Protocol for Small Mustelid Carcass Collection, Handling and Storage

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Abstract

This protocol provides standardized procedures for the collection, handling, and storage of small mustelid carcasses, including stoats (*Mustela erminea*), weasels (*M. nivalis*), and polecats (*M. putorius*). It includes instructions for safe collection, packaging, short- and long-term storage, tissue sampling, labelling, and metadata recording, while ensuring compliance with legal and ethical requirements.

Applying this protocol allows researchers, conservationists, and field collaborators to generate high-quality, well-documented carcass and tissue samples suitable for genetic analysis, morphological studies, pathogen screening, and other research applications. By following these guidelines, data and samples can be shared and compared across studies, supporting collaborative and reproducible research on small mustelid populations.

Introduction and scope

The purpose of this protocol is to collect small mustelid carcasses primarily for **genetic analysis**. However, limiting the use of these carcasses to genetic analysis alone would represent a missed opportunity. Therefore, this protocol aims to be flexible and not exclude additional research applications. Some of these include:

- Genetic analysis (main goal)
- Contaminant screening (e.g., environmental pollutants)
- Morphological studies (e.g., body measurements, age, and sex determination)
- Stomach content and food analysis
- Disease surveillance and pathogen detection

This protocol complements the more general **guidelines for genetic sample collection of small mustelids** (see DOI: dx.doi.org/10.17504/protocols.io.eq2ly4wmplx9/v1) and provides detailed procedures specifically for carcass-based sample collection. The protocol focuses on **small mustelids**, specifically stoats (*Mustela erminea*), weasels (*Mustela nivalis*), and polecats (*Mustela putorius*). However, it can be applied to any other small mammal with similar biology and field conditions.

The intended users of this protocol are mainly **field researchers and biologists**, but it is also designed for use by government biologists, students, volunteers, game wardens, conservationists, and others who may find and collect carcasses. Involving a wide range of people increases the chance of collecting more samples. Especially people who spend a lot of time outdoors or near roads professionally or recreationally are likely to find carcasses and are therefore an important source of samples.

The protocol is written for a project in **Switzerland**, but it is kept flexible to apply to other countries. Users must consider and comply with **local and national laws**, including species protection status and permits required for collection and handling. For example, in Switzerland, stoats and weasels are protected under hunting law, requiring permission to collect carcasses. The development of this protocol was also motivated by increasing collaboration among researchers working on small mustelids across Europe. This collaboration has been fostered through the **European Weasel Gang** (https://europeanweaselgang.eu/), an informal network that facilitates communication and coordination among researchers in this field.

1. Collection of carcasses

1.1 Sources of carcasses

Carcasses will most commonly be found opportunistic as:

- Roadkill
- Kills by domestic cats
- (By)catch in trapping activities
- Incidental finds during fieldwork or recreational activities
- Animals that died in wildlife care or rehabilitation centres

While roadkill and cat kills are expected to be the main sources, collectors should remain open to other sources or may plan active sampling (e.g. along roads).

1.2 Data collection and recording

When collecting carcasses, it is crucial to record essential data. At a minimum, record:

- **GPS coordinates** of the find (preferably in WGS84 format)
- **Date** of collection

Additional useful data includes:

- Species identification and certainty of identification
- Cause of death (clearly state if assumed or confirmed)
- Condition of the carcass (fresh, decomposed, scavenged, etc.)
- Name and contact information of the finder/collector
- Notes about habitat and any other remarks
- Photographs of the carcass and surroundings (optional but recommended)

1.3 Safety and hygiene

- Always wear disposable gloves when handling carcasses to avoid contamination and potential pathogen exposure. If gloves are unavailable, a plastic bag turned inside out can be used as an improvised glove.
- Use hand sanitizer after handling the carcass and before touching anything else. Wash your hands if possible.
- Be mindful of traffic safety when collecting roadkill; take appropriate precautions to avoid accidents.

