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**Retrospective Study of Expert Examination Performed by the
Brazilian Federal Police in Investigations of Wildlife Crimes,
2013-2014**

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Abstract: One of the main demands for veterinary medical experts is the forensic investigation of crimes against wildlife. In Brazil, most of these crimes are related to the trafficking of wild animals, whose conducts involve the capture, transport and illegal trade of specimens. All these activities also involve various forms of animal mistreatment. This article aims to present the main types of expert examinations used in investigations of wildlife crimes through a retrospective study of records kept by the Criminalistic System of the Brazilian Federal Police in the years 2013 and 2014. The increase in the number of examinations performed in 2014, compared to the year 2013 (86.15%), was mainly focused on identification, mistreatment and investigation of bird ring forgery, reaffirming the importance of these tests in the casuistry of the Federal Police.

Keywords: Forensic science; Legal veterinary medicine; Wildlife; Crime; Mistreatment.

1. Introduction

Examinations in wildlife crimes are one of the main demands for veterinarians and biologists working as forensic experts in Brazil. These crimes are often associated with animal trafficking; such expression is routinely used to describe all activities involving the capture, transport and illegal trade of wild specimens.

Among the consequences of this practice, we see the decay of many populations and the extinction of many specimens, submission to animal mistreatment, and risks to the public health and the balance of ecosystems. The reduction of biodiversity is a serious threat to several processes that sustain life on the planet. Taking into account the consequences of deforestation, global warming, overhunting, roadkill, animal trafficking and the introduction of exotic and domestic specimens, many scientists believe the planet is on the verge of a new mass extinction from anthropogenic origin.

As a result of increasing anthropic pressure on the environment, police and forensic agencies are increasingly demanded to act in response to crimes against wildlife. In this context, the medical-veterinary expert can contribute decisively in the classification and punishment of these crime perpetrators, as well as in the reparation of the damage caused, with technical and scientific expertise for forensic examination of evidences.

The Legal Veterinary Medicine is the specialty that deals with the forensic use of medical-veterinary knowledge. It avails itself on own techniques such as forensic pathology and the Animal Welfare Science, among others, for the characterization of injuries, traumas and abuses committed against animals, thus providing important tools for the investigation of wildlife crimes.

Therefore, the aim of this paper is to present the main types of expert examinations used in the investigations of crimes against wildlife, through a retrospective study of data in the Criminalistic System of the Federal Police, which stores data of the expert examinations conducted by Federal Forensic Experts throughout the Brazilian territory.

1.1. Literature review

The cultural background of our relationship with wild animals dates back to earlier times of Brazil's discovery by Portugal. The wildlife has always been an important cultural element of the various Brazilian indigenous groups who used different

species for food, company or production of decorations and ornaments such as necklaces, leather hands and headdresses. However, these uses did not represent a threat to species survival¹. After Brazil's discovery, the pioneers were particularly enchanted with the beauty and exotic aspect of the fauna. Soon, these animals were included among the main exports of the colony, along with Brazil's wood. At that time, the parrots were used as pets because of their docile behavior in captivity and because of its ability to mimic human speech, as well as in exhibitions, because of the beauty of their feathers. In addition, they were served as food during long sea journeys. Due to the popularity of these birds in Europe of the sixteenth century, before being called Brazil, the country was called Land of Parrots².

Over time, the problems caused by over-exploitation of several species of fauna became evident, which brought the necessity of legislation aimed at their protection. The factors that most influence the situation of endangered species are habitat loss and capture for the illegal trade, contributing to the decline of many populations. Unplanned urban sprawl and increase of agricultural borders over the preserved areas have generated strong pressure over several landscapes and biomes. The main consequences of these actions are the loss, degradation and fragmentation of habitat. Nevertheless, other factors that contribute to the reduction of populations include hunting for food, crop protection, fur, leather and feathers, competition of exotic species, diseases and climatic phenomena³.

