

TECHNIQUES FOR CAPTURE-RECAPTURE STUDIES OF LEPIDOPTERA POPULATIONS

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One of the primary requirements in the study of any animal population is the development of techniques which minimize the effect of the research program on the situation investigated. This problem is ever present in biological work, and is particularly important in attempts to study an animal under "natural" conditions.

During the past year techniques of investigation have been developed for research on the population dynamics and genetics of a colony of the checkerspot butterfly, *Euphydryas editha* Boisduval, which we feel have certain advantages over those employed by previous workers (*e.g.*, Dowdeswell, *et al.*, 1940). The colony range was subdivided into a number of areas easily recognized by landmarks, and these areas were given letter designations. During the flight period of the butterfly a standard routine was followed. Either daily or (late in the flight period) every other day, a regular route through the areas was worked by two investigators. One collected every specimen of *Euphydryas editha* encountered (a more than 95% capture success rate was maintained throughout the study). The other carried a knapsack containing slotted boxes lettered to correspond with the areas. As each butterfly was collected it was grasped with forceps and with its wings folded over its back placed deep in a glassine envelope. The envelope was then dropped into the appropriate slotted box.

After the collecting routine had been completed for all areas the investigators returned to a central point in each area to carry out the releasing procedure. Each individual was removed from its envelope and examined for marks. If none were found the individual was given a number, and marked with that number. Marking was accomplished with a "Magic Marker" dye pencil. This felt-tipped marking device deposits a quick-drying permanent stain on the wings. Specimens were marked on the under surface, using a 1-2-4-7 system; tens on the right wings, digits on the left wings (see Fig. 1). Different colors were used for hundreds. During marking one person held the specimen with the wings folded over the back and applied the dye with the marker held in the other hand. The other person inserted a smooth piece of cardboard between the upraised wings to act as a backing for applying the dye, and manipulated the wings with forceps where necessary. The marking procedure is shown in Figure 2. The area in which the individual was captured and its sex, condition, and wing length were recorded. Then the butterfly was released and watched until it was seen to be flying normally. If when the specimen was removed from its envelope it was found to be marked, then its number, area of recapture, and condition were recorded and it was released.

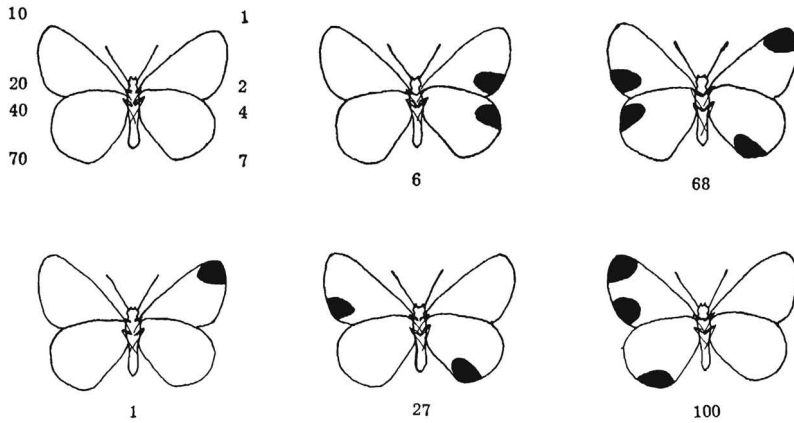


Fig. 1. The "1-2-4-7" marking system. Key individual in upper left.

With the procedure outlined above, information was gathered on the population size, dispersal, variation, emergence pattern, and sex ratio of the butterfly under study. These data may be analyzed for subpopulations determined on the basis of sex, area, time of capture, recapture pattern, condition, etc. For a further record of the variation present a random sample of males was removed from the population. This was done by killing every tenth male regardless of mark or condition. The only exceptions to this sampling procedure were made when individuals were accidentally killed or badly injured. When this happened the damaged butterfly was substituted for the next individual scheduled to be sampled. During the five week flight period of *Euphydryas editha*, 185 specimens (119 males, 66 females) were marked and released and these marked specimens were retaken a total of 224 times.

The analysis and interpretation of the data gathered will be reported elsewhere. The routine outlined above has several advantages over those used previously. It seems desirable to complete the collecting before any releasing is done. Although this does not allow the individual to be released in precisely the location of its capture, it does prevent the recapture of individuals already handled on the same day. Considering the rather high number of multiple recaptures, minimizing the handling was deemed more critical than precise release points. We feel that sufficient release point accuracy was achieved by releasing in the center of the appropriate area, especially as many individuals are chased before capture and thus suffer a certain unavoidable displacement.

Previous workers have solved the "same day recapture" problem by placing the butterflies in individual pillboxes. At least in the species which we have studied, the butterflies show no sign of damage after repeated stays in glassine envelopes. The latter have the advantage of being semi-transparent (no problem of determining occupancy) and much less bulky. The envelopes restrain the insects without damaging them. Handling is greatly facilitated as the butterflies are easily inserted into and removed from the envelopes.

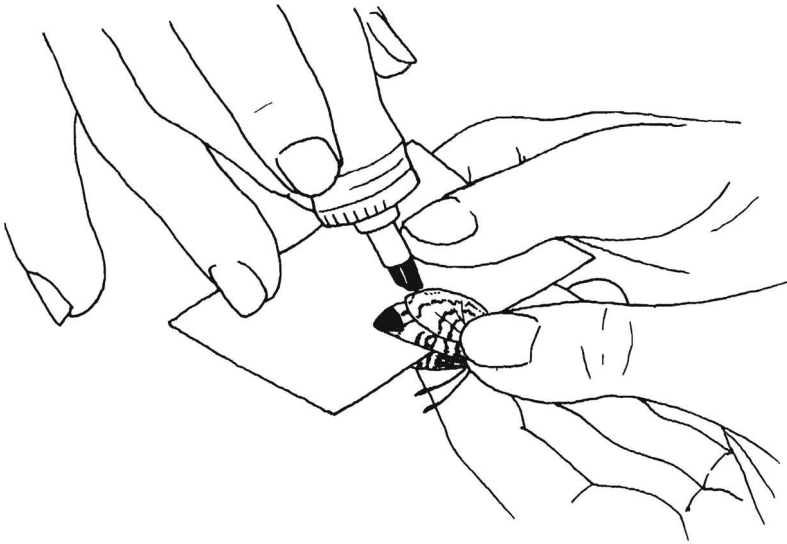


Fig. 2. Marking technique.

The marking system has the following advantages. Every butterfly can be given an individual number. The marks can be made large without significantly adding to the weight of the butterfly, and the marking device is neat and simple (no "paintpot" to spill). Having a fairly large mark and using the 1-2-4-7 system greatly reduces the problem of detecting marked individuals which have been damaged (single paint spots may be totally lost). One quickly grows accustomed to the 1-2-4-7 system and can read the marks instantaneously. Furthermore, we believe our field observations and data show no signs of our study causing serious disturbance in the behavior of the population. There was no indication of "net shyness" or "net happiness", and no sign of damage caused by the handling system (our few "mistakes" were sampled). One question which still needs to be investigated is the possible effects of the marks on predation, mating behavior, and the like.

With minor modifications we feel that our techniques will be applicable to a broad spectrum of field studies of Lepidoptera populations.

ACKNOWLEDGEMENTS

We would like to acknowledge the assistance of J. C. MONTGOMERY and O. E. SETTE with several aspects of the work described. This work was supported in part by a grant G-14740 from the U. S. National Science Foundation.

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