1.4 Packaging

- Place the carcass into a **plastic bag** and tie it closed with a secure knot.
- Place that bag into a **second plastic bag** and tie it closed as well. This double-bagging reduces the risk of contamination and leakage.
- Insert a label or note with the collected metadata (minimum: label ID, date, GPS coordinates) **between the two bags** to prevent sample misidentification if outer labels become damaged.
- Avoid reusing bags or containers from previous collections to prevent cross-contamination.

1.5 Short-term storage before transfer

- If possible, keep the carcass cool in a **cool box** or refrigerator until it can be delivered to the local collection coordinator. This should be done on the same day or overnight.
- Freezing the carcass immediately after collection is discouraged if there is any intention of conducting pathogen or disease analyses later because freezing can destroy or reduce the viability of pathogens.
- If transfer to the collection point is delayed or not possible, freezing is the only alternative to prevent carcass degradation, but it should be considered a last resort after consultation with the coordinator.

2. Handling and initial processing at collection points

2.1 Receiving and transfer to the coordinator

- The ideal situation is to have **local collection points** where carcasses can be brought for initial handling. Usually, this is managed by a person responsible for mustelid research in that area, hereafter called the **coordinator**.
- The coordinator may be responsible for a local or national collection effort.

Options to transport the specimen to the coordinator/collection:

- The finder or collector can bring the sample to the coordinator in person.
- The sample can be sent by mail or courier—if so, ensure the following:
    - Send packages **in the afternoon** just before the parcel drop-off deadline for next-day delivery.
    - Select the **next-day delivery option** to minimize transit time.
    - Do **not send before the weekends** to avoid waiting time in transit.
    - Use **cool packs** and/or **insulated packaging** (e.g., bubble wrap, multiple paper layers) to keep samples cool during shipping.
    - Confirm that the delivery address is correct and someone is available to receive the package (or a 24h accessible mailbox).
- If feasible, someone from the coordinator's team can pick up the sample from the finder.
- Multiple local collection points (e.g., museums or vets) may be a possible solution to facilitate logistics in remote places.

> ***Note:*** *If bringing or picking up samples, transporting them in a cool box is preferable, but if not possible, transport without cooling is acceptable if the time between collection and processing is short (e.g. a few hours).*

