A literature review of the spider monkey, *Ateles sp.*, *with special focus on risk for extinction*

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SAMMANFATTNING

Litteraturstudie av spindelapan, *Ateles sp*., med fokus på utrotningsrisk.

Den här litteraturstudien summerar och tydliggör taxonomin, geografisk distribution, status, habitat, födoval, hotbild, social struktur och reproduktion för spindelapor, genus *Ateles*, med syfte att redogöra för varför många arter av spindelapor riskerar utrotning. Dessutom diskuteras möjliga åtgärder. De lever i subtropiskt till tropisk regnskog i neotropikerna från södra Mexiko till norra Bolivia. Idag finns det sexton erkända arter och underarter, av vilka tretton är listade som ”sårbar”, ”starkt hotad” och ”akut hotad” på IUCN’s röda lista över hotade arter, endast tre är rankade i den lägsta kategorin. Spindelaporna är en av de största arterna av nya världens apor. De tar sig snabbt fram med hjälp av deras långa svans med gripförmåga, har stora hemområden och föredrar orörd regnskog som habitat. De anses vara specialister på mogen frukt fastän de även har setts äta stora mängder omogen frukt och blad och kan även tillfälligt byta habitat i sökandet av föda. Spindelapan äter väldigt många olika arter av frukt beroende på säsong och tillgänglighet; arter från växtfamiljerna Moraceae, Myristicaeae och Burseraceae har rapporterats från fler områden. De är även viktiga fröspridare pga deras stora fruktintag, vilket kan spela en viktig roll i regnskogens sammansättning i ett längre perspektiv. De lever i ett könssegregerat så kallat fission-fusion gruppsystem, där flera små undergrupper som tillhör en större grupp förenas och skiljs om vartannat. De blir sent könsmogna och har ett långt reproduktionsintervall. Största hoten är avverkning av regnskog, förändring av habitat och inte minst jakt. Många av dess egenskaper och krav på habitat och föda gör den väldigt utrotningskänslig. Information om spindelapors ekologi och levnadssätt är viktig för bevarandet av arten.

SUMMARY

This literature review summarizes and clarifies taxonomy, geographic distribution, status, habitat and food choice, threats, social organization and reproduction of spider monkeys, genus *Ateles*. The aim of the study is to asses why spider monkeys are vulnerable for extinction and discuss possible conservation actions. Spider monkeys live in subtropical and tropical rainforest in the Neotropic ecoregion from southern Mexico to northern Bolivia. At the time sixteen species and subspecies are accepted, of which thirteen are considered as endangered, vulnerable or critically endangered at the IUCN’s red list; only three of them are at least concern. They are one of the largest New World monkeys. They travel fast with assistant by their prehensile tail, have large home ranges and prefer undisturbed old rainforest as habitat and are considered to be ripe-fruit specialists, although they have been seen to eat larger amount of unripe fruits and leaves and can temporally shift habitat in search for food. Many different kinds of fruits are eaten depending on the availability and season but species from Moraceae, Myristicaeae and Burseraceae family are reported from several sites. They are also important seed dispersals, which may play a role in the rainforest composition in long terms. They live in a fission-fusion system in sex segregated social groups, where small subgroups join and split. Reproductively they mature late and have long interbirth interval. Major threats are habitat reduction and not least hunting. Many of the spider monkeys characteristics and demand for special and large habitat and suitable food makes it very

vulnerable for extinction, and all this information is important for the conservation of the species.

RESUMO

Uma revisão de literatura sobre o macaco-aranha, Ateles sp., com foco no risco de extinção.

Essa revisão de literatura resume e esclarece a taxonomia, distribuição geográfica, status, habitat e escolha alimentar, ameaças, organização social e reprodução do macaco-aranha, gênero Ateles. O objetivo do estudo é avaliar as causas da vulnerabilidade à extinção e discutir possíveis ações para conservação. O macaco-aranha vive na floresta tropical e subtropical da ecorregião Neotropical, desde o sul do México ao norte da Bolívia. Atualmente 16 espécies e subespécies são aceitas, das quais 13 são consideradas ameaçadas, vulneráveis ou criticamente ameaçadas na lista vermelha da IUCN; somente três delas estão apenas preocupantes. Trata-se de um dos maiores macacos do Novo Mundo. Eles se deslocam rapidamente com a ajuda de sua cauda preênsil, têm grande area de vida e preferem mata preservada e antiga como habitat, são considerados especializados em frutos maduros, no entanto eles têm sido observados comendo grande quantidade de frutos verdes e folhas, e podem temporariamente mudar de hábitat em busca de alimento. Muitos tipos diferentes de frutos são comidos, dependendo da disponibilidade e da estação do ano, embora espécies das famílias Moraceae, Myristicaeae e Burseraceae tenham sido registradas em vários locais. O macaco-aranha é importante dispersor de sementes, podendo ter um papel na composição da floresta em longo prazo. Eles vivem em um sistema de fissão-fusão, em grupos sociais segregados por sexo, onde pequenos grupos se juntam e se separam. A maturidade sexual é tardia e apresentam um longo intervalo entre partos. As maiores ameaças são a redução de habitat e não menos importante a caça. Muitas das características dos macacos-aranha e a demanda por hábitat específico e amplo e alimentação adequada o tornam muito vulnerável a extinção, e todas essas informações são importantes para a conservação da espécie.

ZUSAMMENFASSUNG

Eine Litteraturstudie über Spinnenaffen, *Ateles sp*., mit speziellem Fokus auf Bedrohung einzelner Arten

Diese Literaturübersicht unfasst Taxonomie, geographische Verteilung, Populationstatus, Habitatwahl, Nahrungsvorlieben, Bedrohungen, soziale Organisation und Reproduktion von Spinnenaffen, *Ateles sp*. Die Studie diskutiert welche Spinnenaffenarten vom Aussterben bedroht sind sowie mögliche Gegenmaßnahmen. Spinnenaffen leben in tropischen und subtropischen Regenwald in der neotropischen Ökoregion vom Süden Mexikos bis zum Norden Boliviens. Zur Zeit werden sechzehn Arten und Unterarten allgemein akzeptiert, davon gelten laut IUCN's Roter Liste dreizehn als gefährdet, stark gefährdet oder kritisch gefährdet; nur drei Arten oder Unterarten gelten als nicht gefärdet. Spinneaffen gehören zu den größten Affen der Neuen Welt. Zur Fortbewegung benutzen sie ausser Händen und Füssen auch den Schwanz und legen große Strecken zurück. Sie bevorzugen unsprünglichen alten

