ECOLOGICAL NOTES ON MOSQUITOES ASSOCIATED WITH BROMELIADS [1]

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Epiphytic bromeliads living on a variety of host plants are conspicuous elements of the flora of Puerto Rico. In the coastal plain they are found in small numbers attached to mangroves growing near the seashore or to trees growing along the rivers. They are particularly abundant in the dense forest of the mountains, occurring in such numbers as to obscure almost completely the trunks of Sierra palms and other host trees. Conditions favorable for their development appear to be heavy rainfall, high temperature, and protection from direct sunlight. Perhaps the most conspicuous bromeliad growing in the mountainous region of Puerto Rico is *Catopsis berteroniana.*

The epiphytic bromeliad is an herbaceous plant with a shortened stem bearing a rosette of leaves and a panicle of flowers. Each narrow, lanceolate leaf has a sheath which surrounds the stem, and forms, with the sheaths of the other leaves of the rosette, a basin in which water and organic material collect. Special hairs, which are developed on the inner surface of the sheath, absorb water and dissolved substances for the plant. In the basins of these plants aquatic conditions suitable for the development of mosquitoes, snails, nematodes, midges, crustaceans, rotifers, etc., are found.

In the mountains of Puerto Rico large numbers of mosquitoes are found in bromeliads. Here the heavy annual rainfall (over 100 inches) insures the presence of water in the leaf basins at all times. The water usually is yellowish or brownish, the coloration being caused by the decomposition of leaves and other organic materials which are washed into the bromeliads during the heavy rains. Certain observations pertaining to the temperature and pH value of the water, as well as to the species encountered, are summarized in Table 1.

The range of temperature of the water in bromeliads containing mosquito larvae was 65°–81° F. The temperature was usually

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less than 75° F. The higher temperatures are not common, as they are found only when the plants are exposed directly to the sun. The prevailing low temperatures of water in bromeliads are responsible to some degree for the slower rate of development of these mosquitoes.

The waters in all bromeliads examined were acid, the range of pH value being 3.8–6.6. The only sources of water in these plants are rain waters or dew, which has a pH value of 7. The shift to the acid condition apparently is a result of the decomposition of the organic materials present in the leaf bases. Possibly humic acids are liberated. Although certain protozoa, rotifers, and crustaceans have been cited [2] living in waters with a pH value as low as 3.2–3.8, no similar records for insects are available. Mosquito larvae have been taken in water with a pH range of 5.8–8.6 [3], but no records of insects developing in waters more acid than this are available. The bromeliads are likewise living in an acid environment since they utilize the water and dissolved materials contained in the leaf bases. The method by which a protoplasmic system adapts itself to a medium that is strongly acid or alkaline is not completely understood. The theory that hydroxyl and hydrogen ions penetrate membranes slowly and are neutralized by buffers within the protoplasm appears to be as adequate as any.

The species of mosquito larvae that were taken from bromeliads were *Wyeomyia mitchellii* Theobald. *Culex americanus* (Neveu-Lemaire), *Megarhinus portoricensis* Roeder, and *Corethrella appendiculata* Grabham. The larvae of *W. mitchellii* are bright yellow and have slightly flattened bodies. Much of their time is spent feeding over or resting on the debris at the bottom of the water. They come to the surface for air less often than the majority of mosquito larvae. The larvae of *C. americanus* have bodies well provided with tufts of bristles. They are usually found at the surface and descend to feed for only brief intervals. The larvae of *C. appendiculata* are small, active forms which were always associated with one or both of the above species. *M. portoricensis* was taken only once in bromeliads at Maricao, P. R., August 1935, at an elevation of 2,000 feet. This record is not included in table 1, as temperature and pH values were not taken.

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[2] Heilbrunn, L. V. An Outline of General Physiology, p. 381. Philadelphia. 1937.
[3] Chapman, R. N. Animal Ecology, p. 151. New York. 1931.

TABLE 1—COLLECTION RECORDS OF MOSQUITOES BREEDING IN BROMELIADS IN PUERTO RICO, 1936.

Date	Locality	Elevation feet	Collection No.	Temperature of water oF.	pH of water	Species present
January 28	Maricao National Forest	3,000	1	73	6.5	*Culex americanus*
		.....	2	74	6.4	*C. americanus, Corethrella appendiculata*
		.....	3	77	5.8	*C. americanus, Wyeomyia mitchellii*
		.....	4	71	6.4	*C. americanus, C. appendiculata*
		.....	5	73	6.0	*W. mitchellii*
		.....	6	72	6.4	*W. mitchellii, C. americanus*
		.....	7	71	6.3	*C. americanus*
		.....	8	73	6.6	*C. americanus*
		.....	9	72	6.0	*W. mitchellii*
		.....	10	71	6.4	*W. mitchellii, C. americanus*
March 24	Luquillo National Forest	3,000	1	68	5.0	*C. americanus, C. appendiculata*
		.....	2	68	5.5	*C. americanus, C. appendiculata*
		.....	3	68	4.0	*C. americanus, W. mitchellii*
		.....	4	68	3.8	*C. americanus*
		.....	5	66	4.5	*C. americanus*
		.....	6	66	4.5	*C. americanus*
		.....	7	66	4.3	*C. americanus*
		.....	8	66	3.8	*C. americanus*
		.....	9	66	3.8	*C. americanus*
		.....	10	67	4.3	*C. americanus, W. mitchellii*
May 5	Maricao National Forest	3,000	1	81	5.5	*W. mitchellii, C. appendiculata*
		.....	2	77	5.0	*C. americanus*
		.....	3	78	5.5	*C. americanus, W. mitchellii*
May 21	Luquillo National Forest (Bretton Peak)	3,500	1a	65	5.5	*C. americanus, W. mitchellii*
		.....	b	66	6.0	*C. americanus*
		.....	c	66	4.5	*C. americanus*
		.....	d	66	4.7	*C. americanus, W. mitchellii*
		.....	e	66	4.5	*C. americanus, W. mitchellii*
		.....	f	67	5.6	*C. americanus*
		.....	g	67	6.0	*C. americanus*
		.....	h	67	4.5	*C. americanus*
		.....	i	66	4.8	*C. americanus, W. mitchellii*
		.....	j	66	5.0	*C. americanus*
May 21	Luquillo National Forest	3,000	2a	68	5.5	*C. americanus*
		.....	b	68	6.0	*C. americanus*
		.....	c	68	6.0	*C. americanus*