Differential Traceology Protocol: Methodology for Verifying Relict Hominoid Traces in Light of Comparative Anatomy and Biomechanics

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1. Introduction: Relevance of the Differential Traceology Protocol

1.1 Problem Overview and Scientific Context

The discovery of supposed footprints of a large, previously unknown bipedal primate, referred to as a Relict Hominoid (RH) – or more commonly known in popular culture as Bigfoot, Abominable Snowman, or Yeti – remains one of the most discussed, yet least verified, pieces of evidence in cryptozoology.Historically, much of the collected trace evidence has been rejected by the scientific community due to the lack of rigorous, reproducible analytical methodology, leading to frequent instances of false identification, falsification, and perceptual errors.To move from empirical observations to standards acceptable for forensic or biological examination, it is necessary to develop a unified scientific and practical protocol.

The purpose of this paper is to present a standardized guide to differential traceology aimed at field researchers. The guide offers clear criteria and methods for objectively distinguishing genuine prints attributed to RG from those of known animals, primarily*Homo sapiens* And *Ursus spp.*(bear), which are most often involved in cases of false identification.

1.2 The Need for Comparative Anatomy of the Foot

The main task of differential diagnosis of RG traces is to strictly exclude traces of known types, based on fundamental differences in the anatomy of the foot and the biomechanics of movement.[1]In North America and Eurasia, the main source of confusion is the hind feet of bears, as they can leave prints that vaguely resemble human feet.

A professional approach requires a critical analysis of morphological features. Thus, the foot

of a modern person (*H. sapiens*) is characterized by a rigid longitudinal arch optimized for long runs and walks, as well as a relatively short and narrow shape. The bear's foot, by contrast, is more rounded or triangular, often leaves no full heel print, and has non-retractable claws. A hypothetical RG print would exhibit a unique set of features, including exceptional size, flatness or flexibility of the midfoot, and a strict absence of claws, indicating a different evolutionary adaptation than known hominins and carnivores.

2. Differential Traceology Methods: Comparative Fingerprint Analysis

A key verification step is the careful measurement and morphological analysis of a single print. This analysis is divided into quantitative and qualitative parameters, which are critical for excluding known species.

2.1 Quantitative Parameters: Size and Proportions

The first and most obvious diagnostic feature that distinguishes RG traces is their scale.

The typical length of a print attributed to Bigfoot or Yeti ranges from 38 to 50 centimeters, with average values usually falling in the 40–45 centimeter range.The width of the RG print is also significantly greater than known analogues, amounting to 15–23 centimeters.

By comparison, the barefoot footprint of an adult human is typically no more than 25–30 centimeters long. The footprints of a large bear, such as a grizzly, can reach 28 centimeters, but those of a black bear are typically smaller (12–20 cm).[1]Thus, size is a first-order criterion of significance, allowing one to quickly weed out most human and bear tracks, although it does not in itself guarantee that the track belongs to a RG, since it is possible to make a large fake.

2.2 Qualitative Anatomical Analysis: Arch and Biomechanics

The most critical differences are observed in the anatomy of the foot, particularly in the arch structure. Modern humans have a rigid longitudinal arch, so during normal walking, the midfoot often leaves a less distinct imprint or no imprint at all.

In hypothetical casts of the RG, on the contrary, either pronounced flat feet or the presence of the so-called**Intermediate Tarsal Flexion** (*midtarsal break*).This sign appears as a bend or increased pressure in the central part of the footprint, which does not correspond to the rigid

arch of the foot, characteristic of*H. sapiens*.Anthropologists believe the presence of a flexible middle joint in the prints is a strong argument in favor of a non-human origin, since such flexibility is absent in modern humans but is observed in some large primates.[1]

The fact that a creature presumably very heavy (over 200 kg, as discussed below) and strictly bipedal retained a flexible middle joint indicates a unique evolutionary path. This anatomical structure may be an adaptation for better shock absorption and maneuverability when moving across uneven or complex forest terrain, rather than optimization for fast and long runs across open terrain, as was the case in the genus*Homo*.

2.3. Fingers and Differentiation from*Ursus spp.*

Analysis of the fingers and the presence of claws provides key differences between the RG and the bear.

