

Breeding in the deep sea

Fish within the deep sea vary on size; in the abyss the fish are generally larger than those in the mesopelagic zone (Wagner, 2002). This is believed to occur because the fish in the deeper water spend more energy growing and mature much later than those in the mesopelagic (Castro and Huber, 2004; Karleskint, 1998). Therefore the fish living in the deepest waters have very low reproduction rate compared to that of the mesopelagic (Catul et al, 2011).

Most eggs, larvae and some juveniles of the deep sea fishes are found within the plankton where they are very well camouflaged and are transparent in light (Catul et al, 2011; Steele et al, 2009). The increased productivity in the shallow waters allows the young fish to grow faster. The larvae of the deep sea angler *Cryptopsaras couesi* is generally distributed with the surface waters between 30-65m depth (Minchin, 1988). These young fish then descend to various levels within the ocean; this type of movement is called ontogenetic migration (Haedrich, 1996).



Figure 14 *Cyclothone microdon* can change sex from male to female (Steele et al, 2010)

Sexual dimorphism is common in the deep sea fish. Females grow to a larger size than the males as this allows the female to produce more eggs (Steele et al, 2010). The fecundity of many deep sea fish is low, the lanternfish for example produce only 200- 1,000 eggs produced by each female (Catul et al, 2011). Many deep sea fish spawn throughout the year exceptions include *Benthosema pterotum*, which only spawns once in its life (Catul et al, 2011). Fish such as *Cyclothone microdon* shown in figure 14 are capable of changing sex (Steele et al, 2010).

Bioluminescence can be used for seeking out mates in the deep sea. The male lanternfish has a photophore located dorsally on the tail that produces a bright light, the females light is weaker and is located on the ventral side of the tail, this adaptation allows the fish to know if the fish nearby is male or female (Karleskint, 1998). The photophores can also be used to identify different species with various numbers present of different species (Karleskint, 1998).

Adult angler fish have worldwide distribution through various depths (Minchin, 1988). The male deep sea angler fish is parasitic and is dwarfed compared to that of the female. The males smell the female pheromones she has released into the water by using olfactory organs located at the front of his head (Pough et al, 2004). The males have a specifically designed mouth that can rasp at the side of the female's body to become fused over several weeks. The female supplies the male with blood and essential nutrients and the male provide the females with sperm for the rest of her life (Munk, 2000). More than one parasitic male can fuse with a female; Monk, 2000 found a female *Neoceratias spinifer* with 3 fused males attached.

Young fish undergo metamorphosis either in the plankton or shortly after travelling deeper into the water column. During metamorphosis the female deep sea angler fish swim to a greater depth, where they stay to feed, grow and mature (Pough et al, 2004). The males however only feed during the larval stage, and during metamorphosis grows into slender shape and swims constantly using up the reserves in their liver in order to find a female to fuse with (Pough et al, 2004)