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# Collection and preservation of animals Specimens

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**ABSTRACT**

The collection and preservation of animal specimens are indispensable for scientific research, education, and conservation. Traditional preservation techniques, such as hypothermia with specialized solutions, have evolved into advanced methods like oxygenated perfusion under hypothermic and normothermic conditions, ensuring better tissue metabolism and structural integrity. Preservation time is now a critical phase, offering opportunities to evaluate organ quality, conduct repairs, and optimize specimen use. Innovative methods have proven effective in preserving structural details, minimizing shrinkage, and enhancing clarity, making them invaluable for museum applications. Beyond their historical and educational roles, museum specimens serve as vital genetic resources, supporting conservation genetics and offering insights into biodiversity. Case studies emphasize the importance of ethical collection practices and their role in ecological research. Advancing technologies and strategic genetic resource management will further enhance the relevance of preserved specimens, ensuring they remain a cornerstone of scientific discovery and conservation for future generations.

Key words; Specimen, Animal, Preservation, Collection, Species, etc.

## I. INTRODUCTION

A preserved animal or animal component used for scientific purposes is called a zoological specimen. They may be used to confirm a species' identify, permit research, and raise public

awareness of zoology, among other purposes [1]. Specimens of zoology are quite varied. Microscope slides, skeletal material, castings, pinned insects, dried material, animals kept in liquid preservatives, mounted specimens, and study skins of birds and mammals are a few examples. Zoological specimens are kept at natural history museums [2].

## A. Specimen collection

Vital information about a patient's health is provided by laboratory testing. Accurate test findings are a major factor in making the right diagnostic and treatment choices. Accurate test findings are contingent upon proper specimen handling, collection, and patient preparation [3]. The integrity of the specimens determines how accurate the test findings are.

### 1. Importance of specimen collection

Numerous laboratory tests are conducted when a patient appears with a condition, and these tests are crucial to the ultimate diagnosis and treatment of the illness. Decisions on diagnosis and treatment are based on the accuracy of these data. Proper patient preparation, specimen collection, and handling are required to guarantee the highest level of accuracy in the findings [4]. This necessitates delivering properly collected specimens to the lab on schedule. For the careful collecting of specimens and the disposal of contaminated specimens and other biological waste, all medical professionals and laboratory workers handling the specimens should be aware of and adhere to the appropriate sterile procedures and guidelines [5]. It is the duty of every individual engaged in the collection and processing of specimens to guarantee their own and the patients' safety. Before collecting the specimen, the individual should be aware of the correct test description, the process, and the instructions for handling and storing the specimen [6]. The patient should be made aware of any dietary, fasting, or medical limitations beforehand. Accurate lab findings depend on the availability of a suitable transport infrastructure for the prompt transportation of specimens to the laboratory [7]. Prior to beginning antibiotic treatment, the specimen for bacterial culture should be gathered in sterile containers and sent to the laboratory as soon as possible. Never put an eye, internal ear, or genital tract specimen in the refrigerator. General errors that frequently occur during specimen collection include incorrect specimen labelling, failure to include relevant clinical information on the request form, inadequate quantity of collected specimens, incomplete and inaccurate patient instructions prior to specimen collection, use of inappropriate containers that result in specimen contamination or leakage, and improper temperature storage that degrades sample quality [8]. If addressed, these errors that occur during specimen collection and transportation to the lab may significantly improve test findings, aiding in more accurate diagnosis and treatment choices [9].

### 2. Safety and Disposal Considerations in Specimen Collection

Laboratory and medical staff should adhere to the most recent approved sterile procedures, which include taking care while using needles and other sterile equipment, in all situations where specimens are gathered and processed for testing. All biological material, including contaminated specimen collecting supplies, should be

treated as potentially harmful. After a patient is discharged, it is still the duty of everyone engaged in specimen collection and preparation to follow the most recent guidelines created to protect patients and medical personnel [10].

