

## ANATOMY EDUCATION IN CAMPUS FLORESTA, UNIVERSIDADE FEDERAL DO ACRE: THE USE OF ANIMAL SKELETONS AS DIDACTIC RESOURCES

## ENSINO DE ANATOMIA NO CAMPUS FLORESTA, UNIVERSIDADE FEDERAL DO ACRE: O USO DE ESQUELETOS ANIMAIS COMO RECURSOS DIDÁTICOS

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### ABSTRACT

The study of anatomy, since the beginning of the formation of western culture, was derived from philosophical and methodological basis for understanding the form, function and origin of the man. It has been the basis for students of the courses in Health Sciences and Biological Sciences, with indispensable use of corpses and/or cadaveric parts for a better understanding of the structures of the human body and animals. Thus, using mainly techniques of biological maceration and necrophagous insects (Coleoptera, *Dermestes maculatus*), it was possible to prepare 13 complete skeletons of animals that are being used in the disciplines of Human and Animal Anatomy taught at the Didactic Laboratory of Comparative Anatomy and Physiology of the Universidade Federal do Acre, Campus Floresta, Brazil.

**Keywords:** Anatomical techniques; Didactic collection; Osteology.

### RESUMO

O estudo da Anatomia desde o início da formação da cultura ocidental, baseou-se em bases filosóficas e metodológicas para entender a forma, a função e a origem do homem. Tem sido a base para estudantes dos cursos de Ciências da Saúde e Ciências Biológicas, com a indispensável utilização de corpos e/ou partes cadavéricas para uma melhor compreensão das estruturas dos corpos dos animais e dos seres humanos. Assim, utilizando técnicas de maceração biológica e insetos necrófagos (Coleoptera, *Dermestes maculatus*), foi possível preparar 13 esqueletos completos de animais que tem sido utilizado nas disciplinas de Anatomia humana e animal ministradas no Laboratório Didático de Anatomia e Fisiologia Comparada da Universidade Federal do Acre, Campus Floresta, Brasil.

**Palavras-chave:**

## 1. INTRODUCTION

The anatomical approach was first instigated when man had the curiosity to observe in an animal the different parts that constituted it, the relations with the world and its surroundings, from the essentialism of Aristotle to the theory of evolution of Charles Darwin [1-3].

Anatomy is a traditional discipline of health and biological courses and is considered a basic subject for the formation of professionals engaged in related courses, generally the students are devoted to the study of anatomy in the first year of their university activities, because the acquired basis, guarantee a better performance in other disciplines [4].

It is a descriptive science that needs names for the structures and processes of the body. Anatomical terms indicate the shape, size, location, function or similarity of one structure with the other, being studied in three distinct and individual ways: texts, atlas and corpses, and its understanding through texts is extremely difficult, because the complexity in anatomical relationships. Thus, the atlas presents illustrations and schemes, which do not substitute the richness of details and forms of the corpses that gives to the discipline a real object in the study of the anatomy [4,5].

In the 21<sup>st</sup> century, the use of human or animal corpses became an important paradigm, since the access to cadaveric materials was

restricted, being limited to Universities, Higher Education and Research Institutions, due to the legal and ethical difficulty in obtaining them [6]. From the bioethical point of view, the corpse should not be seen as a simple object of study, since it is involved by an emotional bond, becoming important in the process of desensitization of the future professionals. The non-use of this material impairs the learning and humanization processes [7-9].

The preparation of anatomical pieces, like bones, allows a better handling and study by the students. For each anatomical aspect are used properly prepared pieces, providing a better visualization and learning in the theoretical content [10]. With the absence of these didactic resources in the Campus Floresta of the Universidade Federal do Acre, there was an urgent need to invest in the osteological preparations for the creation of a didactic collection for the Laboratory of Comparative Anatomy and Physiology, resulting in a real improvement in the teaching process of Anatomy in this Campus.

This study aims to describe the process of development of the production, maintenance and stock of animal cadaveric parts to be used as didactic resources in the classes of Human and Animal Anatomy at the UFAC Campus Floresta.



