RAFFLES BULLETIN OF ZOOLOGY 1994 **42**(4): 775-780

EXTRACTION OF BACULA FROM TANNED GIBBON SKINS

Thomas Geissmann and **Kelvin K.P. Lim**

***ABSTRACT.* –** Bacula or penis bones are thought to be of great potential importance for the classification of gibbons (Hylobatidae), but not enough specimens have been available for study to either support or reject this view. Because we found that bacula are often well preserved in tanned skins of museum specimens, we developed an easy and safe method to extract these fragile bones from such skins. Our method, described here, may be applied to other mammals as well. In addition, the method is of some value for sexing tanned skins of juvenile gibbons of the *Hylobates concolor* group. Sex determination is difficult in these gibbons and hitherto, there has been no reliable method for sexing tanned skins of these animals.

INTRODUCTION

The shape and the size of penis bones or bacula have been found to be of considerable value in mammal systematics (e.g. Fooden, 1975, 1988; Groves, 1972). Recent proposals for a taxonomic rearrangement of the crested gibbons (*Hylobates concolor* group, Primates) have been based mainly on evidence from bacula (Groves, 1988, 1993, Groves & Wang, 1990; Ma & Wang, 1986; Ma *et al.*, 1988). While working on a comprehensive revision of the systematics of crested gibbons, one of us (TG) discovered that only a few specimens had been available to previous authors and that the variability of gibbon bacula had previously been neither considered nor assessed. It is clear that more bacula must be studied before any reliable conclusions can be drawn about gibbon systematics. A very small os clitoridis was found in three females (one each of *H. hoolock*, *H. leucogenys* and *H. syndactylus*), but not in females of the *H. lar* group (Groves, 1972); its variability and the consistency of its distribution among the various species are, however, unknown.

When primate specimens are preserved for zoological collections, bacula are not usually extracted from the skin and hence remain in place when the skin is tanned. During the present study, we realised that tanned skins provide a largely untapped source for additional bacula. We developed a simple and safe method for extracting these small bones from skins, which is described in the present paper. Although our work was confined to

Thomas Geissmann - Anthropological Institute, University Zürich-Irchel, Universitätsstrasse 190, CH-8057 Zürich, Switzerland. **Kelvin K.P. Lim** - Zoological Reference Collection, Department of Zoology, National University of Singapore, Kent Ridge, Singapore 0511.

gibbons, the method probably also applies to other mammals. Inter- and intra-specific variability in gibbon bacula and their importance for gibbon classification will be assessed elsewhere (Geissmann, in prep.).

MATERIAL

The specimens used in this study are housed in the following collections: BFMO, Bawangling Forestry Management Office on Hainan Island, China (n=1); IEBR, Institute of Ecology and Biological Resources in Hanoi, Vietnam (n=1); IZCAS, Institute of Zoology of the Chinese Academy of Sciences in Beijing, China (n=3); ZRC, Zoological Reference Collection at the National University of Singapore (n=11); and one private collection in Zürich, Switzerland (n=1). The species examined include *Hylobates agilis*, *H. concolor*, *H. gabriellae*, *H. hoolock*, *H. lar*, *H. leucogenys*, *H. moloch*, *H. muelleri* and *H. syndactylus*. Of these 17 specimens 16 are adult, thus increasing the number of previously available bacula

Table 1. Bacula of adult gibbons used in previous studies, and additional bacula extracted for the present study.

Species	Groves (1972)[a]	Groves & Wang (1990)[b]	This study
Hylobates agilis	1		1
H. concolor	1	2	1
H. gabriellae[c]	1		5
H. hoolock	4		1
H. klossii			
H. lar	2		1
H. leucogenys	2[d]	3	3
H. moloch	1[e]		1
H. muelleri	1		1
H. pileatus	2		
H. syndactylus	1		2
	17	5	16

[a] Most of these bacula (n=13) are preserved at the British Museum (Natural History); the remaining 4 specimens are probably not preserved anymore and were originally described by Gerhardt (1909, n=2), Matthews (1946, n=1), and Hill and Kanagasuntheram (1959, n=1).

[b] These specimens are preserved at the Kunming Institute of Zoology (KIZ), but one of them (*H. concolor* KIZ 640291) was apparently lost prior to my visit at the KIZ in Aug. 1990.

