

Movements of black vultures trapped at the Kennedy Space Center

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*Abstract. As black vulture *Coragyps atratus* populations increase, so do their impacts on human activities, including interactions with civilian and military aircraft. Florida has one of the largest black vulture populations in the US. To understand more fully the potential management issues related to the Florida black vulture population, we initiated a program to study movements of black vultures at the Kennedy Space Center (KSC). During 2009-2013, we captured, tagged, and released 248 birds fitted with uniquely coded patagial tags. Additionally, we equipped 7 tagged birds with solar powered GPS satellite transmitters to document in more detail their long-term movement patterns. Through November 2017, 271 resightings were reported from 101 different tagged birds. Most reports were from near KSC (median distance = 28 km). However, birds tagged at KSC were observed as far as 438 km, 340 km, and 233 km north, south, and west of KSC, respectively. Moreover, the 7 birds with satellite transmitters corroborate in detail that vultures frequenting the KSC range widely and are likely drawn from a vast area of Florida and neighboring states.*

INTRODUCTION

Black vulture populations have increased markedly in recent years (Avery 2004). Coincident with rising populations have been reports of increased property damage, livestock depredations, and aircraft safety issues associated with black vultures. Black and turkey vultures represent substantial hazards to aircraft. According to the BASH bird strike database, turkey vultures and black vultures are ranked number 2 and number 5, respectively, in terms of total cost of bird strikes to the Air Force (http://afsafety.af.mil/SEF/Bash/SEFW_stats.shtml). These birds are large (approximately 2 kg), they are not maneuverable, and they fly at altitudes to 1000 m and beyond. Furthermore, vultures are often in flocks, which increases their hazard.

According data from the Breeding Bird Survey, the black vulture population in Florida has been growing at an annual rate of 3.3% across the past 10 years (Sauer et al. 2011). In the southeastern coastal plain, the annual rate of increase is 3.9%, and it is 6.0% nationwide (Sauer et al. 2011). Because the population trend is so strong at all scales, there is little likelihood that black vulture-related problems will dissipate in the foreseeable future.

Vultures roost communally at night with up to several hundred birds sharing the same structure or group of trees. Roost composition is not static, however, and birds often shift among several roost sites from one night to the next. Nightly turnover of birds at a given roost location is about 30%. Thus, dispersal of a single roost site at a given location does not necessarily mean that vultures will vacate the area. The birds likely will simply shift their roosting activity to one of several alternate sites. This implies that for effective management of vulture populations, it will be necessary to identify the locations of all major roosting sites within the area of interest and to document the movement patterns of the birds among roosts as well as their daily activity between the roost and their feeding sites.

In Florida, black vultures are resident year-round, but the extent of their local non-migratory movements is unknown. Therefore, any analysis of the hazard posed by vultures to aircraft will have to include both daily and seasonal movement and habitat use patterns. The area in and around Kennedy Space Center (KSC) harbors a

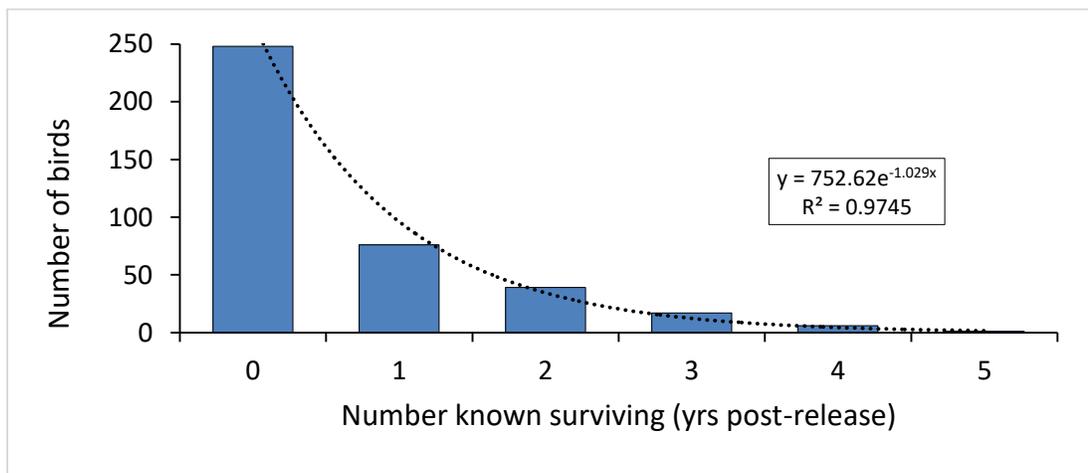
healthy black vulture population which can create dangerous situations for aircraft using the landing strip there as well as at nearby Patrick Air Force Base. While vultures are not the only threat to aviation safety, they are a major one and quantitative information on local black vulture activity and movement patterns can help in development of effective management strategies to lessen risks to pilots. At KSC, we documented short- and long-term black vulture movements and quantified their flight patterns.

