Cynotilapia afra of Thumbi West Island

The *Cynotilapia* species can be distinguished from *Pseudotropheus* species by one anatomical characteristic, *Cynotilapia* possesses conical (unicuspid) teeth which are similar to the dentition found in dogs. The word *Cynotilapia* is Latin for "dog-tilapia" and refers to the shape of their teeth. *Pseudotropheus* on the other hand have teeth that have two points or bicuspid. The structure of their unicuspid teeth may be a remnant of some other feeding regime than they possessed in the past. Males use these teeth to intimidate other males when they are defending their territory rather than feeding on plankton.

Cynotilapia prefer the deeper sediment-free rocky habitat that is found in Lake Malawi but can be found in open water feeding on plankton when available. Males are territorial and use small caves as breeding sites and tend not to move to far away from their territory and thus will feed on the biocover as well. Females will enter the male's territory to spawn and after spawning females will hide in the rocks until releasing their fry. As night falls *Cynotilapia* will seek refuge amongst the rocks and will only venture back into open water at dawn. *Cynotilapia* can be found in open water and are not restricted to cover like other Mbuna species thus *Cynotilapia* may find it easier to colonize other areas.

Cynotilapia afra has the widest distribution of all the *Cynotilapia* species. They can be found from Nkhata Bay north to Chewere in Malawi as well as Mbjenji Island and Jalo Reef. They are also located down the eastern shore from Ikombe in Tanzania, right through Mozambique in suitable habitats, as far as Ntekete in Malawi. There is also a population of *Cynotilapia afra* that is also located in Thumbi West

Photo by Paul Cooley

Island but more on that particular population later.

Cynotilapia afra has become a very popular species amongst aquarists because of its striking color pattern. Each location provides slight variations to a blue fish with black bands. Some variations include striking yellow contrasts and markings. These variations have been explained by a number of different theories, some more likely than others.

The two main schools of thought on the topic of speciation from the mother population are the *sympatric* theorists and the *allopatric* theorists. Sympatric theorists espouse that speciation can occur within the presence of the mother population. The likely hood that

two fish with the same variation will breed is reduced by both males and females using color and patterns to help recognize conspecifics. If the variant fails to find a mate with the same variation then the genes of the parent population will eventually re-establish itself. It hard for those that espouse this theory to support their argument by finding examples in the cichlid population in Lake Malawi.

The allopatric theorists on the other hand propose that speciation occurs because of geographical isolation from the mother population. There are two major allopatric schools of thought. The vicarious theory (Rosen, 1975) advocates that the isolation of the daughter population occurs because of a geographical event such as a rise in the lake level. Once the daughter population is isolated then it is able to follow a different evolutionary path. The *peripatric* speciation or the founder effect theory (Mayr, 1963) believe that as the mother population spreads out a few individuals may reach a previously un-colonised location. These few are then able to breed and stabilise any variation prior to arrival of others from the mother population.

Variation can also be attributed to the *introgressive* hybridization of cichlids. Riseberg and Wendel (1993) as well as Arnold (1997) through their studies formulated that offspring from two different, closely related parental species will result in hybrid offspring that possess a complex mixture of parental genes. It is the mating back or introgression to the parent species over a number of generations that new species are formed.

There have been a number of research studies undertaken to examine hybridization events in cichlids. Stauffer and Hert (1992) examined hybridization in translocated species, Seehausen et al. (1997) under turbid water conditions, Ruber et al. (2001) when secondary contact was made due to fluctuations in the water levels in the lake and McElroy and Kornfield (1993) in the aquarium.

All these theories may help explain why speciation of cichlids in Lake Malawi and other Rift lakes has taken place at a frenetic pace. The use of DNA evidence is not only helping us understand the phylogenetic tree of Lake Malawi cichlids but also identifying possible hybridization events.

This brings us back to the *Cynotilapia afra* population that is located at Thumbi West Island. In the early 1960's T. E. "Peter" Davies and his wife Henny operated a lucrative cichlid export business out of Cape Maclear in southern Lake Malawi, just opposite Thumbi West Island. Ad Konings in talking to Peter Davies on his return to the U.K. and was informed of the circumstances of the establishment of *C. afra* on the island. After operating for several years at Cape Maclear Peter Davies received a letter from the government that he had 48 hours to pack up his belongings and to leave the country as the Malawi government was going to take over his property. He didn't want to

kill the fish (that he had in the holding tanks) so he just released them into the lake in front of his house. This is a sandy beach and most of the fish released were rock-dwelling mbuna. The southern part of Thumbi West (Mitande Point) is the nearest rocky habitat of that release site and some fish made it to those rocks and established themselves. Ad Konings also said that this one-time release scenario is also confirmed by David Eccles, who was fisheries officer at the time.

