

Eyewitness Reports Concerning a Putative North American Hominoid: Anomaly or Artifact?

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Abstract – A large dataset of US and Canadian eyewitness reports concerning a putative North American hominoid is examined in order to ascertain response patterns. The reports are grouped into five categories: 1) eyewitness data, 2) ecological data, 3) ethological data, 4) morphological data, and 5) ichnological data.² There are 36 (out of 78) reported hominoid characteristics that are statistically significant “standouts” (the modal percentages of reports identifying these characteristics are significantly higher than the percentages identifying other characteristics), indicating a reasonable degree of convergence across witnesses. Certain features of the reports are suggestive of morphology and behavior found in apes, such as witness avoidance and flight behaviors. Modelling the cumulative species description curve for the ape superfamily (Hominoidea) suggests that from one to three additional species are likely to be described over the next 49 to 113 years, indicating potential room in the inventory for novel hominoid taxa. The possibility that patterns among reports might be due to some kind of “stereotype activation” distorting sensory interpretation and/or memory is considered in detail.

Keywords: Bigfoot – cryptozoology – eyewitness reports – hominology – hominoid – Sasquatch

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J. Richard Greenwell (1942–2005) was an influential, meticulous, and distinguished cryptozoologist, who, along with Bernard Heuvelmans, co-founded the International Society for Cryptozoology in 1982, and edited its peer-reviewed journal *Cryptozoology* until 1996. He died before the analysis in the current paper could be officially presented in a publication, and hence is granted a posthumous co-authorship, making this Greenwell’s last publication.

2 Ichnological data are obtained from footprints (note from the editor).

Augenzeugenberichte über ein angebliches nordamerikanisches hominoides Wesen: Anomalie oder Artefakt?

Zusammenfassung – Ein großer Datensatz von US-amerikanischen und kanadischen Augenzeugenberichten über ein mutmaßliches nordamerikanisches hominoides Wesen wird untersucht, um Reaktionsmuster zu ermitteln. Die Berichte sind in fünf Kategorien gruppiert: 1) Augenzeugenberichte, 2) ökologische Daten, 3) ethologische Daten, 4) morphologische Daten und 5) ichtnologische Daten.³ Es gibt 36 (von 78) berichtete hominoide Merkmale, die statistisch signifikante „Auffälligkeiten“ darstellen (die modalen Prozentwerte von Berichten, in denen diese Merkmale identifiziert werden, sind signifikant höher als die mit anderen identifizierten Merkmalen), was auf ein hinreichendes Maß an Konvergenz zwischen den Zeugen hinweist. Bestimmte Merkmale der Berichte lassen auf die Morphologie und das Verhalten von Menschenaffen schließen, wie z. B. das Vermeiden, gesehen zu werden, und das Fluchtverhalten. Die Modellierung der kumulativen Artenbeschreibungskurve für die Affen-Superfamilie (Hominoidea) zeigt, dass in den nächsten 49 bis 113 Jahren wahrscheinlich ein bis drei weitere Arten beschrieben werden, sodass Platz für neue Hominoid-Taxa geschaffen werden sollte. Die Möglichkeit, dass wiederkehrende Muster in den Berichten auf eine Art „Aktivierung von Stereotypen“ zurückzuführen sein könnten, die die Interpretation des sensorischen Inputs und/oder die Erinnerung verzerrt, wird ausführlich berücksichtigt.

Schlüsselbegriffe: Bigfoot – Kryptozoologie – Augenzeugenberichte – Hominologie – hominoid – Sasquatch

Introduction

Hominology

Hominology is the study of ape-like organisms (hominoids) evidenced only indirectly via zoomythology, traditional ecological knowledge (or ethnoknowledge), eyewitness reports, and physical traces (e.g. footprints) (see Bayanov, 2012). Papers positively appraising evidences offered in support of the existence of various hominoids such as the North American “Sasquatch” and others (e.g. Wildmen, Almas, and Yeti) have occasionally been published in general science, as well as zoological and anthropological, journals (e.g. Bayanov & Bourtsev, 1974, 1976; Burns, 1962; Byrne, 1962; Cooke, 1975; Heuvelmans, 1952, 1969; Krantz, 1972, 1986; Porshnev, 1974; Rinčen, 1964; Sanderson, 1962, 1969; Strassenburgh, 1975, 1979; Tchernine, 1974, 1975; Tschernezky, 1960; Tschernezky & Cooke, 1975), suggesting some, albeit small, mainstream scientific interest in this matter. In a 2004 column in the journal *Nature*, Henry

³ Ichnologische Daten sind Daten, die aus Fußspuren gewonnen werden (Anm. der Redaktion).

Gee (2004) noted that “[t]he discovery that *Homo floresiensis* survived until so very recently, in geological terms, makes it more likely that stories of other mythical, human-like creatures such as yetis are founded on grains of truth.”⁴

A relatively recent paper, published in the *New Mexico Museum of Natural History and Science Bulletin* (Meldrum, 2007), offers the first formal and systematic description of footprints that have been attributed to one such hominoid, specifically the North American “Sasquatch,” making it a legitimate work of ichnology. This paper involves careful analysis of high-quality casts of a pair of footprints, claimed to have been made by the alleged hominoid of the famous Patterson-Gimlin film of 1967—shot by Bluff Creek, California. The footage shows a purported 2.13-meter-tall bipedal creature striding away from the two eyewitnesses (one of whom was, of course, filming the creature). The casts of the Patterson-Gimlin footprints are held in the National Museum of Natural History, Smithsonian Institution. A further ten casts are held in the Titmus Collection at the Willow Creek-China Flat Museum, California.

Meldrum (2007) generated 3D scans of these casts that are archived at the Idaho Museum of Natural History as part of a footprint virtualization project. He submitted detailed descriptions of both the Smithsonian and Titmus casts, identifying them as the holotype for a new ichnogenus and ichnospecies *Anthropoidipes ameriborealis* (North American Ape Foot). Meldrum (2007) writes that the tracks are “plantigrade pentadactyl bipedal primate footprints [that] imply a primitively flat, flexible foot lacking a stiff longitudinal arch, combined with a derived, non-divergent medial digit” (p. 225). Meldrum’s claim is controversial. Woodley (2011), for example, notes that “extant organismal traces are not regulated by the *Code* (of the ICZN) if established after 1930 (Art. 1.3.6), so strictly speaking, no such nomina can be recognized by the ICZN” (p. 70). Nonetheless, Meldrum (2007) notes that there is some ambiguity in the *Code*, citing as an example an (at the time in press) ichnological naming of fossil tracks of the extant taxon *Homo sapiens* (Kim et al., 2008a, b; see also Meldrum et al., 2011 for another example). Whatever the ultimate status of the nomen *A. ameriborealis*, it is clear that Meldrum (2007) has brought a rare level of scientific rigor to the study of the North American hominoid generally known as “Sasquatch” through this ichnological research.

A major reason for openness to the possible existence of unknown hominoids is that ethnoknowledge and other indirect forms of evidence are known to play a substantial role in the process of species discovery, especially in the case of primates. Rossi, Gippoliti, and Angelici (2018) find that in a sample of 42 discoveries of primate species between 1980 and (roughly)

4 It should be noted that Gee (2004) was writing on the basis of erroneous information suggesting that *Homo floresiensis* went extinct relatively recently. Sutikna et al.’s (2016) more definitive work does not provide evidence that *H. floresiensis* survived beyond 50,000 years before the present. Sutikna et al. (2018) provide evidence that *H. floresiensis* likely went extinct around 50,000 years before the present.

the present, a large percentage (40.5%) of them involved study occasioned by ethnoknowledge. Indeed, studies routinely demonstrate that description records of known species are far from complete (e.g. Giam et al., 2012; Paxton, 1998; Raynal, 2001; Solow & Smith, 2005; Woodley et al., 2008), suggesting that via thorough appraisal of ethnoknowledge and other indirect forms of evidence, the discovery process may be greatly enhanced, and so potentially yield additional zoologically novel taxa.

