A CHAMBER FOR MASS HATCHING AND EARLY REARING OF PRAYING MANTIDS (ORTHOPTERA: MANTIDAE)[1]

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ABSTRACT: A rugged, easily maintained polycarbonate and lucite chamber for the mass hatching and early rearing of praying mantises is described.The chamber is sealed after eggs are introduced so that even the smallest prey (e.g., *Drosophila)* cannot escape. An aquarium pump forces fresh air through a water bottle into the sealed chamber. Gas exchange and the introduction of prey, food, and water occur through several holes that are plugged with foam rubber. If necessary, the temperature of individual chambers can be raised above ambient by placing an incandescent light bulb at the appropriate distance.

The praying mantis' dramatic method of prey capture and the relative ease with which the predatory strike can be elicited in the laboratory have made this insect an important investigatory tool for the study of visually guided behaviors (e.g., Barnes, 1979; Barnes and Mote, 1980; Collet, 1987; Liske and Mohren, 1984; Kirmse, 1985; Horridge, 1986; Rossel, 1986; Prete, 1991; Prete, 1992a, b; Prete, *et al.,* 1992a, b).

In spite of the popularity of mantises among professional and amateur entomologists, information regarding methods of mass rearing and maintaining these insects remains primarily anecdotal. A few informative reports on small scale rearing have appeared (e.g., Heath, 1980), but problems unique to those rearing large numbers of mantises remain unaddressed in the literature. Here, we describe a chamber in which egg cases can be incubated and young (e.g., up to fourth or fifth instar *Tenodera* or *Sphodromantis)* mantises can be easily raised prior to being placed in individual containers. The chamber solves several of the problems that mantis breeders face—for instance: maintaining high humidity, maintaining high prey densities, feeding the introduced prey, and preventing the escape of small prey.

MATERIALS AND METHODS

The chambers are easily built and, with reasonable care, have an indefinite life. The materials needed for the construction of one chamber are these (measurements are given in inches for appropriate items): i) a polycarbonate rodent cage (51 x 41 x 22 cm; Fisher Scientific); ii) one piece of clear lucite (53 x 42 x 0.64 cm); iii) eleven foam rubber plugs (≈3.5

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x 4 cm; e.g., standard *Drosophila* vial plugs); iv) 42 cm long x 3.8 cm (1.5 inches) wide aluminum piano hinge; v) 42 cm long x 1.3 cm (.5 inch) wide aluminum angle; 2.5 cm long (1 inch) 6-32 round head bolts, 1.6 cm long (.625 inch) 10-32 flat head bolts, 1.6 cm long (.625 inch) 6-32 flat head bolts, appropriate washers and nuts. A finished chamber is pictured in Fig. 1.

The first step is to cut the lucite into two sections across its width. One piece will serve as a door, the other as the permanently attached portion of the top. The width of the door can be varied to suit individual preferences but we suggest cutting the lucite into two approximately equal sections. This allows sufficient access to the chamber interior when removing mantises and cleaning without having to remove the entire top. The two pieces of lucite are connected with the piano hinge on the outside of the chamber. If the hinge is not pre-drilled, the 10-32 flat head screws are spaced 10 cm between centers with the heads recessed into the lucite. The aluminum angle is attached to the lip of the door with the 6-32 flat head screws, also spaced 10 cm between centers and recessed into the lucite. Fewer screws should not be used in that one purpose of the hinge and angle is to prevent the lucite from warping. If the two top pieces do not fit snugly under the hinge, the gap can be filled with a strip of .64 cm (.25 inch) wide adhesive foam rubber weather stripping (e.g., Door & Window Weather Strip, Macklanburg-Duncan, Oklahoma City, OK). The top is affixed to the bottom with the 6-32 round head screws. Holes should be drilled through the top such that the screws pass through the center of the rolled lip of the box; The 6-32 nuts will fit snugly within the lip. Holes should be drilled for four bolts on each side (two on each side of the top and two on each side of the door) and for three along the back edge of the top. This is the minimum number sufficient to prevent the top from warping.

Seven 3.2 cm (1.25 inch) holes are drilled in the sides of the box, and four in the top (see Fig. 1 for placement). Foam rubber plugs are inserted into each hole. Standard *Drosophila* vial plugs work well; however; larger holes may be drilled as long as the plugs used fit snugly. Prey, and food for the prey are introduced through these holes.

