

CIIMAR

Rua dos Bragas, 177
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“Comparative Genomics and the Evolution of the Felidae”

by Dr. Warren E. Johnson

A seminar on wildlife genomic prospecting



Terça-feira, 25 de Setembro, 2007

11:00h Auditório do CIIMAR

Comparative Genomics and the Evolution of the Felidae

Warren E. Johnson

Genomics, or the study of the relationships between genetic features and biological function in organisms, is a discipline that has arisen from the study of the whole genomes by integrating traditional genetic disciplines such as molecular, population, and quantitative genetics with new technologies in molecular biology, DNA analysis, bioinformatics and automated robotic systems. Two major accomplishments were achieved over the last few years to vault the Felid family into the genomics era. First, annotation of the 2-fold genome coverage domestic cat genome sequence was completed in 2006 under the coordination of Dr. Steve O'Brien and his colleagues, of which the major highlights for felid genetic studies will be described here. Second, a robust model of the molecular genetic phylogeny of the Felid family was established, which enables us to interpret geographic, temporal, and evolutionary patterns of genetic, epidemiological, and morphological with increased confidence. Our new molecular phylogeny, based upon analyses of 22,789 bp (including 19 autosomal, 5 X-linked, 6 Y-linked and 9 mitochondrial genes) using maximum parsimony, minimum evolution, maximum likelihood and Bayesian phylogenetic analyses is the most comprehensive resolution of the Felidae achieved to date. Combined with paleontological calibration dates (minimum and maximum) of 14 fossils, a very accurate estimate of divergence dates among lineages was also established. From these analyses we showed that modern felids arose in the late Miocene (around 10.8 MYA) and subsequently evolved into eight major lineages through a series of intercontinental movements. Further annotation of the domestic cat, along with more comparative genomic research will be a tremendous catalyst for all researchers interested in felids by allowing for the efficient identification of genes and mutations of functional importance and facilitating the future transfer of discoveries and molecular tools from one species to another. These molecular genetic techniques are providing the means to clarify the evolutionary history of many felid species and to more accurately partition and provide taxonomic nomenclature reflecting this history. Recent research on clouded leopards, tigers, domestic cats, and the Florida Panther exemplify the process and demonstrate the scientific and political issues associated with such research.



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Biography:

Dr. Johnson earned his PhD in Animal Ecology from Iowa State University in 1992 after receiving an MS in Wildlife Ecology from Utah State University in 1984 and a BA in Biology from Oberlin College in 1983. He has been with the Laboratory of Genomic Diversity since 1992. Dr. Johnson specializes in comparative genomics, molecular ecology, population genetics, conservation genetics, and evolutionary biology. Dr. Johnson currently serves as the Scientific Advisor for the Student Intern Program (SIP) for High School students and as co-secretary of the CCR-Staff Scientist / Staff Clinician Organization.

Selected publications:

- Driscoll CA, Menotti-Raymond M, Roca AL, Hupe K, Johnson WE, Geffen E, Harley EH, Delibes M, Pontier D, Kitchener AC, Yamaguchi N, O'Brien SJ, Macdonald DW. 2007. The Near Eastern origin of cat domestication. *Science*. 317:519-23.
- Johnson WE, Eizirik E, Murphy WJ, Pecon-Slaterry J, Antunes A, Teeling E, O'Brien SJ. 2006. The late Miocene radiation of the Felidae: a genetic assessment. *Science* 311:73-77.
- Buckley-Beason, V.A., W.E. Johnson, W. Nash, R. Stanyon, J. Menninger, C.A. Driscoll, J. G. Howard, M. Bush, J.E. Page, M.E. Roelke, G. Stone, P. Martelli, C. Wen, L. Ling, R.K. Duraisingam, P.V. Lam, and S.J. O'Brien. 2006. Molecular evidence for species-level distinction in modern clouded leopards (*Neofelis nebulosa*). *Current Biology*.
- Jae-Heup Kim, A. Antunes, S. Luo, J. Menninger, W.G. Nash, S.J. O'Brien, W.E. Johnson. 2006. Evolutionary analysis of a large mtDNA translocation (numt) into the nuclear genome of the *Panthera* genus species. *Gene*. 366:292-302.
- Troyer JL, Pecon-Slaterry J, Roelke ME, Johnson W, VandeWoude S, Vazquez-Salat N, Brown M, Frank L, Woodroffe R, Winterbach C, Winterbach H, Hemson G, Bush M, Alexander KA, Revilla E, O'Brien SJ . Seroprevalence and genomic divergence of circulating strains of feline immunodeficiency virus among Felidae and Hyaenidae species. *J Virol* . 79: 8282-94, 2005.
- O'Brien SJ, Johnson WE . Big cat genomics. *Annu Rev Genomics Hum Genet* . 6: 407-29, 2005.
- Luo SJ, Kim JH, Johnson WE, van der Walt J, Martenson J, Yuhki N, Miquelle DG, Uphyrkina O, Goodrich JM, Quigley HB, Tilson R, Brady G, Martelli P, Subramaniam V, McDougal C, Hean S, Huang SQ, Pan W, Karanth UK, Sunquist M, Smith JL, O'Brien SJ . Phylogeography and genetic ancestry of tigers (*Panthera tigris*). *PLoS Biol* . 2: e442, 2004.
- Johnson WE, Godoy JA, Palomares F, Delibes M, Fernandes M, Revilla E, O'Brien SJ . Phylogenetic and phylogeographic analysis of Iberian lynx populations. *J Hered* . 95: 19-28, 2004.
- Eizirik E, Yuhki N, Johnson WE, Menotti-Raymond M, Hannah SS, O'Brien SJ . Molecular genetics and evolution of melanism in the cat family. *Curr Biol* . 13: 448-53, 2003.
- Palomares F, Godoy JA, Piriz A, O'Brien SJ . Faecal genetic analysis to determine the presence and distribution of elusive carnivores: design and feasibility for the Iberian lynx. *Mol Ecol* . 11: 2171-82, 2002.
- Murphy, W. J., E. Eizirik, W. E. Johnson, Y. P. Zhang, O. A. Ryder, and S. J. O'Brien. 2001. Molecular phylogenetics and the origins of placental mammals. *Nature*. 409:614-618.