In the current work, we add to the body of intriguing hominological data that has been so far accumulated. We present the results of a statistical examination of a dataset of 1,349 North American (US and Canadian) hominoid eyewitness reports. Contrary to the view of many academic psychologists, which holds that eyewitness memory is unreliable, data indicate that (1) eyewitness memory is not intrinsically unreliable and if properly tested is typically highly reliable (Wixted, 2018), and that (2) human susceptibility to false memory formation likely has been exaggerated (Andrews & Brewin, 2017; Brewin & Andrews, 2017). Indeed, eyewitness reports of “mystery” animals can in some instances provide more than sufficient detail to enable plausible identification of the organism (or object) described (see, e.g., France, 2019; Paxton & Holland, 2005; Paxton, Knatterud & Hedley, 2005; Woodley et al., 2011). In aggregate, eyewitness reports of “mystery” organisms are known to yield valuable quantitative insights into the behavior of what has been observed (Paxton, 2009), and show signs of consistency across reporters, potentially suggesting reliability (Paxton & Shine, 2016). We test for statistically significant convergences among reported traits of allegedly observed hominoids in the data.

We also conduct a cumulative species description curve analysis of the ape superfamily (Hominoidea). This involves fitting a curve to the cumulative description record (i.e. the tally) for ape species (based on year of formal description), and using that curve to predict the point at which the inventory is likely to become fully enriched (i.e. when no further descriptions are likely to be made). The use of taxonomic description rather than discovery is to be preferred in these sorts of analyses (e.g. Woodley et al., 2008) as it is less ambiguous than discovery. For the apes, the earliest formal description was made by Linnaeus in 1758 (humans), and the most recent were in 2017 (the Skywalker hoolock gibbon, Fan et al., 2017, and the Tapanuli orangutan, Nater et al., 2017).

Critically, in analyzing these data we recognize that it is not possible to use these to demonstrate the existence of a North American hominoid (this cannot be done with minimal physical evidence), and are mindful of Paxton’s (2011) argument that eyewitness reports might in some instances tell us more about the reporting process than about what is being reported. Nevertheless, we endeavor to ascertain what patterns and consistencies are present among these reports; additionally, we examine factors seldom considered in evaluating eyewitness reports of “mystery” animals, such as available demographic information about the eyewitnesses and ecologi-

cal factors potentially relevant to the content of reports. Consistency among reports constitutes a type of interrater reliability, potentially indicating a “signal” in observational “noise,” insofar as it suggests the presence of some phenomenon driving reports that is not idiosyncratic to eyewitnesses and might therefore have an independent, objective reality. When such consistency is present and is inconsistent with explanations that refer only to known animals (or, more broadly, only to essentially “conventional” phenomena), this might be taken to favor claims of possible zoological novelty (for examples of how “grouping” approaches have been used to falsify “monster” claims, see France, 2019; Woodley et al., 2011).

In a similar vein, it should also be stressed that cumulative description curves cannot show precisely what is left to be described; but they can indicate roughly how many taxa might yet be described, and they can also indicate the time frame over which such descriptions are likely to occur. Despite limitations, combining the results of such analysis with appraisals of eyewitness data pertaining to a potentially zoologically novel hominoid might reasonably increase the epistemic probability that such a thing exists (for related arguments, see Woodley et al., 2008).

Methods

The eyewitness database used presently was assembled by the late John Green during the period from 1950 to 1996 (Green, 1968, 1970, 1973, 1978, Short & Green, n.d.), and was electronically compiled and supplemented by Bobbie Short as part of the *Bigfoot Encounters* database (a link to the archived repository of these data is provided in the references). The sources of the data broke down as follows: books (1.8%), colleagues (22.4%), computer survey (20%), deposition (0.5%), hearsay (1%), internet (0.3%), interview (6.9%), letter (13.1%), magazine (1.6%), newsletter (7.6%), newspaper (18.9%), observation [by Green] (0.2%), phone call (3.4%), police report (1.7%), and radio (0.5%); Green collected reports from 1950 to 1996, but the reports included information on at least the year in which the sighting occurred, and it was on the basis of the time that sightings occurred, not on the basis of when they were collected, that our analysis was conducted.. Characteristics associated with each sighting were coded by Green's daughter and tabulated in Excel. JK and JRG reduced the data into smaller tables, organized under the following five categories:

1. *Eyewitness characteristics*: These include information about the demographic, socioeconomic, and educational characteristics of the eyewitnesses. This is critical for assessing the validity of certain stereotypes about the role of lack of education and parochialism, and/or the existence of a Bigfoot subculture (e.g. Regal, 2011), in influencing patterns among sightings.

2. *Ecological characteristics*: These include information about the time of day of the sighting, visibility conditions, sighting duration, and distance (of the alleged hominoid) from the eyewitness in each case.
3. *Ethological characteristics*: These include behavioral observations associated with the hominoid reported by eyewitnesses, such as walking behavior, vocalization, object handling, food preferences, and aggression, as well as association with water sources and behavior possibly related to proximity to the eyewitness.
4. *Morphological characteristics*: These include observations relevant to the morphological profile of the hominoid, such as hair coverage, height, and craniometry, as well as whether bear-like traits were present. The last of these is especially important, since Lozier et al. (2009) suggest on the basis of ecological niche modelling that the distributions of eyewitness reports of the hominoid converge on the known spatial and habitat distributions of the Black bear (*Ursus americanus*). Given that such bears can rear up onto their hind limbs as part of threat display and curiosity-related behaviors (mimicking bipedalism), it is possible that some witnesses might be misreporting bears as hominoids. The explicit lack of bear-like traits among the eyewitness reports would count against this hypothesis, however.
5. *Ichnological characteristics*: These include reports of purported hominoid tracks, specifically footprints. Through this dataset we investigate the length of tracklines; the length, width, and depth of individual tracks; heel width and depth; and toe depth in order to characterize the properties of the largest possible set of tracks. We also examine eyewitness estimates of track-maker weight, in addition to the properties of the tracks that eyewitnesses themselves made in moving through an area.

The following is an example of a sighting report (Short & Green, n. d.):

Pierce County, WA

Graham, November 6, 1976

Bill Brevick of Graham alone with Paul Willis, Scott Martin and Milo Rogers camped about 5 miles north of Windy Pass on Mt. St. Helens. While walking around at night, they found on steep pumice slope 30 to 50 footprints that were 18 inches long, sinking about three inches down compared to their one inch. They took flash picture. Stride was four to five feet. Where they found it, was tough to walk.

Various data points can be extracted from this report, including the day, month, and year of the sighting, the number of witnesses, the location of the sighting, the rough time of day in which the sighting occurred (“night,” in this case), the presence of ichnological data, the lengths and depths of footprints, the estimated stride length, and the depth of the witnesses’

own footprints (for comparative purposes). The database assembled from such data extraction was initially analyzed by JK and JRG, and was reanalyzed by MAWOM. Two-tailed statistical significance values along with 95% confidence intervals are reported for a subset of the percentages (computed using chi-squared), in order to determine if the modal (highest-percentage) “responses” were reported significantly more than the others. This was calculated by taking the target item’s percentage (only in instances where the modal percentage was >50%) and comparing it with the aggregate percentage of the remaining items. All analyses were conducted using an online chi-squared by percentage calculator (medcalc.net).

The fully coded Green dataset employed here includes a total of 1,386 reports for which data on at least one relevant characteristic could be obtained. A very small number of sightings (one) was excluded on the basis of absurdity. The one excluded account reported a hominoid strolling around Hollywood, California. Approximately 6.5% of observations were alleged to have occurred prior to 1950, with the earliest from 1869. All data are archived in the form of Excel files by JK. The online database of reports compiled by Short (Short & Green, n.d) contains a larger number of sightings ($N=4,724$), covering a wider range of years (up to 2001). These additional reports could not be employed in the current analysis because they have not been coded. We have no reason to believe that the smaller subsample of coded reports used here is in any way unrepresentative of the total report pool. In any case, whether this subsample is representative of the full sample can be directly tested in future research by comparing the results of our analysis to those obtained from the use of the full dataset, once this is coded.

In order to avoid use of a large number of discrete tables (89 in total), we chose to report the percentage values of the highest-percentage “responses” to each “item” (where a “response” is some datum from a report and an “item” is some category of information to which the datum corresponds—an example of an “item” would be “month of sighting” and an example of a “response” to that “item” would be “November”). This allowed presentation of a more manageable number of tables (one main table per set of related “items” containing just the highest-percentage “responses” to the “items” in the set). We also report the averages of various “responses” in separate tables. This approach brought the total table number down to 15.

Finally, we conducted the cumulative species description curve analysis on the description record of the apes (Hominoidea). For this analysis, two different curvilinear functions were fitted to the data (description dates for each ape species were obtained from Wikipedia, Anon., 2019). The first was the Michaelis-Menten function (a rectangular hyperbola developed to model the relationship between enzyme reaction velocity and substrate concentration), which has been adapted by various researchers to model the relationship between the rate of taxonomic description and the number of years that have elapsed since the first description was made (e.g. Paxton, 1998; Woodley et al., 2008). Another function (negative quadratic) was also

fitted to the data in order to determine whether a better fit to the observed cumulative description record could be achieved. These analyses were conducted in Excel and R.