Fresh humid air is supplied to the chamber by a standard aquarium pump attached to an 8 oz (237 ml) polyethylene wash bottle (Carolina Biological) containing water. After clipping off the thin tip to increase air flow, the nozzle of the bottle is inserted into the chamber through the center of one of the foam rubber plugs. Any mid-sized pump ($\approx$2500 cc/min at 4 PSI) is sufficient to aerate two chambers. If chambers become too humid, any number of foam rubber plugs can be replaced with square pieces of fine screen taped over the holes and/ or the wash bottle

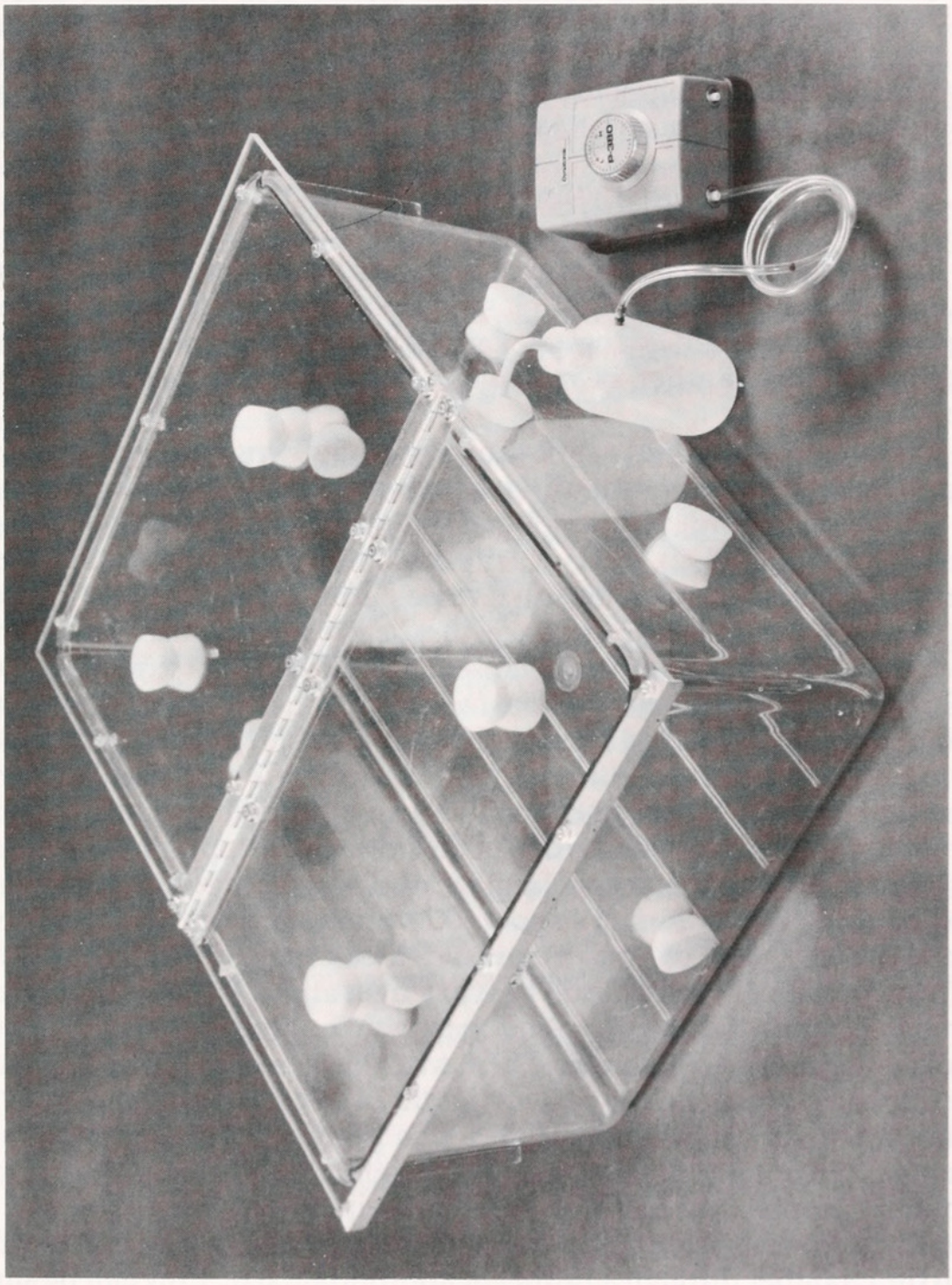

Figure 1. Finished hatching and rearing chamber. Photo by Carl Leet.

can be emptied. Internal chamber temperature can be monitored by an aquarium thermometer and, if necessary, the temperature can be raised above ambient by placing an incandescent light bulb at the appropriate distance.

Perch sites for the mantises are supplied by a continuous (2.5 meter) length of 15 cm high heavy ($\geq$ 5 x mm) plastic mesh folded back and forth inside of the chamber (e.g., Co-Polymer Gutter Guard, Allumax Home Products, Lancaster, PA).

