

**COMMUNICATION TOWERS:
A DEADLY HAZARD TO BIRDS**

**REPORT DOCUMENTS A REPORT COMPILED BY
AMERICAN BIRD CONSERVANCY
JUNE, 2000
KILLING OF 230 BIRD SPECIES**

**Gavin G. Shire
Karen Brown
Gerald Winegrad**

COMMUNICATION TOWERS: A DEADLY HAZARD TO BIRDS

**A REPORT COMPILED BY AMERICAN BIRD CONSERVANCY
DOCUMENTING THE KILLING OF 230 BIRD SPECIES**

Table of Contents

Executive Summary	3
Introduction	4
Results	5-6
Table of Species	7-13
Efforts Towards Resolution	14
Graphs	15-17
Distribution Map	18
Conclusions	19
References	20-23

American Bird Conservancy extends special thanks to Sky Calypso and Appalachian Trail Conference for their financial support in the production of this report. ABC would also like to acknowledge the following for their assistance: Karen Brown, Hawk Mountain Sanctuary, The US Fish and Wildlife Service, Paul Kerlinger, Michael Avery and Bill Evans.

American Bird Conservancy is dedicated to the conservation of birds and their habitats throughout the Americas.

American Bird Conservancy
1250 24th St. NW, Suite 400. Washington, D.C. 20037
Tel (202) 778-9666 Fax (202) 778-9778
www.abcbirds.org

EXECUTIVE SUMMARY

There are over 77,000 communications towers in the US, which provide nationwide coverage for cellular telephone, television and radio, paging, messaging, wireless data and other industries. Nearly 50,000 of these towers are required by the Federal Communications Commission to be lit, either because they are over 199 ft. tall, are in the immediate vicinity of an airport, or are situated along major highway travel routes. About 5,000 new towers are currently being built each year but this rate is expected to increase with developing cellular telephone and digital television networks. Bird kills caused by towers, their guy wires and related structures have been documented for over 50 years but there has been insufficient investigation of the extent of tower kills and which species have been affected. The US Fish and Wildlife Service (USFWS) estimates that four to five million birds are killed annually at such towers, although this could be as many as 40 million. However only a cumulative impacts study will answer that question. This report analyzes 149 documents describing tower kills, 47 of which provide data on both the numbers and species of birds killed at selected towers. No such analysis has been done before. While USFWS indicates that nearly 350 species of neotropical songbirds are vulnerable to collisions with tall structures, this report reveals that 230 species of birds have been documented as being killed at towers, over one quarter of all avian species found in the US. Most birds killed are neotropical migratory songbirds which migrate at night when their navigation systems seem to be confused by the tower lights, particularly in bad weather. This report further documents that 52 of these 230 species killed at towers are on either the USFWS's most recent Nongame Birds of Management Concern (a.k.a. Species of Management Concern) List (SMC) or the Partners in Flight (PIF) Watch List. This means that 52 species that are in decline and need special management attention are killed at towers. One of these species, Tennessee Warbler, is the third most commonly killed bird at towers. One species, Red-cockaded Woodpecker, is listed as Endangered. Swainson's Warbler, Cerulean Warbler, Bachman's Sparrow and Henslow's Sparrow, all listed as Extremely High Priority on the PIF Watch List, were documented being killed in large numbers at towers (see p. 5 for an explanation of the USFWS SMC List and PIF Watch List). A total of approximately 545,250 birds were documented as killed at the tower sites during the periods of study, however, these numbers are just the smallest tip of a much larger iceberg, as most studies were sporadically conducted and many studies lasted for only a few days of one year. This document clearly demonstrates that towers kill many migratory birds, and over one fifth of these species are in need of conservation because of dwindling numbers and limited habitat. Mortality at communication towers is another threat to healthy populations of songbirds. This report illustrates the need for further research to determine the exact cause of bird deaths at towers, and how lighting systems and other aspects of tower construction and operation may be modified to avoid such mortality.

ABC is a central participant in the Communication Tower Working Group (CTWG), which is chaired by USFWS and consists of representatives from government agencies, telecommunication, broadcasting and tower industries, scientists and conservation agencies. The CTWG is attempting, through research, to ascertain mitigation measures that can be applied to towers to avoid such large-scale avian mortality.

INTRODUCTION

There has been unprecedented growth in the communications industry in recent years, causing a dramatic increase in the number of communications towers in the US. The Federal Communications Commission (FCC), the federal agency responsible for registering towers, currently has 77,519 towers on its database, of which 58,339 are lit. The telecommunications act of 1996 (designed to provide the public with universal access to wireless communications technology) and recent developments in digital television technology have resulted in approximately 5,000 new towers being erected each year, a rate expected to further increase in the next decade. When towers are registered, the FCC considers lighting and marking recommendations from the Federal Aviation Administration (FAA), and mandates that for the purposes of aviation safety, all towers over 199 ft above ground level, in the immediate vicinity (within a 3.8 mile radius) of an airport, or situated along major automobile travel routes must be lit. Local zoning restrictions must also be complied with but there is no formal consideration of the Migratory Bird Treaty Act (MBTA) of 1918, one of the oldest conservation statutes in existence, which states that no migratory bird may be killed unless it is specifically exempted under a permit. The MBTA is a strict liability statute, making the 'take' of migratory birds without a permit illegal, even if unintentional, incidental or inadvertent. The Endangered Species Act (ESA) gives further, wide-reaching protection to birds on the Endangered Species List. The USFWS conservatively estimates that between four and five million birds are killed each year at communications towers, though the true figure could be greater by an order of magnitude (Manville 2000).

The earliest published study of bird kills at a communication tower dates back to 1949 (Aronoff) with hundreds of thousands of documented bird kills in the 51 years since. These studies conform to no overall protocol and have been conducted in a haphazard and sporadic manner. There has been a notable geographical bias in where these studies were carried out, with no studies found west of the Rocky Mountains and only 14 west of the Mississippi. No studies were found in 29 of the 50 US states. Study sites were not randomly selected and no control or parallel studies were mentioned. In fact, the majority of studies were instigated because bird kills were observed *a priori*, at lit towers situated in rural or open areas, along migratory flyways. Some such studies were simple reports on the number or species of birds found on one morning, others were systematically conducted over a single migration season, multiple seasons, or in some cases, decades. The longest running continuous study was begun in 1955 at the Tall Timbers Research Station in Leon County, Florida (Crawford, 1981). Another study, begun in 1957 but not running continuously, has collected 121,560 birds of 123 species over 39 years. (Kemper 1996). The level of detail covered in these studies varies widely. Some reported the tower height above ground (AGL) and above sea level (MSL), lighting system, supporting structures, and other relevant details such as weather, while others reported only some of these details or none at all. Some studies reported a total number of bird kills with no further analysis, while others gave details of numbers of each species recovered. This report concentrates on the 47 studies with information on species and numbers, meaning the totals reported are only a very small representative fraction of the total number of birds killed at towers around the US each year. Despite the uncoordinated and unfocussed nature of the studies, what they are able to provide is invaluable information on the types of birds most likely to be killed at towers, identifying species of particular conservation concern.

Initial research of tower kill publications was undertaken by Karen Brown, in conjunction with Hawk Mountain Sanctuary, using library and internet searches. Papers with species and numbers lists were separated out for detailed analysis and cross-referenced with USFWS Endangered Species and Migratory Nongame Birds of Management Concern Lists and the Partners in Flight Watch List.

Results

Of the 149 documents examined with information on bird mortality at communication towers, 121 provided some detail on the numbers of birds and 88 provided some detail regarding the species killed. Only forty-seven included complete lists of both numbers and species. Reporting of tower structure varied significantly between studies. Some gave details of height, lighting, guy-wires and related information but many gave none of these. Many of the studies that did report height above ground (AGL) did not give height above sea level (MSL). The top of a 300 ft. tower situated on a 3,000 ft ridge would be substantially higher than a 1,000 ft. tower at sea level but we have no way of determining this in most cases. All of the 47 papers which gave height, reported lit towers over 199 ft AGL - the average reported height being 1,124 ft AGL. It is therefore not possible to make correlations between lit and unlit towers or short and tall towers. Weather factors can play a significant role in bird collisions at towers but only occasionally were these reported in the studies.

It is evident from compiling the studies that there is a clear geographical bias of the tower kill studies to date. Of the 47 studies included in this report only 14 are west of the Mississippi and none is west of the Rockies. Of the 50 US states, 29 do not show tower studies which list species and numbers (see map p. 16).

The studies providing information on numbers killed document a total of **545,250 birds killed** at the sites during the periods of study.

The 47 studies which provide a more detailed analysis describe **184,797 birds of 230 different species killed**, approximately one quarter of the number of species in the US. Of these 230 species, 51 (22.1%, or over one in five) are on either the USFWS Migratory, Nongame Birds of Management Concern List or the Partners in Flight Watch List. In addition, one species found at a tower, the Red-cockaded Woodpecker, is listed as Endangered .

The USFWS is required, by law, to produce a Migratory, Nongame Birds of Management Concern List (a.k.a. Species of Management Concern - SMC), updated every 5 years by the Office of Migratory Bird Management. This is intended to document bird species with “1. Documented or apparent population declines; 2. Small or restricted populations; and 3. Dependence on restricted or vulnerable habitats.” These species of management concern are considered birds that, without additional conservation action, are likely to become candidates for listing under the Endangered Species Act. This listing is an early warning system that these species need special management to ensure their continued population viability. The most recent list was completed in 1995 (Trapp 1995) and contains 124 species, forty-two (or one third) of which have been recorded as killed in tower collisions.