Results

Eyewitness Data

Five items concerned aspects of the eyewitnesses. Table 1 reports the modal percentage responses for corresponding items and the percentages of those responses, along with the total sample size for each item and 95% confidence intervals for modal values > 50%. Two (40%) of the items were associated with significantly elevated levels of responding.

Item	Highest percentage response	Percentage	N
1. Hominoid witness age group	16–20 years of age	25%	510
2. Sex differences among witnesses	Lone males	71%*** (diff = 42%, 95% CI = 35.06% to 48.27%)	873
3. Education level	Secondary	51% (diff = 2%, 95% CI = -11.07% to 14.97%)	219
4. Occupational background	Rural/wilderness related professions	32%	659
5. Wildlife familiarity	Considerable familiarity	91%*** (diff = 82%, 95% CI = 65.11% to 88.83%)	304

*** $p \leq .001$

Table 1: Modal percentage responses for items in the eyewitness dataset

Ecological Data

Nineteen items concerned aspects of the hominoid's ecology. Table 2 reports the modal percentage responses for corresponding items and the percentages of those responses, along with the total sample size for each item and 95% confidence intervals for modal values > 50%. Seven (35%) of the items were associated with significantly elevated levels of responding.

Item	Highest percentage response	Percentage	N
1. Breakdown of sightings by decade	1970–1979	40%	1349
2. Breakdown of sightings by month	July	13%	996
3. Breakdown of sightings over 24-hour period	Day	19%	879

4. Breakdown by day-night	Day	64%*** (diff = 28%, 95% CI = 21.33% to 34.49%)	879
5. Lighting conditions at sighting location	Daylight	56%** (diff = 11%, 95% CI = 4.35% to 17.91%)	828
6. Ranked visibility conditions at sighting location	5 (fair)	26%	744
7. Sighting Duration	Brief (< 1 min)	52% (diff 3%, 95% CI = 3.68% to 10.31%)	778
8. Reported minimum distance between eyewitness and hominoid	1–50 feet, includes “close” and “contact” (0.30–15.24m)*	84%*** (diff = 69%, 95% CI = 57.97% to 76.39%)	451
9. Physical evidence left by sighting location	Tracks	91%*** (diff = 82%, 95% CI = 54.04% to 90.30%)	131
10. Sighting location by US State and Canadian Province	California	26%	1386
11. Degree of remoteness of sighting location	Wild	64%*** (diff = 28%, 22.45% to 33.29%)	1301
12. Degree of precipitation at location	Low	53% (diff = 5%, 95% CI = -8.26% to 18.01%)	215
13. Presence of nearby bodies of water	River	34%	685
14. Habitat at sighting location	Alpine	26%	1209
15. Terrain at sighting location	Some kind of road	28%	1125
16. Tree type at sighting location	Coniferous	61%*** (diff = 22%, 95% CI = 10.38% to 32.79%)	298
17. Degree of tree cover at sighting location	Heavy	54%* (diff = 8%, 95% CI = 0.99% to 14.9%)	786
18. Degree of undergrowth at sighting location	Heavy	38%	512
19. Type of substrate at sighting location	Fine material	45%	547
20. Condition of substrate at sighting location	Dry	49%	166

* $p \leq .05$, *** $p \leq .001$

Table 2: Modal percentage responses for items in the ecological dataset

* Quantitative measurements were originally reported in non-metric units (e.g. feet, inches, pounds). The SI-unit equivalents are reported in parentheses and, in text, are reported instead of their non-metric equivalents.

Elevation, Distance from, and Population of Nearest Town

Hominoid sightings are reported at many elevations above sea level, with the average altitude being quite high at approximately 819 meters (Table 3), relative to a mean elevation of 760 meters for the US and 487 meters for Canada. Sightings are reported from the most remote wilderness locations to the very edges of human habitation. The average distance of the nearest town from reported hominoid sighting locations is about 22 kilometers. The average population of the nearest town is almost 11,000 people.

Average elevation:	2,688 feet (819.30m)	N = 1126
Mean distance from nearest town:	13.4 miles (21.57km)	N = 969
Mean population of nearest town:	10,781	N = 1331

Table 3: Average elevation at reported hominoid sighting location, and mean distance from and population of nearest town

Ethological Data

Seventeen items concerned aspects of the hominoid's ethology. Table 4 reports the modal percentage responses for corresponding items and the percentages of those responses, along with the total sample size for each item and 95% confidence intervals for modal values > 50%. Five (29.4%) of the items were associated with significantly elevated levels of responding.

Item	Highest percentage response	Percentage	N
1. Number	One large	85%*** (diff = 69.68%, 95% CI = 63.75% to 74.35%)	1365
2. Direction of movement relative to eyewitness	Across front of witness	43%	376
3. Length of walking steps	Long	75%*** (diff = 50%, 95% CI = 29.44% to 64.47%)	118
4. Length of running steps	Long	93%*** (diff = 86%, 95% CI = 41.84% to 93.86%)	74
5. Walking speed	Slow	54% (diff = 7.94%, 95% CI = 9.36% to 24.58%)	26
6. Running speed	Fast	64%*** (diff = 29%, 95% CI = 15.38% to 40.36%)	238

7. <i>Use of arms</i>	For picking up something	22%	66
8. <i>Objects handled</i>	Manmade object (inc. vehicle)	31%	44
9. <i>Foods eaten</i>	Meat	22%	63
10. <i>Water-related behavior</i>	Observed nearby	50%	81
11. <i>Vocalizations</i>	Screams	42%	143
12. <i>Odor</i>	Strong	67%*** (diff = 34%, 95% CI = 14.77% to 49.64%)	118
13. <i>Initial activity</i>	Staying still	40%	785
14. <i>Initial behavior in response to encounter w. eyewitness</i>	Fled from witness	26%	672
15. <i>Subsequent behavior in response to eyewitness</i>	Strode away	21%	696
16. <i>Interactions with eyewitness</i>	Looked in window	29%	80
17. <i>Interpreted aggressive behavior</i>	Towards witnesses/humans	37%	73

*** $p \leq .001$

Table 4: Modal percentage responses for items in the ethological dataset

Morphological Data

Thirty-five items concerned aspects of the hominoid’s morphology. Table 5 reports the modal percentage responses for corresponding items and the percentages of those responses, along with the total sample size for all responses classes per item and 95% confidence intervals for modal values > 50%. Twenty-two (62.9%) of the items were associated with significantly elevated levels of responding.

Item	Highest percentage response	Percentage	N
1. <i>Posture and locomotion</i>	Bipedal (erect)	87%*** (diff = 74%, 95% CI = 66.31% to 79.52%)	888
2. <i>Robustness and gracility</i>	Heavy	49%	382
3. <i>Hair color</i>	Brown	33%	646
4. <i>Absence of hair</i>	On face, in addition to elsewhere	89%*** (diff = 79%, 95% CI = 45.98% to 88.97%)	92
5. <i>Frontal torso width in relation to that of humans</i>	Wide	77%*** (diff = 53%, 95% CI = 33.47% to 66.57%)	132

6. <i>Frontal torso shape</i>	Widest at top	54% (diff = 9%, 95% CI = 10.41% to 26.79%)	81
7. <i>Lateral torso shape</i>	Wide	70%*** (diff = 39%, 95% CI = 16.6 to 56.74%)	89
8. <i>Shoulder width in relation to that of humans</i>	Wide	93%*** (diff = 85%, 95% CI = 59.48% to 92.23%)	179
9. <i>Shoulder shape</i>	Loped	53% (diff = 6%, 95% CI = 14.53% to 24.92%)	91
10. <i>Neck length</i>	Short	50%	175
11. <i>Neck width in relation to that of humans</i>	Wide	85%** (diff = 70%, 95% CI = 19.7% to 86.14%)	27
12. <i>Top of head profile</i>	High in back	32%	105
13. <i>Back of head profile</i>	Sloped to shoulders	76%*** (diff = 52%, 95% CI = 16.62% to 72.1%)	41
14. <i>Face appearance</i>	Ape-like	55% (diff = 9%, 95% CI = 10.34% to 27.6%)	99
15. <i>Height of forehead</i>	Low	67%* (diff = 33%, 95% CI = 7.23% to 53.64%)	63
16. <i>Shape of forehead</i>	Sloped back	89%*** (diff = 77%, 95% CI = 31.61% to 89.32%)	44
17. <i>Size of brow ridge</i>	Heavy	62% (diff = 24%, 95% CI = 5.57% to 48.31%)	45
18. <i>Eye size</i>	Large	53.6% (diff = 7.2%, 95% CI = 17.97 to 31.14%)	56
19. <i>Eye spacing</i>	Wide set	43%	44
20. <i>Eye reflectivity color</i>	Reflected red	35%	84
21. <i>Presence and appearance of snout</i>	No snout	95%*** (diff = 89%, 95% CI = 49% to 94.78%)	165
22. <i>Nose shape</i>	Large, flat nose	67%** (diff = 33.34%, 95% CI = 8.37% to 52.94%)	69
23. <i>Mouth size</i>	Large	66%* (diff = 32%, 95% CI = 0.15% to 55.96%)	41
24. <i>Lip thickness</i>	Thin	65%* (diff = 30%, 95% CI = 0.01% to 53.31%)	46
25. <i>Arm length</i>	Long (to knee or below)	69%*** (diff = 38%, 95% CI = 22.99% to 49.82%)	205