METHODS

To obtain the information necessary for effective management, we fitted 7 birds with satellite transmitters to record altitude, heading and speed during daylight hours. We captured black vultures on KSC using baited walk-in traps (9.3 x 3.1 x 1.8-m), and we marked each of them for visual identification with uniquely coded white cattle ear tags (Allflex, Inc., Dallas, TX) attached to the patagium of the right wing (Wallace et al. 1980, Sweeney et al. 1985). We attached solar-powered Global Positioning System (GPS) satellite transmitters (model PTT-100, Microwave Telemetry, Columbia, MD) on black vultures with a backpack harness (Humphrey et al. 2000, Humphrey and Avery 2014). The units weighed 70g, which conformed to the 4% of body mass limit for a 2-kg vulture permitted by the USFWS Bird Banding Lab for attachment of avian transmitters. The transmitters we deployed had been refurbished after being used in a prior study (Avery et al. 2011). We released all captured birds at the trap site, and we solicited reports of sightings of tagged birds which supplemented the information from the transmittered birds.

RESULTS

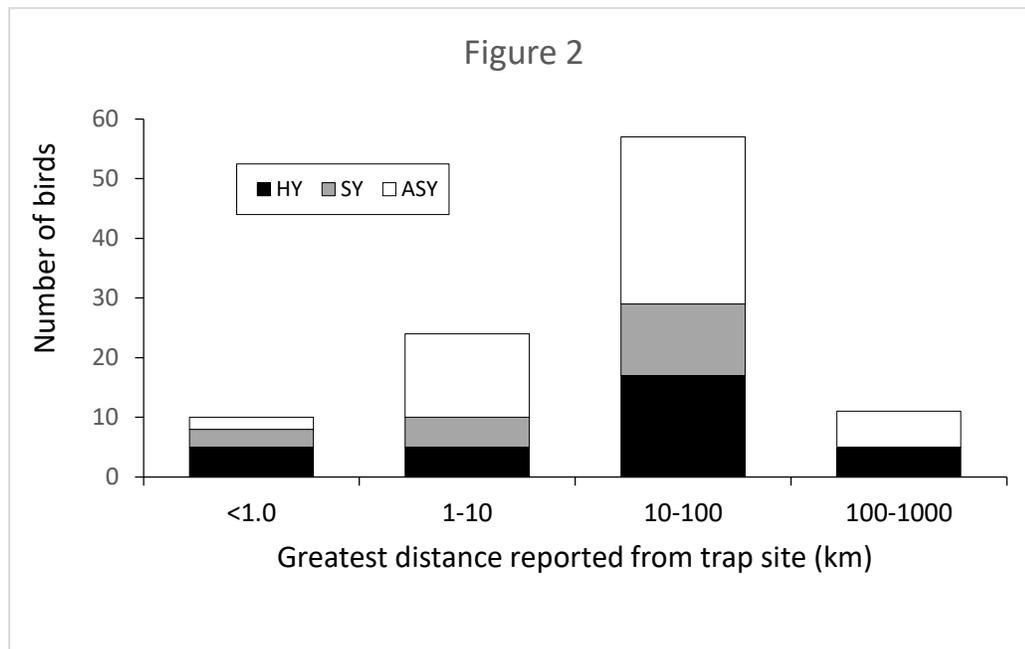
From 21 April 2009 until 31 January 2013, we captured, tagged, and released 248 black vultures at KSC. Through November 2017, there had been 271 resightings representing 102 birds. Individuals were resighted up to 19 times. Based on the reported resightings, 76 individuals were known to survive 1 year post-release, and just 1 individual is known to have survived 5 years post-release (Figure 1).



Age class	Number of birds			Total sightings	Sightings/bird	Days to resighting	
	Tagged	Resighted	% resighted			Mean	Median
HY	68	32	47.1	56	1.8	642	542
SY	40	20	50.0	36	1.8	772	619
ASY	140	50	35.7	180	3.6	672	571
Total	248	102	41.1	272	2.7	682	583

Most of the birds were tagged as ASY, and the number of resightings per bird for this age class was twice that of HY and SY birds. Nevertheless, the proportions of the younger age classes that were resighted exceeded that for ASY birds (Table 1).

