

WILDLIFE FORENSICS: INVESTIGATION TECHNIQUES & LAWS IN INDIA

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INTRODUCTION

Wildlife forensics is one of the fields of Forensic science where different tools and techniques with fullest potential are used to combat various wildlife crimes like Hunting, Poaching, illegal trading, and possession of fauna, flora and the products associated to them that is against the law. We are quite familiar with the fact that illegal trade of different species of plants and animals takes place all over the country on a regular basis. Various species have moved from vulnerable to endangered, near threatened and extinct status due to this very reason. According to in IUCN list published in 2016 Tibetan Antelope (*Pantholops hodgsonii*) shifted³ from Endangered to Near Threatened which is poached commercially for the Shahtoosh wool used for making shawls and scarfs. Bornean Yellow Muntjac (*Muntiacus atherodes*) are now practically nearly threatened because of killing for meat, skins, and traditional medicines while Grey parrot (*Psittacus erithacus*) moved from Vulnerable to endangered. There are various other reasons for the this fall in the population which includes urbanization, cutting of forest areas, pollution, etc.

Wildlife forensics thus assist in investigating such crimes by scientifically collecting evidences from the scene of crime and analyzing them to reach to the perpetrator involved in Hunting, poaching or illegally trading flora and fauna or products obtained from them. This field also addresses the specie, its geographical origin, age of the sample and time since death. International trade is one of the biggest threats to that have caused a 50% decline in the global population since the last 47 years (IUCN 2016). India accounts for quite diversified Biodiversity which is in danger too. The legal framework to regulate and restrict these illegal trading is strong but stronger and stricter rules along with implementation needs to be laid down in order to protect the biodiversity. The overall goal of wildlife forensics is to ensure that forensic tools and technologies like DNA analysis, footprint analysis, microscopic examinations, serological examination, etc. are available , accessible which could be employed

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to reach out to the criminal. Wildlife protection Act (WPA) 1972 states that trade of wild animals, plants and the products obtained from them is prohibited. Wildlife products stands at third most illegally traded materials after narcotics and firearms which are the leading ones.

The prevention of Cruelty to Animals 1960 are solely was framed to protect and safeguard animals against cruelty and any illegal activity in relation to them⁴. Various NGOs also work to look after and see if the rules are being implemented or not. CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is one international agreement between different countries governments that specifically aims at ensuring the international trading of animals doesn't lead to their threatened survival. Medicinal needs (growth medicines, libido increasing medicines, anti- ageing, etc.), Ivory from elephants' tusks, animal skin, meat, hair, scales, etc. are the reasons for the increasing illegal trade resulting from the increased greed of Humans! More than 60-70% people depend on herbal medicines for health which is again a reason behind the illegal trading⁴⁷. The Wildlife Forensic and Conservation Genetics (WFCG) Cell was laid down by merging the Wildlife Forensic and Conservation Genetics Laboratories for strengthening the reinforcement of the Wildlife (Protection) Act, 1972 of India.

WFCG cells is a group of hardworking, dedicated scientists and technologists who have knowledge in the field of this art, and hence they are involved in high end researches. Specifically speaking, they are involved in specie identification and the products obtained thereof. In July 2017, the experts of WFCG were included in the list of scientific experts in Section 293CrPC under subsection 4 by MHA⁵.

In India various projects have been framed to protect certain species from the threat of Extinction which includes Project Tiger, Project Sea Turtle, Elephant, crocodile conservation project, one horned rhinoceros, Hangul (Red deer), cleaning of river Ganga for saving the Indo-Gangetic Dolphins, etc⁶.

⁴ Nishant K, Vrijesh KY, Ajay KR (2017) Wildlife Forensic: Current Techniques and their Limitations. J Forensic SciCriminol 5(3): 306.

⁵ Wildlife Forensic & Conservation Genetics Cell. (2021). Retrieved 29 March 2021, from https://wii.gov.in/wildlife_forensic#:~:text=The%20Wildlife%20Forensic%20and%20Conservation,%20Act%2C%201972%20of%20India.

⁶ Wildlife Conservation Initiatives by Indian Government. (2021). Retrieved 29 March 2021, from <https://www.ranthamborenationalpark.com/blog/wildlife-conservation-initiatives-indian-government/>



Source: https://wii.gov.in/wildlife_forensic

One horned Rhinoceros vision 2020 was laid down to protect them by Ministry of Environment and forests to increase their population by 2020⁴⁹. The illegal exploitation of these innocent species is the result of increasing production of medicines that are used as anti-ageing creams, asthma, high cholesterol levels, goiter, infertility, skin afflictions, etc. To protect and safeguard the rights of these animals and plants, certain action plans other than the above-mentioned act has been enforced by the government which needs stronger implementation forces for the impact that is nee of the hour. Few of them are mentioned below⁷:

- Wildlife Protection Act 1972
- Mining and Mineral Development Regulation Act 1957
- Prevention of Cruelty to Animals 1960
- Water (Fisheries Act 1897
- Prevention and Control of Pollution) Act 1974
- Air (Prevention and Control of Pollution) Act 1981
- Forest Conservation Act 1980
- Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Rights) Act 2006
- Indian Forests Act 1927
- Environment Protection Act 1986
- Biological Diversity Act 2002

⁷ Wildlife Forensic & Conservation Genetics Cell. (2021). Retrieved 29 March 2021, from [https://wii.gov.in/wildlife_forensic#:~:text=The%20Wildlife%20Forensic%20and%20Conse,\)%20Act%2C%201972%20of%20India](https://wii.gov.in/wildlife_forensic#:~:text=The%20Wildlife%20Forensic%20and%20Conse,)%20Act%2C%201972%20of%20India).

HISTORICAL VALUE OF WILDLIFE

In the 1600's, at the time when the pilgrims arrived, wildlife was abundant and was enough meet the needs of the people, which later turned needs into wants, and led to over utilization the use of natural resources for profit⁸.

WILDLIFE PROTECTION DURING ANCIENT INDIA

In India wildlife protection and management is marked to be an old practice. The ancient scripts contain a number of phrases in praise of wildlife creatures. The Hindu Dharma is always seen to connect and link some specific animals with specific God and Goddess; viz. Python linked with God Vishnu, God Shiva is paired with snake, lion is associated with Devi Durga and swan is connected with Goddess Saraswati this way for linking animals with God has resulted as one of the best way for protection of wildlife⁹. In primeval India man had recognized and was aware of the importance and conservation of animals and their side by side existence with human life, because of which animals were worshiped, protected, nurtured and loved. Every God and Goddess in India has been linked with either one of the animal which is respected and worshiped along with the God with equal importance. A huge number of ancient scripts, paintings and art work reflect the worship, love and respect of man for the animal kingdom. According to sacred holy Indian scripts and literatures such as Ramayana, Gita and Mahabharata, that always educates the fellow humans on how, they should always show sympathy, mercy and dignity towards all living creatures by avoiding cruelty and spreading love and respect with loyalty. A number of different communities in the various parts of the Indian country still have that same respect and the base of protect for wildlife kingdom.

