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Pre-Dispersal Seed Feeding Insects of a Desert Legume, *Astragalus nuttallianus*

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temperate waters were not affected by this relatively minor cold period, but does not explain why the "tropical" species affected here were not killed in previous events.

A possible explanation is found in an examination of summer and fall water temperatures in the Aransas Pass at Port Aransas. Historical water temperature data for the Aransas Pass are scanty but a good approximation can be obtained by referencing average air temperatures recorded by the U.S. Weather Service in Corpus Christi. A high correlation ($r = 0.82$, $P < .05$) was seen between daily average air temperature in Corpus Christi and daily water temperature at Port Aransas (National Oceanic and Atmospheric Administration 1981) during 1981. This high correlation allows us to assume that deviations in average air temperature from a 30 year norm would produce a similar deviation from "average" water temperature. Average air temperatures for September through December 1981 were 0.8°C above the 30 year norm and it is assumed that water temperatures were similarly above normal during this period.

Moore (Copeia 170-172, 1975) found that warmer-than-usual summertime water temperatures in the Aransas Pass Inlet in 1972 coincided with the occurrence then of marine fishes usually associated with more tropical waters. Moore (Southwestern Nat. 20:461-466, 1976) also observed a cold kill in the winter of 1973 (following the warm summer previously mentioned) which affected some tropical species, especially snook (*Centropomus undecimalis*), considered rare in winter at Port Aransas.

Warmer than usual summer and fall water temperatures may stimulate more tropical marine species to move inshore or to remain there later into the winter than would occur in cooler years, thus leaving them vulnerable to sudden cold spells.

The University of Texas Marine Science Institute Contribution No. 565.—SCOTT A. HOLT and G. JOAN HOLT, *Univ. of Texas Marine Science Institute, Port Aransas Marine Laboratory, Port Aransas, TX 78373*.

PRE-DISPERSAL SEED FEEDING INSECTS OF A DESERT LEGUME, *ASTRAGALUS NUTALLIANUS*.—During the spring of 1979, we conducted surveys of the pre-dispersal seed-eating insect guild of loco weeds, *Astragalus nutallianus* D.C. Two alluvial plains (bajadas) separated by approximately 25 km, were surveyed. The bajadas are on the Mt. Summerford watersheds on the New Mexico State University Experimental Ranch, 40 km NNE of Las Cruces, N.M.

On each site we classified the loco weeds into 5 relative density classes based on distance to nearest neighbor of the same species. Distance classes in meters were 0-0.5, 0.5-1.0, 1.0-5.0, 5.0-10.0 and 10.0-20.0. At least 10 plants in each of the density class areas were up rooted, placed in plastic bags and transported to the laboratory. We recorded the number of plants of other species within a 1.5 m radius of each plant collected. All pods were stripped from each plant, and the total number of pods and the number of pods damaged by seed-eating insects were counted. A subsample of insect damaged and undamaged pods were opened and the number of seeds present in each was recorded. Another subsample was placed in containers to rear the larvae present. The plant, devoid of pods, was oven dried and weighed.

Five species of pre-dispersal seed feeding insects were recovered from the *A. nutallianus* seed pods: *Pima albiplagiata* *occidentalis* Heinrich (Lepidoptera: Pyralidae), *Strymon melinus* Hubner and *Plebeius acmon* (Doubleday and Hewitson) (Lepidoptera: Lycaenidae), *Tychius* sp. Casey (Coleoptera: Curculionidae) and *Brucophagus* sp. (Hymenoptera: Eurytomidae). *Brucophagus* sp. was absent at one of the sites. No bruchid beetles were reared from the seed pods. The frequency of occurrence of the lepidopterans was the same in seed pods of plants of all density classes. *Brucophagus* sp. was present only at high host plant densities and *Tychius* sp. was found only at low plant densities (Fig. 1). At the site where *P. albiplagiata* was present, all other species occurred at lower frequencies.

Patterns of seed feeding insects and production with respect to plant density were very different between sites with *Pima* present and where *Pima* did not occur. Seed pod production may be the result of differences in the pollinators at the two sites (carpenter bees vs. bumblebees), to flower predation, especially by lycaenid larvae, or to local differences in soil nutrients. Nevertheless, it is apparent that the seed feeding insects do not respond functionally to increased pod production. At low levels of pod production, however, seed feeding was intense.

The interaction between plants and seed feeding insects at the two sites was evaluated by correlation coefficients (Table 1). No outstanding differences were found between the two sites.

TABLE 1.—Product-moment correlations between plant and insect parameters of the pre-dispersal seed predator guild of *Astragalus nuttallianus* at sites with (below the diagonal) and without (above the diagonal) *Pima albiplagiata* in the New Mexican Chihuahuan Desert ($r = 0.224$, $p > 0.05$).