Humans, bears, and (presumably) RGs have the same number of fingers—five. However, their placement differs. In humans, the thumb is located on the inner edge; in bears, by contrast, the outer finger is the largest, and the inner finger (equivalent to the fifth) often doesn't leave an imprint.Bear toes typically form an arch. Bear tracks, according to descriptions, have five toes arranged in a nearly straight line, more reminiscent of the human form. Bear toes are often noted to be longer and more widely spaced, which may be an adaptation for increased stability on soft ground.[1]

Key differentiating feature –**absence of claw marks**.Bear claws are long and non-retractable, and on soft ground they typically leave characteristic pinpoint pits in front of the fingerprints. Genuine humanoid tracks, like those of barefoot humans, do not show claw marks. The discovery of clear claw marks in a large "humanoid" print is an immediate indicator that it is a bear or an unmistakable fake.

2.4 Pressure Distribution Analysis and Mass Estimation

Weight distribution during walking is an important biomechanical indicator. The human footprint is typically deepest under the heel and balls of the feet, while the midfoot is shallower (due to the arch).

In contrast, RG footprints are often described as having a more uniform depression across the entire footprint. This suggests that a very heavy creature with a wide, flat foot distributes its weight more evenly.Such depth and uniformity, traced along the entire length of the track, indicate a creature with an estimated mass significantly exceeding that of a human (presumably >200 kg).

Forensic analysis of the depth of the print suggests that the creature's weight is distributed over two rather than four limbs, unlike a bear, whose total mass (100–300 kg) is distributed

over four paws, resulting in a shallower single print of the hind paw.An additional biometric marker that is extremely difficult to counterfeit is the presence of traces on some casts.**skin ridges (dermatoglyphs)**, indicating a living organism.

Table 1 summarizes the key diagnostic differences.

Table 1: Comparative Differential Diagnosis of Footprints (RG, Human, Bear)

Parameter	**Man (bare foot)**	**Bear (hind paw)**	**Relict Hominoid (RH)**
Print length (cm)	~20–30 (on average ~25)	12–28	35–50 (usually 40–45)
Print width (cm)	~8–12	8–15	15–23 (very wide foot)[1]
Arch of the Foot	Rigid longitudinal arch (often not imprinted)	Flat foot, partially imprinted	Flat/flexible; possible**Intermediate Tarsal Flexion (*Midtarsal Break*)**
Claw Prints	None	Often present (non-retractable)[1]	Strictly absent (key marker)
Depth and Pressure	Uneven (heel/toe)	Shifted towards the front (fingers/claws)[1]	Deep and**uniform**along the entire length (weight >200 kg, bipedal stand)

3. Exclusion Factors: Diagnosis of Counterfeits and Natural Artifacts

Before attributing a trace to an unknown creature, the researcher must exclude all prosaic explanations: human activity (fakes) and natural phenomena (natural artifacts).

3.1. Identification of Signs of Counterfeiting

Most of the crude falsifications, often created using wooden forms, are easily exposed by analyzing biomechanical dynamics.

Signs of artificial prints include:

1. **Simplified form without anatomical details:**Counterfeits typically lack subtle morphological features such as joint folds, skin texture variations (dermatoglyphs), or natural pressure changes.
2. **Static and Repeatable:**A living creature never steps exactly the same way twice. Genuine footprints always show a slight difference.*variability*in shape, depth, and finger placement, reflecting adaptation to the terrain. Fakes, on the other hand, often look like identical "stamps," which was typical of famous false footprints left, for example, by Ray Wallace.
3. **Clean edges and even depth:**Counterfeits often have perfectly smooth, crisp edges and appear to have been pressed vertically by a hard object, with no evidence of ground slippage or gradual change in depth reflecting the dynamics of a stride.

Detecting subtle, natural details in a print—a slight asymmetry between the right and left footprints, a smooth change in depth from heel to toe, or, especially, skin texture—dramatically reduces the likelihood of counterfeiting, as such nuances are extremely difficult to imitate.

3.2. Natural Artifacts and Traceology Errors

Some natural phenomena can mimic large footprints, misleading inexperienced researchers.

