total number. Part of strikes with young birds from total number for gulls in whole - 10,3 % (n=29), Herring Gulls - 50,0 % (n=18), Common Gulls - - 73,3 % (n=15), Great Black-backed Gulls - 50,0 % (n=2), Lapwings - 16,7 % (n=6).

FLIGHT STAGE DURING BIRD STRIKES

TABLE 12

Phase of flight	ECAC	% from 346	% AEROFLOT
Rolling	3	0,8	1

FLIGHT STAGE DURING BIRD STRIKES

TABLE 12

Phase of flight	ROAD	% from 346	% AEROFLOT
Rolling	3	0,8	1
Take-off run and landing roll	87	25,1	5
Take-off	101	29,2	13
Climbing	11	3,2	25
En route	40	11,6	5
Descent	4	1,2	39
Approach	100	28,9	12

AIRCRAFT SPEED DURING BIRD STRIKES

TABLE 13

	Speed of aircraft (km/h)						
	to 100	100-150	150-200	200-300	300-400	400-500	over 500
Number of strikes	19	80	116	127	14	2	3
% based on 358	5,3	22,4	[illegible]	35,5	3,9	0,6	0,8
in Estonian SSR	9,3		20,4			4,5	0,8
% in AEROFLOT	3		71			25	1

[illegible]

Altitude (m)	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Month un-known	Total number of strikes	% based on [illegible]
0-100	1	1		17	30	42	73	47	29	[illegible]	6	1	[illegible]	307	[illegible]
101-400			2	5	5	6	4	5	5	[illegible]	[illegible]		[illegible]	45	[illegible]
401-1000							1	2		1			1	5	1,4
1001-2000							1							1	[illegible]
2001-5000 and above									1	1				2	[illegible]

NUMBER OF BIRDS SEEN

TABLE 15

Number of birds seen	Number of strikes	% based on 114	Number of birds seen	Number of strikes	% based on 114
2-10	76	66,7	41-50	3	2,6
11-20	13	11,4	51-100	8	7,0
21-30	8	7,0	more 100	3	2,6
31-40	3	2,6	unknown	37	-

Number of birds struck
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3
4
5-10

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NUMBER OF BIRDS STRUCK

TABLE 16

Number of birds struck	Number of strikes	% based on 113	Number of birds struck	Number of strikes	% based on 113
1	30	26,5	11-20	2	1,8
2	34	30,1	21-30	3	2,7
3	15	13,3	31-40	1	0,9
4	12	10,6	more 40	2	1,8
5-10	14	12,4	unknown	98	-

Crew recorded bird strikes in 211 cases. This number includes 24 cases, when crew observed birds in the rays of landing lights at night. In 39 cases crew did not record bird strikes (15,6 % from total information with this parameter).

The distance of bird location by crew was 1-1750 m, in average 265 m (n=41). Analogous parameter at night was 50-250 m, in average 150 m(n=4).

In 128 cases crew felt the blow, in 59 did not feel (29,3 % from total number of known collision with this parameter. In 25 cases birds have been observed by crew, but crew simultaneously did not feel the blow (11,9 % from total number of collisions (n=211), when birds have been observed by crew). In 11 cases birds were not observed by crew simultaneously felt the blow (8,6 % from total number of cases with accidental confirmation of bird strikes).

BIRD STRIKES ACCORDING TO AIRCRAFT PART

TABLE 17

Aircraft part	Part struck Total	Part struck % based on 367	Part damaged Total	Part damaged % based on 117	Part with damage %
Radome	7	1,9	-	-	-
Windshield	24	6,5	3	2,6	12,5
Nose	25	6,8	4	3,4	16,0
Engine	65	17,7	24	20,5	36,9
Propeller	19	5,2	1	0,9	5,3
Wing/Rotor	106	28,9	48	41,0	45,3
Fuselage	29	7,9	4	3,4	13,8
Landing gear	27	7,4	4	3,4	14,8
Tail	1	0,3	1	0,9	100,0
Lights	16	4,4	13	11,1	81,3
Other part	48	13,1	15	12,8	31,3
Part unknown	121	-	-	-	-

Number of damaged aircraft parts	1	2	3	4	5
Number of strikes	165	33	15	6	2

Thus, during 1 bird strike (based on 221 strikes) birds damaged simultaneously 1,4 different elements of aircraft.

