

*Peter Brazaitis,<sup>1</sup> B.S.*

## Reptile Leather Trade: The Forensic Science Examiner's Role in Litigation and Wildlife Law Enforcement

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**ABSTRACT:** The forensic science identification of crocodylian hides and products is an immense task that requires the efforts of the forensic science examiner. Positive identifications of reptilian species must be made for use in litigation against traffickers in hides and products of protected species. Two example cases of identification and litigation are presented, and methods of identification are enumerated.

**KEYWORDS:** criminalistics, wildlife, identification systems, hide identification, endangered species, caiman, illegal trade

Concern for the overexploitation of wildlife for commercial purposes prompted the enactment of international and national wildlife regulations to control the trade in endangered and threatened species, including reptiles. The U.S. Endangered Species Act (ESA) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), implemented in 1973, focus on the import, export, and international trade in wildlife and wildlife products. The U.S. Lacey Act prohibits the interstate transportation of protected wildlife and the importation of wildlife taken in violation of the laws of any sovereign country. Penalties for violations include simple seizure for improper documentation, civil penalties, forfeiture of goods, or criminal prosecution. Felony charges under the Lacey Act may result in penalties of up to \$20 000 and five years imprisonment for each violation. CITES is enforced under the ESA, which in turn has been adopted in state wildlife regulations. In effect, U.S. wildlife authorities, both on a national and state level, are charged with enforcing the wildlife regulations of foreign countries as well as those of the United States.

With the implementation of these regulations, the role of the forensic science specialist took on broadened dimensions. Paramount to the protection of endangered species and the success of international conservation and wildlife management efforts is the ability of wildlife officers and forensic science specialists to identify the species protected under the law, and the ability to support that identification under judicial scrutiny.

Shipments of reptile products, often valued at tens of thousands of dollars, destined for legitimate merchants who may be operating under limited financial resources, and to fulfill

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<sup>1</sup>Superintendent, Department of Herpetology, New York Zoological Park, Bronx, NY.

purchase orders with anticipated delivery dates, must be routinely scrutinized. Legitimate shipments should not be unduly delayed or damaged for purposes of inspection. Yet adequate species identification may require hours or days of research by an expert forensic science examiner. While forensic science specialists can be recruited from many disciplines to make detailed examinations under laboratory conditions, wildlife inspectors are expected to target possible violations involving all types of endemic and exotic wildlife in any form, on cursory examination, under frontline conditions.

For effective law enforcement on an international and national level, the forensic science examiner may be asked to (1) give assistance to wildlife law enforcement agencies in the routine screening of wildlife shipments in commercial trade, (2) educate wildlife officers in making cursory species identification, (3) perform forensic science examinations, or (4) research and develop new techniques for species identification. Forensic wildlife specialists may also be required to know tanning and commercial trade. Lastly, they may serve as expert witnesses in court proceedings.

Among the wildlife species most often found in commercial trade are reptiles, particularly crocodylians. Of the 21 species of crocodylians found throughout the world, 17 species and subspecies are protected by more than 87 countries. The majority of the estimated 1.5 million skins presently traded annually are taken from wild populations in poor and developing countries. Three quarters of the skins in trade originate from South America and represent six closely related types of caiman. The majority are believed to be taken illegally. In 1981, South American caiman skins accounted for more than 89% of the 95 000 crocodylian skins and 122 000 crocodylian products that entered the United States, largely through the port of New York [1].

