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A pneumatically operated slurp gun

Abstract—Field tests with a pneumatically operated slurp gun have demonstrated the gun to be effective in capturing epibenthic and pelagic organisms unharmed.

In our study of fauna from shelf and slope waters, we wished to collect motile organisms using conventional SCUBA and lock-out diving. Net captures and poisons were considered impractical. We experimented with various models of slurp guns, giant syringes that capture organisms by suction when the plunger is retracted. Hand-operated models create suction insufficient to capture many types of organisms. We developed a slurp gun that uses a pneumatic piston and compressed air to achieve a mechanical advantage in retracting the plunger.

Description and operation

The gun consists of four main parts (Fig. 1): a nozzle, a body, a plunger, and a pneumatic cylinder (maximum operating pressure 3.45×10^6 Pa or N m^{-2}). The first three parts are Plexiglas and the outer casing of the pneumatic cylinder is brass. The movable internal piston of the cylinder, the shaft connecting the piston and plunger, the pressure tubing, the valves, and the fittings are stainless steel. The low-pressure air hose is flexible rubber.

The volume behind the piston of the pneumatic cylinder is charged initially with air $3.45\text{--}6.89 \times 10^4$ Pa over ambient working pressure. This is accomplished by firing the gun at the working depth and slowly opening valve V-2 until the plunger just returns to the ready position. A three-way valve (V-1; positions: ready, retract, return) permits regulated air ($5.52\text{--}11.04 \times 10^5$ Pa over ambient) to enter the pneumatic cylinder in front of the piston. The pressure difference on either side of the piston ($3.45\text{--}6.89 \times 10^4$ Pa on the back side compared with $5.52\text{--}11.04 \times 10^5$ Pa on the front side) forces the piston backward and retracts the plunger. Retraction stops when the pressure on each side of the piston is equalized by compression of the air behind the piston. This compression prevents the piston and plunger from bottoming out and returns the piston and plunger to the forward position when pressure on the front side of the piston is bled off with V-1 (return position) and check valve V-3.

The gun can be operated with compressed air from a SCUBA tank. A first-stage SCUBA regulator (single-hose type) reduces the high-pressure air of the tank to $5.52\text{--}11.04 \times 10^5$ Pa over ambient water pressure. The regulated air is led via a hose to a quick-release coupling at the three-way valve, V-1. The hose can be 3–7

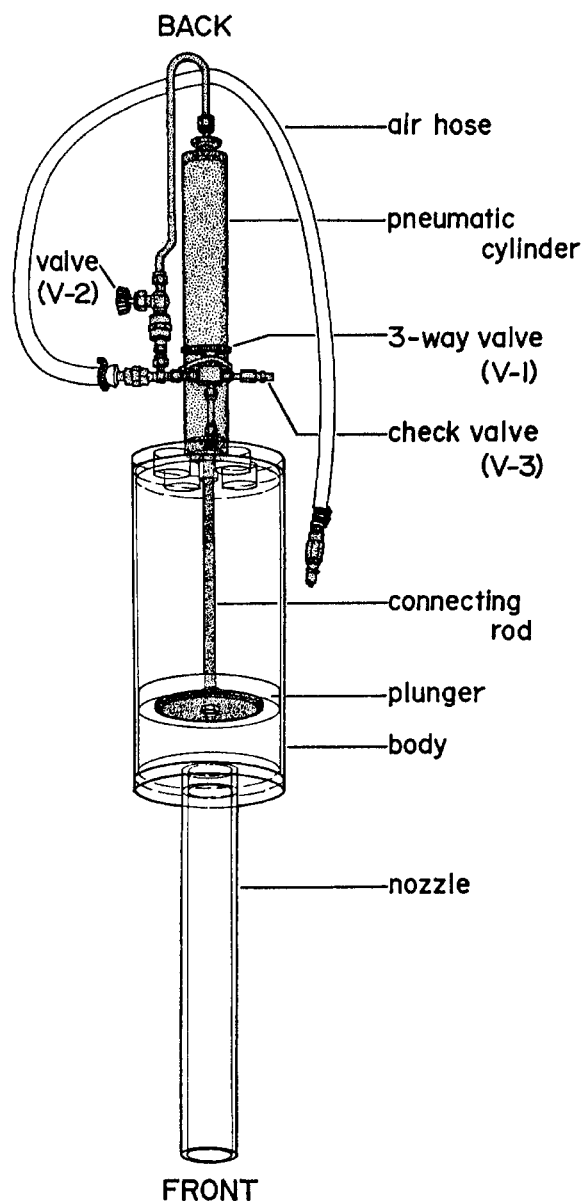


Fig. 1. Diagram of the slurp gun showing the main components. The overall length is 125 cm.

m long, permitting the user to leave the tank on the bottom and to roam in a radius about the tank. The gun can also be used by a lock-out diver by coupling the hose to a regulated gas supply or by using a SCUBA bottle.

The gun weighs about 1 kg underwater and requires both hands to operate (one for the trigger, V-1, and the other for sup-

port). A standard SCUBA tank at 11 m will give about 100 repetitions.

In operation, the nozzle is slowly moved toward an animal and the piston is activated when the animal is about 15 to 20 cm away. There is a slight recoil due to the inertia of the plunger being moved. The clear Plexiglas is transparent underwater so that the animal can generally be approached. If capture is successful, a small mesh nylon bag is placed over the nozzle and the plunger is returned to its original position: this expels the water and the specimen into the bag.

Results and discussion

The gun is remarkable in its ability to capture small organisms. Fish that are strong swimmers or have quick reaction times (e.g. the wrasse: *Thalassoma* sp.; jawfish: *Opistognathus* sp.; damselfish: *Pomacentrus* sp.) are easily taken. On more than one occasion, several fish were captured with one slurp. The main requirement is patience until the fish's head is oriented toward the nozzle of the gun. The fish is usually uninjured because it enters on a cushion of water.

We believe the gun to be a versatile collecting tool and have used it in depths up to 120 m. It can be built with materials that cost less than \$100. The dimensions are not critical and the gun can be built to meet almost any size or specifications of a collector.

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