Protecting the Flying Public and Minimizing Economic Losses within the Aviation Industry

Assistance provided by USDA-Wildlife Services to reduce Wildlife Hazards to Aviation

Fiscal Year 2020

Wildlife biologists and technicians with the USDA-Wildlife Services Program provided 299 staff years of assistance at 776 civil airports and military airbases in FY 2020 to reduce wildlife hazards to aviation. Activities included a broad range of technical assistance (e.g., training of airport personnel, monitoring wildlife populations) and direct management activities (e.g., wildlife dispersal, habitat modification). Program personnel, particularly at civil airports encountered parked aircraft and reduced aviation traffic owing to the COVID-19 pandemic.

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Assistance provided and Cooperator Funding received by USDA-Wildlife Services to reduce Wildlife Hazards to Aviation in FY 2020

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1. Why are aircraft collisions with wildlife a concern at airports?

Aircraft collisions with birds and other wildlife (wildlife strikes) are an increasingly serious economic and safety problem (Marra et al. 2009). Dolbeer et al. (2021) estimated wildlife strikes (96% involving birds) cost the civil aviation industry in the USA a minimum of $196 million annually, 1990-2019. Allan and Orosz (2001) estimated that bird strikes annually cost commercial air carriers over $1.2 billion worldwide, 1999-2000. Globally, bird and other wildlife strikes killed more than 293 people and destroyed over 272 aircraft from 1988 – 2020 (Richardson and West 2000, Thorpe 2012, Avisure 2021).

Efforts to reduce wildlife strikes need to focus on the airport environment because about 72% of all reported bird strikes with civil aircraft in USA occur at less than 500 feet above ground level (Dolbeer 2006, Dolbeer et al. 2021). Of the 59 large (maximum take-off weight >5,700 kg) turbine-powered aircraft (48 civil, 11 military) confirmed to have been destroyed because of bird or other wildlife strikes since 1960 worldwide, 56 (95%) of the strikes occurred during take-off or landing phases of flight at ≤500 feet AGL (Dolbeer 2008, Dolbeer, unpublished data).

2. Why is the wildlife-strike problem increasing?

Wildlife strikes have increased in the past 40 years because of a combination of factors. First, populations of many wildlife species that are hazardous to aviation have increased dramatically. For example, the 36 species of birds in North America with mean body masses ≥2.5 lbs and at least 20 strikes with civil aircraft, 1990-2018 showed a combined population increase from 55 million in 1990 to 89 million in 2018, a net gain of 34 million birds (Dolbeer 2020). These species include Canada and snow geese, white and brown pelicans, turkey and black vultures, sandhill cranes, wild turkeys, bald eagles, great blue herons, double-crested cormorants, ospreys, and red-tailed hawks. The white-tailed deer population increased from about 15 million in 1984 to over 28 million by 2010 (McCabe and McCabe 1997, VerCauteren et al. 2011). Furthermore, most of these species have adapted to living in urban environments, including airports (e.g., Smith et al. 1999; Rutledge et al. 2015).

A second factor relates to aircraft and engine design. Commercial air carriers have replaced their older three or four-engine aircraft fleets with more efficient and quieter, two-engine aircraft. In

1965, about 94 percent of the 1,037 turbine-powered commercial transport aircraft in the USA had three or four engines compared to less than 4 percent of the 7,381 aircraft in 2019 (U.S. Department of Transportation 2021, Aeroweb 2021). With the steady advances in technology over the past several decades, today's two-engine aircraft are more powerful and reliable than yesterday's three and four-engine aircraft. However, in the event of multiple-engine ingestions, especially with large birds such as geese, aircraft with two engines may have vulnerabilities not shared by their three or four engine-equipped counterparts (Langston 2019). A third factor is that birds are less able to detect and avoid the quieter two-engine, turbofan-powered aircraft in use today compared to older, noisier aircraft (Burger 1983, Kelly et al. 2001).

3. Can airport authorities and managers be held liable for wildlife strikes?

Based on a summary of cases by MacKinnon et al. (2001), Dale (2009), and Dolbeer (2018) and legal reviews by Michael (1986), Wilkinson (1998), Matijaca (2001, 2005), and Rillstone and Dineen (2013), it is apparent that airport operators must exercise "due diligence" in managing wildlife hazards to avoid potentially serious liability issues. In the USA, the exercise of "due diligence" to manage wildlife hazards initially involves a Wildlife Hazard Assessment (WHA) at the airport. Based on the WHA, a Wildlife Hazard Management Plan (WHMP) is usually required for airports that are certificated by the Federal Aviation Administration (FAA) for passenger service under U.S. Code of Federal Regulations (14 CFR Part 139.337, hereafter referred to as Part 139-certificated airports). As of December 2020, there were 520 Part 139-certificated airports in the USA (FAA 2021*b*). Airports that are not Part 139-certificated but that accept federal grant-in-aid funding may also be required to conduct WHAs and develop WHMPs (FAA Advisory Circular 150/5200-33C, FAA 2021*c*).