Regenwald als Lebensraum und ernähren sich hauptsächlich von reifen Früchten. Zwischenzeitlich betseht die Nahrung aber auch aus größeren Mengen unreifer Früchte oder Blättern. Spinnenaffen essen viele verschiedene Arten von Früchten; je nach Verfügbarkeit und Saison z.B. Arten von Moraceae-, Myristicaeae- und Burseraceae-Familien. Spinnenaffen tragen stark zur Verbreitung von Samen gefressener Früchte bei, dabei spielen sie möglicherweise auch eine Rolle bei der langfristigen Zusammensetzung des Regenwaldes. Sie leben in nach Geschlecht getrennten sozialen Gruppen, die sich während der Futtersuche in kleinere Untergruppen aufteilen. Die Fortpflanzung beginnt spät und ist von einem langen Zeitraum zwischen den Geburten geprägt. Die größten Bedrohungen der Spinnenaffenarten sind Zerstörung des Lebensraums und nicht zuletzt Jagd. Menschliche Einflüsse umd die Anforderung der einzelnen Arten an große und spezifische Habitate mit geeignetem Futter machen sie anfällig für Ausrottung.

INTRODUCTION

Spider monkeys are one of the most endangered monkey species in the world. The taxonomy of the genus has been under discussion and is still yet not clear. Today there are sixteen accepted species and subspecies in the genus *Ateles;* there might be more to come. This literature review summarizes what has been written about spider monkeys considering their taxonomy, distribution, habitat and food choice, social organization, home range, today status and threats. Most literature in this review is based on research of free-ranging spider monkeys, although some data from captive monkeys are included. This review aims on giving a better picture of why the spider monkeys are so vulnerable for extinction and what their threats are today. To get inspiration and get prepared for this literature review and also to get a better understanding for the life and habitat of spider monkey I stayed at Cristalino Jungle Lodge, Alta Floresta, Mato Grosso, in Brazilian Amazonia, an area where the endangered *Ateles marginatus* live. We saw these spider monkeys on daily fieldtrips at several occasions. Since there is very limited literature available about this specific species, I have included all species and subspecies of genus *Ateles* in this review. Although a lot of research on some spider monkey species has already been carried out, more is needed for conservation success in the future. As a key species, spider monkeys are an important part of the fauna in rainforests and rainforests are required for the survival of spider monkeys.

Taxonomy

Spider monkeys belong to the family *Atelidae* and the subfamily *Atelinae,* genus *Ateles.* Their closest relatives are the howler monkeys, *Alouatta sp,* the woolly monkey, *Lagothrix sp* and muriquis, *Brachyteles* (Rylands et al., 2000).

History of taxonomy

Kellogg and Goldman (1944) were the first to report a complete taxonomy of the spider monkey species, based on the differences in pelage of the spider monkeys. The many different kinds of pelages, i.e. the fur and coat colour, can be explained as a result of many natural barriers leading to widely scattered habitats of widespread distribution of the spider monkeys. Kellogg and Goldman (1944) described four distinct species. First *Ateles geoffroyi* with the nine subspecies *A. g. geoffroyi, A. g. vellerosus, A. g.i yucatanensis, A. g. pan, A. g. frontatus, A. g. ornatus, A. g. panamensis, A. g. azuerensis* and *A. g. grisescens,* all distributed in Central America. Second was *Ateles fusciceps* with the two subspecies *A. f. fusciceps* and *A. f. robustus,* distributed along the Pacific Coast of north-western South America. Third was *Ateles belzebuth* and the three subspecies *A. b. belzebuth, A. b. marginatus* and *A. b. hybridus*; one subspecies located along the Magdalena River valley in Colombia, one in the northwest Amazon and one in the southeast Amazon. Fourth and final species was *Ateles paniscus* with the two subspecies *A. p. paniscus* and *A. p. chamek,* in the southwest Amazon and in the northeast Amazon, respectively (Kellogg & Goldman, 1944).

However, basing the taxonomy of the difference of the pelage has been questioned throughout the years. There is a wide range of variation in the pelage and coat colour within each subspecies. In addition, the colour of the coat can occur more or less in many subspecies (Silva-Lopez, 1996, Froehlich et al., 1991). Groves (1989) revised the taxonomy of *Ateles sp.* He suggested that *A. paniscus chamek, A. p. paniscus* and *A. p.*

marginatus were three different species whereas *A. belzebuth belzebuth* and *A. b. hybridus* were considered as subspecies after an evaluation of the geographical distribution. The taxonomy of other populations did not differ from Kellogg and Goldmans (Groves, 1989). *A. paniscus paniscus* was raised to an own species after a chromosomal investigation by de Boer et al. who reported *A. p. paniscus* to have 32 chromosomes compared to *A. p. chamek* having 34 (de Boer & de Bruijn, 1990). Sampaio et al. (1993) investigated two groups of *Ateles* that were classified by Kellogg & Goldman (1944) as one species but by Groves (1989) as two different species, *Ateles paniscus chamek* and *A. p. paniscus*, and could thereafter support Groves' theory that they are two different species (Sampaio et al., 1993). The conclusion of a study on geographical range of spider monkeys was that *A. g. pan,* by Kellogg and Goldman called the Guatemalan spider monkey, was a part of *A. g. vellerosus* with just some variation of the pelage (Silva-Lopez, 1996).

Based on the differences in karyotype, i.e. the profile of chromosomes, spider monkeys can be divided into four different groups (Medeiros, 1997); first *Ateles paniscus chamek, A. belzebuth belzebuth* and *A. b. marginatus,* second *A. geoffroyi* and *A. b. hybridus*, third *A. f. fusciceps* and fourth group and the only one certain *A. p. paniscus*. Medeiros et al suggested *Ateles paniscus chamek* to be the ancestral karyotype that originated in south-western Amazonia and spread eastward forming *A. belzebuth marginatus*, then forming *A. b hybridus* after a second migration to the Magdalena River Valley. *A. b hybridus* is then thought to have given rise to other populations in the Trans-Andes and to *A. paniscus paniscus* after a migration along the Caribbean coast (Medeiros, 1997). The conclusion of an analysis of cranial and dental variation by Froehlich et al. suggests it may only be three species of the spider monkey in three different areas. *Ateles belzebuth hybridus, A. fusciceps* and *A. geoffroyi* were grouped as one species with different subspecies located in Central America and Colombia. In Amazonia, *Ateles belzebuth marginatus, A. b. belzebuth* and *A. paniscus chamek* were grouped into *A. belzebuth* with the name of the subspecies kept constant. Also *A. paniscus paniscus* was raised to an own species in the Guianas (Guyana, French Guiana, Surinam and north-east Brazil). Thus, Froehlich (1991) suggested three species of spider monkeys. Collins & Dubach (2000) contributed to the taxonomy discussion by identifying four monophyletic species of Ateles based on mitochondrial DNA variation. *Ateles paniscus, A. belzebuth* with three subspecies*: A. b. belzebuth, A. b. marginatus* and *A. b. chamek, Ateles hybridus* and *A. geoffroyi* with the subspecies of Kellogg and Goldman (1944) plus *fusciceps* and *robustus*. (Collins & Dubach, 2000). Collins' and Dubach's results were strengthen by Nieves (2003), showing *Ateles paniscus paniscus* an own species due to the difference in chromosomal numbers. *A. hybridus* was also shown to be a specific species while *A. chamek, A. belzebuth* and *A. marginatus* remained one group and *A. geoffroyi* as a sistergroup to the mentioned (Nieves, 2003).