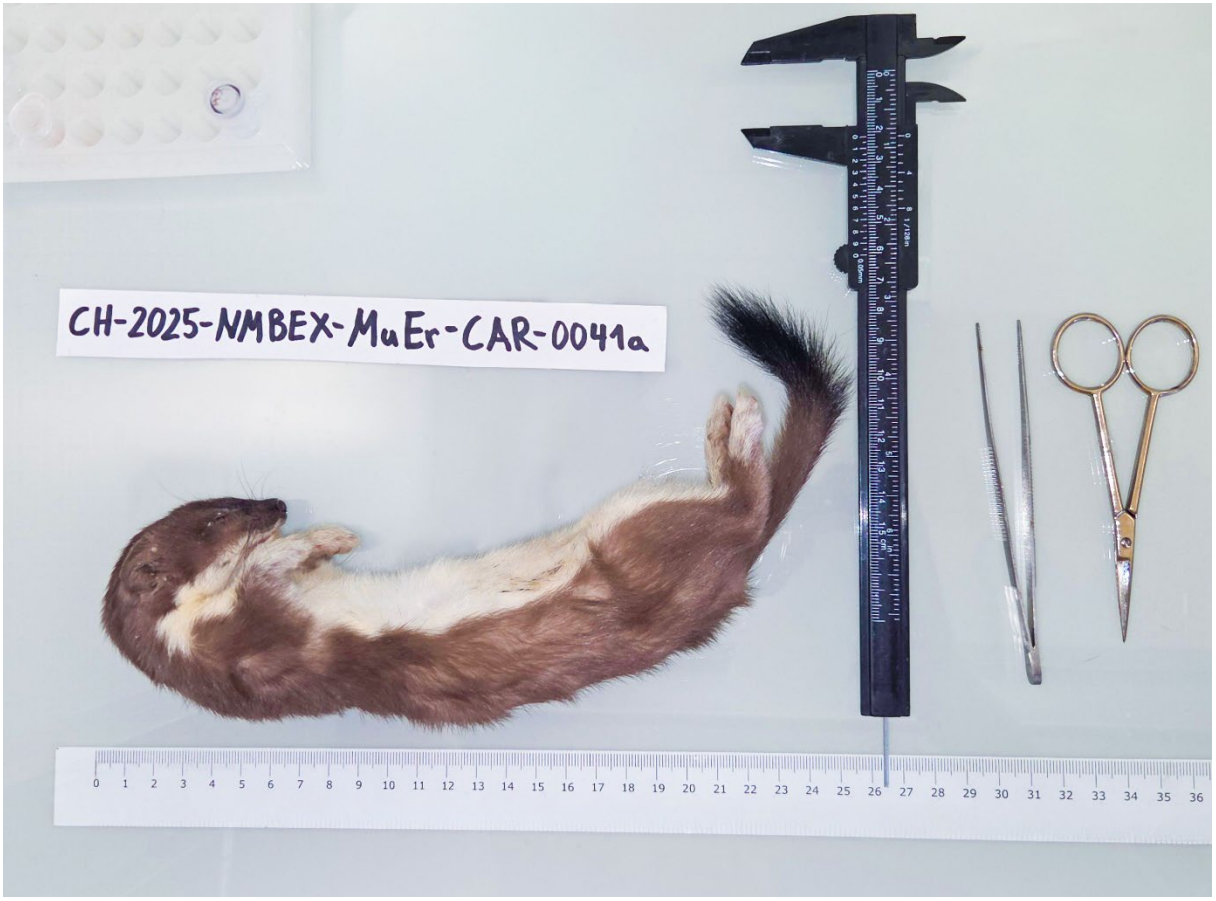

Figure 1: *Example setup of the lab bench during morphological measurements and tissue sampling of small carnivore carcasses.*

2.2 Investigation and measurements of carcasses

Upon receipt, the coordinator or trained personnel will:

- Assign a **unique label ID** to the carcass (see section 3 for the ID system).
- Take morphological measurements (see Fig. 1):
    - **Body length** (excluding tail)
    - **Tail length**
    - **Body weight**
- Determine **sex** (male/female) and **age class** (juvenile, subadult, adult).
- Conduct species confirmation if necessary.

2.3 Tissue sampling for genetic analysis

This is an ideal time to collect tissue samples (e.g. for genetic analysis), as it helps avoid repeated freezing and thawing later. Once sampling is complete, carcasses can be transferred to the freezer for long-term storage, while the tissue sample remains available for immediate or future use.

- Take a tissue sample for genetic analysis.
- For convenience and ease of access, cutting a piece of the **tongue** is recommended as it contains muscle tissue and is relatively easy to sample.
- If the tongue is not in good condition, alternative tissue sources include:

    - Heart muscle (preferred tissue for genetic analysis, but less accessible)
    - Back muscle (can be accessed through the ventral cavity, often less decomposed)
    - Muscle from the hind leg
    - Toe clipping
    - Ear clipping
- Use clean, sterilized tools (scissors, scalpel, forceps).
- Cut small pieces (e.g. minimum of 0.5–1 cm^3) and immediately preserve.
- Preserve in ethanol (95-100%) using small containers (e.g. screw cap microcentrifuge tubes).
- Check guideline for genetic sampling (Dürst 2025, DOI: dx.doi.org/10.17504/protocols.io.eq2ly4wmplx9/v1) of small mustelids for details on sampling and storing tissue.

⚠ ***Important:*** *If the carcass is intended for* ***taxidermy****, take tissue samples in a way that will not be visible on the prepared specimen later on (e.g. tongue).*

2.4 Pathogen analysis (optional)

- If disease or pathogen analysis is planned, this is the **appropriate time** to take the necessary samples or hand the carcass to veterinary specialists.
- This must be done **before freezing** to ensure pathogen viability.
- Details of pathogen sampling are outside the scope of this protocol, but should be coordinated with veterinary or disease specialists.

2.5 Long-term storage

If no pathogen analysis is planned (or has been done), the carcass should be **frozen for long-term storage**.