## 2. METHODOLOGY

### 2.1. ACQUISITION OF MATERIAL

The material used for the preparation of osteological techniques was obtained through different sources:

The cadaverous materials of wild and domestic animals were donated by folks who contacted the Laboratory of Comparative Anatomy and Physiology reporting that the dead animal was available for research. This material was examined and conditionally accepted through a donation term for the

The animals donated to the Laboratory of Comparative Anatomy and Physiology underwent a process of screening and identification, to which they were classified at the lowest possible taxonomic level.

For a more accurate identification of the animals, identification keys were used and consultations were carried out in specific literature for confirmation of the species deposited in the didactic collection of the laboratory [11-14].

After the process of identification of the animals, they were submitted to the techniques of maceration with the help of a necrophagous species (*Dermestes maculatus*) [15-18].

UFAC and a declaration that they were found dead in public roads, in the garbage or died of natural causes. The fish used were purchased from the Resene de Souza municipal market in Cruzeiro do Sul, Acre.

For a greater legality in its execution, the present study had the announce of the Ethical Commission on Animal Use (CEUA) of the UFAC and The Brazilian Government Environmental Agency SISBIO (CEUA 86/2015 and SISBIO 48632-1 and 47706-1).

### 2.2. TECHNIQUES APPLIED

For the development of the maceration technique by *D. maculatus* (FIGURE 1), the animals were stripped and subjected to a process of dehydration in 92° GL alcohol for 48 hours and then the specimens were removed from the alcohol and underwent a drying process by the sun. This drying process lasted for about three days before the animals were later placed in the dermestarium. After this, (FIGURE 2) the bones of the animals were identified following specific literature for each animal group, and arranged for skeletal assembly [19], [20]. The skeletons were assembled with instant adhesive glue, and placed on wood bases on iron supports, obtained through recycled materials.





Figure 1: Cleaning process of soft tissues of osteological parts by *Dermestes maculatus*.



Figure 2: (A) *Dermestes maculatus* larval phase; (B) *Dermestes maculatus* adult phase; (C) *Dermestes maculatus* both in larval and adult phases, performing the soft tissue cleaning process.

The controlled biological maceration technique (FIGURE 3) was applied to clean the bones of animals fixed in 4% formaldehyde, this technique consists of the

use of tap water to assist in the bacterial decomposition of soft tissue in the bone structures.





Figure 3: Biological maceration technique applied to the *Eunectes murinus* skull.

After the process of cleaning the bones and assembling the skeletons, the species were registered in the didactic collection of the Laboratory of Comparative Anatomy and Physiology.

### 3. RESULTS AND DISCUSSION

The preparation of osteological pieces for use in the didactic classes allows the handling and better understanding by the students, however the present study brings a satisfactory result on the techniques applied and the volume of material produced (TABLE 1). According to [21], it is necessary to facilitate the learning, and the practical classes in the laboratory lead students to become familiar with the structures studied in theoretical classes, helping to consolidate

learning. In addition to supplying the needs of courses attended by the Laboratory of Comparative Anatomy and Physiology of the UFAC Campus Floresta, the osteological pieces produced were incorporated into the didactic collection of this laboratory, emphasizing the importance of osteological collections to attend other campus needs, since the material produced serves as reference for other disciplines, such as: Evolutionary Biology, Palaeontology and Zoology. The use of skeletons as a reference for comparative studies among animals is fundamental, as it assists scientific and didactic activities, providing safe information on specific adaptations of vertebrates and is an important tool for scientific research in character identification, for anatomical and phylogenetic analysis [22], [23], [24].

TABLE 1- Corpses of animals used to make anatomical pieces.

