FEEDING HABITS AND INGESTION OF SYNTHETIC PRODUCTS IN A BLACK VULTURE POPULATION FROM CHIAPAS, MEXICO*

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RESUMEN

Los hábitos alimenticios e ingestión de materiales sintéticos fueron estudiados en la población del Zopilote común (*Coragyps atratus*) en el "Valle de Tuxtla", Chiapas, México, entre febrero y diciembre de 1985. La zona de estudio presenta un gran desarrollo agrícola y urbano. La vegetación original de este lugar fue bosque tropical caducifolio.

Se obtuvieron 115 egagrópilas al pie de perchas comunales en árboles y peñascos. Las egagrópilas se colectaron frescas por las mañanas, se midieron y posteriormente se expusieron directamente al sol por 18 hrs. Después de que los materiales sintéticos (plásticos, telas, fibras, etc.) fueron identificados visualmente, todas las muestras fueron colocadas en un horno a 53° C por 18 horas y se pesaron a continuación.

Los restos orgánicos de cada egagrópila fueron separados en grupos (pelos, plumas, plantas, etc.). Las muestras de pelos fueron identificadas utilizando como criterios principales el largo, color, forma de las escamas, grosor, etc. Estas muestras se compararon con otras colecciones de pelos de mamíferos.

Básicamente esta especie consume carroña de animales domésticos y se alimenta principalmente (58.2% de las egagrópilas) de carroña pesada (>3.0 kg; perros, caballos) y (51.3% de las egagrópilas) de carroña de animales de talla mediana (>0.5 <3.0 kg; gallinas, gato doméstico). La mayor parte de su alimentación ocurre en rastros y tiraderos a cielo abierto.

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Se encontraron restos de un tipo de presa en el 54% de las egagrópilas y materiales sintéticos en el 39.1%, de los cuales el 70% fueron restos de plástico. La ingestión de productos sintéticos puede ser una fuente importante de contaminantes químicos, como los plastificantes (PCB'S, ftalatos) entre otros compuestos, que están afectando la estabilidad de la población del Zopilote común en Chiapas, además de ser una causa potencial de muerte por asfixia al ser ingeridos. Es sabido que las poblaciones de esta especie están disminuyendo en toda su área de distribución. Es urgente desarrollar medidas para la conservación de esta especie de tanta utilidad para el hombre.

ABSTRACT

I studied Black Vulture (*Coragyps atratus*) food habits and ingestion of synthetic materials in the "Valle de Tuxtla", in Chiapas, Mexico between February and December, 1985. I collected and analyzed 115 pellets from under communal roosts. This species consumed basically carrion from domestic animals and fed more on heavy (>3.0 kg) carrion (58.2%). Most of feeding occurred in slaughterhouses or urban dumps.

Remains on only one prey were found in 54% of the pellets. In 34% of the total pellets I found synthetic materials; 72.7% of these were remains of plastic bags. The ingestion of synthetic products can be an important source of chemical pollutants as plasticizers, among others, that are affecting the stability of the Black Vulture population in Chiapas.

INTRODUCTION

The Black Vulture (*Coragyps atratus)*), know in Mexico as "Zopilote", is the diurnal raptor with the largest population and distribution on the American continent including Mexico (Brown and Amadon 1979, Alvarez del Toro 1980, AOU 1983, Wilbur 1983).

This bird prefers the lowlands and occurs there in all kinds of habitats; it has adapted well to the presence of human establishments where it has found a continuos food supply (Bent 1937, Wetmore 1965, Goodwin 1978, Stewart 1978). The feeding and foraging habits of Black and Turkey Vultures (*Cathartes aura*) have been described in the last nine years (Stewart 1978, Hernández *et al.* 1983, Paterson 1984, Coleman 1985, Rabenold 1986, Yahner *et al.* 1986). Earlier papers presented only superficial and quantitative data about the feeding habits of the Black Vulture.

At times, this species plays the role of predator, killing and eating sucklings of various domestic animals such as lambs, or preying upon iguana eggs, and baby turtles (Roads 1936, Bent, 1937, Sprunt 1946, Hagopian 1947, Lovell 1952, Sexton 1975, Brown and Amadon 1979). It has also been observed fishing (Jackson *et al.* 1978), and eating salt (Coleman *et al.* 1985). Frequently it acts as a scavenger, eating dead animals, human generated garbage, or rotten fruits and vegetables, including potatoes and even excrement (McIlhenny 1939, 1945, Haverschmidt 1947, Jackson 1975, Stewart 1978, Brown and Amadon 1979, Wilbur 1983). Sexton's study (1975), and Schlatter *et al.* (1978) are the only researches dealing with Black Vulture ecology in the Neotropics.