Only the commercially valuable portions of the animal's skin are taken. Skins are removed from the animal in the field and after defleshing are salted and dried. The skins are transported through a network of individual bush hunters to buyers who sell to local dealers and exporters. Political boundaries and national regulations are often ignored. Exporters in turn ship the skins to tanneries, largely in Europe and Japan. At the tannery, the skins are processed into leather using plant extracts, salts, and commercial enzymes to denature skin proteins and, in some species, to decalcify epidermal bone. Dying and finishing are done with various natural and chemical dyes. A coating of egg albumin, shellac, plant mucilages, or other substances is applied in the finishing process. Processes and ingredients may vary from one tannery to another, and similar species may be mixed at any point in the process without regard to the origin of individual hides or foreign protective regulations. The processed mixed hides are then sold either whole or in cut pieces (flanks, girdles, tails, vests, or small scraps from other cuttings) to manufacturers of such products as shoes and handbags. Legitimate merchants and manufacturers are limited in their source of supplies by the small number of tanneries worldwide capable of processing reptile skins.

From hunter to consumer, the skins of similar species, both endangered and legal, are mixed, shipped and reshipped, cut up, and combined piecemeal, again and again. Export documents indicating country of origin and identifying the species contained in shipments may be fraudulent. Most skins in trade lack official tags or other identifying markings. Only hides of the American alligator bear identifying tags [2].

No molecular assays have yet been developed to aid in the species identification of tanned hides and products. The present state of the art relies entirely on the interpretation of gross morphological characteristics. Two recent cases typify the scope of the problem, the state of the art, and the role of the forensic science examiner.

### **Case 1**

Two thousand two hundred tanned and finished flank skins of South American caiman, representing shipments from France and Japan, were seized on entry into the United States

by agents of the U.S. Fish and Wildlife Service at the port of New York for identification. Flanks are narrow strips of skin taken from the sides of the crocodylian's body (Fig. 1c) [3]. Skins were invoiced and accompanied by export documents indicating the species to be the common caiman, *Caiman crocodilus crocodilus*, from Colombia, a nonendangered species permitted for commercial trade and importation into the United States.

#### *Method of Examination*

The flanks first were examined for evidence of ventral or belly scales (Fig. 1a) and dorsal scales along the longitudinal borders, and for excessive skin folds bearing small scales at the ends of the flanks. These scales define the limits of applicable characteristics. Both dorsal and ventral scales were identified by their shape and character. Flank and ventral scales were further examined for the presence or absence of sensory organs (Fig. 1b). The lack of organs indicated that the flanks were from a member of the New World alligatorid family, separating it from most of the world's crocodylians.

Some or all of the belly scales of some species of crocodylians contain bony plates or osteoderms that lie just under the skin surface. These may be small round or elliptical plates composed of a single flat bone found in the ventral scales of some of the true crocodyles, or a bony plate composed of two or more flat sutured bones found in some members of the family Alligatoridae. The presence and composition of these bony plates is enhanced by shaving and dyeing during the tanning and finishing process. Evidence of osteoderms on the flesh side of the ventral scales (Fig. 2), and the presence of surface pitting on the dermal surface of the ventral scales (Fig. 3), indicated the species to be of the genus *Caiman*, and confirmed the South American origin [3].

Earlier investigations showed that flank skin could be used to distinguish the endangered protected Yacare caiman, *Caiman crocodilus yacare*, from the common nonprotected caiman, *Caiman c. crocodilus*. *Caiman c. crocodilus* regularly displays two to three rows of large heavily keeled flank scales between the dorsal and ventral scales (Fig. 4a, b) while *Caiman c. yacare* typically displays four or more rows of small, round, poorly keeled flank scales (Fig. 4b, c) [4].

#### *Conclusion*

Based on the number and arrangement of the rows of scales on the flanks, in conjunction with a lack of sensory organs and the presence of osteoderms and surface dermal pitting, all but 178 of the skins were identified as belonging to the species *C. c. yacare*, the Yacare caiman. The Yacare caiman is common in world trade, considered endangered, and prohibited from entry into the United States. It is not endemic to Colombia but ranges throughout Bolivia, Paraguay, and Southern Brazil. In Brazil it is reported to be taken illegally in great numbers in violation of Brazilian wildlife regulations. Because of the illegal trade in this species, shipments of skins from Bolivia and Paraguay are frequently routed and redocumented through other South American countries, France, and Japan before being shipped to manufacturers in the United States.

