BUOYANCY MECHANISM, AND DENSITY OF SAND TIGER SHARK
(EUGOMPHODUS TAURUS)

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ABSTRACT

The note deals with the buoyancy mechanism in sand tiger shark effected by gulping of air into the stomach.

Sand tiger sharks (genus *Eugomphodus*) are known to be the only shark capable of storing air in their stomach to maintain neutral buoyancy. The stored air in stomach allows these sharks to float in water inspite of their bulky bodies. At shark encounter, Sea World of Florida, 13 individual sand tiger sharks (*Eugomphodus taurus*) are kept since last 12 months. Instances are reported and observed by present author that these sharks often come to surface and gulp air from the atmosphere. It was thought that the gulped air would perhaps be the only source which makes these sharks buoyant, permitting their bulky bodies to float close to the surface with their backs to arch out of the water. To confirm the presence of air in stomach of these sharks and also to note its role in making animal buoyant, an experiment was designed. A normal sized healthy shark (*Eugomphodus taurus*) was selected, the shark was measured and weighed in water at a depth of 10 cm and out of water and also with air and without air in the stomach. Air inside the stomach was first visualized by seeing through endoscope with I. V. extension SRT with 3 way stop-cock valve 180 cm (Olympus). The shark was caught by dip net, with the net tied around the body and its mouth was opened by introducing a galvanized tube covered with a soft towel. Through this tube the endoscope was inserted into the stomach.

The density of shark was calculated by using the formula given by Baldridge (1970):

$$D_T = \frac{d}{1-(w/W)}$$

Where $D$ represented the density of the shark at temperature $T$, $d$ is the density of the sea water in which the shark was immersed at the temperature $t$, $w$ is the apparent weight of submerged shark and $W$ is the weight of the shark in air.

**OBSERVATIONS**

*Date of observation:* 17th August, 1988.

*Place:* At Sea World Florida Shark Encounter.

*Measurements of the shark:* Precaudal length: 149.4 cm, fork length: 171 cm, total length: 203.4 cm, weight of shark in air (W): 62.2 kg; weight of shark in water at 10 cm depth (w): 1.4 kg; weight of shark in water post air removal at 10 cm depth: 4.4 kg.

*Temperature of sea water:* 24.5 °C.

*Salinity of sea water as percentage:* 3.0.

*Ph of sea water:* 8.15.
time of shark's release after air removal: 1010 hrs.

time of shark's first movement after air removal: 1500 hrs.

time of shark's firstgulp of air from surface: 1610 hrs.

Density of shark with air in the stomach = 1.02 
\[ \frac{1}{1-1.4/62.2} \] = 1.022.

Density of the shark with air removed from the stomach = 1.02 
\[ \frac{1}{1-4.4/62.2} \] = 1.0977

The weight of the shark in water after the air was removed from the stomach demonstrated a sudden increase of 3 kg compared to its weight in water with air in the stomach. Upon the shark's release, it sunk to the bottom where it remained at the same spot for 4 hrs 50 mins. The shark displayed signs of stress and was swiftly pumping water through the gills. For some period of time the shark's jaws were seen to perform regular pumping action as well. Despite periodic interference from jew fish (present in the tank) the shark remained quite stationary. After 4 hrs 50 mins. the shark made its first attempt to move, but only able to turn on other side. After 6 hrs the shark finally began to swim towards the surface. Its swimming speed was faster, its tail end drooping prominently towards the bottom. Having completed one and a half lap of the tank, the shark thrust forward assuming an almost vertical position and clearing its head from the water as far as fifth gill slit. The jaws opened and fully protruded as air was inhaled, before the shark fell back into the water, streaming bubbles from the gill slits. Thirty minutes of further observations showed that the shark did not gulp air again, it then swam at a comfortable rate, its body horizontal and notably buoyant in the water. The whole episode was filmed using video camera stationed above and below the surface.

Figure 1 A-L has been drawn from the stills of the video film. It shows how the shark raised from resting position and travelled half part of the tank before it thrust above the surface to take air and finally went down and swam comfortably. The density of shark both with air and without air in the stomach was estimated as 1.23 and 1.0979 showing difference of 0.135. It is recognized that hydrostatic lift provided to living sharks

![Fig. 1. A-L. Drawn from the stills of the video film shows the various steps sharks took to gulp air starting from resting position, gulping posture and finally swimming comfortably. A: resting at the bottom; B & C posture showing upward movement; E: attains vertical position; F & G: reaching to surface and thrusting out of water to gulp air; H, I, J, & K: retreating downward after gulping air and L: finally swimming.](image-url)
by its buoyant liver also at times be augmented by the presence of air and other gasses in the shark’s stomach. Significance of air in the stomach of sand tiger shark has been established by this experiment. Sand tiger sharks are often seen swimming close to surface and also found resting at the bottom. In doing so they have to regulate the volume of air in stomach perhaps by expelling out gasses through mouth or it has developed some mechanism. Whatever is the phenomenon needs detailed studies.

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REFERENCES