4. How does an airport manage wildlife hazards?

Managing bird and other wildlife hazards at airports is a complex, public-sensitive endeavor involving many species of wildlife governed by the international Migratory Bird Treaty Act and various federal, state, and local regulations. For example, 591 species of birds, 51 species of terrestrial mammals, 36 species of bats, and 23 species of reptiles were identified in wildlife strikes with civil aircraft in the USA, 1990-2019 (Dolbeer et al. 2021). Because of the complexity and sensitivity involved in managing wildlife hazards, airports are required to employ professional biologists trained in wildlife hazard management at airports to assess hazards, provide training, and to assist in the development, implementation, and evaluation of WHMPs (14 CFR Part 139.337 and FAA Advisory Circular 150/5200-36B [FAA 2021*c*]). Such professionally developed and implemented management plans minimize the likelihood of catastrophic or substantial-damage wildlife strikes on an airport and provide crucial support during litigation in the aftermath of any significant strike event that might occur. Cleary and Dolbeer (2005) provide detailed information on the development and implementation of these management plans as well as on FAA regulations and guidelines regarding wildlife hazards to aviation. DeVault et al. (2013) discuss the scientific foundations of wildlife management in airport environments.

5. What role does USDA-Wildlife Services (WS) play in managing wildlife hazards at airports?

The WS program provides federal leadership for resolving conflicts between wildlife and people. The WS program, with professional biologists available for consultation and other services in all 50 States and U.S. Territories and for U.S. military installations worldwide, is internationally recognized for research and management programs to resolve conflicts between wildlife and humans. WS's National Wildlife Research Center, headquartered in Colorado with field stations in 7 other states, provides a scientific foundation for management programs.

The FAA, with two staff wildlife biologists to deal with wildlife hazards to aviation nationwide, has historically partnered with the WS program to provide professional assistance to airports. The FAA has a Memorandum-of-Understanding (MOU) with WS (signed in 1978; updated in 1989 and 2005) stating that "FAA or the certificated airport may request technical support from WS to lessen wildlife hazards" (Cleary and Dolbeer 2005). In addition, the Department of Defense (DoD) has a similar MOU with WS (signed in 1990) for assistance with wildlife damage issues at DoD facilities (Cleary and Dolbeer 2005). Finally, the National Association of State Aviation Officials (NASAO) and WS have a MOU (signed in 2006 and updated and expanded in 2013 to include the FAA) which states that the three organizations have a mutual goal "to provide technical and operational assistance and necessary training to the aviation community in order to ultimately reduce the risk of wildlife hazards and ensure safer operations at airports." Many wildlife hazard management programs at airports have been developed, implemented, or overseen by WS biologists. WS receives no appropriated federal funding to deal with wildlife hazards at airports but is authorized by the U.S. Congress to enter into cooperative service agreements with airport authorities and other entities to provide services on a cost-reimbursable basis.

5a. Managing wildlife hazards at airports and air bases is a specialized, public-sensitive activity: are WS biologists qualified and trained to work in this environment?

In 1996, WS developed a 3-day Airport Training Course to ensure that employees conducting work at airports understood the airport environment and the regulations, policies, and agency roles for both civil and military aviation. In 2010, an additional course (Advanced Airport Training) was developed to assist with recertification and cater to longer term airport biologists. As of January 2021, 885 WS biologists have successfully passed the FAA-approved Airport Training Course (FAA Advisory Circular 150/5200-36B [FAA 2019*c*]) and 292 biologists have taken the Advanced Course. Additionally, because WS biologists address wildlife damage management issues throughout the USA and abroad (see section 5b below), WS possesses a network of experienced employees to exchange information regarding wildlife damage management techniques, especially those best suited for issues arising at airports. Also, WS biologists working at airports and military airbases are scientifically supported by WS's National Wildlife Research Center (see DeVault et al. 2013 and Section 5e below).

5b. At how many airports did WS biologists provide assistance in reducing wildlife hazards in 2020?

The number of civil and military airports requesting assistance from WS has steadily grown over the past 30 years in concert with the increased awareness of the risk that wildlife poses to aviation safety. WS assistance grew from primarily short-term consultative work (e.g., 1-day site

visits) at about 40 airports in 1990[a] to 299 staff-years of assistance at 776 airports in 2020 (638 civil and 138 military) in 50 states, 4 U.S. territories, and 14 foreign countries (Table 1; Figures 1, 2). WS provided full-time (≥1 staff year) of assistance at 145 airports in 2020 (Table 2). In 2020, assistance was provided at 380 (73%) of the 520 Part 139- certificated airports in the USA (Table 3). The 380 certificated civil airports where WS assisted served 284 million commercial passengers and recorded 13.1 million and 10.6 million commercial and general aviation (GA) aircraft movements, respectively, in 2020 (Table 4). The 259 non-certificated civil airports in USA where WS assisted recorded 0.5 million and 7.6 million commercial and GA aircraft movements, respectively.

5c. What types of assistance were provided by WS biologists at airports to reduce wildlife hazards in 2020?

WS biologists provided a wide range of technical and direct management assistance at airports (Tables 5, 6; Figure 3). Consultations with airport authorities regarding wildlife issues was the most common technical service provided (680 airports) followed by training of airport personnel in wildlife identification and control methods (385 airports involving 3,883 personnel). Other technical assistance provided included continued monitoring of wildlife, development and revisions of Wildlife Hazard Management Plans, Environmental Assessments, and Wildlife Hazard Assessments (250, 174, 64, and 36 airports, respectively).

