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# Voucher Specimen Collection, Preparation, Identification and Storage Protocol: Animals

Standards for Components of British  
Columbia's Biodiversity No. 4a

Prepared by  
Ministry of Environment, Lands and Parks  
Resources Inventory Branch  
for the Terrestrial Ecosystems Task Force  
Resources Inventory Committee

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# Preface

This manual presents standard protocols for collecting animal vouchers in British Columbia (plant and fungi vouchers are covered in manual No. 4b). The manual was compiled by the Elements Working Group of the Terrestrial Ecosystems Task Force, under the auspices of the Resources Inventory Committee (RIC). The objectives of the working group are to develop inventory methods that will lead to the collection of comparable, defensible, and useful inventory and monitoring data for the species component of biodiversity.

This manual is part of the Standards for Components of British Columbia's Biodiversity (CBCB) series. The series includes an introductory manual (*Species Inventory Fundamentals No. 1*) which describes the history and objectives of RIC, and outlines the general process of conducting a species inventory according to RIC standards, including selection of inventory intensity, sampling design, sampling techniques, and statistical analysis. The *Species Inventory Fundamentals* manual provides important background information and should be thoroughly reviewed before commencing with a RIC wildlife inventory. RIC standards are also available for vertebrate taxonomy (No. 2), animal capture and handling (No. 3), and radio-telemetry (No. 5). Field personnel should be thoroughly familiar with these standards before engaging in field inventories which involve any of these activities. The rest of the series is comprised of standard protocols designed specifically for groups of species with similar inventory requirements.

Standard data forms are required for all RIC species inventory. Survey-specific data forms accompany most manuals while general wildlife inventory forms are available in *Species Inventory Fundamentals No. 1 [Forms]*. This is important to ensure compatibility with provincial data systems, as all information must eventually be included in the Species Inventory Datasystem (SPI). For more information about SPI and data forms, visit the Species Inventory Homepage at: <http://www.elp.gov.bc.ca/rib/wis/spi/>

It is recognized that development of standard methods is necessarily an ongoing process. The CBCB manuals are expected to evolve and improve very quickly over their initial years of use. Field testing is a vital component of this process and feedback is essential. Comments and suggestions can be forwarded to the Elements Working Group by contacting:

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Wildlife Inventory Section, Resource Inventory Branch  
Ministry of Environment, Lands & Parks  
P.O. Box 9344, Station Prov Govt  
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The Resources Inventory Committee consists of representatives from various ministries and agencies of the Canadian and the British Columbia governments as well as from First Nations peoples. RIC objectives are to develop a common set of standards and procedures for the provincial resources inventories, as recommended by the Forest Resources Commission in its report "The Future of our Forests".

For further information about the Resources Inventory Committee and its various Task Forces, please access the Resources Inventory Committee Website at:  
<http://www.for.gov.bc.ca/ric>

## Terrestrial Ecosystems Task Force

All decisions regarding protocols and standards are the responsibility of the Resources Inventory Committee. The following people made substantial contributions to various sections of this manual: Introduction - Rob Cannings, Andrew Harcombe, Leah Westereng; Birds - Mike McNall, Jim Cosgrove; Mammals - Lesley Kennes; Amphibians and Reptiles - Kelly Sendall; Fish - Kelly Sendall; Terrestrial Arthropods - Rob Cannings, David Blades; Aquatic and Marine Invertebrates - Kelly Sendall. Helpful comments were submitted by Peter Newroth and Del Meidenger.

Background information and protocols presented in this version are based on the unpublished draft government report, *Manual for Voucher Specimen Collection, Preparation, Identification and Storage Protocol for Inventories in British Columbia*, prepared for the Resources Inventory Committee by M.G. Shepard and M. Lambert. Assistance for this draft manual was appreciated from the following people listed. Brenda Callan provided a synopsis of protocol for fungi voucher specimens that was most useful in the preparation of this report. Stan Orchard (herpetology) and Adolf Ceska (vascular plants) made valuable suggestions on the specimen preparation sections. Julie Oliveira gave us information on preserving marine algae. Rob Cannings and Trudy Chatwin provided direction on the preparation of this manual, and Phil Lambert was a constant source of helpful comments throughout the project.

This manual was edited to its final form by Leah Westereng.

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# 1. Introduction

The Resources Inventory Committee (RIC) of British Columbia has a mandate to develop standardized procedures for inventory for provincial resources. Interest in, and demand for, information from biological inventory and research is at a high level for several important reasons. The documentation of biological diversity including the distribution and abundance of organisms (much of which is unknown), is considered a vital ethical and management task. Inventory information is critical to the requirements of Forest Renewal British Columbia (FRBC) and the Forest Practices Code that it supports, Protected Area Strategies, land-use planning, and management issues in general.

Museum collections of biological specimens are the fundamental reference material that documents the province's biological diversity. Such collections are essential for research in the science of systematics, which embraces classification, taxonomy, evolutionary relationships and evolutionary processes. Conserving biological diversity and ecological integrity in British Columbia is intimately connected to taxonomic knowledge. It is impossible to carry our biological inventories of threatened ecosystems such as coastal old-growth forests, southern interior grasslands or freshwater ponds and rivers, without being able to identify and name the distinctive and ecologically critical organisms that are present. Without such inventories of "name-able" organisms people cannot communicate, values of areas cannot be assessed, necessary research cannot be done, and management and protection plans cannot be developed. Natural history museums have the responsibility to develop well-documented field collections; to preserve them; to study them and to publish the results of research; to make them available for examination or loan; to serve as repositories for specimens and associated data; and to provide expert information on taxonomy, identification and distribution (Miller and Nagorsen 1992).

Because of the increased demand for biological information it is imperative that collection standards be established and accuracy in identification be encouraged. This manual presents a standard protocol for voucher specimens, a subset of inventory collections designed to ensure the reliability of the inventory.

During ecological, environmental and taxonomic studies, as well as basic species inventory, biological specimens are often collected and identified. These identifications are used in subsequent analyses and reports to come to certain conclusions. If these identifications are incorrect, false conclusions can be made. If results of future studies disagree with those of the initial study, the initial results can be verified only if representative specimens are available for reexamination. The information contained in these specimens is irreplaceable because we cannot go back in time and resample. Thus, it is imperative that in any inventory or study whose conclusions depend on the identification of biological specimens, provisions are made for the deposition of voucher specimens, preferably in a recognized museum with facilities for maintenance of biological collections (Green and Lambert 1994).

Voucher specimens are defined, and their importance is noted, by Miller and Nagorsen (1992). They "... are representative specimens that are collected in biological field surveys and research, and that are preserved to permit independent verification of results and to allow further study. The term "specimen" covers diverse materials such as photographs and tape recordings, but usually refers to more traditional preparations like skins, skulls, pressed

plants or dead animals in preserving fluids... Many kinds of animals and plants that are of interest in environmental impact studies or biological surveys can only be reliably identified when they have been preserved as specimens. Without such voucher specimens it is impossible to independently verify an investigator's claims, it is impossible to re-evaluate the species present in a sample in light of changing knowledge and taxonomic revisions, and it is impossible to reliably make historical comparisons or true ecological changes over time due to environmental effects such as pollution or climate change".

Specific voucher collections (i.e. collections of one biological group from one project) are stored as discrete units for a designated time period. This allows easy access for verification of identifications or additional taxonomic examination. After the designated time has elapsed, museum curators select appropriate specimens from the voucher collection for permanent accessioning into the main reference (research) collections. These latter collections are arranged taxonomically. Therefore, in addition to the primary reasons for making voucher collections, any government supported inventory offers the opportunity for the growth and improvement of the provincial collection.

The voucher specimens, as part of the main collection, then become invaluable for other research such as studies on seasonal occurrence, distribution and biogeography, life history, and taxonomy. Biologists also have an ethical obligation to use fully any plants and animals that they collect, particularly if the species are uncommon or if they are from areas that are subsequently altered by human activity (Miller and Nagorsen 1992).

Responsibilities of museums are to provide curatorial, legal and technical advice on collecting, preserving, documenting and depositing voucher specimens. Arrangements with museums for training field investigators and for accepting voucher specimens should be planned early in a project so that training needs can be met and logistical considerations can be addressed. Museums must maintain voucher specimens in good condition and make them and their data readily accessible. Field investigators and collectors are responsible for properly sampling, preserving and documenting specimens as outlined in relevant protocols and for ensuring that satisfactory samples of collections are deposited in museums after a project is completed. Investigators should cross reference voucher specimens in all reports and publications.

This document should be considered a dynamic document as procedures and techniques change and improve. Note that this manual presents standard protocols for collecting animal vouchers only. Information on collecting and preparing plant and fungi vouchers is covered in manual No. 4b.

## **1.1 Ethical Considerations**

The inventory and/or management of free-living wild mammals, birds, reptiles and amphibians may require their capture and handling and/or collection for the identification of specific characteristics as well as for other purposes. Guidelines in the *Live Animal Capture and Handling Guidelines*, manual no. 3, present a standardized approach to the justification and ethical considerations research and operational wildlife workers should consider when planning and performing the capture and handling of any wild animal. It is expected that protocols in the above mentioned manual will be followed, as this information will not be

repeated here. Some general considerations when planning to collect vouchers are provided below.

### **1.1.1 General Considerations**

Investigators have an obligation to identify and assess the consequences of their research activities on wild animals, populations and the environment. Whenever possible, action should be taken to avoid, alleviate or minimize any adverse effects. Research activities should include the collection of adequate samples to ensure valid research results, yet be balanced to minimize adverse effects. Investigators should always weigh potential gain in knowledge against the negative consequences of disturbance. Although short-term detrimental effects may result from research activities, research can ultimately yield long-term positive effects for the affected population.

Investigators must also take into account that the sounds, the behaviours and the simple presence of humans as they approach and move closer to sensitive areas may elicit a response from animals. In addition, species that are not under study may be disturbed.

### **1.1.2 Collecting and Trapping**

Whether one is collecting study animals for eventual release or for museum preparations, the same humane considerations should apply. These animals should not be exposed to excessive or inappropriate handling, conspecific aggression, predation, temperature extremes, or undue suffering.

The permanent removal of large numbers of animals from any wildlife population should be avoided, unless justified for very specific scientific reasons. Similarly, the collection of large numbers of females from any population for destructive sampling should be avoided. Systematists should investigate extant collections for suitable specimens before conducting any field work.

### **1.1.3 Euthanasia of Study Animals**

Animals that have been captured so that samples could be collected and that cannot be released should, whenever possible, be distributed to colleagues for further study. However, if the animal is in chronic distress or pain, or if release or rehabilitation is neither feasible nor likely to succeed, then euthanasia may be the only alternative. If animals must be destroyed subsequent to a study, or as part of a study, then it should be done using a method of euthanasia which is humane, instantaneous and considered acceptable (see Reference section). If the researcher does not have plans to preserve the whole specimen him or herself, then the method of euthanasia should not interfere with any future research potential of the carcass or any specific post mortem analyses. In both the field and the laboratory, the investigator must be careful to ensure that euthanized animals are dead before disposal. Disposal of carcasses must be in accordance with acceptable practices as required by municipal or institutional regulations. Animals containing toxic substances or drugs should not be disposed of in areas where they may be scavenged or become part of the natural food chain.