Civil charges were brought under the ESA. The importer did not contest the forensic identification but cited the foreign suppliers for including endangered species contrary to his purchase order. However, the French and Japanese suppliers did contest the identification. They cited the species name *Caiman c. crocodilus* listed on the Colombian export documents which had accompanied the shipment as proof that the flanks were from the nonendangered species, although Yacare caiman do not occur in Colombia. Based on their own commercial knowledge, they questioned the validity of the criteria used in making the identification. Commercial nomenclature is frequently based on colloquial designations founded on the common results of processing treatments during tanning rather than by scientifically

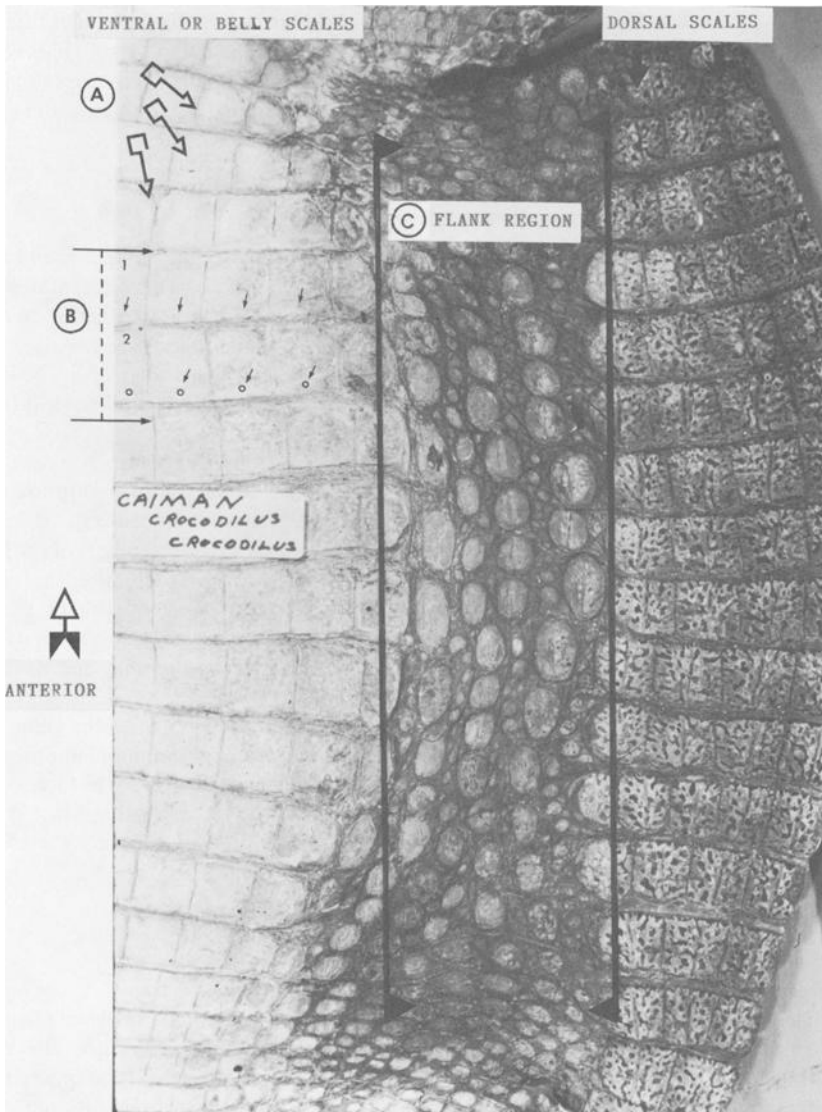


FIG. 1—(a) Ventral or belly scales are square shaped scales arranged in transverse rows. Each ventral row laterally ends in a posteriorly rounded scale. (b) Row 1 is ventral scales which lack sensory organs. Small arrows indicate the position on each scale where sensory organs occur on all crocodilians except the New World family of alligatorids. Row 2 is ventral scales on which diagrammatic sensory organs are drawn for comparison. (c) Dark brackets indicate the flank region which is the portion of the caiman skin most often used commercially. The flank is cut from the body skin approximately along the lines of the dark bracket. Parts or whole ventral and dorsal scales frequently are found along the margins of the cut flank. The small rounded scales and skin folds at the ends of the brackets are the bases of the front and hind limbs.

