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# Effect of Lunar Synchronization on the Reproduction Time of Discus Fish (*Symphysodon* sp.) Under Controlled Aquarium Conditions

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**Abstract:** The reproduction times of the discus fish were observed for 2 years under fully-controlled production conditions. The position of the moon was also recorded on the spawning day of the fish at a light photoperiod of 14 h and a dark photoperiod of 10 h with water quality parameters of 27-30°C, pH 4.5-6.5 and conductivity of 80-200 μS. Of 102 observed reproductions, 28 occurred at the first quarter of the moon, 28 at full moon, 40 at the last quarter and 6 at new moon. Accordingly, it has been concluded that the discus fish display a reproduction behavior according to the lunar cycle even indoors, although they do not receive direct moonlight.

**Key words:** Discus, symphysodon, lunar synchronization, spawning, breeding, Turkey

## INTRODUCTION

Discus (*Symphysodon* sp.) is one of the most demanded aquarium fish in the world where there is an importation of ornamental fish amounting to about US$ 292 million (FAO, 2005; Koh *et al*., 1999; Din *et al*., 2002; Chong *et al*., 2002). The trade of aquarium fish is considerably increasing day by day in Turkey, like in all around the world (Ng and Tan, 1997). It is striking that there is a small number of scientific studies concerning species like discus which has a commercial value in such a large sector (Chelappa *et al*., 2005). Updated information is needed about the behavior, development, reproduction biology and ecology of aquarium fish (Chong *et al*., 2002; Chelappa *et al*., 2005).

Determining the reproduction time of fish is an important issue for producers to make necessary preparations in the production of eggs and larvae and particularly in terms of obtaining maximum performance from the limited number of matured fish. Knowing the position of lunar cycle is an element that may relatively help producers in obtaining more productivity from fish by arranging the spawning time. Therefore in the formation of the production protocol, taking lunar synchronization into account besides environmental factors such as water quality, tank structure, feeding program and photoperiod may increase the productivity of the protocol. In this study, the effect of lunar movements on the reproduction time of the discus fish is observed under controlled conditions. There are a number of literatures about the fact that the position of the lunar cycle, namely, lunar and semi-lunar cycles has a direct effect on the reproduction activity of many marine and freshwater fish (Johannes, 1978; Lam, 1983; Taylor, 1984; Thresher, 1984).

In many experiments, carried out both in nature and under laboratory conditions, it is reported that lunar movements have one-to-one relations with the gonad development, hormone secretion and reproduction time of fish species such as Acanthuridae, Apogonidae, Balistidae, Blenniidae, Carangidae, Chaetodontidae, Cichlidae, Epinephelinae, Labridae, Lutjanidae, Mugilidae, Mullidae, Opistognathidae, Pomacentridae, Pseudochromoids, Pteroidae, Scaridae, Siganidae, Sphyraenidae and Sparidae (Nakai *et al*., 1990; Hoque *et al*., 1999; Rahman *et al*., 2000; Harahap *et al*., 2001). In professional systems and particularly under controlled production conditions, any factors affecting production are desired to be under full control with a view to increasing the reproduction performance.

## MATERIALS AND METHODS

With a view to collecting data about the reproduction time of the discus fish. About 10 fish couples of different races in two production systems were utilized. Composed of 2-3 years old 10 female and 10 male discus fish (*Symphysodon* sp.), one couple of melon race, one couple of red-turquoise race and 3 couples of blue-diamond race, a total of 10 fish couples were used.

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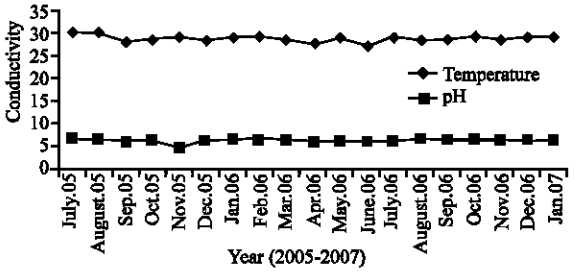


Fig. 1: Monthly average water temperatures and pH values during the study

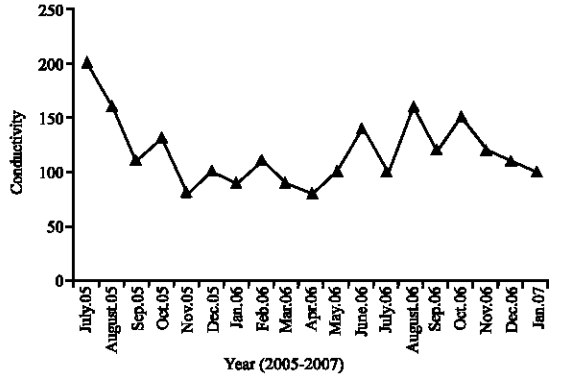


Fig. 2: Monthly average conductivity (μS) values during the study

The reproduction time and periods of the fish were observed during 19 months between July 2005 and January 2007. The production systems were composed of an indoor discus production laboratory of 10 $m^2$ in the Living Resources Unit of the Department of Aquaculture in the Faculty of Fisheries at Canakkale Onsekiz Mart University and an indoor production site of 12 $m^2$ of a semi-professional producer and located in another city.