Most resightings occurred within KSC or nearby; just 11 of 102 reports of tagged birds were >100 km (Figure 2). The few distant reports of tagged birds ranged from Everglades National Park (340 km south) to Edisto Island, SC (438 km north), and across the peninsula to Indian Shores, FL (233 km west). Potentially, black vultures at KSC are interacting with conspecifics throughout peninsular Florida, eastern Georgia, and southern South Carolina, an area on the order of 200,000 km².



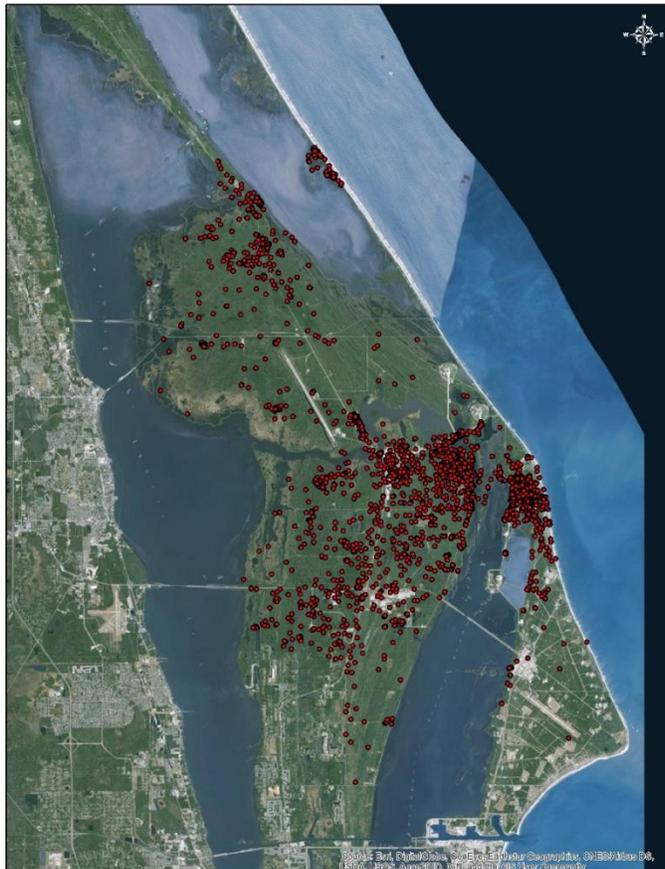
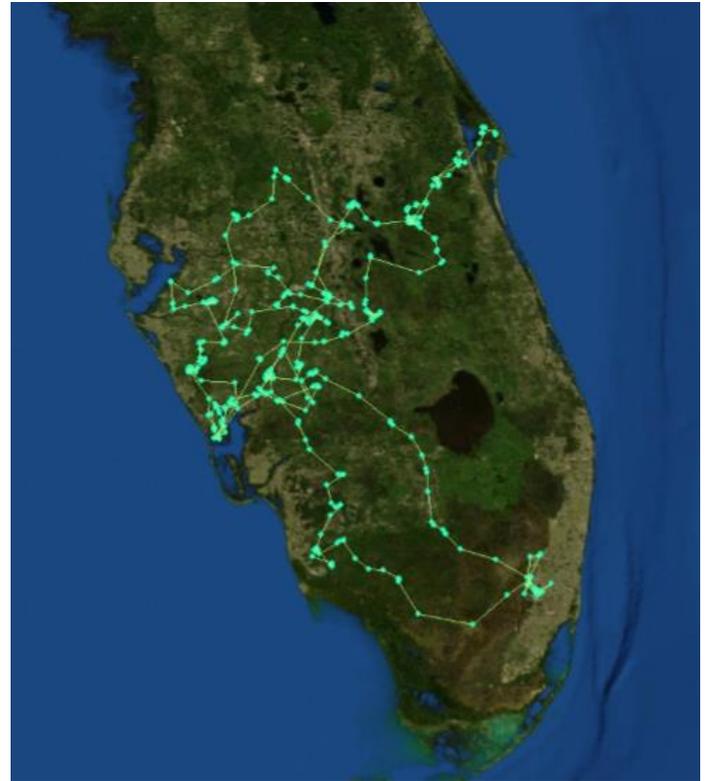
Transmitter Birds

The 7 transmitted birds produced an average of 4684 (SD = 1336) data records, of which an average of 363 (SD = 250) had a recorded speed >1 knot, indicative that the bird was in flight (Table 2). One bird, PMH, is known dead. Its transmitter and wing tag were recovered at the last recorded location. The fates of the remaining birds are not known. Two birds, PMP and PMV, were resighted after their units had stopped transmitting, so cessation of transmitting is not a reliable indicator of death of a transmitted bird.