WILDLIFE IN MEDIEVAL INDIA

Archaeological evidences such as animal skeleton have been found which indicates what would have happened previously with the wildlife and a brief idea regarding the differences and changes that occurred in culture, land and habits of man. There are perfect evidences which give a solid proof about the massive rice production in various parts of India, where rice was

⁸ Chardonnet, P., Clers, D. B., Fischer, J. R., Gerhold, R., & Lamarque, F. (2002, May 1). *The value of wildlife*. ResearchGate. https://www.researchgate.net/publication/11393617_The_value_of_wildlife

⁹ Dr. M. Velmurugan. (2017). *HISTORICAL DEVELOPMENT OF WILDLIFE PROTECTION IN INDIA*. International Journal of Current Research and Modern Education (IJCRME). <https://www.google.com/url?sa=t&source=web&rct=j&url=https://core.ac.uk/download/pdf/144879266.pdf&ved=2ahUKEwitnqTMz9fvAhWdxTgGHVlbBk8QFjAOegQIExAC&usg=AOvVaw2UBwVKAvgPgL4oXyYhIHgbY>

cultivated¹⁰. During this time period wildlife was being consumed as a prime item of meat as a part of food for living by a large number of communities of the Harappa civilization¹¹. Skeletal bones and remains of wild animals were excavated in huge number including animals like the wild rabbit, cheetah, and fox; the Indian one-horned rhinoceros, huge elephants, etc. A huge amount of animal remains and skeletons were also excavated from the Indus valley during the time of Mohenjo-Daro civilization⁵³.

WILDLIFE DURING MUGHAL REGIME

Mughals seemed to be very concerned regarding the conservation of environment they had a huge affection for beautiful gardens, magnificent orchards and parks around their palace and constructions which lead to increase in greenery and habitat for animals¹². Akbar had a religious policy completely based on tolerance which also showed his tremendous concern regarding the conservation of animals and birds due to which endeavors were followed strictly in order to lessen down the number and nearly stop the brutal and irrelevant killing of wildlife. Mughal court also patronized the usage of animal kingdom as relevant and important segment in the creation of portraiture and landscapes.

LEGISLATION ON THE ISSUE OF PRESERVING WILDLIFE IN INDIA

Wildlife preservation in India gains a huge importance due to its history and the stories of legends from the past centuries. In the third century B.C Kautilya was the one who first set down the written game laws in the history of India. Even after so many various measures taken to conserve wildlife it seems that protecting animals is only limited to particular species and leaving their habitats ignored behind. For the first time in 1878 Indian Forest Act, ventured to conserve some parts of the lands owned by the Government for the animals by announcing these lands as a reserved forest. In order to prevent wildlife extinction and realizing it's the

¹⁰ Dr. M. Velmurugan. (2017). *HISTORICAL DEVELOPMENT OF WILDLIFE PROTECTION IN INDIA*. International Journal of Current Research and Modern Education (IJCRME). <https://www.google.com/url?sa=t&source=web&rct=j&url=https://core.ac.uk/download/pdf/144879266.pdf&ved=2ahUKEwitngTMz9fvAhWdxTgGHVlbBk8QFjAOegQIExAC&usq=AOvVaw2UBwVKAyPgL4oXyYhIHqBY>

¹¹ National Research Council (US) Committee on Agricultural Land Use and Wildlife Resources. (1970). *Historical Perspective - Land Use and Wildlife Resources - NCBI Bookshelf*. NCBI Bookshelf. <https://www.ncbi.nlm.nih.gov/books/NBK208755/>

¹² Goyal, S. (2017, May 29). *What are the steps taken for the Conservation of Wildlife?* Jagranjosh.Com. <https://www.google.com/amp/s/m.jagranjosh.com/general-knowledge/amp/what-are-the-steps-taken-for-the-conservation-of-wildlife-1496065929-1>

necessity Central Government and the State Government enacted several legislations⁵³. Later in 1972 the Government was able to actually bring the Wildlife protection act in action. This act prohibits illegal dealing and trafficking of endangered rare species of animals. However, not only restricting to this act but Indian Government has played a huge role by taking several measure for protection of the animal kingdom and launching various acts for animal conservation that is needed to be spoken in brief which has helped the country in maintaining its wildlife treasure¹³.

WILDLIFE CONSERVATION INITIATIVES AND SOME IMPORTANT PROJECTS BY INDIAN GOVERNMENT

Project Tiger

‘Project Tiger’ initiated in the year 1972 is amongst the most ambitious conservation projects in the world and one of the most successful wildlife conservations attempts. The main motive of this project was to save tiger from reaching the dangerous level of extinction because tiger servers as one of the main part of the ecosystem by balancing the food chain. As tigers are at the top of the ecological food chain hence conservation of tigers directly effect on the conservation of the animals serving the lower level of the food chain. This project covers almost 37,761 km of tiger habitat in the form of forests, meadows, mountains and scrubland. Ministry of Environment Forest and Climate Change sponsored the tiger project in which about 47 tiger reserves were situated in more than 17 regions which also included the Ranthambore National Park and Corbett National Park, which assesses the count of tigers, their hunting places, habits and their habitat, under the control of the specially assigned Tiger Task Force particularly for this project⁵⁶. Project Tiger has proved successful in protection, maintaining and increasing the count of tigers in nature. As tiger is also the national animal of India it becomes more significant in this account for conserving the national animal. Despite of conservation measures taken by the Indian Government for almost three decades and also the increase in number, tiger still remains one of the endangered predators of the developing and emerging world. The reason for this drawback can be said to be, revenge killings due to man- animal conflicts, due to agriculture and industrial expansion and development huge decrease in habitat for tigers is

¹³ Patel, A. C. (2011, June 11). *The importance of wildlife in India*. India Study Channel.
<https://www.indiastudychannel.com/resources/141853-The-importance-of-wildlife-in-India.aspx>

seen, and the most important factor for this can be the tremendously huge demand for the parts of animal body, nails, teeth and skin of tiger.