Double Bear Print (*Overstep Registration*)

The most common case of false identification is when a bear, while walking slowly, places its hind paw exactly in the print of its front paw.The result is an elongated, large footprint that can resemble a giant foot, especially on soft substrate.A closer look, however, reveals inconsistencies such as duplicate fingerprints, claws in unusual locations, or an overly pointed heel.

Snow Melting (Thermal Erosion)

The edges of footprints in the snow melt and spread under the influence of solar radiation, which leads to the merging of small traces into large, shapeless outlines.Tracks of small animals, such as foxes or hares, can combine to form large, vague ovals that are mistakenly

interpreted as Yeti tracks.

Soil Erosion

Water and weathering can smooth out the details of a track (erosion), erasing claw marks or breaking up the outline of the toes, making the print more foot-like and less distinct.The researcher must exclude such phenomena, as well as simple optical illusions created by shadows or fallen leaves.[1]The forensic approach dictates that a single print in an unmarked area always arouses suspicion; conversely, a serial, extended trail of footprints following a consistent trajectory increases the likelihood of authenticity.

4. Field Documentation and Evidence Collection Protocols (Forensic Approach)

The scientific value of any trace evidence directly depends on the rigor of its recording and documentation. This documentation must comply with forensic trace evidence standards.

4.1 Standardized Photography and Scaling

Photographic recording should be carried out immediately after detection,*to*any physical intervention.

Commit protocol:

1. **Scaling:**The frame must include a scale ruler or tape measure placed at the same level as the print itself.Without scale, dimensions cannot be verified.
2. **Perspective:**The camera must be held**strictly parallel to the plane of the trace**(ideally using a tripod and level) to avoid perspective distortions and ensure accurate representation of shape and size.
3. **Lighting and Relief:**To identify fine details of the relief and trace depth (critical for pressure analysis) it is necessary to use**side lighting**Directed light from a flashlight at an acute angle emphasizes the shadows and contours of the print.
4. **Photo series:**Photos are taken perpendicularly from above, at an angle from the side (to demonstrate depth) and in the direction of the track's movement (for context).

All original digital files must be saved without compression or editing. The field log records the date, time, precise GPS coordinates, and the georeferencing of photographs to specific tracks.

4.2. Application of 3D Scanning and Photogrammetry

Modern technologies offer non-invasive methods for digitalizing the shape of a footprint,

surpassing traditional plaster casting in accuracy and speed.

3D Scanning

Specialized portable 3D scanners (such as structured light or laser) allow you to quickly create an accurate digital copy of a print (a point cloud).The advantage is the efficiency and ability to accurately measure all parameters (length, width, depth, volume) in laboratory conditions, as well as compare the model with databases of known traces.[1]3D scanning allows for the analysis of the trace's geometry without destroying it and serves as an independent digital archive.

Photogrammetry

In the absence of an expensive scanner, photogrammetry can be used, in which multiple overlapping photographs taken from different angles around the footprint are processed with specialized software to create a 3D model.This method requires camera stability, but allows you to obtain a high-quality 3D impression using a standard camera or smartphone.

4.3. Methodology for Making High-Precision Plaster Casts

Despite advances in digital technology, the plaster cast remains critically important*material evidence*.

Typical plastering algorithm:

1. **Preparation:**Carefully remove any foreign objects from the print using a fine brush or tweezers, being careful not to disturb the edges.If the soil is dry and loose, the surface should be secured with aerosol hairspray from a distance of 20–30 cm, which will prevent it from washing away during pouring.
2. **Limitation:**A border (formwork) made of plastic or thick cardboard is installed around the footprint to prevent the plaster from spreading.
3. **Filling:**Plaster (dental or alginate is recommended for thin parts) is mixed to the consistency of thick sour cream, avoiding the formation of air bubbles.[1]The mixture is poured very carefully, not in a stream into the center, but along the edge or through a spatula, so as not to blur the relief.The thickness of the cast should be 1.5–2 cm for strength.
4. **Snow conditions:**Plastering on snow is a complex technique because regular plaster generates heat. It is necessary to use a cooled mixture, sulfur plaster, or pre-treat the footprint with a special aerosol (such as wax spray) to create a heat-insulating film.

After curing (15 minutes to an hour), the cast is carefully removed and labeled (date, location, leg match), then transported for further drying and laboratory analysis.

