



Institute of
Molecular and
Cell Biology

PRESS RELEASE

17 MARCH 2009

ELEPHANT SHARKS: SEEING THE DEEP BLUE IN COLOUR

Sequencing of elephant shark genome takes big step forward with discovery of colour perception in the deep-sea fish

1. Scientists from the Institute of Molecular and Cell Biology (IMCB) under the Agency for Science, Technology and Research (A*STAR) and the Institute of Ophthalmology at University College London (UCL) have made the surprising discovery that the elephant shark, a primitive deep-sea fish that belongs to the oldest living family of jawed vertebrates, could see colour like humans. The finding, published in the March 2009 issue of the prestigious journal, *Genome Research*, would enhance scientists' understanding of how colour vision evolved in early vertebrates over the last 450 million years of evolution.

2. Led by Prof Byrappa Venkatesh of IMCB and Prof David Hunt of UCL, the research team found that the elephant shark had three cone pigments for colour vision and, like humans, it accomplished this through gene duplication. Said Prof Venkatesh, "It was unexpected that a 'primitive' vertebrate like the elephant shark had the potential for colour vision like humans. The discovery shows that it has acquired the traits for colour vision during evolution in parallel with humans." This underscores the utility of the elephant shark, first proposed in 2005 by the IMCB group as a valuable reference genome, in understanding the human genome which belongs to the same evolutionary tree.

3. In another paper titled "Large number of ultraconserved elements were already present in the jawed vertebrate ancestor" published in the journal *Molecular Biology and Evolution* in March 2009, the researchers revealed that they discovered that the protein sequences in elephant shark were evolving at a slower rate than in

other vertebrates. This meant that the elephant shark had retained more features of the ancestral genome than other vertebrates belonging to the same evolutionary tree¹, and hence was a useful model for gaining insight into the ancestral genome, in which the human genome also has its roots.

4. Prof Venkatesh's team had also demonstrated in several scientific publications² that human DNA sequences were more similar to elephant shark than to any other fish.

5. Prof Venkatesh added, "We expect the sequencing of the whole genome of the elephant shark to be completed by early 2010, the availability of which will then enable scientists to explore the important functional elements in both the human and elephant shark genome that have remained unchanged during the last 450 million years of evolution." The two latest findings have come less than two years after IMCB secured generous funding from the National Institutes of Health, USA, to sequence the whole genome of the elephant shark.

6. Said Prof Neal Copeland, Executive Director of the IMCB, "We are excited by the latest findings reported by Prof Venkatesh's group, which raised the visibility of IMCB and Singapore in the international field of genomics. IMCB remains committed to using the tools of modern science to make important, basic discoveries that will advance the understanding of the human genome and common human diseases."

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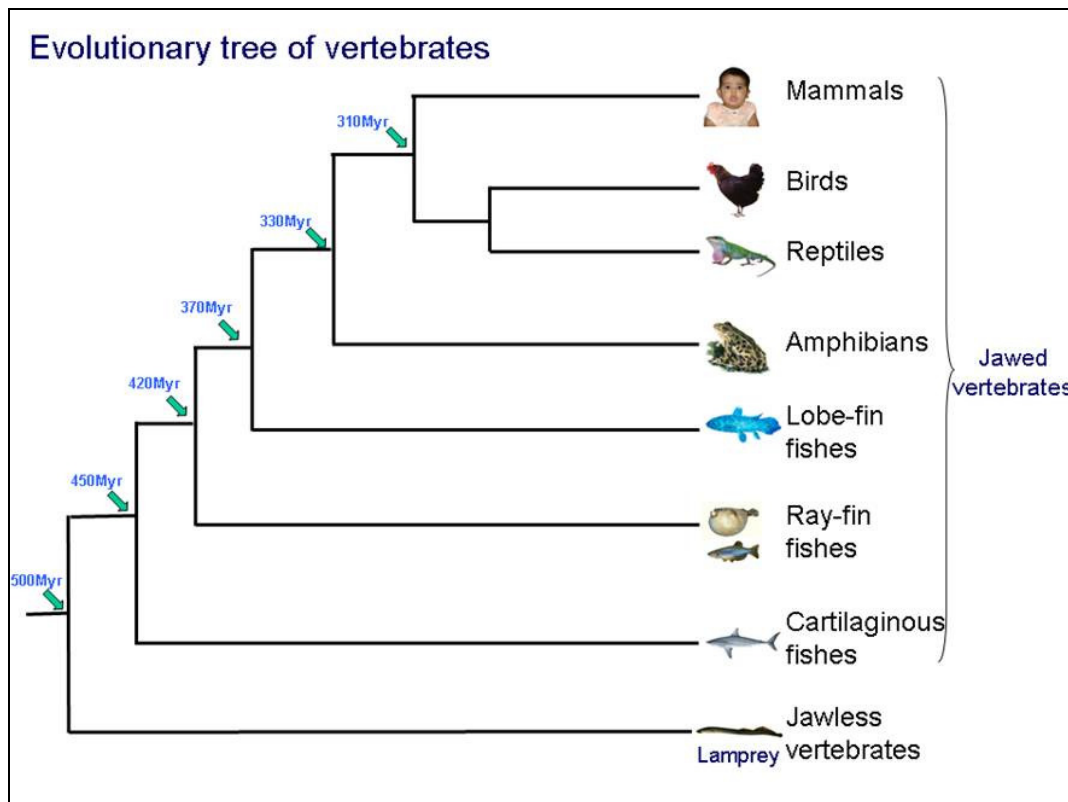
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¹ Please refer to *Figure 1, Simplified evolutionary tree of vertebrates* in the Annex.

