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FREEZE DRYING TECHNIQUES FOR PRESERVING DRAGONFLY SPECIMENS

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The theory of freeze drying is reviewed and an efficient method for spreading live dragonflies described. Freeze drying preserves the natural appearance of dragonflies, is efficient, yields durable specimens, and produces specimens of high taxonomic value.

INTRODUCTION

Living dragonflies are among the most colorful insects. Color and color patterns are frequently of taxonomic value, but often fade and are lost after death. Color loss may vary from a mere fading of abdominal color, to a loss of all color patterns. Coinciding color loss is an associated reduction in specimen durability. It has long been known (TILLYARD, 1917) that the excretion of alimentary canal contents during slow death reduces the fading of abdominal color patterns. Methods of preservation which have shown promise include: degutting (LONGFIELD, 1960), vacuum drying (MOORE, 1951), low temperature vacuum drying (DAVIES, 1954), alcohol (YOUNG, 1966), and acetone (WHITE & MORSE, 1973). The author has had exceptionally good results with freeze drying techniques; his oldest freeze dried specimens retaining their natural color after five years.

METHODS

Freeze drying is a process in which water is removed from a frozen object in the form of water vapor. This is possible because ice and water vapor are in equilibrium over a range of pressures below 4.58 mm Hg, and temperatures

below 0.098°C. The freeze drying process can be divided into a freezing and a drying phase. Specimens previously killed and stored by freezing are partially thawed to allow straightening of the abdomen, positioning of the head and wings, and adjustment of the legs. Specimens are placed on the freeze dryer shelf and the shelf temperature lowered to approximately −50°C. After specimens have adequately frozen, the vacuum pump is switched on and the pressure of the chamber reduced to 10 microns Hg. The temperature of the condenser is lowered to less than −50°C and the temperature of the shelf allowed to rise to −20°C. Under these conditions solid water in the specimens changes to water vapor and escapes into the vacuum chamber. The lower temperature of the condenser causes water vapor to be frozen on the walls of the condenser, which in turn reduces the vapor pressure of water in the chamber. This allows further sublimation of water vapor from the specimens. Care should be exercised when setting shelf temperature to insure that specimen temperature, which is higher than shelf temperature, remains below 0.098°C. Higher temperatures will allow the frozen water in specimens to melt and boil which results in the alteration of colors. Completion of drying is indicated when the vacuum reaches its maximum low which generally occurs within 48 hours. The freeze dryer we use can dry approximately 1000 enveloped specimens or 100 spread specimens per run.

The following sequence illustrates an efficient method for spreading live specimens. Specimens may be frozen alive before spreading to facilitate the process, but specimens should not be allowed to thaw for very long. The materials needed are a piece of corrugated cardboard about 6 by 12 inches, bobby pins, and 1 by 1.5 inch rectangles cut from index cards. The specimen is held dorsal side down, and head nearest the edge of the cardboard while two bobby pins are inserted over the wings (the lower portion of each bobby pin is inserted between the corrugations in the cardboard, while the upper portion is bent upward to avoid damage to the wings). A piece of index card is then slid under the wings and the wings on that side of the body released by depressing the end of the bobby pin. The wings may then be easily arranged, first on one side and then on the other. The small paper rectangles are then bobby pinned over the wings to flatten and protect the wings. Actual pinning is done after freeze drying to avoid the escape of lipids through the pin hole and on the surface of the specimen.

DISCUSSION

In all cases freeze drying increases the durability of specimens. The body of freeze dried specimens is very resistant to crushing and the legs of specimens killed by freezing are characteristically in a tucked position which protects the legs from breakage. Accessory genitalia are often favorably extended by the positive internal pressure during freeze drying, and color and color patterns

are preserved in natural condition with few exceptions. The blues of the Coenagrionidae and Aeshnidae fade rapidly as these insects become stressed and eventually die in envelopes. This is also true for the bright green of *Ophiogomphus*, the bright red of *Sympetrum*, and the bright yellow of *Macromia*. The life of specimens stored in envelopes can be extended by storage in a cool, dry place. To reduce color loss due to stress and eventual death, specimens should be frozen alive as quickly as possible after capture. Specimens may be stored frozen up to four months and possibly longer without noticeable color loss. If impractical to store specimens by freezing prior to freeze drying, enveloped specimens in dry climates can be allowed to die slowly in the shade, or treated with acetone in humid climates. The results of both alternative pretreatments are improved if cool dry air is circulated around the specimens. In conclusion, freeze drying preserves the natural appearance of dragonflies, is efficient, yields durable specimens, and produces specimens of high taxonomic value.

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