

Fur or Fire: Was the use of fire the initial selection pressure for fur loss in ancestral hominins?

A variety of reasons have been advanced to explain the loss of fur in humans and why they differ in this way from all other primates. None of these reasons has become generally accepted as the explanation for the absence of functionally effective thermally insulating fur. The hypotheses previously advanced have not satisfactorily explained why humans are the unique naked ape. This paper proposes a new hypothesis; that *Homo sapiens* ancestors use of fire created the initial selection pressure leading to fur loss in humans.

1 **Fur or Fire: Was the use of fire the initial selection pressure for fur loss in ancestral** 2 **hominins?**

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4 **Introduction**

5 A variety of reasons have been advanced to explain the loss of fur in humans and why they differ in
6 this way from all other primates. None of these reasons has become generally accepted as an
7 explanation for the absence of functionally effective thermally insulating fur. An aid to body cooling
8 on the savannah was first proposed by Raymond Dart (P. Wheeler, 1992) and remained the
9 conventional explanation for some time although the controversial aquatic ape theory has drawn
10 particular attention to the anomaly of naked humans (Hardy, 1960; Morgan, 1997). Sexual selection
11 was tentatively proposed by Darwin in the Decent of Man (Darwin, 1871) and more recently some
12 other explanations have been proposed including neotony (Gould 1977), use of clothing (Kushlan,
13 1985), enhancing social communication (Simmons, 2001), parental selection (Harris, 2006),
14 bipedality (P. E. Wheeler, 1984), allometry (Schwartz & Rosenblum, 1981), cooling (Morris, 1967),
15 hunting (Brace, 1966), carrion eating (Stephensson, 1972). A defensive response to ecto-parasites is
16 another (Pagel & Bodmer, 2003)(Rantala, 1999) that has gained recent attention. Even the pleasure
17 of skin-to-skin contact between mother, partner and infant has been postulated as enhancing
18 relationships thus increasing survival in hairless individuals (Giles, 2011). A review paper by (Rantala,
19 2007) provides a discussion of the hypotheses and any empirical evidence for them. This paper
20 proposes a new hypothesis; *Homo sapiens* ancestors use of fire created the initial selection pressure
21 leading to fur loss in humans.

22 **A Fur Reduction Selection Pressure Proposed**

23 One driver that has not received attention as a selection pressure is the human adoption of the use
24 of fire. It seems likely that fur would be selected against in a fire using, pleistocene lifestyle. While
25 the insulating properties of fur assist in keeping the body warm, and protecting it from strong
26 sunlight, the same insulating property is likely to prevent the skin beneath the fur from feeling the
27 heat until, at least on some occasions, it is too late and the hot fur ignites. Even small burns are
28 serious injuries and would have been particularly debilitating in a Pleistocene life. Infections from
29 burns, even small burns on feet from walking barefoot on cinders, or hot cinders settling on sleeping
30 people, would have been more likely to incapacitate or become life threatening when compared to
31 burns treated with modern medical procedures within contemporary hygiene standards. Even today
32 infections from burns are the most important and potentially serious complications that occur in the
33 acute period following the burn (Rafla & Tredget, 2011).

34 Pyjama fires and beard fires are modern day examples of this proposed selection pressure. There are
35 government standards dedicated to ensuring the safety of children's pyjamas with respect to their
36 flame retardant properties and child's clothing fires are associated with nearly 300 emergency-
37 room-treated burn injuries to children each year in the United States (U.S. Consumer Product Safety
38 Commission, 2000).

39 Humans are messy eaters and one can easily imagine more serious conflagrations arising from time
40 to time from the accumulation of cooked meat juices, including fats and oils dripping and coalescing

41 in the fur after cooking prey species that had fattened up over the summer. Men who wear beards
42 tend to dribble into them (Stephensson, 1972) and it is likely that food generally, and fats and oils in
43 particular, dribbled well down the body of our less genteel ancestors. Given that the face is
44 particularly hairy in men, and beards accumulate much of spillage beard fires would be particularly
45 dangerous, even if less likely. There are examples of people dying from beard fires in historical
46 ("Certain accursed ones of no significance," 2011) and in modern times (Koljonen, 2008) (Unknown,
47 1949)(Unknown, 1973). The naked part of the face and the eyes are however, particularly sensitive
48 to radiant heat (Tannam, 2012) and this could partially explain the continuation of facial hair despite
49 almost complete loss of body hair.

50 **The Mechanism of Selection**

51 The actual mechanism for differential selection is that those with lesser insulating fur (thinner,
52 shorter or finer) would more quickly detect dangerously elevated temperatures from radiation and
53 are therefore more likely to move or otherwise reduce the risk of fur catching on fire. Selection for
54 less fur, allowing individuals to be more sensitive to dangerously high temperatures, would have
55 started when fire was first being used. Fire selection against hirsuteness would have initiated a
56 positive feedback loop, with less fur for warmth resulting in increased dependence on fire, in turn
57 increasing selection pressure against hirsuteness.