## 1.2 Compliance with Laws and Regulations

- Permits are required to collect within protected areas (e.g. parks). Investigators must obtain and comply with all permits required for the collection of any species (plants or animals).
- Permits are required for the handling and capturing of wildlife. Investigators must obtain and comply with all permits required for the capture, handling and collection of those animals, and the collection of those plants which are of the correct species and in the appropriate jurisdiction.
- Investigators must be familiar with the current provincial list of threatened and endangered species put out by the Conservation Data Centre (CDC), (B.C. Ministry of Environment Lands and Parks 1999), and must comply with all rules and regulations pertaining to these.
- Applications must be made well in advance of the sampling dates to allow adequate time for processing. Failure to obtain permits can result in seizure of gear and penalties.
- **Note:** if a permit can not be obtained to collect a certain specimen, do not collect it (even if it is a recommended voucher requirement).

### 1.2.1 Protected Areas

Depending on where the inventory survey takes place, one or more of the following may be required to access an area or to collect vouchers:

- Wildlife Sanctuary permit (written permission to be obtained from the Ministry of Environment, Lands and Parks' Regional Manager)
- Provincial Parks permit (contact the Resource Officer in the Park District of interest)
- National Parks permit (phone the office of the national park of interest)
- permission to work on First Nations or private property

Two acts of legislation forbid collection in provincial parks and ecological reserves: The Park Act (Section 8, Park and Recreation Area Regulations, O.C. 867/90, Division 6, Section 32(1)) and the Ecological Reserve Act (Ecological Reserves Regulations, 335/75, Section 1).

The Park Act and Ecological Reserve Act both provide the legislation which clearly prohibits the collection and removal of all natural resources within the parks and ecological reserves. Violators are subject to prosecution under the terms of the regulations (fines) and the judgments held before the courts for charges submitted.

Collection and research may only occur under the authority granted and outlined in a Park Use Permit, Recreation Area Permit or Ecological Use Permit. Permits are issued by the various Park District offices through the province, upon application and review by District staff. The Resource Officer is normally the lead coordinator in reviewing and issuing new permits involving collection and research.

### 1.2.2 Wildlife

Wildlife for which a possession permit from a Regional Manager or Wildlife Branch Director is required is that which is described in the Wildlife Act. Possession permits are issued pursuant to Section 19 of the WILDLIFE ACT, and BC Regulation 337/82, section 1(l). The authority for capture of wildlife comes under section 1(c) of the same regulation.

There is no prescribed application form for wildlife possession permits at this time. Written request for possession permits must be made to the Ministry of Environment, Lands and Parks' (MELP) Regional Manager. Requests for possession permits must provide the necessary details as to collectors' names, sampling period, locations to be sampled, gear types to be used, general purpose of the inventory, species, description, number, location of storage/display, and responsible institution/agency (who will be collecting what, where, when, why and how). Reference should be made to authority (permit) under which the wildlife was collected. Note: If wildlife (dead or alive) is to be exported out of British Columbia, a "BC Wildlife Export Permit for Live Wildlife (or Dead Wildlife, Parts or Derivatives)" must be obtained. Application forms are available from Regional Managers or the Wildlife Branch Director. Wildlife permits cover terrestrial vertebrates as well as sea otters, but do not include migratory birds (see below).

### **1.2.3 Migratory Birds**

Migratory birds are under federal jurisdiction, therefore possession permits cannot be issued by the MELP Regional Manager. Migratory birds are regulated under the Migratory Bird Convention Act and capture and handling permits can be obtained through the Canadian Wildlife Service (CWS).

### **1.2.4 Fish (freshwater)**

The Ministry of Environment, Lands and Parks' Regional Managers issue permits for the collection of fresh-water fish captured in British Columbia.

### **1.2.5 Marine Invertebrates, Saltwater Fishes and Salmon in Fresh-water**

The Department of Fisheries and Ocean (DFO) is responsible for permits governing the collection of marine invertebrates, saltwater fishes and salmon in fresh-water. To obtain a "Licence to Fish for Scientific Purposes" apply to the DFO regional office responsible for the area where the inventory will be conducted (see below). Note that to collect fish in a contaminated area a "Licence for the Harvest of Contaminated Shellfish" is required (currently \$100 cost). These permits are issued pursuant to subsection 4.(1) of the Management of Contaminated Fisheries Regulations, and Part VII of the Fishery General Regulations, Fisheries Act, R.S.C. 1985, c.F-14.

Contact numbers for permits to collect in non-contaminated area:

- South Coast phone (250) 756-7233 ; fax (250) 756-7162
- North Coast phone (250) 627-3007 ; fax (250) 627-3411
- Howe Sound, Fraser River, Boundary Bay phone (604) 666-8614 ; fax (604) 666-7112

Contact numbers for permits to collect in contaminated areas:

- South Coast phone (250) 954-2676 ; fax (250) 248-6776
- North Coast phone (250) 627-3007 ; fax (250) 627-3411

Written requests for licences must provide the necessary details as to collectors' names, sampling period, locations to be sampled, gear types to be used, general purpose of the inventory, species, description, number, location of storage/display, and responsible institution/agency (who will be collecting what, where, when, why and how).

### **1.2.6 Marine Mammals**

Marine mammals are covered under the Canada Fisheries Act and are the responsibility of the Department of Fisheries and Oceans. Marine mammals are not addressed in this manual.

## **1.3 Health Hazards**

Inventory personnel must be aware of health hazards associated with working with wild animals and chemicals used for preserving specimens. Ford and Tesch (1993) discuss some of these concerns. Although it is beyond the scope of this manual to cover these health hazards, below are some common sense precautions:

- familiarize yourself with the disease hazards in the area and the animals that carry them
- inquire about needed vaccinations
- take care to avoid being bitten or scratched by wild animals
- know how to clean up spills and treat for any chemicals that you use
- wear protective gear and disinfect equipment as needed
- immediately wash and treat cuts

## **1.4 Special Training**

All personnel including project managers, crew leaders and any other persons who are independently collecting data on a provincially-funded species inventory project must have successfully completed the training course “Introduction to Wildlife Inventory” that is based on the *Species Inventory Fundamentals* manual (No. 1). This course, along with other species inventory courses, are offered through the British Columbia Forestry Continuing Studies Network (FCSN).

*The Chemical Immobilization of Wildlife* training course is also required by any biologist who will be using chemical means to restrain wildlife. This course has been developed by the Canadian Association of Zoo and Wildlife Veterinarians.

## 2. Protocol Overview

This section describes the recommended protocol from design of the project with respect to collecting vouchers through to incorporation of vouchers into museum collections.

### 2.1 Office Procedures

This stage involves determining what specimens are to be collected, how they are to be prepared and the cost. The following are recommended:

- Obtain information regarding what species to expect in inventory area using sources such as literature, government biologists (e.g. Wildlife Branch, Royal BC Museum), university biologists, non-government museums and naturalists groups.
- Contact appropriate museum staff to discuss what collection priorities should be made, as well as the latest in collection and field preparation techniques.
- Obtain necessary permissions for collecting and access (see section 1.2).
- Make cost estimates (including staff time and expenses) for field collections, collection and preparation materials, transport of specimens, storage costs, and identification of specimens.
- Obtain all necessary collection and preparation equipment before departing.
- Make arrangements for transporting hazardous materials and specimens (see section 2.5).
- Keep in contact with appropriate museum to arrange timing of delivery of prepared specimens (see section 2.6).

### 2.2 Voucher Requirements by Taxonomic Group

If vouchers need be collected, the type of voucher to collect and the number of vouchers to be collected, depend on many things. If whole specimen vouchers are to be collected, one must consider 1) the efficiency that one can catch/collect the species and prepare them; 2) feasibility of taxonomic identification with regard to available exports and published keys; 3) if the taxonomic group to be collected can act as an indicator that can be related to management; and 4) if the collections can be made available in a reasonable length of time to create useful data (body of knowledge).

For some species, vouchers are not required as field data by qualified observers is accepted. This data may include direct observations of the species or its sign. Depending on the species, using animal sign can be easier to sample than it is to sample the animal directly, and equally as reliable. For other species photographs, scats, pellets, sound recordings, etc. are routinely accepted as vouchers that adequately document occurrence. Still, in some situations a whole voucher specimen is required either for identification purposes or to complete a reference collection. When whole specimens are required it is expected that common sense will be used. For example, whenever possible trap mortalities should be used as wildlife specimens rather than killing another animal.

Collection of rare species may endanger the population - do not collect if this situation is likely. Do not collect more specimens than can be reasonably handled. To document the



presence of a species, it is generally accepted that one specimen of each species is adequate. However, for taxa that are difficult to identify and for small organisms, additional specimens may be needed.

It is impossible to generalize as to how many specimens should be collected. See *Voucher Requirements*, sections 3.1, 4.1, ...7.1, for detailed recommendations. Inventory personnel must also discuss this issue with museum curators prior to field work.

## **2.3 Preparation and Care of Specimens**

### **2.3.1 Photo Documentation**

Photographs taken to provide documentation for species identification should be taken with a macro or close-up lens, and they should show features used for identification and scale of the photo. Photographs should be submitted with the pertinent raw data. It may be necessary to take more than one picture of one specimen from different angles.

Ensure that slides or prints are kept in appropriate protective sleeves. They should be returned to the photographer once species identification has been verified or arrangements made for them to be kept as part of a permanent species record.

### **2.3.2 Whole Specimens**

After specimens are collected, special care is needed to ensure that they will arrive at the museum in excellent condition. In general, to avoid decomposition, specimens should be prepared as soon as possible after collection, if not already done in the field (see taxon specific sections). Permissible time will vary with temperature and humidity conditions, however do not delay. Specimens that are not killed in the initial collection procedure, must be anaesthetized appropriately (see section 1.1). Methods vary with taxon.

It is important to note that methods may have to be varied to suit taxonomists who will be identifying the specimens. The reference section of this manual includes publications and reports that provide more complete details on collection, preparation and preservation of specimens.

**Note:** Specimens may not be accepted by the museum if they are not prepared properly (as outlined in relevant protocols).

## **2.4 Data Needs**

The value of a voucher specimen relies on and can be greatly enhanced by accurate and detailed data gathered at the time of collection. This section provides general guidelines and recommended data to be recorded along with voucher specimens. See appropriate taxa group for specifics.

### **2.4.1 Field Notebook**

Waterproof notebooks and indelible ink pens are recommended for use in the field. Although notebook set up depends on personal preference, legibility and clarity of entries are critical.

These must be unambiguous so that other people can read and understand what is written. It is crucial that general data such as habitat, date, and weather be associated with the appropriate specimens. It is recommended that the date and location be written at the top of each page, and when either changes, broad dividing lines be used to distinguish such changes. Avoid abbreviations, if they are used a key must be included in the field notebook or permanently attached to it. Also, if ditto marks are used then the information must be exactly the same.

