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Aspects of Ecology and Conservation
of the Pygmy Loris *Nycticebus pygmaeus* in Vietnam



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Dem Andenken meines Vaters

Preface

The first pygmy lorises came to the Endangered Primate Rescue Center in 1995 and were not much more than the hobby of the first animal keeper, Manuela Klöden. They were at that time, even by Vietnamese scientists or foreign primate experts, considered not very important. They were abundant in the trade and there was little concern about their wild status. It has often been the fate of animals that are considered common not to be considered worth detailed studies. But working with confiscated pygmy lorises we discovered a number of interesting facts about them. They seasonally changed the pelage colour, they showed regular weight variations, and they did not eat in certain times of the year. And I met people interested in lorises and told them, what I had observed and realized these facts were not known. So I started to collect data more or less to proof what we had observed at the centre. Due to the daily veterinary tasks data collection was rather randomly and unfocussed. But the more we got to know about the pygmy lorises, the more interesting it became. The answer to one question immediately generated a number of consecutive questions. After publishing a few small articles on pygmy lorises I got the chance to compile it all to a thesis. I do apologize for the mosaic-like character of the thesis, but that is what I had.

Probably we are still far from understanding the pygmy lorises' ecology. Despite its obvious shortcomings – being slow, unable to leap or jump, being small – the pygmy loris is a highly adapted animal, which has developed numerous strategies to survive in a seasonally hostile environment. The pygmy loris might at first glance not seem to be a very fascinating primate species, but it is an animal that deserves attention and I would be glad if with my thesis contributes to its understanding and conservation.

Abbreviations

CRES	:	Centre for Natural Resources and Environmental Studies
EPRC	:	Endangered Primate Rescue Center
FFI	:	Fauna and Flora International
FPD	:	Forest Protection Department
FZS	:	Frankfurt Zoological Society
IUCN	:	International Union for the Conservation of Nature
SFNC	:	Social Forestry and Nature Conservation
WAR	:	Wildlife at Risk
WFFT	:	Wildlife Friends of Thailand
WWF	:	World Wildlife Found
ZSCSP	:	Zoological Society for the Conservation of Species and Populations

Photographic and other sources:

Photographs used in the thesis have solely been taken at the EPRC by the author, Tilo Nadler or Elke Schwier. Helga Schulze contributed the drawings of the dental comb and fur colouration.

Intention of this thesis

This thesis addresses aspects of conservation and ecology of the pygmy loris, which have previously not been considered. It addresses the overdue questions of what the pygmy loris actually looks like and its taxonomic status in relation to the other forms of *Nycticebus*. It discusses the situation of pygmy lorises in the illegal wildlife trade and the handling of confiscated lorises. It gives an overview about health problems in a population of trade-confiscated pygmy lorises and unveils a surprising new aspect of the animals' ecology, evaluates their possibilities for reintroduction and finally provides insight to the feeding behaviour of pygmy lorises in the wild. Though at first sight there might be no red string visible, the thesis follows a thread given by the pygmy loris itself: recognized - traded and confiscated – brought to a rescue centre - studied at a rescue centre – reintroduced –free-ranging.

Structure

The first chapter introduces the species and gives an overview about the current state of knowledge, the situation in Vietnam and introduces the site where the materials were compiled. For those who miss information in the introduction: the chapter refers exclusively to sources, specifically concerning *N. pygmaeus* (resp. *intermedius* as the junior synonym) or generally to the genus *Nycticebus*. It does not as commonly done infer information about *N. coucang* or *L. tardigradus* to *N. pygmaeus* because the aim is to show the actual state of knowledge on *N. pygmaeus* as a distinct species. And this inferring of information has already lead to misunderstandings of the species and a very unclear perception of *N. coucang* and *N. pygmaeus*. In all later chapters, however, information on all Asian loris species is taken into account and discussed.

Chapters 2, 3, 6 are each centred around a recent publication on lorises. These chapters start with an introduction and give a larger overview about the topic, briefly summarize the publication and finally discuss the topic in respect to the publication. The publications in full length are attached at the end of the dissertation. Chapters 4, 5 and 7 are data chapters and comprise unpublished materials and follow the normal structure of a scientific publication. Finally all findings of the thesis are briefly summarized in English and German.

Contents

1. Introduction	p.1
2. Seasonal changes in pelage in Pygmy Lorises Taxonomical and ecological implications of a seasonal colouration change	p.14
3. Pygmy lorises in the trade The need to improve the process of handling and confiscation of lorises	p.22
4. Health problems of Pygmy Lorises Main health problems in captive pygmy lorises and ways to address them	p.33
5. Seasonal bodyweight change in Pygmy Lorises Ecological implications of a seasonal bodyweight change	p.62
6. Reintroduction of Pygmy Lorises Towards a successful reintroduction of pygmy lorises	p.74
7. Diet and feeding behaviour of Pygmy Lorises Omnivory as a strategy to overcome times of food shortage	p.85
Summary	p.96
Zusammenfassung	p.99
Attachments	p.102
Acknowledgements	
Curriculum vitae	

1. Introduction – The Pygmy Loris *Nycticebus pygmaeus*

Taxonomy

Within the strepsirrhine primates there are two infraorders - the Lemuriformes and the Lorisiformes. Due to taxonomic changes the infraorder of the Lorisiformes only comprises one superfamily - the Loroidea. Within the Loroidea there are two families, the Galagidae and the Lorisidae (BULLETIN OF ZOOLOGICAL NOMENCLATURE, 2002). The Lorisidae comprises of the African (*Arctocebus* and *Perodictus* and possibly the new genus *Pseudopotto*) and the Asian slow climbers (*Loris* and *Nycticebus*). The commonly used term ‘prosimians’ includes all strepsirrhine primates and also a convergent group of secondary nocturnal haplorrhine primates, the tarsiers.

The genus *Nycticebus* formerly comprised two species, *Nycticebus coucang* and *Nycticebus pygmaeus*. Recent taxonomic revision has upgraded the northern form of the slow loris *N. coucang bengalensis* to full species level such that currently there are three distinct species recognized: *Nycticebus bengalensis*, *Nycticebus coucang* and *Nycticebus pygmaeus* (GROVES, 1971, 2002, 2004). Another possible species of slow loris from Java is being discussed (GROVES, in print). Since all publications prior to 2002 refer to the slow loris in Vietnam as *N. coucang*, for the purpose of this thesis we use *N. coucang* as a synonym for *N. bengalensis*, when referring to the Vietnamese slow loris.

The pygmy loris, pygmy slow loris or lesser slow loris *Nycticebus pygmaeus* was first described by BONHOTE in 1907. Though originally classified as a full species (BONHOTE, 1907) the taxonomic status of the species has been the subject of some controversy. Doubts were raised about the specific rank of the taxon (HILL, 1953, PETTER et al., 1970, PENG, 1990) and the description of a new species of loris, *Nycticebus intermedius* (DAO, 1960, ALTERMAN et al., 1997) further confused the situation. However, recent studies (ZHANG et al., 1993, WANG et al., 1996, GROVES, 2001, 2004, STREICHER et al., 2002, STREICHER, 2003, 2004, ROOS, 2004, see Chapter 2) did not support the existence of the new loris species and at present *N. pygmaeus* is considered a distinct species with no subspecies and *N. intermedius* is considered a junior synonym for the species.



Plate 1.1 *Nycticebus pygmaeus*

Anatomy

The pygmy loris is a small sized animal with a bodyweight normally between 350 and 600g (TAN, 1994, RATAJSZCZAK, 1998, FITCH-SNYDER et al., 2001) although - following recent taxonomic classification- even individuals with a bodyweight up to 800g are known (ZHANG et al., 1993). The head-body length of pygmy lorises is given as 210-290mm (CORBET et al., 1992, Fauna & Flora International, 1999). Sexual dimorphism has been suggested for bodyweight and size (KAPPELER, 1991, GROVES, 2004), but in 23 specimens at the EPRC no sexual dimorphism in size could be observed (Table 1.1, and Chapter 5).

Table 1.1 Morphometrics of pygmy lorises at the EPRC

Measurement	mean value in mm	number of animals n	min-max in mm
Head body length*	215 ± 10	23	195-230
Upper arm length	61 ± 4	24	55-70
Forearm length	63 ± 3	24	57-68
Tigh length	64 ± 3	24	57-69
Knee height	75 ± 4	24	68-84
Hand length	38 ± 3	24	32-48
Hand span	53 ± 3	24	45-58
Foot length	44 ± 5	24	33-54
Foot span	18 ± 3	24	15-25

* Head body length measured from vertex with the head at a 90 ° angle.

The pygmy loris exhibits a number of anatomical peculiarities.

The pygmy loris' dental formula is:

$\frac{M_3 M_2 M_1 P_4 P_3 P_2 C I_2 I_1 I_1 I_2 C P_2 P_3 P_4 M_1 M_2 M_3}{M_3 M_2 M_1 P_4 P_3 P_2 C I_2 I_1 I_1 I_2 C P_2 P_3 P_4 M_1 M_2 M_3}$

$M_3 M_2 M_1 P_4 P_3 P_2 C I_2 I_1 I_1 I_2 C P_2 P_3 P_4 M_1 M_2 M_3$

The mandibular incisors are long and slender and form a closed row, termed the dental comb (Fig.1.1). The lateral boundaries of the dental comb are formed by the canines, which represent functional incisors (BYRD et al., 1982). The dental comb has a horizontal procumbency and serves important functions during grooming and food acquisition.