Direct management assistance included lethal removal of hazardous wildlife (393 airports), non-lethal dispersal of hazardous wildlife (349 airports), modification of habitats to discourage wildlife (274 airports), and capture and translocation of wildlife away from the airport (190 airports, Table 5). Lethal control of protected species was done under state and federal permits as a last option after solely non-lethal options had been determined to be ineffective or impractical.

In addition to work done on airport property, WS biologists provided technical and direct management assistance regarding off-airport wildlife attractants at 263 airports (Table 5).

5d. At how many airports did technical or direct management assistance by WS biologists result in a reduction, suppression, or prevention of hazards caused by wildlife in 2020?

WS biologists estimated that technical or direct management assistance resulted in a reduction, suppression, or prevention of wildlife hazards at 515 (66%) of the 776 airports where some type of assistance was provided (Table 7, Figure 4). This total included 254 (67%) of the 380 Part 139-certificated civil airports assisted. These estimates of successful intervention are conservative. WS biologists indicated that there was insufficient time since management actions had been implemented or insufficient information from airport personnel to assess whether or not hazards had been reduced, suppressed, or prevented on many airports. Wenning et al. (2004), Dolbeer et al. (2007, 2014), Dolbeer and Franklin (2013), and Washburn (2019) provided summaries of specific accomplishments by WS biologists at airports and airbases nationwide in reducing wildlife hazards since 1990. Recent analyses have documented an overall national decline in damaging wildlife strikes in the airport environment at Part 139-certificated airports during the past 2 decades (Dolbeer 2011, Dolbeer et al. 2014, Dolbeer et al. 2021). The work by WS personnel, as documented in this report, has likely been a major factor in the decline in these damaging wildlife strikes.

[a] Years refer to Federal Fiscal Years (e.g., 1990 = 1 Oct 1989-30 Sep 1990).

5e. Besides technical and direct management assistance at airports, what other roles does WS play in mitigating wildlife hazards to aviation?

WS biologists working at airports and airbases are supported by WS's National Wildlife Research Center (NWRC). NWRC has a field station (located at NASA's Glenn Research Center, Plum Brook Station near Sandusky, Ohio) devoted to applied research in methods to mitigate wildlife hazards to aviation. Numerous research collaborations involving NWRC have occurred or are ongoing at civil and military airports through interagency and cooperative agreements with other government agencies, airports, universities, and private companies (Table 8). In addition, WS, through an interagency agreement with the FAA, manages the National Wildlife Strike Database (NWSD) which contains over 243,000 reports of wildlife strikes with civil aircraft in USA, 1990-2020. The NWSD provides the scientific foundation for research and management activities and for the development of national policies and regulations related to mitigating the risk of wildlife strikes to aircraft (e.g., Cleary and Dolbeer 2005; Dolbeer and Wright 2009; Pitlik and Washburn 2012; DeVault et al. 2011; Dolbeer et al. 2014, 2018, 2019; FAA 2021*d*).

6. Conclusions

Because of expanding populations of many wildlife species that are hazardous to aviation and the adaptation of these species to urban environments, mitigation efforts to minimize the risk of wildlife strikes are increasingly important at both civil and military airports worldwide. In response, WS has developed a national network of professional wildlife biologists who are highly qualified and specifically trained to deal with these unique, complex, and public-sensitive challenges. As documented in this report, WS provides substantial assistance and effective, science-based mitigation for a variety of wildlife hazard issues at airports. However, a major challenge facing WS is that no Congressional funding is available to provide a foundation for wildlife hazard mitigation work. Thus, assistance provided by WS is often limited by the availability of funds by cooperators on an annual basis. In many situations, WS is unable to address significant wildlife hazard issues requested and desired by cooperators because no funding or insufficient funding is available to do the necessary work.

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Table 1. Staff-years expended and number of civil airports (Part 139 and General Aviation)[a] and military airbases served by USDA-Wildlife Services (WS) biologists in provision of technical and direct management assistance to reduce wildlife hazards to aviation, FY 2020.

		Number of airports assisted						Number of airports assisted			
State/ Terr.	WS staff years	Civil (P139)	Civil (GA)	Mili-tary	Total	State/ Terr.	WS staff years	Civil (P139)	Civil (GA)	Mili-tary	Total
AK	17.69	24	6	13	43	ND	2.05	8	1	2	11
AL	3.46	5	10	3	18	NE	3.02	7	1	1	9
AR	1.26	6	7	1	14	NH	3.28	2	4		6
AZ	3.20	3	2	3	8	NJ	8.02	4	3	1	8
CA	19.69	14	5	12	31	NM	1.47	4	4	2	10
CO	6.44	14	14	3	31	NV	1.88	1		3	4
CT	1.00	4	3		7	NY	11.05	7	2		9
DE	2.14		1	1	2	OH	6.79	12	12	1	25
FL	15.52	5	2	18	25	OK	6.58	2	5	4	11
GA	2.22	4	5	3	12	OR	2.66	5	3		8
GU[b]	2.27	4			4	PA	8.14	12	7	1	20
HI	35.57	8	4	3	15	PR	1.02	3			3
IA	1.80	7	8		15	RI	1.32	1	5		6
ID	0.08	5	1		6	SC	7.15	8	6	4	18
IL	9.39	18	5		23	SD	0.97	5	3	1	9
IN	2.12	7	5		12	TN	2.95	7	3		10
KS	4.28	7	4	2	13	TX	12.70	17	9	8	34
KY	1.28	6			6	USVI	2.79	2			2
LA	3.02	9	4	2	15	UT	2.87	7	1	1	9
MA	2.66	8	7	1	16	VA	14.34	9	8	6	23
MD	9.08	3	1	2	6	VT	3.73	2	7		9
ME	1.35	4	6		10	WA	8.72	10	11	3	24
MI	4.73	19	6	2	27	WI	3.21	9	25	1	35
MN	2.38	9	25		34	WV	1.89	6	1	1	8
MO	7.42	10	1	1	12	WY	0.04	8			8
MS	2.58	5	1	2	8	Mil_Fgn	4.93			20	20
MT	1.16	7	1		8						
NC	11.78	6	4	6	16	**Total[d]**	**299.11**	**379**	**259**	**138**	**776**

