

Contributed Papers

Diet of Tapirs (*Tapirus terrestris*) Introduced in a Salt Marsh Area of the Baixada do Massiambu, State Park of the Serra do Tabuleiro – Santa Catarina, South of Brazil

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Abstract

A survey on the food items from salt marsh vegetation in the diet of the tapir was conducted in the Baixada do Massiambu, on the Serra do Tabuleiro State Park. From March to October 2004, eight animals, males and females of different ages kept in semi-captivity in a 160 ha area, were studied by means of direct observations and fecal analyses. Each consumed plant species was collected and identified, the consumed plant part marked, and each feeding event for each species counted. Eighty-two consumption events, from 32 species and 22 families of plants, were recorded. The consumed plant parts were leaves, small stems, flowers, bracts and ripe and unripe fruits. The most sought after plant parts were leaves and stems, followed by flowers and fruits. The most consumed plants were basically those of the herbaceous and shrubby orders. Predominantly, seeds of Butiá (*Butiá capitata*) and Jerivá (*Arecastrum romanzoffianum*) were found in the faeces. Tapirs feed on a great diversity of plant parts and species, thus evidencing, from the point of view of their diet, great plasticity in adaptation to the salt marsh area.

Introduction

Tapirs in the wild, as with the great majority of mammals, face declines in population numbers. These reductions are partly due to hunting (Bodmer, 1991) and partly to continuous loss of habitat (Richard and Juliá, 2000). Large mammals play an important role in molding the plant community, and herbivores are key elements for the dispersion of seeds, thus affecting various species of the understory, both in terms of their distribution and density (Dirzo and Miranda, 1991; Janzen, 1971; Fragoso, 2003). Dirzo and Miranda (1991) also affirm that more critical processes, such as the contemporary loss of animal species, may be a result of the alteration of herbivore patterns; again, due to the absence of the large herbivores.

The lowland tapir (*Tapirus terrestris*) was amply distributed throughout Brazil (Brooks *et al.*, 1997) and today stands among other species in danger of extinction. It has been deemed as vulnerable (IUCN, 2004). Notably, populations in the Atlantic forest are the most reduced and threatened due to habitat loss and fragmentation. Populations of the extreme South of Brazil are rarely, if ever, studied, especially regarding basic information such as management, distribution and density (Brooks *et al.*, 1997; Bevilaqua and Hermes Silva, 2002). The Atlantic forest has received historical pressures for nearly 500 years after colonization (Pádua, 2004). As a result, less than 8% of the forest cover remains in diverse fragments and in forest islands (Carvalho *et al.*, 2004). The constant loss of habitats, alongside the consequent genetic effects of

fragmentation, renders an even more critical scene than that hypothesized by Dirzo and Miranda (1991).

Under the present circumstances, studies for the reintroduction, genetic conservation and enhancement of the living conditions of captive animals are of paramount importance. In 1978, two tapirs brought from the northern Brazilian state of Rondônia (Brazilian Amazon) were introduced as part of the “Project for the Restoration of the Lost Fauna of the Baixada do Massiambu”, in an area of the Serra do Tabuleiro State Park (Parque Estadual da Serra do Tabuleiro – PEST), Southern Brazil. This project originated due to the necessity to restore the ecological balance of the coastal area of the park, which still held reasonably well preserved areas where botanical aspects were yet intact, but certain fauna had perished, especially mammals and certain great birds (Reitz, *et al.*, 1982).

These mammal and bird species were extirpated from the area as a result of human occupation in search of better living conditions in the proximities of the coast (real estate ventures), of tourism at the beaches and other sea attractions, and of the land use for agro-pastoral activities (Quadros and Cáceres, 2001) and other historical colonial pressures (Pádua, 2004). The list of lost species was created with the backing of research from zoological literature and of interviews with technicians and ex-occupants of the area.

Although the project was abandoned due to the lack of human and financial resources, some animals were maintained in an enclosed area at the visitors' center (Bevilacqua and Tortato, 2003). Thus displayed, these animals act as flagship species assisting the park's ecological education program. For 26 years, the tapirs have been held in this system of semi-captivity, where they subsist and reproduce. Consequently, this study was conducted in order to document the dietary adjustment of the tapirs to this environment, since it is characteristic of all areas of salt marshes of the Brazilian coast (Brooks *et al.*, 1997). This unique habitat, today, as a result of human occupation, is rarely found.