Moreover, illegal trade is an important fact to be considered. According to Destro (2012), to estimate the number of animals taken from nature is a difficult task, since wild animals capture is a common practice in Brazil, despite prohibition by law. Although there are estimates of the number of animals received by the Wild Animal Screening Centers (CETAS), the data do not allow a complete assessment framework, since most animals seized in inspecting actions are released before arriving at the CETAS in order to preserve their wild condition.

Given this reality, in order to protect the fauna richness, a gradual process of editions of normative instruments began in Brazil to regulate the breed and trade of wildlife. Such legislation has experienced many advances and setbacks throughout the history, resulting in a tangle of laws, decrees, regulations and instructions of great complexity. Thus, a broad and critical analysis of this

legislation is necessary, which considers its various technical, historical, cultural, social, and ethical aspects, with all the consequences for the environment^{4,5}.

The Federal Police Department (DPF) is the Brazilian institution that carries out exclusively the federal judicial police functions in Brazil. With the introduction of Decree 4,503 / 01, DPF was given new powers to fight against environmental crimes such as genetic material smuggling, trafficking of specimens of wild fauna and flora, biopiracy and other related crimes, perpetrated by criminal organizations, which have interstate or international effects and that require constant repression.

1.1.1 Crimes against fauna

Several innovations in environmental legislation enhanced ruling attributions of the Constitution of 1988, which introduced the so-called third generation rights, including environmental protection. It became an important legal instrument for the protection of the Brazilian biodiversity. By the Constitution, the environment has to be considered a good of diffused interest, that is, a matter of shared responsibility among all human beings. For instance, even if an animal is part of an individual patrimony, as an environmentally relevant good, owners are publicly accountable for their ecological mismanagement⁶.

Article 225, § 1, item VII, of the Constitution protects fauna by prohibiting practices that endanger its ecological function, cause the extinction of species or submit animals to cruelty, exercising, in the Constitution, the role of the environment main guide⁷. As a result of this constitutional article, the Law of Environmental Crimes was published. Law No. 9,605, of February 1998⁸. This law states about specifications of penal and administrative sanctions resultant from harmful conducts and activities to the environment. It is possible to remember that the applicable penalties to the offenses committed against the fauna species result from the state and society's obligation in safeguarding an ecologically balanced environment, since it is a people's common use that should be preserved and maintained for present and future generations.

In addition, the law 9.605/98 is very important, since, according to the most conservative estimates, Brazil is home keeps 13.2% of the world biota⁹. This legal instrument aims to curb the illegal trade, poaching and abuse, among other crimes that affect national biodiversity.

Due to its diversity, Brazilian fauna has scientific and also incalculable economic value, attracting attention inside and outside the country. The fauna trade, however, is not always done with the observance of the standards that rule the activity, and the international trafficking is an extremely lucrative option. To that extent, the problem of the Brazilian fauna trade cannot be seen dissociated from the issue of trafficking, because the practices of internal trafficking are highly significant in the country and it is not possible to differentiate, on many occasions, the domestic illegal trade activity to the international trafficking¹⁰.

The illegal wildlife trade is linked to other types of unlawful activities involving drugs, weapons, alcohol and precious stones. In South America, for example, the drug cartels have great participation in the black market of wild animals¹¹.

According to Sampaio (2014), document submission is compulsory to verify the legality of the trade of live and slaughtered animals, parts, products and by-products. It is required the purchase invoice for the national trade of domestic animals and aquatic organisms not listed in the Appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and documents of the Ministry of Environment. The national trade of native and exotic wildlife requires an invoice provided by the breeding or legalized merchant. In the case of export and import of live specimens, products and byproducts of native and exotic wildlife, export permits are required, issued by the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) or import permits, issued by the destination country and the authorization of the Ministry of Agriculture, Livestock and Supply - MAPA (zoo sanitary requirements). Fish products and by-products not listed in Appendices of CITES (Normative Instruction IBAMA no 140 / 2006), specimens, products and byproducts of fauna considered domestic or personal items made with pieces of native or exotic wild animals and species of hunting trophies not listed in Annex I of CITES are exempt from IBAMA's license.