[a] Part 139 airports are certificated for passenger service (see footnote in Table 3). Military total includes 1 U.S. Air Force Base (Dover) certificated under Part 139; 99 civil airports were joint-use with military.

[b] Includes 3 airports in Pacific Island Territories outside of Guam.

[c] U.S. military airbases at foreign locations.

[d] See Figures 1 and 2 for trends in numbers of airports served and staff-years of assistance, 1999 - 2020.

Table 2. Distribution of staff years expended at 776 civil and military airports where USDA-Wildlife Services (WS) biologists provided technical and direct management assistance to reduce wildlife hazards to aviation, FY 2020.

	WS staff years expended by number of airports[a]					
Type of airport	≤ 0.10	0.11 to 0.25	0.26 to 0.50	0.51 to 0.99	≥1.00	Total airports
Civil[b]	483	25	35	18	77	638
Military	27	20	12	11	68	138
Total	**510**	**45**	**47**	**29**	**145**	**776**

[a] In FY 2020, 299 staff years of assistance was provided at the 776 civil and military airports (Table 1).

[b] Includes 99 civil airports with a military "joint-use" presence.

Table 3. Number of civil airports (Part 139-certificated and General Aviation) and military airbases requesting assistance from USDA-Wildlife Services for wildlife hazard issues, FY 2020.

Airport status	Number (%) of airports requesting assistance
Civil: Part 139-certificated[a, b]	380 (49)
Civil: General Aviation	259 (33)
Military	137 (18)
Total	**776 (100)**

[a] The U.S. Code of Federal Regulations (14 CFR Part 139) requires the Federal Aviation Administration (FAA) to issue airport operating certificates to airports that serve scheduled and unscheduled air carrier aircraft with more than 9 seats or that the FAA Administrator requires to have a certificate. Part 139-certificated airports experiencing hazardous wildlife conditions as defined in Part 139.337 must conduct formal Wildlife Hazard Assessments and develop Wildlife Hazard Management Plans as part of the certification standards. In December 2020, there were 520 Part 139-certificated airports in the USA (FAA 2021*c*).

[b] One of the 138 military airbases held a Part 139 certificate.

Table 4. Number of passenger enplanements and aircraft movements in 2020[a] at 380 Part 139-certificated civil airports and 259 non-certificated (General Aviation) civil airports in USA requesting assistance from USDA-Wildlife Services for wildlife hazard issues, FY 2020.

Airport status (14 CFR Part 139)	Number of passenger enplanements	Aircraft movements (departures and arrivals)			
		Com-mercial[b]	General aviation[c]	Military[d]	Total
Part-139-certificated (380)	283,570,305	13,077,864	10,583,706	1,833,522	25,495,092
Non-certificated (259)	36,908	530,390	7,562,753	712,419	8,805,562
Total	**283,607,213**	**13,608,254**	**18,146,459**	**2,545,941**	**34,300,654**

[a] Passenger enplanement data were obtained from FAA Terminal Area Forecast (TAF, FAA 2021*a*) and reduced by 60% to adjust for the overall 60% reduction in passenger traffic in 2020 because of the Covid-19 outbreak (IATA 2021). Aircraft movements for 336 civil airports were obtained from FAA Air Traffic Activity System (ATADS, FAA 2021*b*). Movement data for remaining airports were from the TAF or, if not available from TAF, from https://www.airnav.com/.

[b] Air carrier, air taxi and commuter aircraft.

[c] Includes itinerate (take off and land at different airport) and local (take off and land at same airport) movements.

[d] Totals exclude over 2 million military and civil aircraft movements at 138 military airbases.

Table 5. Types of technical and operational (direct management) assistance provided by USDA-Wildlife Services biologists to reduce wildlife hazards at airports, FY 2020.

Category of assistance	Type of assistance to reduce wildlife hazards	Number of airports	% of total airports assisted (N = 776)
Technical	Consultation regarding wildlife issues	680	88
	Training of airport personnel[a]	385	50
	Continued wildlife monitoring[b]	250	32
	Wildlife Hazard Management Plan	174	22
	Environmental Assessment	64	8
	Wildlife Hazard Assessment	36	5
	Total airports with Technical Assistance	**757**	**98**
Direct management	Lethal control of hazardous wildlife	393	51
	Non-lethal dispersal of hazardous wildlife	349	45
	Habitat modification	274	35
	Live-trap/ translocate wildlife from airport	190	24
	Total airports with Direct Management Assistance	**443**	**57**
Off-airport[c]	**Total airports with off-airport Technical or Direct Management Assistance**	**263**	**34**

[a] Number of airports where training took place; personnel from additional airports attended some of these training courses (See Table 6).