In 2001 the workshop "Primate Taxonomy for the New Millenium" was held by the IUCN/SSC Primate Specialist Group (PSG). Rylands et al. (2000) listed six species and sixteen subspecies which today are the most recent accepted taxons: *Ateles geoffroyi geoffroyi, A. g. azurensis, A. g. frontatus, A. g. grisescens, A. g. panamensis, A. g. ornatus, A. g. vellerosus, A. g. yucatensis, A.g. fusciceps, A. g. rufiventris, A. chamek, A. paniscus, A. marginatus, A. belzebuth, A. hybridus hybridus, A. h. brunneus.* The

difference from Kellogg and Goldmans' first taxonomy was placing *chamek, paniscus* and *marginatus* as own species (Rylands et al. 2000, Rylands 2001).

Groves published in 2001 the book Primate Taxonomy. The differences from Rylands et al. 2001 were that *fusciceps* and *rufiventris* were maintained as subspecies of *A. fusciceps*. *Ateles g. panamensis* and *A. g. azurensis* were synonymized and *A. g. frontatus* synonymized with *A. g. geoffroyi*, but *A. hybridus brunneus* was not recognized. (Groves, 2001 see Rylands, 2001).

Thus, the taxonomy of spider monkeys has been discussed and still is. New technologies in combination with studies contribute and justify changes of the taxonomy. The same situation seems to concern many of New World primate species.

Common names

The spider monkeys common names are frequently used, often to clarify when talking about the different species in terms of changing the taxonomy. Their common names are often a description of pelage, the area where they live or a name after the person who first described the species. Sometimes more than one name is used for the same species. In table 1, common names of the accepted taxons are listed (Rylands et al., 2000).

Table 1. Common names of the spider monkeys (Rylands et al., 2000)

Species and subspecies	***Common names***
Ateles geoffroyi geoffroyi	Geoffroy's spider monkey
A. geoffroyi azuerensis	Azuero spider monkey
A. geoffroyi frontatus	Black-browed spider monkey
A. geoffroyi grisescens	Hooded spider monkey
A. geoffroyi panamensis	Red spider monkey
A. geoffroyi ornatus	Ornate spider monkey
A. geoffroyi vellerosus	Mexican spider monkey
A. geoffroyi yucatanensis	Yucatán spider monkey
A. geoffroyi fusciceps	Brown-headed spider monkey
A. geoffroyi rufiventris	Colombian black spider monkey
A. chamek	Black-faced black spider monkey
A. paniscus	Red-faced black spider monkey
A. marginatus	White-whiskered spider monkey
A. belzebuth	White-bellied spider monkey
A. hybridus hybridus	Variegated spider monkey
A. hybridus brunneus	Brown spider monkey

Anatomy and characteristics

Anatomy and body mass

Ateles belongs to the subfamily *Atelines*, a group of monkeys with prehensile tails. Having a prehensile tail is very favourable when feeding in the canopy. When moving with tail assist the side-to-side motion is better controlled than moving without tail (Schmitt et al., 2005). The tail allows spider monkeys to swing and balance so they can travel fast. The tail is very long and distally it is naked. The body of *Ateles* is thin, arms and legs are long and slender with four functional fingers on the hands, and the thumb is absent or has no function (Kellogg & Goldman, 1944).

Spider monkeys are among the largest of the New World primates. The body mass of the adult female monkey ranges from 7.3 kg to 9.4 kg and for the male 7.8 kg to 9.4 kg. Of all the species of spider monkeys, *Ateles chamek* (Black spider monkey) is the largest with a female body mass of 9.3 kg and male body mass of 9.4 kg in (Smith & Jungers, 1997).

Colours and characteristics

The characters and colours of spider monkeys have been described carefully. As mentioned before, some of the typical colours and characteristics are used as common names. In table 2, the main colour and characteristics are listed for each of the subspecies based on Kellogg and Goldman's review of the spider monkey (Kellogg & Goldman, 1944). There are also variations within each subspecies and the colour and signs are not constant, even some overlapping between the subspecies can occur (Silva-Lopez 1996, Froehlich et al., 1991).

Table 2. Colour, characteristics and signs of the spider monkey (Kellogg & Goldman, 1944).

Species and subspecies	***Colour, characteristics, signs***
Ateles geoffroyi geoffroyi	Pale yellow-brown fur mixed with long black and brown hairs. Variable dark marks on head and limbs.
A. geoffroyi azuerensis	Very pale orange colour to golden with a black face.
A. geoffroyi frontatus	Black forehead, brown body, yellow belly, white side whiskers.
A. geoffroyi grisescens	Dusk yellow-grey to golden long hairs. Head and neck black.
A. geoffroyi panamensis	Intense dark red colour of body, brown or black face.
A. geoffroyi ornatus	Dark glossy yellow-golden fur.
A. geoffroyi vellerosus	Black head, neck and shoulder, pale yellow-brown body.
A. geoffroyi yucatanensis	Short and thin pelage. Brown-black head and neck. Dark face with pale cheeks. Grey-brown body.
A. geoffroyi fusciceps	Rough pelage, brown-black fur on body, brown head.
A. geoffroyi rufiventris	Deep black colour of body and flesh-coloured face, white hairs on chin.
A. chamek	Body and face with deep black colour, hairs are of middle length.
A. paniscus	Body with black fur and face flesh-coloured/red-faced. The hairs are longer than other spider monkeys.