Tag-Unit	Age-Sex	Date released	Last contact	Number of records			Final location
				Total	In air	%	
MHT-48	SY - U	21 Apr 2009	10 Sep 2013	4933	351	7.1	Osceola County
MHX-51	ASY - U	21 Apr 2009	4 Mar 2012	4412	527	11.9	KSC
PMH-54	SY - U	23 Sep 2010	26 May 2011	2892	211	7.3	Dead; Holopaw, Osceola County
PML-61	ASY - U	23 Sep 2010	4 Aug 2012	7059	897	12.7	Brevard County
PMP-56	SY - U	23 Sep 2010	3 Jan 2012	5725	144	2.5	Resighted 3 May 2012, KSC
PMT-59	SY - M	24 Apr 2012	11 Nov 2013	3131	162	5.2	Eastern Orange County
PMV-50	ASY - F	24 Apr 2012	2 Jun 2013	4639	247	5.3	Resighted 1 Mar 2016, Collier Co., landfill

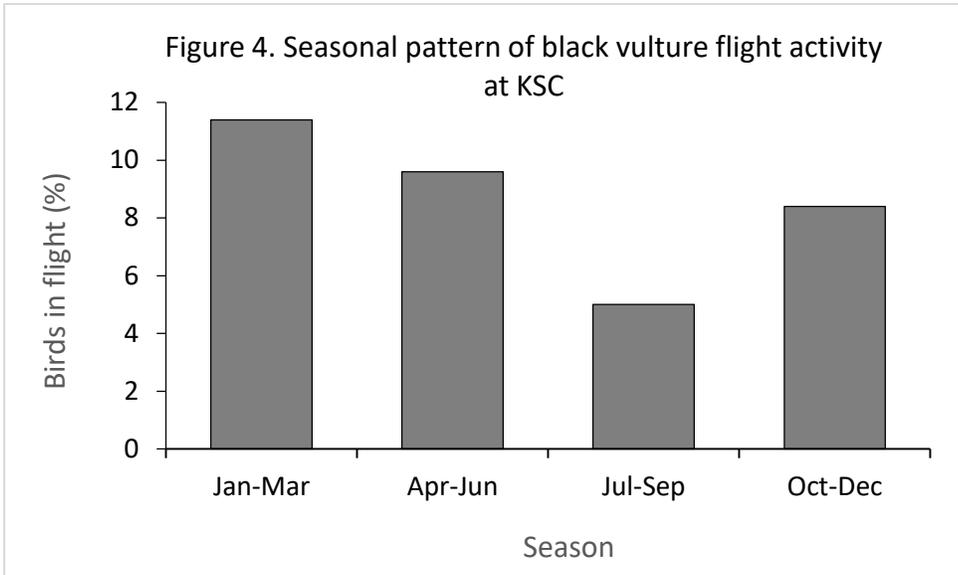
Across all birds and seasons, 7.7% of total records birds were indicative of birds in flight. This compares to 8.4% for the 11 black vultures tracked in a previous study at Marine Corps Air Base, Beaufort, SC (Avery et al. 2011).

The transmitted birds did not restrict their movements to the Space Center. This was exemplified by BLVU PMH which ranged from KSC to Florida's Gulf coast and into south Florida.



Thus, to make our analysis of their movement patterns more relevant to the KSC, we selected just the locations falling within the boundary of the facility (Figure 3).