Parameters	1	2	3	4	5	6	7	8	9	10	11
1. Meters between plants		-0.224	-0.147	-0.251	-0.232	0.028	0.253	-0.027	0.044	0.452	-0.204
2. Pods per plant	0.027		0.866	0.823	0.027	-0.177	0.014	0.023	-0.056	-0.221	0.009
3. Pods predated per plant	0.038	0.639		0.570	-0.014	-0.154	-0.010	-0.094	0.051	-0.129	0.007
4. Plant dry weight	0.301	0.557	0.333		0.140	-0.179	-0.006	0.043	-0.048	-0.205	0.083
5. Seeds per pod	-0.303	-0.239	-0.156	-0.307		0.030	0.057	0.009	0.073	-0.032	0.022
6. Seeds predated per pod	0.308	-0.232	-0.178	-0.261	0.197		-0.096	-0.111	0.009	0.158	0.130
7. Plant H_{max}	-0.107	0.060	-0.064	-0.007	-0.058	-0.092		0.130	-0.183	-0.054	-0.219
8. <i>Plebeius acron</i>	0.105	0.133	0.043	0.217	-0.092	-0.034	0.097		-0.809	-0.094	0.164
9. <i>Stromon melinus</i>	-0.149	-0.157	-0.054	-0.124	0.072	-0.025	-0.040	-0.714		-0.084	-0.230
10. <i>Tuchius</i> sp.	0.357	-0.115	-0.012	0.176	-0.151	0.215	-0.037	0.027	-0.279		0.217
11. <i>Brucophagus</i> sp.	-0.117	-0.022	-0.096	0.199	-0.095	-0.085	0.036	0.051	-0.127	-0.310	
12. <i>Pima albiplagiata</i>	-0.132	0.016	-0.127	-0.073	0.054	0.045	0.338	-0.221	0.182	-0.013	-0.198

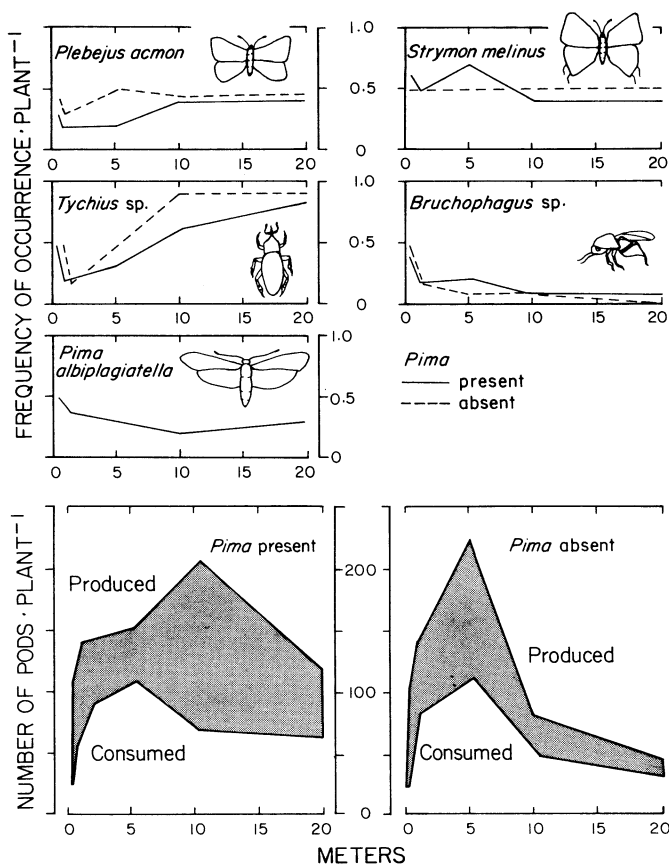


FIG. 1.—Frequency of occurrence of seed feeding insects reared from the legume, *Artragalus nuttallianus* plants at relative densities based on 5m nearest neighborhood distances, i.e. 0-5 most dense, 15-20 least dense (upper panels) and the relationship between mean numbers of pods per plant and seed consumption in the presence and absence of the lepidopteran seed consumer *Pima albiplegiatella*.

Tychius was the only seed feeder to show any correlation to any of the measured plant parameters, but this was probably due, in part, to the greater number of *Tychius* in the samples.

A. nuttallianus has a bilocular pod, with a complete septum separating the two rows of seeds. All insect species found here, with the exception of *Brucophagus* sp., fed on more than one seed, but apparently could not consume large numbers. Thus, the plant apparently compensates for intense seed herbivory through herbivore satiation. Interestingly, all species, with the possible exception of *Tychius* (Clark & Burke, Southw. Entomol. 2:106-126, 1974), are polyphagous (Tietz, Index to Life Histories, Early Stages and Hosts of the Macrolepidoptera of the Continental United States and Canada. Vol. I., Alan Museum, Sarasota, Florida, 1972). Green and Palmbald (Ecology 56:1435-1440, 1975) isolated nine pre-dispersal seed feeding insects from *Astragalus cibarius* Sheld and *Astragalus utahensis* (Torr.) T. and G., of which three were hemipterans, that leave little visible sign of seed feeding. They also isolated two species of lycaenid, neither of which were present at our study sites. The study of seed herbivory on *Astragalus canadensis* L. (Platt, Hill and Clark, Oecologia 17:55-63, 1974) revealed only one species of *Tychius*. However, their results correspond to what we found with five seed feeding insects, i.e., a lower intensity of seed destruction at higher seed production levels. In the system we examined, nevertheless,

lepidopteran larvae consumed greater numbers of seeds per individual, and because of their greater mobility, attacked more pods per plant than other, more numerous, seed herbivores.