## 2.4.2 Field Labels

Field labels should be written on waterproof paper (anonymous (undated) recommends Permafibre) in India ink or pencil. Labels and inks should be tested in water and the fixing/storage chemicals prior to going into the field. For specimens that are housed in jars or other containers, the labels should be placed inside, not on the outside. For specimens that can have labels attached directly to them, be sure that the labels are securely fastened.

## 2.4.3 General Data Requirements

Voucher data must be recorded in the field (preferably in a waterproof surveyors notebook). The order of notebook entries should approximate the label format being used for ease in label preparation and duplications, especially when label preparation will be done by someone other than the collector.

The absolute minimum voucher data that must be included is the field collection number, the date and a detailed location. Without these, specimens are virtually useless.

- **Field Collection Number:** A unique field label should be assigned to each specimen. A lifetime system is recommended rather than labels for each expedition or year. A label may look like "M.G. Shepard 2094" where the collector and number are unambiguous. The label may refer to either an individual specimen or a batch (a series of specimens collected at the same station on the same date, with the same background data). The collector must indicate clearly whether the label refers to an individual or a lot.
- **Collection Date:** Format for dates is YYYY/MM/DD. Note that four digits are used for the year. The time of collection may be useful for species that have activity patterns that change temporally.
- **Detailed Location:** It is important that the place of collection can be precisely located in the future. Include country, province, city, and gazetted location name. Location must include latitude and longitude or Universal Transverse Mercator (UTM) coordinates (use NAD83 when using a GPS or a 1:50,000 map), as precisely as can be calculated, plus a brief written description, noting elevation, as well as direction and distance from a conspicuous landmark.
- **Recommended Additional Data:** Many aspects of the specimen and its environment may be useful to record. Check with curators for suggestions to enhance the value of specimens.
  - **Collector name:** It is important to note the collector's name (full name is preferred, but initials and full surname should be included at minimum). This acknowledges this person and is useful when details need to be tracked should data be misplaced or additional information desired.

- **Habitat:** Basic descriptions of the collection area should be made in as much detail as is practical. Aspects that may be useful include vegetation, associated flora and fauna, altitude, cover, depth of collection, substrate, water temperature, pH, salinity, clarity, nutrient load, type of bottom, conductivity, current speed, light conditions and weather.
- **Collection method:** The method used to capture the specimen.
- **Mode of Acquisition:** How the museum acquired each specimen (gift, etc.).

**Note:** Specimens may not be accepted by the museum if they are not labelled properly. Specimens without the associated minimum data required can make a valuable voucher virtually useless.

#### 2.4.4 Identification of Specimens

Specimens will need to be identified and all data verified. A useful reference for species identification experts is *Directory of Experts in the Identification of BC Species*, compiled by H. Nadel (1996). This technical working paper (WP19) can be viewed online at: <http://www.for.gov.bc.ca/hfd/pubs/docs/wp/wp19.htm> or it can be ordered through Queen's Printers of Victoria (stock number: 7655000058) via their internet homepage: <http://www.publications.gov.bc.ca/> by searching under the Ministry of Forests.

### 2.5 Transportation of Specimens

Specimens should be stored and transported carefully to ensure that they remain in excellent condition. This may involve attention to such details as light conditions, dust, humidity, temperature, packing of containers, and transport of dangerous goods.

#### 2.5.1 Transport of Dangerous Goods

Federal Transport of Dangerous Goods regulations apply to the shipping of many chemicals such as formalin, ethanol and isopropanol and special shipping arrangements must be made with companies able to handle dangerous goods. The Chief of Biological Collections at the Royal British Columbia Museum (RBCM) can provide recommendations for shipping companies that are able to handle dangerous goods. Specimens must be shipped in adequately padded wooden, plastic or metal shipping containers to prevent damage to the specimens and leakage of preservative during normal handling.

#### 2.5.2 Containers for Liquid Storage

In the field use glass or plastic containers and be sure the lid is tightly sealed with the appropriate gaskets so that leakage of liquid or noxious fumes will not occur. Do not use metal containers which corrode and can stain specimens. Metal drums are most useful for large fish, but should be painted on the inside to prevent contact of fluid with metal. Preservatives should fill the entire container so that there is no air pocket. In rough transport the air pocket or bubble can slosh around and damage delicate specimens. If the curved sides of a bottle are likely to cause the specimens to be preserved in a curled position, place container on its side during fixation so that the specimens will be preserved in a straight position. Do not overcrowd the bottles, buckets or vats used. If preserved with ample room, fins and other appendages are more likely to be fixed in the preferred position.

## 2.6 Deposition Policy

### 2.6.1 Museum Accessioning

Museums must know in advance when to expect a collection and the size of the collection so that they can be ready to process the incoming specimens. Museum staff and inventory personnel should be in frequent contact to ensure the most efficient handling of specimens. A copy of any written reports and field notes associated with the voucher specimens should accompany the collection.

The recommended repository for the majority of taxa considered in this manual is the Royal BC Museum. The mandate of this institution includes “to collect, preserve and research the natural history of British Columbia” and has the required expertise to oversee the storage and management of biological collections and their related data.

The University of British Columbia may also be used as a repository for some of the taxa considered in this manual if the Royal BC Museum does not need or want to store them.

**Royal BC Museum**  
Chief, Natural History Collections,  
675 Belleville Street,  
PO Box 9815 Stn Prov Gov't  
Victoria, BC V8W 9W2

**University of British Columbia**  
6270 University Blvd.,  
Vancouver, BC V6T 1Z4

**Note:** Specimens may not be accepted by the museum if they are not collected, prepared, labelled and contained properly (as set out in this manual and as per other specifications required by the collection manager), or if sufficient funds have not been allotted to cover the cost of storing and maintaining them.

### 2.6.2 Museum Curation

The Royal BC Museum can provide curation services for voucher specimens. Specimen "curation" includes a) receipt of specimen and data, issue of Temporary Receipt Form; b) preservation of specimen; c) notification of curator for designation of specimen; d) accession of specimen, notification to donor of accession number and designation; e) preparation of specimen, label(s) attached to all pieces; f) specimens stored in collection; g) full data on a computerized database.

The following curation rates are given as a guideline for estimating the cost of incorporating voucher specimens into the collections at the Royal BC Museum. Rates will vary with expertise of staff, complexity of identification, etc.

#### **Curation Rates Per 6.5 Hours**

- Birds: 3 - 4 robin sized specimens
- Mammals: 0.5 - 5 specimens
- Amphibians: 25 - 35 specimens
- Reptiles: 25 - 35 specimens
- Fish: 25 - 35 specimens
- Terrestrial Invertebrates: 20 - 30 specimens

- Aquatic and Marine Invertebrates: 10 - 15 lots

### **2.6.3 Museum Storage**

Only voucher specimens collected to the standards outlined herein will be stored at the Royal BC Museum. Such storage will be for a minimum period of five years or such time as is negotiated between the collecting agency and the Royal BC Museum. Beyond this “voucher storage period” some specimens may become part of the Royal BC Museum’s permanent collection.

## **2.7 Material Specifications and Collection Costs**

### **2.7.1 Material Specifications**

As emphasized in the previous sections, specimens must be collected, prepared, labelled and contained properly to be accepted by the museum. For each taxon group you will find a section that describes the specific equipment required for preparing and storing specimens. It is very important that specified materials are used as this will ensure that specimens arrive at the museum in the appropriate form and will prevent re-doing specimens which wastes both time and money.

#### **Storage - General Information**

Wet specimens are stored in brasilicate glass jars, covered by a polyethylene lid with a polyethylene gasket. Oversize specimens are stored in plastic vats. The preserving fluid is isopropanol except in entomology where the preserving fluid is ethanol. A 45 gallon drum of 99% isopropanol is approximately \$280.00 and a 5 gallon pail of 95% ethanol is approximately \$100.00.

Dry specimens are pinned and stored in unit trays in cabinets (entomology), stored in Durphy boxes in Lane cases or are stored on shelving in Lane cases.

### **2.7.2 Costs**

At first glance, it may seem a simple matter to deal with specimens from an inventory project. Inventory personnel might collect samples, put the specimens in jars and ship them to a museum to handle. However, when examined in detail, it becomes apparent that the costs of collecting the organisms are just a fraction of the total financial picture. For example, Scudder (in press) calculated that for a sampling period of one night per week over seven months for terrestrial arthropods, processing and identifying only the moths caught (excluding other insects), would take one person approximately four months to accomplish!

Collection costs include not only the actual cost of collecting a specimen in the field, but the costs associated with preparing, storing and maintaining the collection. All these elements must be considered when making a budget.

**Note:**

- The museum may not accept specimens if sufficient funds have not been allotted to cover the cost of storing and maintaining them.
- Costs given in this document are estimates only (as of spring 1999).

## 3. Birds

### 3.1 Voucher Requirements

Generally, inventory projects do not include the collection of birds. Museum collections should be consulted as a bench mark for each inventory study. Species may be documented using one or more of the following:

- Visual or song identification by qualified observers. This is generally accepted for common species.
- Photographs and sound recordings.
- Complete written descriptions as found on BC Field Ornithologists Rare Bird Report Forms. These are routinely accepted for rare, unusual or hard to identify species.
- Mist netting, banding, marking and radio-telemetry for positive identification are options as well.
- Collecting a specimen to positively identify a species or subspecies or for further analysis (use this method only in specific cases – see below).

Proper provincial and federal permits will have to be secured if in anyway species are disturbed.

In some cases collecting of specimens may be considered the best way to positively identify species or subspecies or needed for further analysis. Natural history museums must first be canvassed to see what material has already been collected. If existing material is not available or adequate to meet the needs, advice on collecting should be sought from professionals. Provincial and federal authorities must be contacted for proper permits. If firearms are required all federal and provincial laws must be followed. Local law enforcement officers and Conservation Officers should be notified.

### 3.2 Data Needs

- Record information immediately at the time of observation.
- Standard data to be recorded are observer, species, subspecies, sex, age, number of birds, as well, exact dates and localities are very important - especially for specimens.
- Additional data is very useful such as map grid, latitude and longitude, UTM or GIS, ecoregion as described by Demarchi (1995, 1996), habitat description and detailed breeding information.
- In the case of captures or collected specimens total length, tarsus, wing span, exposed culmen, weight and wing cord are the standard measurements. Many other measurements and samples can be taken see Foster and Cannell (1990). Use standard and accepted abbreviations (Resources Inventory Committee 1998).

## 3.3 Preparation and Care of Specimens

### 3.3.1 Documentation of Field Observation

Birds that are considered rare or are seen outside their known range should be well documented. Listed below is the information found on the BC Field Ornithologists Rare Bird Report Form. Information should be phoned into the Rare Bird Alert hotline and field documentation sent to the local representatives. Other observers present are encouraged to submit their own report as well. For Rare Bird Alert (RBA) contacts phone: Vancouver (604) 737-3074; Victoria (250) 592-3381; Nanaimo (250) 390-3029.