### B. Specimen preservation

The majority of biological specimens are kept in museums for type specimen and voucher specimen records as well as for use in a variety of scientific investigations. Typically, specimens are preserved using varying concentrations of formalin along with a few other preservatives such as alcohol, buinsfluid, etc. When these preservatives are utilised, there are undoubtedly ongoing issues with colour loss over time [11]. One important factor in the classification of biological specimens is body colour. Museums all around the globe are searching for alternatives to traditional preservatives like formalin and alcohol because of their many other drawbacks [12].

#### 1. Importance of specimen preservation

In order to guarantee the validity and repeatability of research findings, specimens used in scientific studies must be stored for a long time as "evidence." As voucher specimens, dried specimens and specimens submerged in preservation fluids that have undergone morphological examination are kept in specimen repositories for long-term preservation. DNA materials are often thrown away once the DNA sequence information has been extracted, registered in public databases, and published in research publications, but scientifically significant morphological specimens, such as name-bearing type specimens, must be preserved forever. Research results often cannot be confirmed later using the same subject because, even if a voucher specimen is saved, it may be difficult to extract high-quality DNA from the same specimen again if it has been dried or chemically processed. Preserving tissue and/or DNA samples used in DNA research as "voucher specimens" for the DNA sequence information is crucial to resolving this problem. Semi-permanently preserving such samples is thus a key goal of the Centre for Molecular Biodiversity Research in order to guarantee the repeatability of study findings.

### C. Classification of animals on habitat:

**Aerial Animals:** Aerial animals are those that spend the most of their time in the air. This group includes birds.

**Amphibians:** Both land and water may support amphibians. Amphibians have no emotion. The skin of amphibians is not scaly. Their skin is porous and slimy, allowing water and air to flow through it. Gills are present in certain amphibians from birth. Frogs, toads, salamanders, and caecilians are a few types of amphibians.

**Aquatic Animals:** Aquatic animals are those that inhabit water. Gills are specialised respiratory organs found in many aquatic species, including fish. The membranes that make up gills are joined by blood vessels. Gills expel carbon dioxide and draw dissolved oxygen from water.

**Arboreal Animals:** Trees are home to arboreal creatures. For instance, chameleons, squirrels, lizards, monkeys, etc.

**Terrestrial Animals:** Terrestrial animals are those that inhabit land. Typically, they have four legs. The sensory organs of terrestrial animals are highly developed. For instance, dogs, cats, tigers, lions, elephants, etc.


**Figure 1 Classification of animals on habitat**

## D. Preservation Techniques

Curators educated in the recognised procedures for preparing and caring for an alcoholic collection are found in the majority of the largest museums and institutions that have preserved collections of amphibians and reptiles. However, many non-professional natural history enthusiasts have the desire and ability to acquire and conserve herpetological specimens but are unaware of the appropriate methods. This page aims to assist these individuals because, if specimens are properly labelled, maintained, and set in a regular posture, even modest collections that are haphazardly put together may be very beneficial.

**Formalin:** Whenever feasible, specimens should be fixed and injected using formalin. A formaldehyde gas (CH20) solution in water is marketed under the name "formalin." In the United States, pharmacies and chemical supply businesses sell it at strengths ranging from 38% to 40%. Formalin is sold under the names "Formol" and "Formolina" in numerous pharmacies in Latin American nations. Before being employed as a preservative, formalin has to be diluted with water. For the majority of uses, a 10% formalin strength works well. A ratio of nine parts water to one part formalin should be used if the initial strength was 40%. Formalin has many benefits over alternative preservatives, including being widely accessible, affordable, and allowing specimens to almost ever decompose in it. Additionally, a little amount of concentrated stock solution may be diluted as required. Its main drawbacks are that it smells very bad, it is quite toxic and may cause a rash or skin irritation, it can make specimens brittle if the solution is too powerful, it quickly fades certain colours, and it must to be kept in rustproof containers. It is advised to buffer the 10% solution since formalin has a minor acidity. A combination of monobasic and dibasic sodium phosphate, at 13 gm/gallon [monobasic] and 24 gm/gallon [dibasic]), is one possible buffering scheme.