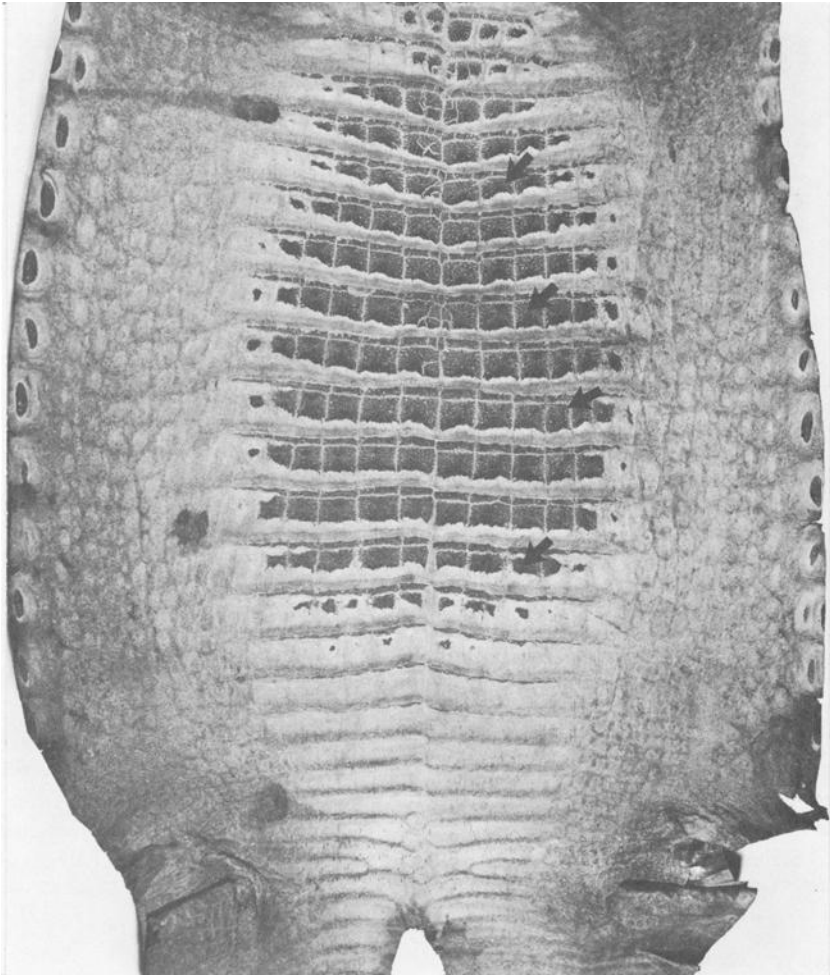


FIG. 2—Arrows indicate the remnants of two-part bony plates or osteoderms, which are found in the ventral scales of New World crocodilians of the genera *Caiman*, *Melanosuchus*, and *Paleosuchus*. *Paleosuchus* is not used commercially because of its extensive bony armor, which does not produce usable leather. During tanning, the osteoderms are chemically reduced, and shaving results in the osteoderm remnants that are most visible on the flesh side of the tanned skin, as shown.

accepted phylogenetic standards. The issues were resolved by giving an educational presentation on species distribution and identification to representatives of the companies involved under the auspices of the U.S. Fish and Wildlife Service [4]. A consequent plea of “no contest” by the parties involved resulted in a penalty payment of \$10 000 and forfeiture of all but 178 flanks. The returned flanks lacked sufficient characteristics to make positive species identifications.