*Data from the BC Field Ornithologists Rare Bird Report Form:* Species; Date and Time; Number of Birds/Sex/Age/Plumage; Name/Address/Phone # of person completing form; Others present; Location; Optical Equipment Used; Light Conditions/ Distance of Bird/ Duration of Observation; Description; Vocalizations (if any).

### 3.3.2 Whole Specimens

- As a partner and repository of specimens the Royal BC Museum should be contacted for guidelines on collecting, and preparation of natural history specimens.
- In general, voucher specimens are collected for the specific purpose of supporting some type of research or report. The Royal BC Museum is willing to hold the specimens in an unprepared state for as long as the researcher needs (for a storage fee) if that is all that is required by the researcher. At the end of the voucher contract the Royal BC Museum is free to use the specimens in whatever manner they see fit including disposing of them. Usually, only the skeleton is salvageable and the skin is discarded.

#### Storing specimens in the field

- Seal specimens individually in a ziplock type plastic bag with a field label as described in section 2.4.2 with the date, location, collector and field reference number.
- Keep specimens cold (ice packs in an insulated bag works well) and freeze as soon as possible. Dry ice in an insulated chest will last up to eight days in the field and can be used to refreeze the ice packs as well.
- Tissues may need to be taken in the field for mDNA analysis. Check with the lab where this work is to be done for preservation method.

#### Preparation

- In the case of birds it is best to prepare the specimens as soon after collection as possible to avoid freezer burn, etc. However, if the researcher has no need to have the specimens prepared then they can be left unprepared.
- The Royal BC Museum can be hired to do the specimen preparation. The Royal BC Museum can also provide identification and anatomical data from the preparation. Samples for DNA or amino acid analysis can be obtained if required along with any other special needs. In many cases it is safer for the preparation to be done at the Royal BC Museum as they have approved Class II biohazard facilities in place.
- Note that a taxidermist may or may not know how to prepare a museum quality study skin, as it is not something that a taxidermist would normally do.



### 3.4 Museum Accessioning

- It is necessary to arrange to have whole birds prepared as museum specimens for identification at the Royal BC Museum before field work is started.
- Deliver specimens to the Royal BC Museum in person to ensure that they do not thaw in transit. Thawed specimens may be unuseable.

**Royal BC Museum Contact:** Michael McNall, Ornithology Collections Manager  
Phone (250) 387-2927 Fax (250) 387-5674  
Email mmcnull@rbml01.rbcm.gov.bc.ca

### 3.5 Materials and Costs

- It is necessary to get an estimate of the cost to have birds prepared as museum specimens for identification before field work is started.
- The costs of preparing a bird is only partly based on the size of the bird but also on they type of bird. Some birds, owls for example, have very thin skins that tear easily. These are slower to do than some of the other birds. Others, such as sea birds, often have a lot of subcutaneous fat and are much slower to dry.
- The cost of preparing a bird will increase if the skeleton is to be prepared as a separate specimen.
- In general a preparator can do about five small birds (wrens) or three midsize birds (duck) or one large bird (heron) per day (not including skeleton preparation). The cost of a preparator for a day is \$225 per 7 hour day.
- The cost of housing should also be figured into the budget. Costs of cabinets and drawers and annual maintenance fees vary as to size and number of specimens.

**Table 1. Cost of materials associated with whole bird specimens.**

Item	Specifications	Cost (\$)
Durphy boxes	Small (skeleton & egg storage)	1.00 each
Durphy boxes	Medium (skeleton & egg storage)	1.50 each
Durphy boxes	Large (skeleton & egg storage)	2.00 each
Drawers	Small, 25 per case	65.00 each
Lane cases		958.00 each
glassware, gaskets, lids	for storage of unprepared wet specimens only	
Tubs	for storage of unprepared wet specimens only	18.75 each
Vats	for storage of unprepared wet specimens only	172.00 US each

### 3.6 References

American Ornithologists' Union. 1998. A.O.U. Check-list of North American birds. 7<sup>th</sup> ed. The Union, Washington, DC. 829 pp.

- Anderson, R.M. 1960. Methods of collecting and preserving vertebrate animals. 3rd ed., rev. Dept. Secretary of State, Ottawa , ON. Bull. / Nat. Mus. Can., Biological series No. 18, No. 69. 164 pp.
- Beltane, A.K. 1990. Bird study skin preparation. Draft Rep. Royal B.C. Mus. Victoria, BC. 23 pp.
- Campbell, R.W. N.K. Dawe, I. McTaggart-Cowan, J.M. Cooper, G.W. Kaiser, M.C.E. McNall. 1990. The birds of British Columbia, vols. 1 and 2. Royal B.C. Mus., Victoria, BC.
- Cannings, R.J. 1998. The birds of British Columbia: a taxonomic catalogue. Wildl. Bull. No. B-86. Min. Environ., Lands and Parks, Wildl. Br., and Resources Inventory Br., Victoria, BC. 243 pp.
- Demarchi, D.A. 1995. Ecoregions of British Columbia, 1:2 million Map, 4<sup>th</sup> ed. Min. Environ, Lands and Parks., Wildl. Br., Victoria, BC.
- Demarchi, D.A. 1996. Introduction to the ecoregions of British Columbia: Draft. British Columbia. Min. Environ, Lands and Parks., Wildl. Br., Victoria, BC.
- Foster, M.S., and P.F. Cannell. 1990. Bird specimens and documentation: critical data for a critical resource. *Condor* 92:277-283.
- Pyle, P. 1987. Identification guide to North American passerines: a compendium of information on identifying, ageing, and sexing passerines in the hand. Slate Creek Press, Bolinas, CA., 278 pp.
- Resources Inventory Committee. 1998. Vertebrates of British Columbia: scientific and English Names. Standards for Components of BC's Biodiversity No.2. Version 2.0. Min. Environ., Lands and Parks, Resources Inventory Br., Victoria, BC. 122 pp.

## 4. Mammals

### 4.1 Voucher Requirements

- Generally, inventory projects only include the collection of mammals when it is necessary for identification purposes. After identification has been determined, the voucher may be prepared as a museum specimen for their permanent collection, stored in an unprepared state for a time, or discarded. This will depend on the species collected, the condition of the specimen after identification, and what material has already been collected and preserved at the museum, etc.
- Whole specimens are not required for identification of species of large mammals. For small mammals and bats, particularly for the genera *Sorex*, *Tamias* and *Myotis*, whole specimens will likely be necessary for accurate identification. Contact the Royal BC Museum for specifics.
- When whole specimens are collected for identification purposes or are needed for further analysis, natural history museums must first be canvassed to see what material has already been collected. If existing material is not available or adequate to meet the needs, advice on collecting should be sought from professionals.
- When inventory methods involve trapping, the Royal BC Museum should be contacted to see whether they are interested in specimens from trap mortalities.
- See Table 1 below for details regarding suggested vouchers for inventory groups (listed in the order found in the Components of British Columbia's Biodiversity RIC manual series). If no voucher requirement is listed, then visual detection or identification from animal sign by qualified observers is considered adequate. When possible, photographs should be used to confirm observations.

**Table 2. Suggested vouchers for taxon-specific mammal inventories.**

Series #	Mammals	Suggested Vouchers
20	Bats	<ul style="list-style-type: none"> <li>• wing punch or whole specimens for easily misidentified species when capture is part of the inventory protocol (e.g. <i>Myotis lucifugus</i> from <i>M. yumanensis</i> and distinguishing between long-eared bats: <i>M. keenii</i>, <i>M. evotis</i>, and <i>M. septentrionalis</i>)</li> <li>• morphometric data, photographs, digital sonograms or cassette tapes with reference calls should also be collected as evidence of rare or endangered bats</li> </ul>
21	Bears	<ul style="list-style-type: none"> <li>• hair and scat can be collected for mitochondrial DNA analysis to determine species in areas that both black and grizzly bears occur</li> </ul>
22	Beaver & Muskrat	<ul style="list-style-type: none"> <li>• whole specimens not necessary</li> </ul>
23	Hare & Cottontails	<ul style="list-style-type: none"> <li>• whole specimens only if trap mortalities occur</li> </ul>

Series #	Mammals	Suggested Vouchers
24	Marten & Weasels	<ul style="list-style-type: none"> <li>whole specimens only if trap mortalities occur</li> <li>photographs if possible to distinguish between <i>Mustela</i> species or fisher and marten tracks</li> </ul>
25	Medium-Sized Territorial Carnivores - Wolverine, Coyote, Red Fox, Lynx, Bobcat, Fisher, and Badger	<ul style="list-style-type: none"> <li>photographs if possible to help record species occurrence and distinguish between species, e.g. between fisher and marten when tracks are used for inventory</li> </ul>
26	Moles & Pocket Gopher	<ul style="list-style-type: none"> <li>whole specimens only if trap mortalities occur</li> </ul>
27	Mountain Beaver, Woodrat, and Porcupine	<ul style="list-style-type: none"> <li>whole specimens only if trap mortalities occur</li> </ul>
29	Pikas & Sciurids	<ul style="list-style-type: none"> <li>whole specimens only if trap mortalities occur</li> </ul>
31	Small Mammals - Shrews, Voles, Mice, Rats and Lemming	<ul style="list-style-type: none"> <li>3 of each species: 1 of each sex (if sexes are distinguishable) and the 3<sup>rd</sup> a juvenile (of either sex) is preferred, especially if there is much difference from the adults.</li> <li>Specimens are particularly important for the difficult to distinguish genera: <i>Sorex</i> and <i>Tamias</i>.</li> </ul>
32/33	Aerial-based / Ground-based Inventory Methods for Selected Ungulates	<ul style="list-style-type: none"> <li>whole specimens not necessary</li> </ul>
34	Wolf & Cougar	<ul style="list-style-type: none"> <li>whole specimens not necessary</li> </ul>

## 4.2 Data Needs

Enclose a field label with each specimen as described in section 2.4.2 with the collection date, location, collector's name and field collection number.

## 4.3 Preparation and Care of Specimens

### 4.3.1 Hair Samples

- Hair capture sites should be checked carefully to ensure that all hairs are collected.
- A sheet of white reflective plastic can be run under the wire etc., so that the hairs are more visible.
- Place each hair sample (i.e., all the hair from one barb) in a separate envelope which is marked with the site sample number. All hair sample envelopes from one site should be put in a large envelope.
- Record site sample details in a field notebook.
- Hair samples and envelopes can be dried and stored in a freezer (Woods *et al.* 1996, Gibeau and Herrero 1996) or dried and stored in a cool, dry place.
- Send samples to a laboratory that specializes in DNA analysis from hair to obtain species identification. Note that results from different labs may vary, thus all samples from one project should be sent to the same lab.

### 4.3.2 Tissue Samples

- Seal specimens individually in a ziplock type plastic bag with a field label as described in section 2.4.2 with the date, location, collector and field reference number. Keep bats

and *Peromyscus* tissue separate from other specimens so that only they need to be treated with extra caution.