Study Area

The PEST is one of the most significant units of Brazilian conservation protecting Atlantic forests, and it is the largest unit of integral protection of the state of Santa Catarina, made up of 90.000 ha (figure 1). Among the ecosystems of the park are: dense rainforests (with umbrophile plants), mixed rainforests, mangroves, high elevation grasslands, salt marshes, cloud forests, as well as insular ecosystems (Klein, 1981).

The park is situated in an important transition area between Atlantic vegetation, subject to strong tropical climatic influences (North of Brazil), and habitats subject to more temperate influences (Southern Brazil).

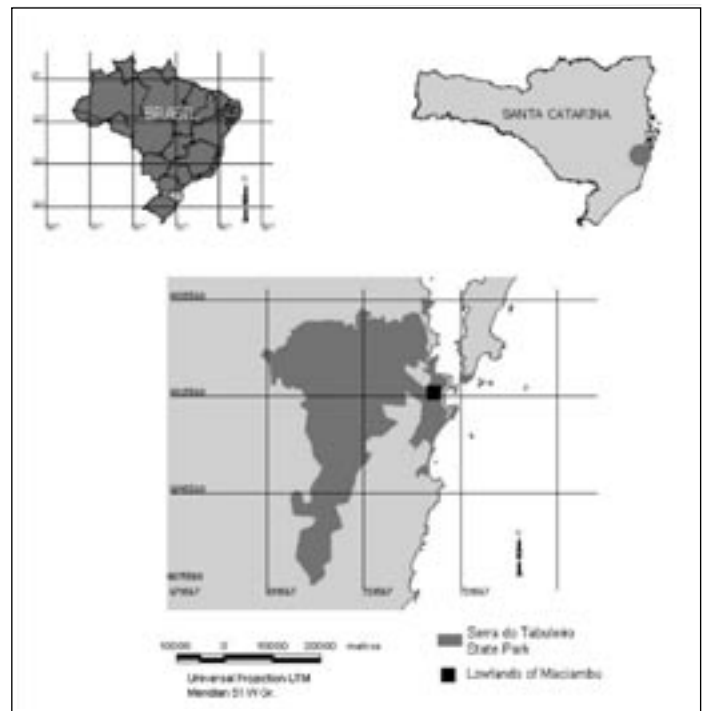


Figure 1. State Park of the Serra of Tabuleiro and area of study (Black Square).

Hence, it houses diverse plant and animal species, with areas of endemism, and for some taxa representing the southernmost geographical distribution limits.

The salt marsh area, located in the grasslands of Massiambu (central-western areas of the Park) (figure 1) is made up of 700 ha at 30-40 m elevation. The grasslands are totally covered with natural vegetation, which, according to Klein (1981), is predominantly constituted of herbaceous and shrubby species, with some sparse arboreal-shrubby agglomerations. Another characteristic of these low quaternary coastal areas is the edaphic condition of the sandy soil, which is distributed in the form of sand bars interspersed by permanent and temporary lakes. The climate is classified as subtropical humid, mesothermic (averages of 22°C), without strong drought seasons.

Within this habitat, a fenced area of semi-captivity was created encompassing 160 ha, retaining the representative prairie characteristics as described above.

Methods

Tapirs have subsisted in semi-captivity for many years and, apparently, have not faced major problems, for, according to handlers and park staff, there is no unfavorable history about them (deaths and disease). From an initial couple, today eight individuals persist



Figure 2. Direct daytime observations conducted when animals were spotted and followed. Note the aspect of the salt marshes (typical Brazilian coastal vegetation).

(various others have been moved to regional zoos), hence demonstrating that these animals have been reproducing – an excellent welfare indicator of wildlife in captivity.

Twice or three times per week, during the morning, the tapirs are fed pumpkin, cassava, cabbage, lettuce, banana, papaya and equine ration (Bevilacqua and Tortato, 2003). This alimentary supplement does not attend to the nutritional requirements of a large herbivore such as the tapir (Deutsch and Puglia, 1988). Furthermore, not all animals come to feed these supplements (personal observations).

