# ARTICLES

## Scavenging and predation by Black Vultures *Coragyps atratus* at a South American sea lion breeding colony

**H.J. Pavés, R.P. Schlatter & C. I. Espinoza**

**Summary**

Many animal species benefit from resources provided by other species. Such species may develop or coevolve particular interspecific relationships (for example: competition, depredation and mutualism). During two sea lion breeding seasons (1996-97 and 1997-98), we observed behavioral interactions at the Punta Lobería Southern Sea-lion *Otaria flavescens* colony. We documented facultative mutualism, commensalism and depredation by Black Vulture *Coragyps atratus*, Kelp Gull *Larus dominicanus* and Domestic Dogs *Canis familiaris* on sea lions. Competitive relationships between Black Vulture and dogs were observed. We recorded depredatory behaviour by vultures on live seal pups. Black Vultures were the dominant bird consumer on carcasses in the absence of feral dogs. Sea lion mother displayed agonistically when Black Vultures approached their pups. Vultures fed on sea lion placentas and umbilical cords during the birth period. 12-17% of the sea lion pups suffered attacks by Black Vultures during our two season's observations. Dogs compete advantageously with vultures on seal pup carcasses. We postulate that the shift from mutualistic scavenging to depredation by vultures may be influenced by hunger stress due to competition with feral dogs for limited sea lion carrion.

**Resumen**

Distintas especies de animales se asocian y benefician de los recursos generados en una colonia reproductiva de lobo marino común (*Otaria flavescens*), desarrollando un conjunto de relaciones interespecíficas coevolutivas particulares (competencia, depredación, mutualismo, entre otros). Durante dos periodos reproductivos (1996-1997 y 1997-1998) se realizaron observaciones de las conductas interespecíficas en la colonia reproductiva de Punta Lobería (38º39'S; 73º29'W). Se registraron relaciones de tipo mutualista, comensal y depredadoras, entre Jote cabeza negra (*Coragyps atratus*), Gaviota dominicana (*Larus dominicanus*) y Perros domésticos abandonados (*Canis familiaris*) sobre *O. flavescens.* Relaciones competitivas entre Jote cabeza negra, Jote de cabeza colorada (*Cathartes aura*), Gaviotas dominicanas y perros domésticos fueron también identificadas. Los Jotes en ausencia de perros vagos tienden a ser los carroñeros dominantes en este tipo de gremio. Las madres de los cachorros de lobo marino común despliegan conductas agonísticas ante la aproximación de jotes quienes se alimentan de las placentas y cordones umbilicales

expulsados durante el parto. Se registraron conductas de tipo depredadora de jotes sobre cachorros vivos de lobo marino común. Entre un 12% y 17% de los cachorros sufrieron ataques por jotes durante ambas temporadas. Los perros vagos compiten en forma ventajosa con jotes por carroña. Se postula que la redirección de una conducta carroñera mutualista a depredadora, en el jote de cabeza negra, estaría influenciada por estrés alimentario, bajo el efecto competitivo dominante con perros vagos por cadáveres de lobos marinos.

**Introduction**

Some animal species establish themselves in reproductive colonies of vertebrates and, according to their ecological role, develop different types of interspecific relationships. Morin (1999) described these relationships as being either mutualistic (i.e. positive relationship between both species), competitive (i.e. negative relationship between both species) or depredatory (i.e. positive effect on the predator species and negative effect on the prey species). When analyzing the interspecific social behaviour described for sea lions (Otariidae), it is possible to identify some of those described by Morin (1999), such as depredation (Oosthuizen *et al.* 1997) and mutualism between avian scavengers and sea lions (Majluf 1992). Some of the identified mutualistic interactions, however, are facultative. In such cases the presence of a perturbing factor within the system can affect the stability of that relationship (Morin 1999). Thus, Aurioles & Llinas (1987) described changes in the mutualistic relations between gulls and sea lions towards one of a depredatory nature, with negative effects on the reproductive success of sea lions.

