

# CHaPRE

Center for Human and Primate Reproductive Ecology

Richard G. Bribiescas, Director

Evolution, Life History, Darwinian Medicine, Conservation...

A Yale Institute for Biospheric Studies Research Center

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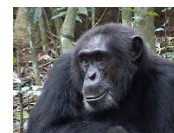
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## Director's Commentary: Reproductive Ecology, Cancer Risk, and Evolutionary Medicine

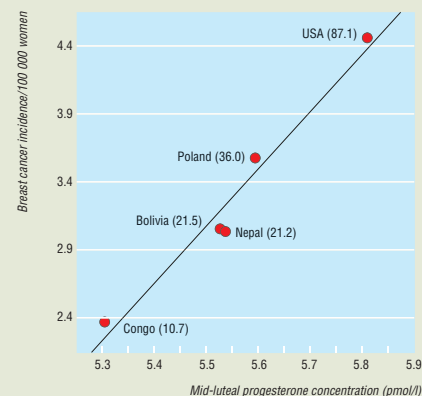
*One of the core goals of CHaPRE is to advance our understanding of the relationship between ecological context and contemporary health issues by incorporating tenets of evolutionary and life history theory into our comprehension of the development and source of disease.*

Medical professionals and people outside of evolutionary anthropology often inquire about the practical utility of reproductive ecology. What can understanding the interaction of reproductive function and environment tell us about contemporary health risks? This is a fair question since most aspects of human biology research have broader biomedical implications for understanding and treating various disorders.

Probably the most salient answer to this question involves the definition of illness and disease as well

as the importance of understanding the etiology of illness. Of particular importance to reproductive ecology is the risk and prevalence of sex steroid related cancers. Sex steroids stimulate cell growth in many parts of the body, including estrogens on breast tissue and androgens such as testosterone on the prostate. However these very same steroids also stimulate the growth of cells that are potentially cancerous. Many tumor growths are acutely sensitive to steroid hormone exposure, including cancers of the breast, ovary, and prostate. Upon initial diagnosis, these cancers are often initially treated with drugs that either inhibit the production of specific steroids or block their effects on target receptors. In essence, chronic exposure to specific endogenous steroid hormones may contribute to cancer risk.

How is reproductive ecology relevant? Researchers have shown that population variation in hormone levels, and therefore chronic exposure, are correlated with a higher risk of several forms of cancer. Mounting data suggests that industrialized populations, such as in the US, are at much higher risk of sex steroid related cancers. For example, CHaPRE affiliate Grazyna Jasienska and colleague Inger Thüne have shown that populational levels of progesterone are strongly associated with breast cancer risk. Although less thoroughly investigated, it is likely that similar processes are involved in prostate cancer risk.



**Breast cancer risk and salivary progesterone levels in several populations (Jasienska G. & Thüne, I., 2001, BMJ, Vol. 322, pp. 586-7)**

From a public health perspective, it would be quite valuable to identify relatively simple and cost effective strategies for decreasing the risk of steroid related cancers, such as basic lifestyle changes related to diet and exercise. Several investigations have shown that energetic expenditure can decrease the risk of breast cancer, most likely by attenuating the amount of endogenous estrogens. Reproductive

ecology researchers have consistently reported on the influence of energetic status on ovarian steroid levels, a finding that is taking on renewed significance in our struggle with cancer.

Understanding the evolutionary adaptiveness of hormone variation can also shed light on the present high incidence of breast and prostate cancer in more developed parts of the world. Specifically, life history theory aids us in understanding how these detrimental traits persist, even though common sense might tell us that natural selection should eliminate the genes responsible for cancer. While higher hormone levels may augment early fertility, subsequent increased risk of cancer later in life may simply reflect a life history trade off between early reproductive effort and survivorship.

Clearly, reproductive ecology provides a unique perspective that presents many of these health issues in a new light. Indeed, variation in other hormones such as leptin and insulin and their role in obesity and diabetes reflect the importance of population variation, ecological factors, and evolutionary context in understanding the core health challenges in present day society.