26. <i>Arm width</i>	Bulky	72%*** (diff = 45%, 95% CI = 18.62% to 63.13%)	69
27. <i>Hand size</i>	Large	96%*** (diff = 92%, 95% CI = 13.18% to 97.19%)	23
28. <i>Hand appearance</i>	Human-like	98%*** (diff = 96%, 95% CI = 17.35% to 98.59%)	49
29. <i>Lateral appearance of abdomen</i>	No protrusion	71%** (diff = 42%, 95% CI = 14.75% to 61.27%)	63
30. <i>Buttocks appearance</i>	Human-like	55% (diff = 10%, 95% CI = -17.51% to 35.5%)	47
31. <i>Presence of tail</i>	No tail	100%*** (diff = 0, 95% CI = 100% to 100%)	33
32. <i>Leg length in proportion to overall height in relation to humans</i>	Medium	43%	139
33. <i>Leg width</i>	Wide	74%*** (diff = 48%, 95% CI = 24.79% to 63.98%)	92
34. <i>Foot length in relation to body size</i>	Large	77%*** (diff = 55%, 95% CI = 15.24% to 75.38%)	32
35. <i>Foot width in relation to foot length</i>	Wide	95%*** (diff = 90%, 95% CI = 11.26% to 96.45%)	20

* $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

Table 5: Modal percentage responses for items in the morphological dataset

Height

Hominoid eyewitnesses offering information about height invariably described the animal as having a very tall stature, with an average height of over 2 m (Table 6). There would be a difference between the hominoid’s standing height and walking height, with the latter probably appearing to be several centimeters less than the former. Also, depending on the nature of the ground substrate, hominoid feet, as indicated by many track finds, would sometimes sink 6 cm or more into the ground, which should result in a slightly shorter perceived height. Eyewitnesses seemingly did not take these factors into account, and we have not attempted to interpret from the reports when a given stature corresponded to a standing height or a walking height.

Mean height:	7 feet, 6 inches (2.32m)	$N = 630$
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Table 6: Estimated height of reported hominoid

Ichnological Data

For those cases with data concerning tracklines, about half of all reported hominoid tracklines involved between one and ten tracks. These data are presented in Table 7.

Item	Highest percentage response	Percentage	N
1. Number of reported tracks per track-line seen, counted or estimated	1-10	51.2% (diff = 2%, 95% CI = 9.79% to 14.45%)	254

Table 7: Modal percentage response for an item in the ichnological dataset

Track length

The most commonly recognized and discussed feature of reported hominoid tracks is their length. The average track length in the database is 40.78 cm (Table 8). Smaller tracks ranging down to about 25.4 cm in length and larger tracks ranging up to about 55.88 cm in length were also reported.

Mean track length:	16.056 inches (40.78 cm)
Median track length:	16.250 inches (41.28 cm)
SD:	3.018 inches (7.67 cm)

Table 8: Length of reported hominoid tracks ($N = 495$)

Track width

Track width is the second most commonly recognized and discussed feature of reported hominoid tracks. The average track width in the database is just over 18.41 cm (Table 9). Track width generally varies in accordance with track length.

Mean track width:	7.247 inches (18.41 cm)
Median track width:	7.000 inches (17.78 cm)
SD:	1.695 inches (4.31 cm)

Table 9: Width of reported hominoid tracks ($N = 306$)

Heel Width

The average width of the heel in reported hominoid tracks is 12.63 cm, a little more than five centimeters narrower than the overall foot or track width (Table 10). This is similar to what is found in the human foot, the heel of which is also narrow relative to the overall foot.

Mean heel width:	4.971 inches (12.63 cm)
Median heel width:	5.000 inches (12.7 cm)
SD:	1.168 inches (2.97 cm)

Table 10: Heel width of reported hominoid tracks ($N = 99$)

Track Depth

The third most commonly recognized and discussed feature of reported hominoid tracks is the depth of the track in the ground. The average track depth in the database is 6.08 cm (Table 11). This is consistent with a heavy weight on the part of the trackmaker. However, track depth will vary with the nature of the substrate, and sometimes the amount of moisture. Substrates composed of rock or gravel will record no track at all. Hard compacted ground will leave little or no track outline. Soft substrates, particularly when moist, will leave better outlines and provide measurable depths and visible morphological features.

Mean depth in ground:	2.392 inches (6.08 cm)
Median depth in ground:	2.75 inches (6.99 cm)
SD:	4.228 inches (10.74 cm)

Table 11: Depth in ground of reported hominoid tracks ($N = 177$)

Heel Depth

The average depth of the heel in the ground in reported hominoid tracks is 3.69 cm (Table 12). In human bipedal striding, the heel is first to impact the ground, and is thus usually what leaves the deepest impression. This may not always be so in the case of the hominoid, as there is evidence for a locomotory function called the compliant gait, in which the leg is partially lifted in a bent position and lowered in a way that the foot makes contact with the ground more horizontally than in a normal human stride (Meldrum, 2004). This gait has also been referred to as a “Groucho Marx walk.” Such a gait would result in a reduced heel impact, one which would produce a lesser heel depth than foot depth. This is indicated by the database heel depth data.

Mean depth in ground:	1.453 inches (3.69 cm)
Median depth in ground:	1.250 inches (3.18 cm)
SD:	1.867 inches (4.74 cm)

Table 12: Depth in ground of heel in reported hominoid tracks ($N = 32$)

Toe Depth

The average depth of the toes in the ground in reported hominoid tracks is 3.2 cm (Table 13). In human bipedal striding, the toes leave the ground last, providing the “toe off” force for the leg swing, and are thus what usually leave the second deepest impression (Meldrum, 2004). If the hominoid uses a compliant gait in its locomotion, as discussed above, this will produce a more horizontal ground impact by the foot, and, as with a reduced heel impact, it will also result in a reduced toe off, one which would produce a lesser toe depth than foot depth. This is consistent with the toe-depth data below.

Mean depth in ground:	1.259 inches (3.20 cm)
Median depth in ground:	1.250 inches (3.17 cm)
SD:	0.853 inches (2.17 cm)

Table 13: Depth in ground of toes in reported hominoid tracks ($N = 27$)

Eyewitness track depth

Hominoid *eyewitness* track depth has comparative relevance. The mean depth in the ground is 2.11 cm (Table 14). This value is less than a third of that for reported hominoid tracks, consistent with a much greater weight on the part of the entities making the alleged hominoid tracks than on the part of the human eyewitnesses.

Mean depth in ground:	0.831 inches (2.11 cm)
Median depth in ground:	0.69 inches (1.75 cm)
SD:	2.053 inches (5.21 cm)

Table 14: Depth in ground of hominoid eyewitness tracks ($N = 105$)

Eyewitness Weight

The weight of the eyewitnesses associated with hominoid tracks is also of interest. The average weight of the track eyewitnesses who provided weight data is 84.20 kg (Table 15). This can be related to the depth of the eyewitness tracks given in Table 14. Due to the varying substrates in the sample it is not possible to estimate average hominoid weight in light of the human weight and footprint data.

Mean weight:	185.62 lb (84.20 kg)
Median weight:	186.00 lb (84.37 kg)
SD:	45.071 lb (20.44 kg)

Table 15: Average weight of track eyewitness ($N = 64$)

Cumulative Species Description Curve Analysis

There are 26 known species of ape (Hominoidea), this being the presumed superfamily to which the hominoid belongs (e. g. Greenwell & King, 1981; Krantz, 1986; Meldrum, 2007; Strassenburgh, 1975). The complete description record for Hominoidea is presented in Table 16.