The pellet formation and composition of undigested and indigestible organic materials in falconiforms has been well documented (Fisher 1893, Errington 1930, Duke *et al.* 1976). The family Cathartidae is no exception, as the California Condor (*Gymnogyps californianus*), Andean Condor (*Vultur gryphus*), Turkey Vulture, and King Vulture (*Sarcoramphus papa*) produce pellets (Rea 1973, Duke *et al.* 1976, Peterson 1984, Coleman 1985, Snyder, Wallace and Wilbur, pers. comm.). Recently, Coleman (1985) and Yahner *et al.* (1986) have reported on pellets from Black and Turkey Vultures but did not separate the pellets of each species, because both species roosted in the same study area. Rabenold (pers. comm.), and Coleman (pers. comm.) found pellets of the Black Vulture in northeastern United States.

The ingestion of synthetic products, like plastics, is well documented in some species of procellariforms (Kenyon and Kridler 1969, Hays and Cormons 1974, Pettit *et al.* 1981, Bourne and Imber 1982, Furnes 1983, 1985a, b, Zonfrillo 1985). In raptors, Mundy and Ladger (1976) and Mundy (1982) report synthetic materials such as plastics, glass and china in the nest and in regurgitations of Griffon Vultures (*Gyps africanus, G. coprotheres*). Dobbs (pers. comm.) indicates the presence of synthetic materials at the base of cliffs below Cape Vulture (*G. coprotheres*) nests, and Coleman (pers. comm.) has found such materials in Black Vulture nests.

This paper reports Black Vulture feeding habits in urban and farming areas in the Neotropics, hair identification techniques from raptor pellets, and ingestion of synthetic products. Main objectives were to study carrion consumption by this population and to

know the source of possible environmental pollutants that may be affecting this species.

STUDY AREA, MATERIALS AND METHODS

The study area was "El Valle de Tuxtla" (16° 45' N, 93° 06' W) in the northeastern part of the "Depresión Central de Chiapas". Six vulture roosts were studied in "Reserva Ecológica del Zapotal" in "Cerro Hueco". The principal roost, where vulture pellets were collected, is a cliff 30 m high, surrounded by dead trees. Three other roosts were on live trees "Copalillo" (*Bursera* sp.) with 20 m or more in height, and two on live trees of "Cedro" (*Cedrella* sp.) with more than 25 m in height. These last five roosts were used only to roost overnight, and they were at no more than 250 m from the principal cliff.

One hundred and fifteen pellets were collected below the roosting places between February 4 and December 14, 1985. I selected only fresh and complete pellets during the morning hours, because most of them would otherwise have been destroyed by insects later in the day.

This area shows a high degree of farming and urban development; there are cattle ranches and few industrial plants. The municipal slaughterhouse and dump, poultry ranches, local zoo (ZOOMAT) dump, and farms are the places where vultures feed. The foraging range of Black Vulture in this area must be extensive as the distance from the roosts on "CerroHueco" to local zoo dump is 500 m or less, and to chicken ranchs 14 Km.

The average elevation is 530 m; the mean annual temperature is 25° C and the climate is hot and humid. The original vegetation was deciduous tropical forest (Miranda 1952), of which only some remains can be found on steep slopes (Rzedowski 1983).

The length of each pellet was measured. It was then exposed to direct sunlight for two days (18 sun hours). After the synthetic materials were visually identified, all pellets were placed in an oven for 18 hours at 53° C. and weighed later.

The organic remains of each pellet were visually separated into groups (hairs, feathers, plants, etc.). Later, samples of hair (more than 50 samples of hairs) from each pellet were cleaned following

the technique of Aranda (unpublished data). Plant remains were only considered if they were inside the pellet.

Hair samples were identified with a microscope, using a combination of the techniques of Dearborn (1939) and Kennedy (1982). The principal criteria used for identifying hair were length, color, shape and tickness. These samples were compared with the collection of wild mammal hair at the "Instituto Nacional de Investigaciones sobre Recursos Bióticos" (INIREB), and other collections of domestic mammals.

RESULTS

The Black Vulture roosts in the study area in places with little or no human disturbance such as cliffs, but also near major food sources such as poultry ranches.

The dimensions of the pellets were 12.8 ± 6.7 mm (SD), (range 19.4–89.6 x 16.0–50.7 mm), and the average weight was 1.9 g (range 0.57–12.9 g). Fifty-four percent ($n = 62$) of the pellets contained feathers of domestic chicken (*Gallus gallus*), and 27% ($n = 31$) of these pellets consisted of feathers only; one pellet contained hair of Collared Peccary (*Tayassu tajacu*) from carcass in a local zoo (Table 1). Of the total sample, 84 pellets contained hair, 4 contained bones, 4 contained chicken skin scales, 2 contained bills, and another 1 hoof (undetermined).