- Keep specimens cold (ice packs in an insulated bag works well) and freeze as soon as possible. Dry ice in an insulated chest will last up to eight days in the field and can be used to refreeze the ice packs as well.

### **4.3.3 Whole Specimens**

- Currently the Royal BC Museum is the only facility in the province with the necessary biohazard equipment and staff trained to prepare whole small mammals as museum specimens for identification. Because of the health risks and because of the need to meet museum standards for prepared specimens it is recommended that this work be done by the Royal BC Museum. It would be necessary to arrange to get this work done at the Royal BC Museum before field work is started.
- The Royal BC Museum is also willing to hold specimens in an unprepared state for as long as a researcher needs (for a storage fee) if that is all that is required by the researcher. At the end of the storage period the Royal BC Museum is then free to use the specimens in whatever manner they see fit including disposing of them.

### **Collecting**

Care should be taken in handling fresh small mammals and their traps because of disease hazards. Rabies risks are covered by the mandatory RIC Bat Inventory training course. It is strongly recommended that the RIC Small Mammal Inventory training course be taken as well to cover methods of dealing with the risk from Hanta virus (in *Peromyscus*) and plague.

### **Killing**

- To kill small mammals humanely place them in a sealed container with a cotton ball soaked with Isoflurane (available from veterinary suppliers) for about 10 minutes.

### **Storing specimens in the field**

- Seal specimens individually in a ziplock type plastic bag with a field label as described in section 2.4.2 with the date, location, collector and field reference number. Keep bats and *Peromyscus* separate from other specimens so that only they need to be treated with extra caution.
- Keep specimens cold (ice packs in an insulated bag works well) and freeze as soon as possible. Dry ice in an insulated chest will last up to eight days in the field and can be used to refreeze the ice packs as well.
- Fluid preservation of small mammals is not recommended because it is not possible to see coat colours and because it roughly doubles the preparation time and cost. In an emergency, where freezing is not possible, specimens can be fixed in 10% formalin or in 95% ethanol.
- Tissues may need to be taken in the field for mDNA Analysis. Check with the lab where this work is to be done for preservation method.

### **Preparation**

- In the case of mammals it is best to prepare the specimens as soon after collection as possible to avoid freezer burn, etc. However, if the researcher has no need to have the specimens prepared then they can be left unprepared.

#### 4.4 Museum Accessioning

- It is necessary to arrange to have whole small mammals prepared as museum specimens for identification at the Royal BC Museum before field work is started.
- Deliver specimens to the Royal BC Museum in person to ensure that they do not thaw in transit. Thawed specimens may be unuseable.

**Royal BC Museum Contact:** Lesley Kennes, Registrar and Mammal Collection Manager  
Phone (250) 387-1216 Fax (250) 387-5360  
Email lkennes@rbml01.rbcm.gov.bc.ca

#### 4.5 Materials and Costs

- It is necessary to get an estimate of the cost to have whole small mammals prepared as museum specimens for identification from the Chief of Collections at the Royal BC Museum before field work is started.
- Specimens submitted to the Royal BC Museum will be prepared as standard round study skins and skulls. Extra preparation may be needed for identification depending upon taxonomic group such as X-rays, tissue samples and mDNA analysis, or genital bone preparation. The current charge for preparation of a small mammal varies from about \$80.00 to \$150.00 depending on the preservation state of the specimen and the amount of extra preparation.
- The cost of housing should also be figured into the budget. Annual storage fees are based on the amount of cabinet space used to store the vouchers. This will vary as to size and number of specimens.

**Table 3. Cost of materials associated with whole mammal specimens.**

Item	Specifications	Cost (\$)
Durphy boxes	Small	1.00 each
Durphy boxes	Medium	1.50 each
Durphy boxes	Large	2.00 each
Drawers	Small, 25 per case	65.00 each
Drawers	Large, 10 per cabinet	75.00 each
Trays	Polyethylene trays for small mammals, (8 fit per drawer)	7.90 + tax each
Lane cases		958.00 each
Mammal case	Large	2,399.50 each

#### 4.6 References

Gibeau, M., and S. Herrero. 1996. Grizzly bear population estimate for the Banff/Kananaskis Region; 1996 field season plan. Eastern Slopes Grizzly Bear Research Project, Calgary, AB 4 pp.

Nagorsen, D.W. 1990. The mammals of British Columbia. A taxonomic catalogue. Royal BC Mus., Memoir No. 4.

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- Nagorsen, D.W., and R.M. Brigham. 1993. Bats of British Columbia. Roy. BC Mus. Handb., Victoria, BC.
- Woods, J.G., B.N. McLellan, D. Paetkau, M. Proctor, P. Ott and C. Strobeck. 1996. Census techniques for bears. West Slopes Bear Research Project, Revelstoke. 10 pp. Draft discussion paper.

# 5. Amphibians & Reptiles

## 5.1 Voucher Requirements

The identification of most species of amphibians and reptiles can be adequately confirmed from photographs (provided that diagnostic features are clear), so collecting is not required during inventory projects for identification purposes. Concern for declining populations of several species of amphibians necessitate that communication between involved agencies occurs before any collecting is done. Generally, collections should not be made unless there is a need for tissue, i.e. DNA work, disease analysis.

### Diversity Inventory

A photograph (showing diagnostic features) of each amphibian or reptile species encountered should be taken to provide documentation of identification.

### Directed Inventory

If collecting is required to obtain tissue for a project, then the number to be collected must be determined on a project to project basis. Consult the research technicians at the lab you will be working with to determine how much tissue will be required.

## 5.2 Data Needs

- Required Data Fields
  - Field collection number (Collector's number); Collector's name; Collection date; Detailed location (gazetteered location name as well as Latitude and Longitude or UTM; Elevation (m); Genus; Species; Identifier; Date of identification; Sex; Age; Snout to vent length (cm or mm); Collection method (capture method).
  - Enter sample data including location and physical site information and specimen data including taxonomy and number of collections separately (both data sets can later be linked by the collector's number).
  - Use a .dbf file format to record data digitally.
- Labels
  - Write data in dark pencil onto appropriately sized label paper.
  - Minimum label data required: Field collection number; Collection date; Genus; Species; Location description; Latitude / Longitude or UTM.

## 5.3 Preparation and Care of Specimens - Amphibians

### 5.3.1 Photographs

- Photographs of amphibian species encountered should be taken with a macro or close-up lens, and they should show features used for identification.
- Photographs should be submitted with the pertinent raw data.
- It may be necessary to take more than one picture of one specimen from different angles.



### 5.3.2 Whole Specimens

#### Killing

- Amphibians are most efficiently killed by immersing them into a solution of chloretone, made by dissolving a few grains of hydrous chlorobutanol crystals (available at a pharmacy or through Fisher Scientific) in a litre of water.

#### Fixing

- Use a container with a tight fitting lid. (A "Tupperware" type plastic container approximately 33 x 21 x 6 cm works.)
- Line the bottom with a white paper towel or cheesecloth soaked in 10% buffered formalin and position the animal so measurements can easily be taken and examined for key features. Formalin penetrates the body cavity of small amphibians quickly but large frogs and salamanders will require injections into the gut, body cavity and large muscle masses.
- When the floor of the tray is covered with specimens, blanket them with a second paper towel wet with formalin and carefully fill the tray with formalin to about one third its depth. Be sure that labels with field data are assigned to the proper specimen. Most specimens will have hardened enough to maintain their shape after a few hours.
- Attach field tags to the specimens. The tags should be tied with a square knot above the knee on the right rear leg of frogs and large salamanders and around the neck of small salamanders. Larvae should be placed in small vials with buffered formalin.
- Transfer specimens to a jar where they are immersed in 10% buffered formalin.
- Larvae should be placed in small vials with 10% buffered formalin. A field label should be put into the vial and another field label should be attached by a string and tied to the vial under the lid.
- Amphibian eggs require special care, as they are easily damaged. Single, short strings or small clumps of aquatic eggs can be placed directly into small bottles or vials of 10% buffered formalin.

## 5.4 Preparation and Care of Specimens - Reptiles

### 5.4.1 Photographs

- Photographs of reptile species encountered should be taken with a macro or close-up lens, and they should show features used for identification.
- Photographs should be submitted with the pertinent raw data.
- It may be necessary to take more than one picture of one specimen from different angles.

### 5.4.2 Whole Specimens

#### Anaesthetizing

- Reptiles may be killed by injecting them with the anaesthetic Nembutal, diluted 1:5 to 1:10 depending on the size of the specimen. Specimens die quickly and are ready for fixing. Muscle contractions and kinking may occur if too much is injected.
- Ether is another method of killing reptiles. Place a cotton swab soaked in ether in a covered container and insert the animal.

## Fixing

- Reptile skin inhibits preservatives from entering the body quickly enough to prevent rotting, so injections must be used.
  - Small lizards should either be injected with 10% buffered formalin into the body cavity or have a cut made on the left ventral (underside).
  - Larger lizards should be injected with 10% buffered formalin in each leg segment and at the base of the tail just underneath the skin.
  - Snakes should be injected with 10% buffered formalin at three or four points between the snout and vent. The tail is injected separately. The hemipenes should be everted and tied off.
  - Turtles should have the head and neck extended from the shell and a piece of wood or plastic put into the mouth to keep the jaws open. With the snout up 10% buffered formalin should then be injected into the neck, limbs, tail and deep into the body cavity and lungs to keep the specimen from floating in the preservative.
- Place specimens into a hardening tray which can be a plastic container with a tight fitting lid approximately 33 x 21 x 6 cm. Line the bottom of the tray with white paper towels or cheesecloth that have been soaked in 10% buffered formalin solution. The specimens should be positioned in a way which allows key features to be seen readily, the maximum number of measurements to be obtained and permits placement in a bottle.
- Cover specimens with a layer of paper towels soaked in formalin. Carefully fill the tray with formalin to about one third its depth. Keep track of the animals in the tray so that the correct label with field data is assigned to the proper individual. Most reptiles require soaking for several hours or overnight in the hardening tray.
- When the specimens are hardened, remove them from the tray and tie on their field tags. Snakes should have their tags sewn on.
- Reptile eggs may be put directly into a vial or bottle of 10% buffered formalin. Large eggs should be injected with a 10% buffered formalin.

## 5.5 Museum Accessioning

The collection manager at the museum needs to know approximately when the voucher specimens are to arrive. Close contact should be maintained to ensure efficient handling of the specimens. Any interim reports or field notes must accompany the voucher collection upon arrival.

**Royal BC Museum Contact:** Kelly Sendall, Invertebrate Zoology Collection Manager  
Phone (250) 387-2932 Fax (250) 387-5360  
Email ksendall@rbml01.rbcm.gov.bc.ca

## 5.6 Materials and Costs

Table 4. Materials associated with preparing whole amphibian and reptile specimens.