Partners in Flight (PIF) is a cooperative effort by conservation organizations, federal and state agencies, private corporations and academicians, designed to protect the long-term well-being of birds in the Western Hemisphere. Its rigorously peer-reviewed Watch List documents the top 100 species in the highest tiers of conservation concern, behind those already listed under the Endangered Species Act. It takes into account relative abundance, range size, population trends and habitat threats to index birds in three priority ratings; 1. Extremely High, 2. Moderately High and 3. Moderate. Of the 100 species on the list, 29 have been documented as killed by tower collisions (29%). Fourteen of these are ‘Extremely High Priority’, 9 are ‘Moderately High Priority’ and 6 are ‘Moderate Priority’.

Of particular concern to conservationists and all others involved with avian species is this report's finding that 52 species of birds that are of management concern and that need special focus to prevent their further decline have been killed at communications towers.

Most birds killed are neotropical, migratory songbirds which migrate between North America and Central/South America. Many of these species face grave threats to their populations from habitat loss and modification, introduced species such as cats, poisons such as pesticides, and building strikes. Mortality at communication towers is another threat to healthy populations of these songbirds.

Documented kills include 10 of the 33 species listed as 'Extremely High Priority' on the PIF Watch List and also on the USFWS Species of Management Concern List. These include Black Rail, Bell's Vireo, Golden-winged Warbler, Swainson's Warbler, Henslow's Sparrow, Bachman's Sparrow and McCown's Longspur. Four species, Smith's Longspur, Harris' Sparrow, Nelson's Sharp-tailed Sparrow and Franklin's Gull, are listed on the PIF 'Extremely High' Category but not on the USFWS list.

Also killed at towers and represented on both lists are Yellow Rail, Wood Thrush, Black-throated Blue Warbler, Bobolink, Prairie Warbler, Worm-eating Warbler, Painted Bunting, Seaside Sparrow, Red-headed Woodpecker and Dickcissel. There are 22 other species killed at towers that are on the USFWS list but not the PIF list, including Alder Flycatcher, Sedge Wren, Least and American Bitterns, Blackpoll Warbler, Blue-winged Warbler, Field Sparrow and Tennessee Warbler - the third most commonly killed bird at towers (17,689 recorded) behind Ovenbird and Red-eyed Vireo. Obviously, the numbers reported are just the tip of an iceberg, since most carcasses are scavenged very quickly and the vast majority of the nearly 50,000 lit towers are not checked for bird mortality, even during spring and fall migration.

Of the 230 species killed, forty-one (17.8%) were warblers (including Ovenbird, Redstart and waterthrushes), twenty-three (10%) were sparrows, and twenty-two (9.5%) were waterfowl (including ducks, grebes and gallinules).

Ninety-two percent of birds killed at towers in the studies were migratory. The majority of these (57% of the total) are known to migrate predominantly or frequently at night (as classified by the *Birds of North America* - Poole *et al*, eds. 1992 -). These include warblers, sparrows (the two largest groups by species), thrushes, flycatchers and vireos. However, studies rarely mentioned at what time of day birds were collected.

For birds listed on USFWS SMC and PIF Watch lists, data were researched to show how these kills were distributed throughout the 47 studies. This reveals whether birds are killed in high numbers at a few towers, or in more moderate numbers per tower but at many more towers. These data show that, even where total kills numbered in the thousands, for all but three species (Tennessee Warbler, Blackpoll Warbler and Prairie Warbler) kills averaged less than 85 individuals of any one species at a single tower. This is evidence that bird mortality at communication towers is not specific to a few, select towers but is rather distributed widely for lit towers over 200 ft.

List of Species Killed at Towers Documented by 47 Studies.
Listed by Number Killed, in Descending Order

Key :

USFWS SMC = US Fish & Wildlife Service Migratory Nongame Birds of Management Concern List (Species of Management Concern).

PIF = Partners in Flight Watch List.

Highlighted Species are on either of the above lists or The Endangered Species List.

Y = species is on the USFWS SMC List.

1,2 & 3 are PIF Watch List Designations. 1 = Extremely high. 2 = High. 3 = Moderate.

For example Cerulean Warbler is on USFWS SMC List and PIF Watch List as Extremely High Priority. 164 individuals were recorded at 5 towers.

Number of towers where bird species were found was only calculated for species of management concern.

SPECIES	USFWS SMC	PIF	# KILLED	# OF TOWERS FOUND AT
Ovenbird			22619	
Red-eyed Vireo			19707	
Tennessee Warbler	Y		17689	32
Common Yellowthroat			10397	
Bay-breasted Warbler			10396	
American Redstart			8392	
Blackpoll Warbler	Y		6304	32
Black-and-white Warbler			6099	
Philadelphea Vireo			4317	
Swainson's Thrush			3943	
Palm Warbler			3441	
Gray Catbird			3238	
Northern Waterthrush			3148	
Northern Parula			2662	
Magnolia Warbler			2630	
Connecticut Warbler			2624	
Blackburnian Warbler			2538	
Ruby-crowned Kinglet			2336	
Yellow-rumped Warbler			2287	
White-eyed Vireo			2222	
Cape May Warbler			2199	
Black-throated Blue Warbler	Y	2	2061	25
Indigo Bunting			1892	
Unidentified birds			1833	

SPECIES	USFWS SMC	PIF	# KILLED	# OF TOWERS FOUND AT
Gray-cheeked Thrush	Y		1793	30
Rose-breasted Grosbeak			1580	
Veery	Y		1511	23
Chestnut-sided Warbler	Y		1426	32
Savannah Sparrow			1335	
Black-throated Green Warbler			1330	
Hooded Warbler			1245	
Solitary Vireo			1220	
Bobolink	Y	3	1201	30
Nashville Warbler			1098	
Golden-crowned Kinglet			1071	
Prairie Warbler	Y	2	1018	6
Orange-crowned Warbler			959	
Marsh Wren			888	
Swamp Sparrow			850	
Mourning Warbler			814	
House Wren			804	
Yellow-throated Vireo			801	
White-throated Sparrow			797	
Chipping Sparrow			733	
Canada Warbler			689	
Wood Thrush	Y	2	684	25
Sora Rail			657	
Scarlet Tanager			615	
Grasshopper Sparrow	Y		582	27
Yellow-billed Cuckoo	Y		568	17
Kentucky Warbler			568	
Trail's Flycatcher			545	
Golden-winged Warbler	Y	1	542	15
Prothonotary Warbler		2	476	7
Wilson's Warbler			466	
Lincoln's Sparrow			463	
Song Sparrow			422	
Yellow Warbler			419	
Red-winged Blackbird			410	

SPECIES	USFWS SMC	PIF	# KILLED	# OF TOWERS FOUND AT
Brown Thrasher			376	
Northern Oriole			362	
Yellow-throated Warbler			339	
Swainson's Warbler	Y	1	336	9
Red-breasted Nuthatch			335	
Summer Tanager			323	
Hermit Thrush			302	
Least Flycatcher			280	
Pine Warbler			278	
Worm-eating Warbler	Y	2	255	7
Yellow-bellied Flycatcher			251	
Brown-headed Cowbird			243	
Yellow-bellied Sapsucker			228	
Brown Creeper			228	
Rufous-sided Towhee			204	
Vesper Sparrow			191	
Eastern Wood-Pewee			183	
Dickcissel	Y	2	171	16
Mourning Dove			165	
Cerulean Warbler	Y	1	164	5
Dark-eyed Junco			149	
Field Sparrow	Y		147	9
Varied Thrush			146	
Warbling Vireo			144	
Virginia Rail			144	
Yellow-breasted Chat			143	
Clay-colored Sparrow		3	135	10
Acadian Flycatcher			134	
Great Crested Flycatcher			128	
Pied-billed Grebe			123	
Sedge Wren	Y		107	3
Black-billed Cuckoo			104	
Louisiana Waterthrush	Y		103	9
Cedar Waxwing			102	
Eastern Meadowlark	Y		97	5

SPECIES	USFWS SMC	PIF	# KILLED	# OF TOWERS FOUND AT
Fox Sparrow			91	
American Tree Sparrow			90	
Blue Grosbeak			86	
Blue-winged Warbler	Y		83	4
Northern Flicker	Y		79	14
Orchard Oriole			79	
Bachman's Sparrow	Y	1	74	2
Purple Finch			70	
Yellow Rail	Y	2	67	15
Winter Wren			62	
Ring-necked Duck			61	
Northern Cardinal			54	
American Tree Sparrow			54	
Sharp-tailed Sparrow sp.		1	51	6
Green-backed Heron			50	
Henslow's Sparrow	Y	1	49	4
Common Snipe			49	
White-crowned Sparrow			41	
Northern Mockingbird			38	
Eastern Kingbird			37	
Willow Flycatcher			36	
Le Conte's Sparrow			36	
Chimney Swift			33	
Common Gallinule			33	
European Starling			33	
Red-headed Woodpecker	Y	3	33	6
American Bittern	Y		32	4
Common Nighthawk			29	
Blue-Winged Teal			28	
Alder Flycatcher	Y		25	4
Eastern Phoebe			23	
American Coot			23	
Least Bittern	Y		22	4
Unidentified flycatchers			19	

SPECIES	USFWS SMC	PIF	# KILLED	# OF TOWERS FOUND AT
Pine Siskin			18	
Cattle Egret			17	
Turkey Vulture			16	
Goldfinch sp.			15	
Purple Gallinule			14	
House Sparrow			14	
Tree Swallow			14	
Downy Woodpecker			13	
Rusty Blackbird			12	
Seaside Sparrow	Y	2	12	2
Lesser Scaup			12	
Slate-colored Junco			12	
Lapland Longspur			9	
Spotted Sandpiper			9	
Black Rail	Y	1	8	1
Green-winged Teal			8	
Ground Dove	Y		8	2
Harris' Sparrow		1	8	2
Wood Duck			8	
American Woodcock		3	8	4
Clapper Rail			7	
Belted Kingfisher			7	
Snow Bunting			7	
Whip-poor-will			7	
Chuck-will's Widow		3	6	2
Painted Bunting	Y	2	6	3
Yellow-crowned Night-Heron			6	
Blue Jay			6	
American Robin			6	
King Rail			5	
Purple Martin			5	
Hooded Merganser			5	
Eastern Bluebird			5	
Barn Swallow			4	

