

Genome of the world's largest bony fish may explain fast growth rate and large size

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The genome of the ocean sunfish (*Mola mola*), the world's largest bony fish, has been sequenced for the first time by researchers from China National Genebank at BGI-Shenzhen and A*STAR, Singapore. The researchers, who include Nobel Laureate Sydney Brenner, publish their results in the open access journal *GigaScience*. The ocean sunfish genome revealed several altered genes that may explain the fast growth rate and large size of the fish as well as its unusual endoskeleton.

The ocean sunfish, which can be found in tropical and temperate sea zones such as the Mediterranean and the Atlantic, can grow up to a length of 2.7m and weigh 2.3 tons. Even though its diet, which consists mostly of jellyfish, is nutritionally poor, the ocean sunfish grows at an unusually fast rate of almost one kilogram per day - other fishes grow at 0.02 to 0.5 kilogram per day. As well as the extreme [growth rate](#), females can produce more eggs than any other known vertebrate (up to 300,000,000 at a time). The ocean sunfish lacks a tail giving it a truncated appearance.

Byrappa Venkatesh, who initiated and co-led the project from A*STAR, said: "We sequenced the pufferfish (*Takifugu rubripes*) genome in 2002, the second vertebrate genome to be sequenced. Pufferfish and ocean sunfish belong to the same Order but differ dramatically in morphology. So we were keen to sequence the ocean sunfish genome and compare it with the pufferfish genome, to identify genetic changes that have occurred in the ocean sunfish lineage and that might give clues to the highly derived phenotype of the ocean sunfish."

The researchers hypothesized that the ocean sunfish's unusual appearance may be due to the loss of HOX genes that control the body plan of an organism on the head-tail axis by specifying which parts of the body - such as head, thorax or abdomen - the different segments of an embryo will form. They were surprised to find out that this wasn't the case, as they discovered that the ocean sunfish possessed HOX gene clusters similar to that of pufferfish.

Focusing on the genetic background of the ocean sunfish's fast growth rate and unusual body shape, the researchers also discovered that several genes involved in growth hormone signalling evolve very fast in the ocean sunfish when compared to other bony fishes, which may explain its large size and fast growth rate.

Unlike other bony fishes, the ocean sunfish's skeleton is largely made up of cartilage and not bone. Looking for clues to why this is the case, the researchers analysed genes that are known to be involved in bone formation.

Guojie Zhang, who is Associate Director at the China National Genbank and co-led the project, said: "We found changes in genes encoding for cartilage formation. This may contribute to the development of predominantly cartilaginous skeleton in this gigantic fish."

Identification of the genomic changes that underlie the ocean sunfish's unusual body shape, size and skeleton using this reference genome could facilitate future studies into the ocean sunfish and the genetic basis of its difference from other fishes, according to the researchers.

Byrappa Venkatesh said: "Vertebrates exhibit a wide diversity in their morphology, physiology and behaviour. Understanding the genetic basis of this diversity is a major goal of evolutionary biology. We still have a lot to learn from the ocean sunfish genome assembly. One way to

pinpoint more genetic changes specific to ocean sunfish would be to sequence more closely related species such as porcupine fish, box fish, triggerfish, and triplespines."

Guojie Zhang added: "This is one of the 30 fish genomes that have been sequenced for the G10K project. The availability of high throughput DNA sequencing technology makes it possible to sequence whole genomes of a wide range of 'non-model' species, allowing us to uncover the [genetic basis](#) of their phenotypic diversity and their adaptation."

More information: Hailin Pan et al, The genome of the largest bony fish, ocean sunfish (*Mola mola*), provides insights into its fast growth rate, *GigaScience* (2016). [DOI: 10.1186/s13742-016-0144-3](https://doi.org/10.1186/s13742-016-0144-3)

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