[b] Airports where Wildlife Hazard Assessments (WHA) have been completed but monitoring of wildlife and wildlife attractants is being done continuously under a WHA protocol to maintain the WHA in a current state.

[c] FAA Advisory Circular 150/5200-33b "Hazardous wildlife attractants on or near airports" provides guidance on land uses that have the potential to attract hazardous wildlife within 10,000 feet of runways and within the flight paths of arriving and departing aircraft within 5 miles of runways (FAA 2021*d*, Pfeiffer et al. 2019).

Table 6. Number of airports where technical training was provided in the identification and management of wildlife hazards to aviation and total airport personnel trained by USDA-Wildlife Services biologists, FY 2020.

State	Number of airports	Number of persons trained	State	Number of airports	Number of persons trained
AK	32	245	ND	8	68
AL	5	55	NE	9	41
AR	14	14	NH	2	31
AZ	4	46	NJ	2	16
CA	24	117	NM	4	28
CO	21	194	NV	2	12
CT	4	39	NY		
DE	1	1	OH	14	82
FL	5	30	OK	2	38
GA	1	8	OR	6	86
GU	4	99	PA	14	259
HI	7	149	PR	2	20
IA	10	62	RI		
ID	3	55	SC	8	34
IL	13	137	SD		
IN	7	49	TN	10	76
KS	5	41	TX	19	231
KY	4	223	USVI	2	12
LA	2	12	UT	4	47
MA	7	65	VA	12	174
MD	1	10	VT	2	11
ME	3	60	WA	10	145
MI	15	84	WI	10	57
MN	6	54	WV	6	75
MO	11	125	WY	6	57
MS	4	31	Mil-Fgn[a]	6	124
MT	7	60			
NC	5	94	**Total**	**385[b]**	**3,883[c]**

[a] U.S. military airbases at foreign locations.

[b] Personnel from several airports sometimes attended training courses provided by WS at an airport; thus, total airports from which personnel received training is greater than indicated.

[c] See Figure 3 for trends in number of airports where training was conducted and number of airport personnel trained, 2001 - 2020.

Table 7. Number of Part 139-certificated airports, non-certificated airports, and military airbases at which technical or direct management assistance by USDA-Wildlife Services (WS) biologists resulted in an estimated reduction, suppression, or prevention of hazardous conditions caused by wildlife, FY 2020.

	Number of airports (% of total airports assisted)			
	Part 139-certificated civil airports (n = 379[a])	Non-certificated civil airports (n = 259[b])	Military airbases (n = 138)	All airports (n = 776)
Reduction of hazards from target wildlife species [c]	249 (66)	152 (59)	99 (72)	500 (64)
Suppression of hazards from target wildlife species [d]	244 (64)	140 (54)	96 (70)	480 (62)
Prevention of hazards from target wildlife species [e]	213 (56)	114 (44)	92 (67)	419 (54)
Reduction, suppression, or prevention of hazards from target wildlife [f, g]	**254 (67)**	**161 (62)**	**100 (72)**	**515 (66)**

[a] In addition, 1 of the 138 military airbases held a Part 139 certificate.

[b] General Aviation airports.

[c] As examples, airport installed anti-perching devices or removed vegetation attractive to hazardous wildlife because of WS recommendation; WS successfully initiated program to remove hazardous wildlife from the airport.

[d] Successful WS direct management activities or technical assistance recommendations initiated in previous years were continued or maintained in 2020 (e.g., continued management of vegetation, continued removal of deer as a follow-up to more extensive removal initiated in earlier year to initially get problem under control).

[e] WS recommendation or intervention resulted in prevention of development or activity that would have resulted in increased wildlife numbers at airport (e.g., prevention of on-airport wetland mitigation, landfill expansion near airport, or planting of landscape vegetation attractive to wildlife).

[f] These estimates of successful intervention are conservative because WS biologists indicted that there was insufficient time since management actions had been implemented or insufficient information from airport personnel to assess whether or not hazards had been reduced, suppressed, or prevented on at least 50 airports.

[g] See Figure 4 for trends in the reduction, suppression, or prevention of hazards from target wildlife at airports served by WS, 2002-2020.

Table 8. Science-based activities provided by USDA-Wildlife Services (WS) to support technical and direct management assistance efforts at airports and within the broader aviation industry to mitigate wildlife risks to aviation, FY 2020.