To attend to their nutritional needs, the tapirs feed on various items from the vegetation of the salt marshes. To document the diet consumed by the animals within this area, direct daytime observations were made (figure 2) of eight tapirs, males and females alike of different ages. The survey was carried out during the year of 2004, from March to December, making up a total of 30 field days. The observations were done, when necessary, with the help of binoculars and with the largest possible observational distance to lessen any influence on the animals' behaviors. The tapirs were followed as long as observation was possible. Each consumed plant species was collected, identified and had its consumed plant part marked, and the number of feeding events for each plant was thus counted. Macroscopic observations of the feces were also conducted in the field.

Results and Discussion

Eighty-two consumption events of 33 different species in 22 families were registered. The consumed structures were small stems, leaves, flowers, bracts, ripe and unripe fruits (table 1). We observed that tapir consume a large range of plant species as well as diverse plant parts. Similar diets were accounted by Tobler (2002) and Acosta *et al.* (1996) with Baird's tapir (*Tapirus bairdii*) and Mountain tapir (*Tapirus pinchaque*), respectively, in which various genera and families were similarly found.

The first record of the consumption of pteridophytes by tapirs is noted. It was expected that tapirs feed on ferns, as this normally drought-resistant vegetation is widely available at the study site. Tapirs are selective animals (Salas and Fuller, 1996; Terwilliger, 1978) and search for various plant sources according to availability and nutritional need. Bodmer (1990) argues that the strategies of herbivory vary from the low rate of forage on highly nutritional foods (proteins and starch), to intensive forage of low nutritional quality (cellulose). Large non-ruminant ungulates, such as tapir, have the advantage of large fermentation chambers: they can rely on foods of low quality and do not need to expend time finding highly nutritional resources.

Analyses of preference for plant species showed that these approximated a normal distribution, notably with *Piper* (11 events), *Ludwigia multinervia* (9), *Miconia ligustroides* (7) and *Tibouchina urvilleana* (7), totalizing 54% of the consumption events. With exception to *Ludwigia*, the other three genera have been reported in the diet of tapirs: *Piper* (Richard and Juliá, 2000) in lowland tapirs, *Miconia* (Tobler, 2002) and *Tibouchina* (Naranjo e Cruz, 1998) both in Baird's tapir. These genera do not present great nutritional appeal but are more amply distributed in the area and thus seem to be commonly consumed by ungulates (Van Soest, 1982) when facing the absence of fruits of more nutritional value.

When evaluating the preference of plant families, a distribution close to uniformity among consumption events was observed. However, we note that Melastomataceae (16%) and Piperaceae (11%) outstood all, followed by Onagraceae (9%) and Clusiaceae (8%), making up 44% of the total of consumption events per family. Lizcano and Cavelier (2004) noted that the Melastomataceae family had the greatest number of consumed species in their studies with Mountain tapirs in Colombia. They also made note of the importance of *Miconia* (4 sp.) and *Tibouchina* (1 sp.) genera, the most abundant in our study as well.

These most frequent dietary families and species are predominant in the first stages of succession and thus indicate that tapirs can withstand well in modified areas. In figure 3, results show a greater number of

Table 1. Consumed plant species, their families, consumed structures and number of consumption events.