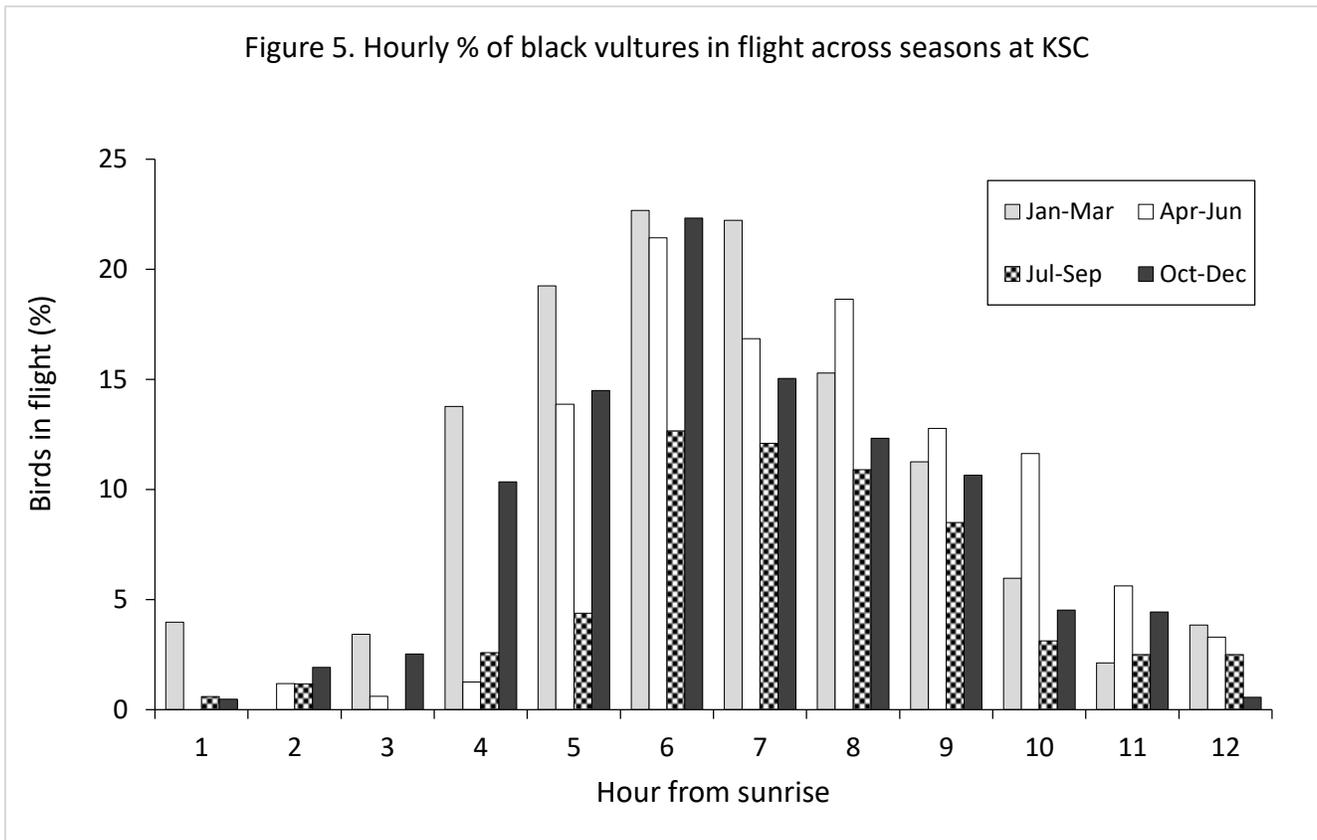
We adjusted the times of the resulting 8001 records to express them in terms of hours after local sunrise (time = 0), and then calculated the hourly percentage of black vultures in flight for each of the next 12 hours. With this



more focused sample of locations, the overall percentage of black vultures in flight at KSC was 8.5%. The seasonal pattern of flight activity for these 7 transmittered birds at KSC reflected the same pattern we observed at Beaufort, with maximum flight activity (11.4%) occurring during the January-March, and minimal flight activity (5.0%) during July-September (Figure 4).

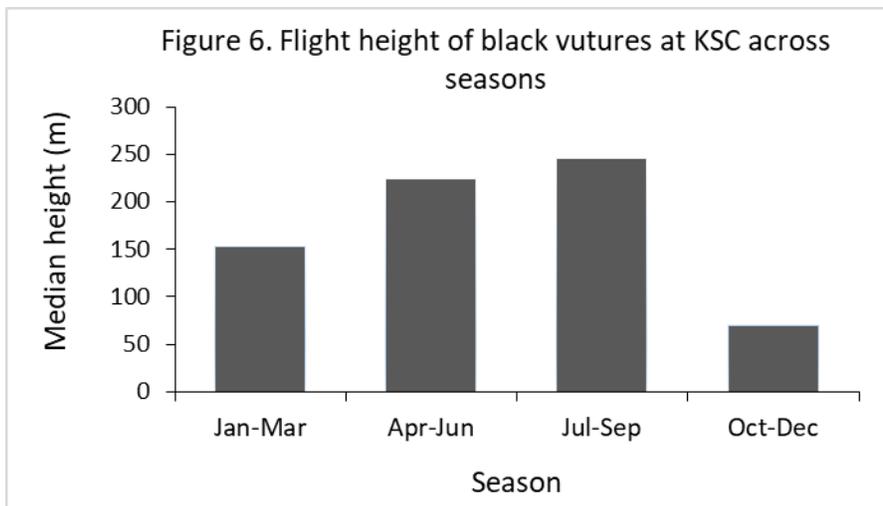
The pattern varied somewhat with season, but generally black vultures were in the air mostly during hours 5-8 after local sunrise (Figure 5).