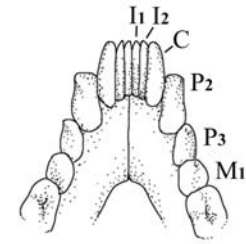


Fig.1.1: anterior mandibular dentition with toothcomb.

As in all prosimians except the tarsiers, pygmy lorises' eyes have a tapetum lucidum , which enhances night vision. Pygmy lorises also have a moist rhinarium to enhance the perception of smell (FLEAGLE, 1978), a fact reflected in the name of the order; strepsirrhini - the moist-noised primates.

The blood vessels on the lower arms and legs form a three-dimensional network, the rete mirabile (MIYAKE et al., 1991). They assure continuous perfusion of the muscles and enable the loris to maintain a grip for extended periods of time (FITCH-SNYDER et al., 2001, PUSCHMANN et al., 2004) and probably also play a role in thermoregulation.

The second digit on the hind and the front limbs is reduced, a result of their quadrupedal walking along the branch (PREUSCHOFT et al., 1995). The nail of the second digit on the hind leg has a long bent shape and forms the "grooming claw".

Pygmy lorises have brachial glands located on the medial surface of the upper arm that produce scent (HILL, 1956). The function of the brachial glands is not quite clear, they seem to serve for scent marking and potentially they serve for allospecific defence. The brachial glands produce a secretion, which contains toxins (ALTERMAN, 1995).

The digestive system of the lorises is simple, without any chambered site to facilitate bacterial fermentation (HILL, 1953).

Other than in the anthropoids the uterus of the pygmy loris has two distinct horns (HILL 1972).

Reproduction

Pygmy lorises reproduction is strictly seasonal. Even under captive conditions they maintain their seasonal pattern and oestrus occurs only between the end of July and the first third of October (FENG et al., 1992, 1994, JURKE et al., 1997). During oestrus females show a distinct vaginal swelling and the testes of the males are visibly enlarged (FENG et al., 1992, FITCH-SNYDER et al., 2003). After a pregnancy of six months, births consequently occur in from January to mid March (FENG et al., 1992, JURKE et al., 1997, 1998, FITCH-SNYDER

et al., 2001). In North American facilities, 45% of the litters born are singletons, the remainder are twins or triplets; even quadruplets have been seen (FENG et al., 1994, MASOPUSTOVA, 2001, FITCH-SNYDER, 1998, FITCH-SNYDER, et al., 2001). A typical behaviour is the parking of the infants from the first day of life onward, while the female goes foraging (FITCH-SNYDER, 2000). Maturity is reached at 18 months in males and 16 months in females (FITCH-SNYDER et al., 2001).

Longevity

Due to the short time the species has been kept in captivity longevity has not been determined; studbook data indicate life spans of at least 15 years in captivity (FITCH-SNYDER, 2002).

Social system

Pygmy lorises in the wild have mostly been observed as singly individuals (DUCKWORTH, 1994, TAN, 1994, TAN et al., 2001, POLET et al., 2004, NGUYEN, 2004) and they are assumed to have a solitary social pattern. Olfactory cues are probably the most important means of communication and pygmy lorises have an elaborate scent marking system (FISHER et al., 2003a, 2003b). Vocal communication also plays an important role (FITCH-SNYDER, 2000, ZIMMERMANN, 1995). However, no behavioural studies of pygmy lorises have yet been made in the field.

Distribution

The pygmy loris is distributed east of the Mekong River in Vietnam, eastern Cambodia, Laos and southernmost China (RATAJSZCZAK, 1988, NISBETT et al, 1993, DUCKWORTH, 1994, FOODEN, 1996, ZHANG et al., 2002, THANH, 2002). In Vietnam sightings have been reported from all over the country in a variety of different habitats, from primary forest to secondary forests and bamboo plantations (WOLFHEIM, 1983, GROVES, 1971, HUYNH, 1998, FITCH-SNYDER et al., 2002, NGUYEN, 2004, POLET et al., 2004).

Status in the wild

Due to the spraying of defoliants during the war, excessive logging and the conversion of forests into agricultural land, forests in Vietnam are rapidly declining (THANH, 1996, NADLER et al., 2004). Vietnam has lost much of its original forest cover and in 1993 only about 30% of the country's land area was forest covered. Only about 10% of the remaining forests are rich closed-canopy forests, the rest are plantations, poor and regenerating forests (FOREST INVENTORY AND PLANNING INSTITUTE/ MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT, 2001). Slash and burn cultivation destroys pygmy loris

habitats and the animals are completely eradicated from large areas (RATAJSZCZAK, 1998). In the absence of baseline data MacKINNON et al. (1987) tried a rough estimation based on the species' distribution range, habitat loss within this range and an assumed density of the animals and estimated a total number of about 72,720 *N. pygmaeus* in Vietnam. The fact, that HUYNH (1998), at that time a leading conservationist in Vietnam, estimated Vietnam's total pygmy loris population to be about 600-700 individuals reflects the impossibility of assessing the numbers without field data.

The species is heavily exploited for traditional medicines and the pet trade and the degree of exploitation is certainly not sustainable (RATAJSZCZAK, 1998, NOOREN et al., 2001, THANH, 2002). It has been concluded from the reduced numbers of pygmy lorises in the Vietnamese markets that the wild populations are declining (NADLER, pers. comm.). In the field pygmy lorises are more and more difficult to observe (MINISTRY OF SCIENCE, TECHNOLOGY AND ENVIRONMENT, 2000, THANH, 2002, NGUYEN, 2004).

Protection status

Vietnamese law protects the pygmy loris at the highest possible level (COUNCIL OF MINISTERS, 1992, THE GOVERNMENT OF VIETNAM, 1996) and prohibits any exploitation. The IUCN Red List of Endangered Species (HILTON-TAYLOR, 2002) lists the species within the category 'Vulnerable' and the Red Data Book of Vietnam places the species in the same category (MINISTRY OF SCIENCE, TECHNOLOGY AND ENVIRONMENT, 2000). In 1994 Vietnam became a member of CITES and pygmy lorises are listed in Appendix II.

Traditional beliefs

Pygmy lorises are not only reported to make nice toys, alive or mounted (MINISTRY OF SCIENCE, TECHNOLOGY AND ENVIRONMENT, 2000), their hair is also believed to have haemostatic qualities (HUYNH, 1998). Local people believe that the pygmy loris' bite is toxic and potentially lethal. A more anecdotic belief tells that pygmy lorises use the wind to move from branch to branch and in some areas the loris is called the 'monkey that moves with the wind "khi gio" (HUYNH, 1998, NGUYEN, 2004). Sightings of the animal are said to announce imminent misfortune and the animals are used for black magic (FITCH-SNYDER, pers. com.).

The Endangered Primate Rescue Center

The Endangered Primate Rescue Center was established in 1993 at Cuc Phuong National Park. Cuc Phuong National Park is the oldest National Park in the country, located at 20°14'-20°24'N and 105°29'-105°44'E and comprising an area of 22.000 ha of tropical evergreen

forest-covered limestone hills (VO et al., 1996, BIRDLIFE INTERNATIONAL, 2000). The rescue centre was established with the goal of caring for endangered primates confiscated by Vietnamese authorities from the illegal wildlife trade. The foundation of captive breeding populations of rare primate taxa and the eventual release of the captive bred offspring is also part of the task appointed to the centre in fulfilment of the National Biodiversity Action Plan for Vietnam (GOVERNMENT OF VIETNAM & GLOBAL ENVIRONMENTAL FACILITY PROJECT, 1994). Within the past years the centre has worked on the confiscation and rescue of endangered primates and has successfully kept and bred a number of rare primate species. At the moment the centre has a unique primate population of more than 120 animals of 15 Indochinese primate species. Unfortunately hunting still continues and the numbers of the primates in the wild are still rapidly decreasing; the centre's work has become a crucial component of conservation for some species. Located at the headquarters of Cuc Phuong National Park, the centre comprises 20 cage complexes, a quarantine station and two semi-wild enclosures. The centre is funded by zoos, zoological societies (FZS, ZGAP), various foundations (ARCUS Foundation, Deutsches Tierhilfswerk, Andreas Stihl Stiftung) and private donations. It is run by a team of three foreigners (director, veterinarian, head animal keeper) and 18 Vietnamese staff members.

Pygmy lorises at the Endangered Primate Rescue Center

Pygmy lorises at the EPRC originate from many different sources; they are confiscated by Forest Protection authorities from hunters, traders and animal transports or they are brought by tourists, who "rescued" them by buying them in markets or from traders, or they are donated former pets. On arrival at the EPRC the animals receive a health check, are marked with a transponder, samples are taken for genetic screening and the animals undergo six weeks quarantine (STREICHER, 2004). After quarantine they are housed in large outdoor cages with open soil, natural vegetation and a furnishing of bamboo and branches. Sleeping boxes are provided as refuges. The enclosure fencing consists of small mesh wire to prevent rodents and snakes from entering the cage. Snakes are a potential threat to the animals and rodents are not only efficient food competitors, but might also spread disease. Animals are kept either in breeding groups with one male and several females, as single individuals or in non-breeding groups consisting only of several females and their offspring below two years of age.