**Alcohol.** Ethyl alcohol is an extremely costly preservative due to the high federal tax on it, unless a university, museum, or other such organisation may buy it. The strength at which it is often marketed is 95% (190 proof). It should be utilised fully for injection and mending. It should be used in a ratio of three parts 95% alcohol to one part water for reptile storage. Due to evaporation, alcohol kept in open containers quickly loses its potency. An alcoholometer may be used to measure strength. Alcohol-fixed specimens need to be closely monitored for indications of decay. Ethyl alcohol may be found in alcoholic drinks, shaving creams, and Bay Rum. They must be used without dilution and only in an emergency. Only 50% of a 100 proof spirits is ethyl alcohol.

**Steps for the preservation of specimens for scientific study are as follows:**

**Euthanizing:** In accordance with the Institutional Animal Care and Use Committee's (IACUC) recommended best practices, specimens should be put to sleep in a manner that leaves them calm and uninjured.

**Injection and slitting:** Liquid preservatives must be injected hypodermically or via slits into the body cavities, limbs, and tail.

**Fixing:** In order for the specimens to harden in the correct posture, they should be placed on trays while they are still relaxed.

**Labeling:** Every specimen should have specific information linked to it, either directly or in a notebook, with a number that matches a numbered tag fastened to the specimen.

**Storage:** Specimens should be kept in liquid preservative for a minimum of a few days after being properly fixed. Following this, they may either be left in the liquid or moved to plastic bags for short-term storage.

## II. LITERATURE REVIEW

(Li et al., 2023) [3] The use of natural history specimens to study environmental changes has grown in popularity. There has been a renewed emphasis on the completeness of biological collections to provide data for present and future study since the current use of museum specimens has expanded beyond their original taxonomic duty. In order to respond to enquiries about the shift in the prevalence of five common reptile species as a result of Perth's fast urbanisation, we utilised the Western Australian Museum's collections. When comparing the years 1990–1999 to 2000, we found a substantial decrease in collecting effort ($F = 7.65$, $p < 0.01$). According to spatial analysis, the bulk of the areas (91%) were poorly sampled, 8.5% were moderately sampled, and just 0.5% of our research region was well sampled. A substantial discrepancy in specimen collecting efforts for 13 common reptile species across time and place was found by examining the pattern of specimen acquisition from 1950 to 2010. A significant number of historical specimens lacked details, such as the location and time of collection. To guarantee that collections are able to respond to enquiries about environmental change, more funding for museums as well as more systematic collecting in terms of geography and time are recommended.

(Ragavan et al., 2023) [12] When choosing the sample size and sampling frame for effective field sampling in animal disease prevalence investigations, management tactics and the use of cutting-edge technology are equally crucial. The integrity of the data produced, prevalence estimations, and ensuing disease control policy choices are all directly impacted by the calibre of biological samples obtained in the field. Therefore, the concepts of priority setting in disease control plans may be compromised if the quality of biological samples obtained in the field is compromised. Field-collected biological samples from domestic animals are valuable resources that need careful preparation for collection, field storage, transit, and laboratory storage. The accuracy of disease prevalence statistics is directly impacted by poorly managed field sampling,
which also has a major negative effect on sample number and quality. A poor selection of containers, storage, transportation, and sampling equipment can compromise the integrity of the sample and, as a result, affect the final result. We have seen possibilities and problems in the field sampling of animals for disease prevalence investigations throughout the last two years as part of our One Health animal sampling effort in India. The purpose of this document is to guarantee that high-quality samples are accessible for testing by offering information on technology and management techniques for effective biological sample collecting from the field.