<i>Homo sapiens</i> (Linnaeus, 1758)
<i>Pongo pygmaeus</i> (Linnaeus, 1760)
<i>Hylobates lar</i> (Linnaeus, 1771)
<i>Pan troglodytes</i> (Blumenbach, 1775)
<i>Hylobates moloch</i> (Audebert, 1798)
<i>Hylobates agillis</i> (Cuvier, 1821)
<i>Symphalangus syndactylus</i> (Raffles, 1821)
<i>Nomascus concolor</i> (Harlan, 1826)
<i>Pongo abelii</i> (Lesson, 1827)
<i>Hoolock hoolock</i> (Harlan, 1834)
<i>Nomascus leucogenys</i> (Ogilby, 1840)
<i>Hylobates muelleri</i> (Martin, 1841)
<i>Gorilla gorilla</i> (Savage, 1847)
<i>Hylobates pileatus</i> (Gray, 1861)
<i>Nomascus nasutus</i> (Künckel d’Herculais, 1884)
<i>Nomascus hainanus</i> (Thomas, 1892)
<i>Hylobates klossi</i> (Miller, 1903)
<i>Gorilla beringei</i> (Matschie, 1903)
<i>Nomascus gabriellae</i> (Thomas, 1909)
<i>Hylobates albibarbia</i> (Lyon, 1911)
<i>Pan paniscus</i> (Schwartz, 1929)
<i>Nomascus siki</i> (Delacour, 1951)

Hoolock leuconedys (Groves, 1967)
Nomascus annamensis (Thinh et al. 2010)
Hoolock tianxing (Fan et al. 2017)
Pongo tapanuliensis (Nurcahyo et al. 2017)

Table 16: Description record for Hominoidea along with describer and description dates

Modelling patterns in the description record for this superfamily yields indications as to whether the record is exhausted or not (i.e. whether or not it can accommodate additional taxa). One approach to modelling these records involves the use of the Michaelis-Menten function (e.g. Paxton, 1998; Woodley et al., 2008).

Michaelis-Menten function:
$$S_{(n)} = \frac{S_{(\max)}n}{B + n}$$

Where n is the number of years that have elapsed since the year of first description, $S_{(n)}$ is the difference between the numbers of species known in the initial year and year in which the most recent description was made. $S_{(\max)}$ and B are regression constants calculated through the method of lesser squares. The value of B was here estimated to be 14.5 and the value of $S_{(\max)}$ was estimated to be 25. The resultant predicted numbers of descriptions per unit time yielded a relatively poor fit to the observed numbers, however ($r=.75$, $p<.001$), especially early on in the history of the description record, where the predicted numbers were far greater than the observed numbers. Given this relatively poor fit, an alternative function was fitted to the description record, specifically a quadratic function.

Quadratic function:
$$S_{(n)} = an^2 + bn + c$$

Where n is the number of years that have elapsed since first description and a , b and c are coefficients corresponding to the quadratic and linear coefficients and the constant respectively. The constant value was here estimated to be 0.021. This fitted the observed description record almost perfectly ($r=.99$, $p<.001$), and is clearly (i.e. based on what is sometimes termed the “Inter-Ocular Trauma Test”) a substantially better fit to the data than the Michaelis-Menten function. The results of this analysis are graphed in Figure 1, and indicate that the observed and expected description records are in strong agreement, with the observed numbers of taxa at any given point throughout the description record history being very strongly aligned with the predicted numbers.

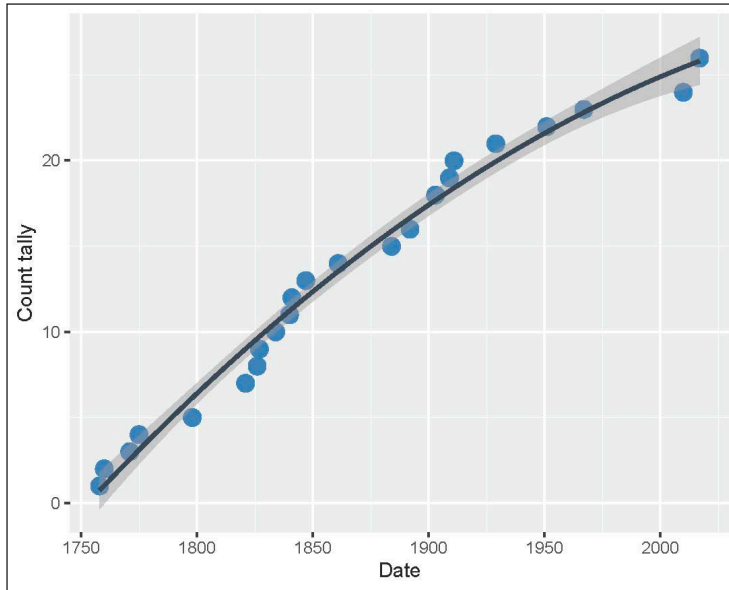


Figure 1: Record of all 26 described ape species fitted to a negative quadratic form function with 95% confidence intervals.

The inflection point in the curve (i.e. when the trend goes from positive to negative) can be used to estimate the point at which the record becomes saturated. The extrapolated trend inflects in the year 2104, or 346 years after the initial description was made (*Homo sapiens* in 1758). The difference between the predicted numbers of species in 2104 and 2017 is 1.53, indicating that (rounding to the nearest whole species) two new ape species might be described and added to the description record between these years. The lower 95% confidence interval inflects negatively in 2069, 52 years after 2017, and indicates that 0.55 new taxa (or one rounded to the nearest whole species) remain to be described. The upper 95% confidence interval inflects negatively in 2133, 116 years after 2017, and indicates that 2.7 new taxa (or three rounded to the nearest whole species) remain to be described.

Discussion

We found that all age groups are represented among eyewitnesses, that males reported hominoid sightings far more often than females, that 86% of witnesses had college and/or secondary education, that both urban and rural population groups are substantially involved in making sightings reports, as are many different kinds of professions within these groups, and that most

witnesses claimed to have a strong familiarity with wildlife. These data indicate that whatever role there might be for a Bigfoot subculture (for a related discussion see Regal, 2011, on “crack-pots” in cryptozoology) in reporting sightings has been minimal, with witnesses exhibiting a high diversity of backgrounds.

Hominoid sightings were reported every month of the year, in both daylight and darkness, usually under good visibility conditions, with half of them lasting at least a minute, and with half of them placing the hominoid within approximately 15 meters of the witness. The data indicate that most eyewitnesses should have been able to accurately identify ordinary animals had they been the source of the perception. We also found that most sightings were associated with a coniferous, montane forest habitat characterized by heavy tree cover and undergrowth, and that, within this habitat, about half of the reports came from open terrain that provided extended fields of view.

Among the relevant subset of witnesses, most described single animals that took large steps when walking or running. The animals’ arms were used for a wide variety of functions, and many different kinds of object were reportedly handled. Hominoids were reported to eat various sorts of food, indicating that they exhibit a generalized diet consistent with opportunistic omnivory. Even so, the most common single food item reported was meat. The animal was often reported to be in proximity to, and often interacting with, sources of water, and in general appeared to have a close familiarity with water. The behavior of the organism when first encountering a human usually involved avoidance or flight responses. Its subsequent behavior usually also involved flight responses. A small minority of eyewitnesses reported aggressive behaviors. All such eyewitnesses apparently survived such encounters, so the reported aggressive behaviors could also be interpreted as bluff responses (assuming that there have not been many unknown fatal encounters). A few eyewitnesses actually reported bluff responses. In summary, the behavioral data indicate that the animal is a solitary, fast-moving biped that uses its upper limbs to manipulate various kinds of object; that it eats a wide variety of foods; that it has a close familiarity with water; and that it rarely interacts with humans, usually departing the area rapidly when humans are encountered.

In terms of physical appearance, the hominoid was described as a dark, hair-covered, erect biped with a height of over 2.32 meters, and as having great overall robustness, but particularly so in its upper body. The neck was described as thick, and the top or rear of the head as peaked, suggesting a sagittal crest. The brow ridge was described as heavy, surmounted by a low and sloped-back forehead. The face was described as ape-like, rather than monkey-like or human-like. A bear-like snout was not reported on the face. Neither bear-like paws nor a tail were reported. On this basis, the plausibility of the inference based on Lozier et al.’s (2009) analysis, namely that the hominoid and the Black bear are likely one and the same, is diminished.