References

- Alterman, L., Hale, M. E.** 1991. Comparison of toxins from brachial gland exudates from *Nycticebus coucang* and *N. pygmaeus*. *American Journal of Physical Anthropology*, Sup. 12: 43.
- Alterman, L., Freed, B. Z.** 1997. Description and survey of three *Nycticebus* species in Bolikhamxay Province, Laos. *Primate Eye* **63**: 16.
- Bonhote, J. L.** 1907. On a collection of mammals made by Dr. Vassal in Annam. *Proceedings of the Zoological Society of London*, **4**.
- Birdlife International Vietnam Programme.** 2000 Sourcebook of Protected Areas. www.birdlifevietnam.com
- Byrd, K. E., Swindler, D. R.** 1982. The dentition of the Lorisoidae. Pp. 27-37. In : Haines, D. E. (ed.) : *The lesser bushbaby (*Galago senegalensis*) as an animal model : selected topic*. CRC Press, Florida.
- Corbet, G. B., Hill, J. E.** 1992. *The Mammals of the Indomalayan Region : A systematic review*. Oxford University Press. Oxford.
- Council of Ministers.** 1992. Decree No. 18/HDBT of January 17 prescribing the list of precious and rare forest plants and animals and the regime of management and protection thereof.
- Dao, V. T.** 1960. Sur une nouvelle espèce de *Nycticebus* au Vietnam. *Zool. Anz.* **164**: 240-243.
- Duckworth, J. W.** 1994. Field sightings of the pygmy loris (*Nycticebus pygmaeus*) in Laos. *Folia Primatol* **63**: 99-101.
- Fauna & Flora International.** 1999. *Primate Field Guide Vietnam*. Fauna & Flora International Indochina Programme. Lotus Press, Hanoi.
- Feng, Q., Wang, Y., Li, C.** 1992. Reproduction of slow loris (*Nycticebus intermedius*) in captivity. *Dongwuxue Yanjiu/ Zool Res* **14**: 21-26.

- Feng, Q., Wang, Y., Li, C.** 1994. Progress of studies on intermediate slow loris in captivity. *Zhongguo Lingzhanglei Yanjiu Tongxun / Chinese Primate Research and Conservation News* **3** (1): 11-12.
- Fisher, H. S., Swaisgood, R. R., Fitch-Snyder, H.** 2003 a. Odor familiarity and female preferences for males in a threatened primate, the pygmy lorises (*Nycticebus pygmaeus*): applications for genetic management of small populations. *Naturwissenschaften* **90**: 509-512.
- Fisher, H. S., Swaisgood, R. R., Fitch-Snyder, H.** 2003 b. Countermarking by male pygmy lorises (*Nycticebus pygmaeus*): do females use odor cues to select mates with high competitive abilities? *Behav Ecol Sociobiol* **53**: 123-130.
- Fitch-Snyder, H.** 1998. Asian prosimians North American regional studbook. Vol. IV. Zoological Society of San Diego. San Diego
- Fitch-Snyder, H.** 2000. Reproductive patterns in a breeding colony of pygmy lorises (*Nycticebus pygmaeus*) measured by behavioral and physiological correlates of gonadal activity. Masters thesis. San Diego State University. San Diego.
- Fitch-Snyder, H.** 2002. Pygmy loris (*Nycticebus pygmaeus*) international studbook. March 2002. Center for breeding of endangered species, Zoological Society of San Diego.
- Fitch-Snyder, H., Schulze, H., Larson, L. (eds.)** 2001. Management of Lorises in Captivity. A Husbandry Manual for Asian Lorises (*Nycticebus* & *Loris* ssp.) Center for Reproduction in Endangered Species (CRES), Zoological Society of San Diego. San Diego.
- Fitch-Snyder, H., Ehrlich, A.** 2003. Mother-infant interactions in slow lorises (*Nycticebus bengalensis*) and pygmy lorises (*Nycticebus pygmaeus*). *Folia Primatol* **74**: 259-271.
- Fitch-Snyder, H., Jurke, M.** 2003. Reproductive patterns in Pygmy Lorises (*Nycticebus pygmaeus*): Behavioral and Physiological Correlates of Gonadal Activity. *Zoo Biology* **22**: 15-32.

- Fitch-Snyder, H., Vu, N. T.** 2002. A preliminary survey of lorises (*Nycticebus spp.*) in Northern Vietnam. Asian Primates – A Newsletter of the IUCN/SSC Primate Specialist Group Vol. **8**, No.2: 1-6.
- Fleagle, J. G.** 1978. Primate adaptation in Evolution. Academic Press. New York.
- Fooden, J.** 1996. Zoogeographie of Vietnamese Primates. Int J Primatol Vol. **17**(5): 845-899.
- Forest Inventory and Planning Institute/ Ministry of Agriculture and Rural Development.** 2002. Data on the Situation of Forests in Vietnam. Vietnam Environment Monitor 2002: 9-10.
- Government of Vietnam & Global Environmental Facility Project VIE/ 91/G31.** 1994. National Biodiversity Action Plan for Vietnam, Hanoi.
- Groves, C. P.** 1971. Systematics of the Genus *Nycticebus*. Pp. 44 – 53. In: Proc. 3rd Int. Congr. Primat., Zürich 1970, Vol. 1.
- Groves, C. P.** 2001. Primate Taxonomy. Smithsonian Institution Press, Washington.
- Groves, C. P.** 2004. Taxonomy and biogeography of primates in Vietnam and neighbouring regions. Pp. 15-22. In: Nadler, T., Streicher, U., Ha, T. L.(eds.): Conservation of Primates in Vietnam. Haki press, Hanoi.
- Groves, C., Maryanto, I.** Craniometry of slow lorises (Genus *Nycticebus*) of insular Southeast Asia. In: Shekelle, M. (ed.): Primates of the Oriental Night. Treubia. Special issue. In print.
- Hill, W. C. O.** 1953. Primates: Comparative anatomy and taxonomy. Vol. I, Strepsirrhini. Edinburgh University Press, Edinburgh.
- Hill, W. C. O.** 1956. Body odour in lorises. Proc Zool Soc London **127**: 580.
- Hill, W. C. O.** 1972. Evolutionary Biology of the Primates. Academic Press, London, New York.

- Hilton-Taylor, C.** (comp.) 2002. IUCN Red List of Threatened Species. IUCN, Gland and Cambridge.
- Huynh, D. H.** 1998. Ecology, Biology and Conservation status of Prosimian Species in Vietnam. *Folia Primatol* **69** (suppl 1): 101-108.
- International code of zoological nomenclature executive secretary.** 2002. Opinion 1995: Lorisidae Gray, 1821, Galagidae Gray, 1825 and Indriidae Burnett, 1828 (Mammalia: Primates): conserved as the correct original spellings. *Bulletin of Zoological Nomenclature* **59** (1), March 2002: 65-67.
- Jurke, M. H., Czekala, N. M., Fitch-Snyder, H.** 1997. Non-invasive detection and monitoring of estrus, pregnancy and the postpartum period in pygmy loris (*Nycticebus pygmaeus*) using fecal estrogen metabolites. *Am J Primatol* **41**: 103-115.
- Jurke, M. H., Czekala, N. M., Jurke, S., Hagey, L. R., Lance, V. A., Conley, A. J., Fitch-Snyder, H.** 1998. Monitoring Pregnancy in Twinning Pygmy Loris (*Nycticebus pygmaeus*) Using Fecal Estrogen Metabolites. *Am J Primatol* **46**: 173-183.
- Kappeler, P. M.** 1991. Patterns in sexual dimorphism in bodyweight among primates. *Folia Primatol* **57**: 132-146.
- MacKinnon, J., MacKinnon, K.** 1987. Conservation and status of the primates of the Indo-Chinese subregion. *Primate Conservation* **8**: 187-195.
- Masopustova, R.** 2001. The Quadruplets and Twins of Lesser Slow Loris in Prague Zoo. *Gazella* **28**: 63-71.
- Ministry of Science, Technology and Environment (ed.)** 2000. Red Data Book of Vietnam, Vol. 1. Animals. Hanoi.
- Miyake, S., Ikedo, A., Ohta, S., Matsumoto, S.** 1991. Three-dimensional analysis of the peculiar arterial pattern of the extremities in lorisidae: the rete mirabile. Pp. 569-570. In: Akiyoshi, E. et al. (eds.): *Primateology today*. Elsevier Science Publishers.
- Nadler, T., Streicher, U.** 2004. Primates in Vietnam – an Overview. Pp. 3-11. In: Nadler, T., Streicher, U., Ha, T. L. (eds.): *Conservation of Primates in Vietnam*. Haki Press. Hanoi.