[c] A specimen at the Muséum National d'Histoire Naturelle in Paris (MNHN C.G.1971 No.81) which was identified as adult *H. gabriellae siki* by Groves and Wang (1990), was identified as juvenile *H. leucogenys leucogenys* by one of us (TG), and is not included in this list.

[d] Although one of these 2 specimens was identified as "*H. conc*. subsp." in Groves (1972, p. 34), it was reported to be "*H. concolor leucogenys*" in the original description by Hill and Kanagasuntheram (1959).

[e] An additional specimen identified as "*H. lar moloch*" by Groves (1972) is not used in this list, because it was originally labelled as *H. leuciscus* by Gerhardt (1909). Although earlier authors frequently used the name "*leuciscus*" for Javanese gibbons (i.e. *H. moloch*), the same name was also applied to gibbons from Borneo (especially to *H. muelleri abbotti*). Moreover, Gerhardt (1909, p. 354) himself even identified a gibbon from Sumatra as *H. leuciscus.* As a result, the baculum described by that author cannot be reliably attributed to any one of the currently recognised species.

of adult gibbons by more than 70% (see Table 1). The taxonomic treatment of the Hylobatidae used here follows the one proposed in Geissmann (1994a).

METHODS, RESULTS AND DISCUSSION

The gibbon penis is relatively thin and can easily be broken away from the tanned skin. We found that the baculum in gibbons is situated near the tip of the penis and is not likely to be damaged if the penis is carefully broken off at its base. Many of the more ancient male skins in museum collections lack a penis, probably as a result of inappropriate handling.

The tanned penis is very hard and it is difficult to cut away the dried tissue without damaging the fragile baculum. Direct treatment with hydrogen peroxide (H_2O_2) may damage both the baculum and the skin. We obtained the best results by simply immersing the tanned penis in boiling water. After about 20 min (range: 10-60 min), the skin and other non-ossified tissue became soft enough to permit manual removal of the baculum. In several cases, the soft tissue split open after a few minutes of boiling and either the base or the tip of the baculum protruded, permitting careful removal. The addition of 1-4% H_2O_2 to the hot water adequately bleaches the bone. It is not necessary for the extraction process, but appears to shorten its duration. After drying, the extracted bacula are ready for study.

We recommend that all skins subjected to this procedure are clearly labelled to show that this has been carried out; the sex determined should be clearly stated, with a note, where relevant, that it was different from the original identification. The soft tissue and the baculum or os clitoridis should be stored with a label indicating their provenance and the collection number of the original specimen. The soft tissue may be of use for DNA-analysis and should not be discarded.

With the fast method described above, large numbers of gibbon bacula can easily be prepared for study in only few hours. The new bacula made available during the present study provide a view of the considerable intra-species variability of this bone for the first time. An example of this variability is shown in Fig. 1.

As an additional finding, our method proved to be helpful in sexing gibbon skins. This is especially important with gibbons of the *concolor* group as females have an elongated clitoris similar in shape to the penis (Geissmann, 1993). In addition, juvenile males and females of the *concolor* group have the same blackish fur colouration, whereas adult animals exhibit pronounced sexual dichromatism of the pelage, with males being essentially black and females yellowish or beige (Geissmann, 1993). Moreover, juvenile gibbons of the *concolor* group appear sexually undifferentiated in their vocalisations: Juveniles of both sexes produce female-like vocalisations in their songs (Geissmann, 1993, 1994b). As a result, even captive juveniles are often difficult to sex unless they can be closely examined, and incorrectly sexed animals are repeatedly encountered in zoos (TG, unpublished observations). Moreover, in museum specimens, the external genitalia are often shriveled and wrinkled to a degree that precludes identification of the sex even with careful examination. For instance, all 10 juvenile gibbons of the *concolor* group examined by one of us (TG) at the Zoological Institute of the Academia Sinica in Beijing (IZCAS) are labeled as males. We suspect that this identification may be based largely on fur colouration and/or the presence of a penis-shaped appendix in the genital region and is probably incorrect in about 50% of specimens. Because the appendage approximately regains its original size and shape when immersed in boiling water, the difference between

