Pterapogon kauderni, a unique species

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***Pterapogon kauderni* is a good paradigm about how ornamental fish farming could have a positive impact on the survival of certain endangered species, offering to the market of aquarium fishes, specimens born in captivity which would alleviate pressure on the wild populations.**

The "Banggai cardinal fish" (*Pterapogon kauderni.* Koumans, 1933), is a small tropical marine species with a very restricted range in nature. This species is mainly located in the archipelago of which are named (Banggai Islands, Sulawesi, Indonesia), being counted around 74 points of localization in thirty islands (Vagelli, 2005). Its addition to the set of species kept in aquarium, did not occur until 1995, when Dr. G. Allen, introduced them that year during the MACNA VII Congress.

The species barely measures 8 cm in total length and presents a very attractive pattern of coloration: with a silver body and three large vertical black bands, highlighting a small constellation of white spots between the second and the third band, as we can see in the images. Only two species share the genus *Pterapogon*: the one in question and the Australian *P. mirifica*.

In nature the species lives in small groups, usually is present in areas of calm and shallow waters (between 1 and 6 meters) in seagrass beds, reef coral or sand bottoms. Although cited living under the protection of the long spines of sea urchins (genera

Pterapogon kauderni, macho incubando

Diadema and *Tripneustes*), the fact is that them also are located under the protection of large anemones and between the branches of hard and soft corals (Allen, 2000 y Vagelli et al, 2004). *P. kauderni* is a diurnal Apogonidae that feeds on small pelagic organisms, mainly crustaceans. But its diet is wider, being identified in their stomach contents: annelids, molluscs and fish larvae.

Breeding in captivity

The species has the reputation of "easy to reproduce in captivity." But the truth is that when moving from theory to practice, there are various difficulties to successfully complete the process. My personal experience in keeping and breeding this species in aquarium for two years can be summarized as follows: "not too much difficult species at the phase to form pairs, easy to spawn in captivity with proper food, but not so easy to get more than 15% of healthy adult individuals from spawning".

Turning now to the details will have to start by saying that P. kauderni as many other apogonidae, is a mouthbrooder (males) with no apparent sexual dimorphism. To address its reproduction in captivity, should be starting from a group of young. The procedure used in my case, has been to allocate groups of 6-7 individuals in specific aquariums of 450 L. Well fed and without competition from other species, it is usual that a dominant couple is formed after a time of two to four weeks (also I have observed the formation of couples in community aquariums). Despite to have a roomy aquarium (because they are juveniles just with 5-6 cm of length), it is usual that the newly formed couple extends its territory around the tank and begin to show an aggressive behaviour against the rest of the group, whose quality of life is degraded very quickly. At that point, we proceed moving the recently formed couple to a 200L specific aquarium. After this, the rest of the group is recovered in a short time and often a second pair is formed in just two weeks, which is again relocated, as the first, in another aquarium of 200L.

Again, food and water quality are key to the rapid growth and maturation of the specimens. The food provided has been based on a porridge with fresh seafood including several species of algae and some vitamin supplements. This diet has been supplemented by *Mysis sp.* and frozen red mosquito larvae. Periodically they have been fed with Artemia salina alive. Two to three

Pterapogon kauderni, pareja

daily feedings. The specimens in these conditions, grow and mature very quickly and after a period of two to three months will begin to produce the first courtship and spawning. Environmental conditions: T:27-28,5 ºC, pH: 8,2, S: 33-35 g/L. The spawns have always occurred during the day, most often early in the morning.

The reproductive process observed in the aquarium differs slightly from that takes place in nature where as has been previously described (Vagelli, 2004), a gravid female chooses a male from the group several days prior to starting the courtship. The couple leaves the group and defends a small territory, driving out the other specimens that get too close. In aquariums(200-400L) inhabited only by pairs or small groups, as soon the dominant couple is formed (time before the first spawning happen), proceeds to drive out the rest of the group. If the couple and the rest of the group are kept in the same aquarium, the couple stays together and the female always spawn with the same male.