The illegal wildlife trade involves several types of conduct, which are replaced by new criminal practices over time. The most common practices take place in the total or partial absence of documents required for commercialization; or presentation of false documents such as invoices, licenses and transport licenses. There is also the use of legal documents to cover up illegal activities and

other types of fraud. Recent operations of the Federal Police have found out fraud in animal identification systems, mainly adulteration or falsification of sealing rings, in birds, to be used in animals captured from nature¹².

Criminal groups often infiltrate in public agencies persuading authorities and officials in order to facilitate the illicit traffic. Moreover, the people involved can easily be replaced by others, more efficient, experienced and qualified for the activity. This great power of mobility and changeability is a major problem to map criminal networks and their place of work^{13,4}.

The criminal organizations are structured in the shape of a network. Hernandez & Carvalho (2006) identify it as a set of interwoven lines with intersecting nodes forming centers for exchanges of information, goods and services. Information that comes to one of these lines of junctions can easily spread to the other parts of this 'tissue'. According to Hernandez & Carvalho (2006) the network is a set of interconnected nodes, the node being the point at which straight lines intersect.

The traffic structure also presents common characteristics to the information society, requiring equipment to enable updating of information on routes, the most quoted animals on the black market, new forms of fraud and the ways of corruption. New technologies are more and more being used to increase the chances of success of criminal operations, either through mobile phones, computers to defraud documents or internet sales, among others¹³.

1.1.2. Forensic examinations in crimes against fauna

According to Mirabet (2011), the examination is not a simple means of proof. The expert is a technical enthusiast, advisor to the judge, with the function of providing instructive technical data besides auditing and forming of the corpus delict.

Forensic expertise is the set of inquiries and medical know-how procedures, necessary to clarify a fact of interest for justice. The examinations can be performed on living or dead bodies, skeletons, animals and objects¹⁴.

Veterinary examinations can aim to species identification, injury diagnosis, cause of death, among others, and it may even assist in the investigation of cases with human victims^{15,16}.

The strengthening of forensic science focused on the preservation of fauna is a global trend. The Kenyan government, for example, has just opened an

advanced genetics laboratory that applies forensic analysis on protecting species at risk, such as rhinos and elephants . In addition, there is the largest forensic laboratory of wildlife, the US Fish & Wildlife Services Lab, in the United States, with several services dedicated to fauna¹⁷.

Considering the casuistry of the Federal Police, the main expert examinations related to animals are presented below.

1.1.2.1 Identification of species

According to França¹⁵, identity is the character set which indicates a person or thing, making it distinct from the others. Identification is the process of establishing the identity of something. It constitutes one of the main forensic examinations in cases of crimes against wildlife. In this case, the objective is to identify the species involved, classifying them in taxonomic categories. Its result has many legal implications, since some species have different levels of protection according to their risk of extinction.

1.1.2.2. Classical taxonomy

This biological classification should take place from the division to which they belong, passing neatly by Philo, Class, Order, Family and Gender, to get to the species or even Subspecies. The taxonomy aims to identify species, not specimens¹⁹.

The species is a group of individuals (specimen) that show a greater or lesser degree of a constantly present intra-population variability. Knowledge of polymorphism is critical to the circumscription of the species. Incidentally, this is the chief task of the taxonomist: To know the variability and to separate it into intra and inter population¹⁹. For the correct use of classical taxonomy, it is needed constant study and consultation of the literature containing the most current ratings and classifications. Information can also be searched in zoology museum collections or pattern banks produced by forensic services themselves ¹⁹.

1.1.2.3. Forensic genetics

Forensic analysis of Animal DNA (deoxyribonucleic acid) and identity tests are quickly becoming common, solving civil or criminal cases, kinship analysis, determination of paternity, lineage reconstruction, estimated inbreeding, stud

book²⁰ identification, species determination, among others. Almost all animal species can be genetically characterized to a high degree of certainty²¹. DNA tests in wild animal investigations emerged from a merger between genetic conservation research and forensic genetics, because of the growing need for investigative tools by the wildlife defense agencies. The development of analytical techniques, an area of genetics of conservation recognized since some time ago, now is receiving increasing attention by providing genetic evidence for agencies responsible for investigating wildlife crimes. In this context, DNA analyses are related to the identification of species (molecular taxonomy), population, kinship or individual identification of a certain sample²¹.