WS program	Primary activities	Sponsors[a]
Operations	• Managed the National Wildlife Strike Database and produced annual strike report summarizing data from 1990-2018, • Partnered with Embry Riddle Aeronautical University for technical support of NWSD and to participate in various outreach programs within aviation industry to promote the accurate reporting of wildlife strikes, • Worked with Commercial Aviation Safety Team (CAST) to monitor trends in high-risk strikes (e.g., Dolbeer 2016) and to update CAST concerning USDA WS NWRC activities related to NTSB recommendation A-10-87, • Worked with USAF Safety Center, U.S. Navy, Air National Guard and USDA WS NWRC to prioritize research projects related to wildlife hazards and military aviation, • Conducted outreach through ARCCoS training events, • Conducted outreach through AAAE ASOS schools, • Provided 1 initial and 2 advanced Wildlife Hazards at Airports trainings for USDA personnel, WI DOT (1) and USFWS (1). • Developing ConOps for BDR	FAA/USN/ ANG
Research[b]	• Development of aircraft lighting to increase visibility of aircraft to birds, • Movement patterns of raptors and other birds near airports, • Evaluation of alternative land covers to mitigate strike risk and reduce maintenance costs for airports, • Evaluating unmanned aerial systems as bird hazing tools, • Evaluating unmanned aerial systems in wildlife survey applications.	FAA

[a] Air National Guard (ANG); Federal Aviation Administration (FAA); U.S. Navy (USN).

[b] Research directed by the National Wildlife Research Center, Ohio Field Station, Sandusky, Ohio.

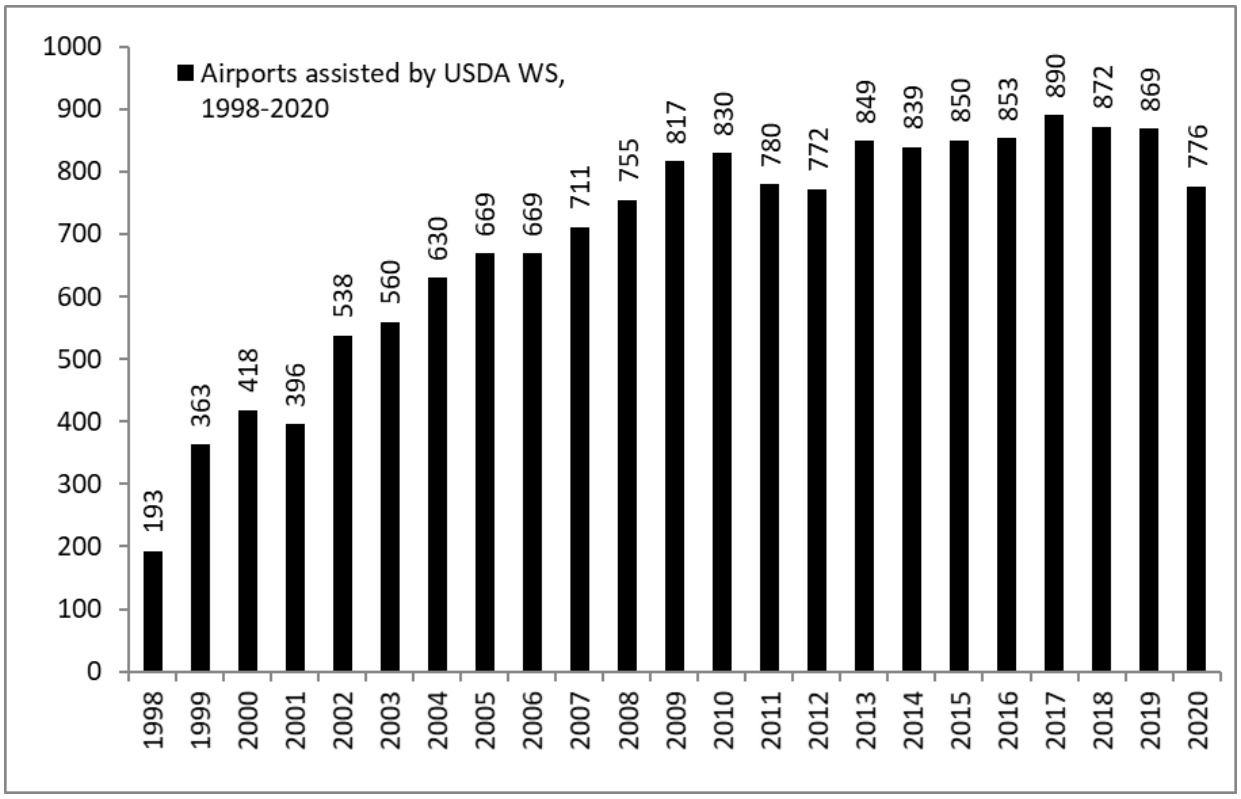

Figure 1. Airports assisted by USDA-Wildlife Services (WS) in provision of technical and direct management assistance to reduce wildlife hazards, 1998 - 2020. In 2020, WS personnel provided 299 staff-years of assistance at 776 airports (638 civil, 138 military) in all 50 U.S. States, 4 U.S. Territories, and 14 foreign countries (see Table 1). Data on airports assisted are not available before 1998, but WS personnel estimated only about 40 airports were assisted in 1990 (primarily 1-day site visits or telephone consultations) with a steady increase to 193 airports in 1998.

