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NEOTROPICAL VULTURE SCAVENGING SUCCESSION AT A CAPYBARA CARCASS IN EASTERN ECUADOR

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Sucesión de buitres neotropicales sobre la carcasa de una capibara en el Oriente del Ecuador.

Key words: Black Vulture, *Coragyps atratus*, Greater Yellow-headed Vulture, *Cathartes melambrotus*, King Vulture, *Sarcoramphus papa*, behavior, foraging, scavenging succession.

INTRODUCTION

Multiple species of vulture coexist in Neotropical lowland forests, creating a diverse avian scavenging community. Sharing ephemeral resources such as carrion among many scavengers creates high competition. Dominance among competitors largely depends on body size (Petrides 1959, Wallace & Temple 1987, Kendall 2013). Large-bodied competitors may be displaced by greater numbers of small-bodied competitors (Petrides 1959, Gomez *et al*. 1994, Kendall 2013). Species' preferences for carcass condition causes temporal variation in carcass use and promotes coexistence when competition is high (Lemon 1991). Species differences in foraging behavior and social hierarchy create further temporal variation in carcass use, resulting in scavenger 'succession.'

Neotropical vulture succession was observed in June 2012 along the Tiputini River, Ecuador, at a naturally occurring capybara (*Hydrochoerus hydrochaeris*) carcass. We observed changes in Neotropical species abundances as the carcass was consumed. A large carcass such as a capybara may be an infrequent occurrence in lowland forest, as most carcasses available in this habitat are small (Houston 1985). This event provided a unique opportunity to observe the interactions of multiple scavenger species. Few accounts exist of Neotropical scavenger succession in conjunction with carcass condition and none exist for Greater Yellow-headed (*Cathartes melambrotus*), Black (*Coragyps atratus*), and King Vultures (*Sarcoramphus papa*) concurrently.

METHODS

We studied scavenging succession on the Tiputini River, near the Tiputini Biodiversity Station (0º38'S, 76º08'W), Orellana Province, Ecuador. The study site is intact, lowland forest in the Yasuní Biosphere Reserve, 100 km ESE from the nearest city, Coca. We retrieved the adult capybara carcass from the Tiputini River on 25 June 2012. There were no openings on the body, although vultures attempted to feed on the carcass while it was floating in the river.

We placed the carcass on a high sandy riverbank away from rising waters, < 1 km from where it was originally encountered. The capybara carcass (estimated body mass: 45 kg) was staked into the riverbank to prevent it from being moved out of camera range. A heat- and motion-sensitive camera with a 30 s delay between photographs was used to document scavenger activity. We placed the camera 0.5 m high at the treeline on open beach, approximately 1 m from the carcass. The camera's field of view captured approximately 10 m^2 of beach. Individuals were counted and identified to species when possible. Given the small field of view, our analysis was largely limited to the immediate vicinity of the carcass. Vultures were not differentiated by distance from the carcass.

We documented carcass condition each day using a handheld camera. Percent carcass consumption was estimated by comparing photographs to the initial state of the carcass. During our brief visits, photographs taken with a handheld camera showed vultures beyond the camera trap's field of view. Handheld photographs supplemented missing data. Our visits were at 10:39–11:30 h (day 1), and 10:44–10:50 h and 13:27–13:50 h (day 2). No vultures remained while we were present.

The camera trap was set up at 17:30 h EST on 25 June 2012 (day 0), and subsequently removed at 13:15 h on 28 June (day 3). Images were recorded on 26–28 June. Pictures were taken only from 11:30 h day 1 to 10:44 h on day 2, and from 13:50 h day 2 to 10:43 h on day 3 due to technical difficulties. Fewer photos were taken on day 3 than expected because activity was outside the field of view after the carcass was dragged from its stakes. Due to detection failure and the small field of view, we consider the images taken as representative of the changes in group composition and not true species abundances at the carcass. We interpreted the maximum number of individuals photographed together as the minimum number present within the same time interval.

RESULTS

No vultures returned to the carcass on day 0. Only Black and Greater Yellow-headed Vultures were present on day 1, while all three species were present concurrently on day 2. Greater Yellow-headed Vultures were photographed sporadically on day 2 and did not return on day 3. The number of Black Vultures increased throughout day 2, reaching 18 individuals in the afternoon (Fig. 1). Nineteen Black Vultures were present the morning of day 3. On day 3, one adult and one juvenile King Vulture were photographed separately, but within 30 min of each other. Although the carcass had been dragged out of view, the behaviors of vultures photographed suggest that there was little scavenging activity. The maximum numbers of birds observed were four Greater Yellow-headed Vultures, nineteen Black Vultures, and six King Vultures.