This theme has been developed in parallel with human forensic genetics and benefited from the horizontal transfer of molecular and statistical techniques; however, it remains a highly specialized area with its own challenges²². One of the fundamental steps of forensic genetics is the collection of samples that can consist of any fragments of tissue, such as blood, hair, horns, feathers, meat, bones, feces, carcasses, etc¹⁹. Products resulting from the processing of animal parts can also be object of analysis, as well as issues related to the identification of the species, origin of the specimen, among others. According to Ogden (2009), the main techniques currently used for animal DNA test are:

- a. DNA sequencing. It identifies each nucleotide (base) in a specific target region of DNA (genetic marker). Species identification usually involves sequencing of around 500 DNA bases to provide a species-specific sequence.
- b. SNP. The SNP markers (Single Nucleotide Polymorphism) allow the study of specific regions of DNA. It led to the development of faster tests, inexpensive, that do not require long fragments of high quality DNA, though less information is obtained compared to DNA sequencing. Some examples of this commonly used method in forensic examinations are the PCR-RFLP and allele-specific PCR.
- c. Microsatellites. Microsatellite molecular markers are differences between DNA sequences due to a variation in the number of repeating units of DNA in a specific region. This number changes lead to different sizes of DNA fragments, which can be separated by electrophoresis.
- d. DNA Barcode. Sequencing a region of gene encoding cytochrome oxidase protein I (COI) of mitochondrial DNA is a new faster and affordable method to

facilitate species identification. It has standardized steps for all kind of animals, from picking fragment, until conditions to perform PCR. In this way, a database is created, though this technique can be little sensitive to identify closely related species²³

1.2.3 Forensic pathology

1.2.3.1. Physical examination of live animals

The examination of live animals involves the investigation of trauma, morphological characterization of injuries and their respective harmful agents, whether of mechanical, physical, chemical or physical-chemical order. The study of lesions allows grading it in minor, serious or very serious, which can eventually have impact on the case. In such cases, one should carry out clinical tests, similar to those conducted in veterinary medicine routines, with particular attention to findings that may have forensic repercussion²⁴.

1.2.3.2 Forensic necropsy of animals

It consists on the examination of corpses for identification, determination of cause and time of death and characterization of lesions and their harmful agents. The practice in forensic necropsy requires specific training for its use in forensic science, for proper evaluation of crime traces, including knowing the pathological characteristics of each animal species^{25,26}.

During body examination, one can determine the causes, conditions, and driving mechanisms of death by studying the tissue changes. The presence of cadaverous fauna may be an important aid element to determine the time of death, being a study object of forensic entomology^{27,28}. Detailed forensic necropsy is essential to support reasonable suspicions²⁹.

Forensic toxicology exams still help by investigating intentional or accidental poisoning, and identifying and quantifying toxic agents³⁰.

1.2.4. Animal welfare

The concept of animal welfare refers to a good or satisfactory quality of life regarding certain aspects related to health, happiness, longevity and natural behavior³¹. It should propose a link with other concepts such as needs, freedom, adaptation, feelings, suffering, pain, anxiety, fear, boredom and stress³².

The Animal Welfare Science also constitutes an important tool for the diagnosis of mistreatment while providing the necessary foundations for understanding the different contexts in which animals are introduced. It allows the analysis of environmental factors, nutritional status, socialization, stress and behaviors³³ based on the concept of the Five Freedoms³⁴.

1.2.5. Crime scene examination

The proposal of a crime scene investigation (CSI) is to apply scientific methodology to conduct a systematic evaluation of the site to collect physical evidence, to reconstruct events, to identify and relate (or exclude) a suspect with the victim or the place, in order to solve a crime. The subsequent forensic work conducted in a laboratory depends on the quality of the work performed by the CSI team³⁵.

According to Espinoza (2013), crime sites in open areas, as in most cases involving wild animals, present challenges due to many natural factors, such as weather conditions and the presence of other animals.