Interestingly, red-eye reflectivity (the modal reflectivity color) indicates the absence of a *tapetum lucidum*. This biological structure is a reflective layer at the back of the retina that increases visual sensitivity at low light levels, and is thus found in most nocturnal mammalian species. However, the reflected light from a *tapetum* is typically yellow or green. Red reflectivity is known to be merely a product of the reflection from blood vessels at the rear of the eye, and the reported red (or orange) eye reflectivity in the hominoid is consistent with that. These reports are intriguing, especially as such anatomical details are not commonly known to non-specialists. The presence of red, amber or orange eye reflectivity (which were collectively reported in 42% of relevant eyewitness reports – in many cases no color was given for reflectivity), potentially indicating the lack of a *tapetum* in the hominoid, might be consistent with the observation that a significant majority of sightings occur during the day or under conditions of daylight, suggesting a primarily diurnal activity cycle. This could be thought unsurprising since nocturnality in primates is very rare.

Coniferous forests, where, based on a subset of the data, a significantly larger number of hominoid sightings occur relative to other ecological contexts, would require that the hominoid engage in more extended and faster travel over much wider areas in order to subsist, owing to low primary productivity. This factor, along with their omnivorous diet and the necessary bipedal locomotion required to cover such areas, might select for more “human-like” buttocks as a functional adaptation to bipedalism allowing the attachment of the very heavy muscles that would be required for strenuous bipedal locomotion in mountainous terrain. Our data do indicate a slight (but not significant) tendency for human-like buttocks to be reported on the hominoid.

Consistent with Meldrum’s (2007) ichnological research, most putative hominoid track (*A. ameriborealis*) reports in the dataset describe something similar to human tracks in their general outline, and, when features are apparent, in their morphology. Their main difference from human tracks, at least superficially, is their much larger size coupled with the indications of a compliant gait. So-called *A. ameriborealis* may be due to: 1) the passage of a large animal representing an as yet unrecognized species; 2) the passage of a human or a large animal representing a recognized species, but whose tracks have somehow been misinterpreted or distorted; 3) the activities of hoaxers; or 4) the ground indentations left by other causes that are not accurately identified for whatever reason(s). A total of 495 *A. ameriborealis* finds are included in the dataset. Both single and multiple track finds are included. Sometimes, hundreds of tracks were reported over a distance of a mile or more. However, most of the track reports in the dataset do not involve claimed sightings of any animal or animals that might have made the tracks. The average length of *A. ameriborealis* is 40.78 cm in the current data, while the average width is 18.41 cm. These measurements are far greater than those for the mean length and width of human male feet in North America, which are 26.67 cm and 9.91 cm respectively. The average depth in the ground of *A. ameriborealis* is 6.08 cm, consistent with a very

large weight on the part of the trackmaker. Data on eyewitness track depth reveals an average depth in the ground of only 2.11 cm. The average weight of the eyewitnesses in the dataset is 84.2 kgs.

It should be noted that this is not the first paper to examine data from this dataset. Papers by Richard Beeson published in the 1970s and 80s (Beeson, 1979, 1988) analyzed a very small subset of the Green dataset (a few hundred reports). As in the current work, Beeson (1988) noted that the putative hominoid is mostly encountered as a singleton (90% of reports); however, he observed that it is also “inordinately nocturnal” (p. 239). He furthermore claimed that it is associated with “anthropomorphic” (p. 239) characteristics that are “closely associated with the life-environment of those who report them” (p. 239).

On the basis of this analysis and other considerations, Beeson (1988) suggests that “Sasquatch” “is far more illusive [sic] than any other known animal and many times more illusive [sic] than any other primate” (p. 239) and finally that it “is strikingly a larger-than-life animal” (p. 240). Beeson’s conclusion is that tactical deceit concerning the existence of what he terms “improbable species,” such as Sasquatch, functions as a mechanism of social control in human behavioral ecology.

Examination of the more comprehensive sightings dataset indicates that only the observation that singletons are mostly encountered is sustained (we find that “one large” animal is encountered 85% of the time [based on the relevant subset of sightings data], $p < .001$). The claim that the hominoid is “inordinately nocturnal” is not evidenced by the full dataset, with a significant majority of sightings offering relevant data occurring during the day (64%, $p < .001$) and under “daylight” lighting conditions (56%, $p < .01$). Although this pattern of reports might well reflect the fact that an anomalous animal is simply more likely to be spotted under daylight conditions than at night, it is nevertheless inconsistent with the claim made by Beeson based on his own analysis of a small subset of the data. We note also that Beeson (1979) erroneously asserts that red eyeshine indicates the presence of a *tapetum lucidum*, when in fact it indicates the opposite (p. 95). Moreover, we do not detect patterns in the data suggestive of anthropomorphism, or projections of the eyewitnesses’ life-environment onto the habitat of the hominoid. Instead we find that eyewitnesses come from a large variety of “ecological” contexts, with no indications of significant aggregation around “rural” or related settings. Moreover, we fail to see how the Green dataset employed here and in Beeson (1979, 1988) can function to adequately test Beeson’s social control via tactical deception hypothesis. Beeson (1979, 1988) maintains that the existence of Sasquatch is highly improbable. This may indeed be correct, but his bases for this claim are not especially compelling—for example, the idea that Sasquatch is “strikingly a larger-than-life animal,” that sightings indicate primary nocturnality (which, as already mentioned, is false), and that there is nothing “in the Sasquatch’s environment requiring” the great elusiveness attributed to it (he has no obviously adequate basis for such certainty about this) (Beeson, 1988: 239–240).

Although highly speculative, several researchers have suggested that the hominoid commonly known as “Sasquatch” might be an indigenous North American ape of some kind, perhaps an evolutionary offshoot of *Gigantopithecus* (an extinct East Asian Pleistocene primate that survived from around 5 million to approximately 100,000 years ago; Weidenreich, 1945), which may have crossed the Bering Strait land-bridge into continental North America prior to speciating into a novel hominoid species (Krantz, 1986, 1992, 1999; Meldrum, 2007; note that Heuvelmans, 1952 and Coon, 1954 had already proposed a connection between the Yeti and *Gigantopithecus*). Insofar as physical anthropologists have deigned to offer an opinion on the potential taxonomic status of the hominoid, *Gigantopithecus* is the most commonly (75%, or 12 out of 16 respondents) listed likely candidate (Greenwell & King, 1981). Such an ape would solve a zoological enigma, i. e. the conspicuous absence of indigenous primates in the North American continent, despite the presence of such animals in South America, Europe, Africa, and Asia. The morphological data strongly suggest that the hominoid is ape-like in appearance. Some interesting regularities in the ethological data also hint that the observed animal may be an ape of some sort. For example, at least half of all “Sasquatch” encounters for which relevant data were available involved an initial response by the animal to immediately withdraw and avoid contact with the eyewitness. It is pertinent here that, while great apes are now known to have mild, retreating dispositions—unless they are harassed or attacked—such a pattern of behavior only became apparent to primatologists, and then known to the general public, after difficult and extensive fieldwork on habituation to the presence of researchers that began proper in the 1960s and 1970s (e. g. Tutin & Fernandez, 1991). Interestingly, many of the accounts in the dataset describing avoidance or flight behaviors on the part of the hominoid predate by years or even decades similar accounts by field primatologists concerning the great apes. Also of interest is the reasonable probability that, if most of the reports in the dataset were fabricated accounts, a much higher proportion of descriptions involving “monster” motifs would likely be apparent, including harassment and attack behaviors (again this is inconsistent with Beeson’s reading of the data, which he argued supports the idea that the hominoid “is strikingly a larger-than-life animal”). An alternative explanation would be that hoaxers have too poor an imagination to include such motifs in their fictitious accounts, which seems unlikely; a further alternative explanation is that hoaxers often have been sophisticated enough to avoid offering “sensational” stories, but we have no obvious way to ascertain the probability that this is true.

A further striking regularity is that, even though a large primate of the reported height and bulk of the hominoid would certainly have no trouble in seriously injuring or killing a human, violence of that sort was not described in the subset of reports that included “attacks.” The possibility of bluff attacks, as engaged in by gorillas, might be considered, especially since

almost 5 percent of the relevant reports presented interpretations of behaviors as bluffs, again consonant with an ape-like behavioral pattern.

