When I first went to Nicaragua as a young doctoral student from the University of California at Berkeley in 1984, the communist Commander Daniel Ortega was in power and civil war was raging between the Sandinistas and the Contras, who were backed by President Ronald Reagan. The strict US embargo inflicted even greater poverty on the country, its infrastructure was in tatters and there were no spare parts for cars. Even so, we had to find a way to cross the war zone between Costa Rica and Nicaragua, because there was no longer a direct bus connection into the country, but that’s another story.

There were other foreigners in the war-torn country too, providing humanitarian aid, but I was there to catch fish for research purposes. Specifically, the reason I was there was the Midas cichlid, a species which stands out due to its unusual appearance and interesting colouration. In most populations, about 90 percent of the fish have black and white stripes, with about 10 percent losing the black colour once they reach a length of about 10 centimetres, becoming bright yellow. It is to this feature that they owe their name, being a reference to King Midas in Greek mythology, as everything he touched turned to gold.

The American zoologist and ecologist George Barlow (1929–2007) had been studying the mating and aggressive behaviour of this species (Cichlasoma, now known as Amphilophus citrinellus) with a number of doctoral students, since the mid-1970s. Golden and “normal” black and white females prefer to breed with males of the same colouration, and golden cichlids have an advantage during aggressive territorial rivalry as well as during mating rituals. The main emphasis was placed on their behavioural biology, for example, looking at the issue of whether young fish learn this preference for fish of the same colour from their parents or siblings, or whether it is an inborn trait. However, George Barlow’s interest was not in the evolutionary consequences of this partner choice, and my main interest, as a doctoral student of his from Berkeley, was in gaining a better understanding of the emergence of new species.

Initially, I hadn’t actually wanted to study this species. After all, what could there be left to discover where a dozen doctoral students had already been? But then I noticed that the individual members of this species not only differed significantly in colour, but also in terms of other morphological structures. There were significant variations in body shape within the population of any single lake, with particularly marked differences in the shape of the jaw. Cichlids have developed the fifth branchial arch, which in more basal fish still supports gills for breathing, into a “second jaw”, known as the pharyngeal jaw, which enables them to process sources of food that remain inaccessible to other fish.

This evolutionary innovation probably contributed towards making the Cichlidae the most diverse family of all fish and vertebrates – with over 3000 species. The Midas cichlid is able to grow very strong “molariform” pharyngeal jaws, which have very strong molar-like teeth that enable it to break hard snail shells, or “papilliform” jaws with small, sharp teeth, with which it can efficiently macerate soft food such as insect larvae. The papilliform Midas cichlids are unable to break snails’ shells, however. It seems feasible to propose that this variety of forms associated with feeding may be the decisive factor in the life sciences.
Dawin's idea, that natural selection is the mechanism through which species evolve, has been a cornerstone of evolutionary biology. On one hand, this process is driven by the struggle for existence and the reproductive success of individuals. On the other hand, sympatric speciation, which is the emergence of new species within a single geographical area, is a complex process involving various biological and ecological factors.

Species concept in evolutionary biology

Darwin's definition of species was based on the idea that species are permanent and distinct entities. However, this concept has been revised and refined over time. The biological species concept, proposed by Alfred Russel Wallace and later developed by Ernst Mayr, defines a species as a group of populations that can interbreed and produce fertile offspring. This concept has been widely adopted in evolutionary biology.

Species emergence

The emergence of new species through natural selection and speciation is a complex process that involves various factors. One of the key mechanisms of allopatric speciation is geographical isolation. When two populations are separated by a geographical barrier, they may evolve different traits, leading to the formation of new species.

Cichlids in Nicaragua

Cichlids are a family of fish that can be found in freshwater habitats around the world. They are particularly well-studied in the large Nicaraguan lakes, where there are several in Nicaragua, because, as we now know, each of these species has come almost exclusively as a non-adaptation to the selective breeding process.

New species in Nicaragua

During his career, the famous evolutionary biologist Ernst Mayr (1904–2005) was, for many decades, one of the most important figures in the study of speciation and evolutionary biology. His work laid the foundation for modern evolutionary theory, and his influence has been felt throughout the field.

New species in research

The emergence of new species has been a major issue in evolutionary biology. During the mid-20th century, Mayr and other evolutionary biologists were fascinated by the research on speciation. They believed that the study of speciation could provide insights into the processes of evolution and the formation of new species.

The modern synthesis

The modern synthesis, which emerged in the mid-20th century, was a synthesis of the ideas of natural selection, genetics, and population dynamics. It provided a coherent theoretical framework for the study of evolution and speciation, and it helped to integrate the findings of various branches of evolutionary biology.

The emergence of new species

The emergence of new species has been a major focus of research in evolutionary biology. The modern synthesis, which emerged in the mid-20th century, was a synthesis of the ideas of natural selection, genetics, and population dynamics. It provided a coherent theoretical framework for the study of evolution and speciation, and it helped to integrate the findings of various branches of evolutionary biology.

Conclusion

The study of speciation and the emergence of new species is a complex and fascinating field of research. The modern synthesis, which emerged in the mid-20th century, was a synthesis of the ideas of natural selection, genetics, and population dynamics. It provided a coherent theoretical framework for the study of evolution and speciation, and it helped to integrate the findings of various branches of evolutionary biology.