- **Carcasses:**
    - Store frozen at a minimum of **-20 °C**. Colder temperatures (e.g., -80 °C) are preferable if facilities allow.
    - Ensure carcasses are **double-bagged** with clear labelling on the outer bag, including sample ID, date, and location information.
    - Avoid thawing and refreezing cycles to maintain sample integrity.
- **Tissue samples in ethanol:**
    - Store tissue samples in screw-cap microtubes filled with **>95% ethanol** (preferably 99%).
    - Keep these samples at **-20 °C or lower** for long-term preservation.
    - Ensure labels are ethanol-proof.
- **Database management:**
    - Maintain a secure, backed-up **digital database** with detailed metadata for all samples.
    - Update the database whenever samples are moved, processed, or used in analyses.

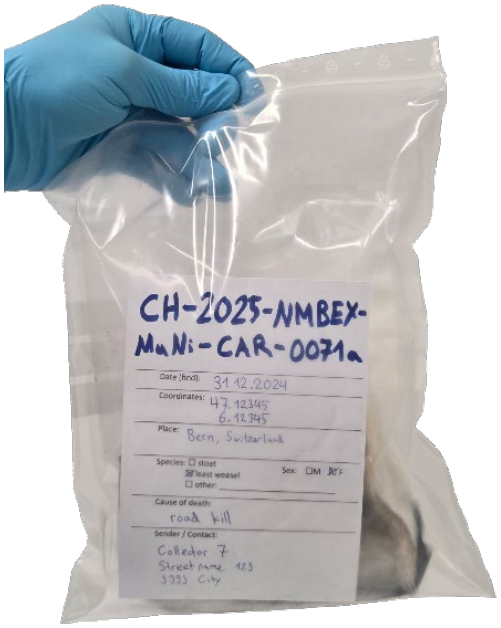

Figure 2: *Example of a carcass that is double-bagged, labelled, and prepared for storage in a freezer.*

> ⚠ ***Important:*** *Use of* ***double-bagging*** *for carcasses and placement of a note with the sample ID, collection date, and GPS coordinates alongside the sample reduces the risk of misidentification if labels become detached or mixed up.*

3. Labelling and sample identification system

To maintain consistency across all collections and enable easy tracking and data sharing, use a **standardized unique ID format**:

[CountryCode]-[Year]-[InstitutionCode]-[TaxonCode]-[SampleType]-[SampleNumber][LetterSuffix]

Component	Description	Format / Rules
CountryCode	Country of sample collection	2-letter ISO 3166-1 alpha-2 code
Year	Year of collection	4 digits
InstitutionCode	Code for the collecting or managing institution	Exactly 5 uppercase letters (complete with Xs if necessary)
TaxonCode	Code for species or taxon, based on Latin name	4 letters: 2 from genus + 2 from species (first letters uppercase)
SampleType	Type of material collected	3 uppercase letters
SampleNumber	Unique identifier for the sample (=individual)	Exactly 4 digits (with leading zeros if necessary)
LetterSuffix	Optional letter to indicate sub-samples from the same individual	1 lowercase letter starting from a

Example: CH-2025-NMBEX-MuNi-CAR-0071a
This represents:

- CH = Switzerland (ISO 3166-1 alpha-2 country code)
- 2025 = Year of collection
- NMBEX = Institution code (e.g. Natural history museum of Bern, completed with an X)
- MuNi = Taxon code (e.g. *Mustela nivalis*)
- CAR = Sample type (e.g. carcass)
- 0071a = Sample number 71, subsample "a" (e.g. a carcass will most likely be the first sample taken)

3.1 Taxon code

Standardized codes for taxon codes include:

Common name	Scientific name	Taxon code
Stoat	*Mustela erminea*	MuEr
Least weasel	*Mustela nivalis*	MuNi
European polecat	*Mustela putorius*	MuPu
Long-tailed weasel	*Mustela frenata*	MuFr
European mink	*Mustela lutreola*	MuLu
American mink	*Neogale vison*	NeVi
Pine marten	*Martes martes*	MaMa
Stone marten	*Martes foina*	MaFo
Red fox	*Vulpes vulpes*	VuVu
Eurasian badger	*Meles meles*	MeMe
Unspecified Mustela	*Mustela sp.*	MuSp