Finally, modelling the species description record for the ape superfamily (Hominoidea) indicates that it has yet to reach peak enrichment, with approximately two new taxa potentially to be described between the present and 2104 (when the curve inflects negatively, with one and three new taxa being indicated by the lower and upper 95% confidence intervals respectively). It is worth reiterating that novel ape species have been formally described as recently as 2017 (Fan et al., 2017; Nater et al., 2017); moreover, the situation with the hominoid may be akin to that of the two gorilla species, both of which were ethnoknown for several years prior to formal description, having even taken on something of a mythical status among naturalists at the time (Dixon, 1981). Thus a potential precedent exists in the history of the ape description record for a highly elusive and highly zoologically novel taxon persisting for many years prior to formal scientific description. Cumulative species description curves cannot tell us precisely what is left to be formally described; they can indicate, however, whether or not the record could accommodate novel taxa, which leaves open the possibility that currently ethnoknown organisms might be among those awaiting formal description. It should also be noted that our model assumes that the effort expended on searching for new taxa is constant and that species are equally detectable. Future research can focus on explicitly modelling variations in these factors in order to test the robustness of our findings.

Despite the foregoing, there are certainly grounds for skepticism about the existence of the hominoid. There are reasonable doubts concerning certain key evidences taken to support its existence, such as the Patterson-Gimlin footage and the alleged presence of dermatoglyphics (skin ridges) in the plaster casts of supposed Sasquatch tracks, which have been subjected to severe criticism (Naish, 2017; J. Meldrum, personal communication, informs us that he is preparing a response to these claims). Supposed DNA evidence for the existence of unconfirmed hominoids (e.g. Sasquatch and Yeti) has either been of exceptionally poor quality or has not been subjected to adequate scientific analysis (see, e.g., the controversies surrounding the publication of Ketchum et al., 2013), or has been attributed to known animals (Sykes, Mullis, Hagenmuller, Melton & Sartori, 2014). Moreover, our findings cannot exclude the possibility of a “stereotype activation” effect among the witnesses, whereby unusual features of the behavior of known animals become interpreted in the minds of eyewitnesses as indicative of the presence of “Sasquatch,” biasing their interpretations of events and reconstructions of memories so as to favor alignment with the Sasquatch stereotype.

Nevertheless, it should be understood that the case for the view that eyewitness memory is highly and inherently unreliable, and that individuals are very susceptible to false memory formation and to biases that distort perception, judgment, and memory, is quite poor. Indeed, scrutiny

of these psychological orthodoxies, possibly prompted by the low replicability of experimental social psychological research, sometimes called a “replication crisis” (Świątkowski & Dompnier, 2017), has accumulated evidence in recent years indicating that these orthodoxies are incorrect (Andrews & Brewin, 2017; Brewin & Andrews, 2017; Jussim, 2012; Wixted, Mickes & Fisher, 2018; Wixted, 2018).

Wixted et al. (2018) observe that “the message from experimental psychology—namely, that eyewitness memory is inherently unreliable and that eyewitness confidence should be disregarded—is incomplete, to say the least,” in light of the fact (among others) that “when investigators probe eyewitness memory, either via identification procedures (recognition tests) or interviews (recall tests), the information they receive is likely to be very reliable” (p. 333). To be sure, they do not deny that eyewitness memory is susceptible to contamination with false information, especially in the course of incompetent probing of memory,⁵ and they also observe that repeated probing of memory in the course of an investigation tends to reduce memory reliability, hence first accounts of memories are to be given greatest evidential weight (all else equal); still, Wixted et al. (2018) are quick to point out that in the “real world,” eyewitness memory should not be considered inherently unreliable. Consider their argument regarding cases where DNA evidence exonerated those falsely convicted on the basis of eyewitness testimony, which critics of the reliability of eyewitness memory frequently invoke:

It might be argued that the perspective we have advanced here is defensible in theory, but that, in practice, eyewitness evidence is so often mishandled that it is nevertheless valid to assert that eyewitness memory is (for all practical purposes, anyway) inherently unreliable. However [. . .] we believe that this is not a viable position. First, keep in mind that in the DNA exoneration cases for which the nature of the initial ID could be determined, the witnesses did not express high confidence. In fact, in no such case was a witness both mistaken and highly confident [. . .] These findings provide direct evidence that, by the time of the first ID in a typical police investigation, eyewitness memory is usually not contaminated to the point where a mistaken ID will happen with high confidence. That obviously can happen, but the available evidence suggests that it is not a frequent occurrence. If it were, one would expect to find many cases in which the initial ID in a DNA exoneration case were made with high confidence. So far, there is no such evidence. (Wixted et al., 2018: 333)

5 Evidently, however, stress is not among the factors that plausibly render eyewitness memory unreliable: “Contrary to decades of thinking, not only is eyewitness memory highly reliable on an initial test, it remains reliable even when the crime in question was highly stressful [. . .]” (Wixted, 2018: e14). Thus, the stress potentially associated with certain possible hominoid encounters should not be expected to render eyewitness testimony relating to them of no scientific value.

Wixted et al.'s (2018) findings are consistent with the broader literature on the reliability and accuracy of eyewitness memory under ordinary or "real-world" conditions. This is made plain in Koriat, Goldsmith, and Pansky's (2000) review of evidence on memory accuracy, which indicates that the common view that eyewitness memory is highly and intrinsically unreliable derives from the results of experiments that subject participants to unusual, artificial conditions (which, we note, seem designed to maximize the rate of memory errors):

[A] great deal of the work on memory errors defies the principle of representative design advocated by Brunswik [. . .] Consider, for example, false recalls in the DRM paradigm. The results indicate that the rate of false recall is roughly equal to that of accurate recall. If this finding were representative of memory performance in general, that is, if information retrieved were as likely to be correct as wrong, then memory would be totally useless. However, this high rate of false memories for particular items was obtained under deliberately contrived conditions. Under more representative conditions, a recalled item is much more likely to be correct than false [. . .] Thus, the output-bound accuracy of free recall has been found to be remarkably high across many experiments, typically ranging from 0.85 to 0.95. That is, over 85% of the items typically recalled are correct [. . .]. (p. 522)

Importantly, there is evidence that even under those contrived conditions, human memory is *still* very reliable:

Interestingly, this conclusion [about high free recall accuracy] holds true even for the contrived circumstances of the DRM paradigm when the entire recall output is considered. In McDermott's [. . .] Experiment 1, for example, in which lists of 15 words were used, rates of correct and false recall were 0.58 and 0.44, respectively, for an immediate test, and 0.50 and 0.46, respectively, for a delayed test. Fortunately, McDermott also reported data on extralist intrusions, which averaged 0.22 and 0.32 words, respectively, for each list [. . .]. On the basis of these data, we calculated the output-bound accuracy for each test: It amounted to 0.93 for the immediate test and 0.91 for the delayed test! Thus, recall responses in the DRM paradigm are remarkably dependable overall. (Koriat et al., 2000: 522)

The conclusion that this body of research offers continues to find support—in other words, the finding that human free recall of memories tends to present highly accurate information seems to be replicable. For instance, Diamond, Armson, and Levine (2019) report the following: "In the present study, participants underwent complex real-world experiences that were nonetheless controlled and verifiable, freely recalling these experiences after delays of 2 days to 3 years. As expected, memory quantity and episodic detail richness declined with increasing age and retention interval. Details that participants did recall, however, were highly accurate (93–95%) across age and time. This level of memory accuracy far exceeds comparatively low estimations among memory scientists and the public, as confirmed by an online survey" (p. 2). So there is evidence not only that free-recall memory in the "real world"

is very highly accurate, but that it remains so even years after the event(s) it concerns. Again, this is not an isolated finding: “With respect to retention interval, the present results are consistent with previous studies showing very high output-bound accuracy for naturalistic content after delays of week[s] to years [. . .] although initial event-proximal recall attempts likely enhanced memory in these studies. Participants in the present study performed free recall for the first time days-to-years after the initial event” (Diamond et al., 2019: 28). We should emphasize that a reasonably substantial proportion (at least ~13% but perhaps up to ~56% or even more is possible, though we cannot say given the data available) of the data used in our quantitative analysis above likely represents freely recalled sightings.