The different animal species which occur in a sea lion colony develop specific relationships, often site-specific and characteristic of that particular community or colony which is permanently trying to stabilize with adaptative behavioural strategies. This study identifies and describes the interspecific relations of a scavenging/depredatory guild generated by a temporal surplus of carrion during the early stages of the pup-guarding period in a South American sea lion *Otaria flavescens* colony at Punta Lobería, southern Chile. We also identify other types of interactions, perturbing agents and predators of *O. flavescens*. We suggest that a switch by Black Vultures *Coragyps atratus* from scavenging (mutualism) to predation, as well as the recent influx of dogs into the area, has caused instability within the colony resulting in the decline and desertion by sea lions.

**Study area and methods**

During the sea lion breeding seasons 1996-97 and 1997-98 (southern hemisphere summer) we investigated interspecific interactions between birds and sea lions at the sea lion colony of Punta Lobería

(38º39'S; 73º29'W, Chile; Figure 1). This colony consisted of about 2000-3000 sea lions, with a birth rate of 14.7 to 27.1% and an population mortality of 3.1–5.4% per season (population size 1995-1996 = 2857, sea lion death = 155; population size 1996-1997 = 2120, sea lion deaths = 66), and 16.9%-20.6% of pup mortality (sea lion pup deaths 1995-1996 = 75, sea lion pup deaths from 1997 - 1998 = 45) (Espinoza 2001). In this study, we recorded the behaviour of the following species in the sea lion colony: Kelp Gull *Larus dominicanus*, Turkey Vulture *Cathartes aura*, Black Vulture, and Feral Dogs *Canis familiaris*. Bird species were identified with the aid of a field guide (Araya & Millie 1996).

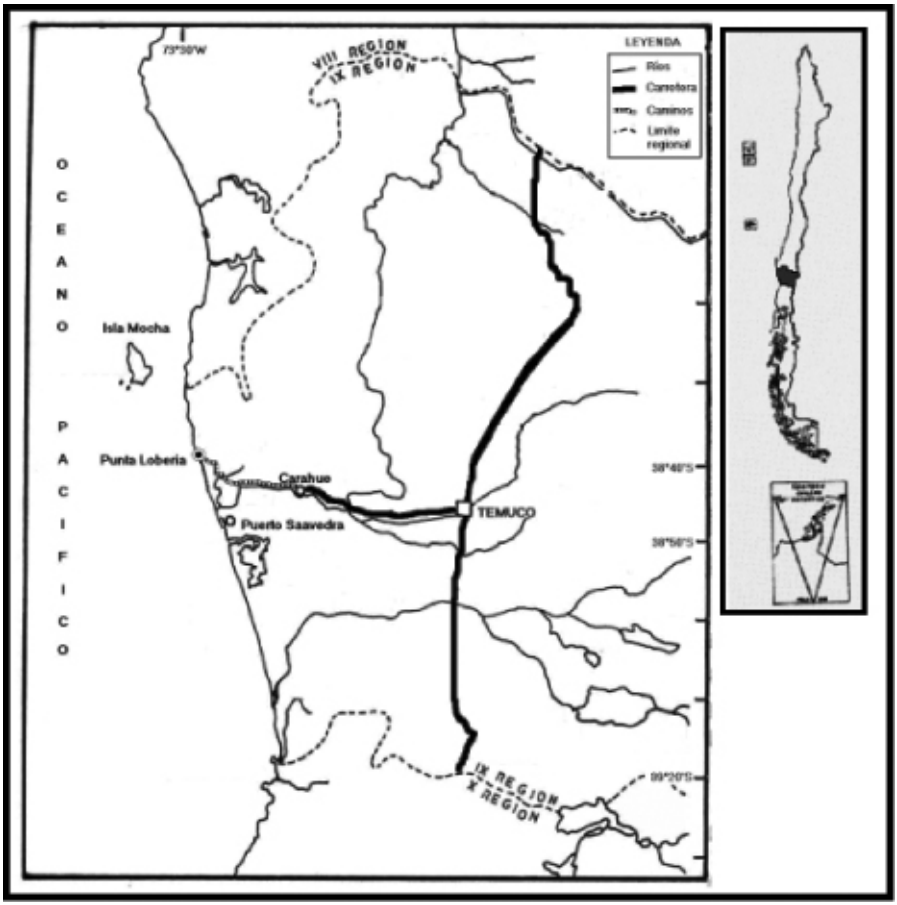


Figure 1. Geographic location of Punta Lobería (38º 39'S, 73º 29'W) on the coastal zone of the IX region, Chile (from Paves *et al.* 2005).