A. marginatus	Deep black colour with white semilunar forehead and white side whiskers, the hairs are rather long compared to other spider monkeys.
A. belzebuth	Black upper parts and white under parts with a sharp line on the sides. The face black, forehead is white-golden-brown. Rather short pelage.
A. hybridus hybridus	Brown coloured fur on the upper parts and a white triangular forehead path. White or pale brown under parts. Side whiskers white to dark brown.
A. hybridus brunneus	Mainly brown

Geographical distribution

Spider monkeys are widely distributed in rainforests from southern Mexico, through Central America to north of Bolivia. Table 3 lists the country distribution of spider monkeys. Because of the difficulty to find data of the specific areas of recent distributions, the distribution is only listed of all the countries that inhabit spider monkeys. The specific areas are generally much smaller.

Table 3. Primate distribution, countries (Brazil Threatened Species Workshop participants, 2003, Rylands et al., 2003a, Primate Specialist Group, 1996, Rylands & Members of the Primate Specialist Group, 2000a, Cuarón et al., 2003a, Rylands & Members of the Primate Specialist Group, 2000b, Rylands & Members of the Primate Specialist Group, 2000c, Rylands & Members of the Primate Specialist Group, 2000d, Rylands & Members of the Primate Specialist Group, 2000e, Cuarón et al., 2003b, Cuarón et al., 2003c, Defler & Rodríguez-M, 2003a, Defler & Rodríguez-M, 2003b, Rylands et al., 2003b, Rylands et al., 2003c, Cuarón et al, 2003d).

Species and subspecies	***Geographic distribution***
Ateles geoffroyi geoffroyi	Costa Rica, Nicaragua
A. geoffroyi azuerensis	Panama
A. geoffroyi frontatus	Costa Rica, Nicaragua
A. geoffroyi grisescens	Colombia, Panama
A. geoffroyi panamensis	Panama, Costa Rica
A. geoffroyi ornatus	Costa Rica
A. geoffroyi vellerosus	El Salvador, Guatemala, Honduras, Mexico
A. geoffroyi yucatanensis	Belize, Guatemala, Mexico
A. geoffroyi fusciceps	Ecuador
A. geoffroyi rufiventris	Colombia, Panama
A. chamek	Brazil, Peru, Bolivia
A. paniscus	Brazil, Suriname, French Guiana; Guyana, Venezuela
A. marginatus	Brazil
A. belzebuth	Brazil, Colombia, Peru, Ecuador, Venezuela
A. hybridus hybridus	Colombia, Venezuela

A. hybridus brunneus	Colombia

Status

All species and subspecies of spider monkeys have been evaluated by the IUCN Primate Red List Authority. Statuses of all subspecies are listed in table 3, where only four out of the sixteen subspecies of *Ateles* are at least concern (LC), "a widespread and abundant taxa". Three of the *Ateles* are in the vulnerable category (VU), considered to be in a high risk of extinction. Four are in the endangered category (EN), considered very high risk of extinction. Most subspecies of *Ateles*, five of them, are considered critically endangered (CR), "facing an extremely high risk of extinction". *A. hybridus brunneus* and *A. g. fusciceps* are ranked as the most threatened of *Ateles* spp., though they are on IUCN's Top 25 list of the World's most endangered primates (IUCN, 2007).

Table 3. IUCN Red List status of spider monkey (IUCN, 2007). The status is decribed as least concern (LC), vulnerable (VU), endangered (EN), and critically endangered (CR).

Species and subspecies	**Status**
Ateles geoffroyi geoffroyi	LC
A. geoffroyi azuerensis	CR
A. geoffroyi frontatus	LC
A. geoffroyi grisescens	EN
A. geoffroyi panamensis	EN
A. geoffroyi ornatus	EN
A. geoffroyi vellerosus	CR
A. geoffroyi yucatanensis	VU
A. geoffroyi fusciceps	CR
A. geoffroyi rufiventris	VU
A. chamek	LC
A. paniscus	LC
A. marginatus	EN
A. belzebuth	VU
A. hybridus hybridus	CR
A. hybridus brunneus	CR

Habitat

Spider monkeys live in subtropical and tropical moist lowlands in the Neotropical ecozone (IUCN, 2007). They are habitat specialists, only inhabiting undisturbed old forest (Peres, 1993). Spider monkeys are mainly found in the higher strata of the forest. They are arboreal and spend most of their time travelling in the high canopy (Youlatos, 2002, Campbell, 2005), more than 20 meters above the ground (Mendes Pontes, 1997). They rarely descend to the forest floor but happens occasionally when eating soil or drinking water (Campbell et al., 2005), but never to travel (Youlatos, 2002). Many of the trees that are possible food resources for spider monkeys grow along rivers (Chapman et al., 1989). In north-eastern Brazilian Amazon, *Ateles* species was totally

absent in secondary forest compared to the adjacent primary forest (Parry et al., 2007). Although they are said to be habitat specialists *Ateles* species have been seen to be rather flexible in habitat choice, using four out of six different habitats in Maráca Ecological Station, northern Brazil (Mendes Pontes, 1997). They can temporally shift habitat for a larger availability for food (Wallace, 2006). Spider monkeys have been seen to live in young regenerating forest (20 years old) in Costa Rica, with trees not taller than four meters, and in other areas, also in Costa Rica, they have been seen to prefer forest at an approximate age of 75-100 years (Chapman et al., 1989a). One important factor of the habitat is the amount of food resources, though they primarily eat fruits (Pontes Mendes, 1997). One reason for why spider monkeys optimal habitat is primary forest is that secondary forest has a very different structure with more under storey vegetation and terrestrial growth, a lower and a more open canopy and significant smaller fruiting trees (Parry et al., 2007).

Ranging pattern and home range

Mean daily path length

Spider monkeys living in a nonseasonal, hyperdiverse environment have a longer mean daily path length than other spider monkeys. *A b. belzebuth* in Yasuní National Park, Ecuador, was studied by Suarez (2006) and the mean daily path length was 3311 meters. These monkeys had an extreme daily path length, visiting many different feeding patches all year around, just like other spider monkeys do only in the wet season (Suarez, 2006). Spider monkeys living in a seasonal environment spend more time travelling in wet season than dry season (Chapman, 1988). The mean daily path length of spider monkeys in Lago, Caiman, northern Bolivia, varied very much with season, from 1460 meters per day in February to 3541 meters per day in September when the wet season starts (Wallace, 2006). Wallace (2006) also found that the mean daily path length increases when the food availability increases and when the food is less abundant the spider monkey shift to a more foliovorus diet and spend less time travelling.