SPECIES	USFWS SMC	PIF	# KILLED	# OF TOWERS FOUND AT
Bell's Vireo	Y	1	4	2
Black Vulture			4	
Blue-headed Vireo			4	
Common Grackle			4	
Herring Gull			4	
Little Blue Heron			4	
Olive-sided Flycatcher	Y		4	1
Myrtle Warbler			4	
Solitary Sandpiper			4	
Bewick's Wren	Y		3	1
Carolina Wren			3	
Double-crested Cormorant			3	
Red-bellied Woodpecker			3	
Hairy Woodpecker			3	
Spotted Towhee			3	
American Pipit			3	
American Goldfinch			3	
Common Redpoll			3	
American Wigeon			2	
Evening Grosbeak			2	
Gadwall			2	
Loggerhead Shrike	Y		2	1
Tricolored Heron			2	
Mallard			2	
Northern Bobwhite			2	
Northern Shoveler			2	
Red Phalarope			2	
Red-breasted Merganser			2	
Red-cockaded Woodpecker			2	1
Redhead			2	
Ruddy Duck			2	
Waterthrush sp.			2	
Upland Sandpiper			2	
Western Meadowlark			2	
Sapsucker sp.			1	

SPECIES	USFWS SMC	PIF	# KILLED	# OF TOWERS FOUND AT
American Black Duck		3	1	1
American Crow			1	
Baird's Sparrow	Y	1	1	1
Bank Swallow			1	
Black-capped Petrel	Y	1	1	1
Blue-gray Gnatcatcher			1	
Eared Grebe			1	
Franklin's Gull		1	1	1
Gray Partridge			1	
Great Horned Owl			1	
Horned Grebe			1	
Lark Sparrow	Y		1	1
Least Sandpiper			1	
MacGillivray's Warbler			1	
Northern Harrier			1	
McCown's Longspur	Y	1	1	1
Northern Pintail			1	
Oriole sp.			1	
Red-bellied Woodpecker			1	
Rock Dove			1	
Smith's Longspur		1	1	1
Snowy Egret			1	
Sooty Tern			1	
Unidentified warbler			1	
Western Tanager			1	
White Ibis			1	
White-breasted Nuthatch			1	
Willet			1	
Yellow-headed Blackbird			1	
Semipalmated Sandpiper			1	
Cliff Swallow			1	
"Brewster's" Warbler			1	
Pectoral Sandpiper			1	
Common Tern	Y		1	1
Killdeer			1	

Efforts to Resolve the Killing of Birds at Towers

While most of the research into bird kills at towers has involved conducting body counts and bird speciation, research into mitigation measures has been scant, but progress is being made in the effort to determine causes of bird collisions with communication towers and to uncover solutions to the problem. There are promising - but as yet systematically untested - ideas which involve changes in lighting protocol, the use of infra-sound, bird diverters, visual markers and other devices. On June 29, 1999, 42 stakeholders representing most of the diversity of interests surrounding the issue, met at the environmental dispute resolution group, RESOLVE, to begin a discussion regarding research needs. The Communication Tower Working Group (CTWG) - specifically tasked to develop and implement a research protocol, and chaired by the USFWS - was formed. The CTWG is composed of representatives of USFWS and other Federal and State government agencies, the telecommunications and broadcast industries, tower companies, research scientists and conservation organizations such as ABC. The CTWG met on November 2, 1999 with industry participation and with a representative of the White House Office of Science and Technology Policy present. The group agreed to the appointment of a Research Committee to develop a research protocol and another committee to recommend funding resources.

On August 11, 1999 the first public workshop on Avian Mortality at Communication Towers was held at Cornell University in conjunction with the 117th meeting of the American Ornithologists' Union. At that meeting, essentially all stakeholders from the various agency, industry research, and NGO perspectives were represented on the 17-speaker and 23-member panel discussion (the complete transcript of that meeting is available on the USFWS web site: <http://migratorybirds.fws.gov/issues/towers/agenda.html>). This workshop was co-sponsored by the USFWS, ABC, and the Ornithological Council. Meanwhile, media interest in the bird-kill issue has been very strong, with articles in Sports Afield, The Boston Globe, Associated Press, Knight Ridder, Reuters, USA Today, Radio World, The Milwaukee Journal, The Wall Street Journal and The Chicago Sun Times, plus segments on National Public Radio's "Morning Edition", CNN, and other media.

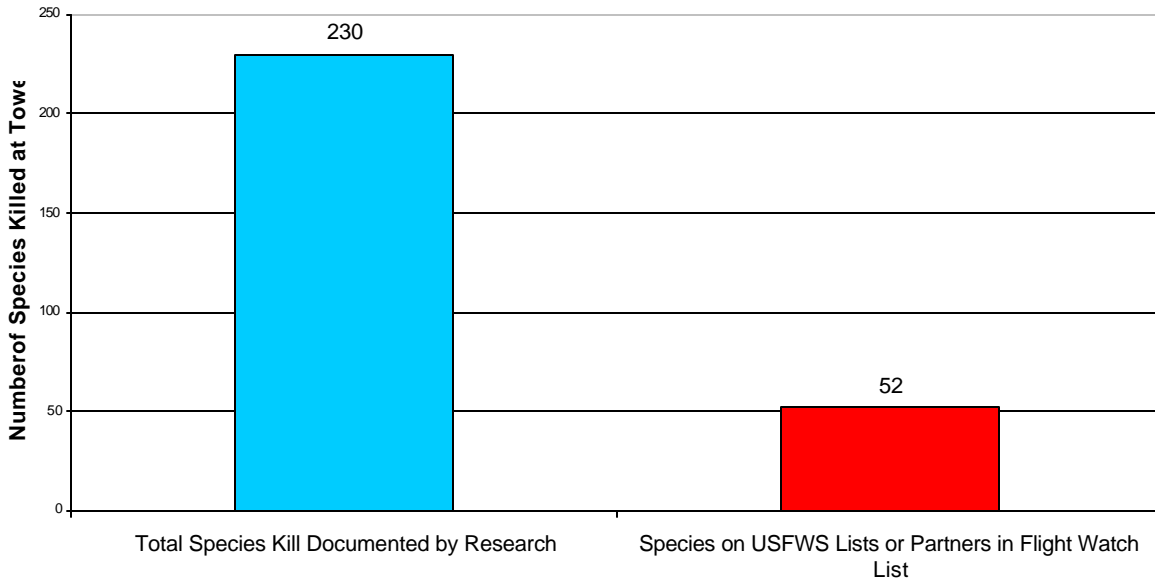
A meeting of the Research Committee was held on April 17, 2000 and hosted by ABC, at which leading scientists on this issue worked to develop a research protocol and appointed sub-committees to further develop these research strategies. Tower industry companies and some environmental groups funded the meeting and are funding the subsequent meeting of the full CTWG. Tom Muir of the White House Office of Science and Technology Policy moderated the meeting that produced a plan for ascertaining why birds are killed at towers and what mitigation measures can be employed. Once the research protocol is approved by the full CTWG, a funding committee will seek the monies to complete the research with the goal of ascertaining what mitigation measures can be employed to end or greatly reduce avian mortality at towers.

ABC continues to meet with federal and industry officials to seek solutions. ABC and Hawk Mountain Sanctuary have joined in filing a petition with the FCC to prevent the construction of a 265 ft., lighted cell tower on the Kittatinny Ridge, near Hawk Mountain. The Federal Communications Commission (FCC) has been requested to require an Environmental Assessment for potential bird mortality at this tower, situated on a major, migratory bird route. No action has been taken by FCC since the petition was filed in September 1999, thus the Hawk Mountain tower application remains blocked. Jamie Clark, the Director of the USFWS, sent a letter to the chairman of the FCC in November 1999, outlining the need for a programmatic Environmental Impact Statement (EIS) on the cumulative impact of towers nationwide, noting the large number of migratory birds killed at towers and requesting a meeting with the Chairman of FCC to discuss the tower mortality situation. While Chairman Kennard's response to Director Clark indicated his agencies lack of support for a programmatic EIS, he did indicate that the FCC would continue to address the impacts of towers on migratory birds on a case-by-case basis. Individuals and conservation groups continue to appeal the location of communication towers in key migratory bird corridors and have been urging research to ascertain measures to prevent avian mortality.

It is hoped that the final research protocol agreed upon by the CTWG will be fully implemented and effective measures will be introduced to end the killing of birds at communication towers. ABC and its partners will be working with the CTWG to ensure that solutions are found and that the protocol is implemented.

