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Automatic feeder for marine mammals

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Abstract

A description of a hydraulically operated automatic cut fish dispenser is presented. This feeder has been found to be highly reliable with a very low rate of breakdowns.

Over the last thirty years there have been many experiments on the variables effecting the behaviour of marine mammals. In a large percentage of these studies the experimenter reinforced the performance of the desired behaviour with either whole or cut fish. In most of these studies the reinforcement was delivered by either the experimenter or the trainer by hand from a fish bucket. This required not only the physical presence of a person during the running of the experiment but also created an interaction between this person and the subject. Whereas in some training situations the presence of an interacting person is both desirable and useful, in other situations it is detrimental and can influence the results. In those situations it would better if the food delivery were totally independent of either the trainer or experimenter. At the very least, the trainer should have the option of how he wants to deliver the food reinforcement, either via the bucket or via an automatic feeder.

Automatic feeders for marine mammal research were used in the 1970s (*e.g.* Anderson 1976, Beach and Pepper 1972, Chun 1978). Unfortunately these feeders were not specifically designed to handle wet, sticky, irregularly sized, easily spoiled, cut fish. For example Schusterman (in Pryor 1986) reports on one dolphin who, after he knew the task perfectly, started responding 100% incorrectly. Upon investigation it was found that the fish in the automatic feeder was spoiled and it was surmised that the dolphin was attempting to communicate this fact to the experimenter. In part because of technical problems, the use of automatic feeders was phased out and the fish bucket returned.

To be acceptable, an automatic feeder for marine mammals must be capable of:

a) reliable delivery of a specified amount of fish
b) preventing the fish from spoiling during the session
c) withstanding the marine environment
d) being easily cleaned and/or sterilized
e) easily loaded with fish
f) holding enough fish to finish a session
g) providing safety for experimenter and the animals.

We report on a feeder which meets the above requirements. The feeder consists of an insulated p.v.c. pipe 1.5 m in length and 76 mm inside diameter. Inside the pipe is a hydraulic piston capable of moving the entire length of the pipe (Fig 1). At the end of the pipe is an optional nozzle with an opening of 2.54 cm.

The feeder operates as follows: At the start of the session the piston is at the base of the pipe. Cut fish and crushed rice are loaded into the top of the pipe until the pipe is full (approximately 3.5 kg). Reinforcement is delivered by advancing the piston, thus pushing fish out of end of the pipe.

The hydraulic piston advances by forcing water into the base of the pipe via the following stages: A 1.5 litre compressed air tank is attached to a sealed water tank containing a minimum of 5 litres of water. This results in a pressurized water tank. Attached to the bottom of the water tank is a pipe leading to a solenoid water valve. When this valve is open the water is forced by the existing air pressure in the tank into the base of the pvc pipe pushing up the piston and thus the fish, resulting in the fish dropping out of the opening. Under normal operating conditions the solenoid valve is controlled by programming equipment.

During over 300 hours of feeder operation we have learned its advantages and limitations. Food preparation is a function of the size of the minimum reinforcement. If the minimum size of reinforcement is 30 g then the constricting nozzle is necessary. In this case only firm fish such as mackerel or herring should be used to prevent jamming. The fish should be cut into pieces no larger than 5 cm and heads and tails should not be used. If the minimum reinforcement is 100 g then it is not necessary to use the nozzle. In this case there is no restriction on the type of fish. It should be cut into 5 cm pieces but heads and tails can