- Nguyen, T. N.** 2004. The status of primates at Pu Mat National Park and suggestions for sustainable conservation approaches. Pp. 85-89. In: Nadler, T., Streicher, U., Ha, T. L. (eds.): Conservation of Primates in Vietnam. Haki Press. Hanoi.
- Nisbett, R. A., Ciochon, R. L.** 1993. Primates in North Vietnam: a review of the ecology and conservation status of extant species, with a note on Pleistocene localities. *Int J Primatol* **14** (5): 765-795.
- Nooren, H., Claridge, G.** 2001. Wildlife Trade in Laos: the End of the Game. A History of Wildlife Trade in Laos to 1995. Netherlands Committee for IUCN, Amsterdam.
- Peng, Y.** 1990. Distribution and taxonomy of Primates. *Primate Report* **26**: 17-28.
- Petter, J. J., Petter-Rousseaux, A.** 1970. Classification of the prosimians. Pp. 281-286. In: Doyle, G.A., Martin, R.D. (eds.): The study of Prosimian Behavior. Academic Press, New York.
- Polet, G. Murphy, D. J., Becker, I., Phan D. T.** 2004. Notes on the primates of Cat Tien National Park. Pp. 78-84. In: Nadler, T., Streicher, U., Ha, T. L. (eds.): Conservation of Primates in Vietnam. Haki Press, Hanoi.
- Preuschoft, H. Witte, H., Fischer, M.** 1995. Locomotion in Prosimians. Pp. 453-472. In: Alterman, L., Doyle, G. A., Izard, M. K. (eds.): Creatures of the Dark. The nocturnal prosimians. Plenum Press, New York.
- Puschmann, W.** 2004. Zootierhaltung. Tiere in menschlicher Obhut. Säugetiere. Verlag Harri Deutsch, Frankfurt.
- Ratajszczak, R.** 1988. Notes on the current status and conservation of primates in Vietnam. *Primate Conservation* **9**: 134-136.
- Ratajszczak, R.** 1998. Taxonomy, distribution and status of the lesser slow loris *Nycticebus pygmaeus* and their implications for captive management. *Folia Primatol* **69** (suppl. 1): 171-174.

- Roos, C.** 2004. Molecular evolution and systematics of Vietnamese primates. Pp. 23-28. In: Nadler, T., Streicher, U., Ha, T. L.(eds.): Conservation of Primates in Vietnam. Haki press, Hanoi.
- Streicher, U.** 2003. Saisonale Veraenderungen in Fellzeichnung und Fellfaerbung beim Zwergplumplori *Nycticebus pygmaeus* und ihre taxonomische Bedeutung. Zoolog. Garten N. F. 73 (2003) 6, P: 368-373.
- Streicher, U.** 2004. Confiscated Primates- health problems and placement options. Pp. 154-160. In: Nadler, T., Streicher, U., Ha, T. L. (eds.): Conservation of Primates in Vietnam. Haki press, Hanoi.
- Streicher, U.** 2004. Seasonal changes in fur pattern and colouration in the pygmy loris *Nycticebus pygmaeus*. Pp. 29-32. In: Nadler, T., Streicher, U., Ha, T. L.(eds.): Conservation of Primates in Vietnam. Haki press, Hanoi.
- Streicher, U., Schulze, H.** 2002. Seasonal changes in fur pattern and colouration in the pygmy loris *Nycticebus pygmaeus*. P.398. In: Caring for Primates. Abstracts of the XIXth Congress of the International Primatological Society. Mammalogical Society of China, Beijing.
- The Government of Vietnam.** 1996. Instruction from the Prime Minister on Urgent Measures For Wildlife Protection and Development, No. 359/ Ttg, 29.05.96. Hanoi, Vietnam.
- Tan, C. L.** 1994. Survey of *Nycticebus pygmaeus* in southern Vietnam. *XVth Congress International Primatological Society*: 136.
- Tan, C. L., Drake, J. H.** 2001. Evidence of Tree Gouging and Exsudate Eating in Pygmy Slow Lorises (*Nycticebus pygmaeus*). *Folia Primatol* **72**: 37-39.
- Thanh, V. N.** 1996. Biodiversity and Biodiversity Loss. Presentation held at the Seminar on Environment and Development in Vietnam. Australian National University. Canberra.

- Thanh, V. N.** 2002. The status and conservation of the loris species, *Nycticebus coucang* and *N. pygmaeus* in Vietnam. P. 254. In: Caring for Primates. Abstracts of the XIXth Congress of the International Primatological Society. Mammalogical Society of China, Beijing.
- Vo, Q., Nguyen, B. T., Ha, D. D., Le, V. T.** 1996. Vuon Quoc Gia Cuc Phuong – Cuc Phuong National Park. Agricultural Publishing House, Hanoi.
- Wang, W., Su, B., Lan, H., Liu, R., Zhu, C., Nie, W., Chen, Y., Zhang, Y.** 1996. Interspecific differentiation of the slow lorises (Genus *Nycticebus*) inferred from ribosomal DNA restriction maps. *Zoological Research* **17**(1): 89-93.
- Wolfheim, J. H.** 1983. *Primates of the World. Distribution, Abundance and Conservation.* University of Chicago Press, Oxford.
- Zhang, Y., Chen, Z., Shi, L.,** 1993. Phylogeny of the slow lorises (genus *Nycticebus*): an approach using mitochondrial DNA restriction enzyme analysis. *Int J Primatol* **14** (1): 167-175.
- Zhang, Y., Chen, L., Qu, W., Coggins, C.** 2002. Past, Present and Future. The Primates of China: Biography and Conservation Status. China Forestry Publishing House. Beijing.
- Zimmermann, E.** 1995. Acoustic communication in nocturnal prosimians. Pp. 311-330. In: Alterman, L., Doyle, G. A., Izard, M. K. (eds.): *Creatures of the Dark. The nocturnal prosimians.* Plenum Press, New York.

2. Seasonal changes in pelage in the Pygmy Loris

Streicher, U. 2003. Saisonale Veraenderungen in Fellzeichnung und Fellfaerbung beim Zwergplumplori *Nycticebus pygmaeus* und ihre taxonomische Bedeutung. *Zoolog Garten N.F.* **73**, 6: 368-373.

Introduction

The original description of the pygmy loris BONHOTE (1907) comprises characteristics of pelage, bodyweight and some morphological measurements. The fur was depicted as being reddish brown-grey with silvery tips and a trace of dark red fur along the spine. HILL (1953) considered the pygmy lorises merely a subspecies of the slow loris *Nycticebus coucang* and distinguished it from the latter by size and fur characteristics, namely a difference in the dorsal stripe. He pointed out that the type specimen of *N. pygmaeus* would largely lack a dark stripe, but considered this to be an individual anomaly. Observed colour variations he believed related to the age of the animals. Based on dentition, the forward production of the premaxilla and the sympatric occurrence with another subspecies *N. c. bengalensis*, he acknowledged the possibility that the pygmy loris might need to be acceded to specific rank. A few years later FIEDLER (1956) classified *N. pygmaeus* as a separate species, in respect to its small size and dental peculiarities. PETTER et al. (1970) still considered *N. pygmaeus* a subspecies of *N. coucang* but GROVES (1971) also suggested giving *N. pygmaeus* full species rank based on craniomorphological features and pelage characteristics. His pelage description was largely identical with the original one, but he considered the dark stripe along the spine to be related to age. CORBET et al. (1992) followed Groves' suggestion and considered *N. pygmaeus* a valid species.

All these different perspectives were based on gross morphological features. First chromosome studies on *N. pygmaeus* testified its close relation to *N. coucang* (CHU et al, 1962, DE BOER, 1973) based on identical chromosome numbers, not allowing an assessment of differences below chromosome level. First investigations on molecular genetics of *Nycticebus* were conducted by ZHANG et al. (1993) and WANG et al. (1996) who found the genetic difference between *N. pygmaeus* and *N. coucang* sufficiently large to justify their classification as different species. GROVES (1998) again emphasized the separate between *N. pygmaeus* and *N. coucang* based on morphometric studies of museum specimen. RATAJSZCZAK (1998) further supported the view that *N. coucang* and *N. pygmaeus* are separate species based on largely sympatric occurrence and differences in biology and reproduction. Ever since, the validity of *N. pygmaeus* as separate species has not been doubted and recent DNA investigations by ROOS (2004) further support their validity as species.

The relation to the slow loris was not the only point of discussion concerning the taxonomic status of *N. pygmaeus*. In 1960, DAO (1960) described a third species of *Nycticebus* - the intermediate or middle slow loris *Nycticebus intermedius*. His description was based on pelage characteristics and morphology. The fur was described as being uniform red-orange with a faint blackish-brown stripe and silvery frosted hair. The validity of this species has been doubted ever since its first description. GROVES (1971) pointed out that the type specimen of *N. intermedius* was an adult *N. pygmaeus* and that the type description of *N. pygmaeus* was based on an infant animal. Later, he consequently considered *N. intermedius* a synonym for *N. pygmaeus* (1998, 2001) and described the species with a fine textured reddish- buff fur and a broad but indistinct dorsal stripe. The opinion that *N. pygmaeus* and *N. intermedius* are just different aged individuals of the same species was supported by RATAJSZCZAK (1998) based on his observations of retarded growth in *N. pygmaeus* under unfavourable keeping conditions. ZHANG et al. (1993) reported that at the Kunming Institute of Zoology *N. intermedius* and *N. pygmaeus* were distinguished based on their differences in bodyweight and pelage. Accordingly, *N. intermedius* would be the larger species weighing about 450-800g and having a dorsal stripe, *N. pygmaeus* would be somewhat smaller weighing 300-450g and lacking a dorsal stripe. But in their molecular genetic studies (ZHANG et al., 1993, WANG et al., 1996) they found little difference between the two forms and suggested considering *N. intermedius* a junior synonym for *N. pygmaeus*. Despite all this seemingly obvious evidence, *N. intermedius* was still maintained as a species by a number of scientists. CORBET et al. (1992) claimed that *N. pygmaeus* and *N. intermedius*, though having indistinguishable skulls, would differ in weight, and pelage characters, without specifying the latter. Publications on *N. intermedius* kept occurring particularly from China (e.g. FENG et al., 1992, 1993, 1994). Further, based on craniomorphologic studies BEUTEL (1995) claimed the variation found in *N. pygmaeus* to exceed the values expected for a single species and postulated more rigorous investigation of the monotypic of this taxon. A recent overview on primates in China (ZHANG et al., 2002) again listed *N. pygmaeus* and *N. intermedius* as separate species with largely sympatric occurrence and *N. intermedius* being the more common species. However, the photographs in the same report featured two representatives of *N. pygmaeus*.

