ries, we must adopt, for now, the taxonomically conservative null hypothesis that these size differences represent population-level variation in a poorly understood within-species morphocline. Such a pattern could be maintained, for example, by a form of character displacement (Brown and Wilson, 1956) in which there is selection for smaller body size in *C. longiscapus* where it occurs in sympatry with *C. muelleri,* but in which such pressure is released in areas where *C. muelleri* does not occur.

Obviously, additional data from new collections are required, particularly from western Colombia, eastern Panama, and Costa Rica. Parallel attempts must be made to locate populations of *C. muelleri* in these regions. Only a broad biogeographic sample of ant colonies and their symbionts will provide the phylogeographic data necessary for understanding: (1) whether the ranges of the two species are broadly continuous or whether they consist of isolated, potentially diverged populations; (2) whether or not *C. longiscapus* and *C. muelleri* are sympatric throughout their ranges, or whether the range of one species is nested within the range of the other; (3) whether there are additional cryptic species within the *C. longiscapus s.l.* complex; and (4) whether the two species consistently cultivate the same two distinct fungal cultivars throughout their ranges. Increased understanding of these factors will in turn allow us to better evaluate hypotheses about the mechanisms that have precipitated cryptic speciation as well as other important evolutionary transitions in *Cyphomyrmex "longiscapus" s.l.*

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References

Adams, R.M.M., U.G. Mueller, A.K. Holloway, A.M. Green and J. Narozniak, 2000a. Garden sharing and garden stealing in fungus-growing ants. *Naturwissenschaften 87*: 491–493.

Adams, R.M.M., U.G. Mueller, T.R. Schultz and B. Norden, 2000b. Agro-predation: usurpation of attine fungus gardens by *Megalomyrmex* ants. *Naturwissenschaften 87*: 549–554.

Bolton, B., 1994. *Identification Guide to the Ant Genera of the World.* Harvard University Press: Cambridge, Massachusetts, 732 pp.

Boomsma, J.J., A.H. Brouwer and A.J. van Loon, 1990. A new polygynous *Lasius* species (Hymenoptera: Formicidae) from central Europe. *Insectes soc. 37*: 363–375.

Brown, W.L., Jr., 1953. Revisionary studies in the ant tribe Dacetini. *Am. Midl. Nat. 50*: 1–137.

Brown, W.L., Jr. and E.O. Wilson, 1956. Character displacement. *Syst. Zool. 5*: 49–64.

Cole, A.C., 1939. The life history of a fungus-growing ant of the Mississippi Gulf Coast. *Lloydia 2*: 153–160.

Currie, C.R., J.A. Scott, R.C. Summerbell and D. Malloch, 1999a. Fungus-growing ants use antibiotic-producing bacteria to control garden parasites. *Nature 398*: 701–704.

Currie, C.R., U.G. Mueller and D. Malloch, 1999b. The agricultural pathology of ant fungus gardens. *Proc. Natl. Acad. Science 96:* 7998–8002.

Eberhard, W.G., 1985. *Sexual Selection and Animal Genitalia.* Cambridge, Massachusetts: Harvard University Press. 244 pp.

Eberhard, W.G., 1996. *Female Control: Sexual Selection by Cryptic Female Choice.* Princeton, New Jersey: Princeton University Press. 472 pp.

Fowler, H.G., 1977. Field response of *Acromyrmex crassispinus* (Forel) to aggression by *Atta sexdens* (Linn.) and predation by *Labidus praedator* (Fr. Smith) (Hymenoptera: Formicidae). *Aggressive Behavior 3*: 385–391.

Gotwald, W.H., 1995. *Army Ants. The Biology of Social Predation.* Ithaca, New York: Cornell University Press. 302 pp.

Green A. M., U.G. Mueller and R.M.M. Adams, 2002. Extensive exchange of fungal cultivars between sympatric species of fungus-growing ants. *Molecular Ecology* 11: 191–196.

Harris, R.A., 1979. A glossary of surface sculpturing. *California Department of Food and Agriculture Laboratory Services/Entomology Occasional Papers in Entomology 28*: 1–31.

Kaspari, M., 1996. Litter ant patchiness at the m^2 scale:disturbance dynamics in three Neotropical forests. *Oecologia 107*:265–273.

Kempf, W.W., 1966 ("1965"). A revision of the neotropical fungus growing ants of the genus *Cyphomyrmex* Mayr. Part II: group of *rimosus* (Spinola) (Hym., Formicidae). *Studia Entomologia 8*: 161–200.

LaPolla, J.S., U.G. Mueller, M. Seid and S. Cover, 2002. Predation by the army ant *Neivamyrmex rugulosus* on the fungus-growing ant *Trachymyrmex arizonensis. Insectes soc. 49*: 251–256.

Mariconi, F.A.M., 1970. As saúvas. São Paulo: *Agronômica Ceres,* 167 pp.

Meier, R. and T.R. Schultz, 1996. Pilzzucht und Blattschneiden bei Ameisen: Präadaptationen und evolutive Trends. *Sitzungsber. Ges. Naturforsch. Freunde Berl. 35*: 57–76.

Mirenda, J.T., D.G. Eakins, K. Gravelle and H. Topoff, 1980. Predatory behavior and prey selection by army ants in a desert-grassland habitat. *Behav. Ecol. Sociobiol. 7*: 119–127.

Mueller, U.G., S.A. Rehner and T.R. Schultz, 1998. The evolution of agriculture in ants. *Science 281*: 2034–2038.

Mueller, U.G. and W.T. Wcislo, 1998. Nesting biology of the fungus-growing ant *Cyphomyrmex longiscapus* Weber (Attini, Formicidae). *Insectes soc. 45*: 181–189.

Mueller, U.G., T.R. Schultz, C.R. Currie, R.M.M. Adams and D. Malloch, 2001. The origin of the attine ant-fungus mutualism. *Quart. Rev. Biol. 76*: 169–197.

Mueller, U.G., J. Poulin and R.M.M. Adams. 2002. Symbiont choice in a fungus-growing ant (Attini, Formicidae). *Behav. Ecol.* (in press).

Rettenmeyer, C.W., R. Chadab-Crepet, M.G. Naumann and L. Morales, 1983. Comparative foraging by neotropical army ants. *Social Insects in the Tropics,* Vol. 2 (P. Jaisson, Ed.) Paris, Université Paris-Nord, pp. 59–73.

Schneirla, T.C., 1958. The behavior and biology of certain Nearctic army ants. Last part of the functional season, Southeastern Arizona. *Insectes soc. 5*: 215–255.

Schneirla, T.C., 1971. *Army Ants. A Study in Social Organization.* San Francisco: Freeman. 349 pp.