Item	Specifications	Supplier
Jars	125ml, dim. 51 x 102mm Cat. No. 21749	Anechemia, Richmond, BC
	250ml, dim. 62 x 127mm Cat. No. 21750	Anechemia, Richmond, BC
	500ml, dim. 76 x 145mm Cat. No. 21751	Anechemia, Richmond, BC
Lids	48mm for 125ml jar (1300/box)	Lukian Plastic Closures, Oakville, ON
	58mm for 250ml jar (1800/box)	Lukian Plastic Closures, Oakville, ON
Liners	polyethylene, 45mm for 125ml jar	Premo Plastics, Victoria, BC
	polyethylene, 54mm for 250ml jar	Premo Plastics, Victoria, BC
Fixative	37% formaldehyde	Northwest Labs, Victoria, BC
Preservative	95% ethanol (not denatured)	Stanchem, Vancouver, BC
Label Paper	78 lb. Permafibre	Coast Paper, Vancouver, BC

## 5.7 References

Heyer, W.R., M.A. Donnelly, R.W. McDiarmid, L.C. Hayek and M.S. Foster, eds. 1994. Measuring and monitoring biological diversity, standard methods for amphibians. Smithsonian Institution, Washington, DC. 364 pp.

Simmons, J.E. 1987. Herpetological collecting and collections management. Society for the Study of Amphibians and Reptiles. Herpetological Circular #16. Univ. Texas. 70 pp.

## 6. Fish

### 6.1 Voucher Requirements

Requirements for fish collection follows the RIC standard entitled *Fish collection methods and standards* (RIC 1997). Note that slight changes and updates to this manual have been made and published in an errata for this manual (see reference section).

- Voucher specimens are representative samples of species identified in the field, collected and preserved to verify the field identification.
- Only one representative sample of each red/blue-listed species should be collected.
- For species that are neither rare nor endangered, two to three specimen can be collected. These specimen should represent the size variability encountered at the sampling site.
- Any mortalities that occur during fish capture for sampling can be submitted as voucher specimens.

### 6.2 Data Needs

- Required Fields: Collector's number (field number); Collector's name; Collection date; Detailed location (gazetteered location name as well as Latitude and Longitude (or UTM); Elevation (m) and/or depth (m); Genus; Species; Identifier; Date of identification; Collection method (capture method).
- Minimum label data required: Collector's number; Collection date; Genus species; Location with Latitude and Longitude or UTM.

### 6.3 Preparation and Care of Specimens

Protocol for fish collection and specimen preservation should follow the RIC standard entitled *Fish collection methods and standards* (RIC 1997). Note that slight changes and updates to this manual have been made and published in an errata for this manual.

### 6.4 Museum Accessioning

- Requirements for fish specimen collection and standards for submission must follow the RIC standard entitled *Fish collection methods and standards* (RIC 1997). The chapter on fish preservation techniques, is extremely useful.
- Samples should be sent by prior arrangement to the Ichthyology Collection, Royal BC Museum.

**Royal BC Museum Contact:** Kelly Sendall, Invertebrate Zoology Collection Manager  
Phone (250) 387-2932 Fax (250) 387-5360  
Email ksendall@rbml01.rbcm.gov.bc.ca

## 6.5 Materials and Costs

**Table 5. Materials associated with preparing whole fish specimens.**

Item	Specifications	Supplier
Jars	125ml, dim. 51 x 102mm Cat. No. 21749	Anechemia, Richmond, BC
	250ml, dim. 62 x 127mm Cat. No. 21750	Anechemia, Richmond, BC
	500ml, dim. 76 x 145mm Cat. No. 21751	Anechemia, Richmond, BC
Lids	48mm for 125ml jar (1300/box)	Lukian Plastic Closures, Oakville, ON
	58mm for 250ml jar (1800/box)	Lukian Plastic Closures, Oakville, ON
Liners	polyethylene, 45mm for 125ml jar	Premo Plastics, Victoria, BC
	polyethylene, 54mm for 250ml jar	Premo Plastics, Victoria, BC
Fixative	37% formaldehyde	Northwest Labs, Victoria, BC
Preservative	95% ethanol (not denatured)	Stanchem, Vancouver, BC
Label Paper	78 lb. Permafibre	Coast Paper, Vancouver, BC
Vats	can hold 4-40 jars	Ecotainer Sales Inc. (604) 535-7293
Tubs		Custom Plastics, Vancouver, BC (604) 879-2991

## 6.6 References

Resources Inventory Committee. 1997. Fish collection methods and standards. Version 4.0. Min. Environ., Lands and Parks, Fish Inventory Unit, Victoria, BC.

The above publication is available on the RIC webpage at:  
<http://www.for.gov.bc.ca/ric/Pubs/Aquatic/fishcol/index.htm>

Peden, A.E. 1976. Collecting and preserving fishes. Museum Methods Manual #3. Royal B.C. Mus., Victoria, BC. 24 pp.

# 7. Terrestrial Arthropods

## 7.1 Voucher Requirements

Ideally all specimens should be submitted as vouchers. All prepared specimens should definitely be deposited. Insect taxonomy is still very 'cloudy' and a species today may be 20 species tomorrow. As well, if the specimens have been prepared, it is better to use them and keep them in good condition. The Royal BC Museum can always make the decision to high-grade them or donate them to another collection. Specimens not identified to species should be submitted as well. These can sometimes turn out to be the most important specimens found in a project. Minimum requirements are listed below.

### Diversity Inventory

- 6 specimens of each species, one of which is fully sorted and identified, mounted and labelled.
- Broad-brush survey: sorted by family. Subsequent work and distribution of specimens at discretion of project proponent and Royal BC Museum curator.

### Directed Taxa Inventory

- Fully sorted and represented specimens identified to species, mounted, and labelled. Collect 3 of each sex (if relevant and possible) or a total of 6. If it is not possible to identify to species, then only list to genus in the final report so that taxonomic refinements can be made.
- Incidentals should be sorted by family or order and stored in alcohol or their future be discussed with the Royal BC Museum curator.

## 7.2 Data Needs

The Royal BC Museum has standards for the type of label paper and sizes of labels for use on specimens either pinned or stored in vials, etc. This helps to avoid having to re-do the labels for each specimen submitted to the museum.

- Pinned specimens: Labels should not exceed 15 x 7 mm and 3 to 4 pt. text should be used.
- Specimens in alcohol: Labels should not exceed 50 x 50 mm and should have sample code written with India ink.
- Specimens in envelopes: Labels inside envelopes should be card-sized (3 x 5 cm).
- Note: All labels must be printed on acid free cotton rag 70-80 lb.

Minimum data requirements for all specimens is the location, date and collector's name.

## 7.3 Preparation and Care of Specimens

Specimen preparation is crucial. Incorrect or careless mounting or preserving of a specimen can greatly reduce its scientific value. Techniques used for proper preparation vary greatly depending on taxon, medium used to collect and preserve specimens and taxonomic expertise enlisted to do identifications. *The Insects and Arachnids of Canada* (Martin 1977) is accepted as the standard for collecting, preparing and preserving specimens. See the reference section for instructions to obtain this document. However, as most specimens will be sent to taxonomists/systematists across North America and Europe, specimen preparation will be governed by the identifier. Resources Inventory Committee (1998) recommends that a list of taxonomic help with specifications for sample preparation be established before the inventory is initiated.

Unless otherwise specified, Martin (1977) should be used as the standard for the Royal BC Museum collections. Page numbers for specific sections refer to Martin (1977).

### 7.3.1 Identification

- A widely used key for basic insect identifications to family is Borror, DeLong and Triplehorn (6<sup>th</sup> ed.) 1989. *Introduction to the study of insects*. Spider identification - Kaston 1972; Myriapod identification - Kevan and Scudder 1989.
- Keys in *Manual of Nearctic Diptera*, volume 1 (McAlpine *et al.* 1981), and volume 2 (McAlpine *et al.* 1987) may also be used for Diptera.
- Standards for species names:
  - Orthopteroid insects - Vickery and Kevan 1985
  - Lepidoptera (except butterflies) - Hodges, R.W. *et al.*, ed. 1983
  - Butterflies - Layberry *et al.* 1998
  - Hymenoptera - Krombein *et al.* 1979
  - Coleoptera - Bousquet 1991
  - Odonata - Walker 1953; 1958; Walker and Corbet 1975
  - Diptera - Stone *et al.* 1965

### 7.3.2 Equipment and Methods for Collecting

Topic	Page reference
1. Nets	11
2. Traps	15
3. Other	33
4. Aspirator	43
5. Soil sampling	47
6. Aquatic traps	57
7. Vertebrate ectoparasites	67
8. Killing bottles	73

Note: Cyanide compounds should not be used; they are extremely poisonous, and adequate killing agents, which are more easily obtained and more simply prepared, are available. Use ethyl acetate, soapy water, or freezing.

### 7.3.3 Equipment and Methods for Preserving and Mounting

Topic	Page reference
1. Relaxing	79
2. Cleaning	79
3. Temporary storage	82
4. Pinning and mounting	85
5. Liquid preservation	98
6. Microscopical preparations	102

### 7.3.4 Preparation Methods - General

See the section *Applying the Methods*, starting on page 124 (Martin 1977) for protocols for a particular taxa. Information specific to Odonata (dragonflies) is provided below.

### 7.3.5 Preparation Methods - Odonata

#### Collecting

- Use a long-handled aerial net. A net opening of at least 18" is recommended. Some collectors feel that a dark net bag (black or green) is less conspicuous and thus is more effective than a white one.
- Observing patrolling dragonflies before swinging away often pays; positioning yourself in the most advantageous location, especially if it is somewhat concealed, is usually fruitful. Move deliberately. Refrain from waving the net around; keep it as inconspicuous as possible.
- Swing at fast-flying, agile species from behind as they fly by; many will easily dodge a net swung head-on.
- When a specimen is captured, place it alive in a glassine envelope (available in several sizes - the most useful is 3.5" x 2.25" - at stamp-collector stores). The wings should be together above the back. Place pairs caught in tandem or in copula in the same envelope if possible. If they are too large to go together in a single envelope, make certain that the fact they were mating is indicated on both envelopes. The collecting data must be written on the envelope in pencil or India ink or other ink that is insoluble in acetone (if the acetone treatment described below is used).

#### Preparation

- While in the field keep the envelopes containing live dragonflies in as cool a place as possible. Store them in a non-crushable box. Tupperware boxes of the proper size are excellent for this purpose.
- The colour pattern of some species (e.g. *Aeshna eremita*, *A. constricta*, *A. canadensis*) fades somewhat soon after capture. If possible, such species should be treated in acetone immediately.
- Acetone treatment: this chemical dehydrates the specimen and dissolves fat, reducing the decomposition of colour pigments. All handling of acetone should be done outdoors or in a fume hood, the fumes are toxic.
  - The acetone is kept in a wide-mouth glass jar or other container inert to the solvent. The wider the mouth, the better. Ensure the lid is leak-proof. Acetone can be purchased at any hardware store.