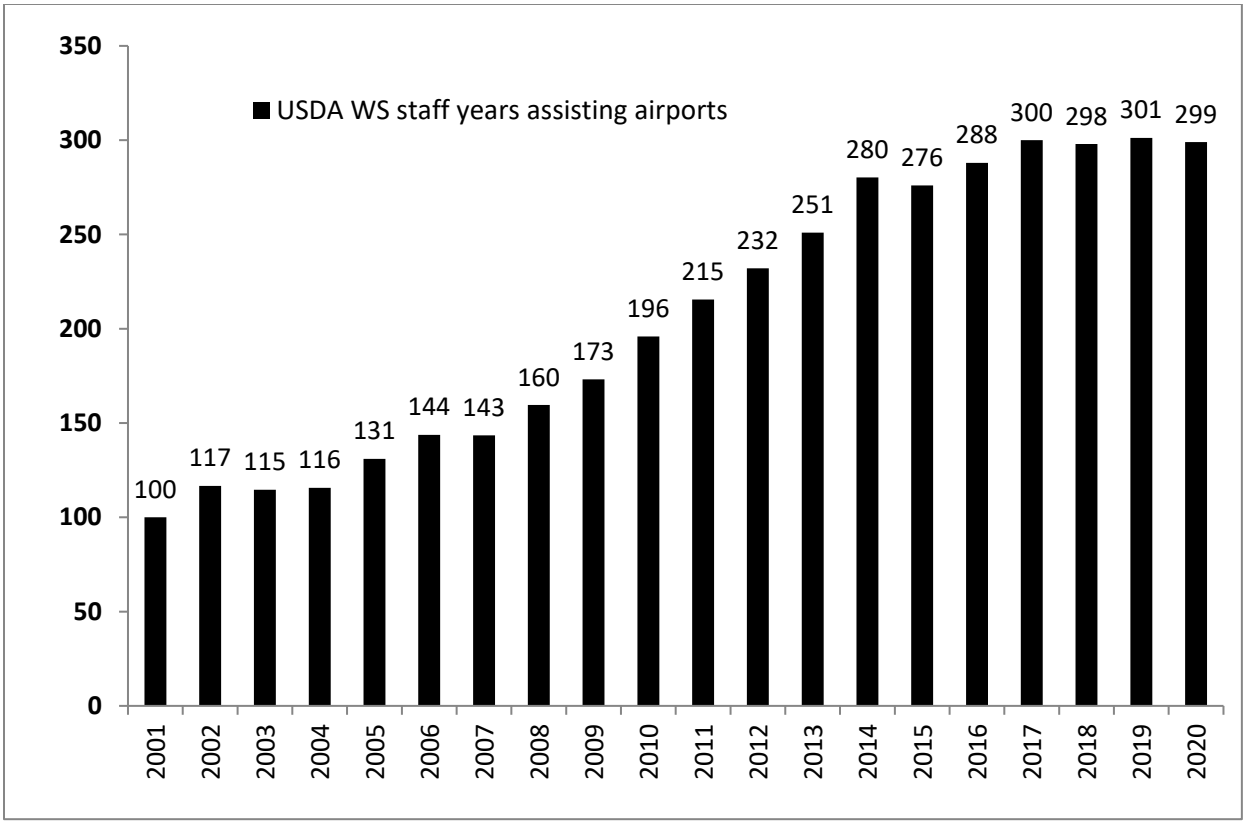

Figure 2. The number of staff years provided by USDA-Wildlife Services personnel in technical and direct management assistance to reduce wildlife hazards at civil and military airports increased from 100 in 2001 to 298-301 in 2017 - 2020. Data on staff years are not available before 2001, but WS personnel estimated <1 staff year of assistance was provided in 1990 (primarily 1-day site visits or telephone consultations) with a steady increase to 100 staff years in 2001.