One could nonetheless wonder whether there are frequently encountered factors that seriously compromise the reliability of eyewitness memory, e.g. biases and suggestions, leading to false memory formation and other errors in memory. But this does not generally seem to be the case. Brewin and Andrews (2017)—summarizing their systematic review of evidence concerning the creation of false childhood memories in adults (apparently the only such review of evidence ever conducted at the time of its publication; see Brewin & Andrews, 2017: 2)—state that “some recollective experience for the suggested [false] events is induced on average in 47% of participants, but only in 15% are these experiences likely to be rated as full memories. We conclude that susceptibility to false memories of childhood events appears more limited than has been suggested” (p. 2). Note that these results pertain to contexts involving direct and often very strong efforts to induce false memories, which is important:

One factor that has not been brought out clearly is that the experimental studies involve deliberate deception from trusted and authoritative family members *often accompanied by other specific and seemingly incontrovertible corroborative evidence*. In our view, deception involving family witnesses and doctored photos for unremembered events is not a trivial or mild intervention [. . .] Given the weak effects of suggestion obtained in the other paradigms where strong deception is not used, we suspect that it is the powerful combination of deception and pressured suggestion that is the main driver of false memories in the laboratory. (Andrews & Brewin, 2017: 46; emphasis in original)

Seemingly consistent with evidence of the relative robustness of memory even to intrusive efforts to create false memories, Semmler, Dunn, Mickes, and Wixted (2018), considering the accuracy of eyewitness identifications in a criminal justice context, find that a variety of factors that could be thought to affect the accuracy of eyewitness identifications of the perpetrators of crimes—such as the amount of time between the commitment of the witnessed crime and the identification of the perpetrator and the distance between the witness and the perpetrator when the crime occurred—fail to affect the reliability of identifications made with high confidence. Further, even the effect of such variables on the accuracy of identifications made with lower

confidence is often minimal or non-existent (Semmler et al., 2018).

All of these findings seem to be concordant with the more general growing realization among psychologists that the fallibility and malleability of human perception and memory have been grossly exaggerated, obscuring the strong tendency toward *accuracy* (Jussim, 2012). Jussim (2012), comprehensively reviewing the then available evidence concerning the alleged effects of sociocultural biases on perception, judgment, and memory, makes clear that these effects are typically *very weak*:

[T]his [review of meta-analytic evidence] means that expectations [this includes stereotypes] bias judgments, on average, about 5% to 10% of the time [. . .]. Or, put another way, on average, expectancies fail to bias judgments about 90% to 95% of the time. I conclude [. . .] that neither the handful of high-impact studies often cited as demonstrating powerful biases nor the broader, more general literature demonstrates that expectancies typically have very powerful effects on perception and judgment. (p. 137)

With respect to memory, Jussim (2012) has this to say:

Overall—that is, averaging over all studies and all types of memory measures—the correlation between expectation and memory was 0.03. Because of the large number of studies and subjects, this correlation was statistically significantly higher than zero. Whether such a low correlation has any practical significance is unclear. In practical terms, it means that, on average, expectations enhance memory for expectancy-consistent information about 1% to 2% of the time [. . .]. On measures of free recall and recognition, there were small overall tendencies to better remember expectancy-inconsistent information ($r = -.08$ and $-.22$, respectively—the negative sign indicating that expectancy-inconsistent information was favored). On measures of response bias, there was a moderate tendency for people to make expectancy-consistent guesses ($r = .30$). (p. 140)

Importantly, then, relevant memory research shows that—contrary to the apparent notions of many self-identified skeptics that memories will strongly tend to be formed and/or expressed such that they align with stereotypes and other sociocultural biases—it is expectation-*inconsistent* rather than consistent information that people are more likely to freely recall.

Interestingly, there are data from another area of anomalistics, ufology, that are consistent with mainstream evidence of high eyewitness accuracy. Consider the following from Sparks (2018):

A witness reliability study conducted by Brad Sparks on the identified flying object (IFO) cases included in the Condon Report—on sightings of aircraft, balloons, celestial bodies, meteors, reentries, and so on—examined how well witnesses were able to observe known objects at known distances and locations [. . .]. A human observer usually cannot determine

the size or distance of an unknown object high up in the sky and, if they try to give a size or distance figure, then it is opinion or interpretation. The shape of an object is observable, while calling a sequence of elongated-shaped lights “windows” is a subjective interpretation, and so on. When subjective opinions and speculations are excluded, the remaining observational data on IFOs in the Condon Report proved 97–98 percent accurate, which ought to make debunkers rethink their position on so-called misperceptions [. . .]. (pp. 380–381)

Bullard (2018) reports the following about one particular “IFO” event:

The Air Force received 78 reports of the Zond-IV space probe reentry in 1968. Most informants gave accurate descriptions of the event, and when distortions crept in they were usually minor and predictable, like the misuse of the term “formation” for the lights, or inaccurate estimates of distance and speed. Only a few witnesses submitted consistent accounts that bore little resemblance to the actual stimulus of several burning lights a hundred miles high over the earth. The observers who adhered to the truth or committed minor deviations far outnumbered the small minority that turned a conventional event into a spectacular “UFO” sighting. (p. 31)

These findings suggest that circumstances in which eyewitnesses might expect to encounter popular ostensibly anomalous phenomena (e. g. seeing lights in the night sky might lead observers to think of UFOs, etc.) do not typically cause eyewitness reliability to be substantially reduced relative to what is found in ordinary conditions.

In light of relevant evidence, then, our view is that skeptical hypotheses that invoke phenomena such as “stereotype activation” are positing effects that are, at best, far too weak to explain the eyewitness data available. Skeptical views that would have us simply dismiss eyewitness data altogether on the basis of its “inherent unreliability” clearly depend on either misunderstanding or ignorance (or both) of the pertinent science. Consistent with remarks from Koriat et al. (2000) quoted above, we would like to emphasize that evidence that eyewitness memory is highly accurate in “real-world” conditions should come as no surprise. Basic evolutionary considerations should lead us to expect that human perception and memory would have to reliably function with a low rate of error if the many environmental challenges our species has faced in its history were to be successfully navigated and surmounted. It is rather theoretically ludicrous to suggest that human perception and memory are so unreliable that we should very rarely take eyewitness testimony seriously. A major problem with the field of social psychology that has in large part produced such absurd ideas is that it tends toward theoretical disarray, given lack of a broadly accepted metatheory to inform theory development (Ketelaar, 2015); this unfortunate situation allows ridiculous implications drawn from (poorly interpreted) experimental findings to go unrecognized as such.

In contrast to what these various findings and considerations would lead one to expect,

Paxton and Naish (2019) claim to find some support for the hypothesis of L. Sprague De Camp that once people became highly familiar with Mesozoic reptiles, reports of “sea serpents” shifted from having a tendency to describe “serpentine” creatures to having a tendency to describe creatures resembling Mesozoic marine reptiles, with the apparent implication that this change was due to the cultural influence of knowledge of such marine reptiles (p. 16). But it must be noted that their measurement model is inadequate to the task of conducting a test of this hypothesis. Their model fails to specify factors necessary to enable satisfactory direct testing of De Camp’s claim, such as measures of cultural variables that could be expected to track development of knowledge of Mesozoic reptiles (one approach would be to track the usage frequencies of relevant words through Google Ngram Viewer). Moreover, given that the hypothesis is highly antecedently improbable, as revealed by the work on perception, memory, and judgment reviewed above, various alternative hypotheses to psychologizing skeptical ones should be seriously considered rather than brushed aside (such as possible changes in the population size of unknown animals and possible changes in opportunities to observe novel fauna due to development of human technology).

Some have argued that when eyewitness testimony is treated uncritically, it commits researchers to take seriously the possible existence of an implausibly large variety of reported but unconfirmed organisms (e.g. Naish, 2017). But we are not suggesting that eyewitness testimony be treated uncritically. The quantitative analysis above—and the emphasis in some of the previously cited work on the fact that the highest evidential value of eyewitness accounts tends to be in *first* accounts given in the course of an investigation—makes this clear. And further, if attention is restricted to those possible unconfirmed organisms for which convergent, high-quality eyewitness data are available, and in which indications of anomalies emerge upon careful testing of those data (again, as above), we strongly suspect that this problem would be avoided.

Overall, we argue that the patterns among the eyewitness reports, coupled with our description curve analysis of the ape species description record, provides a basis for recommending that greater effort be expended to definitively investigate the possibility of an unconfirmed primate inhabiting certain woodlands of North America. Accomplishing this may be very difficult, as simulations have demonstrated that even extremely small numbers of large organisms might be sufficient to maintain a minimally viable population (Brussard, 1986; Guynn, Downing & Askew, 1985); this small population size could allow members to evade formal detection for very long periods of time. If advances in surveillance technology (e.g. drones and satellite imagery; e.g. Holroyd, III, 2016), use of Bayesian models for identifying likely habitat “hotspots” (May, 2012), and environmental DNA sampling are applied in sufficiently intensive research projects, it is unnecessary that should a North American hominoid exist, it must remain unconfirmed indefinitely.

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