Project Elephant

Project Elephant was launched in the year 1992 by the Indian Government, the main aim of this project is to conserve and protect elephants their habitat and migratory route for which various scientifically planned protective management measures were carried out. Under this project, several issues like human elephant conflict and protection of the domestically leaving elephants is considered and looked after. And also the aim is to take measures against poaching activities and unnatural deaths of elephants. The Project Elephant has introduced the concept of Elephant Reserves consisting of areas, irrespective of the legal status, which are crucial for the conservation of elephants. A given Elephant Reserves might consist of reserved forests and National parks, etc. from the beginning Project Elephant has been regularly arranging awareness and educational courses for veterinarians who deal with wild and domesticated elephants at Thrissur and Assam Agricultural University, Kerala Agricultural University and Guwahati. Project Elephant is also running a programmed where the registration of domesticated elephants is done by using microchips. Until now, more than 1,000 elephants are being micro-chipped in Delhi, Assam, Andaman and Nicobar, Arunachal Pradesh and West Bengal.

Crocodile Conservation Project

This is another ambitious project by the Indian government for conservation of the Indian Crocodiles, unfortunately the crocodile species were once almost on the stage of extinction due to which government had to take measures for their conservation. The main objective or motive of this project is to prevent the extinction of the left over population of species of crocodiles and their natural habitat by creating several sanctuaries; in order to promote captive breeding and to improve management; and to involve the local people in this project intimately¹⁴. It is good noticing that within the initiation of Crocodile Project around, 1800 mugger/crocodile, 4000 gharial/alligator, and 1500 saltwater crocodiles were able to be retain.

UNDP Sea Turtle Project

¹⁴ National Research Council (US) Committee on Agricultural Land Use and Wildlife Resources. (1970). *Historical Perspective - Land Use and Wildlife Resources - NCBI Bookshelf*. NCBI Bookshelf. <https://www.ncbi.nlm.nih.gov/books/NBK208755/>

This project was initiated by the Wildlife Institute of India, Dehradun as the implementing agency for conserving and protecting the Olive Ridley Turtles in November 1999, The project consists of 10 coastal states of India especially Odisha where it got a huge contribution in the map preparation that indicates the sites of breeding of the Sea Turtles. Identification of habitats connected to the coast line and breeding places were included in this project and also routes of their migration were included¹⁵. The project also has a huge hand in developing a number of guidelines towards the rate of turtle mortality, for safeguarding and also for increasing amount of tourism in the areas of habitat of these sea turtle. One of the major achievements of this project includes the demonstration of the use of Satellite Telemetry to locate the route of migration of the sea turtles within the sea.

Apart from these projects, Government of India also has been carrying out projects like India Rhino Vision (IRV) 2020 and Vulture Conservation.

MEASURES BY GOVERNMENT OF INDIA FOR THE PROTECTION OF BIODIVERSITY

Including these specified conservation projects mentioned above for the animal kingdom, Government of India also initiated a few projects and measures that focused upon protecting the biodiversity and minimizing the mortality of highly endangered species of animals. Here mentioned are a few steps that Indian Government has taken for the conservation of wildlife and their protection⁵⁷:

- In the Wildlife Protection Act of 1972, Government of India created Protected Areas like National Parks, Sanctuaries and Community Reserves for the habitat of wildlife and declared punishments against those who are involved in the illegal hunting and poaching.
- Wetland (Conservation and Management) Rules 2010 were created for the purpose of protection of wetlands in India. Along with this Central Government also started the scheme called National Plan for Conservation of Aquatic Eco-System which is given right to provide assistance to the states for the proper management of all wetlands reserved.

¹⁵ Dr. M. Velmurugan. (2017). *HISTORICAL DEVELOPMENT OF WILDLIFE PROTECTION IN INDIA*. International Journal of Current Research and Modern Education (IJCRME). <https://www.google.com/url?sa=t&source=web&rct=j&url=https://core.ac.uk/download/pdf/144879266.pdf&ved=2ahUKEwitnqTMz9fvAhWdxTgGHVlbBk8QFjAOegQIExAC&usg=AOvVaw2UBwVKAvgL4oXyYhIHqby>

- Wildlife Crime Control Bureau was established in order to focus and close down the illegal trade of wild animals and rare endangered species.
- Special organizations like Bombay Natural History society, Wildlife Institute of India, and Natural History and Salim Ali Centre for Ornithology are formed to conduct research on conservation and protection of wildlife.
- Government of India has banned the veterinary use of diclofenac drug to check the reducing number of Gyps vulture in India.
- Indian Government also initiated the recovery of endangered species, which included animals like vultures in Punjab, hangul/stag deer in Jammu & Kashmir, Haryana and Gujarat, swiftlet in Andaman & Nicobar Islands, sangai deer in Manipur, snow leopard in Himachal Pradesh, Jammu & Kashmir, Arunachal Pradesh and Uttarakhand and NilgiriTahr in Tamil Nadu.
- State government is also given technical and financial assistance to initiate better measures of conservation and protection for the rare endangered species.
- The State Governments has increased the number and time of patrolling within and around the reserved areas and also strengthen the field formations.
- Government of India started several patrolling strategies for the season of monsoon and focused mainly on the anti-poaching activities, also deployment of anti-poaching team was done.
- Government of India constitutes National Tiger Conservation Authority, in order to provide strength to the tiger conservation.
- In Karnataka, Maharashtra and Odisha the Special Tiger Protection Force (STPF) is established and deployed.
- Government of India also made sure that e-surveillance is being started in Kaziranga National Park in borders of Ratapani Wildlife Sanctuary in Madhya Pradesh and Assam.

There are many more projects and schemes initiated by the Government of India which you will be reading in brief further and also some more international projects, schemes that India has partnered by signing with its neighboring countries like Bangladesh and Nepal regarding the illegal trade of wild animals and specially conservation of animals such as tigers, leopards, etc. Along these wildlife schemes there are a number of other administrative, financial and legal measures which the Government of India is being taking for a bright future of wildlife within the country. In addition, due to the success of some projects and schemes such as the

tiger project, elephant project, crocodile project, projects related to the Indian rhino and their poaching gave the Indian government a huge confidence in moving towards a more effective intact and blooming wildlife.

INVESTIGATIVE TECHNIQUES

There are various investigative tools and techniques which assist the scientists in reaching out to the perpetrator, the victim and the crime committed against the wildlife like poaching, hunting, illegal trade, etc. Different domains of forensics like anthropology, toxicological analysis, DNA and serology, ballistics, hair examination, microscopically examination are majorly carried out to investigate the species of the animal, their age, geographical origin, prey or predator, etc. Following are the major investigative techniques that are quite common and prevails all over the globe for finding the truth behind the crimes against wildlife.