The report on a new loris species in Laos (ALTERMAN et al., 1997) again supported the assumption of a third species of loris differing from *N. pygmaeus* and *N. coucang* in size and colouration and potentially identical with the species previously described by DAO (1960).

Description of seasonal changes in fur pattern and colouration

Taxonomic considerations on lorises were often based on fur colouration and fur pattern and, therefore, a study on seasonal changes in these characteristics seemed to be an important contribution to clarify the taxonomy. Such a study has finally been conducted at the EPRC. According to the study, fur colouration and pattern do not justify the taxonomic distinction between *N. pygmaeus* and *N. intermedius*. The dark dorsal stripe and silvery frosting that had occasionally been used to distinguish *N. pygmaeus* from other species of lorises were found to be seasonal variations (Plate 2.1). The results of the study were first presented at the Conference of the International Primatological Society in Beijing in 2002 (STREICHER et al., 2002). *N. intermedius* had its strongest supporters in China and the study attracted much attention. It was finally published in German in 2003 and in English in 2004.

The study had a notable impact on further views of lorises' taxonomy. In a recent publication on taxonomy, GROVES (2004) acknowledged the findings of the study and emphasized again the doubts on the validity of *N. intermedius* based on the study's results. ROOS (2004) did largely neglect external characteristics for taxonomic considerations, but his DNA investigations showed little difference between *N. pygmaeus* and *N. intermedius*, and he expressed the accordance of his findings with the study. Since the publication of the study no further publications on *N. intermedius* appeared in China (BLEISCH, pers.com.).



Plate 2.1 Typical summer and typical winter colouration

Discussion

Taxonomical and ecological implications of a seasonal colouration change

Taxonomic considerations based predominantly on fur characteristics have to be viewed carefully. SUMNER (1927) long ago emphasized the difficulties encountered when assessing the colours of animals and suggested a standardized approach, whilst other authors

boldly regarded specific and subspecific determination on coat colour to be “most unsound” (SANDERSON, 1938). Various reasons might account for alterations of the coat colour. In museum specimens drying and preservation might be as altering influences, but different colours might also be the results of plant juices dyes. Colour differences could also be just colour varieties within the species, a phenomenon common in mammals (SANDERSON, 1938), or they could be related to the region of origin (SUMNER, 1926). Certain regional variations are known from the pygmy lorises in Vietnam. Extreme frosting has been observed in some animals originating from the northern provinces of Vietnam and fairly yellowish brown animals had been collected in Dak Lak province in the south, but an assessment of these regional variations is still pending (STREICHER et al., 2002). It is also possible that variations in colour might be merely individual variations, which are known also from other loris species (HILL, 1932). Finally gland secretions are also known to be responsible for coat colour variations (VERON, in litt.).

However, seasonal influences have been largely neglected in the assessment of fur colouration. This might partly be due to the snapshot character of field surveys and museum collection expeditions. Due to their short duration they are unable to provide an overview over seasonal variations and other changing physiological parameters. However, the dark dorsal stripe and silvery frosting occasionally used to distinguish *N. pygmaeus* from other species of lorises appear to be exactly such seasonal variations. Consequently, it seems advisable to follow the recommendation of GROVES (2004) and revise the taxonomic classification of the genus by taking into account potential seasonal variations.

Considering the potential advantages of a seasonal pelage change for the pygmy lorises, it is important to look at it within the context of the pygmy loris' ecology.

The winter pelage and colouration is most distinct between November and February. These are the coldest months of the year in northern Vietnam and temperatures during this time are close to freezing and often below 15°C for several days (NGUYEN et al., 2000). In combination with the low rainfall of this season the conditions are unfavourable for many tropical tree species (NGUYEN et al., 2000) and a large number of trees lose their foliage during this time of year.

During this season, captive pygmy lorises in outdoor enclosures show extensive resting periods and often remain in the same position without moving or feeding for a number of days. First observations on reintroduced, free-ranging lorises with radio transmitters seem to verify this observation for wild animals as well. Lorises do not rest in tree holes but rest either in dense scrub or more often on the fairly exposed, very high terminal branches of trees (STREICHER, 2003). Resting motionless in such an exposed position for longer periods of time requires a useful camouflage. It seems possible that the optically-dividing black stripe and the different colour provide a better camouflage in the partially bare trees.

Because most predators lack trichromatic vision and perceive only a limited range of colours (SUMNER, 2003), the pattern and light intensity of the fur's coloured surface play key roles for camouflage. Unable to detect the orange base colouration, a sleeping loris might appear to a predator as just a light grey shape, optically divided by a dark stripe.

It has been suggested that the bright colour influences mate selection processes. The animals achieve their bright summer colouration already some time prior to the actual mating season. There is no knowledge on the mating behaviour of pygmy lorises in the wild, if males and females pair up prior to mating, or which parameters influence mate selection. Bright orange colour could influence the mate choice. However, there is no notable dimorphism in the colouration of the animals and the latter point seems unlikely.

The fur of many animal species seasonally changes for the purpose of temperature regulation. Summer and winter pelages often have different insulation capacities. The pelage change coincides with the onset of the cold season and with other adaptations of the pygmy loris, which serve predominantly the purpose to overcome the cold season (see Chapter 5). It seems very likely that the winter pelage serves mainly for improved insulation.

References

- Alterman, L., Freed, B. Z.** 1997. Description and survey of three *Nycticebus* species in Bolikhamxay Province, Laos. *Primate Eye* **63**: 16.
- Bonhote, J. L.** 1907. On a collection of mammals made by Dr. Vassal in Annam. *Proceedings of the Zoological Society of London* **4**.
- Chu, E. H. Y., Bender, M. A.** 1962. Cytogenetics and evolution of primates. *Ann N Y Acad Sci* **102**: 253-266.
- Corbet, G. B., Hill, J. E.** 1992. *The Mammals of the Indomalayan Region : A systematic review*. Oxford University Press. Oxford.
- Dao, V. T.** 1960. Sur une nouvelle espèce de *Nycticebus* au Vietnam. *Zool. Anz.* **164**: 240-243.
- De Boer, L. E. M.** 1973. Cytotaxonomy of the Lorisoidae (Primates: Prosimii). II. Chromosome Studies in the *Lorisidae* and Karyological Relationships within the Superfamily. *Genetica* **44**: 330-367.

- Fiedler, W.** 1956. Übersicht über das System der Primaten. Pp. 1 – 266. In: Hofer, H., Schultz, A. H., Starck, D. (eds.): *Primatologia* 1, Basel.
- Feng, Q., Wang, Y., Li, C.** 1992. Mother-infants-interactions in captive middle slow loris (*Nycticebus intermedius*). *Acta theriologica sinica* **12** (3): 167-174.
- Feng, Q., Wang, Y., Li, C.** 1993. Reproduction of slow loris (*Nycticebus intermedius*) in captivity. *Zoological Research* **14** (1): 21-26.
- Feng, Q., Wang, Y., Li, C.** 1994. Progress of studies on intermediate slow loris in captivity. *Zhongguo Lingzhanglei Yanjiu Tongxun / Chinese Primate Research and Conservation News* **3** (1): 11-12.
- Groves, C. P.** 1971. Systematics of the Genus *Nycticebus*. Pp. 44 - 53 in: Proc. 3rd int. Congr. Primat., Zürich 1970, vol. 1.
- Groves, C. P.** 1998. Systematics of tarsiers and lorises. *Primates* **39** (1): 13-27.
- Groves, C. P.** 2001. *Primate Taxonomy*. Smithsonian Institution Press, Washington.
- Groves, C. P.** 2004. Taxonomy and biogeography of primates in Vietnam and neighbouring regions. Pp. 15-22. In: Nadler, T., Streicher, U., Ha, T. L.(eds.): *Conservation of Primates in Vietnam*. Haki press, Hanoi.
- Hill, O. W. C.** 1953. *Primates: Comparative anatomy and taxonomy*. Vol. I, Strepsirhini. Edinburgh University Press, Edinburgh.
- Nguyen, K. V., Nguyen, T. H., Phan, K. L., Nguyen, T. H.** 2000. *Bioclimatic Diagrams of Vietnam*. Vietnam National University Publishing House. Hanoi.
- Petter, J. J., Petter-Rousseaux, A.** 1970. Classification of the prosimians. Pp. 281-286. In Doyle, G.A., Martin, R.D. (eds.): *The study of Prosimian Behavior*. Academic Press, New York.
- Ratajszczak, R.** 1998. Taxonomy, distribution and status of the lesser slow loris *Nycticebus pygmaeus* and their implications for captive management. *Folia Primatol.* **69** (suppl. 1): 171-174.

