between the sharp decrease in oestradiol concentrations around eight days following birth and maternal performance at that time, although this may be confounded by the occurrence of a postpartum oestrus, where sexual motivation may be interfering with that for maternal behaviour.

Two smaller research projects are studying scent-marking and anti-predator behaviour (Walraven, 1990; Walraven and Van Elsacker, 1991). Observations demonstrated the following: a) males marked more frequently than females; b) marking occurred mainly at the borders of the enclosures, adjacent to neighbouring groups, and at feeding sites; c) marking occurred mainly during bouts of intergroup vocalizing and while feeding; d) marking was predominantly circumgenital at the enclosure borders, and predominantly sternal in the interior of the enclosure.

Regarding anti-predator behaviour, different smells were tested which represented: 1) a sympatric predator; 2) an allopatric predator; and 3) an allopatric non-predator. Pieces of cotton wool impregnated with the smell of an ocelot, a polecat, and a common marmoset were placed in the lion tamarin's resting sites (Declerck, 1991). Tha test-animals had also been confronted with smell samples of familiar, as well as unfamiliar conspecifics in the course of the previous study. They were able to distinguish between predator and non-predator smells. They generally avoided the cotton wool impregnated with the smells of ocelots and polecats, which was not true for the smell of the marmoset. When they did approach the "predator smell" they sniffed it more intensively.

A study on contraception as a means of controlling the growth of the population, and as a management tool, was also begun recently. We are studying the effect of melengestrol-acetate (MGA) implants on the implanted breeding female and the possible effects on the non-implanted sexually mature daughters still resident in the family. The main objective is to examine if the breeding female's inability to breed affects the process of social contraception on the younger female group members. Behavioural observations are combined with urine analyses (in collaboration with the University of Gent) to obtain information on underlying hormonal mechanisms.

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**References**

Declerck, L. 1991. De respons van het goudkopleeuwaapje, *Leontopithecus chrysomelas*, op geurstoffen van predatoren. Licentiaatsthesis, Universitaire Instelling Antwerpen, Antwerp. (English abstract available).

Haazen, W. 1988. Studie van het vocale repertoire van het goudkopleeuwaapje, *Leontopithecus chrysomelas*. Licentiaatsthesis, Universitaire Instelling Antwerpen, Antwerp.

Van De Veegaete, P. 1991. De proximale invloeden op moederzorggedrag bij goudkopleeuwaapjes (*Leontopithecus chrysomelas*) in gevangenschap. Licentiaatsthesis, Universitaire Instelling Antwerpen, Antwerp. (English abstract available).

Van Elsacker, L. 1990. De goudkopleeuwaapjes stellen zich aan u voor. *Zoo Antwerpen*, 55(4):34-35. (Also available in French).

Van Elsacker, L. 1991. On the issue of reintroduction projects of lion tamarins in Brazil. *Lutra*, 34:92-93.

Van Elsacker, L., De Meurichy, W., Verheyen, R.F. and Walraven, V. 1992. Parental behaviour in golden-headed lion tamarins (*Leontopithecus chrysomelas*): maternal differences in infant carriage. *Folia Primatol.*, 59:121-126.

Walraven, V. 1990. Het markeergedrag van het goudkopleeuwaapje, *Leontopithecus chrysomelas*. Licentiaatsthesis, Universitaire Instelling Antwerpen, Antwerp. (English abstract available).

Walraven, V. and Van Elsacker, L. 1992. Scent marking in New World Primates: a functional review. *Acta Zoologica et Pathologica Antverpiensia*, 82:51-59.

## MIXED-SPECIES *SAGUINUS* GROUPS AT BELFAST ZOOLOGICAL GARDENS

Associations between sympatric species are a common occurrence in a number of forest primates. These associations range from very temporary encounters to permanent closed membership groups. Tamarin species of the genus *Saguinus* form some of the most stable mixed-species groups observed in mammals.

In the wild, groups of red-bellied tamarins, *Saguinus labiatus*, and saddle-backed tamarins,

*S.fuscicollis*, are reported to spend approximately 85% of their time within 50 m of each other (Buchanan-Smith, 1990). These mixed-species groups are stable and the two species share a common home range which they defend jointly against neighbouring mixed species groups (Buchanan-Smith, 1990; S.M.Hardie, pers.obs.). However, despite the close association found between these monkeys in nature, most captive environments house just one species in any enclosure.

There would be a number of advantages to exhibiting species which associate in the wild in a single enclosure. First, there is good reason to believe that mixed-species exhibits would improve the well-being of the animals concerned; due to the stimulation of greater activity and increased social encounters. Second, a mixed-species exhibit is a more informative and exciting display. Third, the captive environment is ideal for experimentally testing certain hypotheses regarding the costs and benefits to each species in association, under controlled conditions.

There have been some attempts to house more than one species in a single enclosure (see Baker, 1992; Xanten, 1990). These have met with limited success, perhaps because the species selected do not form close associations in nature. There is only one published report of a mixed-species tamarin group in captivity (Heymann and Sicchar Valdez, 1988). This involved wild-caught groups of five *S.mystax* and six *S.fuscicollis*, which lived in harmony and demonstrated the feasibility of keeping groups together in captivity. Here, we describe the formation and behaviour of mixed-species groups of *S.labiatus* and *S.fuscicollis* at the Belfast Zoo, Northern Ireland.