Species	Family (% consumption events per family)	Consumed Structures	N° of events	N° of events (%)	Habit
<i>Alchornea triplinervia</i>	Euphorbiaceae (7)	Leaves	5	6	Shrub
* <i>Blechnum serrulatum</i>	Blechnaceae (4)	Leaves & stems	3	4	Herbaceous
<i>Butia capitata</i>	Arecaceae (4)	Fruits, bracteal inflorescence, bract, unripe fruits	3	4	Shr / ST
Citrus sp.	Rutaceae (4)	Fruits	3	4	Small tree
<i>Clusia Parviflora</i>	Clusiaceae (8)	Leaves & stems	6	6	Shr / ST
<i>Cordia curassavica</i>	Boraginaceae (7)	Leaves, stems and flowers	3	4	Herb / Shr
<i>Cordia monosperma</i>	Boraginaceae	Leaves & stems	2	2	Herb / Shr
<i>Diodia</i> sp.	Rubiaceae (1)	Leaves & stems	1	1	Herbaceous
<i>Erythroxylum amplifolium</i>	Erythroxylaceae	Leaves & stems	1	1	Herb / Shr
<i>Eupatorium</i> sp.1	Asteraceae (3)	Leaves & stems	1	1	Herbaceous
<i>Eupatorium</i> sp.2	Asteraceae	Leaves & stems		1	Herbaceous
<i>Ilex dumosa</i>	Aquifoliaceae (4)	Leaves & stems		1	Herbaceous
<i>Ilex pseudobuxus</i>	Aquifoliaceae	Leaves & stems		3	Herbaceous
<i>Lantana camara</i>	Verbenaceae (4)	Leaves, stems and flowers	2	3	Herbaceous
<i>Ludwigia multinervis</i>	Onagraceae (9)	Leaves, stems and flowers	7	9	Herb / Shr
<i>Miconia ligustroides</i>	Melastomataceae (16)	Leaves & stems	6	7	Herb / Shr
<i>Myrcia rostrata</i>	Myrtaceae (7)	Leaves & stems	2	3	Herbaceous
<i>Ocotea pulchella</i>	Lauraceae (1)	Leaves & stems	1	1	Herbaceous
<i>Oxratea</i> sp.	Ochnaceae (1)	Leaves & stems	1	1	Herbaceous
<i>Philodendron bipinnatifidum</i>	Araceae	Leaves	1	1	Herbaceous
<i>Piper</i> sp.	Piperaceae (11)	Leaves and flowers	8	11	Herbaceous
<i>Psidium cattleianum</i>	Myrtaceae	Fruits	2	3	Shrub
<i>Psidium guajava</i>	Myrtaceae	Leaves	1	1	Small tree
* <i>Samambala</i>	Polypodiaceae (1)	Leaves & stems	1	1	Herbaceous
<i>Sida</i> sp.	Malvaceae (1)	Leaves & stems	1	1	Herbaceous
<i>Smilax campestris</i>	Smilacaceae (1)	Leaves & stems	1	1	Herbaceous
<i>Tibouchina urvilleana</i>	Melastomataceae	Leaves, stems and flowers	6	7	Herbaceous
<i>Tillandsia usneoides</i>	Bromeliaceae (4)	Whole plant	3	4	Climbing plant
<i>Vernonia scorpioides</i>	Asteraceae	Leaves & stems	1	1	Herbaceous
<i>Vernonia</i> sp.	Asteraceae	Leaves & stems	1	1	Herbaceous
<i>Vitex megapotamica</i>	Verbenaceae	Leaves & stems	1	1	Shrub
Non-identified Herbs		Leaves & stems	4	5	Herbaceous

* First record of a pteridophyte in the diet of tapirs. Herb – Herbaceous, Shr – Shrub and ST – Small Tree.

consumption events of plant species of the herbaceous habit (62%), vs. shrubs (26%), small trees (10%) and climbing plants (2%).

Foerster and Vaughan (2002) and Torres *et al.* (2004) found a noteworthy use of areas housing secondary vegetation, even when areas of primary forests were available. This preference is explained by the greater disposition of vegetation in the understory, thus facilitating consumption by tapirs (Foerster and Vaughan, 2002). Secondary areas hold a greater disposal of biomass at ground level and accessible to tapirs;

whereas primary forests concentrate greater biomass (leaves, flowers and fruits) in the upper strata, inaccessible to the animals. Results from other studies corroborate a greater frequency of consumption of plants of the herbaceous, shrubby, or of small tree habits (Torres, 2004; Richard and Juliá, 2000; Tobler, 2002).