58 **Timing of Fur Loss and Fire Use**

59 Exactly when the first widespread use of fire in early Hominin communities occurred is not settled
60 although most archaeologists accept the idea that *Homo erectus* was using fire about 0.5mya
61 (James, 1989). This is up to 700000 years after the appearance of the MC1R gene, a gene associated
62 with dark skin pigmentation (Rogers, Iltis, & Wooding, 2004). Rogers et al (2004) suggest early man
63 must have lost fur thus increasing exposure to sunlight, in turn selecting for MC1R gene. Even a
64 small area of significant fur loss, for example the face for improved social communication, could
65 have selected for the benefit of the skin pigmentation protection afforded by the arising of the
66 MC1R gene so this does not necessarily imply body hair loss. So the earlier arrival of MC1R gene the
67 change in pigmentation is not strong evidence for or against this fur or fire theory.

68 The use of animal hides as protection is believed to have started around 300,000 years ago as
69 indicated by the earliest records of hide scraping (Toth and Schick 1993:161). This means there was
70 some time between use of fire and clothing. Molecular phylogenetic data suggesting that clothing
71 arrived after the use of fire supports this idea. Head and clothing lice diverged between 83000 and
72 170000 years ago, (Toups, Kitchen, Light, & Reed, 2011).

73 **Head Hair and Body Hair**

74 In general, the consideration of facial hair as distinct from body hair, or fur, probably serves as a
75 distraction from focussing on the important question of human fur loss. The range of diversity of
76 facial hair in modern humans suggest it is a result of cultural or other selection pressures in more
77 recent times, rather than being a notable or important difference during the Pleistocene . Indeed all
78 head hair, not just facial hair has variation in it qualities and extent in different ethnicities (Hrdy,
79 1973), but there is no direct evidence regarding the quantum or extent of facial hair in our
80 Pleistocene ancestors. There is some evidence to support the hypothesis that the human beard

81 evolved primarily via intrasexual selection between males and as part of complex facial
82 communication signalling status and aggressiveness (Dixson & Vasey, 2012).

83 **Incomplete Nakedness**

84 Others have described the partial nakedness of humans compared with the absolute nakedness of
85 some terrestrial and aquatic mammals (Hardy, 1960). The proposed fur or fire hypothesis could
86 explain this incomplete absence. An optimal balance would exist between the reduction of burns risk
87 by increased sensitivity against the benefits of insulation and physical protection of the skin. The net
88 result would be an optimal amount of body hair rather than a runaway loss of fur leading to absolute
89 nakedness as seen in other species where the loss was driven by other imperatives and not
90 influenced by the proximity to intense radiation with a risk of fire.

91 **Multiple Drivers**

92 It may be that increasing use of fire, and the attendant risks associated with proximity to fire might
93 have merely initiated selection for fur reduction in Hominins. If so, this does not preclude
94 contributions of some other potential selection pressures that have been proposed. Sexual selection
95 could have proceeded after initial selection created some variation. Indeed one of the objections to
96 sexual selection for hair loss, as first proposed by Charles Darwin in the *Descent of Man*, is that it
97 does not explain the initial selective advantage that may have caused one gender to prefer less fur
98 covering on the other gender (Darwin, 1871). It is worth noting that there is evidence that sexual
99 selection for hairlessness continues given the effort and expense dedicated to hair control in modern
100 society. (Labre, 2002)

101 **Further Evidence Required**

102 Evidence to support or detract from this theory would likely come from a variety of disciplines.
103 Physiological investigation of the insulating properties of fur near open fire, flammability and
104 insulating properties of fur and proximity to fire, comparisons of human body hair with that of other
105 primates, mortality and infection in mammals suffering burns, and perhaps molecular evidence from
106 body hair genes or burn related properties of the Human skin biome are potential sources of data
107 that could be explored in an effort to resolve this important question.

108 **Conclusion**

109 Fur loss in Hominins is likely a result of multiple selection pressures, but Hominin's developing
110 association with fire is proposed as a first step starting them on the path to reduced fur covering.
111 Perhaps, in addition to the better known benefits of fire – improving digestion of food, providing
112 warmth and extending hours available for social interaction, human nakedness can be added.