Size of home range

Spider monkeys have a rather large home range compared to other monkeys in the same habitat. Average size of the spider monkey home range in Santa Rosa, Costa Rica, was 62.4 ha. Fedigan et al. (1988) also found that home range varies with sex; female spider monkeys have smaller home ranges than male spider monkeys. They also saw a trend for females without a dependent infant to have larger home range sizes. There is also a relation between range size and weight for females with a dependent infant (Fedigan, 1988). The differences in ranging behaviour between male and female spider monkeys have also been showed by Symington (1988a). The females used only about 20-33% of the groups total home range area whereas male monkeys seemed to travel over the entire area and spent more time travelling. Symington's two study groups in Manu National Park, Peru, had a home range of 153 ha and 253 ha respectively, overlapping other groups with 10-15% (Symington, 1988a). Males travel more in the outline of their home range, possibly to defence their territory (Chapman, 1990). In Yasuní National Park, Costa Rica, the home range of adult females is 80 ha and home range of the male 350 ha (Dew, 2005).

Travel path and route-based travel

The travel paths and routes of the spider monkey are composed of linear segments. The segments lead to a food resource that many times is out of the expected visibility in the canopy. When the food-resource is exploited, a new segment starts in an other direction than the last segment. In contrast to the travel path during wet season the spider monkey gets more efficient during the dry season, and does not change the direction in the same extent and travels more in a forward direction. Using a spatial memory, spider monkeys can plan their travel to a food resource in advance (Valero, 2007). Ramos et al. (2004) found that spider monkeys use a type of random walks helping them to find new sites and not revisiting already exploited food sites (Ramos et al., 2004). In a certain time in the morning, around 10.30 am, spider monkeys do not travel any further away from their sleeping site. Monkeys may need to travel only a few meters or several hundreds of meters in search for the right food depending on the spatial and temporal variability (Ramos-Fernández et al., 2004). While travelling, spider monkeys use special paths in their home range, not using the entire area of their home range evenly. Many of these routes are also shared together with other monkey species, for example woolly monkeys. These routes are often located along ridges, which can help the monkey to find more fruits thanks to a better sight, it may also be a strategy to avoid predators and can be more energy efficient instead of travelling more up and down. The route-based travel may also play an important role in the social structure of the groups. The subgroups wait and join other groups in these paths and it makes it easier to let the monkeys to keep contact with each other. Data shows that it is possible that these routes are used over a long period (Di Fiore, 2007).

Food choice

Ripe-fruit specialist

Spider monkeys are strict herbivores and never eat animal food, unlike other New World monkeys (Izawa, 1993). They are ripe-fruit specialists and ripe fruits are an important part of their diet all year around (Suarez, 2006). The time spent on feeding is 19-20 % and searching for food only 1 %. Mostly they forage alone or in small groups as they move very quickly through the canopy (Dew, 2005). The composition of diet and ranging pattern are dependent on seasonal variations. Some fruits and leaves can be eaten all year around while some trees only have fruit seasonally (Chapman, 1988). Spider monkeys use the vision to recognize known food item and when presented unknown food items it also uses olfactory, gustatory and tactile cues (Laska et al., 2007). Up to 85% of their diet is composed of fruits. In a comparable study between spider monkeys and woolly monkeys in Yasuní National Park, eastern Ecuador, spider monkeys ate 349 different species of fruiting plants, mostly capsular fruits and fruits rich in lipids, like *Arecaceae, Lauraceae, Meliaceae* and *Myristicaceae.* 27% of the fruit-eating time is spent on lipid-rich fruits, meanwhile for example the woolly monkey, also a ripe-fruit specialist in the same subfamily, only spend 5% of the fruit-eating time for lipid rich fruits. Spider monkeys are more selective in the choice of fruit but less selective in which part of the fruit they eat and spend less time in mastication than the woolly monkey (Dew, 2005). In the same area as above Suarez found the spider monkey to eat more than 235 different species, most important species of the family *Moraceae* and *Myristicaeae* (Suarez, 2006). In the northern part of Brazilian Amazonia, spider monkeys were seen eating 25 species in a field study, mostly ripe or

unripe fruits of *Pradosia suriamensis* (*Sapotaceae*). Second most common tree was *Tetragastris panamensis* (*Burseraceae*), used only for fruits. It is very important with fruit trees that provide fruit throughout the year and the number of plants available. Figs are a very important resource for the spider monkey (Mendes Pontes, 1997), both in fruit-rich and fruit-scarce period (Felton et al., 2007). In Santa Rosa National Park, Costa Rica, fig species were the most commonly eaten fruit (Chapman, 1988). In a field study in Guatemala, the most common eaten fruits were *Brosimum alicastrum* (Moraceae) and *Ficus sp*. (Moraceae) (Cant, 1990). In Bolivia, spider monkeys ate figs all year around and also ate different fig species at different ripeness (Felton et al., 2007). Spider monkeys swallow a large amount of seeds without mastication them first (Felton et al., 2007), as much as 98% of the seeds have been seen swallowed (Link & Di Fiore, 2006), and compared with the woolly monkey they swallow more seeds (Dew, 2005). However, there have been a few examples where the spider monkeys spit out the seeds from large-seeded palms, (*Socratea exorrhiza*, *Astrocaryum murumuru*, and *Attalea phalerata*) (Felton et al., 2007). Many fruit types are eaten by both the spider monkey and the woolly monkey, which leads to feeding competition (Dew, 2005). The availability for food is correlated with the density of the spider monkey (Sorensen & Fedigan, 2000).

Leaves and flowers

In Yasuní National Park, Ecuador, 9% of the diet consisted of young leaves, shoots, buds and other parts of the plant (Dew, 2005). Species eaten among others were *Cecropia sp*. (*Cecropiaceae*), *Abuta sp.* (*Menispermaceae*). Young leaves of *Pentaplaris davidsmithii* (*Malvaceae*), buds, young leaves, petioles and stipules of epiphytic and hemiepiphytic *Anthurium* and *Philodendron* were available and eaten throughout the year. *Passiofloraceae* and mimosoid legumes (*Fabaceae*) were also commonly eaten (Dew, 2005). Only on rare occasions spider monkeys ate flowers, nectar or pollen; only 1% of the diet consists of flower. The small part of flowers eaten comes from species such as *Ireartea deltoidea* (*Arecaceae*), *Phrgmotheca sp*. (*Bombacaeae*), *Cecropia sp*., and *Pourouma sp*. (*Cecropoacae*) (Dew, 2005).

Other food choices

Occasionally spider monkeys eat epiphytic mushrooms. Spider monkeys never eat insects but they do eat termitaria of *Constrictotermes* found on the trees (Izawa, 1993). Although they are said to be strict herbivores, they have been reported to eat caterpillars representing 1% of their diet (Cant, 1990).