DNA analysis

DNA analysis may definitely be appropriate for the identification of individuals, species, relatedness and sex of animals. DNA analysis in wildlife forensics is one of the most effective tools amongst all that is used in dealing with wildlife crime cases, which are involved in DNA typing. It includes steps like the DNA extraction, PCR amplification, sequence comparison and DNA sequencing. The case in which a DNA sample is required to be collected from a live animal, it must always been taken by a qualified vet. DNA typing has been widely applied in crime cases related to wildlife. DNA evidence can easily be contaminated and can degrade rapidly in environmental conditions due to its fragility, so the samples must be collected as soon as possible in case of dead animals.

Where the evidence are enable to be identified by the physical inspection the in such cases DNA analysis can be used to identify the species. Typical regions of DNA that show some kind of variations among species but generally are conserved within species itself are most often targeted. These specific regions of DNA are then sequenced for comparison to already present standard reference database of known species.

Health and safety measures

A lot of attention and care should be taken regarding health and safety when involved in collecting samples. Certain DNA sample evidences may constitute high hazard to health. Some basic precautions that can be taken, but it is it remains the responsibility of the officer who collects the samples to take necessary measures regarding health and safety precautions while

using the kit¹⁶. Forensic laboratories may strictly refuse to accept any such items that are in a condition which is unacceptable risk to their staff. Basic health and safety measure includes:

- Always wear gloves that are provided with the kit when handling any such biological or any other samples
- Never drink, eat, smoke, or touch the facial area or around the facial area when handling such samples.
- Avoid touching sharp items bare handed without any protection, handle carefully and store the evidences in an appropriate solid container.

Contamination of DNA samples is a very serious issue when transporting and collecting the forensic evidence. It is still necessary to emphasize the need for prevention of contamination of the evidences from other biological sources and from any other surface, which encounters the evidence sample. There are a few guidelines, which should be compulsorily followed to reduce the risk of contamination:

- Handle the evidences as carefully and as little as possible.
- Always record and store individual samples evidences in sealed and separate containers, even if they are collected or appear to have come from the same source.
- Always use single-handed disposable, single-use items whenever possible for evidence collection
- Make sure that if any non-disposable materials have been used for collection of evidences then it must be sterilized before use.

For DNA recovery samples can be collected from:

1. Tissue (preferably muscle)
2. Bone
3. Blood
4. Saliva (swabbed from environment), Saliva (swabbed from mouth)
5. Faeces
6. Hair, fur, feathers
7. Vomit

¹⁶ *Wildlife DNA Analysis: Applications in Forensic Science*. (2013, May 28). Wiley.Com.
<https://www.wiley.com/en-ai/Wildlife+DNA+Analysis%3A+Applications+in+Forensic+Science-p-9780470665961>

8. Teeth
9. Horn
10. Ivory
11. Nails, claws, etc.

If populations of certain kind of species are considerably distinct from one another, then in such cases it is possible to use DNA analysis to designate any specific sample to its population of origin. For such analysis, availability of genetic information from all possible sources of populations should be made sure. DNA analysis is currently employed in order to identify the origins of vast range of illegally traded animals.

Morphological Analysis

The morphological or physical characteristics are the most simple and easiest way of one of the wildlife forensic methods in the identification process. In the identification of species based on morphological characteristics of wildlife provides many important clues based on external appearance of that particular species of animal. Different species possess distinct physical appearance like coat, colour, fur, skin, pattern of coloration, eyes, tails, horns etc. Ivory is illegally traded dentine from Asian or African elephant that has a unique characteristic pattern, which is known as Schreyer. It has another characteristics of angled pattern due to which identification is possible even between the species. In cases, where whole skeleton or skin are present as an evidence, then anatomical, morphological and microscopic analysis are very helpful in identification of the individual species. Expertise and database of reference sample becomes highly crucial in identification based on morphology. Paw print can be analysed for the identification the size, weight and height of the animal. Hair analysis can also be done for differentiating among various species.

Age determination

In some cases of wildlife crime investigations it is crucial to know the age of a sample found. For example, if any rhino horn was found and collected prior to the year 1947, then it is considered to pre-date laws prohibiting the trade in rhino horn¹⁷. To make sure and check whether the rhino horn was truly collected legally prior to 1947, processes like stable isotope analysis known as radio carbon dating can be performed. Stable Isotope Analysis is based on

¹⁷ Nishant Kumar, VrijeshYadav, Ajay Kumar Rana. (2017, January). *Wildlife Forensic: Current Techniques and their limitations*. ResearchGate. https://www.researchgate.net/publication/319136233_'Wildlife_Forensic_Current_Techniques_and_their_limitations'_has_been_accepted_for_publication

measuring the natural variation of the chemical elements present in biological samples in order to establish the age of a sample. Age of any animal can also be determined by examining teeth for examples in case of goat, sheep, cattle, etc.¹⁸ and scales in case of fishes.

Sex determination

Areas in which the open and closed hunting season generally vary between the males and females for examples deer; it seems to be very necessary to know the gender of that particular specie to determine whether the animal was legally encountered. If a carcass has been put upon for sale, morphological difference between the female and the male are generally no longer present i.e. antlers or genitalias. Sex of any animal can also be determined by examining the vertebral column, skull, and lumber region. DNA analysis can be used this such cases to determine the gender of the specimen.

Toxicological Investigations

Toxicological analyses seek to detect potentially hazardous compounds if poisoning is suspected in a wildlife crime investigation (pesticides, heavy metals, pharmaceuticals, etc.). Among the technologies available are high-performance liquid chromatography (HPLC), atomic absorption spectroscopy (AAS), and gas chromatography-mass spectroscopy (GC-MS).Based on the preliminary study, the laboratory will choose the best approach.

Organs, body fluids may be used as sample products in toxicological investigations.

- a. Blood/serum: useful in medicine and detection of certain heavy metals.
- b. Liver: beneficial for Heavy metals, chemicals, and pharmaceuticals
- c. Kidney: useful for heavy metals and pharmaceuticals.
- d. Brain: good for gauging enzyme activity in organophosphate poisoning
- e. Lung: good for inhaled toxins
- f. Hair/feathers: can disclose intoxication time frame
- g. Stomach contents/crop contents in birds/vomit: useful for detecting topical toxin ingestion, particularly if highly toxic substances that cause acute death are suspected.
- h. Baits: if there is a suspicion of illegal baiting.