(Zarrin, 2023) [9] In 2016, the State Museum in Lucknow conducted research and created a catalogue for its collection of birds (Zarrin 2016). Using the most recent Indian BIRDS taxonomy, I discovered 3,944 specimens from 635 species and 102 families (Praveen & Jayapal 2023). The collection is by far one of the oldest in Asia, having been assembled between 1823 and 1924 based on specimen labels or field tags. The bulk of specimens are from Uttar Pradesh and Uttarakhand, however some skins are extralimital and some are from other parts of India. The museum is home to many significant species, including the regionally extinct Siberian Crane (Leucogeranus leucogeranus) and the likely extinct Pink-headed Duck (Rhodonessa caryophyllacea). The

collection is in poor overall condition, with 53% of it in need of curative conservation and the remaining 47% in need of preventative conservation. The identification of a few specimens needed to be reviewed after a later comparison with Reid's (1890) catalogues, and I note this as a priority for future investigation.

(Promnun et al., 2023) [6] Thailand's varied herpetofauna has a long history of being collected and catalogued; the Thailand Natural History Museum (THNHM) is home to several specimens. Assessing the richness of the THNHM collection's herpetofauna, determining the species' conservation status, and monitoring the specimens' geographic distribution throughout the nation were the objectives of this study. With 335 species of reptiles and 173 species of amphibians, the THNHM collection has a remarkable inventory. There are more herpetofauna species in this collection than have ever been documented in Thailand, demonstrating the great richness found within these taxonomic categories. However, the assessment of their conservation status—as established by Thailand's Wild Animal Preservation and Protection Act (WARPA), CITES, and the IUCN Red List—has revealed differences in the level of concern for particular species, which may be due to different applications of the evaluation criteria. Among the notable type specimens in the collection are 27 holotypes, which are still poorly understood. Since 2000, the scope of sampling activities has expanded significantly, reaching almost every part of the nation. The vast and organised collection of varied herpetofauna at the THNHM is a useful tool for study and teaching, deepening our knowledge of these species and their importance in the larger scheme of biodiversity preservation.

(Lepoittevin et al., 2022) [10] When a non-vital organ (mostly the kidney and pancreas) or a vital organ (lung, liver, heart, or intestine) fails and there are other options for therapy, organ transplantation is still the final option. It continues to be the best option in terms of public health spending as well as patient life expectancy and quality of life. Unfortunately, only over 25% of people waiting for an organ get a transplant annually, indicating that organ scarcity is still a major problem. Recent donor populations (died after circulatory arrest or by brain death with enhanced criteria) are now being taken into account as a result of this circumstance. The short- and long-term outcomes of the transplant are affected by the conservation circumstances during the ischaemia phase, which are sensitive to these organs. This change calls for improved preservation conditions and more tailored organ donation management. The many facets of preservation will be examined in this broad overview. Preservation, which was first accomplished by hypothermia with the aid of certain solutions, is developing with oxygenated perfusion in hypothermia or normothermia with the goal of preserving tissue metabolism. Additionally, preservation time is evolving into a special window for assessing organ quality, enabling recipient selection optimisation and/or repair.

(Miyan & Khan, 2021) [13] Since the advent of new, effective preservation techniques is altering the landscape of biological specimen preservation in museums, the need of maintaining natural history materials has never been higher. The goal of the current research is to determine if the plastic embedding approach is beneficial for maintaining biological specimens in museums. A variety of insect nymphs and legs were used in the research in

order to preserve them utilising the plastic embedding approach. To remove the natural oils, the specimens were dried and then exposed to 10% acetone. After being cleaned, the chosen specimens were implanted in epoxy resin. After five to seven days, the resin is allowed to fully cure before being cut and polished. Clear structural features, shrinkage, clarity, and the specimen-resin contact were all evident in the findings. As a result, this method worked well for improving the biological specimens' preservation at the museum.

