Measuring Aquarium Fish

How do you measure length and weight of aquarium fish?

By Jay Hemdal

There are good reasons to know the weight (mass) of your aquarium fish. Ideally, the amount of food provided to the fish each day should be a percentage of its weight. In addition, many medications are best dosed in relation to the fish's body mass. Finally, the true carrying capacity of an aquarium is really a relationship of the total fish mass in the aquarium to the volume of water and the amount of surface area, which is where the exchange of oxygen and carbon dioxide takes place.

The purpose of this article is not to provide guidelines for feeding, medicating or determining correct stocking levels. This information appears from time to time in this magazine and is also found on the packaging of some aquarium products. Rather, the following text describes three possible methods for determining the mass of living fishes, including the benefits and drawbacks of each technique.

Direct Determination
Obtaining the actual mass of a living fish is often problematic. Some species cannot tolerate the handling required to obtain such measurements. The physical stress involved may actually cause the death of a delicate specimen. In other cases, the fish are simply not retrievable due to the intricate physical structure of their aquariums. In yet other situations, the labor involved in directly weighing a given fish is greater than the potential benefit that might be gained from obtaining the data.

Nonetheless, the benefits of knowing the weight of your aquarium fish may be significant enough to make such efforts worthwhile. There are four basic methods for directly measuring the mass of a living fish.

In the first method, the fish is captured, moved to a small holding container and anesthetized with Metomidate at 4 to 8 milligrams/liter. Other anesthetics, such as MS-222, can also be used at an appropriate dose.

The fish is then transferred to a clean weighing pan (covered with a soft, wet substrate) and weighed. The time that the fish is removed from the water (without supplemental life support) should be less than five minutes — inclusive of any medical procedures that might be required at the same time. All anesthetics pose an inherent risk to the subject, and cost factors (including time) must also be evaluated.

With the second method, a non-anesthetized fish is captured and moved to a small holding container with sufficient water (which has been weighed previously to determine its weight), and then the fish and container are weighed. The weight of the container and the water can then be subtracted from the total weight and the fish's mass determined.
Examples of Fish Length/Mass Relationships Common NameGenusTotal LengthMass (centimeters)(grams)Neon tetraHyphessobrycon2.00.2DamselfishPomacentrus3.21.3African cichlidHaplochromis3.50.7Royal grammaGramma3.82.4ShinerNotemingonus4.01.4LionfishPterois5.54.5ButterflyfishChaetodon5.58.0Pygmy angelfishCentropyge6.213.2Achilles tangAcanthurus6.68.9DiscusSymphysodon7.019.1African cichlidPseudotropheus8.07.2KoiCyprinus10.718.0BluegillLepomis11.028.0Clown triggerBalistapus12.465.0PiranhaSerrasalmus12.768.5AngelfishPomacanthus14.0116.2Yellow tangZebrasoma15.5120.5GrouperEpinephelus17.0155.0KoiCyprinus25.0235.8LionfishPterois21.6415.5CatfishIctalurus38.0900.4Cich

The primary drawback to this method is one of accuracy. That is, a scale that has a range wide enough to hold a container of water — perhaps a 2-gallon bucket, with a total weight of approximately 20 pounds — will not normally have sufficient accuracy to compute the mass of the fish that might weigh only a pound. Limiting the amount of water in which the fish is held will reduce this problem, but will subsequently increase the stress to which the fish is exposed.

The third method is similar to the previous one. A small, non-anesthetized fish is captured, quickly placed directly on the weighing pan of a scale and the weight measured. Movement of the fish will affect the results of such a measurement, and most aquarists would consider the stress to which the fish would be exposed unacceptable.

A rarely used method for fish mass determination is volumetric displacement. In theory, a fish can be placed in a container

of water that has volumetric graduations on its sides. The displacement of the water after the fish has been added could be used to calculate its mass. Most fishes are neutrally buoyant in water, so the weight of the water displaced can be considered equal to the mass of the fish. In practice, an extremely narrow cylinder would be required in order to obtain an accurate vertical resolution of the water displaced after the fish was placed in the container.

There are other techniques for determining fish mass, but they have distinct limitations. For the two following mass estimation methods, the fish's length must be known: Holding a tape measure against the front of an aquarium as the fish swims nearby is perhaps the best means to determine its length. Taking an instant photograph of the fish alongside an object of known length is another possible method. The refraction of the water does not seem to affect these readings, as it does while scuba diving (where objects underwater appear 30 percent larger or 30 percent closer than they would in the air).

Observational Estimate. Using a fish's length alone, aquarists may sometimes attempt to estimate its mass. Typically, one needs a certain amount of data before attempting such an estimate — either anecdotal knowledge of the mass of similar fishes or knowing the mass of comparable objects in terms of size and density. For example, an uncooked hamburger patty weighs about 110 grams. With a mental picture of this, the aquarist then estimates how many of these "hamburger patties" could be contained in the body of the fish.

In practical use, without a sound frame of reference, observational estimates are often inaccurate to the point of being useless. As an example, twelve aquarists were asked to estimate the mass of six fishes of known mass. Their estimates averaged 75 percent higher than the actual mass of the fishes. Not a single estimate was within 20 percent of that of a given specimen. Observational estimates are best used if one knows from previous experience, the mass of a same-size fish of an identical species derived from a previous direct weighing. Table I gives some examples of direct-measured fish masses that aquarists might find helpful in refining their own observational estimates.

Direct Comparison Against a Known Data Set. This is an improvement of the observational technique in which data previously compiled from fishes of similar length and body morphology is used to obtain a mass estimate of the specimen in question. Aquaculturists have long used this technique for commonly cultured species. For example, tables have been developed that show how many salmonid fry of a given size comprise a kilogram of biomass.

A computer database could be developed to store data from fish length/mass data derived from personal experience, as well as from published literature. One such database, MASLEN (short for MASs LENgth), which I have written, incorporates 10 possible fish body morphologies and data entries for more than 8000 individual fish length/mass measurements. This program, when used to estimate the mass of a fish of known length, routinely achieves an accuracy of within 15 percent of the sample fish's actual mass.

Accuracy suffers when one attempts to estimate the mass of a typical aquarium fish, such as robust, gravid females, or ill specimens that are in an emaciated condition. Nevertheless, such a database program could be used as an adjunct tool for the serious aquarist wishing to estimate the mass of a fish and avoid the inherent stress of direct weighing. At this time, the program I have written still needs work before it can be made available for use by others.