EFFECT ON FLIGHT

TABLE 18

Effect on flight	Number of strikes	% based on 394
None	325	82,5
Abort	69	17,5
Precautionary landing	2	0,5
Engine(s) shutdown	4	1,0
Forced landing	1	0,3
Vision obscured	25	6,3
Other effect	37	9,4

TABLE 19

SERIOUS BIRD STRIKES WITH REMOVAL OF JETS

Date	Aircraft type	Bird species	Flock or single bird	Airport or routine	Phase of flight	Speed (km/h)	Altitude (m)	Number of removal jets
...09.63	Tu-124	Starling	flock	Tallinn	Take-off	310	15	1
...68-69	Tu-124	Gull	flock	Tallinn	Take-off	?	?	1
11.09.71	Tu-124	Herring Gull	flock	Tallinn	Take-off	260	4	2
14.09.71	Tu-124	Herring Gull	flock	Tallinn	Take-off	320	200	2
15.09.71	Jak-40	Gull	?	Tallinn	Take-off	300	200	1
......71	Tu-124	Gull	flock	Tallinn	Take-off	?	?	2
10.05.74	Tu-124	?	?	Tallinn	Take-off	300	100	1
07.09.75	Tu-134	Gull	flock	Tallinn	Take-off	?	?	1
23.07.77	Jak-40	Gull	?	Kärdla - Tallinn	?	?	?	1
19.07.80	Jak-40	Gull	flock	Kärdla	Landing	170	1	1
04.08.80	Jak-40	Gull	flock	Kärdla	Landing	160	10	1
30.06.81	Tu-134	Gull	flock	Tallinn	Landing	?	[illegible]	1
03.12.81	Jak-40	Duck	flock	Kärdla	Landing	200	[illegible]	1
06.01.83	Jak-40	Mallard	flock	Kärdla	Landing	[illegible]	[illegible]	1
23.0[illegible].85	Tu-134	Herring Gull	?	Tallinn	Landing	[illegible]	100	1
12.07.[illegible]	Tu-134	?	?	[illegible]-Tallinn	?	?	?	1
30.09.83	Jak-40	Rough-legged Buzzard	•	[illegible]	Take-off	310	[illegible]	1

SERIOUS [illegible]

Date	Time	Aircraft type	Airport	Bird species	Phase of flight	Number of birds struck	Number of birds seen
1957-60	?	Il-14	Tallinn	Starling	Landing	70	70
spring 60	?	Il-14	Tallinn	Black-headed Gull	Take-off	30	30
nov winter 71	?	Tu-134	Tallinn	Black-headed Gull	Take-off	50	50
the beginning of 70's	?	Jak-40	Riga	Gull	Landing	20	20
...07.77	?	An-2	ACW point	Black-headed Gull	?	64	100
...06.79	02.00-03.00	Tu-134	Tallinn	Black-headed Gull	Landing roll	23	30
30.06.80	19.40	An-2	ACW point	Pigeon	ACW	100	100
30.04.85	04.48	Tu-134	Tallinn	Black-headed Gull	Landing	32	10
09.09.85	08.45	Tu-134	Tallinn	Black-headed Gull	Landing	27	70

CONCLUSIONS

1. During 1983-1990 in average 38,0 bird strikes occured every year with aircraft of ЭСКБ.

2. Total strike rate per 10000 movements in Estonia is very high: in 1986-88 in average 3,0.

3. The most dangerous month is July - 27,4 % from total strikes number.

4. The most dangerous hour is during 08-09.00 - 10,5 % from total strikes number. In the day time 257 collisions occured, at night - 46.

5. Among aircraft, which are exploited by ЭСКБ, the most dangerous for birds based on strike rate per 10000 movements is Tu-134, the least - Yak-40. Absolutely, more often strikes occured with Tu-134 (26,9 % of total number) too. 33,1 % collisions were recorded with turbojet aircraft.

6. 279 strikes of 75,2 % from total number occured in airports. The most dangerous airport absolutely is Tallinn, but based on strike rate per 10000 movements during 1983-1990 - Kärdla.

7. The most dangerous for aviation in all airports group of birds - gulls (61 % from total number). More often collisions occured with birds of [illegible] - 75% %.

8. The most of all strikes were recorded during take-off - 29,2 %.

9. 35,5 % from all strikes were recorded with [illegible] aircraft within the limits of 200-260 km/h.

10. 65,3 % from all strikes were recorded in [illegible] less than 100 m.

11. More often (66,7 % from all cases) flocks (round) of 2-10 birds before strike.

12. The most of all 2 birds (30,1 % from all cases) struck aircraft. Simultaneously, in average 1,11 elements of aircraft got the blow.

13. More often birds struck in wings of aircraft - 37,[illegible] from all cases. 45,3 % from all blows in wings were with damage.

14. Effect on flight were existed in 17,3 % cases.

REFERENCES

Thorpe, J. Analysis of bird strikes reported European airlines 1976-1980. BSCU/17 WP3.

References on papers of soviet ornithologists can find in the full soviet bibliography about aviation and radar ornithology 1982-1990, which is available, as other working paper at this BSCU meeting.