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TRAPPING METHODS FOR RANGELAND INSECTS IN BURNED AND UNBURNED SITES: A COMPARISON

James D. Hansen

ABSTRACT.—Different insect trapping methods were compared weekly on recently burned and nearby unburned rangeland in the Great Basin of western Utah. Flight traps (or wing traps) collected the most specimens (total = 4,916 at burned site, 4,384 at unburned site) but represented the fewest species (no more than 11 spp./wk at either site); this method was not recommended because of difficulty in removing specimens from adhesive. Water traps amassed the next largest number of specimens (x ± SE/wk = 150.9 ± 75.3 at burned site, 158.0 ± 66.4 at unburned site) and the most species (x ± SE/wk = 21.6 ± 6.4 at burned site, 35.1 ± 4.5 at unburned site). The weekly collections from pitfall traps between the sites were significantly different (P < .05) in number of specimens (x ± SE/wk = 8.1 ± 1.5 at burned site, 19.7 ± 4.8 at unburned site) and species (x ± SE/wk = 4.7 ± 0.6 at burned site, 9.5 ± 2.0 at unburned site). Malaise traps were the most convenient. Black Malaise traps collected more specimens (x ± SE/wk = 99.8 ± 19.4 at burned site, 90.6 ± 16.4 at unburned site) and species (x ± SE/wk = 22.9 ± 3.9 at burned site, 19.4 ± 6.5 at unburned site) than white Malaise traps (specimens: x ± SE/wk = 72.1 ± 22.4 at burned site, 87.1 ± 31.2 at unburned site; species: x ± SE/wk = 19.7 ± 6.6 at burned site, 16.4 ± 5.4 at unburned site), although this difference was not significant.

Insect trapping methods vary in their ability to collect insects (Peterson 1953, Southwood 1978). Unfortunately, few studies have compared different insect collecting methods in the same habitat. Recently, Canaday (1987) evaluated differences in sampling insects with sweep nets and with window, sticky, light, suspended cone, and two kinds of yellow pan traps in a Douglas-fir forest in California. Likewise, Norment (1987) compared sticky board and pitfall traps with sweep netting in alpine tundra of the Beartooth Mountains in Wyoming.

Although range fires historically have been common on western rangeland in the United States (Gruell 1985), insects are not often sampled from burned areas. Arthropod responses to grassland fires have been generally examined with prescribed burns (Warren et al. 1987). Most collections (e.g., Nagel 1973, Evans 1984, Forde et al. 1984) used net-sweeping techniques, which implied that substantial post-burn vegetative cover remained.

However, net sweeping is not practical after a severe fire. To collect flying insects following a spring burn on a prairie in Missouri, Cancelado and Yonke (1970) used lightly colored Malaise traps. On recently burned rangeland in the Great Basin, Hansen (1986) used pitfall traps in addition to white Malaise traps.

Insect trapping in burned areas presents unique challenges. Naturally occurring range fires, such as those started by lightning, are unique, uncontrollable events. Insect sampling is difficult to study because the fires are unpredictable in time, location, land ownership, and size of burn. Intensely hot fires destroy the vegetative canopy, thus preventing traditional net sweeping. Burned areas are so severely disrupted that insects are collected during a period of transition and recovery. Changes in plant species composition and vegetative cover vary due to localized environmental factors. Finally, it is unknown whether Malaise traps become attractive because of their structural prominence or the contrast between the white fabric and the dark background.

The objectives of this study were to sample range insects immediately after a natural range fire, to compare previous collection techniques with other methods not traditionally used on burned rangeland, and to ascertain which trapping procedures are feasible under these field conditions.

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MATERIALS AND METHODS

The study area was on a hill ca 10 km north of Kelton in Box Elder Co., Utah. Dominant plant species were cheatgrass, Bromus tectorum L.; big sagebrush, Artemisia tridentata Nutt.; and Utah juniper, Juniperus osteosperma (Torr.) Little. In early July 1985 a fire started by lightning burned an irregularly defined area (5–12 km²), including the north-eastern portion of the hill, which served as the burned study site. A comparison study site was established in an unburned area on the same hill ca 1 km from the fire boundary and 2 km from the burn site. On July 11 the first traps were installed while the burned area was still smoldering.

Different trapping methods were used: (1) An earlier method (Hansen 1986) was repeated using a white Malaise trap made of cream-colored polyester marquisetta; the square trap had four central vanes and was topped with a clear acrylic collecting tube. (2) A similar Malaise trap sprayed black was located 25 m away. The Malaise traps were obtained from BioQuip Products² (Box 61, Santa Monica, CA 90406). (3) Evenly spaced in a line between the Malaise traps were 10 pitfall traps. Each trap, which resembled that described by Morrill (1975), was made of a 4-oz plastic collecting cup housed in a 16-oz plastic cup and topped with a 7-oz tapered plastic cup in which the bottom had been removed to serve as a funnel. (4) Placed on the ground in the same vicinity, a water trap was made from a yellow plastic bowl (21.5 w × 22.0 l × 10.0 h cm) and filled with water and antifreeze. (5) A flight trap was constructed from four 31 × 31-cm plywood squares arranged at right angles and mounted on a pole 113 cm above the ground; the traps were painted flat black and covered with insect trapping adhesive. (6) Nesting traps, comprised of 10 wooden blocks and 100 elderberry (Sambucus sp.) stems, were located at each site on 17 July. Every block contained a total of 50 holes; 10 holes of each size were of five diameters (2, 4, 6, 8, and 10 mm). Half of the stems had 3-mm-diameter holes in one end, while the remaining stems had 6-mm-diameter holes. The blocks were placed 50 m apart and the stems in the ground 3 m apart, both along SE transects. The traps were recovered in late September.

