

THE MANNER AND EFFICIENCY OF RAPTOR DEPREDATIONS ON BATS

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Large bat colonies such as those in the Carlsbad Caverns, New Mexico, attract many species of predators. The most significant are birds of prey, for they commonly feed on bats and are capable of taking them in flight (Bailey, 1928; Stager, 1941, 1948; Constantine, 1948; Eads, Wiseman and Menzies, 1957; Medway, 1958; Baker, 1961; Downing and Baldwin, 1961). Reptiles and carnivores, that might prey heavily on bats were they not terrestrial, are limited by the virtual inaccessibility of bats in their daytime roosts and by their flight habits. Only in a few congested bat caves are carnivores known to consume large numbers of bats. There are isolated cases of bat depredations by fish (Baker, 1961), amphibians (Kinsey, 1961; Elwell, 1962), birds other than raptors (Clay, 1959; Herreid, 1960; Wilks and Laughlin, 1961) and by rodents (Martin, 1961). Allen (1940) summarizes numerous references to fish, reptiles, birds, and mammals preying on bats and also lists spiders and ants as bat predators. Of all these, avian raptors are likely the most effective predators because when locally abundant, bats can constitute major proportions of raptor diets. Owl pellets from the Carlsbad Caverns are composed almost entirely of bat bones and fur.

The number of bats captured, however, is relatively insignificant, and birds of prey are but minor threats to colonies as a whole. The lateness of the hour at which bats emerge almost eliminates them from the diets of diurnal birds, and nocturnal birds are incapable of pursuing and capturing individual bats. Therefore, raptors are a threat only for the relatively short time that bats exit *en masse* from a cavern entrance in the early evening.

During that short time bats are extremely vulnerable. They emerge in dense streams for hours and by hundreds of thousands. In flight, bats are slow, compared to birds, and can be overtaken quickly. Yet, it is surprising that some birds are inefficient at catching bats and the number of captures versus the number of attacks varies greatly among the different species. For example, Red-tailed Hawks (*Buteo jamaicensis*) and Great Horned Owls (*Bubo virginianus*) have difficulty at times in catching bats, and they may miss repeatedly. Accipiters and falcons, however, seldom miss and the reasons lie in the manner of attack and the nature of the bird.

At Carlsbad Caverns National Park, park naturalists have had the opportunity for many years to witness bird depredations on the large colonies of Mexican freetail bats (*Tadarida brasiliensis mexicana*) that exit each evening from the caverns. Through the years, six species of hawks, one falcon, and one owl have been observed. They are: the Cooper Hawk (*Accipiter cooperii*), Sharp-shinned Hawk (*Accipiter striatus*), Swainson Hawk (*Buteo swainsoni*), Red-tailed Hawk, Ferruginous Hawk (*Buteo regalis*), Marsh Hawk (*Circus cyaneus*), Sparrow Hawk (*Falco sparverius*), and Great Horned Owl.

Of the hawks, accipiters are the most efficient. Their method of attack is described by Park Naturalist T. Homer Black (1956): "This bird [Cooper Hawk] chooses an individual bat, pursues it by matching every rapid dart and turn . . . Normally the bat is seized solidly . . . and fully ninety percent of the time the bird secures its intended victim."

The buteos, at their best, are about half as efficient as the accipiters. Swainson and Ferruginous hawks are better than Red-tails and in his observations of a Swainson Hawk, Black (*op. cit.*) stated: "Much as the Accipiters, the Swainson Hawk flies in the bat flight picking out individual bats as its intended prey. Lumberingly, in compari-

son, it tries to match the movement of its prey but as often as not the intended victim escapes its pursuer by rapid and erratic maneuvers which the hawk is incapable of duplicating." On August 23, 1944, a Swainson Hawk attempted to feed in a gusty breeze but missed a high percentage of its strikes. On the evenings of August 22, and September 9, 1944, one of these hawks caught bats easily in a slight breeze, taking six bats on each evening.