### Case 2

Two defendants and their company were criminally charged with fourteen counts each of violations of the ESA and conspiracy involving the sale of the internationally protected and critically endangered black caiman, *Melanosuchus niger*. At the request of the U.S. Fish

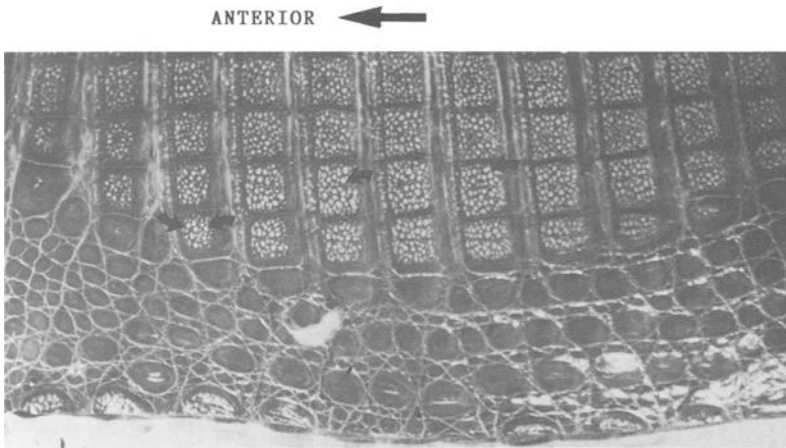


FIG. 3—The dermal side of a tanned and finished Caiman skin is shown. Arrows indicate the light-colored pitting evident on the surface of the ventral scales overlying the bony osteoderms. During processing, the skin shrinks into the natural pitting of the osteoderm. These pits are not receptive to dyes and escape burnishing during the finishing process. *Melanosuchus* or black caiman hides have underlying osteoderms in the ventral scales, but finish with a smooth glossy surface.

and Wildlife Service, 162 skins were forwarded to the United States by authorities in Hong Kong, where the skins were initially seized. The skins were later entered into evidence. Seized business records in the United States indicated that the defendants had arranged the sale of 2692 skins of *Melanosuchus niger* over a period of 3 years from their affiliated tannery in Bolivia to dealers in Switzerland, Italy, and Hong Kong. Under U.S. law, a U.S. citizen may be prosecuted for involvement in such sales even though the skins never enter the United States. Both defendants had a previous history of convictions on civil charges under the ESA. One had served a prison term on criminal charges for similar violations.

#### Method of Examination

The skins that had been forwarded from Hong Kong were first examined to establish their species identity. The ventral scales (Fig. 1a) were examined for the presence of osteoderms (Fig. 2) and the absence of sensory pits (Fig. 1a, b). Osteoderms were present and sensory pits were absent, placing the skins in the caiman group. The extraordinarily large size of the skins, up to four meters in length, indicated a species of great size. *Melanosuchus niger* attains lengths of 5 m while all other members of the caiman group rarely exceed 3 m in length [5-7]. The lack of surface pitting in contrast to pitting found in members of the genus *Caiman* (Fig. 3) indicated the genus to be *Melanosuchus*. The flank scales and the arrangement of rows of scales on the ventral portions of the tail immediately posterior to the anal vent were examined. The flank scales of black caiman differ from other caiman in that they are arranged in five or more alternating rows of small and large, round, poorly keeled or unkeeled scales (Fig. 4a, b, c, d). Black caiman are also distinguishable by the extra random inclusions of scales that break up the uniformity of scale rows on the post-anal ventral regions of the tail (Fig. 5). Examination showed the skins to have flank scalation and ventral tail scalation consistent with scalation characteristic of black caiman, *Melanosuchus niger* [3].