So ultimately, what is the answer to our initial question of how reproductive ecology contributes to our understanding of disease? The answer lies in a fuller appreciation of how non-infectious disease emerges in response to environmental differences and how many of these diseases may in fact be predictable in light of our knowledge of life history trade offs and the proximate mechanisms that govern them.

- Richard G. Bribiescas, CHaPRE Director

For further reading on this topic, please see:

Nesse RM, Williams GC. 1994. *Why we get sick : the new science of Darwinian medicine*. Times Books.

Panter-Brick C, Worthman CM. 1999. *Hormones, health, and behavior : a socio-ecological and lifespan perspective*. Cambridge University Press.

Stearns SC. 1999. *Evolution in health and disease*. Oxford University Press.

## A few words from Stephen Stearns...



*Stephen Stearns, Edward Bass Professor of Ecology and Evolutionary Biology, Yale University, is known for his important contributions to the development of life history theory and evolutionary medicine. He is also a CHaPRE Internal Research Affiliate. Professor Stearns is the author of "The Evolution of Life Histories" as well as the editor of "Evolution of Health and Disease". CHaPRE asked Professor Stearns to comment on the future research directions of human and non-human primate evolutionary biology, reproductive ecology, and life history.*

### The Data Needed for Evolutionary Research on Humans

The data needed to change theory in human behavioral and evolutionary ecology will come from many more directions than I can anticipate. However, I can at least mention one central, important class of data that should not be ignored and will probably remain relevant through numerous changes of theory. Recall that natural selection on a trait occurs whenever three conditions are satisfied:

- (1) there is variation among individuals in lifetime reproductive success;
- (2) there is heritable variation in the trait.

It is not these two conditions but the link between them that determines whether evolution is adaptive or neutral. The link is

- (3) the correlation of the trait with lifetime reproductive success.

To test hypotheses on the adaptive value of human traits we thus need to document current variation in human lifetime reproductive success, variation in the traits of interest, the correlation of the two, and the heritability of the traits, whether genetic or cultural. This goal is both much more important and much more achievable than the reconstruction of Pleistocene selection scenarios that can never be convincingly confirmed.

***"It is ironic that we have far more reliable information on variation in lifetime reproductive success for populations of wild birds and mammals than we do for ourselves".***

**- Stephen Stearns**

It is ironic that we have far more reliable information on variation in lifetime reproductive success for populations of wild birds and mammals than we do for ourselves. The success of long-term studies of red deer, spotted hyenas, chimpanzees, pied flycatchers, and Galapagos finches — to mention only some of the most prominent cases — was made possible by following identified individuals from birth to death. The insights won thereby have revolutionized behavioral ecology. Human individuals are readily identified. Measures of female reproductive success are non-controversial, but measures of male reproductive success properly involve paternity testing that will continue to reveal that 15-20% of children are not fathered by the husband of the woman in question — a sensitive issue that must be handled with appropriate circumspection.

If we measured variation in lifetime reproductive success, and variation in traits of interest, and estimated the heritabilities of those traits, we could infer how natural selection is currently acting, or not acting, in contemporary human populations. We would then know whether it acts in different directions in different types of human populations — rich vs. poor, developed vs. undeveloped countries, among various religions. We could test directly such oft-mentioned hypotheses as the association of cooperation and sacrifice within groups with aggression and competition among groups. We could ask whether there is any evidence that humans are being selected to be more or less social, by biology and by culture, and if so, by what particular mechanisms. And we could, if we did this among evangelical Christian believers in Creationism and its most recent avatar, Intelligent Design, document how natural selection is currently operating in a group of people desperately in need of such information.

The measurement of variation in lifetime reproductive success in a large enough sample of enough different types of individuals and groups to test interesting theoretical ideas would be a huge project. It would be Big Science requiring major funding and international cooperation and coordination. But unlike speculation about the Environment of Evolutionary Adaptation, which cannot be measured, measuring current variation in reproductive success is conceptually simple and logistically straightforward. It could help to convert this part of science from a mode of operation that still often consists of the development of plausible theories corroborated by the selective mention of

confirming instances into rigorous science in which theory contacts reality fairly and objectively.