1.2.6. Document examination

The document examination consists of determining the authenticity / falsehood of documents and signatures and authorship of manuscripts releases³⁷. This task is very important when checking legality of wildlife breeding, through qualified revision of licenses, invoices and delivery notes³⁷.

In Brazil, it is also considered document examination the inspection conducted in rings for passerines, since these identification instruments constitute official public documents. In this sense, when performing examinations in wildlife breeding, the expert must have specific knowledge of technical aspects of the documents related to such activity¹⁹.

2. General objective

This research aims to retrospectively study the types of expert examinations of the Federal Police used in the investigations of crimes against fauna in the years 2013 and 2014

3. Materials and methods

A retrospective study of the information contained in the Criminalistic System of the Federal Police was conducted. This database stores information of all expert examinations conducted by Federal Forensic Experts since 2006 and is administered by the Technical-Scientific board of the institution.

The search was specifically focused on those technical reports produced from 2013 to 2014, containing the keywords "animal" and "fauna".

Outcomes were listed, downloaded and stored in digital files and analyzed individually. The types of forensic examinations related to fauna were tabulated and analyzed in MS Excel® spreadsheet.

According to their nature, all downloaded examinations (100%) have been grouped into the following types, arranged in a table and represented in histograms and frequency diagrams, expressed in percentage (%): anatomopathological, identification, kinship, animal health, mistreatment, ring, poaching, illegal hunting, illegal breeding and others (several tests with smaller casuistry).

4. Results

As a result, 94 expert reports have been found, which were prepared by the forensic units of the Federal Police in the Federal District and in the Brazilian states of Mato Grosso, São Paulo, Amapá, Rio Grande do Sul, Ceará, Espírito Santo, Mato Grosso do Sul, Rio de Janeiro, Minas Gerais, Santa Catarina, Goiás, Paraná and Pernambuco.

Moreover, inquiries including more than one type of examination were detected. In total, 187 expert examinations have been made in the period, of which 81 were from the category of identification (43.32%), 39 of mistreatment (20.86%), 29 of rings (15.51%), 13 of anatomopathological (6.95%), 13 of animal health (6.95%), 2 of poaching (1.07%), 2 of illegal trade (1.07%), 1 of kinship (0.53%), 1 of illegal breeding (0.53%) and 6 in other categories (3.21%). The Figure 01 shows a circular diagram containing the distribution percentage of expert examinations of fauna by types, conducted by the Federal Police in the years 2013 and 2014.