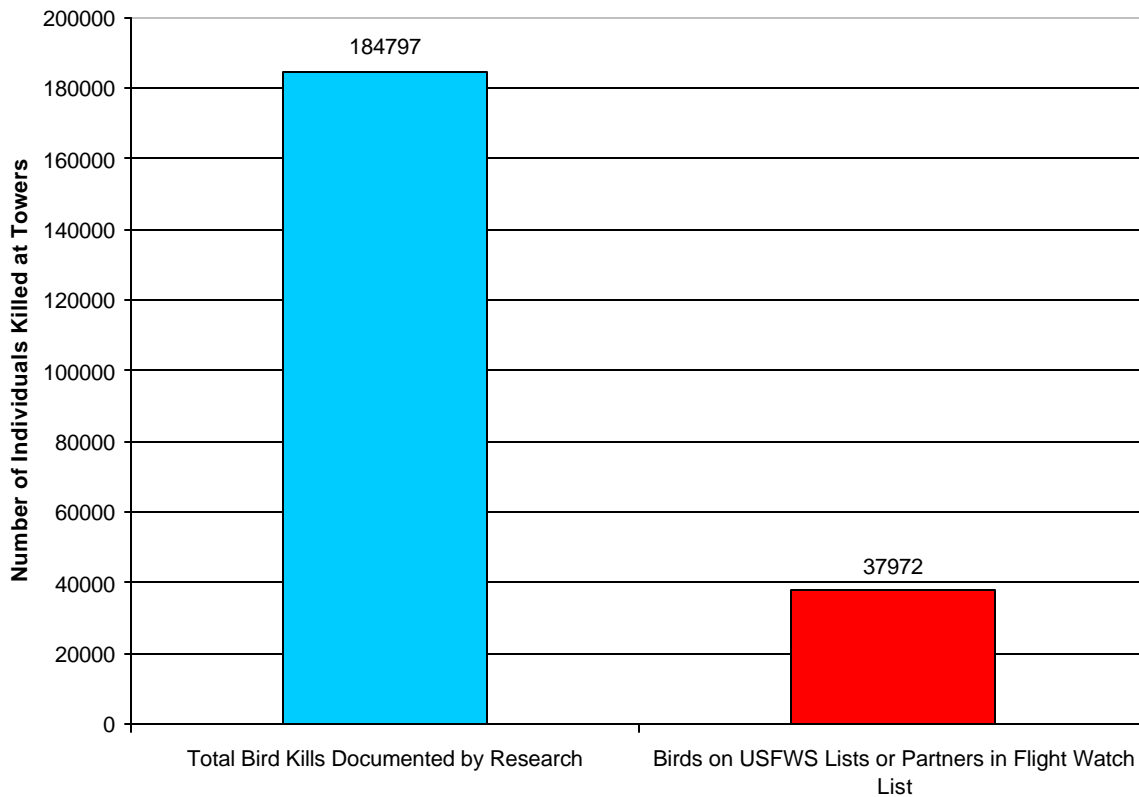
Graph 1

Comparison of Total Number of Birds Species Killed at Towers in 47 Studies With Species on USFWS and Partners in Flight Lists

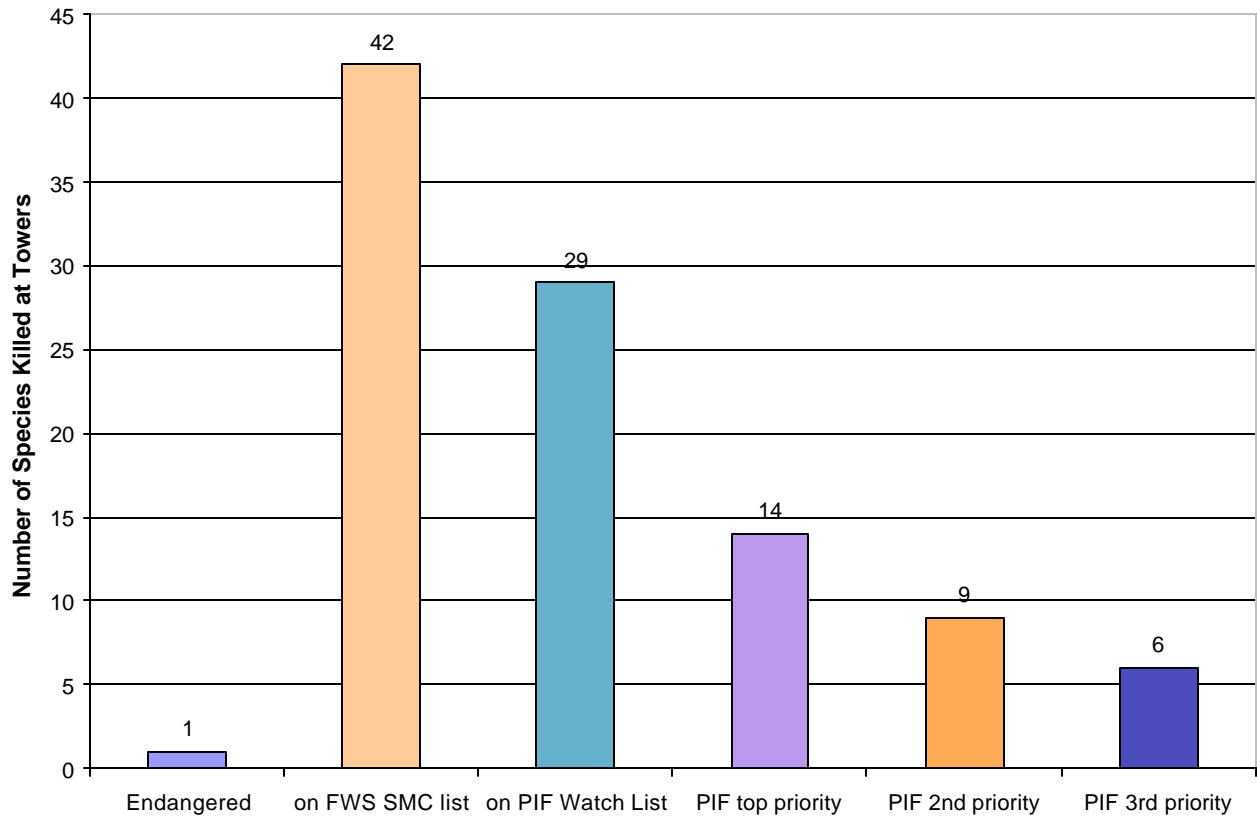


Graph 2

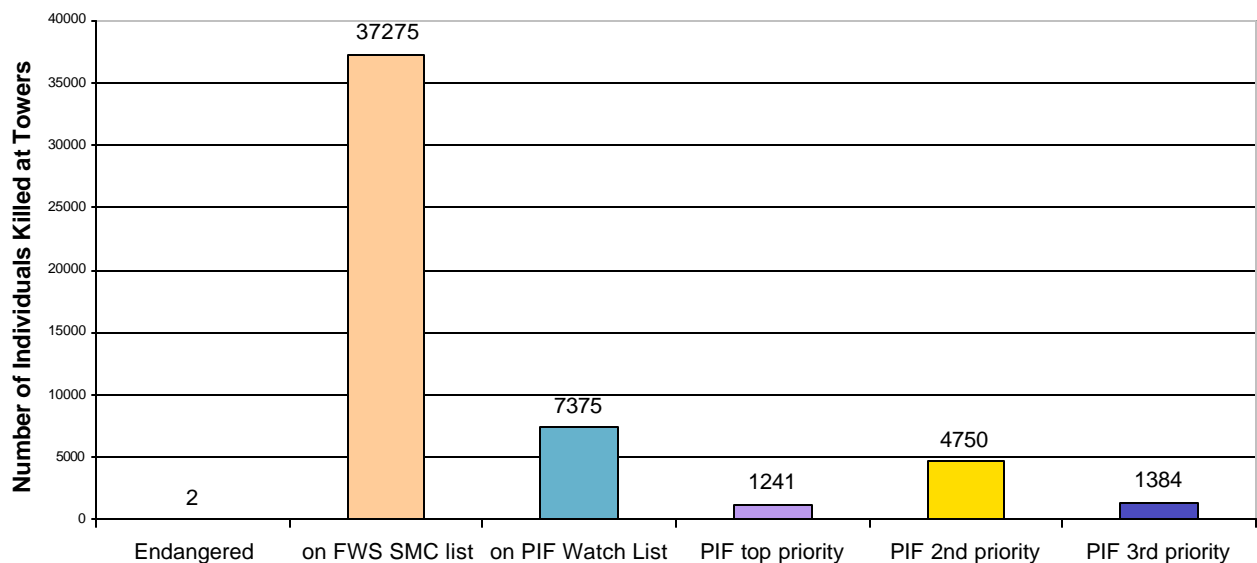
Comparison of Total Number of Birds Killed at Towers in 47 Studies With Total Number of Individuals on USFWS and PIF Lists



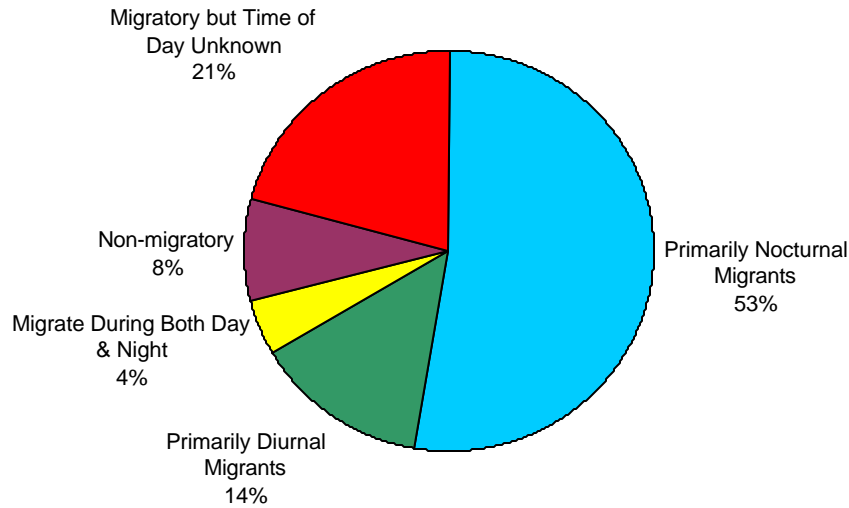
Graph 3
Numbers of Species on USFWS SMC List and PIF Watch List
(Priorities 1, 2 & 3) Killed at Towers in 47 Studies



