NEWS

The Global Mammal Parasite Database: An Online Resource for Infectious Disease Records in Wild Primates

Natural populations of primates host an amazing diversity of parasites and infectious diseases, many of which are endemic in natural populations. These include a tremendous variety of intestinal nematodes, protozoa and bacteria, sexually transmitted viruses such as simian immunodeficiency virus, and vector-borne diseases such as malaria and yellow fever. More recently, infectious disease epidemics have become a major conservation concern, with outbreaks of Ebola hemorrhagic fever and anthrax decimating populations of African apes,[1,2] possibly through spillover from unknown reservoir hosts and domesticated animals. Primates themselves can serve as sources of new emerging diseases in humans.[3–5] Finally, parasites have driven the evolution of a wide variety of behaviors observed in primates, ranging from the consumption of medicinal plants[6] to "fly-swatting" and other behaviors aimed at reducing contact with bot flies and insect vectors of disease.[7,8] Ecological and evolutionary pressures operating on primate mating and social systems could also arise from processes driven by infectious diseases.[9,10] Understanding the diversity, spread, and evolution of parasites in wild primates is therefore important for a wide variety of topics involving primate conservation, behavioral ecology, and human health.

The first step in understanding the role of parasites in primate socioecology and conservation is to improve our knowledge of primate parasites and their occurrence in natural populations. Which parasites are found in wild primates and what percentage of any given population is infected with different parasites? How do parasite richness and infection rates correlate with primate traits such as group size, diet, or body mass? Which parasites do wild primates share with humans and domesticated animals, and do particular host traits, such as habitat use, facilitate the sharing of parasites among host species? Are parasites going extinct as their primate host populations decline? If so, would saving particular parasites help or harm their threatened hosts?

To begin addressing these questions, we have compiled a comprehensive database on the parasites of free-living primates and other mammals.[11–13] The primate component of this Global Mammal Parasite Database is now freely available for others to access via the World Wide Web at http://www.mammalparasites.org/. Records in the GMPD are based primarily on reports of parasites and pathogens from the published literature. The database will be regularly updated as new information is published or uncovered in our ongoing literature searches. The information provided covers all major groups of micro- and macro-parasites found in wild primates, including helminths, protozoa, viruses, bacteria, arthropods and fungi (Fig. 1).

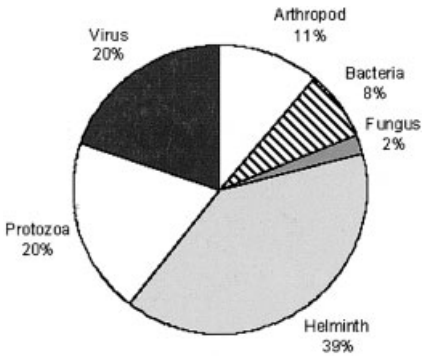

Figure 1. Taxonimic distribution of parasites reported from 119 species of free-living primates (N = 415 parasite species).

In collating this database, we searched the literature for reports of parasites from wild primate populations by using primate species Latin binomials as search keywords in online reference databases, such as Biological Abstracts, AGRICOLA, Medline, PrimateLit, and Web of Science. We also searched by primate genus name, following the taxonomic scheme of Corbet and Hill,[14] as well as by common taxonomic variants.[15,16] For each parasite reported from a wild primate population, we recorded information on host species, parasite species, and sampling locality. The first version of the dataset placed online includes 2,462 lines of data, each line capturing a record of a parasite species reported from a wild host population. This database includes information on 119 primate species and over 400 parasite species. We updated parasite species names based on current online databases. Parasite nomenclature for viruses followed the International Committee on the Taxonomy of Viruses database, which is available online (http://www.ncbi.nlm.nih.gov/ICTVdb/Ictv/). Nomenclature for other parasite species followed the taxonomic guidelines published by the National Center for Biotechnology Information.

On the GMPD search screen, users can identify search terms that specify parasite name, host name, parasite type (using the taxonomic groups

DOI 10.1002/evan.20041
Published online in Wiley InterScience (www.interscience.wiley.com).

listed above), or primate lineage (prosimians, New World monkeys, Old World monkeys, and apes). The input format is set up to search for character strings within words, so that the full parasite or host species name need not be entered. This is important because, in some cases, especially with the older literature, it was impossible to identify hosts or parasites below the genus level. Users can also specify whether records of "zero prevalence" are provided, in which investigators searched for a parasite but failed to find it. Output includes host-parasite species combinations along with information on the prevalence of infection, the location where sampling took place, the numbers of animals sampled, and full reference information. The data are presented in rows and columns in the web browser window, which can easily be copied into a spreadsheet program. Currently we are developing a protocol that will allow users to submit new information or make corrections to the database; for now, new submissions and comments can be sent to us via an e-mail link on the GMPD search page.