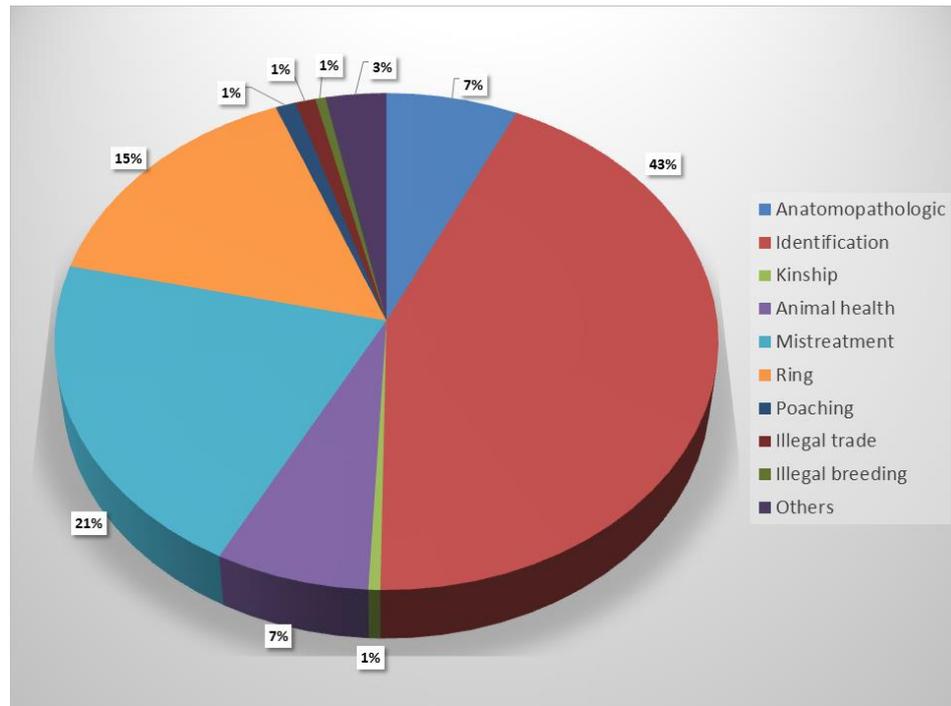


Figure 1:Percentage of expert examinations of fauna per types conducted by the Federal Police in the years 2013 and 2014.

From this data analysis, the identification tests showed relevance (43.32%) when compared to other exams, corroborating to Sampaio (2014) when he says that this is one of the main expert examinations in cases of crimes against wildlife. Even in cases where the main object of research is not to set animal identity, such tests are essential to the appropriate criminal classification and for the maintenance of the chain of custody³⁷.

The tests related to mistreatment of animals accounted for the second highest casuistry in the studied period, with more than 20% of the cases. This confirms the great importance of this criminal modality in relation to other crimes against wildlife.

The number of reports that deal with the authenticity of ID rings is also quite significant (15.51%). IBAMA rings are federal government documents that aim the identification of passerines and their falsification is a crime with a penalty more severe than the very illegal wildlife trade. The falsification of rings implies greater specialization and organization, which adds greater value to the activity.

From the total of 94 retrieved reports, 80 consisted of wild animals exams (85.1%), while 14 referred to domestic animals (14.9%).

It was also possible to observe a significant increase in the number of expert examinations in the considered period. In 2013, 65 tests were carried out, while the year 2014 recorded 121 expert examinations, representing an increase of 86.15%, reflecting a growing concern of the society and authorities with crimes involving animals, which makes the veterinary expertise an activity in expansion. Figure 02 shows a histogram containing a comparison between the numbers of expert examination on fauna conducted by the Federal Police in 2013 and 2014.

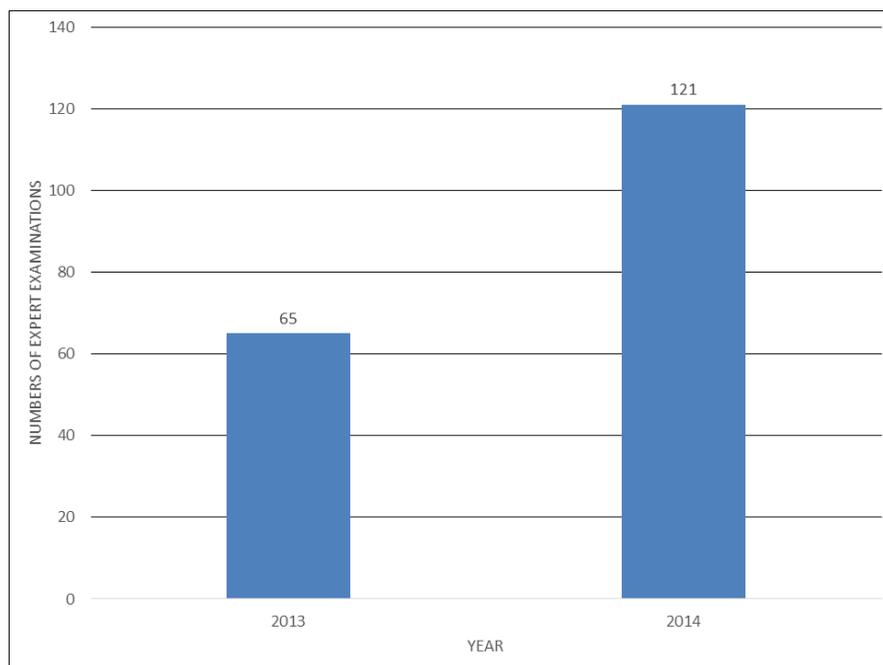


Figure 02: Comparison between the numbers of fauna expert examinations conducted by the Federal Police in the years 2013 and 2014.