During the first sampling period we established the field camp between the 18 December 1996 and 28 February 1997. During the second season we did observation during November 1997 (22-23), December 1997 (6-7 y 20-21) and January 1998 (6-8). The camp was established between 13 January and 26 February 1998. Observations started at 08h00 and finished at ca. 20h00, sampling 69 and 58 days during the first and the second season respectively. Observations were conducted from coastal cliffs, about 80 m a.s.l., using binoculars (7 x10, 7-15x35) and photograph (Vivitar V3000, Nikon N2000 y Nikon FM10) and video (Ricoh 8x) cameras.

We observed three sectors of the sea lion colony (Playa Grande – reproductive area; coastal main rookeries non breeding assemblages; Playa Chica-reproductive and haul out site), and a nearby beach (Lobería beach-human settlement). We recorded scars and morphometrics (e.g. weight, body length) of dead or stranded sea lion pups on the different beaches, especially Punta Lobería. We also conducted periodic counts related to scavenging/depredation of birds and dogs on sea lion specimens.

**Results**

Vulture scavenging and predation

We recorded scavenging on sea lions mainly by Black and Turkey Vultures. On average 70% (76 of 108 individuals) of scavenging vultures were Black Vultures. We identified different types of behavioural interactions for these scavengers:

Interspecific interactions during birth

After the birth of pups and during the mother-pup recognition period, vultures of both species and Kelp Gulls approached the birth area to consume placental remains. During such approaches 89.4% of the sea lion mothers (42 of 47) displayed agonistic behavior, chasing birds away (e.g. bites and calls).

When pups are born and separated from the placenta, they retain a long umbilical cord. Vultures then approached pups to feed on the remains which are still attached to them. At this point they slowly pulled the pup away from the mother, behaviour which the sea lion mother immediately tried to prevent. After 1-36 min of birthing the placenta is expelled (n = 11 births, Pavés 2001). Vultures and Kelp Gulls fed on the umbilical cord as well as on the recently expelled placenta. Vultures rapidly consumed these tissues within 2-3 minutes, a shorter period than Kelp Gulls (i.e. 6-10 minutes). Gulls and vultures also fed on sea lion faeces, with the vultures driving away the gulls form this resource.

Alternatively, when pup births occur with the placenta, mothers tended to bury it and cut the umbilical cord, or permit vultures to feed on this remaning birth tissue (Table 1). This behaviour was recorded during both seasons without significant difference between the participation of mothers or vultures in the cutting of the umbilical cord through the breeding season (Gc test =

1.795, d.f.= 1, P > 0.05; Table 1). We did not observe mother sea lions eating the remains of the amniotic sac or the placenta.

Vulture attacks on live pups

We recorded a total of 0.06-0.10 attacks/day by Black Vultures on solitary (left alone) pups in the study area during 1996-97 and 1997-98. Some pups stranded alive on Playa Lobería beach had fine and/or deep cuts above the upper eyelids, presumably caused by pecking, following vulture attacks. During the 1996-97 and 1997-98 seasons, 12% (7 of 43) and 17% (4 of 24) of pups suffered such attacks (Gc test = 0.093, d.f. = 1, P > 0.05). Pups took evasive action on only five occasions when Black Vultures approached.

Scavenging on pup and other older sea lion carcasses

During the first season we observed three females returning from foraging trips displaying possessive and defense behaviour towards dead pups (i.e. approaching and sniffing carcasses, protecting them from inter-tidal waves and other sea lions). Six females also showed similar behaviour towards pups which were being scavenged by vultures. Each of these females chased vultures away, interposed their body or carried the dead pup away to more solitary areas. Females stayed close to the dead pups for 35-193 min, after which time they deserted the carcasses.