We request that users cite this publication in studies that use information derived from GMPD Database. Previous versions of this database have been used to investigate parasite species richness in primates,[11] host diversification in relation to parasite diversity,[12] prevalence in threatened primates,[17] and associations between transmission mode and host specificity in parasites of primates.[13] Additional databases on carnivores, ungulates, and squirrels will be available through the GMPD in the future, allowing comparisons of disease risk among major mammalian orders, as well as providing a better understanding of overlap in the parasite communities of mammals. A general overview of parasites in mammalian sociality and conservation can be found in Altizer and coworkers[18] and Nunn and Altizer.[19]

ACKNOWLEDGMENTS

We thank Andrew Davis for assistance with the GMPD web page, and Janis Antonovics, Andrew Cunningham, Andy Dobson, Vanessa Ezenwa, John Gittleman, Kate Jones, Patrik Lindenfors, Amy Pedersen, Mary Poss, and Pete Thrall for comments on the database and its construction. Andrew Cunningham, Corine Graham, Amy Pedersen, Mary Poss, and Nicholas Vitone contributed data to portions of the primate database. This research was supported by funding from the National Science Foundation (Grant #DEB-0212096 to CN and SA) and the Center for Applied Biodiversity Science at Conservation International. This work was also conducted as part of the "Infectious Disease and Host Behavior" Working Group supported by the National Center for Ecological Analysis and Synthesis, funded by the National Science Foundation, the University of California, and the Santa Barbara campus.

REFERENCES

1 Walsh PD. 2003. Catastrophic ape decline in western equatorial Africa. Nature 422:61–614.

2 Leendertz FH. 2004. Anthrax kills wild chimpanzees in a tropical rainforest. Nature 430:451–452.

3 Wolfe ND, Escalante AA, Karesh WB, Kilbourn A, Spielman A, Lal A. 1998. Wild primate populations in emerging infectious disease research: the missing link? Emerging Infect Dis 4:149–158.

4 Wolfe ND, Switzer WM, Carr JK, Bhullar VB, Shanmugam V, Tarnoufe U, Prosser AT, Torimiro JN, Wright A, Mpoudi-Ngole E, McCutcham FE, Birx DL, Folks TM, Burke DS, Heneine W. 2004. Naturally acquired simian retrovirus infections in central African hunters. Lancet 363:932–937.

5 Hahn BH, Shaw GM, De Cock KM, Sharp PM. 2000. AIDS as a zoonosis: scientific and public health implications. Science 287:607–614.

6 Huffman MA. 1997. Current evidence for self-medication in primates: a multidisciplinary perspective. Yearbook Phys Anthropol 40:171–200.

7 Dudley R, Milton K. 1990. Parasite deterrence and the energetic costs of slapping in howler monkeys, *Alouatta palliata*. J Mammal 71:463–465.

8 Valderrama X, Robinson JG, Attygalle AB, Eisner T. 2000. Seasonal anointment with millipedes in a wild primate: a chemical defense against insects? J Chem Ecol 26:2781–2790.

9 Freeland WI. 1976. Pathogens and the evolution of primate sociality. Biotropica 8:12–24.

10 Loehle C. 1995. Social barriers to pathogen transmission in wild animal populations. Ecology 76:326–335.

11 Nunn CL, Altizer S, Jones KE, Sechrest W. 2003. Comparative tests of parasite species richness in primates. Am Nat 162:597–614.

12 Nunn CL, Altizer S, Sechrest W, Jones KE, Barton R, Gittleman JL, Antonovics J, Cunningham AA, Dobson AP, Ezenwa V, Pedersen AB, Poss M, Pulliam JRC. 2004. Parasites and the evolutionary diversification of primate clades. Am Nat. 164:S90–S103.

13 Pedersen AB, Poss M, Nunn C, Cunningham A, Altizer S. n.d. Patterns of host specificity and transmission among parasites of wild primates. In preparation.

14 Corbet GB, Hill JE. 1991. A world list of mammalian species. Oxford: Oxford University Press.

15 Rowe N. 1996. The pictorial guide to the living primates. East Hampton, NY: Pogonias Press.

16 Groves CP. 2001. Primate taxonomy. Washington, D.C.: Smithsonian Institution Press.

17 Altizer S, Nunn CL, Lindenfors P. n.d. Do threatened hosts have fewer parasites? A comparative study in primates. In preparation.

18 Altizer S, Nunn CL, Thrall PH, Gittleman JL, Antonovics J, Cunningham AA, Dobson AP, Ezenwa V, Pedersen AB, Poss M, Pulliam JRC. 2003. Social organization and parasite risk in mammals: integrating theory and empirical studies. Ann Rev Ecol Evol Syst 34:517–547.

19 Nunn CL, Altizer S. 2004. Sexual selection, behaviour and sexually transmitted diseases. In: Kappeler PM, van Schaik CP, editors. Sexual selection in primates: new and comparative perspectives. Cambridge: Cambridge University Press. p. 117–130.

Charles L. Nunn
Department of Integrative Biology
Valley Life Sciences Building
University of California
Berkeley, CA 94720-3140 USA
Email: cnunn@socrates.berkeley.edu

Sonia M. Altizer
Department of Environmental Studies
Emory University
400 Dowman Drive, Suite E510
Atlanta, GA 30322
Email: saltize@emory.edu