Remains of large mammals like horses (>3.0 kg, canine, equine) were found in 58.2% ($n = 67$) of the pellets, 51.3% ($n = 59$) contained remains of medium sized animals (>0.5<3.0 kg, chicken, cat), and only one pellet (0.8%) contained remains of a small mammal (*Rattus* sp.), (<0.5 kg).

One single food item was found in 54% of the pellets ($n = 62$), two items in 34% ($n = 39$), three items in 11.3% ($n = 13$), and only one pellet (0.86%) contained four different items.

Synthetic products were found in 39.1% ($n = 45$) of the total pellets ($n = 115$); 70% ($n = 37$) of them contained pieces of plastic bags (Table 2), (see Fig. 1). Furthermore, of the 44 items, 75% ($n = 33$) were white to gray in color, 16% ($n = 7$) were red to yellow, and the rest showed other colors. Finally, 97.7% ($n = 43$) of these materials had a soft texture and only one item was hard.

Table 1

Number and percent of pellets (n = 115) with homogeneous food composition.

Food remains	Homogeneous pellets. (Single food item)	%	Heterogeneous pellets. (>one food item)	%
Chicken (*Gallus gallus*)	31	27.0	31	27.0
Equine (ass, horse)	5	4.3	30	26.0
Goat (*Capra hircus*)	10	8.6	20	17.3
Pig (*Sus scrofa*)	7	6.0	5	4.3
Bovine (Zebu and Holstein)	5	4.3	16	13.9
Dog (*Canis familiaris*)	2	2.0	5	4.3
Domestic cat (*Felis catus*)	1	0.9	4	3.4
Muridae (Rat)	---	---	1	0.9
Peccary (*Tayassu tajacu*)	---	---	1	0.9
Vegetation (Seeds, leaves and fibers)	---	---	86	74.7

Table 2
Synthetic products found in 45 pellets.

Class	Products (n)	Percent of total pellets
Plastic bags	37	25.2
Rayon	5	4.3
Rubber bands	3	2.6
Plastic nipples	2	1.7
Plastic glove	1	0.8
Balloon	1	0.8
Plastic toothpick	1	0.8
Glass	1	0.8
Piece of cloth	1	0.8
Aluminum	1	0.8
TOTAL	53	39.1
Total pellets		115

DISCUSSION

The pellet analysis indicates that the Black Vultures in the Tuxtla Valley are opportunistic feeders. Their predominant foods are large animal carcasses found in urbanized and agricultural habitats, as described by Stewart (1978) and Coleman (1985) for analogous areas in the United States. I could not find remains of wild animals in the pellets, because this population basically feeds in urban and farm lands where wildlife is scarce; also they feed in places where food supply is continuous, like slaughterhouses or dumps.

The presence of vegetable matter, e.g., leaves, stems, etc., in the pellets was probably accidental; it was ingested when these vultures ate carrion on the ground (Paterson 1984, Coleman 1985, Yahner *et al.* 1986). However, the consumption of vegetable products in documented (McIlhenry 1945, Haverschmidt 1947, Brown and Amadon 1979). In the cities and towns of tropical Mexico where there is an abundance and high human consumption of tropical fruits, Black Vultures eat a great quantity of them (pers. obser.), but remains may do not appear on pellets because fruit tissues are soft. Alvarez del Toro and Cartas (pers. comm.) mention that these vultures frequently eat processed food for domestic animals such as "Purina", used in the local zoo. Furthermore when farmers are ploughing the land, it is common to observe some Black Vultures following the plow eating worms and insect larvae (pers. obser.).

Most of the research on Black and Turkey Vultures in North America states that both species coexist in large areas (Stewart 1978, Coleman 1985, Yahner *et al.* 1986). But in my study area the Turkey Vulture is only a rare winter visitor; during this study period I never saw both species eating or roosting in the same places together. Less than 10 years ago in the Tuxtla Valley, both Black and King Vultures were sympatric and synchronic species and both fed in the same places, but now the latter has been extirpated from this area (Alvarez del Toro, pers. comm.).

Why do Black Vultures eat synthetic products? I assume that these are accidentally consumed when the vultures break the plastic bags to reach the domestic wastes that have been placed inside. Nevertheless it may be that some products such as rubber bands are eaten intentionally because they are similar in texture and color

to flesh and may confuse these birds (Fig. 1). Or is it an extension of normal behaviour observed in young Cape Vultures called "Pica" by Dobbs and Benson (1984)?