During both seasons we recorded cliff slides around most of the sea lion colonies (e.g. Playa Grande, main rookeries and Playa Chica). These precipice-slides caused mortalities of sea lions (3.2%, n = 80, and 1.1%, n = 21 of adult sea lions during 1996-97 and 1997-98, respectively; Espinoza 2001), most of which were dragged by the intertidal waves to Playa de Lobería beach where vultures and dogs scavenged on the carcasses. Scavenging birds first consumed the eyes, and then the navel, genitals and anus. After five to seven days the carcasses were reduced to skin and bones. Vultures consumed larger amounts of adult carcasses than of dead pups on Playa Grande and the main rookeries. During the first season, the vultures consumed 0.83 adult carcasses/ per observation day and in the second season they consumed 0.24 adult carcasses/ per observation day, decreasing by 71% between the seasons. During 1996-97 and 1997-98, the vultures fed on 0.17 and 0.10 pup carcasses per day, a decrease of 41% between the seasons. Vultures also fed on sea lion faeces, especially when sea lions moved about the colony. We also observed 37 vultures that pecked the anal region of sea lions before and during defecation.

Feral dogs

Attacks and scavenging

During the period of study we observed pups being killed by feral dogs on Playa Loberia adjacent to the seal colony. Pups, when dragged by waves and stranded on that beach, were attacked immediately by dogs from nearby rural settlements. Dogs preyed on an average of 0.62 and

0.41 pups per day during the 1996-97 and 1997-98 seasons, respectively, a decrease of 34% between the breeding seasons. The dogs fed not only on live pups, but also on carcasses of pup and adult sea lion. The rate of pup carcass consumption per day was 0.91 to 0.67 (i.e. a decrease of 26% between the breeding season), and from 0.33 to 0.12 adult sea lion carcasses per day (i.e. a decrease of 64%). Carcasses were consumed within two or three days, after which time they were reduced to skin and bones. We observed a progressive increase in the amount of dogs at this site. During 1996-97 we recorded six dogs identified individually; increasing up to 16 different dogs on Playa de Lobería (28 dogs were counted during summer 1998-1999).

Interference competition with vultures

We determined that total consumption of sea lions by dogs was significantly more than by vultures during the sampling period ($Gc = 8.030$, d.f. $=1$, $P < 0.05$). However, we deterimined that vultures scavenged a significantly larger amount of adult sea lion carcasses than dogs in the breeding colony. Dogs instead consumed a significant larger amount of southern sea lion pups on Playa Loberia ($Gc = 76.243$, d.f. $=1$, $P < 0.05$). When considering that the average weight of male and female pups was ca. 12 kg (Table 2), dogs would have consumed around 756 and 468 kg of pups during both seasons, respectively. This decreased significantly and by 38% between the two seasons ($Gc = 67.926$, d.f. $=1$, $P < 0.05$).

Another type of interaction observed was that of coastal seabirds, *L. dominicanus* gull and common sea lions. Kelp gulls consume also placental tissues and faeces of sea lions.

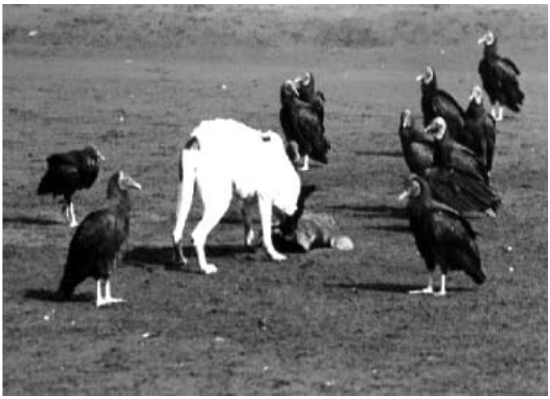

Figure 2. Depredatory action and competition by domestic/feral dogs and Black Vultures on Playa de Lobería. Punta Lobería, IX region, Chile.