The seized business records were examined next to interpret their content for possible conspiracy charges and to establish whether the species quoted as "Lagarto," "caiman,"

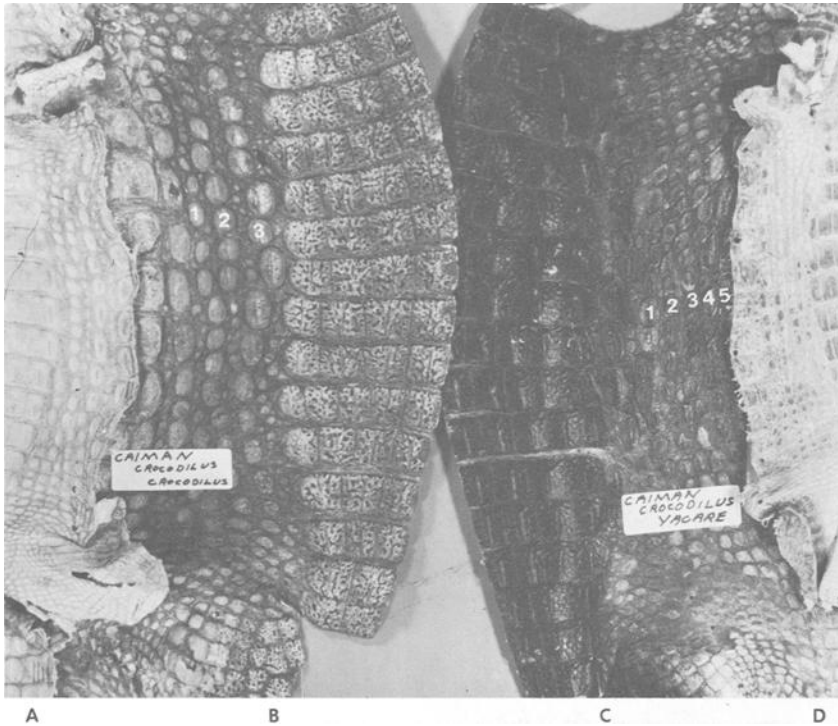


FIG. 4—(a) The bleached “crust” skin of the common caiman *Caiman c. crocodilus*. (b) A raw, dry, salted skin of the same species. Note the flank scales in three rows between the dorsal and ventral scales at about mid-body. Neither tanning nor finishing alter the relative arrangement or number of scales present on an animal in life. (c) The dry, salted skin of a typically darker *Caiman c. yacare*. Note the smaller rounded flank scales of this species arranged in more than four rows. (d) The tanned but unfinished “crust” skin of *Caiman c. yacare*.

common caiman (*Caiman c. crocodilus*), and dusky caiman (*Caiman c. fuscus*) might not actually be referring surreptitiously to black caiman, the true content of the sample shipment. The defendants indicated in correspondence to buyers their intent to trade black caiman under other species names and invoice designations. Thus the prices, local names, and sizes of the skins indicated were compared to valid documents for known species and terminology used in local trade and in scientific publications.

Citations for large numbers of skins with belly widths in excess of 60 cm were indicated in the business records. These figures were compared to belly widths and total lengths for caiman species, both of skins and of living and preserved animals. The total length of a living animal was calculated to be approximately four times the average width of the commercially utilized belly skin. Thus a belly skin of 60 cm or more in width would conservatively indicate an animal of about 2.4 m or more in total length. The dusky caiman, *Caiman c. fuscus*, is a small species averaging 1.2 to 1.7 m, while the common caiman, *C. c. crocodilus*, averages 1.5 to 2.0 m in total length. The black caiman averages 3 to 4 m in total length [5–7].