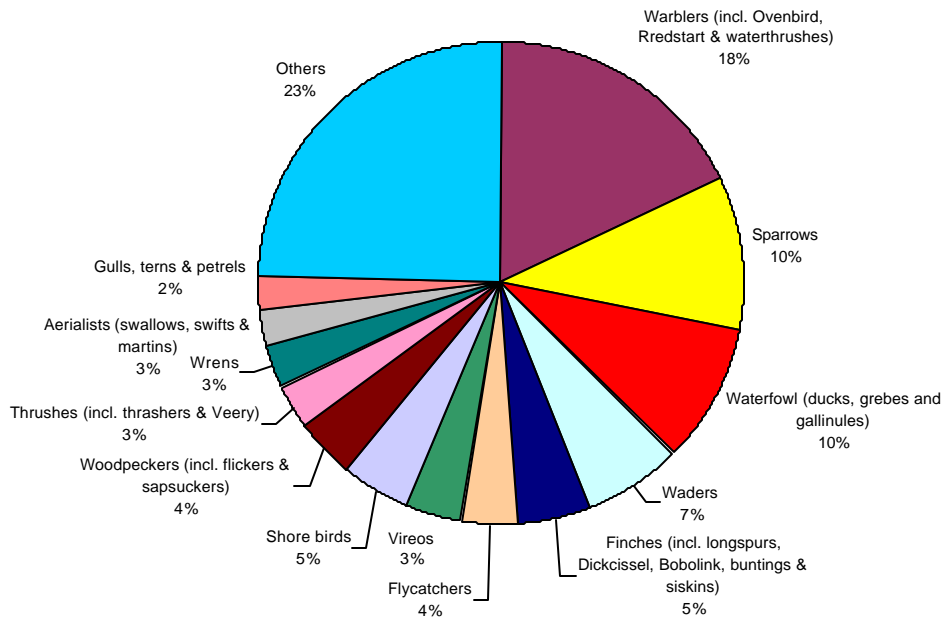
Graph 4
Numbers of Birds on USFWS SMC List and PIF Watch List
(Priorities 1, 2 & 3) Killed at Towers in 47 Studies



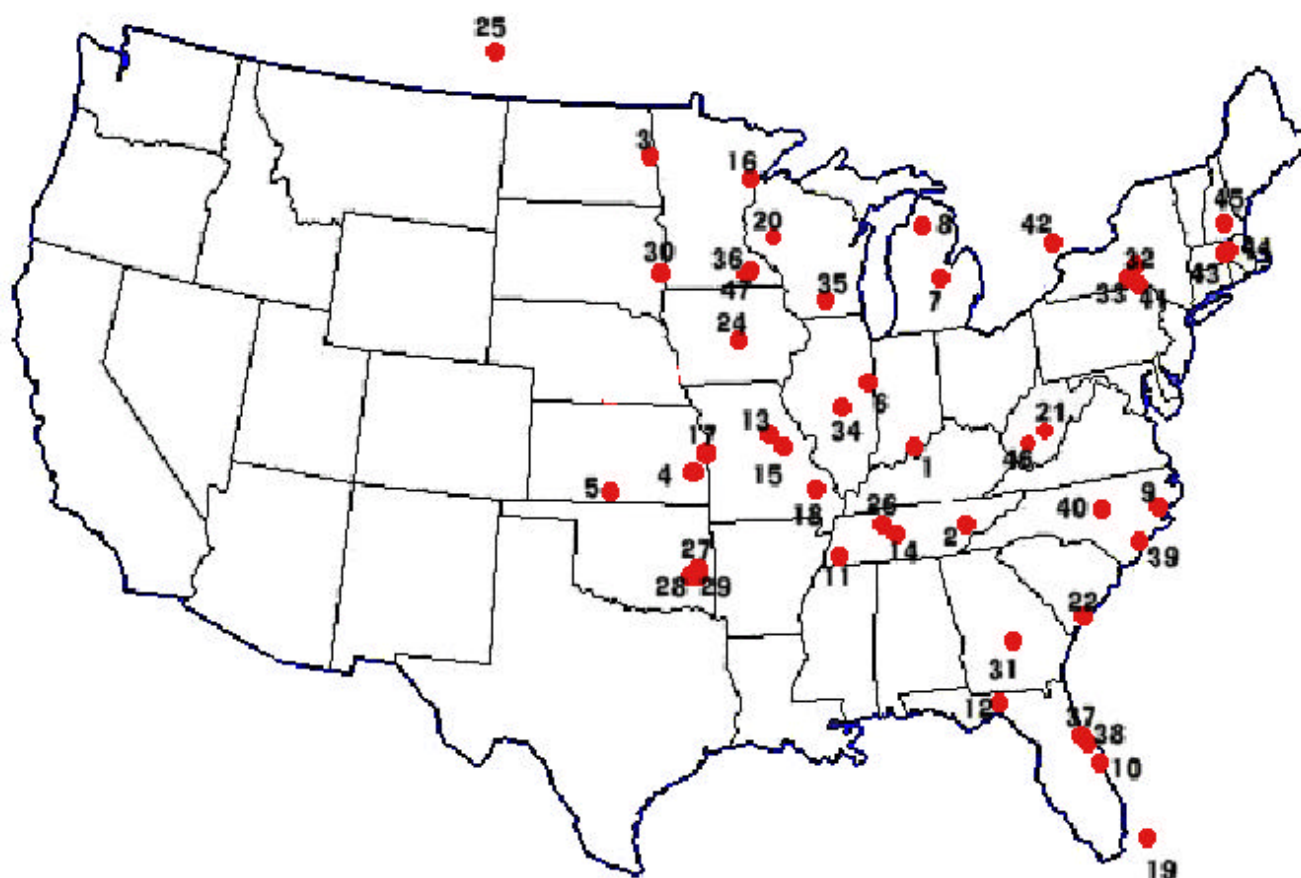
Graph 5
The Proportion of Migratory vs. Non-migratory Birds and
Nocturnal vs. Diurnal Migrants Killed at Towers in 47 Studies



Graph 6
Types of Birds Most Commonly Killed at Communication Towers
in 47 Studies (shown as percentage of the overall total)



Distribution Map of 47 Tower Studies Containing Species and Number Data, Throughout the United States and Canada



- | | |
|--|---|
| 1. Able K.P. 1966, New Albany, IN | 25. Nero R.W. 1961, Saskatchewan, Canada |
| 2. Alsop F.J. & G. O. Wallace 1969, Knoxville, TN | 26. Newman R.J. 1961, Nashville, TN |
| 3. Avery M. 1972, Eastern, ND | 27. Norman J.L. 1975, Coweta, OK |
| 4. Ball Lisa G. et al 1995, Topeka, KS | 28. Norman J.L. 1976, Coweta, OK |
| 5. Boso B. 1965, KS | 29. Norman J.L. 1977, Coweta OK |
| 6. Brewer R. & J.A. Ellis 1958, Champaign, IL | 30. Pierce M.E. 1969, Flandreau, SD |
| 7. Caldwell L.D. & G.W. Wallace 1966, MI | 31. Johnston D.W. & T. P. Haines 1957, Macon, GA |
| 8. Caldwell L.D. & N.L. Cuthbert 1963, Cadiallac, MI | 32. Rosche R.C. 1971, Elmira, NY |
| 9. Carter J.H. & J.F. Parnell 1976, Eastern, NC | 33. Rosche R.C. 1972, Elmira, NY |
| 10. Case L.D. et al 1965, Melbourne, FL | 34. Seets J.W. 1977, Central, IL |
| 11. Coffey B. B. 1964, Memphis, TN | 35. Sharp B. 1971, Madison, WS |
| 12. Crawford R.L. 1978 Talahassee, FL | 36. Strnad F. 1962, Ostrander, MN |
| 13. Elder W.H. & J. Hansen 1967, Columbia, MO | 37. Taylor W.K. 1973, Orlando, FL |
| 14. Ganier A.F. 1962, Nashville, TN | 38. Taylor W.K. 1974, Orlando, FL |
| 15. George W. 1963, Columbia, MO | 39. Teullings R.P. 1972, Bladen County, NC |
| 16. Green J.C. 1963, Duluth, MN | 40. Trott J. 1957, Chapel Hill, NC |
| 17. Gregory H. 1975, Kansas City & Lawrence, KS | 41. Welles M. 1978, Elmira, NY |
| 18. Heye P.L. 1963, Cape Girardeau, MO | 42. Devitt O. 1984 Simcoe County, Ontario, Canada |
| 19. Kale H.W. et al 1969, Grand Bahamas | 43. Baird J. 1970, Boylston, MA |
| 20. Kemper C.A. 1995, Eau Claire WI | 44. Baird J. 1971, Boylston, MA |
| 21. Ellis C.D. 1997, Putnam Co. WV | 45. Sawyer J. 1961, Deerfield, NH |
| 22. Kleen V.M. 1973, Springfield & Charleston, SC | 46. Heron J. 1997, Lewis Co WV |
| 23. Lupient M. 1961, Chippewa Falls, WS | 47. Strnad F. 1975. Ostrander, MN |
| 24. Mosman D. 1975, Alleman, IA | |

Conclusions

It is apparent from analysis of the data that significant numbers of birds are dying in collisions with communications towers, their guy wires and related structures. Occurrences have been recorded of many thousands of bird deaths in a single night at one tower. In 1998 between 5,000-10,000 Lapland Longspurs died at and in the vicinity of three communication towers (the tallest of these was a 420 ft. television tower) and a fourth, non-tower structure in western Kansas. Weather factors, particularly fog or low cloud, may play a significant role in these incidents. Over one-quarter of the bird species in the US have been documented killed at towers, and 22% of those are rare enough to be listed by Partners in Flight or the USFWS as being of conservation concern. The data show that small, nocturnally migrating songbirds such as warblers and sparrows are the most vulnerable to the tower hazard, but more research is needed to ascertain why this is so. Of the larger bird species, waterfowl are most likely to be killed in tower collisions.