- Stephen Stearns

## Featured Scientist: Claudia Valeggia



Assistant Professor, Department of Anthropology,  
University of Pennsylvania, CHaPRE Research Affiliate

*Claudia Valeggia received her Ph.D from the University of California, Davis in Animal Behavior, served as a Post-Doctoral Research Fellow and later as a Research Associate in the Reproductive Ecology Laboratory, Harvard University, Department of Anthropology in collaboration with Peter Ellison. She is currently an Assistant Professor of Anthropology at the University of Pennsylvania. Dr. Valeggia is the director the Chaco Area Reproductive Ecology (C.A.R.E.) Program, with field headquarters in her native Argentina. The C.A.R.E. program focuses on the reproductive ecology of indigenous populations in the South American Gran Chaco. As a CHaPRE Research Affiliate, Valeggia discusses her research and her role within the center.*

My current research interests focus on human reproductive ecology. I became interested in this field during the development of my doctoral research on the reproductive biology of titi monkey females. Given my background in evolutionary biology, I was particularly interested in interpreting features of human reproductive biology as the product of adaptation to formative environments. After completing my Ph.D., I decided to examine the sensitivity of female reproductive physiology to current environmental conditions as a post-doctoral research project.

In 1997 I traveled to northern Argentina, my home country, to conduct a pilot study on the relationship between energetics and postpartum fecundity in Toba women, an Amerindian group inhabiting the province of Formosa. That pilot study has now developed into a full-blown research program known as the Chaco Area Reproductive Ecology (CARE) Program, which I direct. The long-term aim of the CARE Program is to understand the dynamic relationships linking the ecology, behavior, and reproductive biology of the indigenous and non-

indigenous peoples of the Gran Chaco of South America. These populations today represent a spectrum of subsistence regimes ranging from heavy dependence on traditional hunting, fishing, and gathering to more acculturated, peri-urban communities.

The CARE Program, now based at the University of Pennsylvania, consists of a number of related studies with the common theme of exploring the relationships between environment, cultural change, and fertility. Some of the objectives of these studies include i) to characterize the demography and reproductive patterns of Chacoan communities; ii) to monitor seasonal patterns of change in energy balance; iii) to monitor changes in gonadal function in adult men and women; and iv) to characterize infant and child growth and development patterns as they relate to child care practices and environmental stresses. Hormonal analyses will be performed at the Reproductive Ecology Laboratory of the Department of Anthropology of the University of Pennsylvania.



**Ana Gonzalez, a Western Toba grandmother holding Valeggia's son in the village of La Rinconada.**

In addition to the basic science component of the program, we have been working to integrate our studies to public health activities. Anthropologists' contribution to local community health can be substantial if a fluent dialog with public health officers is developed. Ours is a multidisciplinary team, which includes biologists, biological and cultural anthropologists, and obstetric care professionals. We are currently exchanging experiences with some agents at the local Ministry of Health that will hopefully lead to a fruitful collaboration. For example, we are developing strategies to incorporate our results on childcare practices among the Toba and among the Wichí to decrease the staggering infant and child mortality of these groups.

The CARE Program and CHaPRE have shared interests and objectives and I am delighted to be the link between them as external collaborator. One specific collaboration is reflected in the research and training opportunities our program can offer CHaPRE's faculty and students. Ours is a well-

established and active field site. We have been conducting research in urban, peri-urban, and rural areas, both with indigenous and non-indigenous communities, since 1997. I envision many years of fruitful exchange and a great re-productive (academically speaking) success!]

- Claudia Valeggia, Ph.D

To read more on Dr. Valeggia's research, see:

Valeggia, C.R. and Ellison, P. T. (2004) Lactational amenorrhea in well nourished Toba women of Argentina. *Journal of Biosocial Science* 36 (5) 573-595.

Valeggia, C.R. and Ellison P. T. (2003) Impact of breastfeeding on anthropometric changes in a population of Toba women. *American Journal of Human Biology* 15:717-724.

Valeggia, C.R. and Ellison, P. T. (2001). Lactation, Energetics, and Postpartum Fecundity. In: *Reproductive Ecology and Human Evolution*, Peter T. Ellison (Ed.), Aldine de Gruyter, New York., pp. 85-105.