Soil and water intake

As mentioned before spider monkeys are arboreal and rarely descend to the ground (Campbell, 2005). However, they do occasionally, to eat soil, rotten wood or drink water (Izawa, 1993, Dew, 2005, Campbell, 2005). The spider monkeys eat the soil and drink water from special sites called salado sites (salt licks) (Izawa, 1993, Campbell, 2005). Many hypotheses have been discussed why soil seems to be an important part of their diet. The need for phosphor (Dew, 2005) and high mineral content in soil (Izawa, 1993) are suggested explanations. Another explanation why these monkeys eat soil when most other arboreal monkeys avoid the forest floor because of the predators could be that the spider monkeys may utilize safe sites thanks to the special group

composition of the spider monkey (Izawa, 1993). Campbell et al. (2005) showed differences between populations in question of descending to the ground to eat and drink. Southern American populations descended more frequently to the ground than those of Central America and Mexico for drinking water and eating soil, which can be explained by differences in climate, plants or soil (Campbell, 2005). It is not common for New World monkeys to drink from these special drinking sites, the need for salt to complement their diet is one explanation and it is clear that the use of these salado sites is closely related to a vegetarian diet (Izawa, 1993). Dew (2005) suggests the water consumption to be a consequence of their high intake of lipid rich fruits. Water can also be obtained from water-filled tree cavities and raindrops on leaves (Dew, 2005).

Seed dispersal

When spider monkeys use special travel paths, they may influence the forest composition. Fruits they prefer to eat are also those spread by defecation, increasing the amount of fruits in these paths over year and helping them to maintain their habitat (Di Fiore, 2007). Most seeds are after defecation still viable (Chapman, 1989a) and spider monkeys do not affect the germination time of the seeds (Stevenson et al., 2002). Studies show that spider monkey can spread more than 230’000 seeds per monkey and year, for an average distance of 443 meters and sometimes more than 1250 meters per day, eller?. This fact does not only affect the fruit availability for the monkeys in a long term, but also the forest composition may be altered when populations declines. It is therefore a way to keep and influence their habitat (Link & Di Fiore, 2006). Many seeds spread by the monkeys are also eaten again by other animal such as mice and peccaries, so called second seed dispersals, in that second transport many seeds may loose in quality whereas others may also increase in quality (Chapman, 1989a). Many seeds are defecated underneath spider monkeys sleeping trees but also during the day in their travel paths, seeds in these paths have been seen to have a better survival than those underneath sleeping sites (Russo & Augspurger, 2006).

Social structure, grouping and communication

Group size, composition and social structure

Spider monkeys live in small subgroups that join and split, so called fission-fusion structure. Most subgroups consist of 1-4 individuals but can be as large as up 20-30 individuals. Larger groups mainly form when drinking water from salado sites so a few monkeys can drink meanwhile the others are watchers for predators (Izawa et al., 1979). In Costa Rica, Chapman et al. reported the mean group size to be 4.9 individuals on average, with a range of 1-35 individuals (Chapman et al., 1989). Their social system is clearly sex-segregated. Males mostly travel in all-males groups and females alone or with their infant (Fedigan & Baxter, 1984). When travelling over large areas males may be monitoring females in the area (Chapman, 1990). Nevertheless, subgroups of the spider monkey can vary in both size and composition. They can consist of both females and males, only females or only males, and both sexes can travel on their own and, the larger group the larger possibility to contain both sexes (Izawa et al., 1979). Females travel in a more limited area than males. They also spend more time alone or with an infant (Symington, 1988a). Males tend to be more social than females and interact more with each other and at the same time more aggressive, but the aggression is more directed toward females with only a low level of intragroup aggression between males (Fedigan &

Baxter, 1984). One explanation why males tend to form subgroups consisting only of males can be that when they travel along the outlines of their home range they can defend their territory against other groups easier when together (Chapman, 1990). One study of group compositions indicates that unlike many other mammals, the male spider monkey seems to stay in the natal group meanwhile females emigrate in a larger extent (Symington, 1988a). Although the companionship between males is marked, one case of intragroup lethal aggression has been reported by Valero et al. (2006). One young adult male spider monkey had repeatedly got injuries from attacks by other monkeys during two months and later on the same monkey was killed after an attack from at least one adult male (Valero et al., 2006). The fact that spider monkeys are a ripe-fruit specialist may contribute to the small group size (Robbins et al., 1991).

For the female groups the group size also varies with the season. During the fruit-rich period, females associate in a larger extent, the group size increases while in the fruit-scarce period the groups become smaller (Shimooka, 2005). Chapman found that females with a dependent infant spend more time alone (Chapman, 1990) whereas the opposite was found by Shimooka (2005) when females with an dependent infant also spend more time together with other individuals than those without a dependent infant, maybe because of the risk for predation. Groups with males observed do not show the same difference in variation of group size related to fruit availability (Shimooka, 2005). Recently several cases of intra-community infanticide have been reported in Peru and Mexico (Gibson et al., 2008).

Assemblages together with other species of monkeys can occur, the different groups are still distinct and they never interact but they can share the same fruiting trees. *Ateles* species have been seen together with *Alouatta*, *Cebus* and *Saimiri* species (Mendes Pontes, 1997). A study of grooming behaviour of spider monkeys showed that grooming is not a frequent behaviour and is mostly carried out around noon and in the afternoon. Males seem to groom each other, females their offspring or other females and juveniles other juveniles. However, these data was collected from a small reintroduced population of nine adults and six juveniles (Ahumada, 1991).

Communication

Whinnies, i.e. loud calls, are the most common type of communication among spider monkeys. Communication helps them to keep contact with each other and keep their social structure. It is used both within a group and also at longer distances between two or more groups. Subgroups within the distance of the whinnies distribution approach more often than subgroups farther away. In addition, when two subgroups are in the neighbourhood more whinnies are emitted (Ramos-Fernandéz, 2004). The vocalization of the spider monkeys allows them to recognize each other to some extent. It benefits the social structure of spider monkeys and helps them to group, affecting both composition and size. The mother and offspring are also similar in the acoustics (Chapman & Weary, 1990). Whinnies bring information about both the identity and location of the emitter (Ramos-Fernandez, 2004). Other types of communication used by spider monkeys are screaming, which can be heard in a longer distance. They do also have a typical alarm call, used when predators or other threats are nearby. Experiments suggests that the duration of the spider monkeys alarm calls depends on the numbers of relatives in the area, spider monkeys act in a way to benefit their own relatives

(Chapman et al., 1989b). Self-anointing behaviour frequently occurs, the monkeys use different leaves as insect repellent and Laska et al. (2007) suggest it also could be a way to signal social status and to increase sexual attractiveness.