The most significant problem with the data is the uncoordinated manner in which it was collected. The majority of studies began when someone noticed, by chance (either because they lived nearby or were conducting a different kind of study at a tower site), that birds were dying by striking a particular tower or group of towers. Studies were then initiated at those towers which, while being undertaken scientifically, did not conform to any overall protocol for the study of the issue of tower kills as a whole. Some studies were simply records of a one-time bird kill, others lasted over a migration season, some continued for decades. Because the towers came to be studied as a result of the discovery of bird kills, it is not possible to make comparisons with towers which kill very few birds and draw conclusions as to why this is i.e. differences in height, presence/absence or method of lighting, surrounding topography and other factors. Until recently, it has not been possible to discern which part of the tower in particular - if any - a bird is most likely to hit (guy wires, lights, main structure or even the surrounding ground), but with technological advances, more specific details might be provided.

Little research has been conducted to discover a simple way of preventing birds from striking towers that can be retro-fitted to existing structures, whether this be audible (noisemakers, predator calls) or visual (streamers, sleeves, balls, paint, extra lights, changing the duration of the strobes and the flash rate). Further coordinated study is needed, conforming to a scientifically rigorous protocol, to determine the exact cause of bird deaths at towers and how this may be reduced. Paralleling USFWS draft, voluntary, interim guidelines on tower erection, ABC recommends the following measures to minimize the avian hazard at communications towers:

- Reduce numbers of new towers needed to be built by attempting to use existing structures such as buildings and co-locating multiple antennae on a single structure.
- If new towers must be built, construct them to be below 199 ft. tall to avoid the requirement for aviation safety lighting. Construct unguyed towers with platforms that will accommodate possible future co-locations and build them at existing 'antenna farms', away from areas of high migratory bird traffic, wetlands and other known bird areas.
- Where towers over 199 ft. are absolutely necessary, use the minimum amount and intensity of lighting allowed under FCC regulations.
- Minimize the tower 'footprint' on newly constructed towers.
- Dismantle inactive towers as soon as possible.
- Use visual daytime markers in areas of high diurnal raptor or waterfowl movements.
- Security lighting for on-ground facilities should be minimized, point downwards or be down-shielded.
- Allow access to tower sites for monitoring purposes.
- Existing evidence may suggest that the use of white strobes results in less circling behavior by nocturnal migrants and thus fewer mortalities than red pulsating lights. However, the reasons for these differences are unclear and the data require further, rigorous scientific verification.

REFERENCES

SCIENTIFIC PUBLICATIONS

- Aronoff, A. 1949. The September migration tragedy. *Linnaean News-Letter* 3(1): 2
- Able, K.P. 1973. The Changing Seasons. *American Birds*. 27:1. pp 19-23
- Anonymous. 1961. Large bird kills at TV Towers. *Bluebird*. 28:1. pp 9
- Avery, M. and T. Clement. 1972. Bird Mortality at 4 Towers in Eastern North Dakota: Fall 1972. *Prairie Naturalist*. 4:3/4 pp 87-95
- Avery, M., P.F. Springer and J.F. Cassel. 1977. Weather Influences on nocturnal bird mortality at a North Dakota tower. *Wilson Bulletin*. 89:2 pp 291-299
- Bagg, A.M. 1969. The Changing Seasons. *Audubon Field Notes*. 23:1 pp 4-12
- Bagg, A.M. 1971. The Changing Seasons. *American Birds*. 25:1 pp 16-23
- Baird, J. 1962. The Changing Seasons: a summary of Fall migration. *Audubon Field Notes*. 16:1 pp 4-6
- Baird, J. 1964. The Changing Seasons. *Audubon Field Notes*. 16:1 pp 4-6
- Baird, J. 1970. Mortality of Fall Migrants at Boylston television tower in 1970. *The Chickadee* : 40 pp 17-21
- Baird J. 1971. Mortality of Birds at the Boylston Television Tower in September of 1971. *The Chickadee* pp 20-25
- Balcomb, Richard. 1986. Songbird Carcasses disappear rapidly from agricultural fields. *Auk*. 103:4 pp 817-820
- Ball, Lisa G., K. Zyskowski and G. Escalona-Segura. 1995. Recent Bird Mortality at a Topeka Television Tower. *Kansas Ornithological Society*. 46:4 pp 33-36
- Ball, R.E. 1973. Bird Mortalities at towers in Marysville, MS: fall 1972. *Transactions of the Missouri Acad Sci*. 7:8pp 294
- Boso, B. 1965. Bird Casualties at a Southern Kansas TV tower. *Transactions of the Kansas Academy of Science*. 68:1 pp 131-136
- Breckenridge, W.J. 1959. Spring migration: western Great Lakes region. *Audubon Field Notes*. 13:4 pp 371-373
- Brewer, R and J.A. Ellis. 1958. An Analysis of migrating birds killed at a television tower in east central Illinois. *Auk*. 75:4 pp 400-414
- Browne, M.M. and W. Post. 1972. Black rails hit a television tower at Raleigh, North Carolina. *Wilson Bulletin*. 84:4 pp 491-492
- Caldwell, L.D. and N.L. Cuthbert. 1963. Bird Mortality at Television Towers near Cadillac, Michigan. *The Jack-Pine Warbler*. 41:2 pp 80-89
- Caldwell, L.D. and G.J. Wallace. 1966. Collections of migrating birds at Michigan television towers. *Jack Pine Warbler*. 44:3 pp 117-123
- Carter, J.H. III and J.F. Parnell. 1976. TV tower kills in eastern North Carolina. *Chat*. 40:1 pp 1-9
- Case, L.D., H. Cruickshank, A.E. Ellis & W.F. White. 1965. Weather causes heavy bird mortality. *Florida Naturalist*. 38:1 pp 29-30
- Chamberlain, B.R. 1955. Fall Migration: southern Atlantic Coast region. *Audubon Field Notes*. 9:1 pp 17-18
- Chamberlain, B.R. 1957. Fall Migration: southern Atlantic Coast region. *Audubon Field Notes*. 11:1 pp 15-18
- Chamberlain, B.R. 1958. Fall Migration: southern Atlantic Coast region. *Audubon Field Notes*. 12:1 pp 19-21
- Chamberlain, B.R. 1961. Fall Migration: southern Atlantic Coast region. *Audubon Field Notes*. 15:1 pp 23-26
- Cochran, W.W. and R.R. Graber. 1958. Attraction of Nocturnal migrants by lights on a television tower. *Wilson Bulletin*. 70:4 pp 378-380
- Coffey, B.B., Jr. 1964. Two bird kills at WMC-TV, Memphis. *Migrant*. 35:2 pp 53
- Crawford, R.L. 1971. Predation on birds killed at TV tower. *Oriole*. 36:4 pp 33-35
- Crawford, R.L. 1974. Bird Casualties at a Leon County, Florida TV Tower. *Bulletin. Tall Timbers Res. Stn*. 18 pp 1-27
- Crawford, R.L. 1976. Some old records of TV tower kills from southwest Georgia. *Oriole*. 41:4 pp 45-51
- Crawford, R.L. 1978. Autumn bird Casualties at a northern Florida TV Tower: 1973-1975. *Wilson Bulletin*. 90:3 pp 335-345
- Crawford, R.L. 1981. Bird Casualties at a Leon County, Florida TV Tower: A 25 year migration study. *Bulletin of Tall Timbers Research Station*. 22 pp 1-30
- Cunningham, R.L. 1964. Fall Migration: Florida region. *Audubon Field Notes*. 18:1 pp 24-28
- Cunningham, R.L. 1964. Spring Migration: Florida Region. *Audubon Field Notes*. 18:4 pp 442-446
- Cunningham, R.L. 1965. Fall Migration: Florida Region. *Audubon Field Notes*. 19:1 pp 28-33
- Devitt, O. 1984. Birds of Simcoe County, Ontario. Bereton Field Naturalists' Club,
- Dunbar, R.J. 1954. Bird Mortality - Oak Ridge. *Migrant*. 25:4 pp 63-64
- Eaton, S.W. 1967. Recent tower kills in upstate New York. *Kingbird*. 17:3 pp 142-147
- Edscorn, J.B. 1974. The fall migration: Florida Region. *American Birds*. 28:1 pp 40-44
- Edscorn, J.B. 1975. The fall migration: Florida Region. *American Birds*. 29:1 pp 44-48
- Elder, W.H. and J. Hansen. 1967. Bird Mortality at KOMU-TV tower, Columbia, Missouri, fall 1965 & 1966. *Bluebird*. 34:1 pp 3-7
- Ellis, C.D. 1997. Back to the Tower: Tower Killed Birds at Putnam County, West Virginia. *Redstart*. 64 pp 112-113
- Feehan, J. 1963. Destruction of Birdlife in MN—Birds Killed at the Ostrander TV Tower. *Flicker*. 35 pp 111-112
- Ganier, A.F. 1962. Bird Casualties at a Nashville TV tower. *Migrant*. 33:4 pp 58-60
- George, W. 1963. Columbia tower fatalities. *Bluebird*. 30:4 pp 5
- Gollop, M.A. 1965. Bird Migration collision casualties at Saskatoon. *Blue Jay*. 23:1 pp 15-17
- Goodpasture, K.A. 1974. Fall 1972 television tower casualties in Nashville. *Migrant*. 45:2 pp 29-31
- Goodpasture, K.A. 1974. Fall 1973 television tower casualties in Nashville. *Migrant*. 45:3 pp 57-59
- Goodpasture, K.A. 1975. Nashville tower casualties, 1974. *Migrant*. 46:3 pp 49-51
- Goodpasture, K.A. 1976. Nashville television tower casualties, 1975. *Migrant*. 47:1 pp 8-10