Of all the hawks, the Red-tail has the most spectacular manner of attack but it is the least efficient as a predator of bats. Black (*op. cit.*) describes the actions of this bird: "Its method of operation differs radically from that of the Accipiters and Swainsons which are quite similar. Moving along a hundred feet or more above the column of bats, this bird closes its wings and drops like a stone into the swarm of bats below. By the time it reaches the column the bats have scattered widely and the Red-tail grabs futilely for them. Flying through the scattered swarm, the bird turns and snatches at nearby bats but its maneuvers are so slow the bats have little difficulty in avoiding the hawk and rarely is the Red-tail successful in taking one. So futile are its efforts it would seem its actions are more in the nature of sport rather than a serious attempt at securing food. One evening a Red-tail was observed to make 43 individual passes at the flight, during the course of an hour, and securing from its efforts only a single bat."

On the evening of September 15, 1944, a Red-tail was observed to plunge some 600 feet into the bat flight on one of its many dives. Constantine (1948) in describing the activities of Red-tails at Bracken Cave, Comal County, Texas, said: "They would soar through the compact stream of emerging bats five or six times before catching one in their talons." These observations indicate an efficiency of at least 20 per cent, probably as high as this bird ever attains.

At Frio Cave, Uvalde County, Texas, I observed a Red-tail taking bats in a manner somewhat different from that described above. Instead of making high dives, the hawk flew slowly, a foot or two above the stream of bats which extended out from the cave entrance for several hundred feet. Following along, it finally dipped, grabbed a bat, and flew off. The bats made no evasive maneuvers and apparently were relying upon the density of their numbers for protection. It is interesting to note that the bats scattered widely when attacked from above but made no attempt to evade the hawk when it followed directly behind.

There are only sporadic occurrences of Sparrow Hawks at the Carlsbad Caverns. The most extended visit of this bird was during October of 1959 and 1960. Park Naturalist Paul F. Spangle and I observed the falcon capture several bats. In 1959 the bird was observed from October 6 throughout the remainder of the month, but it was not until the evening of the 16th that it attacked the flight. The bird entered the flight several times and caught a bat on each occasion but dropped it after flying a short distance. It consumed the last bat caught and then flew into the cavern entrance where it remained for the evening. If this one evening is indicative of the bird's overall efficiency, this Sparrow Hawk was close to 100 per cent efficient although it kept only one of the first several bats captured.

On numerous occasions the Sparrow Hawk flew into the cavern entrance and remained for long periods of time. Whether or not it pursued bats inside or went in to rest could not be determined. On October 21, 1960, the bird attacked the return flight at 5:15 a.m., but it was not noticed if it captured a bat.

Sparrow Hawks do not remain aloft and soar as do buteos and accipiters. Instead, they sit for long periods atop yuccas or on stalks of sotol (*Dasyllirion*) near the entrance.

For many years the most consistent bat feeders were Great Horned Owls. One pair,

and sometimes their young, made regular appearances about sundown. They have not been seen at the entrance since 1953, and it is not known why they no longer appear. In at least one year, 1945, they nested on a ledge high inside the entrance. In other years they commonly nested in a canyon one-half mile away.

Of their feeding activities, Black (*op. cit.*) remarked: "Usually the male appears first, arriving while it is still quite light and before the flight begins. The birds begin feeding from the north or south slopes of Bat Cave Draw, flying back and forth through the column of bats from one slope to the other and grasping for their prey as they go. Rarely do they attempt to follow a bat that escapes their initial strike and in contrast to hawks, which alight only when a kill is made, the owls alight at the completion of each pass. Rarely do they return to the perch from which the strike was launched but continue on to the opposite side."