Circadian rhythm

Ateles species are diurnal and the daily activity starts about an hour after sunrise and ends about two hours after sunset (Muñoz-Delgado et al., 2004), when they always return to a sleeping site (Chapman, 1989b). Their activity shows a bimodal pattern with two peaks, one before noon and one in late afternoon. Climate factors, such as temperature during night and day, cloudiness, and sultry, influence onset and end of the daily activity (Muñoz-Delgado et al., 2004). Once the spider monkeys have returned to their sleeping site, they stay there until sunrise and very seldom leave during night. Chapman found that most of the trees used as sleeping trees were large emergent trees that were rather difficult to reach. These trees were often used repeatedly in a large extent and spider monkeys were seen to rotate between these sites. This behaviour was more frequent for females (Chapman, 1989b). 75 % of the movement time is made up of long-distance travel through the canopy (Dew, 2005).

Reproduction

Spider monkeys mature late compared with what could be expected in terms of their body size, and they give birth to their first infant at an age of 7-8 years (Chapman & Chapman, 1990). Spider monkeys have a long birth interval, 34.5 +/- 5.8 months have been reported in *A. chamek* in Peru, which is longer than other species of primates (Symington, 1988a). Chapman & Chapman (1990) reported an interbirth interval of 36 months (range 32-50) in free-ranging spider monkeys and for captive a mean length of 34.6 months. Captive spider monkeys do not show seasonality in their births, but in free-ranging populations a low grade of seasonally has been seen. In Costa Rica, births were higher in the beginning of the rainy season, May to July, when fruits are more abundant (Chapman & Chapman, 1990). The gestation is about 7-7.5 months long, and lactations of at least one year and up to twenty months have been seen in captive spider monkeys (Eisenberg, 1973). Intragroup infanticide by other males have been observed and reported which have an influence and shortens the otherwise long interbirth interval (Gibson et al., 2008). All copulations are initiated by the female and no precopulatory rituals have been observed. The copulation, which mostly takes place away from other adults, is carried out without any vocalization (Campbell, 2006). In Peru, one highly suspected forced copulation by the male has been reported (Gibson et al., 2008).

Predators

There is not much about predators on *Ateles* to find in the literature. There are a few case reports of predation on the spider monkey. Because of the large body size of the spider monkey, Matsuda & Izawa (2008) suggest that the Jaguar *(Panthera onca)* and Puma *(Felis concolor)* are the only major potential predator of the adult spider monkey, but smaller carnivores could be a threat for younger and smaller primates. Harpy eagle (*Harpia harpyja*) and crested eagle (*Morphnus guianensis*) are also two predators of the young spider monkey (Di Fiore, 2007).

Threats

Altered habitat, habitat loss, deforestation

Deforestation of rainforest because of cattle-raising, agricultural practices and timber extraction is a well known problem among conservationists. Non-deforestation threats for the ecology of forest are selective extraction of plants and animals, biological invasion, fragmentation, climate change, changing atmospheric composition and changing tree turnover rates (Phillips, 1997), all of them a direct or indirect threat to spider monkeys. The forest is not only exploited for agricultural practices, cattle-raising and timber extraction. Hunting and fishing and plants are used for food or medicinal purpose (Silva López, 1988). Removing important keystone plants from the forest influence the density of spider monkey population (Symington, 1988b). Densities of *Ateles* species are higher in intact forests, which could indicate that with protection and regeneration of tropical dry forest, the habitat, and therefore populations will regain (Sorensen & Fedigan, 2000). In Costa Rica, *A. geoffroyi* is only found in the largest protected areas (Zaldivar, 2004), an indication for the need of large home areas, and in Brazilian Amazon, it is totally absent in some regions with secondary forest (Parry et al., 2007). However, if there are some larger trees available, spider monkeys have been seen to survive in smaller forest patches caused by deforestation but in these small forests remnants they will be very vulnerable to hunting and genetic drift (Bernstein et al., 1976).

Large decreases in group density and distribution have been seen in Guyana in a survey 1995, and compared to a similar survey 1975 in the same area, both the total number of sightings of spider monkeys and the total percentage representation among all primates had decreased, which can be explained by habitat loss and hunting. In some parts where the spider monkey has been the most abundant sighted species, it is now total absent (Sussman & Phillips-Conroy, 1995). In Amazonia, spider monkeys are now less abundant and populations are still decreasing, in some areas they are totally absent (Mittermeier, 1989). Fragmentation is another problem for the monkeys, such in the case with *A. marginatus* that has very restricted distribution and the area is cut off by roads and plantations (Rylands, 2003). Hydroelectric installations are also a large threat; flooding is a direct threat but also the establishment of infrastructure is a large indirect threat making the area more attractive for ranchers, colonists and for timber exploitation (Martins et al., 1988). Road kills are also common and a large threat for primates and other animals when crossing roads that have divided their home range (Vallarades-Padua, 1995). Selective extraction of plants and trees may also be a threat to spider monkeys, depending on which species extracted. Extracting food resources is a direct threat and loosing sleeping trees an indirect threat, making them more vulnerable to predators when sleeping in less appropriate trees.

The Amazon Deforestation Monitoring Project started in 1988. For most years, the deforestation has increased, but the last three years there has been a decrease in deforestation. Still the deforestation was more than 11 000 km^2 in 2007, peak year was 1995 with almost 30 000 km^2 of rainforest cleared only in Brazil (Embassy of Brazil in London, 2007). It should be remembered that these numbers only account the clearing of rainforest, other types of exploitation and disturbances that is affecting the spider

monkeys are not included. Conservation of the forest is of low political and economic priority (Mittermeier, 1989).