¹⁸ SudhirYadav, Ashwini Kumar Dixit. (2016, July). *Forensic approaches in the solution of wildlife crime*. ResearchGate.
https://www.researchgate.net/publication/307160297_Forensic_approaches_in_the_solution_of_wildlife_crime

- i. Carcass insects: Useful if the corpse is cruelly degraded; may only indicate the presence or absence of toxin; Toxins may take out from eggs, pupae, and pupa cases¹⁹.

Isotope Analyses

Stable isotope analysis, commonly known as isotope analysis, is a relatively new technique for measuring the fluctuating ratios of stable elements in tissues including bones, teeth, skin, and feathers. Because different geographic regions and diets have various ratios of the different isotopes of chemical elements, this ratio shows where an animal lived when the tissue was created as well as its food. As a result, isotope analysis can aid in determining an animal's origin and likely migration patterns. It is used in archaeology, ecology, geology, and other fields of study. The most common elements employed in isotope analysis are carbon, hydrogen, oxygen and nitrogen. In a nutshell, the chemical components in biological tissues, such as bone, have a precise ratio of isotopes, such as 99 percent ¹²C and 1% ¹³C. In forensic science, stable isotope ratios in hair, bone, and tooth enamel have been used to pinpoint the geographic origin of individuals, animals, and animal products, as well as the origin of plants, particularly pharmaceuticals. Isotope analysis is carried out using mass spectrometry, and the data must be measured and interpreted in specialised facilities⁶².

Footprints Analysis

Wildlife footprints are crucial evidence in forensic research. Footprints are the imprints of an animal's foot on areas where it walks or in captivity. The pattern and scale of the footprints are used to determine the species type and age. The detection of undetectable tracks on hard surfaces is a serious difficulty for species identity based on footprint impressions, and these footprint locations are frequently contaminated by the presence of other animals²⁰.

Microscopy

Microscopy involves morphology, elemental analysis and cuticular scale pattern of the hair. Hair plays an important role which can be used in identification of the species. Scanning Electron Microscope (SEM) can be used for the identification of the animals based on hair

¹⁹ Beiglböck, C., & Walzer, C. (2019). *Handbook on Standard Operating Procedures (SOP) in Forensic Investigations of Suspected Illegal Killing of Wildlife* [Ebook] (1st ed.). Research Institute of Wildlife Ecology (FIWI) of the University of Veterinary Medicine Vienna, Austria /Alpbionet 2030 project.

²⁰ 2. K, N., KY, V., & KR, A. (2017). Wildlife Forensic: Current Techniques and their limitations. *Journal Of Forensic Science & Criminology*, 5(4). doi: 10.15744/2348-9804.5.402

evidences. SEM provides higher range of magnification and coupled Energy Dispersive Spectra (EDS) which will be helpful in the identification of geographical region by elemental analysis like Sodium, Potassium, Calcium and Sulfur. Hair scale pattern of different types of species have been described in Australia and Europe for the mammalian species. Microscopic techniques requires samples for microscopic examination in well preserved which is a limitation of this technique²¹.

Radiography

Forensic radiography (i.e. the use of x-rays) is a crucial and mostly used complementary examination tool in forensic examinations. Various abnormalities and thus evidences may be documented with this method, the most significant being:

- Foreign objects (projectiles, projectile parts/-abrasion, etc.)

Metal residues like steel or lead show high opacity in radiographs and small fragments of them can be detected by radiography. Copper, mostly used as a jacketing material for bullets which is less opaque and more difficult to detect. Dirt on the skin of soiled carcasses or grit in the stomach of birds should not be confused with bullet fragments. Radiograph is also helpful in showing metal residues in the stomach of birds of prey that have scavenged on hunted animals or their remains, thereby ingesting bullet remains. One thing should be taken care that finding metal residues in a corpse does NOT necessarily mean that the animal died due to shooting since, especially with shotgun-pellets, these may be retained in the body after a non-lethal shooting.

- Measurement of bone density, age determination

Bone density may provide information on the health - and the nutritional status - of an animal. Evaluation of the epiphyseal plate or - line in long bones sometimes help to determine the approximate age of an animal²².

LAWS APPLICABLE

Wildlife Protection Act

²¹ (2021). Retrieved 14 April 2021, from <http://www.annexpublishers.co/articles/JFSC/5402-Wildlife-Forensic-Current-Techniques-and-their-Limitations.pdf>

²² (2021). Retrieved 14 April 2021, from <https://www.alpine-space.eu/projects/alpbionet2030/wpt2/d.t2.2.1 -practical-handbook-on-forensic-procedures-in-wildlife-crime.pdf>

Wildlife Protection Act, 1972 has been accepted and adopted by all the states. This is the first comprehensive legislation relating to the protection of wildlife was passed by the Parliament and it was assented by the President on 9th September 1972 and came to be known as the Wild Life (Protection) Act, 1972.

When this act was passed the wildlife protection subject was in State List and states were empowered to make law on it. The Parliament passed this Act using provisions in Article 252 of the Constitution²³.

Salient features:

- This act has 7 chapters, 66 sections and 6 schedules for now.
- Any amendment to this act can be done on the recommendation of an expert committee,
 - that has been put together by the Indian Board of Wildlife.
- The 6 Schedules of the Act specify the level of protection for different species.
- Schedule I and II are for endangered species, that deserve rigorous protection and the breach of these rules results in serious punishment.
- Schedule III and IV is for species that are not endangered, but the protection and punishments are equally rigorous.
- Schedule V delineates the animal species that can be hunted, like deer or ducks, and the rules pertaining to their hunting.
- Schedule VI covers the protection and trade of medicinal plants as well as agricultural species of plants²⁴.

According to the **Section 54** of the Wildlife Protection Act, the central government may by the information from the parliament can authorise the Director of Wildlife preservation or any other officer not beneath the rank of Assistant Director of Wildlife Preservation to accept payment of a sum of money by way of compensation of the offence done by that person, which such person have suspected to have committed.

According to **Section 3** of this Act, the Central Government may appoint a Director of Wildlife Preservation, Assistant Directors of Wildlife Preservation and such other officers and

²³ Wildlife Protection Act, 1972: Its need, objectives and featuresThe Fact Factor
https://thefactfactor.com/facts/law/civil_law/environmental_laws/wild-life-protection-act/1454/

²⁴ (2021). Retrieved 29 March 2021, from <https://brainly.in/question/10550889>

employees whenever necessary and required. According to **Section 4**, the State Government under the said Act can appoint Chief Wildlife Warden, Wildlife Warden, Honorary Wildlife Wardens and other officers and employees if necessary. As per **Section 6** the State Governments and the Administrators in Union Territories could organize a Wildlife Advisory Board.