- Roos, C.** 2004. Molecular evolution and systematics of Vietnamese primates. Pp. 23-28. In: Nadler, T., Streicher, U., Ha, T. L.(eds.): Conservation of Primates in Vietnam. Haki press, Hanoi.
- Sanderson, I. T.** 1940. The mammals of the north Cameroon forest area. Transactions of the Zoological Society of London **14**: 623-725.
- Schwartz, J., Beutel, J. C.** 1995. Species diversity in lorises: a preliminary analysis of *Arcticebus*, *Perodicticus* and *Nycticebus*. Pp. 171-192. In: Alterman, L.; Doyle, G. A.; Izard, M. K. (eds.): Creatures of the Dark. The nocturnal prosimians. Plenum Press, New York.
- Streicher, U.** 2004. Seasonal changes in fur pattern and colouration in the pygmy loris *Nycticebus pygmaeus*. Pp. 29-32. In: Nadler, T., Streicher, U., Ha, T.L.(eds.): Conservation of Primates in Vietnam. Haki press, Hanoi.
- Streicher, U., Schulze, H.** 2002. Seasonal changes in fur pattern and colouration in the pygmy loris *Nycticebus pygmaeus*. P.398. In: Caring for Primates. Abstracts of the XIXth Congress of the International Primatological Society. Mammalogical Society of China, Beijing.
- Streicher, U., Nadler, T., Zinner, D.** 2003. Re-introduction study of Pygmy lorises in Vietnam, *Re-introduction News*. Newsletter of the IUCN/SSC Re-introduction Specialist Group. Abu Dhabi, UAE. No.23: 37-40.
- Sumner, F. B.** 1926. An analysis of geographic variation in mice of the *Peromyscus polionotus* group from Florida and Alabama. Journal of Mammalogy **7**: 149-184.
- Sumner, F. B.** 1927. Linear and colorimetric measurements of small mammals. Journal of Mammalogy **8**:177-206.
- Sumner, P., Mollon, J. D.** 2003. Colors of Primate Pelage and Skin: Objective Assessment of Conspicuousness. American Journal of Primatology **59**: 67-91.
- Wang, W., Su, B., Lan, H., Liu, R., Zhu, C., Nie, W., Chen, Y., Zhang, Y.** 1996. Interspecific differentiation of the slow lorises (Genus *Nycticebus*) inferred from ribosomal DNA restriction maps. Zoological Research **17**(1): 89-93.

Zhang, Y., Chen, Z., Shi, L., 1993. Phylogeny of the slow lorises (genus *Nycticebus*): an approach using mitochondrial DNA restriction enzyme analysis. *Int. J. Primatol.* **14** (1): 167-175.

Zhang, Y., Chen, L., Qu, W., Coggins, C. 2002. Past, Present and Future. *The Primates of China: Biography and Conservation Status*. China Forestry Publishing House. Beijing.

3. Pygmy Lorises in the trade

Streicher, U., Schulze, H., Fitch-Snyder, H. Confiscation, rehabilitation and placement of Slow Lorises. Recommendations to improve the handling of confiscated slow lorises *Nycticebus coucang*. In: Shekelle, M. (ed.): *Primates of the Oriental Night*. Treubia. Special issue. In print.

Introduction

Right in his original description of the species, BONHOTE (1907) mentioned the value of pygmy lorises for tourism, export and decoration (skin). Realizing the threats this might hold for the species, he suggested considering the species as vulnerable and recommended forbidding all hunting, trapping, capturing, and selling of pygmy lorises in markets, as well as the specific protection of pygmy lorises at all National Parks.

Despite the recent interest in primate fieldwork in Vietnam, there has been little focus on the situation of lorises in the trade. Paradoxically, the main source of information on the species has come predominantly from captive and traded animals. The information on the occurrence of the pygmy loris is often based less on sightings than on captive specimens and skins held at traders' and hunters' houses or on specimens confiscated from illegal trading (FITCH-SNYDER et al., 2002, THANH, 2002). Even new species have been described based on market animals (RICHARDSON et al., 1995).

Pygmy lorises are traded for their assumed medicinal values and for the pet trade and by ethnic minorities also for food (MacKINNON et al., 1987, HUYNH, 1998, THANH, 2002, SCHULZE et al., 2004, ROBERTON et al., in prep.). Amazingly, the Red Data Book of Vietnam lists, in addition to other characteristics of the species, its specific values; valuable for science in evolutionary studies, valuable to keep for display and export and the leather can be used to produce mounted specimens (MINISTRY OF TECHNOLOGY, SCIENCE AND ENVIRONMENT, 2000)! Dried lorises' skins can be found in most animal markets in Cambodia (STICH et al., 2002, WILD AID unpublished). Buddhist beliefs in Laos prevent the use of lorises for food or medicinal purposes to a certain degree, but still lorises are still traded for the pet market (NOOREN et al., 2001).

Pygmy lorises are common in the trade all over their distribution area. In the early nineties, hundreds of pygmy lorises could be seen in animal markets (HUYNH, 1998, RATAJSZCZAK, 1998, NADLER, pers. com.). In 1997 animal traders were officially banned from the main market building in Hanoi and the numbers of pygmy lorises in the markets heavily decreased (NADLER, pers. com.). Despite being much lower than in former times, however, the numbers of pygmy lorises in the main animal market in Hanoi are

gradually increasing again (Table 3.1). This might reflect the recently increasing demand for wildlife products, which has been identified in Vietnam, particularly in the main cities (DO, 2003, SFNC, 2003).

Table 3.1 Pygmy lorises offered in Dong Xuan Market, Hanoi

Date	Number
4.8.2000	-
28.8.2000	2
6.9.2000	-
20.9.2000	2
5.10.2000	2
30.10.2000	-
11.11.2000	3
6.12.2000	-
3.2.2001	1
22.2.2001	2
23.3.2001	1
14.4.2001	3
9.5.2001	1
11.5.2001	2
23.7.2001	2
14.8.2001	6
23.8.2001	4
19.9.2001	1
26.11.2001	7
17.12.2001	7
26.4.2003	11

Lorises are protected nearly all over their distribution range (Table 3.2) and hunting, trading or keeping lorises is mostly illegal. Vietnamese forest protection law protects the pygmy loris on the highest possible level, and has done so since 1992 (COUNCIL OF MINISTERS, Decree No. 18/HDBT, Decree No. 48/2002/ND-CP, correction list No. 3399/VPCP-NN). Thus, all exploitation including hunting, catching, killing, purchasing, selling, storing, raising in cages and transporting of the animals or products thereof is prohibited. But the enforcement of the laws is low; lack of incentives, poor support from superior authorities, inadequate salaries, corruption and alcoholism have been identified as the main obstacles for correct enforcement (SFNC, 2003). The numbers of confiscations of lorises do not reflect the numbers in the trade but rather the lack of motivation in forest protection forces to confiscate the inconspicuous primate. For example, between 2000 and 2004 the Forest Protection Department in Ho Chi Minh City, a major trade point for southern Vietnam, reported only three official loris confiscations (WAR, unpublished). During the same period, however, sometimes more than ten pygmy lorises were counted by observers in the main animal market in a single day (pers.observ.). Improved law enforcement had been postulated as a crucial measure for loris conservation in Vietnam (HUYNH, 1998).

Table 3.2 Protection status of lorises

Country	Species	Legislation	Contents	Fine
Bangladesh	<i>Nycticebus coucang</i>	3rd Schedule of the Bangladesh Wildlife Preservation Act, 1974	Complete protection from hunting, killing or capture	
Buthan	Not mentioned	-		
Burma	No data available	-		
Cambodia	<i>Nycticebus tardigradus</i> <i>Nycticebus pygmaeus</i> <i>Nycticebus Coucang</i>	PRAKAS 359 Ministry of Forestry and Fisheries Species List prohibited to hunt from 1.8.1994	Prohibited to catch, hunt, poison or transport	10,000 to 1,000,000 Real (2.5 – 250 USD) 1 month to 1 year imprisonment
China	<i>Nycticebus coucang</i> <i>Nycticebus pygmaeus</i>	Class 1 protected	Illegal to capture, hold, trade, transport	Severe (death penalty theoretically possible for smuggling Class 1 protected animals e.g. pandas)
India	<i>Nycticebus coucang</i> <i>Nycticebus tardigradus</i>	Schedule I of Indian Wildlife Protection Act 1972 (1991)	Cannot be poached, kept, trophied or have derivatives extracted out of.	100,000 Indian Rupees (2150 USD) Up to 7 years imprisonment
Indonesia	<i>Nycticebus coucang</i>	Decree of Agriculture Ministry No.66 of 1973, Government Regulation No. 7 of 1999 concerning the Protection of Wild Flora and Fauna, Act No. 5 of 1999	Catching, killing, keeping, hurting, transporting and trading of live or dead lorises, parts of their bodies and derivatives or products made of them is prohibited	Up to 100,000,000 Rupiah (10970 USD) Up to 5 years Imprisonment
Laos	Not mentioned	-		
Malaysia	<i>Nycticebus coucang</i>	Schedule 1 of Totally Protected Wild Animals	Hunting, killing or capturing Hunting immature animals Hunting females	Up to 5.000 Ringgit (1310 USD) Up to 3 years imprisonment Up to 6.000 Ringgit (1580 USD) Up to 6 years imprisonment Up to 10.000 Ringgit (2630 USD) Up to 10 years imprisonment
Sri Lanka	-	Fauna and Flora Protection Act 1937 (1993)	Forbidden to hunt, shoot, kill, wound or take any wild animal or have in personal possession or under personal control any wild animal, whether dead or alive or any part of such animal	10.000-20.000 Rupees (100-200 USD) or imprisonment from 2-5 years or both.
Thailand	<i>Nycticebus spp.</i>	Wildlife Preservation Act of 1992	Keeping, hunting or trading the species is illegal	Up to 40.000 Baht (1000 USD) Up to 4 years imprisonment
Vietnam	<i>Nycticebus Pygmaeus</i>	List IB, Art. 18 HBDT Ministerial Decision on the List of Rare and Endangered Wild Fauna and Flora from 1992 (2002)	Exploitation strictly forbidden (hunting, catching, killing, purchasing, selling, storing, raising in cages, transporting animals or products thereof)	Has to be prosecuted as a criminal case