In August 1992, a mixed-species group was created from one pair each of *S.labiatus* and *S.fuscicollis*. The group remained stable over approximately nine months, and was split up only after the death of the female *S.fuscicollis* during labour. The male was subsequently removed and a new pair of saddle-backs were successfully introduced to the original *S.labiatus* pair in June 1993. The mixed group has been shown to consist of two groups of "pair-bonded" animals that spend a much greater percentage of their time with their mate than with individuals of the other species. However, individuals of different species spend some 25% of their time in close (< 1 m) contact. As the cage used was some 10 m x 3.5 m x 4 m, this demonstrates a significant coincidence in time and space. Interactions between the species were relatively rare, and involved calls, huddling, displacements, and other non-injurious behaviour.

After it was shown that stable mixed-species groups could be formed from captive-born animals, the main focus of research was centred around an investigation of the costs and benefits of association. In order for the association to evolve, the benefits accrued by the members of a polyspecific group must outweigh the costs. Increased conspicuousness and feeding competition are examples of potential costs. Benefits may include predator detection, avoidance or defence, increased encounter rate with food, and defence of food resources. In order to determine how each species is affected by the association, tests are currently being conducted to compare behaviour in an out of association. Monospecific groups of both species are also being tested for responses to presentation of different classes of objects. For example, novel non-threatening objects are presented to the subjects in various areas of their enclosures, and the latency to approach provides a comparison of relative "curiosity"; while the presentation of threatening objects is used to examine the role of both species in dealing with potential dangers. In addition, objects which contain food and others without food are used to examine the ability of each species to learn properties of new objects and to retain the information. Species are initially tested alone and subsequently when with the other species to see exactly how the association affects their behaviour. Details on interactions, competition, spacing, and general behaviour are recorded. Recently, two other mixed-species groups have been formed, and we plan to form at least two more larger breeding groups. One mixed group has been allowed to free-range in a wooded area, to examine whether they really do behave similarly to their wild counterparts.

An assessment of this free-ranging group was made over a period of four months, from June to October 1993. The animals were based in an outdoor enclosure, wih heated boxes place in the centre. Their enclosure was located on the edge of a large wooded area. After a month of baseline acclimatisation and data collection, an opening was made in the cage wall, giving access to the woods. Potentially, they could range for over a kilometre within the Zoo. All members of the mixed-species group made forays of up to 30 m from the base on

the first day. Their activity time increased significantly after the release, and they adapted well to the arboreal environment. Both species foraged for plant matter and animal prey species which were novel to them. The *S.labiatus* male successfully hunted two small birds. With few exceptions, the group subsequently remained within a 30 m radius of the home base. The species differed in a number of behavioural variables: the *S.labiatus* pair preferred different foraging sites and food resources from those of its congener, and this was reflected in the divergent locomotory and foraging techniques used. *S.fuscicollis* were frequently displaced from food sites by the dominant *S.labiatus*, although both species remained within 5 m of each other for much of the time. Interspecific interactions ranged from aggression to grooming and play: there were no injuries. The frequency of interactions increased significantly over the period of the study, and reached a climax when the *S.fuscicollis* male was observed mating with the *S.labiatus* female.

We hope to continue cataloguing the nature of this association, and evaluate its suitability as a longterm method of exhibiting tamarins in captivity. It will be especially important to compare behaviour around the time of infant birth to see if each species can rear their young successfully in the mixed environment. Finally, as *S.labiatus* and *S.fuscicollis* also associate with *Callimico goeldii* in the wild, we would indicate that it may be appropriate to examine the possibilities of captive mixed-species groups involving all three species (Pook and Pook, 1982; Buchanan-Smith, 1991; S.M.Hardie, pers.obs.).

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**References**

Baker, B. 1992. Guess who's coming to dinner. *AAZPA 1992 Regional Proceedings*, pp.62-67.

Buchanan-Smith, H.M. 1990. Polyspecific association of two tamarin species, *Saguinus labiatus* and *Saguinus fuscicollis*, in Bolivia. *Am.J.Primatol.*, 22:205-214.

Buchanan-Smith, H.M. 1991. Field observations of Goeldi's monkey, *Callimico goeldii*, in northern Bolivia. *Folia Primatol.*, 57:102-105.

Heymann, E.W. and Sicchar Valdez, L.A. 1988. Interspecific social grooming in a mixed troop of tamarins, *Saguinus mystax* and *Saguinus fuscicollis* (Platyrrhini: Callitrichidae), in an outdoor enclosure. *Folia Primatol.*, 50:221-225.

Pook, A.G. and Pook, G. 1982. Polyspecific association between *Saguinus fuscicollis*, *Saguinus labiatus*, *Callimico goeldii*, and other primates in northwestern Bolivia. *Folia Primatol.*, 38:196-216.

Xanten, W.A. 1990. Marmoset behaviour in mixed species exhibits at the National Zoological Park, Washington. *Int.Zoo Yearb.*, 29:143-148.

# News

## Field Investigations on Masked Titi Monkeys (*Callicebus personatus melanochir*) in Una, Bahia, Brazil

The four subspecies of the masked titi monkeys (*Callicebus personatus*) are endemic to the Atlantic forest region of eastern Brazil (Hershkovitz, 1990). The coastal rain forest is nearly completely destroyed, and *C.personatus* is considered the most endangered species of its genus (Mittermeier *et al.*, 1982). It is also one of the least known of the titi monkeys. Only the results of one short study have been published so far (Kinzey & Becker, 1983). In 1991, a longterm study on the behaviour and ecology of the masked titi monkey, *C.p.melanochir*, was initiated in the vicinity of the town of Una in the state of Bahia, eastern Brazil. The study area is a forest fragment of 100 ha, which is part of a forest of 400 ha owned and protected by the local cocoa growing authority CEPLAC (*Comissão Executiva do Plano da Lavoura Cacaueira*). The study site consists mostly of secondary forest, and contains three or four family groups.

Titi monkeys are generally very difficult to observe because they are quick-moving, extremely shy, and very quiet (see, for example, Easley, 1982 for