We wish to thank Mr. Gregg Forbes for the identification of the species of Lepidoptera. These observations were supported, in part by a NSF grant, DEB 77-16633 to Walter G. Whitford.—HAROLD G. FOWLER and WALTER G. WHITFORD, *Dept. of Biology, New Mexico State Univ., Las Cruces, NM 88003*. Present address of HFG, *Dept. of Entomology & Economic Zoology, Rutgers Univ., New Brunswick, NJ 08903*.

ANURANS OF VEKOL VALLEY, CENTRAL ARIZONA.—Herpetofauna samples taken in July, 1980 and May-June, 1981, in Vekol Valley, Arizona (T9S, R1E) by the Phoenix District Office of the U.S. Bureau of Land Management revealed an exceptional variety of desert anurans.

Northern sections of Vekol Valley are dominated by combinations of Lower Colorado and Arizona Upland vegetation types (Brown et al., *J. Ariz. Acad. Sci.* 14, Suppl. 1, 1979), where soils are coarse and shallow. Southern sections are dominated by mesquite (*Prosopis velutina*), tobosca grass (*Hilaria mutica*), creosote (*Larrea tridentata*) and deep clay soils. The entire valley is dissected by a large intermittent wash (Vekol Wash). Several man-made dikes in southern sections of the wash hold surface water throughout the year.

Samples were obtained by a modified array trapping method (Jones, *Southwestern Nat.* 26:107-115, 1981), which consists of a series of four 18.4 m pitfall traps and 7.2 m aluminum drift fence. Six arrays were placed in Vekol Valley and six in Lower Colorado/Arizona Upland adjacent to Vekol Valley. Arrays were checked every three days; voucher specimens were taken for each anuran, and deposited at the USNM in Washington, D.C. Specimens were also obtained by walking through standing surface water (rainpools and dirt reservoirs).

Six different desert anurans were collected in Vekol Valley and only one, *Scaphiopus couchi*, in adjacent Lower Colorado/Arizona Upland. The occurrence of *Gastrophryne olivacea* in Vekol Valley represents the first record of this species in this area. Nelson (Cat. Amer. Amphib. Rept.:122.1-122.4, 1972) found desert grassland (similar to that in Vekol Valley) was important for exploitation of desert regions by *G. olivacea*. Generally, *Bufo alvarius*, *Bufo retiformis* and *Bufo cognatus* are found in areas, e.g. agricultural, with persistent surface water. Fouquette (Cat. Amer. Amphib. Rept.: 93.1-93.4, 1970) stated that *B. alvarius* requires permanent water. Hulse (Cat. Amer. Amphib. Rept.: 207.1-207.2, 1978) described relatively strict distributional relationships between *B. retiformis* and persistent surface water. He also hypothesized that *B. retiformis* distribution had expanded with development of agriculture. Similarly, Stebbins (A field guide to western reptiles and amphibians, Houghton-Mifflin Co., Boston, 1966) described *B. cognatus* distribution associated with persistent water provided by agriculture.

Verification of *Bufo debilis* in Vekol Wash represents a significant range extension, approximately 140 km west-northwest of records reported by Bogart (Amer. Mus. Novitates 2100:1-36, 1962). The record also represents the first verified sympatry of *B. debilis* and *B. retiformis*. *B. debilis* exploits xeric sites within the Chihuahuan Desert in southeastern Arizona, surfacing only for short periods when surface water is available (Stebbins, *ibid*).

We attribute the large variety of anurans in Vekol Valley to large, persistent standing water that accumulates on the surface. Large surface water buildup results from relatively high rainfall (especially in summer months), clay soils and man-made dikes. Deep, clay soils of southern Vekol Valley provide an excellent environment for aestivation during dry periods. Clay soils also hold greater amounts of moisture for longer periods of time than do coarse soils. Conant (*in* Trans. Symp. Biol. Resources Chihuahuan Desert Region, U.S. and Mexico [R. H. Waver and D. W. Riskind, eds.], U.S.D.I., Nat. Park Serv. Proc. Trans. Ser. 3, 1978) attributes many of the Chihuahuan Desert's small but diverse pockets of anurans to man-made structures that retain surface water. Soils on Lower Colorado/Arizona Upland are shallow and quite coarse, and these factors greatly reduce surface water buildup and duration. During our studies, Lower Colorado/Arizona Upland surface water was available only during convective storms in July and August. Absence of all anurans but *Scaphiopus couchi* reflects lack of adequate surface water, soil moisture, and soil texture and depth. *S. couchi* is more adapted to xeric conditions than most anurans (McClanahan, Comp. Biochem. Physiol. 20:73-99, 1967), and such adaptations allow this anuran to exploit Lower Colorado/Arizona Upland habitat types.

We are uncertain if these anuran populations were naturally established or man-caused. Brown et al. (*J. Ariz. Acad. Sci.* 14, Suppl. 1, 1979) recognizes southern portions of Vekol Valley as desert