The formation of the Amazon River and its fish fauna

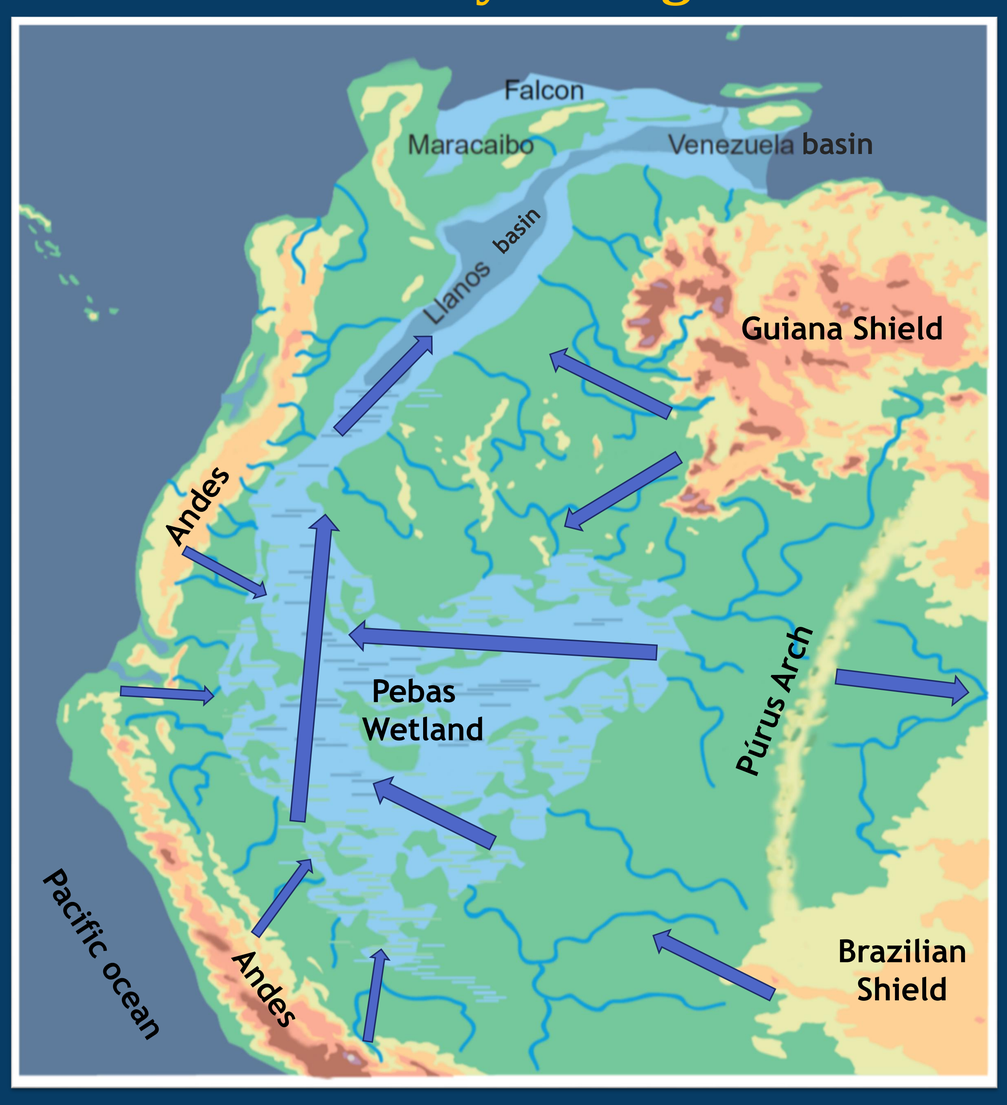
120 million years ago

During the breakup of the Gondwana supercontinent, the South American and African plates separated from each other 120 million years ago. At this time (145 to 65 million years ago), water flowed from east to west.

20 million years ago

30 million years ago, the Nazca plate collided with the South American plate, leading to the formation of the Andes mountain range. The subduction of the Nazca plate under the South American plate caused large earthquakes, and mountain-building processes in the Andes continue to this day. The Purus Arch (located slightly west of Manaus, at 62°) formed in the middle of the continent along with the Andes, creating a corresponding water divide. The rivers that flowed from Purus to the west then turned north towards the Caribbean Sea. The rivers that flowed from Purus to the east emptied into the Atlantic Ocean, following a similar path to the modern-day Amazon River. The rising Purus Arch formed a barrier to the dispersal of fish species between the eastern and western regions.

15 million years ago



24 million years ago, the giant (1 million km2) wetland of the Pebas formed due to the subsidence of the area as the Andes rose. The sinking was faster than the sedimentation from material flowing down from the mountains. The Pebas wetland was mainly a system of lakes, intertwined with swamps and surrounded by rainforest. The fish fauna in the eastern and western regions remained distinct. Fish in the Pebas lakes were able to move freely throughout western Amazonia. This region was occasionally connected to the Caribbean Sea, allowing marine species to enter the lakes. Several fish groups (such as river stingrays and drums) adapted to freshwater and remained in the Pebas system.

7 million years ago

The rise of the Andes continued, and the outflow to the Caribbean Sea ceased. Sediments washed down from the mountains accumulated in the Pebas wetland, gradually filling it up. The water level rose, and finally, 7 million years ago, the river broke through the Purus Arch. The river began flowing in its current direction, and the two different fish faunas merged into a single entity.

Amazonian Ice Ages (<2.5 million years ago)

Cyclic (approximately 100,000-year) ice ages caused significant changes in rivers, even though there was no ice in the Amazon region. During the peak of glaciation, sea levels dropped up to 100 meters, and the rivers carved very deep valleys. This cutting of river channels deep into their valleys occurred up to 4,000 km from the mouth of the Amazon. The remarkable depth of the Rio Negro near Manaus (about 100 m, 80 m deeper than the current sea level) is a reminder of those distant times. When sea levels rose again, large floods occurred in the Amazon. These cyclic changes led to constant changes in the structure of river basins and water divides. Fish fauna may have been isolated in certain areas for thousands of years, but then spread rapidly to new areas. All of this contributed to the very high and unique diversity of the fish fauna.

References

1. Nazca laam. https://et.wikipedia.org/wiki/Nazca_laam
2. Historical Biogeography of Neotropical Freshwater Fishes. edited by James S. Albert, Roberto Reis
3. Amazon River. https://en.wikipedia.org/wiki/Amazon_River

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