Table 1. Participation frequency by South American (SAM) sea lion females and Black Vultures cutting new-born sea lion pup's umbilical cords at Punta Lobería, IX region, Chile.

| Group | 1996-97 n (%) | 1997-98 n (%) | Behaviour or action |
|---|---|---|---|
| Vultures | 16 (67) | 3 (30) | Umbilical cord consumption; separating placenta from pups |
| SAM sea lion females | 8 (33) | 6 (60) | Dragging pups and flattening placenta, thus cutting umbilical cord |
| None | | 1 (10) | Pup with complete placenta and umbilical cord |

Table 2. Morphometric measures of sea lion pups captured on Playa Lobería during seasons 1996-97 y 1997-98. IX region. N = sample size; SD = standard deviation.

| | Male | | | | | Female | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Breeding Season | | Total (cm) length | | Weight (kg) | | | Total length (cm) | | Weight (kg) | |
| | N | Mean | SD | Mean | SD | N | Mean | S D | Mean | SD |
| 1996-97 | 5 | 76.5 | 4.5 | 13.3 | 3.9 | 14 | 77.0 | 4.55 | 12.2 | 2.66 |
| 1997-98 | 1 | 76.5 | - | 8.4 | - | 3 | 76.8 | 0.29 | 11.0 | 2.64 |
| Mean | 6 | 76.5 | 4 | 12.5 | 4 | 17 | 76.9 | 4.57 | 12 | 2.61 |

**Discussion**

The Black Vulture is one of the most common scavenging birds along the southeastern Pacific Ocean (Murphy 1936, Mann 1954, Schlatter *et al.* 1978, Araya *et al.* 1986, Majluf 1992, Crovetto 1993). This gregarious species gathers at places where there is a continuous food supply, such as at seal colonies (Araya *et al.* 1986, Majluf 1992, Crovetto 1993, Pavés *et al.* 2002), guano bird colonies (Mann 1954), garbage dumps (Schlatter *et al.* 1978) and at fishmeal mounts near fishing ports in northern Chile (Roberto Schlatter pers. obs.), and this results in a patchy distribution. This plasticity of feeding sites and food types reflects the trophic behavioural adaptations of the Black Vulture, an opportunist and generalist species which has allowed it to be sucessful in different habitats (Housse

1933, Mann 1954, Barros 1962, Houston 1974, Schlatter *et al.* 1978). As people have been settling on the coasts with their hungry dogs and other domestic animals, scavenging by domestic and feral dogs on carcasses has become regular.

Vulture scavenging and predation

The behaviour displayed by Black and Turkey Vultures on carcasses and placentas was similar to that observed for the Andean Condor *Vultur gryphus* in Chile (Mann 1954), Sheathbill (*Chionis alba*) and Giant Petrels (*Macronectes spp.*) in Argentina (C. Campagna pers. comm.) and the Black-backed Jackal (*Canis mesomelas*) in South Africa (Oosthuizen *et al.* 1997).

Black Vultures often gather in large groups to exploit food sources, displacing other, more subordinate, species (e.g. Turkey Vultures, caracaras, chimangos, kelp gulls; Schlatter *et al.* 1978), and they are thus the dominant bird species in this scavenger guild. However, when a predator or carrion feeder of larger body size is present, Black Vultures are displaced from carcasses.

We suggest that the trophic plasticity of Black Vultures and their capacity to learn new behaviour is likely to underlie its ability to switch from a scavenging to a predatory role. This shift could be stimulated by the presence of more dominant competitors, like dogs, limiting the consumption of carcasses by Black Vultures at out study site (see also Schlatter *et al.* 1978).

Redirected feeding behavior by vultures is supported by this study as well as previous studies of scavenging birds in Chile (Housse 1933, Barros 1962). Thus, Black and Turkey Vultures, in places with little available food, may attack new-born lambs and eat other atypical prey items (Barros 1962). Such a switch does not appear to happen when food resources are abundant (Housse 1933, Barros 1962).

A similar switch in feeding behavior has also been identified among scavenging African vultures such as African White-backed *Gyps africanus* and Rüppell's Vultures *Gyps ruppellii* (Houston 1974). However, it is rather unusual that Black Vultures would attack live prey of greater size than itself, such as a growing sea lion pup (D. Houston pers. comm.). To solve difficulties likely to occur when encountering large prey, Black Vultures may attack in groups rather than as solitary individuals, thus increasing the likelihood of success of such attacks.