Pterapogon kauderni, pareja con el macho incubando día 1

In the aquarium, we can see some change in behavior in the couple, two or three days before they spawn. The Courtship itself is initiated by the female, who displays behaviors that include body vibration, "positioning" in parallel with the male, and also occasional touches flank against flank. During this same period, the male can perform certain characteristic "yawns". Spawning is very fleeting, personally I haven't been able to watch it, but is described (Petersen, 2013) that “the female spawns a mass of about 40-70 eggs and the male, very close to it, proceeds to fertilize the egg mass as they are being expelled and subsequently introduced into the mouth, all in about three seconds. "

The eggs show an orange color and are large, with a diameter close to 3 mm and remain grouped by means of adhesives chorionic filaments.

After spawning, the female follows next to the male for several hours or even all the day (we can still see sporadic physical contacts between both). Meanwhile, the male focuses on incubating eggs. During the period of embryonic development, occasionally you can see the male projecting outward from his mouth the egg mass for a moment, driving out non-viable eggs and reintroducing "the block" of eggs alive promptly. In the oral cavity of the male embryo development continues until completion. In the processes of incubation I have been able to be monitored in my tanks, there comes a time when a slight changes can be appreciated in the oral cavity and the degree of opening in the gill covers (both areas look slightly bulkier), even breathing rate looks different (slightly faster). Considering the hypothesis that this event coincides with the hatching of larvae inside the male's mouth, I have recorded a time between 18 and 21 days until embryonic development is completed.

Once they hatch, the larvae remain in the oral cavity of the male about ten days more (occasionally I have registered for this period until twelve days, with previous partial expulsions of fry). Under these conditions the larvae continues to evolve, thanks to endogenous food provided by their large yolk sac. In the literature, several authors contemplate times ranging from a minimum of 18 and a maximum of 28 days for the entire process.

During the days of the whole process, from spawning to the expulsión of the larvae, the male does not feed. The female does it normally.

Among my pairs of P. kauderni, has been prevalent in their first spawnings, that the male disrupts incubation in the first week, usually on the 4th or 5th day. Has not been possible objectify if the cause of interrupting the process is motivated by reasons of infertility in the spawns or perhaps for reasons of stress in the newly formed couples. Additionally, two adult males with several incubations already made, stopped the process and expelled the eggs when they were disturbed (they are very sensitive during this period to any work on the aquarium).

When the larvae are finally released (usually I've detected them early in the morning), we can see that they are already tiny replicas of their parents (without having gone through any larval pelagic stage). In nature, larvae seek protection in the vicinity of the tentacles of an anemone or between the spines of a sea urchin, while in the aquarium they try to adapt to anything that gives them a safe shelter. Larvae have presented a size between 7 and 8mm LT. They are translucent, but show many melanophores and fins strongly pigmented in black. Larvae present on its flanks two vertical stripes, the first at eye level and the second at the beginning of the dorsal fin. Morphologically they are a faithful reflection in miniature of the adult specimens. They are vigorous, photophilic and remain close to the surface and close to the light source. They are always positioned in angle with respect to the water surface, with the head directed toward it. They do not seem especially frightened. Considering the full set of my experiences, the number of larvae finally expelled has ranged from a minimum of four and a maximum of ten.

The larvae are collected and transferred for its development to an aquarium of about 10 L. simply equipped with a line of gentle aeration and various objects on the bottom, simulating "artificial sea urchins".

Pterapogon kauderni, macho incubando adecuando la posición de los huevos

It was offered as first food, newborn nauplii Artemia salina enriched with essential fatty acids: the Ω-3 HUFA. docosahexaenoic a. (DHA) and eicosapentaenoic a. (EPA) and the Ω-6. arachidonic acid (ARA). An effective way to enrich the nauplius is to wait until the first moult (about 6-8 hours after hatching) and then proceed to provide a mixture of unicellular algae: *Isochrysis sp.* (66%) and *Nannochloropsis sp.* (33%). Before that time the nauplius don't begin to feed by filtering of suspended particles. *Isochrysis sp*. presents together with *Pavlova sp.* one of the nutrient profiles with higher levels of DHA between phytoplankton species commonly cultured. Complementarily, *Nannochloropsis sp*. has a high level of EPA. For the first two or three days, I have preferred to use Artemia cysts of medium size (nauplius with 450 µ of length). The food is accepted from the first moment. The larvae are very active during the day in mid-water. They are provided with a long photoperiod, with just 6 hours of night. During the night, they stay in the mid-water aquarium. Copepods (nauplii and semi-adults) are an excellent alternative to *A. salina* nauplii, given that unlike *Artemia,* directly provide certain levels of DHA and EPA.