- Goodpasture, K.A. 1978. Television tower casualties, 1976. *Migrant*. 49:3 pp 53-54
- Goodwin, C.E. 1975. The winter season: Ontario region. *American Birds*. 29:1 pp 48-57
- Goodwin, C.E. and R.C. Rosche. 1971. The fall migration: Ontario. *American Birds*. 25:1 pp 49-54
- Green, J.C. 1963. Destruction of Bird Life in Minnesota - Sept 1963. *Flicker*. 35:4 pp 112-113
- Green, J.C. 1964. Fall migration: western Great Lakes region. *Audubon Field Notes*. 18:1 pp 33-34
- Gregory, H. 1975. Unusual fall tower kill. *Bluebird*. 42:4 pp 9-10
- Hall, G.A. 1975. The Fall Migration: Appalachian Region. *American Birds*. 29:1 pp 57-61
- Hall, G.A. 1976. The Fall Migration: Appalachian Region. *American Birds*. 30:1 pp 67-71
- Hall, G.A. 1977. The Fall Migration: Appalachian Region. *American Birds*. 31:2 pp 176-179
- Hatch, D.R.M. 1966. Fall Migration: northern Great Plains Region. *Audubon Field Notes*. 20:1 pp 61-64
- Herdon, L.R. 1973. Bird kill on Holston Mountain. *Migrant*. 44:1 pp 1-4
- Heron, J. 1997. TV Transmission Tower Kills in Lewis County, West Virginia. *Redstart* 64 pp 114-117
- Heye, P.L. 1963. Tower fatalities. *Bluebird*. 30:1 pp 7
- Hoskin, J. 1975. Casualties at the CKVR-TV tower, Barrie. *Nature Canada*. 4:2 pp 39-40
- James, D. H. and H. Shugart. 1967. Fall Migration: central southern region. *Audubon Field Notes*. 21:1 pp 45-47
- Janssen, R.B. 1963. Destruction of bird life in Minnesota- Sept 1963. Birds killed at the Lewisville television tower. *Flicker*. 35:4 pp 110-111
- Janssen, R.B. 1963. Destruction of bird life in Minnesota- Sept 1963. Birds killed at the Lewisville television tower. *Flicker*. 35:4 pp 113-114
- Johnston, D.W. 1957. Bird Mortality in Georgia, 1957. *Oriole*. 22:4 pp 33-39
- Johnston, D.W. and T.P. Haines. 1957. Analysis of mass mortality in October, 1954. *Auk*. 74:4 pp 447-458
- Kale, H.W., II, M.H. Hundley and J.A. Tucker. 1969. Tower-killed specimens & observations of migrant birds from Grand Bahama Isl. *Wilson Bln*. 81:3 pp 258-263
- Kemper, C.A. 1958. Destruction at the TV tower. *Passenger Pigeon*. 20:1 pp 3-9
- Kemper, C.A. 1959. More TV tower destruction. *Passenger Pigeon*. 21:4 pp 135-142
- Kemper, C.A. 1996. A Study of Bird Mortality at a Central Wisconsin TV Tower from 1957-1995. *Passenger Pigeon* 58 pp 219- 235
- Kemper, C.A. 1964. A Tower for TV: 30,000 dead birds. *Audubon Magazine*. 66:1 pp 86-90
- Kibbe, D.P. 1975. The Fall Migration: western New York and northwestern Pennsylvania. *American Birds*. 29:1 pp 53-57
- Kibbe, D.P. 1976. The Spring Migration: Niagara-Champlain region. *American Birds*. 30:1 pp 64-66
- Kleen, V.M. and L. Bush. 1973. The Fall Migration: middle western prairie region. *American Birds*. 27:1 pp 66-70
- Knauth, O. 1972. Hundreds of Birds die after hitting TV tower. *Des Moines Sunday Register*. 24 sept pp 3
- Laskey, A.R. 1957. Television tower casualties: Nashville. *Migrant*. 28:4 pp 54-57
- Laskey, A.R. 1960. Bird Migration casualties and weather conditions, autumns 1958-1959-1960. *Migrant*. 31:4 pp 61-65
- Laskey, A.R. 1962. Migration data from television tower casualties at Nashville. *Migrant*. 33:1 pp 7-8
- Laskey, A.R. 1963. Casualties at WSIX TV tower in autumn, 1962. *Migrant*. 34:1 pp 15
- Laskey, A.R. 1963. Mortality of night migrants at Nashville TV towers, 1963. *Migrant*. 34:4 pp 65-66
- Laskey, A.R. 1964. Data from the Nashville TV Tower casualties. *Migrant*. 35:4 pp 95-96
- Laskey, A.R. 1967. Spring mortality of Black poll warblers at Nashville TV tower. *Migrant*. 38:2 pp 43
- Laskey, A.R. 1968. Television tower mortality at Nashville, autumn 1967. *Migrant*. 29:2 pp 25-26
- Laskey, A.R. 1969. TV tower casualties at Nashville in autumn 1968. *Migrant*. 40:2 pp 25-27
- Laskey, A.R. 1969. Autumn 1969: TV tower casualties at Nashville. *Migrant*. 40:4 pp 79-80
- Laskey, A.R. 1971. TV tower casualties at Nashville: spring and autumn, 1970. *Migrant*. 42:1 pp 15-16
- Lavendel, Brian. 1999. Special Report: Menace in the Sky. *Animals*. 132:4 pp 12
- Lister, R. 1965. Fall Migration: Northern Great Plains Region. *Audubon Field Notes*. 19:1 pp 48-53
- Lupient, M. 1961. Fall Migration: western Great Lakes region. *Audubon Field Notes*. 15:1 pp 42-44
- Lupient, M. 1962. Fall Migration: western Great Lakes Region.. *Audubon Field Notes*. 16:1 pp 34-35
- Manual, D.D. 1963. TV Transmitter kills in South Bend, Indiana, fall 1962. *Indiana Audubon Quarterly*. 41:3 pp 49-53
- Manville, A.M. II. The ABC's of avoiding bird collisions at communication towers: the next steps. Proceedings of the Avian Interactions Workshop, Dec 2, 1999. *Charleston, SC Electric Power Res. Inst.* 14 pp. *In Press*.
- Mosman, D. 1975. Bird Casualties at Alleman, Iowa TV tower. *Iowa Bird Life*. 45:3 pp 88-90
- Nero, R.W. 1961. Regina TV tower bird mortalities - 1961. *Blue Jay*. 19:4 pp 160-164
- Newman, R.J. 1957. The Changing Seasons. *Audubon Field Notes*. 11:1 pp 4-6
- Newman, R.J. 1958. The Changing Seasons. *Audubon Field Notes*. 12:1 pp 4-9
- Seasons. *American Birds*. 29:1 pp 23-28
- Newman, R.J. 1961. Fall migration: central southern region. *Audubon Field Notes*. 15:1 pp 46-51
- Newman, R.J. and G.H. Lowery, Jr. 1959. The Changing Seasons. *Audubon Field Notes*. 13:4 pp 346-352
- Niles, D.M., S.A. Rohwar, J.A. Jackson and J.D. Robbins. 1969. An observation of midwinter nocturnal movement and tower mortality of tree sparrows. *Bird Banding*. 40:4 pp 322-323
- Norman, J.L. 1975. Birds Killed at a TV tower near Coweta, Oklahoma. *Bulletin of the Oklahoma Ornithological Society*. 8:3 pp 25-27