Being unable to outmaneuver bats, owls do not single out individuals and pursue them. They wait for the stream to become attractively thick and then drive through with open talons and strike by setting their wings, rearing to a sitting position, and thrusting out with their talons. Whether they hit or miss they proceed to the opposite side before launching another attack. Usually one attempt in about three is a successful capture. At times owls have been observed to take a bat in each talon although the occurrence is not common. If successful in an attack, the owl alights on a secure perch with its victim in its feet. It rips off both wings with its beak and rapidly devours the body.

Although the owl is less efficient than the other birds of prey, with the exception of the Red-tail, its ability to continue feeding after dark makes it a more dangerous enemy. One evening, one was observed to devour 27 bats in a period of approximately one hour.

One summer, for a period of more than two weeks, the male Great Horned Owl took the first several bats caught to the female. After thus disposing of six or eight, he devoured the remainder himself. That same year the pair brought down two young owls and allowed them to feed for a period of more than a week. That particular year was the only one in which more than two owls have been observed using the entrance of the Cavern for a feeding station at the same time.

In 1944, there were more species of raptors present than in any other year and observations were made on 196 consecutive evenings from May 1 through November 12. Great Horned Owls were present 103 nights (52 per cent); Red-tailed Hawks 20 nights (10 per cent); Swainson and Marsh hawks 16 nights (8 per cent); Ferruginous Hawks 4 nights (2 per cent); and Sharp-shinned and Sparrow hawks one night (0.5 per cent). From May 1 through July 31, the owl was the only species present. On August 1 the Sparrow Hawk appeared for one evening. Throughout the remainder of the month the only species observed was a Swainson Hawk. In September there were 17 nights when more than one species was present and 8 nights when there were as many as three. Of the three species there were as many as five individuals: two owls, two Red-tails, and one Swainson Hawk.

One falcon which is common about the bat caves of Texas but has not yet been observed at Carlsbad Caverns is the Peregrine Falcon or Duck Hawk (*Falco peregrinus*). Stager (1941, 1948), Constantine (1948), and Eads, *et al.* (1957) have reported on Duck Hawks feeding at Ney and Bracken caves, Texas, and describe them as very efficient bat catchers. Stager reported that Duck Hawks at Ney Cave began circling and making rapid dives directly above the mouth of the cave prior to the emergence of the bats. They kept up a steady cry, as if they were calling the bats to

come out, and the instant the bats appeared the band of six falcons went to work. Darting from above, or on the flanks of the column, the birds cut into the onrushing mass with talons set, and they seldom emerged on the opposite side without their prey held fast. The owner of Ney Cave informed Stager that the falcons had been catching bats at the cave for several years.

Observations seem to indicate that all the raptors take their prey with open talons. It has appeared at times, however, that accipiters at the Carlsbad Caverns struck with talons closed. Several times bats have been observed to fall below the birds after a strike was made, only to be recovered in mid-air. Whether they were actually killed with closed talons or had torn loose from an open talon strike is uncertain.

SUMMARY

Six species of hawks, one falcon, and one owl, have been observed feeding on bats at Carlsbad Caverns, New Mexico. A second species of falcon has been observed at other bat caves. The most efficient of these birds are fast fliers and single out individual bats. The slower the bird, the less efficient it is in pursuing individuals. The Red-tailed Hawk and Great Horned Owl, the least efficient birds, attack the flights as a whole and seldom single out individuals. Although the owl is not so efficient at capturing bats, it is the most dangerous predator because it can consume more bats because of its larger size, has the ability to feed well after dark, and is the most consistent bat feeder throughout the year. Duck Hawks, accipiters, and buteos soar continuously until a kill is made. Sparrow Hawks remain aloft for only short periods of time, and the owl alights after the completion of each pass.

The efficiency of the birds, expressed as a percentage of number of kills versus number of attacks is best rated as follows: falcons, about 90 to 100 per cent; accipiters, about 90 per cent; buteos, about 20 to 50 per cent; and the owl, about 30 per cent.

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Carlsbad Caverns National Park, Carlsbad, New Mexico, February 17, 1962.