3.2 Sample type abbreviations

Standardized codes for common sample types include:

Code	Sample type
CAR	Carcass (whole)
TIS	Tissue sample
SCT	Scat (faeces)
HAI	Hair
SWB	Swab (oral/rectal)
BLO	Blood

Note: *Even though other sample types are not covered in this protocol, the ID structure is designed to accommodate additional types for completeness.*

3.3 Suffixes for sub-samples

When multiple samples of the same or different types are taken from a single individual, append a **letter suffix** (a, b, c, etc.) to indicate that they are subsamples from the same source.

3.4 Labelling materials and practices

- Use **durable, waterproof and ethanol-proof labels**.
- Preferably write labels with a **pencil** or ethanol-proof ink to ensure longevity in ethanol and freezing conditions.
- Make sure the **metadata** recorded in the database matches **exactly** the physical labels on the sample tubes and carcass bags.
- Include the **sample ID, date and GPS coordinates** on the label to ensure that, even in the case of an error or mix-up, the essential information remains linked to the specimen.

3.5 Metadata record

See Appendix A of the guidelines for genetic sampling of small mustelids for details and a complete list of metadata fields.

- Alongside physical labelling (ID), maintain a **digital database** of all samples with detailed metadata fields including:
    - Unique sample ID
    - Date (and time) of collection
    - GPS coordinates (WGS84)
    - Species identification and certainty
    - Cause of death (confirmed or assumed)
    - Condition of the sample (carcass)
    - Collector/finder name and contact
    - Storage location (Institution)
    - Morphometrics (Bodysize, Weight, Sex, etc.; if available)
    - Comments and photos (if necessary)
- An **Excel template** for metadata entry will be provided upon request for uniform data collection and easy sharing.

4. Safety and ethical considerations

4.1 Personal safety and hygiene

- When collecting carcasses, always be aware of **traffic risks**, especially when handling roadkill. Use high-visibility clothing or vests if possible and exercise caution near roads.
- Always wear **disposable gloves** when handling carcasses to avoid direct contact with potentially infectious material. If gloves are unavailable, a plastic bag turned inside out can be used as an improvised glove.
- Use **hand sanitizer** after washing your hands to further reduce contamination risk.
- Avoid touching your face, eyes, or mouth during and immediately after handling carcasses until your hands are properly cleaned.
- Never eat, drink, or smoke while handling carcasses.
- Do not store carcasses in any fridge or freezer that is also used for food or non-research purposes. Only use designated units.

4.2 Legal and permit requirements

- Ensure you are aware of **local and national laws** regarding the collection of wildlife carcasses.
- Many small mustelid species, such as stoats and weasels, are **protected by law**, so **permission is required** to collect samples, even if the animal is already dead.
- The finder or collector might have to contact the responsible **game warden** or **hunting department** to obtain the necessary permits before collection.
- If there is an intention to use the animal for **taxidermy**, an additional permit may be required from wildlife authorities.
- Always comply with regulations related to the **transport, storage, and use** of wildlife specimens.

4.3 Ethical considerations

- Be respectful of local communities and landowners; obtain permission if accessing private land.
- Ensure data and samples are used responsibly and shared according to agreed-upon terms.

5. Roles and responsibilities

- **Finder / Collector:**
    - Locate carcasses in the field or elsewhere.
    - Collect carcasses following safety and handling protocols.
    - Record initial data including GPS coordinates, date, and condition.
    - Transport or send carcasses to the local coordinator.
    - Obtain any necessary collection permits (or in agreement with the coordinator).
- **Coordinator:**
    - Assign unique sample IDs.
    - Receive carcasses and perform measurements (and tissue sampling).
    - Manage storage of carcasses and tissue samples.
    - Maintain the database and ensure metadata quality.
    - Coordinate pathogen sampling if applicable.
    - Facilitate sample sharing and communication between institutions.
    - Ensure compliance with legal and ethical requirements (e.g. proper permits and agreements are in place before transferring samples).