Larvae constantly look for food near the surface and mid-water. Well fed the growth is appreciated right away. When completing the first week of free swimming (about 17 days after birth), the specimens measures 1 cm LT of average and have completed their pigmentation. Sometimes, I have observed a peculiar behavior: "if the light of its aquarium suddenly switch on, without going through a state of soft light, then they go into shock and fall down laterally on the substrate and remain motionless as if dead during 20-30 seconds, after which go to mid-water normally ". Similar behaviors has been described by other authors (Vagelli, 2004) who have linked those abnormal behaviours to deficiencies of essential fatty acids in the diet. When completing three weeks of free swimming, thirty days post hatching (30 dph), they maintain a remarkable growth rate, averaging 1.5 cm LT. At this stage of its development significant size differences are seen between different specimens. At this point, changes are introduced into the diet, providing both *Cyclops sp.* lyophilized as different porridge of marine molluscs and crustaceans finely sieved. The reality is that they are very selective with the new foods and because of this, remain as their main food, the nauplii and metanaupliu enriched of *Artemia salina*. Promptly, they are moved to a second aquarium of 30 L equipped with a filtration system, which generates a current against which the young of *P. kauderni* swim incessantly. The photoperiod was reduced to 14 h. When they reach two months the growth rate remains high, the largest specimens measured 2.2 cm LT. Over time the growth rate is somewhat lower, averaging 2.7 cm when they reach three months old (at this time the diet includes frozen crustaceans and small crushed dry food).

Pterapogon kauderni, larvas con 5dias vistas desde la superficie

At four months they average 3,1 cm TL, to the five months their size reach 3,4 cm and when they are seven months old are near of 4,5 cm TL. In the literature are cited some developments faster than what I've registered in my experience. Sexual maturity is reached about nine months old.

Basic maintenance during development includes daily siphoning the bottom of the breeding tank and two water changes per week. In the eleven full developments of fry performed, has been observed in some cases, the appearance of a specimen that has presented defects such as "deformed operculum". Usually these abnormal specimens have not reached adulthood. In all developments, the number of larvae expelled by breeding males has been much less than the mass of spawned eggs (between 10 and 25%).

The contrasted longevity of the species in aquarium is about five years.

Current status of the species: threats and opportunities

As the abundant literature on this unique and beautiful species has repeatedly pointed out, several aspects of its biology makes it a highly vulnerable species . It should first be noted that this is a species whose ontogenesis does not provide a pelagic larval stage, so the species does not have great capabilities of expansion towards new areas. Secondly, we have their reproductive strategy based on oral incubation with spawns of just 40-70 eggs, which represents a very low potential of fertility. Its popularity in the marine aquarium has generated an intensive capture since almost a decade, which has resulted in a significant decrease of their wild populations according to various field surveys (Lunn and Moreau 2004 Vagelli 2005). Due to all of those circumstances, the species is found since 2007, included in the Red List of Threatened Species IUCN with the status "EN" v3.1 (Allen, 2007). The situation worsened even more when in 2012 it began to be detected in native specimens imported, an increased incidence of a viral disease (iridovirus) capable of killing a large number of individuals of this species in a short time.

However, the fact that its captive breeding is feasible and relatively simpler than other tropical marine species kept in aquarium creates a great opportunity to improve the expectations of medium-term survival of the species. This opportunity for becoming a reality, have to be able into the trade of ornamental fishes, of replacing the *P. kauderni* specimens taken from the wild by specimens bred in captivity.


Pterapogon kauderni, alevines con 40 dias

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In this sense, different institutions and public aquariums have launched several breeding programs in recent years. Although the key to its final success will depend largely on good international coordination and appropriate stance of marine aquarists, in the sense of verifying the origin of the specimens prior to purchase.

Another possibility would be, some kind of controlled reproduction of this species in "fish farms" located in natural microhabitats. In this regard it is noteworthy that the species was artificially introduced in 2000 in the Lembeh Strait, North Sulawesi, outside its natural range (Allen, 2007). Subsequent scans have verified that this subpopulation has prospered. ©

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