- Kill the dragonfly before inserting the envelope into the jar. This can be done by placing a few drops of ethyl acetate in the envelope. As soon as the insect is dead, the abdomen should be straightened and the envelope containing the dragonfly should be immersed in the acetone. If no poison is available, the envelope and dragonfly can be placed in the acetone, killing the dragonfly. However, if this is done, the envelope will have to be removed from the jar after a minute or so, and the abdomen straightened if necessary, before replacing the envelope in the acetone. Otherwise, acetone-killed dragonflies will have curled abdomens, which are difficult to measure.
- Leave the dragonflies in the acetone for at least 24 hours. The usual procedure is to take the envelope out for drying when the next day's catch is ready to go into the jar(s). The acetone should be replaced after four or five uses; yellowish acetone indicates a change is necessary.
- Drain acetone out of the envelopes and dry them in a well-ventilated place.
- When the envelopes are dry they are stored in tupperware or cardboard boxes that will withstand crushing. Store the envelopes vertically, like a card file.
- Specimens can be shipped by mail in this manner. Simply make certain the box is nested in a larger box, protected on all sides by 7.5-10 cm of packing material.
- Federal Transport of Dangerous Goods regulates the shipping of acetone and so it is best to get it after you arrive at your destination. Take the necessary jars or containers with you though, as it is may be hard to find a good jar with the right dimensions.
- If you cannot use acetone, simply dry the specimens as rapidly as possible after they have been killed. Placing the boxes containing specimen envelopes at close range over or under electric lights is helpful. The faster the drying occurs, the better the colour preservation.
- Another alternative is storage in 95% ethanol either in or without envelopes. If envelopes are not used, specimens can later be removed from the alcohol and dried in envelopes in the correct position. Both air drying (above) and ethanol treatment are less desirable than the acetone treatment.

### **Preservation and Documentation**

Once specimens are brought to Royal BC Museum, they are removed from the glassine envelopes and store permanently in mylar envelopes (see below). Each mylar envelope contains only one specimen. Collection data are entered on computer and are printed out using a laser printer in a standard format (see below). The sheet is then cut into the proper labels (usually 3 from each page) and the labels are inserted in the envelopes behind the specimen. Any original determination labels are retained in the envelope behind the label. The envelopes are then stored vertically in cabinet drawers, much like a card file.

Mylar envelopes: The envelopes are made of Mylar with a mono-molecular coat of cellophane, which allows heat sealing of the edges. The envelopes were originally designed by the Royal BC Museum and custom made by University Products, MA. University Products now carries them as a stock item in their catalogue.

Labels: Printed on 8 ½" x 11" acid free heavy paper stock. This can be obtained from Crown Paper, Saanich, BC. Product #SRC 11433036, Curtis Britewater Text, 80 WT, 23" x 35" cut to 11" x 8 ½".

## 7.4 Museum Accessioning

- Specimens should be properly mounted, labelled, and identified before being submitted to the Royal BC Museum.
- Specimens must also be entered into a database. A database of specimens collected is vital to collection management, distribution mapping, and so on. This database can be prepared by the project proponent (best) or can be done later at cost. If the database is prepared outside the museum, it is recommended that the Royal BC Museum database program/fields are used.
- If bulk samples were collected in alcohol, they should be stored in alcohol. Their future should be discussed with the relevant museum curator.

**Royal BC Museum Contact:** David Blades, Entomology Collection Manager  
Phone (250) 387-9424 Fax (250) 387-5360  
Email dblades@rbml01.rbcm.gov.bc.ca

## 7.5 Materials and Costs

Costs for database entry and for storage materials (vials, cabinets) should be built into project budget at the outset. Storage of a single project is not likely to occupy a whole cabinet so the cost for the cabinet portion used is normally determined. The Royal BC Museum's standards for vials, pins, cabinets, etc. are certain products sold by BioQuip Inc. (see list below). [BioQuip Inc., 17803 LaSalle Ave., Gardena, CA, USA 90248; Phone: (310) 324-0620; Fax (310) 324-7931].

**Table 6. Materials associated with preparing terrestrial arthropod specimens.**

Order #	Item	Cost in 1999 (US funds)
2525TAN	Cornell University System Cabinets	\$842.00 each
1012AM	Cornell Drawers (25 per cabinet)	\$36.00 each
1025AA	Cornell Unit Pinning Trays	\$2.33 each
1025A	Cornell Unit Pinning Trays	\$1.38 each
1025B	Cornell Unit Pinning Trays	\$1.05 each
1025C	Cornell Unit Pinning Trays	\$0.78 each
8804P	Screw cap vials with caps with Polyseal lining	\$4.55/dozen
8806P	Screw cap vials with caps with Polyseal lining	\$5.40 / dozen
1202S	Series Insect Pin, stainless, pack of 100	\$8.50 / 100

## 7.6 References

Borror, D.J., C.A. Triplehorn and N.F. Johnson. 1989. An introduction to the study of insects. 6th ed. Philadelphia, Saunders College Pub., 875 pp.

Bousquet, Y. 1991. Checklist of beetles of Canada and Alaska. Ottawa, Canada: Agric. Can.: Canada Communication Group.

Hodges, R.W. *et al.*, ed. 1983. Check list of the lepidoptera of America North of Mexico. E.W. Classey Limited and The Wedge Entomological Research Foundation, London. 284 pp.

Kevan, D.K.McE., and G.G.E. Scudder. 1989. Illustrated keys to the families of terrestrial arthropods of Canada. Ottawa, Biological Survey of Canada.

Krombein, K.V. 1979. Biosystematic studies of Ceylonese wasps, V: a monograph of the ampulicidae (hymenoptera: sphecoidea). Washington, Smithsonian Institution Press, 29 pp.

Layberry, R.A., P.W. Hall and J.D. Lafontaine. 1998. The butterflies of Canada. Univ. Toronto Press Incorp., Toronto, ON. 280 pp.

Martin, J.E.H. 1977. The insects and arachnids of Canada, part 1: collecting, preparing and preserving insects, mites, and spiders. Can. Dep. Agric., Publ. 1643. 182 pp.

Martin (1977) can be ordered through Canadian Government Publishing. Its catalogue order number is A42-42-1977-1 and it costs \$3.50 + tax + shipping & handling. Contact information:

- Toll free: Phone: 1-800-635-7943      Fax: 1-800-565-7757
- Immediate ordering service: Phone: (819) 956-4800 or Fax: (819) 994-1498
- Mail orders: Canadian Government Publishing, Ottawa, ON, K1A 0S9
- Internet e-mail: [publications@pwgsc.gc.ca](mailto:publications@pwgsc.gc.ca)
- Visa and MasterCard orders: Fax: 1-800-565-7757.

Publication listings can be found on their Internet site at: <http://publications.pwgsc.gc.ca>. At this Government of Canada webpage go to "Canadian Government Publishing", then Search by subject, and choose "Natural Sciences". The title *The Insects and Arachnids of Canada* will be listed. Instructions will advise you to call 1-819-956-4800 to receive a free copy of the Agriculture catalogue for a complete listing of titles. Cat. No. P62-40-1-1994E.

McAlpine, J.F., B.V. Peterson and G.E. Shewell, eds. 1981. Manual of nearctic diptera: Vol.1. Monograph No. 27. Res. Br., Agric. Can.

McAlpine, J.F., B.V. Peterson and G.E. Shewell, eds. 1987. Manual of nearctic diptera: Vol.2. Monograph No. 28. Res. Br., Agric. Can.

Resources Inventory Committee. 1998. Inventory methods for terrestrial arthropods: Standards for Components of BC's Biodiversity, No. 40. Version 2.0. Min. Environ., Lands and Parks, Resources Inventory Br., Victoria, BC. 68 pp.

Scudder, G.G.E. 1994. An annotated systematic list of the potentially rare and endangered freshwater and terrestrial invertebrates in British Columbia. Victoria, BC. Entomological Society of British Columbia, 92 pp.

- Vickery, V.R., and D.K.McE. Kevan. 1985. The grasshoppers, crickets, and related insects of Canada and adjacent regions: Ulonata: Dermaptera, Cheleutoptera, Notoptera, Dictuoptera, Grylloptera, and Orthoptera. Ottawa, Res. Br., Agric. Can., 918 pp.
- Walker, E.M. 1953. The odonata of Canada and Alaska. Toronto, Univ. Toronto Press, ON.
- Walker, E.M. 1958. The odonata of Canada and Alaska. Toronto, Univ. Toronto Press, ON. 318 pp.
- Walker, E.M., and P.S. Corbet. 1975. The odonata of Canada and Alaska. Toronto, Univ. Toronto Press, ON.

## 8. Aquatic and Marine Invertebrates

### 8.1 Voucher Requirements

#### Diversity Inventory

- Submit at least one specimen for each species collected per locality. All species from a single collection locality should be divided into lots and placed in glass jars. A lot consists of one or more specimens of one taxonomic level identified in the associated report, from a single locality. If identified to species, each vial or jar should contain only one species from one locality. In the case of very small organisms, it is preferable to submit more than one specimen of each species.
- Microscope slides may be submitted as vouchers for some taxa providing they are permanent mounts and the specimen can be identified from the slide.

### 8.2 Data Needs

- Required data fields: Field collection number; Collector; Collection date; Location (gazetteered name and Latitude and Longitude or UTM); Elevation (m) and/or depth (m); Collection method (capture method); Genus; Species; Determiner; Determination date.
- Label data required: Field collection number; Collection date; Genus; Species; Location with Latitude and Longitude or UTM.
- All specimens should have taxonomic data with identification to the lowest level possible using available keys and ability of collector. Confirmations are preferred. Taxonomic data should include:
  - Order
  - Family
  - Genus
  - Species
  - Species Authority (e.g., Scheltema, 1997)
  - Determiner name (person who identified the specimen)
  - Determination date (year, month, day)
  - Age (adult, larva, juvenile, egg)

### 8.3 Preparation and Care of Specimens

For detailed protocol see Green and Lambert (1994).

#### Killing and Fixing

- Anaesthetize soft bodied invertebrates to prevent contraction and distortion of specimens. As this method changes drastically depending on taxa, contact the Royal BC Museum's collection manager for details on relaxing the animals that are to be collected.
- Sort specimens as far as possible and place in appropriate sized jars. Pack specimens loosely so that fixative can freely circulate (approximately space use, 30% specimen and 70% fixative).

- Fix specimens in neutralized 10% buffered formalin. The length of time that specimens should be fixed varies with the size of the specimen. Each major taxon of invertebrates requires a special method that is ideal for that group. Ethanol (70%) can also be used depending on taxa. See references listed below for details.
- Sponges should not be fixed in formalin because the silicious spicules of Hexactinellida will dissolve. Use 70% ethanol instead.
- Place a field label in the jar. Each label must have the field collection number, date, descriptive location and location coordinates (latitude/longitude or UTM) as a minimum.
- For zooplankton, disconnect the cod-end from the plankton tow net and carefully decant the water and plankton into a pre-labelled bottle. To ensure that all plankton are collected, rinse the cod-end several times, pouring each rinsate into the bottle. The sample is then fixed by adding 10% buffered formalin (10 ml for each 90 ml of sample volume). Plankton lots should be transferred to isopropanol (IPA) or ethanol after approximately 24 hours in formalin.