RESULTS AND DISCUSSION

Prior to hatching, egg cases are hung from the plastic mesh with wire hooks and the door is bolted closed. Generally, we incubate simultaneously four to eight egg cases of about the same age in one chamber. Although the chamber is relatively easy to use, precautions are necessary.

For over two hundred years, those who have written about keeping mantises have continually reminded their readers that cannibalism can be held to a minimum by supplying the mantises with sufficient prey (Prete and Wolfe, 1992). This is easily done with a chamber from which prey cannot escape and, if fed, survive well until eaten. For early instars, we suggest the following procedure: just before the mantises hatch and prior to bolting the chamber lid closed, place a jar (approximately 50 x 110 cm) half filled with commercial *Drosophila* food on its side under one of the foam rubber plugs. Placing the jar on its side prevents mantises from becoming entrapped in the food. Shortly after the first hatching (and then as needed) anesthetized flies can be added by pouring them through a funnel inserted into one of the holes in the top of the chamber. If the foam rubber plug is kept in place during the procedure and is just pushed aside by the funnel's spout, flies and mantises cannot escape. When the jar needs refilling, it can be righted easily by means of a long sturdy wire with 1.5 cm of the tip bent at a right angle. The wire is inserted through a hole in the top of the chamber (with the plug kept in place), and hooked under the lip of the jar. Then, with the jar's base pushed against the side of the chamber, it is pulled upright and slid, if necessary, directly under the foam rubber plug. With practice, this procedure takes only seconds. Once upright, the jar can be refilled with *Drosophila* food through a funnel and returned to its side with the wire hook.

Obviously, other prey, such as crickets of any size, can be introduced into the chamber through a funnel of appropriate size. Prey can be supplied with slices of vegetables impaled on a thin stainless steel wire that is bent at the tip and inserted through one of the holes in the top. The wire

should extend sufficiently far beyond the top to prevent it from falling into the chamber. Although crickets can be maintained on just vegetables with high water content, such as potatoes, if they become thirsty or hungry they will prey on the mantises. To avoid this problem, we also supply the crickets with powdered laboratory rodent food and fresh water. The former is simply poured through a funnel into the chamber. Water is supplied in a slice of wet sponge impaled on a thin stainless steel wire as is done with vegetables. The sponge should not be so wet that it loses water into the chamber. We have found it best to place a small plastic dish into which the crickets can climb (such as a small jar lid) under the sponge to keep excess water off the chamber floor. This can be done by placing the dish under the hole through which the sponge will be inserted before the lid is bolted down or by first threading the wire on which the sponge is impaled through the center of the dish. Obviously, if the latter method is used, a hole large enough to accept the dish has to be cut in the lid.

Once mantises reach approximately the sixth instar (depending on species), we transfer them into aquaria with screen tops; immediately after their final molt, they are placed in individual containers.

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many species it did not initially evolve with, including native species of *Pheidole* and *Monomorium* ants, and even small rodents like mice and rats. For example, *T. caespitum* won't forage in bright sunlight and the resultant heat, therefore limiting its foraging times in warm areas to night and morning hours; some species of ants can forage at much higher temperatures during the day, and mice probably compete with the pavement ant for food during the nocturnal periods. Other factors which may impact the competitiveness of *T.caespitum* are the large nest sizes and foraging areas it maintains (nests may be up to 7 square meters, foraging areas may be up to 40 square meters), its tolerance of other ant species in its area and its high investment in reproductives (up to 50% of the colony's energy may go toward reproductives).

There were several notes of local entomological interest preceding Mr. King's talk. Concerning the widely publicized decline in monarch butterfly populations due to severe cold and logging in their overwintering forests in Mexico, Dale Schweitzer suggested that local factors may have also played an additional factor. He reported that population levels in Cumberland Co., New Jersey appeared to be building in July, but never appeared as a flush of adults in August as expected, possibly due to cooler summer temperatures and/or disease. Mildred Morgan stated that numbers of monarchs tagged at Cape May, New Jersey by Jane Ruffin and herself was one-tenth that of the previous year. Barbara Kirschenstein reported on small flies (family Phoridae) attracted to iodized salt. Society president Joe Sheldon urged everyone to attend the traveling insect exhibition, "Backyard Monsters" at the Franklin Institute, Philadelphia, which features monstrous robotic insects, a marvelous collection of OH MY! insects from around the world, interactive exhibits and an operational scanning electron microscope. The meeting at the Academy of Natural Sciences was attended by 27 members and their guests.

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