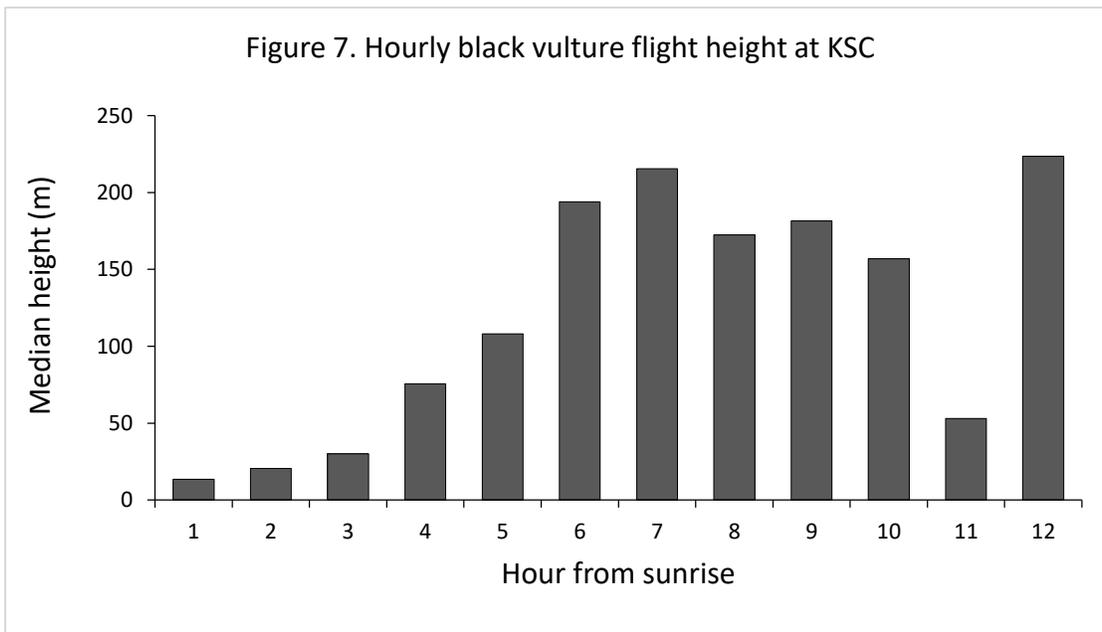
Figure 5. Hourly % of black vultures in flight across seasons at KSC



Median flight altitude of black vultures at KSC varied from 69.5 m during October-December to 246 m during July-September (Figure 6). During daylight hours, the median flight altitude increase steadily up to hour 7 after sunrise (215.5 m) and then remained at 157 m or greater through hour 10 before abruptly declining (Figure 7). The observed resurgence in hour 12 is difficult to explain except as the consequence of statistical vagaries associated with the small sample size (N = 14) for that hour.

Figure 6. Flight height of black vultures at KSC across seasons





SUMMARY

Black vultures tagged at the Kennedy Space Center represent a small fraction of the total number of vultures that potentially pass through the facility in a given week, month, or year. The area from which vultures are drawn to KSC extends throughout peninsular Florida and beyond into Georgia and South Carolina. Any efforts to implement population management strategies would have to account for this wide-ranging aspect of the population to be effective. Our results show that black vultures are mostly in the air during hours 5-8 after sunrise, and that when aloft, they are generally above 150 m. There is also a seasonal aspect to their behavior, with most activity occurring in the winter (January-March), and the summer months (June-August) having the least flight activity. Integrated management to reduce adverse impacts to property and human health and safety at specific sites will likely include intense harassment, removal of food resources, and application of perch deterrents.

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