### **Storage**

The specimens must be housed in vials or jars which fit the following specifications, in order to fit standard storage units:

- Vials may not be smaller than 2 drams. The diameter of a vial may not exceed 21 mm and the height (with cap or stopper) may not exceed 90 mm.
- Vial caps must have a cone-shaped polyethylene liner. Vials with neoprene stoppers are not acceptable.
- Specimens too large to fit into vials are stored in jars (below).
- Jar lids should be made of polypropylene and have a flat polyethylene liner.

### **Preservation**

- After fixation, small specimens are transferred to 70% ethyl alcohol or 60% isopropanol.
- The ethanol/isopropanol is changed at least once after collection. If the fluid discolours after that, the alcohol continues to be changed until the fluid remains clear.
- Specimens should not occupy more than 30% of the volume of a vial or jar.
- Specimens are sorted so that all specimens within a vial or jar have the same collection data and taxonomic data as listed in the Data Needs section.

## **8.4 Museum Accessioning**

After competent identification, aquatic invertebrate vouchers can be deposited at Royal BC Museum. Note that the federal Transport of Dangerous Goods Act regulates the shipping of formalin, ethanol and isopropanol.

**Royal BC Museum Contact:** Kelly Sendall, Invertebrate Zoology Collection Manager  
 Phone (250) 387-2932 Fax (250) 387-5360  
 Email ksendall@rbml01.rbcm.gov.bc.ca

### Data Records

- All available data for each specimen is recorded in a computer database.
- Specimens may come into the Royal BC Museum with either a code in each vial or jar which is cross-referenced to a catalogue supplied with the specimens, or with all the collection data and taxonomic data in each vial or jar. Computerized field records are an asset.

### Storage

The specimens must be housed in vials or jars which fit the Royal BC Museum's specifications, in order to fit standard storage units.

## 8.5 Materials and Costs

**Table 7. Materials associated with preparing marine/aquatic invertebrates specimens.**

Item	Specifications	Supplier
Jars	125ml, dim. 51 x 102mm Cat. No. 21749	Anechemia, Richmond, BC
	250ml, dim. 62 x 127mm Cat. No. 21750	Anechemia, Richmond, BC
	500ml, dim. 76 x 145mm Cat. No. 21751	Anechemia, Richmond, BC
Lids	48mm for 125ml jar (1300/box)	Lukian Plastic Closures, Oakville, ON
	58mm for 250ml jar (1800/box)	Lukian Plastic Closures, Oakville, ON
Liners	polyethylene, 45mm for 125ml jar	Premo Plastics, Victoria, BC
	polyethylene, 54mm for 250ml jar	Premo Plastics, Victoria, BC
Fixative	37% formaldehyde	Northwest Labs, Victoria, BC
Preservative	95% ethanol (not denatured)	Stanchem, Vancouver, BC
Label Paper	78 lb. Permafibre	Coast Paper, Vancouver, BC
Vats	can hold 4-40 jars	Ecotainer Sales Inc. (604) 535-7293
Tubs		Custom Plastics, Vancouver, BC (604) 879-2991

## 8.6 References

Cavanagh, N., R.N. Nordin and P.D. Warrington. 1994. Biological sampling manual. Min. Environ., Lands and Parks. Victoria, BC 64 pp.

Green, G., and P. Lambert. 1994. Protocols for reference and voucher collections of aquatic invertebrates stored at the Royal British Columbia Museum. Fraser River Action Plan 1994-15. Royal B.C. Mus., Victoria, BC, and Environment Canada.

The above publication is available online through Environment Canada at <http://www.pyr.ec.gc.ca/ec/frap/frapdata/frap/Default.htm>. At this site choose "English", choose 'Publications', choose 'Environment Quality' (you will now be at

<http://www.pyr.ec.gc.ca/ec/frap/frapdata/frap/pubs.html>). This publication is listed under the title "Monitoring Approaches & Data Management". Click on the title to view.

Lambert, P. 1993. Procedures and standards for processing invertebrate specimens (except insects). Draft document. Royal B.C. Mus. Victoria, BC.

Scudder, G.G.E. 1994. An annotated systematic list of the potentially rare and endangered freshwater and terrestrial invertebrates in British Columbia. Victoria, BC. Entomological Society of British Columbia, 92 pp.



# Glossary

**BIODIVERSITY:** Jargon for biological diversity: “the variety of life forms, the ecological roles they perform, and the genetic diversity they contain” (Wilcox, B.A. 1984 cited in Murphy, D.D. 1988. Challenges to biological diversity in urban areas. Pages 71 - 76 in Wilson, E.O. and F.M. Peter, Eds. 1988. Biodiversity. National Academy Press, Washington, DC. 519 pp.).

**BLUE LIST:** Taxa listed as BLUE are sensitive or vulnerable; indigenous (native) species that are not immediately threatened but are particularly at risk for reasons including low or declining numbers, a restricted distribution, or occurrence at the fringe of their global range. Population viability is a concern as shown by significant current or predicted downward trends in abundance or habitat suitability.

**CBCB (Components of B.C.’s Biodiversity) Manuals:** Wildlife species inventory manuals that have been/are under development for approximately 36 different taxonomic groups in British Columbia; in addition, six supporting manuals.

**CDC (CONSERVATION DATA CENTER):** The B.C.’s Conservation Data Centre is a program of the Resources Inventory Branch of the Ministry of Environment, Lands and Parks. The CDC systematically collects information on the rare and endangered plants, animals and plant associations in the province. This information is compiled and maintained in a computerized database which provides a centralized, objective source of information on the status, locations and level of protection of these rare organisms and ecosystems. Their goal is to assist in preserving the biodiversity of the province by providing accurate information on rare species and plant associations. See <http://www.elp.gov.bc.ca/rib/wis/cdc/>

**CHIN:** Canadian Heritage Information Network.

**CWS:** Canadian Wildlife Service.

**DFO:** Department of Fisheries and Ocean.

**EWG (Elements Working Group):** A group of individuals that are part of the Terrestrial Ecosystems Task Force (one of 7 under the auspices of RIC) which is specifically concerned with inventory of the province’s wildlife species. The EWG is mandated to provide standard inventory methods to deliver reliable, comparable data on the living “elements” of BC’s ecosystems. To meet this objective, the EWG is developing the CBCB series, a suite of manuals containing standard methods for wildlife inventory that will lead to the collection of comparable, defensible, and useful inventory and monitoring data for the species populations.

**FCSN:** Forest Continuing Studies Network.

**INVENTORY:** The process of gathering field data on wildlife distribution, numbers and/or composition. This includes traditional wildlife range determination and habitat association inventories. It also encompasses *population monitoring* which is the process of detecting a demographic (e.g. growth rate, recruitment and mortality rates) or distribution changes in a population from repeated inventories and relating these changes to either natural processes

(e.g. winter severity, predation) or human-related activities (e.g. animal harvesting, mining, forestry, hydro-development, urban development, etc.). Population monitoring may include the development and use of population models that integrate existing demographic information (including harvest) on a species. Within the species manuals, *inventory* also includes, *species statusing* which is the process of compiling general (overview) information on the historical and current abundance and distribution of a species, its habitat requirements, rate of population change, and limiting factors. Species statusing enables prioritization of animal inventories and population monitoring. All of these activities are included under the term *inventory*.

**MELP:** Ministry of Environment, Lands and Parks.

**OBSERVATION:** The detection of a species or sign of a species during an inventory survey. Observations are collected on visits to a design component on a specific date at a specific time. Each observation must be georeferenced, either in itself or simply by association with a specific, georeferenced design component. Each observation will also include numerous types of information, such as species, sex, age class, activity, and morphometric information.

**POPULATION:** A group of organisms of the same species occupying a particular space at a particular time.

**PRESENCE/NOT DETECTED (POSSIBLE):** A survey intensity that verifies that a species is present in an area or states that it was not detected (thus not likely to be in the area, but still a possibility).

**PROJECT AREA:** An area, usually politically or economically determined, for which an inventory project is initiated. A project boundary may be shared by multiple types of resource and/or species inventory. Sampling for species generally takes place within smaller, representative study areas so that results can be extrapolated to the entire project area.

**PROJECT:** A species inventory project is the inventory of one or more species over one or more years. It has a georeferenced boundary location, to which other data, such as a project team, funding source, and start/end date are linked. Each project may also be composed of a number of surveys.

**RBCM:** Abbreviation for the Royal British Columbia Museum.

**RED LIST:** Taxa listed as RED are candidates for designation as Endangered or Threatened. Endangered species are any indigenous (native) species threatened with imminent extinction or extirpation throughout all or a significant portion of their range in British Columbia. Threatened species are any indigenous taxa that are likely to become endangered in British Columbia, if factors affecting their vulnerability are not reversed.

**RELATIVE ABUNDANCE:** The number of organisms at one location or time relative to the number of organisms at another location or time. Generally reported as an index of abundance.

**RIC (Resources Inventory Committee):** RIC was established in 1991, with the primary task of establishing data collection standards for effective land management. This process

involves evaluating data collection methods at different levels of detail and making recommendations for standardized protocols based on cost-effectiveness, co-operative data collection, broad application of results and long term relevance. RIC is comprised of seven task forces: Terrestrial, Aquatic, Coastal/Marine, Land Use, Atmospheric, Earth Sciences, and Cultural. Each task force consists of representatives from various ministries and agencies of the Federal and BC governments and First Nations. The objective of RIC is to develop a common set of standards and procedures for the provincial resources inventories. [See <http://www.for.gov.bc.ca/ric/> ]

**ANIMAL SIGN:** Any animal attribute that reveals its presence, without the need for capturing or seeing the animal directly (*e.g.*, deer pellets, animal tracks, and conspicuous residents such as beaver dams).

**SPECIMEN:** In this manual the term specimen includes diverse materials such as photographs and tape recordings, but usually refers to more traditional preparations like skins, skulls, pressed plants or dead animals in preserving fluids.

**SPI:** Abbreviation for ‘Species Inventory’; generally used in reference to the Species Inventory Datasystem and its components.

**STUDY AREA:** A discrete area within a project boundary in which sampling actually takes place. Study areas should be delineated to logically group samples together, generally based on habitat or population stratification and/or logistical concerns.

**SURVEY:** The application of one RIC method to one taxonomic group for one season.

**SYSTEMATIC SAMPLE:** A sample obtained by randomly selecting a point to start, and then repeating sampling at a set distance or time thereafter.

**TERRESTRIAL ECOSYSTEMS TASK FORCE:** One of the 7 tasks forces under the auspices of the Resources Inventory Committee (RIC). Their goal is to develop a set of standards for inventory for the entire range of terrestrial species and ecosystems in British Columbia.

**VOUCHER (SPECIMEN):** Representative specimen that are collected in biological field surveys and research, and are preserved to permit independent verification of results and to allow further study. Specimen in this manual includes diverse materials such as photographs and tape recordings, but usually refers to more traditional preparations like skins, skulls, pressed plants or dead animals in preserving fluids.

**YELLOW-LIST:** Includes any native species which is not red- or blue-listed.

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