4.4. Collection of Biomaterials for Genetic Analysis (DNA/eDNA)

Collection of biological samples represents the most promising direction for final

identification.

1. **Soil sampling:**After making the impression, or if one was not made, it is necessary to take soil samples directly from the depth of the impression, using sterile instruments and gloves.Microscopic particles of epidermis, sweat or other cellular material may be preserved in the soil.
2. **Control samples:**It is essential to take similar soil samples a few meters away from the track (background samples) to exclude contaminating DNA during laboratory analysis.
3. **Search for hair and fabrics:**It's important to carefully examine the print itself and its surroundings. If the creature was covered in fur, hairs may become stuck in the mud or on sharp protrusions in the ground, rocks, or branches within the print.Hairs are collected with tweezers, placed in paper envelopes or foil, and labeled. They are valuable for both morphological and genetic analysis.
4. **eDNA Genetic Analysis:**Extracting environmental DNA (eDNA) from soil samples is a modern approach. Even without visible bioparticles, soil can contain the genetic material of organisms that have passed through it.Keeping samples cool and dry (4°C) until analysis and strictly preventing contamination with human DNA are critical.

The discovery of dermatoglyphs on casts, mentioned earlier, opens a direct route to collecting epidermal microsamples that can be sequenced.

5. Track Analysis: Biomechanics of Bipedalism

The study of the sequence of footprints (trackways) allows us to assess the gait habitus and is key to confirming the strictly bipedal locomotion characteristic of hominoids.[1]

5.1 Gait Type Identification: Bipedalism vs. Quadrupedalism

The track of the footprints attributed to the RG must be**strictly bipedal**: the prints follow one after another, without paired traces from the front and back paws.This immediately distinguishes it from the typical gait of quadrupeds.

Bears that can briefly stand on their hind legs soon return to a quadrupedal gait. Even with direct recording (*overstep registration*), when the hind paw is placed into the imprint of the forepaw, the series will show signs of a quadrupedal pattern. Therefore, a long, unbroken sequence of tens or hundreds of meters of single bipedal tracks practically rules out a bear.

5.2 Biomechanical Parameters of Habitus

Step Length

Stride length (the distance between successive footprints of the same foot) is a crucial characteristic. The average human stride length during leisurely walking is 0.6–0.8 meters.

Suspected RGs often exhibit an unusually long, even stride: from 1.0 to 1.5 meters, and in some cases up to 2.0 meters.The presence of a very long stride (more than 1.2–1.3 meters) without signs of running is a critical difference, since it is physically impossible for a person of average height (180 cm) to maintain such a rhythm.[1]This indicates a creature of significantly greater height (presumably 2.5–3 meters) and, probably, with a different ratio of the length of the limbs to the body.

Stadle Width

When a person walks, their feet are placed along two parallel lines corresponding to the width of the pelvis, with a slight angle of outward rotation of the feet (10–20 cm between the lines).[1]In the reports on the RG tracks it is often emphasized that the tracks are located almost**one line**– that is, each imprint is placed exactly before the previous one, along the central axis of the body.

The narrow, single-line stance of the legs suggests specific biomechanics indicating a very wide pelvis (necessary to support a large mass) and a specific way of moving, in which the feet are placed directly under the center of gravity for maximum stability, which is typical of creatures with a large mass moving over difficult terrain.

5.3. Rhythm and Trajectory Analysis

An authentic track should exhibit a natural rhythm and adapt to the terrain. Stride intervals should be uniform, except on uphill, downhill, or curved sections, where stride length varies regularly.

Trajectory analysis helps rule out counterfeiting. If a track's path ends without apparent cause (for example, in the middle of a flat field), this is a strong indicator of a forgery. Genuine tracks should lead to a specific destination or pass through terrain that is unusual for a person avoiding obstacles.In addition, genuine RG tracks, according to observations, are clearly separated and do not show signs of dragging (shuffling), which indicates a high instep.

Table 2 systematizes the biomechanical parameters of gait.