King Vultures did not arrive until day 2 when there was significant activity at the carcass. The first adult King Vulture arrived in the morning. It fed and departed, then returned less than two hours later with a second adult and a sub-adult. A second family unit of King Vultures (one adult and two juveniles) was present in the afternoon of day 2. The six King Vultures were distinguished by plumage and family: there were three adults, one sub-adult (a 4–5 year old, indicated by mottled coverts), and two juveniles

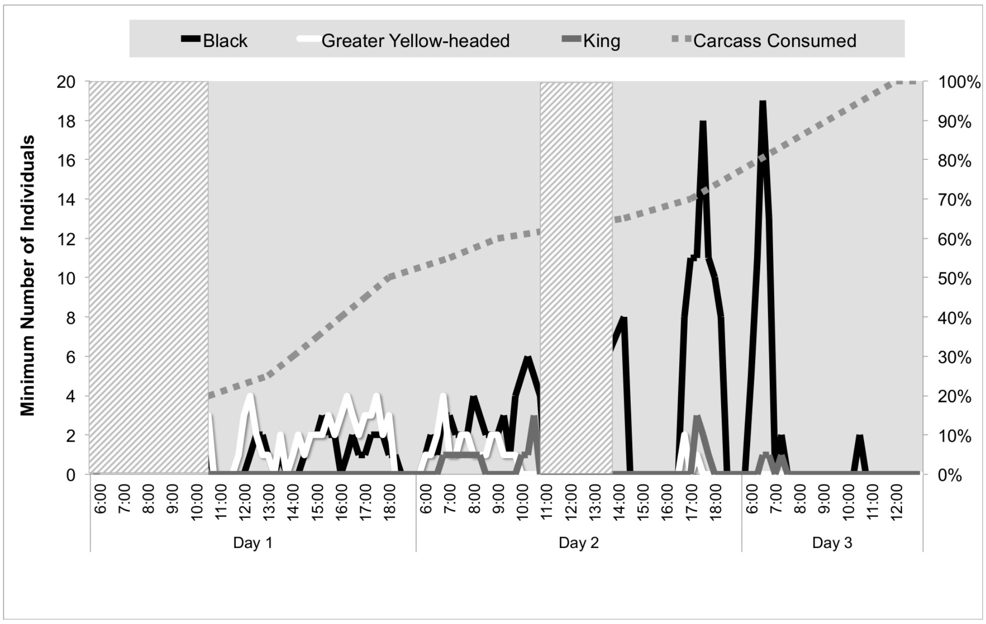

FIG. 1. Changes in composition of vultures photographed feeding on a capybara carcass in Yasuní, Ecuador over a three-day period. Vultures were photographed by detection using an automated trail camera. The maximum number of vultures photographed within 15 min intervals is given for each species. Missing periods of data collection due to camera malfunction are noted. Observation ceased at 13:15 h on Day 3.

(< 2 years old, with completely black plumage; Eitniear 1996).

There was a maximum of two unidentified individuals in any picture. Vultures were only photographed during daylight hours (approximately 06:00–18:20 h) and there was no evidence of nocturnal mammalian scavengers. Aside from decomposition by bacteria and arthropods, the carcass was consumed by vultures in less than three days. Black Caracaras (*Daptrius ater)* were photographed, briefly, in the distance on day 1 and day 2. Because of the number of large birds present, it is more likely that caracaras were investigating rather than attempting to feed.

The carcass was intact and bloated on day 0 (Fig.1). By midday of day 1, bloating of the carcass was significantly diminished, with a large opening exposing the ribcage. In the afternoon of day 2, there were openings at the lower abdomen, neck, shoulder, ribcage, and anal region of the carcass. Advanced decomposition was indicated by the cessation of bloating (Reed 1958). By sunset on day 2, the carcass was pulled from its stakes and dragged completely from camera view.

DISCUSSION

Black Vultures were the most abundant species and appeared continuously after midmorning day 2. The presence of King and Greater Yellow-headed Vultures was episodic as they were often temporarily absent from photographs. For example, four Greater Yellow-headed Vultures were photographed multiple times throughout day 1 and early morning day 2 (Fig. 1). Based on multiple occurrences of the maximum number of individuals observed, we can infer that individuals did not 'dine and dash'. Individuals, instead, lingered at the site, returning to the carcass multiple times. Similar numbers of Black Vultures were present before sunset on day 2 and immediately after sunrise on day 3. Black Vultures lingered at the carcass after it was mostly consumed. King Vultures did not linger as long at the carcass and only two individuals returned in the morning of day 3.