- Norman, J.L. 1976. Birds Killed at a TV tower near Coweta, OK. *Bulletin of the Oklahoma Ornithological Society*. 9:3 pp 20
- Norman, J.L. 1977. Birds Killed at a TV tower near Coweta, Oklahoma in the fall of 1976. *Bulletin of the Oklahoma Ornithological Society*. 10:1 pp 6-8
- Norwood, J.R. 1960. TV tower casualties at a Charlotte station. *Chat*. 24:4 pp 103-104
- Ogden, J. 1960. Observations at a TV tower during a bird fall. *Migrant*. 31:4 pp 65-67
- Parmalee, P.W. and B.G. Parmalee. 1959. Mortality of Birds at a television tower in central Illinois. *Bulletin of the Illinois Audubon Society*. 11:1 pp 1-4
- Parmalee, P.W. and M.D. Thompson. 1963. A Second Kill of Birds at a television tower in central Illinois. *Bulletin of the Illinois Audubon Society*. 12:8 pp 13-15
- Peterson, P.C., Jr. 1959. TV tower mortality in western Illinois. *Bulletin of the Illinois Audubon Society*. 11:2 pp 14-15
- Peterson, P.C., Jr. 1967. Fall migration: middle western prairie region. *Audubon Field Notes*. 21:1 pp 44-45
- Peterson, P.C., Jr. 1971. Fall migration: middle western prairie region. *American Birds*. 25:1 pp 64-66
- Peterson, P.C., Jr. 1968. Fall migration: middle western prairie region. *Audubon Field Notes*. 22:1 pp 44-45
- Pierce, M.E. 1969. Tall Television tower and bird migration. *South Dakota Bird Notes*. 21:1 pp 4-5
- Poole, A., F. Gills & P. Stettenheim. Eds. 1992-. Birds of North America. American Ornithologists Union., *Acad Nat Sci PA*
- Potter, J.K. and J.J. Murray. 1949. Fall Migration: middle Atlantic coast region. *Audubon Field Notes*. 3:1 pp 8-10
- Pulich, W.M. 1962. A Record of the Yellow Rail from Dallas County, Texas. *The Auk* 78: 639-640
- Purrington, R.D. 1969. Fall Migration: central southern region. *Audubon Field Notes*. 23:1 pp 65-70
- Robbins, S.D. 1967. Fall Migration: western great lakes region. *Audubon Field Notes*. 21:1 pp 36-38
- Robbins, S.D. 1969. Fall Migration: western Great Lakes Region. *Audubon Field Notes*. 23:1 pp 55-56, 64
- Robertson, W.B., Jr. and J.C. Ogden. 1969. Fall Migration: Florida region. *Audubon Field Notes*. 23:1 pp 35-40
- Rosche, R.C. 1970. The fall Migration: western New York and northwestern Pennsylvania. *Audubon Field Notes*. 24:1 pp 43-47
- Rosche, R.C. 1971. The fall Migration: western New York and northwestern Pennsylvania. *American Birds*. 25:1 pp 54-57
- Rosche, R.C. 1972. The fall Migration: western New York and northwestern Pennsylvania. *American Birds*. 26:1 pp 60-62
- Sawyer, P.J. 1961. Bird Mortality at the WENH-TV Tower in Deerfield, New Hampshire. *New Hampshire Audubon Quarterly*. 14:2 pp 46-49
- Scott, F.R. and D.A. Culter. 1971. The Fall Migration: middle Atlantic Coast region. *American Birds*. 25:1 pp 36-40
- Seets, J.W. and H.D. Bohlen. 1977. Comparative Mortality of birds at television towers in central Illinois. *Wilson Bulletin*. 89:3 pp 422-433
- Sharp, B. 1971. Heavy Mortality of migrating birds at Madison's TV towers. *Passenger Pigeon*. 33:4 pp 203-204
- Stevenson, H.M. 1956. Fall Migration: Florida region. *Audubon Field Notes*. 10:1 pp 18-22
- Stevenson, H.M. 1958. Fall Migration: Florida region. *Audubon Field Notes*. 12:1 pp 21-26
- Stevenson, H.M. 1958. Spring Migration: Florida region. *Audubon Field Notes*. 12:4 pp 344-348
- Stevenson, H.M. 1959. Fall Migration: Florida region. *Audubon Field Notes*. 13:1 pp 21-25
- Stevenson, H.M. 1960. Spring Migration: Florida region. *Audubon Field Notes*. 14:4 pp 379-383
- Stevenson, H.M. 1966. Fall Migration: Florida Region. *Audubon Field Notes*. 20:1 pp 30-35
- Stevenson, H.M. 1973. The Fall Migration: Florida Region. *Audubon Field Notes*. 27:1 pp 45-49
- Stoddard, H.L. 1962. Bird Casualties at a Leon County Florida TV Tower, 1955-1961. *Tall Timbers Res Stn Bull*. 1
- Stoddard, H.L. & R.A. Norris 1967. Bird Casualties at a Leon County Florida TV Tower, an 11 Year Study. *Tall Timbers Research Station Bulletin*.
- Strnad, F. 1962. Birds Killed at the KROC-TV tower, Ostrander, Minnesota. *Flicker*. 34:1 pp 7-9
- Strnad, F. 1975. More Birds at KROC-TV Tower, Ostrander Minnesota. *Loon*. 47 pp 16-21
- Taylor, W.K. and B.H. Anderson. 1973. Nocturnal Migrants killed at a south central Florida TV tower, autumn 1969-1971. *Wilson Bulletin* 85:1 pp 42-51
- Taylor, W.K. and B.H. Anderson. 1974. Nocturnal Migrants killed at a south central Florida TV tower, autumn 1972. *Florida Field Naturalist*. 2:2 pp 40-43
- Tennessee Ornithological Society. 1973. Bird Kill on Holston Mountain. *Migrant*. 44:1 pp 1-4
- Teulings, R.P. 1972. The fall migration: southern Atlantic Coast Region. *American Birds*. 26:1 pp 45-50
- Teulings, R.P. 1974. The Fall Migration: southern Atlantic Coast Region. *American Birds*. 28:1 pp 37-40
- Teulings, R.P. 1975. The fall Migration: Southern Atlantic coast region. *American Birds*. 29:1 pp 40-43
- Tordoff, H.B. & R.M. Mengel 1956. Studies of Birds Killed in Nocturnal Migration. *Univ. Kansas Publ. Mus. Nat. Hist* 10 pp 1-44
- Trapp, J. L. 1995. Migratory Nongame Birds of Management Concern in the United States: The 1995 List. Office of Migratory Bird Management, USFWS, Washington, DC. U.S. Govt. Printing Office 1996:404-991/44014. 22 pp
- Trott, J. 1957. TV tower fatalities at Chapel Hill. *Chat*. 21:1 pp 28
- Welles, M. 1978. TV tower kills at Elmira. *Kingbird*. 28:3 pp 159-161
- Whelan, P. 1976. The bird killers. *Ontario Naturalist*. 16:4 pp 14-16
- Willard, D.E. and B.J. Willard. 1978. The interaction between some human obstacles and birds. *Environmental Management*. 2:4 pp 331-340
- Zimmerman, D.A. 1975. The Changing Seasons. *American Birds*. 29:1 pp 23-28

BOOKS AND POPULAR ARTICLES

- Avery, M.L., P.F. Springer and N.S. Dailey. 1978. Avian Mortality at man made structures: an annotated bibliography. *USFWS, National Power Plant Team. FWS/OBS-78/58* pp 108.
- Bell, Robert N. 1998. Towers in city parks draw opposition. *The Indianapolis Star*. April 16, pp B3
- Bell, Robert N. 1999. Parks board OK's wireless-tower contract. *The Indianapolis Star*. February 17. pp. B3
- Borestein, Seth. 1999. Towers serious threat to birds. *The Denver Post*. August 8. pp. A4
- Bowman, Lee. 1999. Communications Towers Disorient, Kill Thousands of migrating birds. *Pittsburgh Post-Gazette*. Sept 25
- Braile, Robert. 1999. Proliferation of towers poses threat to birds. *The Boston Globe*. May 23, 1999 New Hampshire Weekly, p.1
- Craig-Lich, Alicia. 1998. The hazards Indy park towers pose to birds. *The Indianapolis Star*. March 9, 1998. Editorial, p. 5
- Jaroslow, B. 1979. A Review of factors involved in bird tower kills, and mitigative procedures. The mitigation symposium: a national workshop on mitigation losses of fish and wildlife habitats. *U.S. Forest Service General Technical report RM-65*. pp 469-473 in G.A. Swaisson, tech. Coord.
- Jones, Meg. 1999. Fast-multiplying communications towers signal lethal threat for migratory birds. *Milwaukee Journal Sentinel*. August 27. News, p.1
- Kelly, Dan. 1999. Local zoning boards win cell phone ruling. *Eagle Times*. September 27
- Lafee, Scott and Mark Sauer. 1999. As cellular phone sales increase, so do bird deaths; Sound Effect. *The San Diego Union-Tribune*. October 6. Lifestyle, p. E1-2
- Olendorf, R.R.1986. Raptor Collisions with utility lines and fences: an annotated bibliography (rev. draft). *U.S. Bureau of Land Management, Sacramento, California*. pp 14.
- Pittman, Craig. 1999. Proposed tower might endanger birds. *St. Petersburg Times*. November 1 pp 1B
- Tordoff, H.B. and R.M. Mengel. 1956. Studies of birds killed in nocturnal migration. *University of Kansas Publications, Museum of Natural History* pp 10 (1):1-44
- Vosburgh, J.; 1966. Deathtraps in the flyways. Pages 364-371 in: A. Stefferud, ed. *Birds in our lives. USFWS, Bureau of Sports Fisheries and Wildlife*.
- Watson, Traci. 1999. Communication Towers are Silencing Songbirds. *USA Today*. Sept 2.
- Weindensaul, Scott. 1999. Tower lights can fatally attract migratory songbirds. *Philadelphia Inquirer*. July 27, pp. D3
- Weir, R.D. 1976. Annotated Bibliography of bird kills at man made obstacles: a review of the state of the art and solutions. *Canadian Wildlife Services, Ontario Region, Ottawa*. pp 85.
- Unknown. 1973. Bird Kill on Holston Mountain. *Tennessee Ornithological Society*.
- Unknown. 1999. Wildlife Refuge no place for tower. *The Tampa Tribune*. November 9 Nation/World, p. 6
- Unknown. 1999. Towers make skies dangerous for birds. *The Arizona Republic*. Aug 13. pp. B4

WEB SITE ADDRESSES

- | | |
|--------------------------------------|--|
| American Bird Conservancy: | http://www.abcbirds.org/TowerKills.htm |
| Bird Studies Canada: | http://www.bsc-eoc.org/migmain.html |
| Cornell Laboratory of Ornithology: | http://birdsource.cornell.edu/conservation/Towerkill.htm |
| Fatal Light Wareness Program (FLAP): | http://www.flap.org/ |
| National Audubon Society: | http://www.audubon.org/bird/watch/ |
| Tower Kill.Com: | http://www.towerkill.com |
| USFWS: | http://www.fws.gov/r9mbmo/issues/tower.html and
http://migratorybirds.fws.gov/issues/towers/agenda.html . |
| WWF Canada: | http://www.wwfcanada.org/ |