## CHaPRE Welcomes Hurtado as a New External Affiliate



**A. Magdalena Hurtado, Associate Professor of Anthropology, University of New Mexico.**

CHaPRE is delighted to welcome the addition of Associate Professor A. Magdalena Hurtado of the Department of Anthropology, University of New Mexico as an external affiliate. Her role will be to advise the director on matters related to CHaPRE supported research and aid in developing new research programs. Professor Hurtado is known for her investigations in evolutionary epidemiology, parental care, human ecology, demography, hunter/gatherer foraging strategies, and life history theory. Her field studies include forays into Paraguay, Peru, Venezuela, and Brazil. She is perhaps best known for her work among the Ache of Paraguay as well as the Hiwi of Venezuela where she studied the sexual division of labor, the evolutionary context of allergic conditions and more recently, the immunology of susceptibility to infectious diseases and research

ethics. Hurtado is also co-author with Kim Hill, also of the University of New Mexico, of the book 'Ache Life History: The Ecology and Demography of a Foraging People' published by Aldine-DeGruyter, co-editor with Francisco Salzano of the book 'Lost Paradises: The Ethics of Research and Publication' published by Oxford University Press, and profiled in 'The Biography, Anthropologist: Scientist of the People' by Mary Batten, published by Houghton-Mifflin. To read further on Professor Hurtado's research, please see:

Hurtado A M, I Hurtado, K Hill 2003 Public Health and Adaptive Immunity among Natives of South America. In Salzano F and A M Hurtado, Editors, Lost Paradises and the Ethics of Research and Publication. NY: Oxford University Press.

Hurtado A M, K Hill, W Rosenblatt, J Bender, T Scharmen. 2003 Longitudinal study of tuberculosis outcomes among immunologically naive Aché natives of Paraguay. American Journal of Physical Anthropology, Volume 121, Issue 2, Pages 134 - 150

Hurtado AM, C Lambourne, P James, K Hill, K Cheman, K Baca 2005 Human Rights, Biomedical Science and Infectious Diseases among Indigenous Peoples of South America. Annual Review of Anthropology, in press.

## Ngogo Report



**Ngogo, Kibale Forest, Uganda, is the home of the largest concentration of wild chimpanzees in the world (photo courtesy of David Watts)**

*Understanding the evolution and life history of our closest evolutionary relative....*

This past summer, data collection has continued at Ngogo. Yale biological anthropology graduate student Sholly Gunter under the direction of Professor David Watts, has just completed her second season of research on the reproductive strategies of chimpanzees at Ngogo, Kibale National Park, Uganda. Her summer research has illuminated many new avenues for behavioral and endocrine research with the wild chimpanzees at the site.

During her two months in Uganda, Gunter collected 67 individual urine samples from 6 female chimpanzees, with 5 estrus cycles represented. Samples were collected using plastic bags, or pipetting urine from leaf litter. Urine was tested in the field using over-the-counter LH detection kits to determine the possibility of ovulation. All samples were frozen and shipped to CHaPRE for analysis. Immediate plans for the samples include analysis to pinpoint the exact timing of ovulation and several validation studies.

In the coming years, Gunter will return to Uganda to continue collection of endocrine and behavioral data as part of her dissertation research. Once rigorous behavioral data begins and can be correlated with endocrine data, she expects to find changes in behavioral patterns for both male and female chimpanzees that coincide with the various stages of the estrus cycle. Among other things, Gunter's future plans include investigations into relationships between c-peptide, feeding rates and the estrus cycle, as well as urine analysis of post-reproductive females and those with apparent reproductive pathologies.

## CHaPRE Represented at the European Society for Evolutionary Biology, Krakow, Poland

August 15 - 20, 2005, Director Richard Bribiescas, and CHaPRE Research Affiliates, Gillian Bentley, Peter Ellison, Grazyna Jasienska, and Michael Muehlenbein presented research in a symposium co-organized by Jasienska and Bribiescas on Human Life History and Energetics at the 10th Congress of the European Society for Evolutionary Biology, hosted by Jagiellonian University.

## Supporting and Collaborating with CHaPRE

If you are interested in supporting or collaborating with CHaPRE, please contact the director, Richard G. Bribiescas (203-432-3671). Proposals are accepted at any time.

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