The Figure 03 presents a comparative histogram between the numbers of each type of expert examinations of fauna in the years 2013 and 2014. It's possible to observe that the increase in the number of examinations performed in 2014, compared to the year 2013 (86.15%), was mainly focused on identification, mistreatment and investigation of bird ring forgery, reaffirming the importance of these tests in the casuistry of the Federal Police

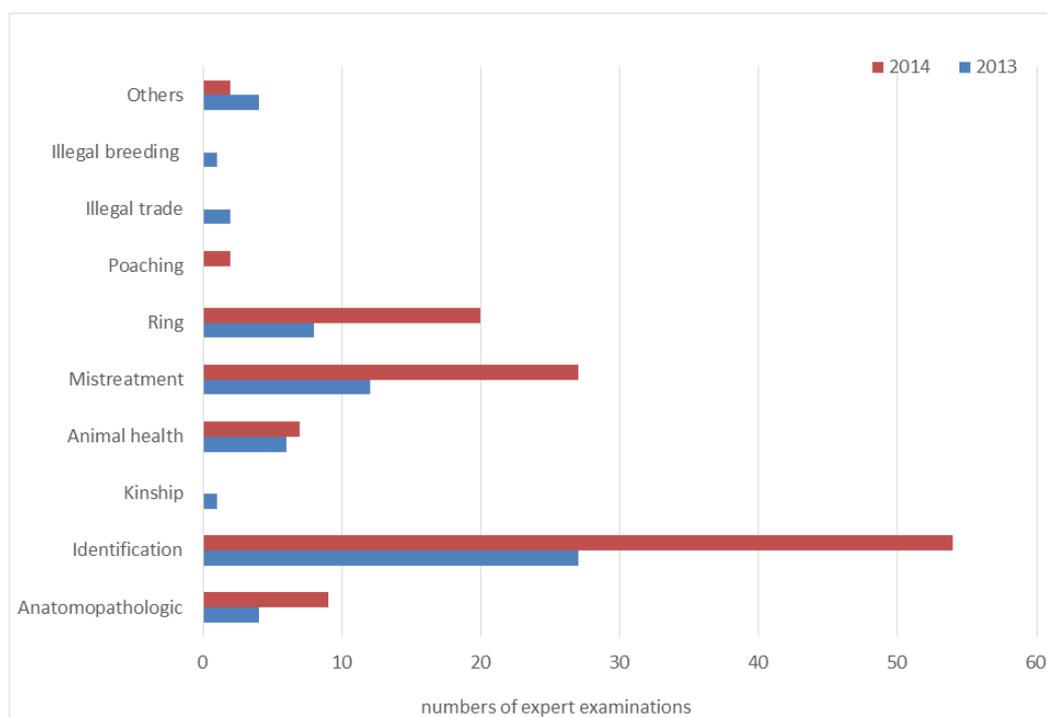


Figure 03: Comparison between the numbers of expert examinations of fauna per type, conducted in the years 2013 and 2014.

5. Conclusions

The present research is not exhaustive, and there is a need for additional studies and improvement of official databases on the subject. The presented results do not represent all the crimes investigations against fauna in the period, but only those cases where the performance of federal forensic exams was actually requested. However, the analyzes presented here allow important conclusions about the actual need for training and research in Forensic Veterinary Medicine.

The growing organization of criminal groups that see the fauna as an attractive source of illegal profits requires better preparation and planning of governmental policies. The Brazilian Federal Police, in its constitutional assignment of the Union Judiciary Police, which operates throughout the national territory, is the competent department for the investigation of organized crime in interstate and international level, including wildlife trafficking. More effective results in combating these crimes necessarily involve an increase on the number and training of forensic experts, as well as providing adequate facilities for the processing of physical evidence.

Besides the identification and appropriate offenders punishment, another important aspect of wildlife protection refers to formal and informal education. Brügger (2004) draws attention to the fact that, while the laws refer to a coercive universe, education moves predominantly in a sphere of freedom as awareness of the need. The need here is located beyond the conservationist universe. It concerns the paradigm shifts that involve, among other things, the vision of animals as sentient beings and therefore worthy of moral consideration.

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