Hunting and pet-keeping

Ateles has historically been a subject for hunters since the meat is considered as very tasty by natives (Kellogg & Goldman, 1944). In Guyana, Suriname, French Guiana and northeast Brazil hunting is the largest threat to primates in undisturbed tropical forest. Logging is also facilitating the hunting threat since it makes the forest more available for hunters by means of roads (de Toisy et al., 2005). Spider monkeys are primarily hunted for the meat; the large size of the monkey does not make it appropriable as pet which can be another cause for smaller monkeys to be hunted (Sussman & Phillips-Conroy, 1995). Although sale is forbidden by law in Mexico (Silva López, 1988), the opposite have been showed in Mexico City where the spider monkey is the most common monkey to keep as a pet, where the pricing is about 500 USD. Pets are sold and bought at markets in Mexico City and along highways in the south (Duarte-Quiroga, 2003). Mostly local hunters do not shoot monkeys because they are found interesting and curious in combination with practical reasons, the monkeys are sleeping during night when the hunter are active (Silva López, 1988). For some minority groups in rural Colombia, primates are still legal to hunt for food (Defler et al., 2003). When spider monkeys are hunted for the pet trade the female is hunted and killed, and sometimes even other adults who gets in the way are killed, to get the infant, which can be sold for 18-260 USD (Ortis-Martinez, 2007). Fat from spider monkeys is also used to soothe neck pain in some areas, making spider monkeys a target for hunters (Silva López, 1988). The trade of primates and other wild animals have decreased since Convention on International Trade in Endangered species of Wild Fauna and Flora (CITES) was drafted (Mittermeier, 1989). All the Latin American countries are now members of CITES, Mexico was the last to join in 1991 (CITES, 2008).

Potential solutions to protect spider monkeys

It has been difficult to find updated data on *Ateles* regarding densities, distribution and number of primates. This is required for a successful conservation work. Many data on spider monkeys are too old to be used in work with conservation. Another area lacking information is if *Ateles* subspecies differ regarding habitat- and food choice, ranging pattern and reproduction. More research is needed to compare the different subspecies to get a whole picture of genus *Ateles* and how to apply conservation work. The major tool for conserving spider monkeys is protecting the rainforest, but also protection against poaching and illegal trade is necessary. Laws and regulations are needed, and an international agreement of all countries inhabiting spider monkeys. Since spider monkeys are spread over large areas crossing frontiers, many countries have to work together. It is not enough that only a few countries work with conservations actions. Stopping the deforestation of rainforest require changes in the politics and economical interests.

Primate conservation is pleasant to work with. It is easy to get peoples attention to primates compared to other animals, their looks attract people and they remind of human beings, especially primate infants. To get economical funds to primates should not be difficult compared to for example insect or plant conservation projects. However,

there are many other projects to compete with, like projects regarding other primates, carnivores, birds, amphibians, plants and trees. If all conservation organisations regarding rainforest projects as well as involved countries could work together, there would be a more striking effect. In addition, funding could be used in a more effective way. On a local level, it is necessary to use already reliable methods to repair damaged habitat and facilitate the ranging of spider monkeys. Maintaining forest strips and corridors are helpful to keep large home areas.

In the literature, there are many management suggestions for howler conservation, which should be applicable also for spider monkeys. Small isolated populations in fragmented areas can be treated as captive populations and when necessary, individuals should be added and removed. Other suggestions are to work with farmers and landowners and have a community based forest management. Creating large national or international game reserves could benefit populations (Horwich, 1997*).* To educate and to get people aware of the importance of primates and their habitat are necessary to succeed in conservation. Several successful campaigns, including exhibits and lecture programs, distribution of films, posters, T-shirts and educational materials, are taking place in South American countries. Getting media attention and the use of primate pictures on stamps and magazine covers are effective ways to reach the public.

To stop hunting spider monkeys for food will take a long time. It is easy for all wealthy countries to say stop hunting when rural people of Amazons are trying to survive or to improve their low standard of living. In addition, information to all these rural people is hard to distribute. Effort must be put on stopping the demand for primates as pets, where CITES already have done a great work. With the information channels of today it should be easy to reach a great majority of the world population. It is of major importance to control the pet trade, both in the export country and the import country (Mittermeier, 1989).

It must be a way to get local people to save the spider monkey and the rainforest, an economical benefit to stop hunting them. Ecotourism could be an alternative in some areas to use the rainforest, funding larger areas for conservation. Making parks and reserves sell sustaining may increase the size of protected areas. I think hunting pressure will last very long, so the greatest effort must be put on preserving their habitat. If lager habitats can be preserved, the hunting pressure will be a less threat. It is important to localize and identify fragmented populations to manage them for conservation. For reducing numbers of road kills, installations of pole bridges over the roads have been successful, letting the primates cross roads and be able to use a larger area. Both tamarins and capuchins have been seen to use these bridges (Vallarades-Padua, 1995), but I have found no records if *Ateles* have been seen to use these bridges or not.

It should be remembered that a lot of the work and research that is needed would be very difficult in many areas. For example, in Colombia are areas where most conservation actions are needed closed to official workers and conservationists. To confirm populations and carry out census are in some areas very difficult and dangerous due to insurgents. In those areas with guerrilla groups, conservation of primates should be included in talks and negotiations. It is of high importance that researchers and conservationist get access to these areas (Defler et al., 2003). I assume there are similar

problems in many other countries as well. This makes conservation of primates even harder, a lot of effort must be put on politicians, and conservation must have an economic value.

Closing words

With a large home range, large body size and long reproductive rate, just like spider monkeys have, the risk for extinction increases (Zaldivar, 2004). Being a food specialist also makes the spider monkey more vulnerable for extinction (Sorensen & Fedigan, 2000). The large-scale conversion of rainforest is a direct threat to the spider monkey though secondary forest is unsuitable as habitat for spider monkeys. Native people and hunters are not always aware of the spider monkeys status, the laws and punishments that regulate hunting, and it is therefore very important to educate the local people for protection and conservation of the spider monkey (Ortis- Martinez, 2007). However, as long as they are protected from hunting and other human activities and have access to large areas they may be able to live in an altered habitat since they have been seen in young regenerating forests (Chapman et al., 1989a). As long as there is a demand to keep monkeys as pets, there will be a market for it. Spider monkeys easily breed in capture (Kellogg & Goldman, 1944) and even have a lower reproductive rate than free-ranging spider monkeys (Chapman & Chapman, 1990), which could help the most endangered species to survive as long as their habitat is protected. The facts that the meat is desirable, the large size of the monkey, late maturation and long birth interval makes it highly vulnerable (Chapman, 1989). More long-term scientific research of spider monkeys adaptability to altered habitat is necessary in combination with large censuses of spider monkeys. In addition, large protected areas and possibly breeding programs is necessary to save spider monkeys survival. Some conservations actions could be reintroductions and translocations of spider monkeys. Lately, leaders and population of the world have put more focus on climate change and rainforest conservation, but still today, there is a large scale of ongoing deforestation. Hopefully there will be a drastic change very soon to preserve rainforest all over the world to save spider monkeys and other threatened species, both animal and plants. To succeed, many countries, organizations and people have to work together for a mutual goal. The costs of conservation must be shared by all though the benefits are international.

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