King Vultures appear to be highly social and recruit conspecifics to the carcass, as they commonly feed in pairs or groups of three (Wallace & Temple 1987, Houston 1988). We observed two families of King Vulture. The first adult King Vulture departed and returned less than 2 h later with two conspecifics, suggesting social relationships are important for King Vultures.

Black Vultures are also highly social and likely recruit other individuals to carcasses (Ward & Zahavi 1973, Rabenold 1987), which was evident in our study by the increasing abundance of Black Vultures with time. As reported by Houston (1988), Black Vultures arrived at the carcass in small groups throughout day 2. The lack of recruitment of individuals to the carcass on day 1, contrasted to the rapid recruitment on day 2, suggests that most of the Black Vultures were not near the site on day 0 or day 1. Black Vultures often follow other birds to find carrion (Rabenold 1987, Houston 1988, Buckley 1996). It is unsurprising that Black Vultures were attracted to carrion over great distances as they fly at high altitudes to facilitate visual detection of carcasses (Houston 1988) and lowland forests have little topographic variation with high visibility above the canopy.

Black Vultures are limited to forest edges (Graves 1992) and are found in greater densities with human settlements. It has been suggested that Black Vultures never occur in undisturbed forest (Houston 1988), however this study suggests otherwise. While there is some level of disturbance from the biodiversity station, which produces a small volume of trash that may attract Black Vultures, only a single pair of Black Vultures has been noted to regularly visit the biodiversity station to scavenge (JMM pers. observ.). At least 19 individuals were identified in this study, providing evidence that some numbers of Black Vultures persist in intact forest.

Though large numbers of Black Vultures dominated the carcass, there is evidence of interspecific hierarchy among Neotropical Vultures (Wallace & Temple 1987). On day 1, Greater Yellow-headed Vultures dominated the carcass due to the lack of interspecific competition. Greater Yellow-headed Vultures were, however, displaced in the presence of more birds. King Vultures appeared to dominate the carcass in the morning of day 2, supporting previous conclusions that King Vultures dominated smaller species (Wallace & Temple 1987). King Vultures often stood on top of the carcass and appeared to exclude other species from the carcass simply by their large size, reducing the number that could feed on a carcass at one time. King Vultures had a less dominant presence in the afternoon when there was a high abundance of Black Vultures. Greater Yellow-headed and King Vultures were photographed together the least, suggesting that King Vultures may competitively exclude Greater Yellow-headed Vultures.

Greater Yellow-headed Vultures were the first to leave the carcass completely, and were less active after the carcass was nearly half scavenged. It has been suggested that *Cathartes* vultures prefer fresh carcasses (Lemon 1991), but it is unclear from our results whether the departure of Greater Yellow-headed Vultures was due to competition or carcass condition. Black Vultures reached their maximum abundance when the carcass was largely consumed (Fig. 1). King Vultures showed little activity after this point, reappearing only briefly on day 3. This supports earlier observations that King Vultures do not scavenge on very old carrion, but Black Vultures will continue to scavenge (Lemon 1991). Carcass condition is a measure of scavenging activity, and has been used in previous scavenging studies (Houston 1986, Lemon 1991). Documenting carcass condition in this study both indicated scavenging activity and provided some ecological information about the scavengers.

Using a camera trap allowed us to observe vultures feeding without disruption; however, this limited the detail and concreteness of our results. The camera trap also documented carcass condition and allowed us to estimate carcass condition in real time, which assisted in filling information gaps and assessing whether it was due to a lack of scavenger activity or technical difficulty. But because of the technical difficulties we experienced using a camera trap, we did not fully capture scavenging activity at the carcass (Fig. 1). The camera trap was useful for aging and identifying returning King Vultures and for identifying species in poor light conditions. Multiple camera traps or empirical observation with a camera trap is recommended for future studies to further evaluate scavenger activity.

Sociality is important for the success of vultures in lowland forests. The capybara carcass was available to all three species, which may be a rare occurrence in lowland forest habitat where vultures instead feed on smaller carrion. This event allowed us to observe three Neotropical Vulture species concurrently. The number of Black Vultures present in this study suggests that there is potential for communication about the location of carrion among vultures in lowland forest systems, attracting individuals from great distances. Black Vultures are frequently seen in large groups in other regions but have not, to our knowledge, been documented in such high densities in lowland forest. This study provides important baseline information on scavenging succession within lowland forests; however, there is a need for more research on the ecology of Neotropical Vultures to fully understand their roles in lowland forests.

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