In both production systems, the fish were produced in aquariums located in a fully indoor place that did not receive direct daylight and moonlight. It was intended to maintain similar features concerning the production aquariums and medium conditions in both systems. A total of 10 aquariums with the dimensions of 40×40×40 $cm^3$ and with a water capacity of 50 L were used for each couple. While filtration was performed by external bioball and ceramic filters with fibers inside and full of peat in closed-circuit aquariums, a sponge filter was placed in each aquarium. During data collection, a light photoperiod was applied for 14 h and a dark photoperiod was applied for 10 h by means of an automatic timer. Commercial discus feed (Tetra Diskus, Germany) and handmade gel feeds were used in feeding. Water temperature varied between 27 and 30°C, pH between 4.5 and 6.5 and conductivity between 80 and 200 μS during the experiment (Fig. 1 and 2). Water was kept at the same level in all aquariums and water was changed by filling in new water instead of the flushed water depending on pollution. While normal production protocols were applied under these conditions, the dates when the fish spawned and the position of the moon at that moment were recorded.

## RESULTS AND DISCUSSION

Although, the course of water quality parameters in the production tanks according to monthly averages was not constant as shown in Fig. 1 and 2, it was at stable levels. There occurred a total of 102 spawnings within 19 months. When the spawning times and numbers of the matured fish are observed, about 28 out of 102 reproductions occurred at the first quarter of the moon while 28 occurred at full moon, 40 at the last quarter and 6 at the new moon (Fig. 3).

In this study, it is concluded that the position of lunar cycle is effective on the spawning time of the discus fish under controlled production conditions. About 28 reproductions were recorded at the first quarter and 28 reproductions at full moon whereas, 40 reproductions were recorded at the last quarter.

On the other hand, only 6 reproductions occurred at the new moon. According to these data, it is concluded that the discus fish do not choose the new moon in other words, the times when there is no moonlight for reproduction.

The reproduction of the discus fish during the times when there is moonlight although, little may indicate that parental care may be performed more effectively. The spawning activity have been observed to make a peak in some demersal-spawning marine fish several days prior to full moon and several predictions have been put forth as the reason of this; Parental care is more fruitful at nights due to light intensity (Allen, 1972; Moyer, 1975) and fries take advantage of moonlight and escape from predators (Allen, 1972).

Another indication about the advantages of lunar spawning cycle in marine fish is that there exist more planktonic food sources for fries since many of the invertebrates spawn at lunar cycle (Allen, 1972) and that lunar movements are supposed to be used among the species as a clue for being able to reproduce simultaneously and in a synchronized way (Nakai *et al*., 1990). Similar predictions to previous studies can be carried out also for this behavior of discus fish. Many of the studies that have related lunar synchronization with the reproduction of fish so far have been observed under natural conditions and reported. Nevertheless, this study

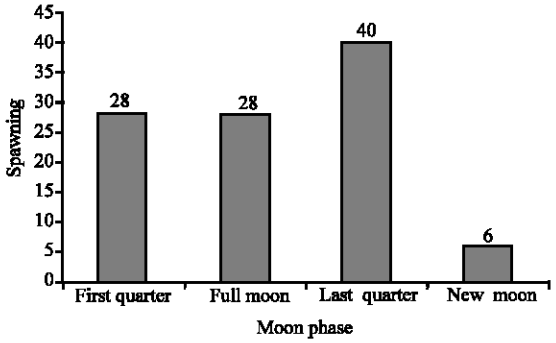


Fig. 3: Reproduction numbers at four different lunar cycles

has observed the relation of discus fish produced in aquariums under fully-controlled conditions with lunar synchronization. In some species such as nesting pomacentrides, important changes may occur at moonlight due to parental care (Moyer, 1975). Many marine fish are known to directly react to tidal changes however, many of them react to lunar rhythm even in aquariums having a constant water regime and follow the lunar cycle (Schwanck, 1987). Also in this study, it is concluded that the discus fish arrange their reproduction time according to the position of the moon under controlled conditions.

There are many scientific data about the effect of lunar or semilunar synchronization on the reproduction cycle of fish (Rahman *et al*., 2003, 2004; Park *et al*., 2006). The reproduction behavior has been reported to have a relation with the moon in species of reef fish such as Acanthuridae, Apogonidae, Balistidae, Blenniidae, Carangidae, Chaetodontidae, Epinephelinae, Labridae, Lutjanidae, Mugilidae, Mullidae, Opistognathidae, Pomacentridae, Pseudochromoids, Pteroidae, Scaridae, Siganidae, Sphyraenidae and Sparidae (Takemura *et al*., 2004). In addition recently, it has been proved that the gonad development of the rabbitfish (Siganidae) is according to lunar synchronization (Hoque *et al*., 1999; Rahman *et al*., 2000, 2003; Park *et al*., 2006).

## CONCLUSION

According to this study, it is difficult to state that the reproduction time of the discus fish is completely dependent on lunar synchronization however, it can easily be said that they prefer the periods when there is more moonlight for reproduction. On the grounds of this, it can be concluded that the discus fish which display parental care behavior need the illumination of aquariums although, little at nights during parental care when they are produced under controlled production conditions. This application may have an effect of indirectly increasing the life percentages of eggs and larvae. Being unable to have a direct contact with moonlight at nights under controlled conditions, these fish can be assumed to feel the position of lunar cycle and arrange their reproduction times according to it.

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