Classification	Popular name	Type
Fishes		
Osteoglossiformes		
Osteoglossinae		
<i>Osteoglossum bicirrhosum</i> (Cuvier, 1829)	Arowana	Skeleton
Clupeiformes		
Pristigasteridae		
<i>Pellona castelnaeana</i> (Valenciennes, 1840)	Amazon longfin herring	Skeleton
Siluriformes		
Pimelodidae		
<i>Pseudoplatystoma tigrinum</i> (Valenciennes, 1840)	Catfish	Skull skeleton
Birds		
Piciformes		
Ramphastidae		
<i>Pteroglossus castanotis</i>	Chestnut-eared aracari	Skeleton/ Assembly
Crocodylia		
Alligatoridae		
<i>Paleosuchus palpebrosus</i> (Cuvier, 1807)	Dwarf caiman	Skeleton
Reptilia		
Squamata		
Boidae		
<i>Eunectes murinus</i> (Linnaeus, 1758)	Green anaconda	Skeleton/ Assembly
Didelphimorphia		
Didelphidae		
Didelphinae		
<i>Didelphis marsupialis</i> (Linnaeus, 1758)	Common opossum	Skeleton
Rodentia		
Erethizontidae		
Erethizontinae		
<i>Coendou prehensilis</i> (Linnaeus, 1758)	Brazilian porcupine	Skeleton
Carnivora		
Caniformia		
Canidae		
Carnivora		
Felidae		
<i>Felis catus domestica</i> (Linnaeus, 1758)	Cat	Skeleton
Mammalia		
Artiodactyla		
Bovidae		
<i>Bos taurus</i> Linnaeus 1758	Cattle	Skeleton/ Assembly
Mammalia		
Placentalia		
Chiroptera		
<i>Artibeus</i> sp	Bat	Skeleton



A total of 13 skeletons were prepared between mammals, reptiles and fishes (FIGURE 4), the process of production of osteological pieces, besides contributing to the improvement of anatomy teaching and for the creation of a didactic material collection, unburdened the institution. The costs of including this material to UFAC's assets would be R\$24.962,00 according to the survey in e-commerce sites that sell anatomical products

for educational purposes [25]. This cost estimate could be even greater considering that the pieces that appear in the online stores are restricted to dogs, cats, fishes, some birds and skulls of large domestic animals (TABLE 2), and the didactic collection of the Laboratory of Comparative Anatomy and Physiology, has complete specimens of wild animals (TABLE 1).

TABLE 2 - Sale price of osteological pieces in store (<https://www.3bscientific.com.br>)

Popular name	Species	Commercial value	Bone type	Assembly type	Part of the skeleton
Domestic dog	<i>Canis lupus familiaris</i>	R\$ 6.041,00	Natural	Rigid	Entire
Domestic cat	<i>Felis catus</i>	R\$ 5.267,00	Natural	Rigid	Entire
Chicken	<i>Gallus gallus</i>	R\$ 3.021,00	Natural	Rigid	Entire
Fish	<i>Cyprinus carpio</i>	R\$ 2.578,00	Natural	Rigid	Entire
European rabbit	<i>Oryctolagus cuniculus</i>	R\$ 5.034,00	Natural	Rigid	Entire
Domestic cattle	<i>Bos taurus</i>	R\$ 3.021,00	Natural	Rigid	Skull





FIGURE 4: (A) Arowana skeleton *Osteoglossum bicirrhosum*; (B) Brazilian porcupine skeleton *Coendou prehensilis*; (C) Domestic cat skeleton *Felis catus domestica*; (D) Common opossum skeleton *Didelphis marsupialis*; (E) Domestic dog skeleton *Canis lupus familiaris*; (F) Bat skeleton *Artibeus* sp; (G) Chestnut-eared aracari skeleton *Pteroglossus castanotis* (assembly process) (H) Domestic cattle skeleton *Bos taurus* (assembly process); (I) Green anaconda skeleton *Eunectes murinus* (assembly process).



## 4. CONCLUSION

The work of production of osteological pieces for use in practical classes taught in the Laboratory of Comparative Anatomy and Physiology or as reference material for scientific research, registered in the *osteoteca* of said laboratory in the Campus Floresta of UFAC, obtained a result with average production of one skeletal piece per month over a year. The 13 complete animal skeletons became part of the didactic collection available to Campus Floresta students who did not have any skeleton pieces until the beginning of this work. The importance of the production of anatomical pieces for the improvement of anatomy teaching is emphasized, since the contact with natural cadaveric parts helps in the desensitization and allows a greater handling and better study during the classes making the teaching-learning process of the students more efficient.

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