In feces, leaves and stems were mostly found, and seeds were only found in some. When the latter were found, they made up the main constituent of the fecal bolus. The seeds were of the *Butia (Butia capitata)*

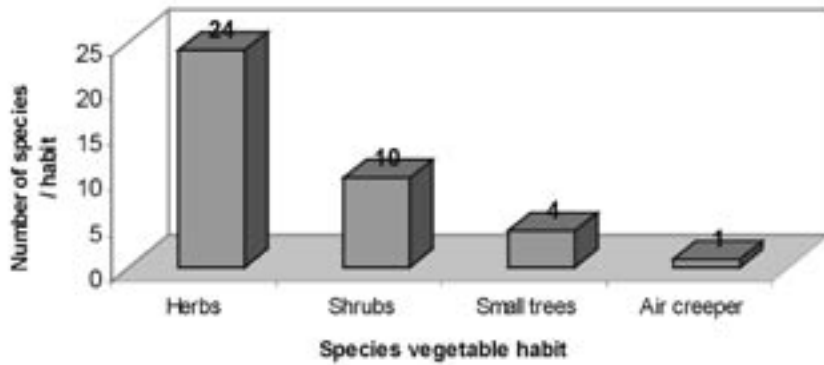


Figure 3. Habit of the plants among the consumed species. Some species occurred in two habits.

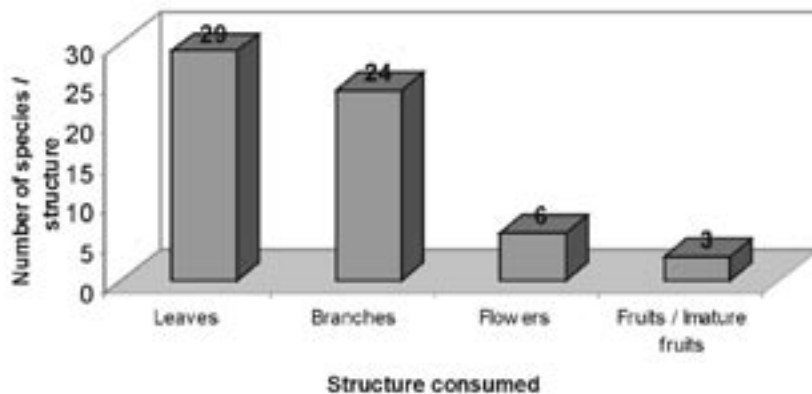


Figure 4. Most consumed plant parts.

and Jerivá (*Arecastrum romanzoffianum*) palm trees, both in the Arecaceae family. The faeces with seeds were found in periods of palm fruitage. When the fruits were ripe, they were intensely consumed, having registered predation over flowers, bracts and unripe fruits as well. This indicates an intense use of better nutritional quality resources when available. Galetti *et al.* (2001) found a low diversity of seeds in the feces of lowland tapirs, notably finding those of the Jerivá tree (*A. romanzoffianum*), achieving an average of $72,54 \pm 181$ seeds in 22 faeces during the dry season and $310 \pm 692,84$ during the rainy season, in a sampling of 10 faeces, where only 12% of the total possessed more than 100 seeds. Seasonal changes in the feces and an intense use of fruits when available were noted, reinforcing the selective behavior of the animals (Fragoso *et al.*, 2003; Janzen, 1982; Bodmer, 1991; Galletti *et al.*, 2001; Rodrigues *et al.*, 1993). Foerster and Vaughan (2002) attribute seasonal differences to the size of the used habitat and to the pattern

of animal distribution in face of the fruitage of certain plants. Another line of evidence is the overlap of areas used among animals which initially occupied different locations.

The presence of many seeds in feces seemingly contradicts the results found by Bodmer (1990), Torres *et al.* (2004) and Naranjo and Cruz (1998) that report in their fecal analyses more proportions of leaves and fibers than seeds. However, in figure 4, we show that the higher occurrence of consumption events of plant parts were for leaves (47%), followed by stems (39%), flowers (9%) and fruits (5%), thus concurring with the above authors.

Differences in number of seeds found in feces may be accounted for by their captive status, where the animals were fenced within a limited space with a much smaller area per animal (20 ha/individual) than found by Foerster and Vaughan (2002) in a natural environment (60-240 ha). Hence the animals were always close to the seasonal sources of fruits for forage.

Conclusions

The introduced tapirs at PEST exhibited high plasticity when adapting to conditions of captivity, using a diverse range of plant species and parts, including local fruits when available. This alimentary plasticity, the pattern of consumption of areas with herbaceous and shrubby vegetation (characteristic of degraded areas) along with selective feeding behavior and tolerance to the congested presence of several animals in small areas, raise questions for new judicious discussions and studies on the reintroduction of tapirs to the wild.

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