A recent overview lists known occurrences of pygmy lorises in the trade (SCHULZE et al., 2004). Pygmy lorises do not only occur in the national but also in international trade and official confiscations and illegal purchases are known from Cambodia, Laos, Thailand, China, Taiwan, Hong Kong, Singapore, Japan, Russia, Poland, Germany and the Netherlands (LE

DIEN DUC, 1993, COMPTON et al., 1998, MASAPUSTOVA, 2001, SCHULZE et al., 2004). Lorises are listed in CITES appendix two, but despite the vivid trade only for two pygmy lorises official CITES documents have been issued at the Vietnamese CITES authority within the last years (CITES authority Hanoi, pers.com.).

Lorises are probably not a prime target for hunters but are rather collected during logging and slash and burn agricultural activities (RATAJSZCZAK, 1998). In addition to unsustainable hunting, widespread lack of knowledge on the species has worsened the situation. In southern China pygmy lorises have been eradicated locally since they were assumed to be a crop pests and were not considered primates (SHI, pers. com.).

Due to their small size, lorises are easy to transport and are transported by land, sea and air. Lorises are transported by land in a variety of different containers including baskets, boxes and sacks are common (STREICHER, 2004). For short distances lorises are often merely tied to poles and sticks (NOOREN et al., 2001, WILD AID unpublished). All animal transport usually results in a certain mortality of the transported animals depending on species and transport conditions (JONES, 1974). Illegal trade pays particularly little respect to the transported animal's health and transport mortalities are likely to exceed by far the rates known from legally traded species. Due to indifference and mere lack of knowledge, however, transport conditions do not often improve much after forest protection forces and animal rescue teams take over an animal (THANH, 1996, STREICHER, 2004). From a shipment of 102 pygmy lorises confiscated at a Taiwanese airport in 1993, more than 80% died between confiscation and arrival at their final destination at Saigon Zoo (EUDEY, 1995). Stress during transport has been identified as a main threat for animals' health (FOWLER, 1974) but injuries, dehydration and mere exhaustion are also transport-associated health problems in pygmy lorises (MASOPUSTOVA, 2001, STREICHER, 2004).

The care given to an animal during and immediately after capture is known to play an important role for an animal's survival, but the care after arrival at the final destination (be it a rescue centre, zoo or other long-term holding facility) is equally important. Mortality figures and quality of care during the first 30 days are strongly correlated (JONES, 1974).

There is little information on mortality rates in lorises after confiscation. SCHULZE (1998) reported high mortalities in *L. tardigradus* after translocation to a new facility and out of a large transport of slow lorises confiscated in Indonesia about 80% died within the first three months after confiscation (HAAS, in litt.). From seven confiscated lorises transferred to Saigon zoo, three died within the first six weeks (EUDEY, 1995). All pygmy lorises confiscated at Prague airport and brought into quarantine at Prague zoo between 1990 and 2000 died (MASOPUSTOVA, 2001). Death cases after arrival at a new facility might still be related to stress during transport and weeks might pass until the full results of transport related stress become apparent (FOWLER, 1974).

After confiscation lorises were in most cases released (WANG et al., 1996, THANH, 1996, STREICHER, 1998, SCHULZE et al., 2004, WAR, WFFT, WILD AID unpublished data). Introduction of disease, food competition and hybridisation with resident species are only some of the problems associated with such wild releases (KLEIMANN, 1996, CHIVERS, 1991, IUCN, 1998, IUCN, 2002, SOORAE et al., 2002). Such releases were nowhere monitored and it is unknown how many of the released animals survived at all.

Captivity also largely failed to provide a solution to the problem. Rescue centres and Asian zoos were confronted with the task of taking over confiscated lorises, which sometimes comprised as many as 100 individuals (SUN, in litt., PROFAUNA unpublished). Due to limited knowledge on correct handling and management of lorises, mortalities were exceedingly high. Despite their small size lorises required a lot of cage space and could not be successfully kept in large groups (HAAS, in litt.). The mere proximity of conspecifics might put considerable stress on the solitary lorises (PETTER, 1975, FITCH-SNYDER et al., 2001, SCHULZE et al., 2004) and death cases in lorises were related mainly to stress but also to trauma and disease (see Chapter 4.) Quiet, isolated housing in adequate numbers which would be required for the solitary and nocturnal animals could not be provided at zoos or rescue centres (HAAS, in litt., SUN, in litt.). To keep lorises for good at zoos was only possible in a few cases. Lorises have to be kept in nocturnal exhibits, which require a high degree of management (FITCH-SNYDER et al., in print) and where cage space is usually limited. Consequently, large numbers of animals have been returned to the country of origin (SUN, in litt.) where they then were released.

Though international guidelines on placement of confiscated animals in particularly primates are widely available, especially for primates, (IUCN, 1998, IUCN, 2002, SOORAE et al., 2002) they were not taken into account when dealing with confiscated lorises.

Recommendations to improve the handling of confiscated lorises

The need to develop standards and recommendations for the handling and placement of trade- confiscated lorises became obvious. On an International Workshop on Tarsier and Loris Taxonomy, Husbandry and Conservation in Jakarta in 2003, an effort was undertaken to develop such guidelines. The aim was to provide guidance for those involved in confiscation and handling of confiscated lorises and consequently to reduce mortalities, but also to avoid ill-managed releases of confiscated animals. The recommendations addressed in a concise form all aspects relating to confiscation, rehabilitation and placement in a way practicable for those involved in these processes. It gives guidance on correct handling, construction of transport containers, species identification, measuring, emergency health care, quarantine, short term-housing, feeding and placement options. .

Discussion

The need to improve the process of handling and confiscation of lorises

Improving the present process of loris handling and confiscation requires considerable efforts in capacity building and requires considerable financial and personal resources. Only then can confiscated lorises be integrated into comprehensive conservation programmes and contribute effectively to the species' conservation; otherwise, confiscation and rescue remains predominantly and merely an act of animal welfare (STREICHER, 2004). It can be argued if it makes sense to improve the present process of loris handling and confiscation at all. Regarding the difficulties, including financial and personal commitments related to successful rescue, captive management and reintroduction, would it not be wise to euthanize lorises at the moment confiscation and simply strive to further improve their protection in their habitats?

On the other hand the improvement, which can be achieved is impressive. At the Endangered Primate Rescue Centre, where the recommendations have been developed, the survival rate of newly arriving pygmy lorises is over 90%.

Field data on pygmy lorises are currently very rare (THANH, 2002) and market animals have always been a main source of scientific information (RICHARDSON et al. 1995, RATAJSZCZAK, 1998, FITCH-SNYDER et al., 2002).

As long as field data are missing, confiscated lorises must be considered an important source of information. Lacking a standard format for data collection, confiscating authorities do not collect any data besides species, animal numbers and total weight (SFNC, unpublished, NINH BINH FPD, unpublished). But detailed data collection on these animals would not only be of scientific interest, however, it would also help to develop adequate long-term solutions for the confiscated animals. Data on confiscation locality could provide information on local and regional variations, potentially even on habitat requirements. Data on morphometrics of each confiscated individual at the time of confiscation could help to identify target groups in the species and could help to document seasonal processes. Data collected on animals confiscated together could allow conclusions on their social structure (for example if females are confiscated together with their offspring in November). All these data are important sources of information in respect to later placement options for the animals.

Lorises seem to be rare in the wild (MacKINNON et al., 1987, THANH, 1996, 2002, HUYNH, 1998) and due to the unabated poaching in Vietnam the numbers are probably still decreasing. Captive breeding could become an important contribution to the species' conservation within the near future. Captive breeding populations could assure the availability of reintroduction stock, should reintroduction become a feasible option.

Captive populations would also be an important study possibility in order to further improve the understanding of the species (see Chapter 5).

Releasing radio-collared individuals provides an excellent opportunity to study the ecology of the species (see Chapter 6 and 7). Further, a full understanding of the species' ecology is an inevitable condition for successful captive management, efficient habitat protection, successful reintroduction and other conservation measures.