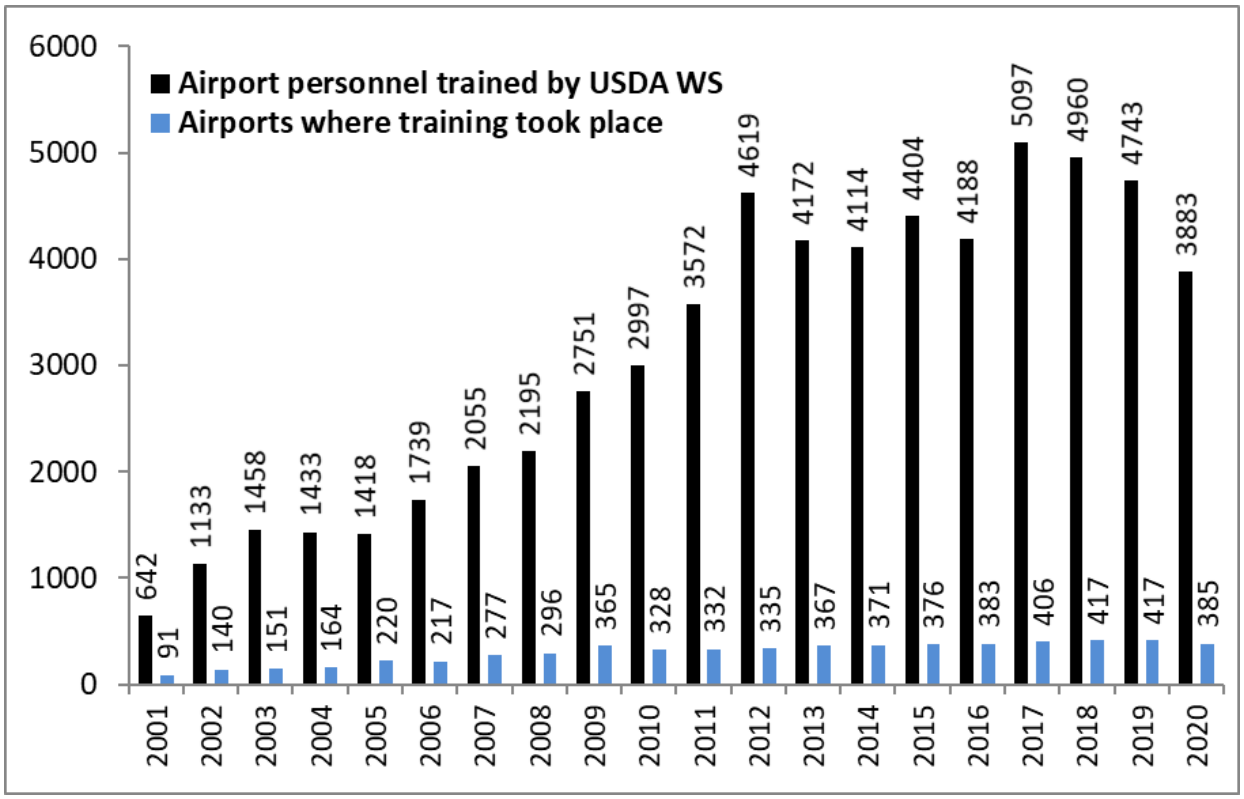

Figure 3. The number of airport personnel trained by USDA-Wildlife Services in identification and management of wildlife hazards to aviation and the number of airports where training took place, 2001 to 2020 (see Table 6). Training activity was reduced in 2020 because of restrictions imposed by the Covid-19 epidemic.

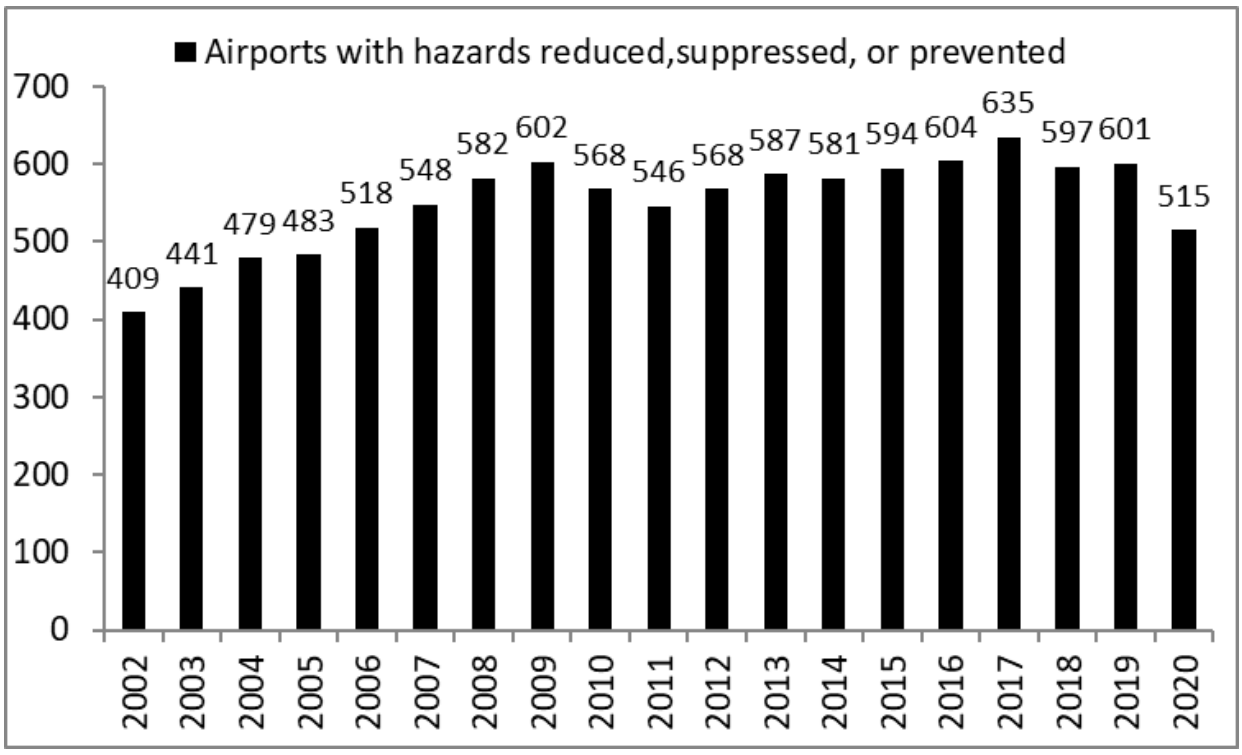

Figure 4. Number of airports and military airbases at which technical or direct management assistance by USDA-Wildlife Services (WS) biologists resulted in an estimated reduction, suppression, or prevention of hazardous conditions caused by wildlife, 2002 - 2020. These estimates of successful intervention are conservative because WS biologists indicted that there was insufficient time since management actions had been implemented or insufficient information from airport personnel to assess whether or not hazards had been reduced, suppressed, or prevented on 40 to 60 airports each year (see Table 7).