*Duties of Wildlife Advisory Board (**Section 8**)*

The Wildlife Advisory Board mainly originated to guide the state government in the following matters.

1. In the selection process of areas which can be signified as Sanctuaries, National Parks and Closed areas and the administration.
2. In organization of the policy and provisions for the protection and conservation of wildlife and specified plants.
3. In any matter regarding to the amendment of any schedule;
4. In relation with the measure to be taken for coordinating with the basic requirements of the tribal peoples and other dwellers of the forests with the protection and conservation of wildlife;
5. In any other matter which is directly related to the protection of wildlife which may be mentioned to it by the state government.

Penalties under the Act

Section 51 of the Act sets out the penalties for the violation of its provisions. Penalties vary depending on: a) the Schedule of the animal(s) to which the offence relates; b) the area to which the offence relates (National Park, sanctuary, tiger reserve, core area of tiger reserve); c) the nature of the offence (hunting/altering the boundaries/ other offence); and d) whether the accused is a repeat offender.

- Minimum punishment prescribed under **Section 51** of Wildlife Protection Act (1972), specifies minimum punishments for certain periods. However, it has been noticed that some of the courts are granting punishment less than the minimum punishment specified. Re-Examination should be led against such orders. Judicial officers should also be sensible and aware about the minimum punishment prescribed.

- Under **Section 51(2)**: When a person is convicted of an offence under the Wild Life Protection Act (1972), the court in which the trial is being done related to the offence could order that any captive animal or derivative, in relation of which an offence has been taken place and any trap, tool, vehicle, vessel or weapon used in the commission of such offence should be surrendered to the State Government. The above section also highlights the point that surrender of the property involved in the offence, is to be done only after conviction of the accused by the trial court. Surrender of property mentioned under Section 51(2) of the Act is not the same as surrendering of property obtained from illegal hunting and trade under Chapter VIA of the Wildlife Protection Act.
- Under **Section 57** of Wildlife Protection Act (1972) in certain cases: – if it is established that a person is in possession, custody or control of any captive animal, it could be supposed that such person is in unofficial ownership or custody of that animal. However, it is also to be borne in mind that even with shifting of burden to the person guilty, the primary liability to prove the case beyond reasonable doubt will still be resting on the prosecution.
- Surrender of property obtained from illegal hunting and trade as mentioned under Chapter VIA is applicable in cases where the person has been convicted of an offence which is punishable with imprisonment for a term of three years or more²⁵.

CASES WITH LANDMARK JUDGMENTS

Three landmark judgments in Assam's wildlife history, court orders rigorous imprisonment for killing mongooses and other protected species.

In a judgment against wildlife crime in Assam, a lower court in Assam's Chirang district sentenced five persons in three separate cases to seven years rigorous imprisonment and a fine of Rs 50,000 each for hunting protected species of birds and animals under different ranges of Manas National Park. 'No other wildlife case, even high profile ones involving rhino poaching in Assam was able to attract such punishment in the history of Assam,' said Dr Bhaskar

²⁵ Sehgal, D. (2021). Prevention and Detection of offences under the Wildlife Protection Act - iPleaders. Retrieved 29 March 2021, from <https://blog.iplayers.in/prevention-detection-offences-wildlife-protection-act/>

Choudhury of the Wildlife Trust of India (WTI). The government of Assam amended the Wildlife Protection Act in 2009, according to which hunting outside the boundary of a national park or wildlife sanctuary is also included as offence punishable under section 51 of the Wildlife Protection Act.

TilakBahadurRai v. State of Arunachal Pradesh, 1979 Cr. L.J. 1404

According to this case, the accused shot and killed a Tiger. It was held by the court that while taking a decision with regards to whether the accused acted in good faith or not when he killed a wild animal, it is mandatory to understand the nature and the dangers that lurked around the accused and under what circumstances did the accused kill the animal. After arguments put forth by both the parties, the Court was of the view that the accused shot the tiger that charged at him in good faith and as a means to protect himself. The Court said that if the accused hadn't shot the tiger which was charging towards him, planning to attack him, then the accused would have been dead. Therefore, in order to protect himself, he shot the tiger and this can be evaluated as self-defense and was, therefore, justified. It was also stated in this judgment that if any animal is killed or wounded as by an individual as a means to protect himself, then such animal is the property of the government. The individual who has shot or killed or injured the animal has no claim on such an animal²⁶.

Naveen Raheja v. Union of India [(2001) 9 SCC 762]

The Supreme Court had to deal with a particularly gruesome problem in this case. A tiger in an Andhra Pradesh zoo was skinned. When the facts of the case were first presented to the Supreme Court, it was stunned and dismayed. The fact that humans were involved in such a heinous act, leaving the voiceless animal helpless and in excruciating pain and agony, tormented the Court to no end. The tiger was not protected by those whose responsibility it was to protect and care for it. As a result, the Supreme Court of India decided that summoning the chairperson of the Central Zoo Authority to appear before the court in person to explain what steps and measures were being taken to protect and preserve the tiger population in zoos. The Supreme Court then issued relevant orders in the matter, including those concerning tiger

²⁶ Tejnani, D. (2021). 15 Landmark Judgement of Indian Judiciary on Animal Rights. Retrieved 29 March 2021, from <https://legaldesire.com/15-landmark-judgement-of-indian-judiciary-on-animal-rights/>

security. The Supreme Court clarified that the Central Zoo Authority must take note of this issue and take the requisite measures to protect the plight of these voiceless animals, as their current state is distressing⁶⁹.

People for Ethical Treatment of Animals v. Union of India, Writ Petition (PIL) (Lodging) No. 2490 of 2004.

PETA filed a Writ Petition in the Bombay High Court against the granting of a censorship certificate to a film titled "TajMahal" under the Cinematography Act, 1952. Protecting animal welfare, according to PETA, is a stated constitutional goal enshrined in Article 51A (g) and a matter of statutory policy under the Prevention of Cruelty to Animals Act, 1960. PETA's key accusation and claim was that the makers of the film "TajMahal" violated the provisions of the Prevention of Cruelty to Animals Act, 1960, as well as the provisions of the Performing Animals Registration Rules, 2001, while the film was being shot. PETA claims that a film wishing to use an animal should receive a no-objection certificate from the Animal Welfare Board of India as a pre-requisite before the Central Board of Censorship issues a certificate of censorship.