The original population at Thumbi West had black dorsal fins. There have been suggestions that the original location of *C. afra* was from Mara Rocks (Stauffer et al. 1996) and Likoma Island (Munthali & Ribbink 1998). Ad Konings believes that the Likoma Island variant is the more likely of the two as the Mara Rocks variant is more elongated than the others.

There have been various studies undertaken of this population and other translocated cichlid species at Thumbi West since the early 1980s. Ribbink et al (1983) conducted a survey of rock dwelling cichlids (i.e. mbuna) and commented that *C. afra* was still confined to Mitande Point. In the work carried out by Stauffer and colleagues in 1991-92 it was observed that specimens were being collected that had blue barring in the black dorsal fins. Stauffer et al. 1996 concluded that this change in color pattern as well as a change in the intermediate dentition was due to hybridizing with the native *Metriaclima zebra*. There was no clear genetic evidence that this was the case.

Streelman and colleagues undertook a research to establish the cause of this change in *C. afra* on the island in July 2001. By this stage the population had dispersed to all suitable habitats around the island. The population density varied around the island and like Stauffer et al. before them they too noticed variations in the blue barring in the dorsal fins. They collected male specimens from six

C. afra Likoma Island Photo by Ad Konings

different sites around the island and then immediately scored the dorsal fins. A zero was given to specimens with pure black dorsal fins to six for specimens that had six vertical blue bands.

Streelman et al. then used the specimen's DNA to try and establish if hybridization had

occurred. Once the DNA had been extracted from thirty two specimens from each site six microsatellite loci were identified. Four of the six microsatellite loci were typed in common with *Metriaclima zebra*. This was also done with the M. zebra population at each site which were distinguished from *C. afra* by their abundance at each site, larger in body size, blue barring in the dorsal fin and bicuspid teeth in the first row.

The visual results showed that fishes at the six sites differed in color pattern. The mean number of blue bars interrupting the black dorsal fin was greater at sites 3 and 4. At these sites more than half the individuals collected had 5 or more blue bars. Fishes at sites 1, 2, 5 and 6 had color patterns similar to one another. In the decade between Stauffer et al study in 1991 the population which was free from blue bars had evolved this color polymorphism. Thus *C. afra* had diverged into northern and southern populations with different colored dorsal fins.

It is believed that divergence in phenotype can take place over 10-15 generations through reproductive isolation from the mother population. If we assume that a generation is able to reproduce every 10-12 months then the allopatric theorists "Founder Effect" may explain the difference in dorsal fins of each test site. The north vs. south population dorsal coloration may have been selected by ecological conditions. On the southern side of the island trade winds stir up the water and make it cloudier than the northern side for four months of the year. In their native habitat *C. afra* would not have had to contend with this cloudy water and this change in color pattern may have developed as part of the selection process for a mate.

Metriaclima zebra Photo by Ad Konings

Streelman et al confirmed through their DNA testing of the population that hybridization had occurred with the native population of *M. zebra* at Thumbi West Island. Most significantly the population on the southern side of the island (1, 5, and 6) possessed mosaic genomes or a mixture of both *C. afra* and *M. zebra* whilst the northern populations on the other hand possessed predominantly *C. afra* genomes (2, 3, and 4). These results may not accurately reflect the situation that has developed on the island as only four microsatellite loci were used in the analysis and many mbuna species share the same ancestral history.

To what extent hybridization has occurred and the reason for it taking place will require further study. Has hybridization occurred because of environmental influences i.e. the trade winds making the water cloudy or is the abundance and size of *M. zebra* males a factor. This does not help explain why the northern population where hybridization is the lowest that blue barring is found in more individuals.

Streelman et al. suggests that this is a re-expression of a phenotype that was absent in the translocated stock. One thing is for sure that *Cynotilapia afra* and Thumbi West Island may help us understand the evolutionary divergence of cichlids and how speciation takes place.

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