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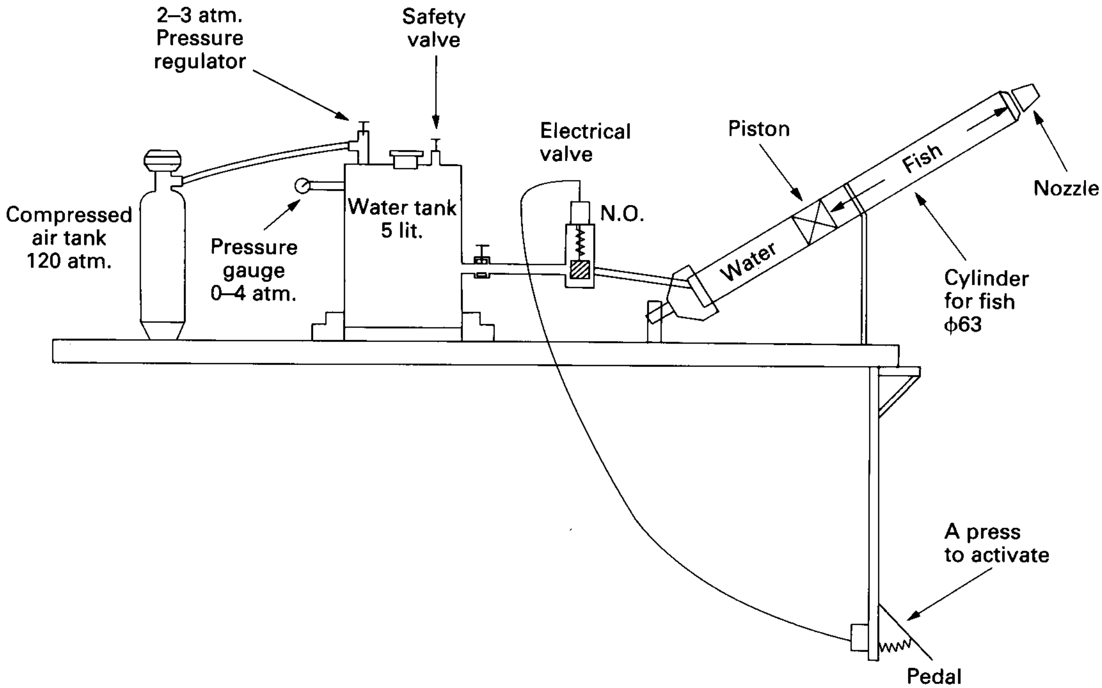

Figure 1. A schematic diagram of the feeder. The air tank compresses the air in the water tank. When the solenoid valve is opened the water is forced into the tube, forcing the piston to advance and pushing the cut fish out of the barrel. The valve adjusts the rate of water flow. The nozzle is removable and is used when less fish per reinforcement is required.

be used. In both cases the fish should be partially frozen and mixed with ice to prevent spoilage.

The amount of fish delivered per feeding can never be very exact. It is a function of the particular size of the fish and the nozzle, the air pressure in the tank, the duration that the solenoid valve is open, and the setting of the adjustable valve controlling the rate of water flowing into the feeder. In experiments with *Arctocephalus pussillus* we have found that without the nozzle two seconds of valve closure resulted in about 100 g of fish. This was enough for approximately 35 reinforcements. When we used the restricting nozzle, two seconds of operation resulted in about 90 reinforcements of 20 to 40 g of fish. In some of our experiment we have had very long sessions and found that the fish was still fresh and palatable at the end of the session.

Because the pipe is detachable, several pipes can be prepared in advance and kept in the cold-room. When the pipes are exchanged it is important to check that the air and water reserves are adequate for normal operation.

Cleaning and Maintenance. At the end of each session the pipe and piston must be thoroughly cleaned. This can be done with a large brush fitted onto a broom handle. The piston is removed and a solution of medical soap is poured into the pipe and the brush is used vigorously. Alternatively, the entire pipe can be easily disconnected from the feeder and cleaned in more controlled conditions.

One of the major advantages of this feeder is that the maintenance is minimal, aside from cleaning, one must check the valves are functional, connections are reliable, and that there are adequate air and water reserves.

We have used this feeder for over 200 sessions and over 1000 hours of experiments. In that time we have had very few problems. When the nozzle was used the feeder infrequently jammed. Once the solenoid valve stuck while open and all of the fish were dumped. We have found that if minimal standards are maintained then the feeder is highly reliable, almost maintenance free, and delivers palatable fish throughout a session. In addition, its operation is silent and theoretically it could work as well underwater as above water (a possible benefit for its use in shows). We consider that the described feeder is well suited for research and possible marine mammal shows. It is relatively inexpensive, easy to operate, and reliable.

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