In this case, the High Court ruled in favour of PETA, holding that any film that intends or wishes to use an animal must first obtain a certificate from the Animal Welfare Board of India, which includes the various provisions of the Performing Animals Registration Rules, 2001. The Animal Welfare Board will investigate whether a film that intends to use an animal in the process of its production is not abusive to the animal and is properly cared for. The Animal Welfare Board will then look at whether the film's creators are following any of the rules set out in the Performing Animals (Registration) Rules, 2001, as well as the Prevention of Cruelty to Animals Act, 1960. The Bombay High Court issued this ruling in 2006 to shield non-human living beings from being abused or exposed to violence during the filming process, which usually lasts many hours. The Bombay High Court's decision protected animals from neglect and cruelty. Simultaneously, filmmakers started to handle animals on set and during shoots with intense care. They provided them with food, water, and shelter, as well as ensuring that they were not treated cruelly by any members of the crew⁶⁹.

SURVEY REPORT

There are several laws that are framed to safeguard the interests of wildlife but in order to do the analysis of the applicability and understanding of the laws by the masses, a survey was conducted on an online platform because of the pandemic which included questions regarding the laws, its general applicability and if we need to amend the existing one. The questions that were asked in the format of a questionnaire are as follows-

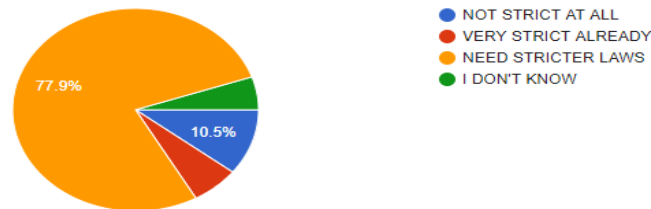
1. What is your name?
2. Are you a forensic science student, researcher, teacher, lecturer, professor, etc.?
3. How strict do you think our laws are in relation to wildlife protection?
4. How important do you think it is to protect and conserve wildlife on a scale from 0 to 10?
5. What is the major threat to wildlife today?
6. Do you know about Wildlife protection act, 1972?
7. Do you know about the prevention of cruelty to animals act, 1960?
8. Do you know that Article 51 (A) of Indian constitution states that it is the duty of every citizen of India to protect and improve natural environment including wildlife?
9. If any illegal killing or cruelty against any animal is witnessed by you, what will you do?
10. Is commercial hunting a sustainable practice?
11. Do we need more rigorous penalties to prosecute people who are involved in hunting, poaching or illicit trading of animals?
12. Should media portals be used more for promoting wildlife conservation?
13. Comment- What according to you could be done to effectively spread awareness and information in order to stimulate the masses about the importance of wildlife and its protection?

Survey analysis

Number of respondents 95

Out of these 95 respondents, 71.6 % (68) were from forensic background, 1.1% (1) from the cyber security, 1.1% pharmacy, 1.1% were from medical field and the rest were from other branches.

The laws were found to be very weak according to the responses as 77.9 % (74) people stated that we need stricter laws in relation to wildlife security, 10. 5% (10) agreed that the laws are not strict at all, while 6.3% (6) respondents felt that the laws are strict already and 5.3% (5) had no clue about it.

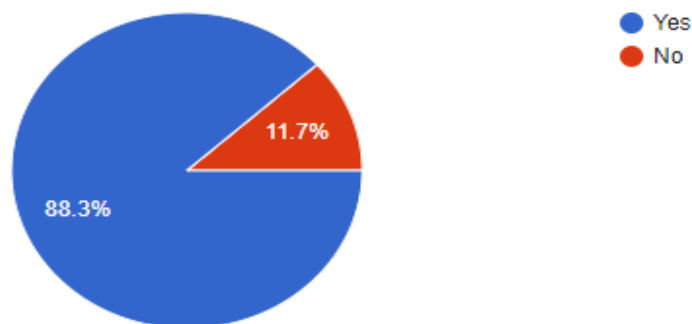


The importance of wildlife on a scale from 1 to 10 was found to be 10/10 by 75.7%, 9/ 10 by 14.9%, 8/10 by 5.3%, 5 by 2 respondents while few respondents scored it 11/10.

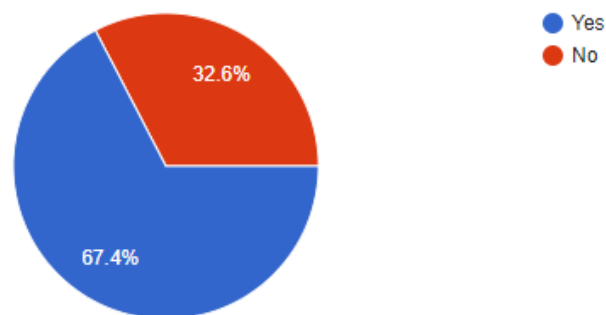
Major threats to wildlife were found to be;

Humans
Wildlife Trade, Destruction of their habitat, Deforestation, Pollution, etc.
Population
Global warming.
Less Jungle, Urbanization
Poaching' and their illegal trading.
Hunting for tooth, horns, skin, nails, feathers
Encroachment
Climate change.
Deforestation, hunting, pollution, plastics, dumping grounds, electric fences, colonization in forest area.
Habitat loss and climate change.
Extinction

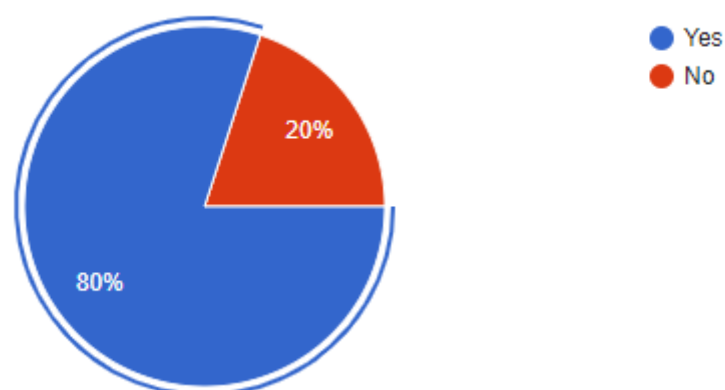
83.3% (83) people knew about the wildlife protection act 1970 while the rest were unaware of it.



Surprisingly even lesser people i.e. 67.4% (64) knew about the prevention of cruelty to animal's act, 1960.



80% (76) people knew about the article 51(A) of Indian constitution states that it is the duty of every citizen of India to protect and improve natural environment including wildlife.