The same types of traps were arranged identically at the other site. From 17 July to 25 September weekly collections were made at both sites. Specimens were sorted to “species” by using the morphospecies classification technique (Janzen and Schoener 1968, Allan et al. 1975).

For each trapping procedure, weekly collection data between the sites were analyzed by using paired Student’s t-test. Linear correlation tests (Zar 1974) were conducted between time of sampling and the collection data.

RESULTS AND DISCUSSION

NUMBER OF SPECIMENS.—An analysis of the data of all the traps indicated that more specimens were collected at the burned site (n = 8,447) than from the unburned area (n = 7,602), a tendency observed in an earlier study involving burned rangeland in the Great Basin (Hansen 1986). Perhaps flying insects in burned areas are attracted to the traps that may replace normal landmarks of the destroyed shrubs and other sheltering plants.

Among the trapping methods (Fig. 1), the flight traps collected the most specimens (burned site, n = 4,916; unburned site, n = 4,384). There were significant differences in weekly number of specimens only with the pitfall traps (t = 2.715, df = 9, P < .05). Pitfall traps from the unburned site consistently had more specimens than those from the burned site. No insects were found in the nest traps at either site.

Among weekly collections, the black Malaise trap obtained more specimens than the white Malaise trap at the burned site (black Malaise trap, \( \bar{x} \pm SE = 99.8 \pm 19.4 \); white Malaise trap, \( \bar{x} \pm SE = 72.1 \pm 22.4 \)) and the unburned site (black Malaise trap, \( \bar{x} \pm SE = 90.6 \pm 16.4 \); white Malaise trap, \( \bar{x} \pm SE = 87.1 \pm 31.2 \)). This occurred even though the white Malaise traps were more conspicuous and, presumably, more attractive to insects. Although differences were not significant, this trend suggested that the color of Malaise traps may affect insect collectability.

²Mention of trade names is for identification only and does not imply an endorsement to the exclusion of other products that may be suitable.
No significant linear correlations with the number of specimens and time of collection were found for any of the trapping methods.

**Number of species.**—Diptera was the most dominant group obtained from all the traps. The flight traps had the fewest number of species of the different traps (Fig. 2). Water traps amassed the most species in the weekly collections (burned site, $\bar{x} \pm SE = 21.6 \pm 6.4$; unburned site $\bar{x} \pm SE = 35.1 \pm 4.5$), and paired Student’s t-tests showed that this difference was significant ($t = 3.027$, df = 7, $P < .05$). The number of species caught per week by the pitfall traps was significantly different between the sites ($t = 2.428$, df = 9, $P < .05$), with consistently more species in the unburned area. More species were obtained each week by the black Malaise traps (burned site, $\bar{x} \pm SE = 22.9 \pm 3.6$; unburned site, $\bar{x} \pm SE = 19.4 \pm 6.5$) than by the white Malaise traps (burned site, $\bar{x} \pm SE = 19.7 \pm 6.6$; unburned site, $\bar{x} \pm SE = 16.4 \pm 5.4$),
although these differences were not significant. There were no significant correlations among trapping data, time of trapping, and collection methods.

**Other Comparisons.**—When trapping efficiency was estimated by the number of specimens collected divided by the number of species, there were no significant differences among the trapping methods except for the flight traps. Hence, other aspects must be considered when selecting trapping procedures.

Flight traps collected large numbers of a few species but required various solvents (e.g., kerosene, gasoline, hexane) to remove specimens from the adhesive. Once extracted, the specimens were often damaged, thus rendering them useless for identification. Also, the traps were unstable and were often blown over by high winds.

The pitfall traps in the burned site were often filled with ash and other debris, thus lowering their efficiency. This problem would have been solved by using covers over the traps.

The greatest diversity of species accumulated in the water traps, which were also easy to use. However, collections were strongly influenced by weather extremes. Flooding during intensive rains, evaporation under drought conditions, and animals drinking the water disturbed the specimens.

The Malaise traps were the most convenient of the traps tested but were unstable in wind. If the traps are too noticeable, they may attract vandals. Painting the fabric black helped conceal the traps and also seemed to increase their collecting efficiency. However, the use of different colors, patterns, and shapes should be further explored.

No bees or wasps nested in wood traps at either site. The time of placement may have been a factor since most shrubs and forbs bloom from April to early July at such sites. At the unburned site the only dominant plant to bloom after the nearby burn was rabbitbrush, *Chrysothamnus* sp. Apparently, xylophagous nesting Hymenoptera associated with this fall-blooming perennial were uncommon at those locations.

**Conclusions**

The selection of trapping method depends on the needs of the researcher. To easily collect ground-inhabiting insects, use pitfall traps; for flying insects, use Malaise traps. To survey for taxonomic diversity, use either Malaise traps or water traps. To obtain the largest number of specimens of flying insects, flight traps are recommended. To meet the replication requirements for statistical analysis, use smaller versions of water traps or, if the species are easily recognizable, flight traps. Pitfall traps provide much data but caution is advised in interpreting results (Southwood 1978).

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**Literature Cited**