Some of the skins were listed in the sales records under the native name “caiman” and the scientific name *Caiman c. crocodilus*, which is a nonendangered, legally traded species. However, in Bolivia the term “caiman” is applied to the protected black caiman while the term “lagarto” is used to describe *Caiman c. yacare*, the endemic Yacare caiman, which is

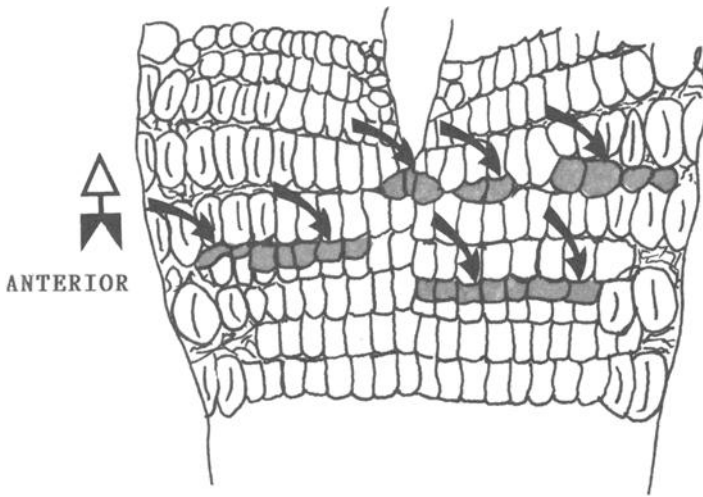


FIG. 5—Dark arrows indicate the inclusions of random “extra” scales (dark shaded) found on the ventral portions of the tail of the black caiman, *Melanosuchus niger*, immediately posterior to the anal vent (the V-shaped slit at the top center of the drawing). These inclusions are diagnostic when found in conjunction with other alligatorid characteristics.

another endangered form. The common caiman, *C. c. crocodilus*, is not endemic to Bolivia [3, 6, 7].

Price comparisons showed that the prices listed for “caiman” citations were considerably higher than those listed for “lagarto” or true *Caiman*. Black caiman skins are traditionally at least two to three times the value of whole *Caiman crocodilus* skins. In addition, *Caiman crocodilus* skins are generally sold as flank skins by the piece, by the square foot of skin, or by weight in kilograms. Because of its greater value and limited numbers, the black caiman is never sold as flanks but only as whole skins, tails, or pelvic or pectoral girdles.

### Conclusion

It was concluded, based on the content of the business records, that the trade citations did indeed refer to inclusions of black caiman, *Melanosuchus niger*, and that the defendants deliberately attempted to conceal the true identity of the endangered species contained in the shipments.

The defendants and their company were convicted on all charges. One defendant received a three-year probationary sentence, was barred from dealing in skins for the same period, was required to perform 250 h of community service, and paid a penalty of \$23 000. The second defendant also received a three-year suspended sentence and a penalty of \$18 000, while the corporation was fined \$35 000.

### Summary

The use of modern forensic scientific technology is just beginning to solve the complex problems of international wildlife law enforcement [8, 9]. Based on the molecular assay of blood or meat, we can determine if the hunter has illegally taken an elk or moose [10], or if the kill was made today or months ago.<sup>2</sup> But the problems in identifying small pieces of

<sup>2</sup>Ted Joanen, Louisiana Department of Wildlife and Fisheries, Grand Chenier, LA, personal correspondence.



tanned and processed skin, scales, shells, bones, or teeth from hundreds of commercially exploited species are immense. Investigations into the gross morphology and molecular "fingerprinting" of crocodilian skins are currently underway by this author under the auspices of the New York Zoological Society and the Department of Biological Sciences of Long Island University.

Today, the pressures to utilize and commercialize wildlife far outstrip our ability to protect vulnerable species through basic wildlife management and traditional law enforcement practices. It is only through the continued development and application of efficient and innovative forensic technology that we can hope to close this gap and truly limit the exploitation of endangered species.

### *Acknowledgments*

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Address requests for reprints or additional information to  
 Peter Brazaitis  
 Department of Herpetology  
 New York Zoological Park  
 Bronx, NY 10460