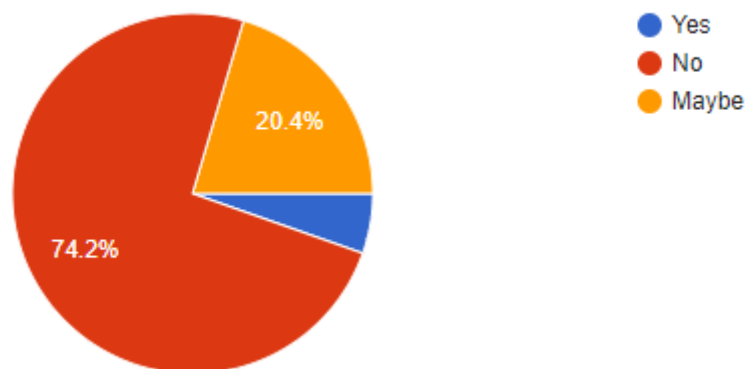


Various aspects of general applicability were observed to our open-end question where the respondent was asked to answer what will he/she do if they witness any illegal killing or cruelty against an animal. The answers (94) that were recorded are as follows;

79.8% (75) stated that they will report a FIR while 4% said they don't know what to do, 3.2 % stated that they will tell their neighbors about it.

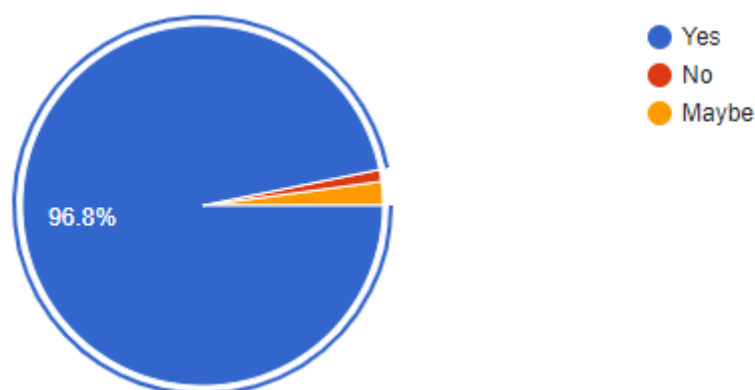
The rest of the answers were Generate social media attention, try to stop it, if I can and report to the police and file a FIR, Report to the animal rescue centers, get a proof, make them understand about what they did and if still they do not stop, report a complaint, prevent it if under my capacity, Call PETA or any animal protection center, Will report to forest helpline 1926, Will try to educate them.

74.2 % (69) out of 93 said that commercial hunting is not a sustainable practice while 20.4% (19) were not sure and answered maybe.



93.6 % (84 out of 93) agreed that more rigorous penalties are required to prosecute people who are involved in hunting, poaching or illicit trading of animals while the rest were not sure and marked maybe as their response.

96.8 % (91 out of 94) respondents agreed that media portals should positively be used more for promoting wildlife conservation.



Remedial action plans which need to be laid down in order to safeguard wildlife and stimulate the masses, aware them about the importance of biodiversity, 63 responses were obtained for the same. Few of them are mentioned below.

- In my opinion people should first themselves take a step forward if any such incident comes their way and then obviously speak about it to as many people as they can reach out and can also promote wildlife security through their social media.
- More print media use than news.
- Social media campaigns and seminars held by and in educational institutions.
- Since only the fear of misfortune makes humans learn their lessons, it would be viable to enforce insanely huge penalties such as rigorous imprisonment or insanely huge lump sum of money.
- Let people know what can be the consequences if they did not conserve it, what basic or necessary steps they can inculcate in their lives.
- Documentary films can be made
- Various awareness campaigns must be started so that the mankind should get familiar to the troubles and problems faced by the wildlife.
- The fine is way to less. 5000 is not way too much to develop threat in the minds of people who earns lakhs out of it.
- Mandatory education on wildlife laws and strict laws and punishments.
- Firstly to make them understand the importance of wildlife and what it does for mankind. Also, humans could be best lured to save mankind if they are shown real benefits of it and be made part of the benefits.
- Celebrate wildlife day, Create awareness program for that, to alert people about importance of Wildlife, Ecology, Tree plantation must etc.
- Improve laws for wildlife. Create awareness and fear in humans for violation of wildlife laws.

- Friendly and informative parks and conservation areas with more communication between the supervisor and citizens.
- Surveys or some small documentary shown to social media or television etc. Or some created animations showing the worse effects of loss of wild life on environment. Another suggestion is as people are more religious so make them believe killing of any animal is a sin and not be counted as a good deed by God.
- Rallies, nukkad nataks, campaigns creating awareness. Include the subject in syllabus for school children to insinuate the value since childhood.
- We need participation of higher authorities like ministers etc. who have a say in the society so as to move people towards these issues and generate awareness about the ills it creates not only for wildlife but for themselves in return.
- Effective implementation of govt.policies needed. -Need to set up and development of govt. Organization's to deal with wildlife issues.
- Mandatory action on environmental impact assessment, drone technologies to be used extensively 24 hrs. for wildlife protection.
- Strict law must be enacted and high penalty must be imposed
- Audio-visual advertisement in regional languages
- Environmental studies as a part of curriculum should not be just a redundant subject, but should be accorded the same status as other important subjects since primary school. We often neglect this subject just in school and are gifted marks for it. Environment deserves better.
- Planning visits to local wildlife and creating volunteering groups to work for wildlife protection.
- Every Hill station should put banners to drive slowly at night and day, Farms should be checked if there is any current in the field because it can harm to animals.

CONCLUSION

As previously stated, wildlife forensics is a branch of forensic science that assists in crime detection by scientifically collecting evidence from the scene of the crime and analyzing it in order to identify the perpetrators involved in hunting, poaching, or unlawfully selling flora and

fauna or products obtained from them. The Wildlife Protection Act of 1972 was the first comprehensive wildlife protection legislation passed by Parliament, based on provisions in Article 252 of the Constitution.

According to a survey of 95 people who answered all 13 questions, 83.3 % people knew about the Wildlife Conservation Act of 1970, while only 67.4% people knew about the Prevention of Cruelty to Animals Act of 1960. It was also found that 93.6% agree that tougher punishments are needed to punish individuals involved in hunting, smuggling, or illegal animal trade. Another important aspect of the survey that should be highlighted is that 96.8% of respondents believe that media portals should be used more to promote wildlife conservation.

Therefore, Remedial action plans needs to be laid down in order to safeguard wildlife and stimulate the masses and aware them about the importance of biodiversity.

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