Public awareness of the pygmy loris is rudimentary or lacking completely. The fact that it has been considered a pest animal reflects the complete lack of understanding and demonstrates how a lack of understanding might lead not only to indifference but also to disastrous measures towards a species. Confiscated animals provide a good opportunity to explain relations between market demand, trade and species extinction. Well-presented examples of confiscation cases can be used to raise concerns about a species' status in the wild and to raise a feeling of commitment. Confiscated animals under captive conditions provide an excellent opportunity to prepare educational materials and films.

According to International Guidelines (IUCN, 1998), confiscated pygmy lorises in Vietnam meet all conditions for euthanasia. From a merely conservation based point of view it might be sensible to sacrifice individuals, which are already in the trade and lost to the wild populations, in order not to endanger the remaining animals in the wild (IUCN, 1998). The guidelines postulate accepting euthanasia as a valid alternative to captive breeding and return to the wild. But accepting these standards does require a broad view of conservation, which can't be taken for granted in a country like Vietnam just undertaking the first steps towards conservation. It is important to educate the public about the seriousness of the wildlife trade and the irreversibility of the damages done to the wild populations. There will always be confiscated animals, which can't be integrated in conservation programmes. It is important that the public realizes that even with confiscations and rescue programmes there is no way back for many animals and they consequently have to be euthanized. If euthanasia is the only solution offered, however, public acceptance for conservation and protection measures might be reduced and forest protection forces discouraged. In the worst case scenario, such a policy might reduce the rangers' readiness to confiscate lorises at all, if they assume that the animals are better off in illegal captivity as a pet than euthanized. The need to euthanize single animals too old or too sick for captive breeding or reintroduction might be more understandable if such an action is contrasted by rescues in a conservation oriented context, for example by integrating animals in a captive breeding programme.

Finally there is a strong aspect of animal welfare justifying all possible efforts to improve the present disastrous handling, confiscation and placement conditions.

The need for scientific investigations, the need to establish captive breeding populations, the need to raise public awareness, the need to offer a more positive conservation approach than euthanasia and finally the need for animal welfare are sufficient reasons to strive to improve current procedures of confiscating and managing confiscated pygmy lorises.

References

- Compton, J., Le, H. Q.** 1998. Borderline – An Assessment of Wildlife Trade in Vietnam. WWF Indochina Programme, Hanoi.
- Chivers, D. J.** 1991. Guidelines for re-introductions: procedures and problems. Symp. Zool. Soc. Lond. No **62**: 89-99.
- Council of Ministers.** 1992. Decree No. 18/HDBT of January 17 prescribing the list of precious and rare forest plants and animals and the regime of management and protection thereof.
- Council of Ministers.** 2002. Decree No. 48/2002/ND-CP of April 22.
- Council of Ministers.** 2002. Correction list No. 3399/VPCP-NN of June 21.
- Do, K. C.** 2003. A Thematic Research Group Report in support of the National Action Plan on Strengthening Wildlife Trade Controls in Vietnam 2004-2010. Unpubl.
- Eudey, A. A.** 1995. Southeast Asian Primate Trade Routes. Primate Report **41**: 33-42.
- Fitch-Snyder, H., Schulze, H., Larson, L. (eds.)** 2001. Management of Lorises in captivity. A husbandry manual for Asian Lorises (*Nycticebus* & *Loris* spp.). Center for Reproduction of Endangered Species, Zoological Society of San Diego, San Diego.
- Fitch-Snyder, H., Schulze, H., Streicher, U.** Enclosure design for *Nycticebus* spp. In: Shekelle, M.(ed): Primates of the Oriental Night. Treubia. In print.
- Fitch-Snyder, H., Vu N. T.** 2002. A preliminary survey of lorises (*Nycticebus* spp.) in Northern Vietnam. Asian Primates – A Newsletter of the IUCN/SSC Primate Specialist Group. Vol.8, No.1,2: 1-6.
- Fowler, M. E.** 1974. Veterinary aspects of restraint and transport of wild animals. Int Zoo Yearb Vol **14**: 28-33.
- Huynh, D. H.** 1998. Ecology, Biology and Conservation status of Prosimian Species in Vietnam. Folia Primatol **69** (suppl 1): 101-108.

- IUCN.** 1998. Guidelines for Re-introductions. Prepared by the IUCN/SSC Re-introduction Specialist Group. IUCN, Gland, Switzerland and Cambridge.
- IUCN.** 2002. Guidelines for the Placement of Confiscated Animals. Prepared by the IUCN/SSC Re-introduction Specialist Group. IUCN, Gland, Switzerland and Cambridge.
- Jones, M. L.** 1974. Mortality of wild-caught animals after arrival in the zoo. *Int Zoo Yearb* Vol **14**: 37-39.
- Kleimann, D. G.** 1996. Reintroduction Programs. In Kleimann, D.G., Allen, M.E., Thompson, K.V., Lumpkin, S., Holly, H. (eds.): *Wild Mammals in Captivity*. University of Chicago Press. Chicago and London.
- Le, D. D.** 1993. Final Report on the Vietnam Wildlife Trade Monitoring Project. Centre for Natural Resources and Environmental Studies (CRES), Hanoi.
- Masopustova, R.** 2001. The Quadruplets and Twins of Lesser Slow Loris in Prague Zoo. *Gazella* **28**: 63-71.
- MacKinnon, J., MacKinnon, K.** 1987. Conservation and status of the primates of the Indo-Chinese subregion. *Primate Conservation* **8**: 187-195.
- Ministry of Science, Technology and Environment (ed.)** 2000. Red Data Book of Vietnam, Vol. 1. Animals. Hanoi.
- Nooren, H., Claridge, G.** 2001. Wildlife Trade in Laos: the End of the Game. A History of Wildlife Trade in Laos to 1995. Netherlands Committee for IUCN, Amsterdam.
- Petter, J.-J.** 1975. Breeding of Malagasy lemurs in captivity. Pp. 187-202. In: Martin, R.D. (ed.): *Breeding endangered species in captivity*. Academic Press, London.
- Ratajszczak, R.** 1998. Taxonomy, distribution and status of the lesser slow loris *Nycticebus pygmaeus* and their implications for captive management. *Folia Primatol.* **69** (suppl. 1): 171-174.

- Richardson, D. M., Ratajszczak R.** 1995. A possible new species of *Nycticebus* from Vietnam. Unknown source.
- Roberton, S., Nguyen, T. T., Nguyen, T.V., Tran, V. P., Ngo, D. H., Hoang, M. L., Doan, D. V., Tran, Q. H., Cao, T. H., Phan, V. L., Tran, V. D.** An Assessment of the Threats to the biodiversity of Phong Nha Ke Bang National Park, Quang Binh province, Vietnam. Repost No. 1: The Illegal Trade in Wildlife. Fauna & Flora International and Phong Nha National Park. Vietnam. In prep.
- Schulze, H.** 1998. Developing a husbandry manual to facilitate the distribution and presentation of information: with special reference to slender loris *Loris tardigradus nordicus* at Ruhr-University, Bochum. *International Zoo Yearbook* **36**: 34-48.
- Schulze, H., Streicher, U.** 2004. Threat for lorises and pottos. In: Conservation database for lorises and pottos. <http://www.loris-conservation.org>
- Schulze, H., Groves, C.** 2004. Taxonomic problems caused by illegal trade. Pp. 33-36. In: Nadler, T., Streicher, U., Ha, T. L. (eds.): Conservation of Primates in Vietnam. Haki press, Hanoi.
- SFNC.** 2003. Hunting and Trading Wildlife: An investigation into the wildlife trade in and around the Pu Mat National Park, Nghe An province, Vietnam. SFNC, Vinh.
- Soorae, P. S., Baker, L. R. (eds.)** 2002. Re-introduction News: Special Primate Issue, Newsletter of the IUCN/SSC Re-introduction Specialist Group, Abu Dhabi, UAE. No. **21**: 60pp.
- Stich, I., Krüger, K.-O.** 2002. Artenschutz in Kambodscha. ZGAP Mitteilungen, 18. Jahrgang, **2**: 7-9.
- Streicher, U.** 1998. Vietnams Tierhandel- Gibt es einen Ausweg? Mitteilungen der ZGAP. 14. Jahrgang, Heft **2**: 4-8.
- Streicher, U.** 2004. Confiscated Primates- health problems and placement options. Pp. 154-160. In: Nadler, T., Streicher, U., Ha, T. L. (eds.): Conservation of Primates in Vietnam. Haki press, Hanoi.

Thanh, V. N. 1996. Biodiversity and Biodiversity Loss. Presentation held at the Seminar on Environment and Development in Vietnam. Australian National University. Canberra.

Thanh, V. N. 2002. The status and conservation of the loris species, *Nycticebus coucang* and *N. pygmaeus* in Vietnam. P. 254. In: Caring for Primates. Abstracts of the XIXth Congress of the International Primatological Society. Mammalogical Society of China, Beijing.

Wang, Z., Wu, D., Chen, H. 1996. Preliminary Survey on Transfrontier Wildlife Trade in Yunnan. Pp. 188-196. In: Schei, P. J., Wang, S., Xie, Y. (eds.): Conserving China's Biodiversity (II). China Environmental Science Press, Beijing.