Table 2: Comparative Analysis of Gait Habitus (Footprint)

Biomechanical Parameter	Human (Normal walking)	Bear (Step/Lynx)	Relict Hominoid (RH)
Gait Type	Strictly bipedal	Predominantly quadrupedal, short	Strictly bipedal for long distances[1]

		bipedal steps[1]	
Step Length (m)	0.6 – 1.0	0.4 – 0.8 (short)	1.0 – 2.0 (unusually wide/long)[1]
Path Width	10 – 20 cm (two parallel lines)[1]	Wide, zigzag[1]	Very narrow, the tracks are placed almost**one line** [1]
Rhythm	Uniform	Complex, frequent overlaps[1]	Smooth, continuous[1]

6. Discussion: Synthesis of Evidence and Scientific Verification

6.1. Set of Criteria as a Basis for Verification

The presented criteria of differential traceology emphasize that proof of the existence of RG cannot be based on a single feature.For example, the absence of claws does not in itself rule out a bear (if the ground is hard or the track is incomplete), and large size does not rule out a fake.

Only the combined discovery of anatomical and biomechanical features, verified using forensic methodology, can ensure the scientific legitimacy of a finding. This includes:

1. **Size:**Length exceeding 35 cm.
2. **Anatomy:**Availability*Intermediate Tarsal Flexion*or flat feet (lack of a rigid arch)*H. sapiens*).
3. **Predator Exclusion:**Strict absence of claws.
4. **Biomechanics:**A continuous trackway of dozens of bipedal footprints, displaying an unusually long (1.0–2.0 m) and narrow, 'stride for stride' gait pattern.

The requirement for a complete, continuous track demonstrating this unique biomechanical triad effectively rules out the vast majority of falsifications and false identifications.[1]

6.2 Comparison with Known Hominids and Primates

The hypothetical anatomy of the RG foot (large, with a flexible midfoot) and its biomechanics (strictly upright posture with a narrow stance) do not find an exact match among known modern primates. In great apes (gorillas, chimpanzees), the foot is characterized by a laterally abducted hallux, which is not observed in either humans or RG footprints.The anatomical

structure of the RG foot, as some anthropologists (for example, G. Krantz and D. Meldrum) believe, may indicate an evolutionary path separate from*Homo sapiens*, possibly with parallels among early hominins.

6.3 Problems and Limitations of Field Research

The quality of the data obtained is highly dependent on the condition of the substrate. In loose sand or in loose soil, trace details (e.g., dermatoglyphs or*midtarsal break*) may be lost or distorted.Erosion is also a significant limiting factor. Therefore, every potential trace must be viewed with skepticism until the possibility of erosion, artifacts, or fabrication has been ruled out.Involving independent experts in the analysis of 3D models and casts is essential to ensure the objectivity and scientific reproducibility of the data.[1]

7. Conclusion: Further Prospects and Genetic Identification

7.1 The Need for a Strict Protocol

This guide provides a scientific and practical basis for the differential diagnosis of relict hominoid traces, systematizing morphological, anatomical, and biomechanical criteria. The transition to rigorous forensic documentation methods—the mandatory use of scaling, side illumination, 3D scanning, and careful collection of casts—is key to transforming cryptozoological finds into verifiable scientific data.Fingerprints are material evidence, their scientific significance is determined solely by the rigor of the protocol for their collection and analysis.

7.2 Future Research Prospects: Genetic Traceology

The most promising direction for obtaining definitive scientific evidence is genetic identification.The detection of fine natural features such as skin ridges (dermatoglyphs) on casts opens the possibility of collecting micro-samples of the epidermis.

The development of techniques is critically important**environmental DNA (eDNA) analysis from soil**Successful isolation and sequencing of genetic material from soil samples collected directly from the footprint, which does not match the DNA of any known animal or human species, would provide irrefutable proof of the existence of the unknown hominoid.Further field research should focus on minimizing human DNA contamination and rapid soil sampling combined with high-precision 3D documentation.

Careful, critical analysis of tracks, relying on exclusionary criteria and advanced documentation techniques, remains a key tool in unraveling the mystery of the relict hominoid.

Sources

Our guide relied on both cryptozoological reports from enthusiasts and data from scientific and forensic studies of footprints. The text includes references to open sources, including the work of anthropologist D. Meldrum.North American Bear Center bear tracking materials, as well as articles and notes,analyzing cases of Bigfoot and their explanationsRecommended forfurther reading:

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