² Please refer to article nos. 2, 3 and 4 in the Annex.

Annex

Figure 1: Simplified evolutionary tree of vertebrates



The research findings described in the press release can be found in the following articles:

1. "Into the blue: gene duplication and loss underlie colour vision adaptations in a deep-sea chimaera, the elephant shark *Callorhynchus milii*", **Genome Research** (2009) 19: 415-426.

Authors: Davies, W.L., Carvalho, L.S., Tay, B., Brenner, S., Hunt, D.M. and Venkatesh, B*.

* Byrappa Venkatesh, email: mcbbv@imcb.a-star.edu.sg

2. "Large number of ultraconserved elements were already present in the jawed vertebrate ancestor", **Molecular Biology and Evolution** (2009) 26: 487-490.

Authors: Wang, J., Lee, A.P., Kodzius, R., Brenner, S. and Venkatesh, B.

3. "Survey sequencing and comparative analysis of the elephant shark (*Callorhynchus milii*) genome", **PLoS Biology** (2007) 5(4): e101.

Authors: Venkatesh, B., Kirkness, E.F., Loh, Y.H., Halpern, A.L., Lee, A.P., Johnson, J., Dandona, N., Viswanathan, L.D., Tay, A., Venter, J.C., Strausberg, R.L. and Brenner, S.

4. “Ancient noncoding elements conserved in the human genome”, **Science** (2006) 314, 1892.

Authors: Venkatesh, B., Kirkness, E.F., Loh, Y.H., Halpern, A.L., Lee, A.P., Johnson, J., Dandona, N., Viswanathan, L.D., Tay, A., Venter, J.C., Strausberg, R.L. and Brenner, S.

About the Institute of Molecular and Cell Biology (IMCB)

The Institute of Molecular and Cell Biology (IMCB) is a member of Singapore's Agency for Science, Technology and Research (A*STAR) and is funded through A*STAR's Biomedical Research Council (BMRC). It is a world-class research institute that focuses its activities on six major fields: Cell Biology, Developmental Biology, Structural Biology, Infectious Diseases, Cancer Biology and Translational Research, with core strengths in cell cycling, cell signalling, cell death, cell motility and protein trafficking. Its recent achievements include leading an international consortium that successfully sequenced the entire pufferfish (Fugu) genome. The IMCB was awarded the Nikkei Prize 2000 for Technological Innovation in recognition of its growth into a leading international research centre and its collaboration with industry and research institutes worldwide. Established in 1987, the Institute currently has 35 independent research groups with more than 400 staff members.

For more information about IMCB, please visit www.imcb.a-star.edu.sg.

About the Agency for Science, Technology and Research (A*STAR)

A*STAR is Singapore's lead agency for fostering world-class scientific research and talent for a vibrant knowledge-based Singapore. A*STAR actively nurtures public sector research and development in Biomedical Sciences, Physical Sciences and Engineering, with a particular focus on fields essential to Singapore's manufacturing industry and new growth industries. It oversees 22 research institutes, consortia and centres, and supports extramural research with the universities, hospital research centres and other local and international partners. At the heart of this knowledge intensive work is human capital. Top local and international scientific talent drive knowledge creation at A*STAR research institutes. The Agency also sends scholars for undergraduate, graduate and post-doctoral training in the best universities, a reflection of the high priority A*STAR places on nurturing the next generation of scientific talent.

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