When classifying the relationship between non-predatory Black Vultures and sea lions we can consider it as being largely mutualistic in nature. This is because vultures obtain food resources from sea lions and the latter benefit by the clearing of potential pathogenic vectors associated with decaying carcasses and afterbirth remains. Mann (1954) mentioned that vultures control the outbreak of epidemics and sucking hemipterans. Furthermore, the acidity in vulture stomachs eliminate a large quantity of bacteria thus acting as a pathogenic filter (Schlatter *et al.* 1978).

This apparent mutualism between sea lion and vulture is however determined by the foraging behaviour and is facultative by nature because there is no strict dependence one on each other (*sensu* Jaksic 2000). This facultative mutualism may switch to depredation when the availability of food resources for vultures is reduced and alternative resources can be exploited (e.g. sea lion pups, new-born sheep, etc.). This behavioural change has been also observed in Western Gulls *Larus occidentalis*, which depredate on California Sea Lion *Zalophus californianus* pups (Aurioles & Llinas 1987; see also Breland & Breland 1961).

The participation of vultures cutting the sea lion pup umbilical cord has not been mentioned previously in the literature and seems to be tolerated by sea lion mothers. However, the aggressiveness with which Black Vultures eat placentas and the redirected predatory behaviour endangers the sea lion pups. Predation risk is likely to elicit the development of parental defensive behaviour and maternal care behaviour such as the rapid cleaning of pups, burying placentas, cutting the umbilical cord and aggressive behaviour towards vultures.

Feral dogs: competition with vultures

Before the arrival of domestic dogs on Playa de Lobería (Figure 1; PL) it was frequent to observe small sea lion haul outs within the study area according to information provided by local people. However, as people settled with their dogs and other domestic animals (e.g. cattle and horses), few sea lions were observed on the beach (up to 3 and 1 in 1996-97 and 1997-98, respectively). Thus, non-breeding assemblages and birth places are located at inaccessible places at Punta Lobería (e.g. Playa Grande, Playa Chica, Roqueríos y Peñón Pilolcura), presumably in response to the effects of such disturbance and predation risk.

The aggressive activity of dogs in front of other smaller animals, the rapid consumption of carcasses, and the burying of placental remains, results in competition between dogs and vultures (Pavés *et al.* 2002). This interference competition (dogs impede resource consumption by aggressiveness; *sensu* Morin 1999) and consumption of carcasses (dogs consume carcasses more rapidly than vultures find the buried placental remains; *sensu* Morin 1999) resulted in vulture displacement and decreased access to food.

Differences in the rate of adult or pup carcass consumption by vultures and dogs has different influences on the competitive relationship: (1) vultures fed on a larger amount of adult sea lions carcasses because these died as a consequence of local cliff slides at the breeding colony which is not accessible to dogs, (2) dogs ate more pups because these were washed ashore from the nearby breeding colony (thus easier access) and here they dominated over the vultures, (3) the decrease in scavenging rate on adult sea lions between the two seasons was the product of reduced mortality due to the local cliff slides and (4) the decrease of sea

lion pup scavenging by the dogs between seasons corresponded to fewer pups being washed ashore and breeding colony topography changes at local beaches (ver Pavés *et al.* 2005). Thus we postulate that in the absence of adult sea lion carcasses, due to reduction in local cliff slides, increases competition between vultures and dogs for drifted dead seal pups.

The high secondary productivity at Punta Lobería probably also attracts other predators (e.g. Pumas *Puma concolor*, South American Foxes *Pseudalopex culpaeus*; Oosthuizen *et al.* 1997, Portflitt & Gomez 1986) would justify the selection of this site for some management. Thus, we consider it necessary to (1) implement legal measures for feral dog population control and (2) limit human activity near the sea lion colonies and haul outs thus avoiding behavioural changes of sea lions as well as between the scavenging guild members which are disadvanted by the presence of dogs.

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