Fig. 1. Variability of the os penis (baculum) of yellow-cheeked crested gibbons (*Hylobates gabriellae*) from the ZRC. Specimens are (from top to bottom): ZRC-4-691, ZRC-4-694, ZRC-4-692, ZRC-4-696. The collecting locality of the first specimen is Trang Bom (Bien Hoa, Vietnam), all others are from Da Ban (Ninh Thuan, Vietnam). All specimens were collected by C. B. Kloss in 1918 (see also Weitzel et al., 1988). Scale divisions are in millimetres.

the prolonged clitoris (a narrow groove along the lower surface) and the penis (a small slit at the tip) can clearly be seen after this treatment. The only juvenile gibbon in our study sample, a mounted Hainan black gibbon (*H. concolor hainanus*) preserved at the Bawangling Forestry Management Office, was included because no adult male of this particular taxon was available for study. This specimen was labeled as a male and was identified as a juvenile female only after having been subjected to the treatment described above.

ACKNOWLEDGEMENTS

We owe our deep gratitude to the officials and staff members of the institutions listed in the Material section for facilitating this research and for giving permission to extract bacula from the gibbon specimens in their care, especially to Prof. Tao Huiguan (BFMO), Dr. Pham Trong Anh (IEBR), Prof. Quan Guoqiang and Prof. Feng Zuojian (IZCAS), and Mrs. Yang Chang Man (ZRC). We are particularly indebted to Prof. R. D. Martin, Dr. D. Brandon-Jones, Ms. D. J. Curtis for reading and commenting upon the manuscript.

REFERENCES

Fooden, J., 1975. Taxonomy and evolution of liontail and pigtail macaques (Primates: Cercopithecidae). *Fieldiana, Zool.* **67**: 1-169.

Fooden, J., 1988. Taxonomy and evolution of the *sinica* group of macaques: 6. Interspecific comparisons and synthesis. *Fieldiana, Zool.* (N.S.) **45**: 1-44.

Geissmann, T., 1993. *Evolution of communication in gibbons (Hylobatidae).* Ph.D. thesis, Anthropological Institute, Phil. Fac. II, Zürich University.

Geissmann, T., 1994a. Systematik der Gibbons. *Zeitschrift des Kölner Zoo* **37**: 65-77.

Geissmann, T., 1994b. Changes in features of crested gibbons (*Hylobates concolor* group). In: *International Studbook: Hylobates concolor (Harlan, 1826) 1994, 2nd Edition*. Ed. J.-M. Lernould, Parc Zoologique et Botanique, Mulhouse, in press.

Gerhardt, U., 1909. Ueber das Vorkommen eines Penis- und Clitorisknochens bei Hylobatiden. *Anatom. Anzeiger, Jena* **35**: 353-358.

Groves, C. P., 1972. Systematics and phylogeny of gibbons. In: *Gibbon and siamang, vol. 1*. Pp. 1-89. Ed. D. M. Rumbaugh. Karger, Basel.

Groves, C. P., 1988. The taxonomy of crested or concolor gibbons. *Australian Primatol.* **3**(1): 33.

Groves, C. P., 1993. Speciation in living hominoid primates. In: *Species, species concepts, and primate evolution.* Pp. 109-121. Eds. W. H. Kimbel & L. B. Martin. Plenum Press, New York and London.

Groves, C. P. & Y. Wang, 1990. The gibbons of the subgenus *Nomascus* (Primates, Mammalia). *Zool. Res.* **11**: 147-154.

Hill, W. C. O. & R. Kanagasuntheram, 1959. The male reproductive organs in certain gibbons (Hylobatidae). *Am. J. Phys. Anthrop.* **17**: 227-241.

Ma, S. & Y. Wang, 1986. [The taxonomy and distribution of the gibbons in southern China and its adjacent region - with description of three new subspecies]. *Zoolog. Res.* **7**: 393-410 (Chinese text, English summary).

Ma, S.; Y. Wang, & F. E. Poirier, 1988. Taxonomy, distribution, and status of gibbons (*Hylobates*) in southern China and adjacent areas. *Primates* **29**: 277-286.

Matthews, L. H., 1946. Notes on the genital anatomy and physiology of the gibbon (*Hylobates*). *Proc. Zool. Soc., London* **116**: 339-364.

Weitzel, V.; C. M. Yang, & C. P. Groves, 1988. A catalogue of primates in the Singapore Zoological Reference Collection, Department of Zoology, National University of Singapore (formerly the Zoological Collection of the Raffles Museum). *Raffles Bull. Zool.* **36**: 1-166.