(Nakahama, 2021) [14] Genetic information at the time of collection is included in museum specimens. It is quite difficult to determine this historical information from samples that are presently being gathered, but it may be useful information for conservation genetics. However, DNA fragmentation and the deamination of cytosine to uracil make genetic research of museum specimens extremely challenging. Numerous approaches, including data processing techniques like next-generation sequencing, have been developed recently for the genetic examination of museum specimens. It is anticipated that new methods for obtaining historical genetic data from museum specimens will provide a fresh viewpoint on conservation genetics. The availability of museum specimens as genetic resources for conservation genetics is the main topic of this study. Perspectives on the potential future use of conservation genetic investigations using museum specimens are explored, along with the introduction of a few case examples. Important guidelines for the utilisation of museum specimens are also included, along with suggested genetic analysis techniques. This paper makes a compelling argument for future conservation genetics research to employ more museum specimens.

(Peng et al., 2021) [15] In the fields of biological research and non-renewable strategic biological resources, biological specimens are crucial materials. The Chinese Academy of Sciences' (CAS) specimen collection serves as a hub for scientific teaching, research, and conservation. It is crucial to China's biodiversity studies and conservation efforts. Important information in three dimensions—species, place, and time—can be obtained from biological specimens. Research on species cognition, biodiversity cataloguing, endangered species conservation and management, alien invasion prevention and control, biodiversity monitoring, species distribution patterns, and biodiversity change are all aided by the use of various levels of such data. The use of biological specimens in biodiversity study and conservation has enormous potential. To better support the development of ecological civilisation and biodiversity conservation in China, specimen resource management and construction must be dedicated to more thorough collection in the future, as well as to strengthening the acquisition of detailed information and building data integration platforms.

(Clemannnn et al., 2014) [16] Preserved faunal specimens in museum collections are very significant tools for learning about the natural world, and knowledge of the natural world is vital in light of the present biodiversity extinction catastrophe. Specimen collections and the advantages they provide are dynamic; there is a constant demand for new and fresh specimens, specimens from uncollected areas, or specimens from other demographic groups. Despite this, there is growing opposition to specimen collection, as well as the false notion that contemporary methods (such molecular studies) and technology (like digital cameras and tracking devices)

make specimen collection unnecessary. Modern technology does not completely remove the need to acquire voucher specimens, although it may sometimes help reduce the quantity that must be gathered. We think that careful specimen collecting is sometimes more important than protecting the lives of every individual, but animal rights concerns have played and will continue to play a vital and desirable role in correcting needlessly terrible treatment of fauna. We contend that museum collections enable thorough taxonomic, biological, and ecological research because they provide crucial, verifiable proof of a species' presence throughout time and location. The prudent collection of specimens is justified by the importance of specimen data for these investigations both now and in the decades and centuries to come. We illustrate the advantages of specimens, the need of ongoing collecting in Victoria, and a framework for directing the decision-making process for vertebrate specimen collection using local examples.

## III. CONCLUSION

The collection and preservation of animal specimens remain vital in advancing scientific research, education, and conservation efforts. Traditional preservation methods, such as hypothermia aided by specific solutions, have paved the way for advanced techniques like oxygenated perfusion under hypothermic and normothermic conditions, which better maintain tissue metabolism and structural integrity. Preservation time is now recognized as a crucial phase for evaluating organ and tissue quality, enabling repair, optimization, and better recipient matching. Innovative preservation techniques have demonstrated remarkable results, including clear structural details, minimized shrinkage, and improved interface clarity between specimens and resin, solidifying their effectiveness for museum applications. Museum specimens, beyond their educational and historical value, have emerged as indispensable genetic resources for conservation genetics. They offer critical insights into biodiversity and allow for retrospective studies that inform conservation strategies. Case studies underscore the value of these specimens in predictive and practical applications, advocating for judicious and ethical collection practices. Localized examples further highlight the benefits of continued specimen collection, particularly in regions like Victoria, where vertebrate specimens contribute to understanding and preserving ecological balance. Looking forward, the integration of modern technologies and the careful management of genetic resources will enhance the utility of preserved specimens, ensuring their significance for generations to come.

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