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115 **Bibliography**

116 Brace, C. L. (1966). What ever happened to hairy man? *Science*, 153(362).

117 Certain accursed ones of no significance. (2011). *Wikipedia*. Retrieved from

- 118 http://en.wikipedia.org/wiki/Certain_accursed_ones_of_no_significance
- 119 Darwin, C. (1871). *The descent of man, and selection in relation to sex*. London: John Murray.
- 120 Dixon, B. J., & Vasey, P. L. (2012). Beards augment perceptions of men's age, social status, and
121 aggressiveness, but not attractiveness. *Behavioral Ecology*, 23(3), 481–490.
122 doi:10.1093/beheco/arr214
- 123 Giles, J. (2011). Naked Love : The Evolution of Human Hairlessness, 5(4), 326–336.
- 124 Hardy, A. (1960). Was man more aquatic in the past? *New Scientist*, 7, 642–645.
- 125 Harris, J. R. (2006). Parental selection: a third selection process in the evolution of human
126 hairlessness and skin color. *Medical Hypotheses*, 66(6), 1053–1059. Retrieved from
127 <http://www.ncbi.nlm.nih.gov/pubmed/16527428>
- 128 Hrdy, D. (1973). Quantitative hair form variation in seven populations. *American Journal of Physical*
129 *Anthropology*, 39, 7–17. doi:10.1002/ajpa.1330390103
- 130 James, S. R. (1989). Hominid Use of Fire in the Lower and Middle Pleistocene. *Current Anthropology*,
131 30(1), 1–26.
- 132 Koljonen, V. (2008). Long Hair, Smoking, and Deep Facial Burns. *Journal of Burn Care and Research*,
133 29(2), 395–397. doi:10.1097/BCR.0bo13e31816679bd
- 134 Kushlan, J. A. (1985). The Vestimentary Hypothesis of Human Hair Reduction. *Journal of Human Evolution*,
135 14(1), 29–32.
- 136 Labre, M. P. (2002). The Brazilian Wax : New Hairlessness Norm for Women? *Journal of*
137 *Communication Inquiry*, 26(2), 113–132.
- 138 Morgan, E. (1997). *The Aquatic Ape Hypothesis*. London: Souvenir Press.
- 139 Morris, D. (1967). *The naked ape*. London: Jonathon Cape.
- 140 Pagel, M., & Bodmer, W. (2003). A naked ape would have fewer parasites. *Proceedings. Biological*
141 *Sciences / The Royal Society*, 270 Suppl , S117–9. doi:10.1098/rsbl.2003.0041
- 142 Rafla, K., & Tredget, E. E. (2011). Infection control in the burn unit. *Burns : Journal of the*
143 *International Society for Burn Injuries*, 37(1), 5–15. doi:10.1016/j.burns.2009.06.198
- 144 Rantala, M. J. (1999). Human nakedness: adaptation against ectoparasites? *International Journal for*
145 *Parasitology*, 29(12), 1987–9. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/10961855>
- 146 Rantala, M. J. (2007). Evolution of nakedness in Homo sapiens. *Journal of Zoology*, 273(1), 1–7.
147 doi:10.1111/j.1469-7998.2007.00295.x
- 148 Rogers, A. R., Iltis, D., & Wooding, S. (2004). Genetic Variation at the MC1R Locus and the Time since
149 Loss of Human Body Hair. *Current Anthropology*, 45(1), 105–108.
- 150 Schwartz, G. G., & Rosenblum, L. A. (1981). Allometry of primate hair density and the evolution of
151 human hairlessness. *American Journal of Physical Anthropology*, 55(1), 9–12. Retrieved from
152 <http://www.ncbi.nlm.nih.gov/pubmed/6789685>
- 153 Simmons, N. (2001). *What is the difference between hair and fur?* Retrieved from
154 <http://www.scientificamerican.com/article.cfm?id=what-is-the-difference-be>
- 155 Stephenson, W. (1972). *The ecological development of man*. Angus and Robertson. Sydney.
- 156 Tannam, M. (2012). *Human Thermoregulatory Response to Infrared Radiant Heating*. Dublin.
- 157 Toups, M. A., Kitchen, A., Light, J. E., & Reed, D. L. (2011). Origin of clothing lice indicates early
158 clothing use by anatomically modern humans in Africa. *Molecular Biology and Evolution*, 28(1),
159 29–32. doi:10.1093/molbev/msq234
- 160 U.S. Consumer Product Safety Commission. (2000). New Labels on Children's Sleepwear Alert

- 161 Parents to Fire Dangers. Retrieved January 29, 2016, from
162 [http://www.cpsc.gov/en/Newsroom/News-Releases/2000/New-Labels-on-Childrens-](http://www.cpsc.gov/en/Newsroom/News-Releases/2000/New-Labels-on-Childrens-Sleepwear-Alert-Parents-to-Fire-Dangers/)
163 [Sleepwear-Alert-Parents-to-Fire-Dangers/](http://www.cpsc.gov/en/Newsroom/News-Releases/2000/New-Labels-on-Childrens-Sleepwear-Alert-Parents-to-Fire-Dangers/)
- 164 Unknown. (1949). Fatal beard Fire. *The Courier Mail*, (November 1949), 1.
- 165 Unknown. (1973, April 5). Fatal Beard Fire. *Eugene Register - Guard*. Retrieved from
166 [https://news.google.com/newspapers?id=dKhVAAAAIBAJ&sjid=4eADAAAAIBAJ&pg=4226%2C1](https://news.google.com/newspapers?id=dKhVAAAAIBAJ&sjid=4eADAAAAIBAJ&pg=4226%2C1399930)
167 [399930](https://news.google.com/newspapers?id=dKhVAAAAIBAJ&sjid=4eADAAAAIBAJ&pg=4226%2C1399930)
- 168 Wheeler, P. (1992). The influence of the loss of functional body hair on hominid energy and water
169 budgets. *Journal of Human Evolution*, 23, 379–388.
- 170 Wheeler, P. E. (1984). The Evolution of Bipedality and Loss of Functional Body Hair in Hominoids.
171 *Journal of Human Evolution*, 13, 91–98.
- 172