The immediate effects of plastic products present in the environment may cause death to some vultures when these products get entangled with the neck, wings or legs, as has been documented in other birds (Walters 1984). Potential long-term effects of the ingestion of plastic products and other synthetic materials, include blockage of the intestine and ulcerations of the stomach (Bourne 1976, Pettit *et al.* 1981), and reduction of the functional volume of the gizzard and digestive capability (Connors and Smith 1982). If chemical pollutants are absorbed into the blood by pinocytotic digestion of microscopic particles in the intestines, appreciable residues of pollutants (like PCB's and Phthalates) may be stored in body tissues (Peakall 1975, O'Shea and Stafford 1980, Pettit *et al.* 1981). The strong proteolytic activity of the gastric juice of raptors (Duke *et al.* 1975) may help in digestion and assimilation of toxic chemicals. Our preliminary chromatographic studies of pollutants of this population of vultures indicate high levels of several organochlorines, and we suspect there are also residues of plasticizers (Albert, Badillo, Barcenas and Iñigo, unpublished data).

It is well documented that several populations of the Black Vulture are in decline in North America, Mexico, and Central America (Parmalee and Parmalee 1967, Russel 1973, Brown 1976, Porter and White 1977, Kiff *et al.* 1983, Stewart 1984, Alvarez del Toro pers. comm., Allan Phillips pers. comm.).

How much do pollutants affect the population dynamics of this species? During my study I found twelve dead Black Vultures in one roost area, but was not able to determine the cause of their death.

The many excellent studies of birds of prey over the last twenty years have shown that these birds are good indicators of the quality and management of the environment. For some fashionable species there are hundreds of research papers, for others no more than ten, as in the case of the Black Vulture, even though the latter may play important roles in ecosystems.

It is necessary to save dump deposits of slaughterhouses and cattle ranches because they are a important food resource for vultures, nevertheless urban dump deposits need to be covered with

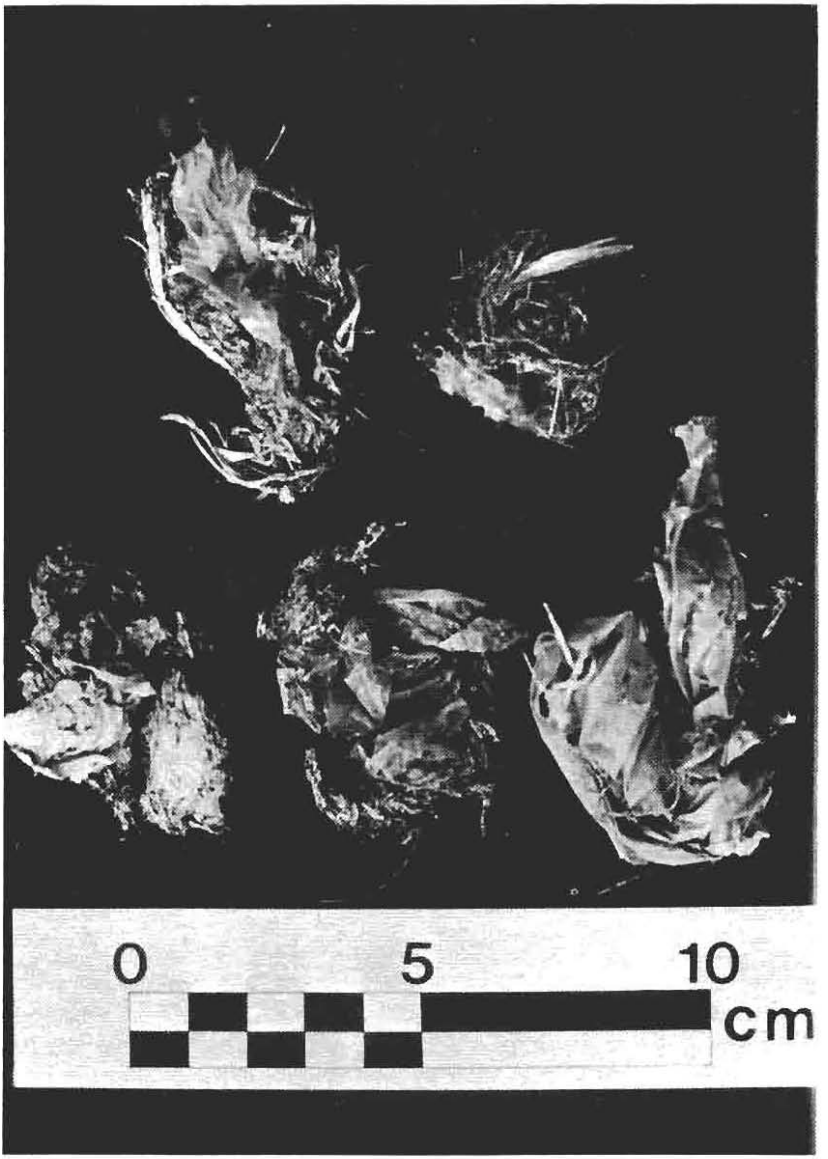

Figure 1
Black Vulture casting pellets with plastic remains.

earth to stop the ingestion of synthetic materials and proliferation of noxious animals (e.g. flies, rats). It is important to increase research efforts on the ecology and toxicology of Black Vultures and other Neotropical raptors.

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