and in cut or damaged bamboo internodes (Arnell 1973). The genus plays an important role in the transmission of sylvan or jungle yellow fever in neotropical America (Arnell 1973).

During September, 1982 an extensive mosquito survey was conducted on Monos Island, one of the several islands situated off the northwestern peninsula of Trinidad. Larvae and pupae of all 3 species of *Haemagogus* were collected from a rock hole. In addition, larvae of *Hg. celeste* were taken from water in an abandoned tire. These represent the first records of these species from such habitats. All immature specimens were transported to the Insect Vector Control Division Laboratory, St. Joseph, where they were reared to adults and identified. The results are as follows: *Haemagogus janthinomys:* two 4th instar larvae and 3 pupae, *Hg. celeste:* two 3rd instar larvae and *Hg. equinus:* two 4th instar larvae were collected from a rock hole at Grand Fond Valley on September 19, 1982. Associated with these were larvae of *Limatus durhamii* Theobald and *Culex originator* Gordon and Evans.

Haemagogus celeste: two 4th instar larvae were collected from an abandoned tire at Morris Bay Valley on September 17, 1982. Associated with these were ten 3rd instar larvae of *Aedes aegypti* (Linn).

The collection of these 3 *Haemagogus* species on Monos Island does not represent new records (see Manuel 1965, Heinemann et al. 1980), but unexpected was the aquatic source of the immature stages. Previously, Chadee et al. (1981) had reported the finding of *Hg. equinus* breeding in abandoned tires and in household containers on Tobago, W.I. and now we find that *Hg. celeste* may use the tire habitat.

It should be noted, however, that no tree hole collections were made on September 19, 1982, so that transference of larvae from tree hole to rock hole through contaminated equipment was not possible.

In addition to the aquatic collections, adults of the 3 *Haemagogus* species were readily taken during human-bait captures at points close to Morris Bay, Grand Fond Valley, Dumas Bay, Balmoral Bay and at Biscayne Bay. Specimens of *Hg. janthinomys, Hg. celeste* and *Hg. equinus* have been deposited in the Insect Reference Collection at the Caribbean Epidemiology Centre (CAREC).

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PSOROPHORA HOWARDII, AN ADDITION TO THE CHECKLIST OF NEW JERSEY MOSQUITOES[1]

JAMES McNELLY[2] AND WAYNE J. CRANS[3]

Psorophora howardii Coquillett is a mosquito of the southeastern U.S. that has been reported as far north as Delaware in the eastern portion of its range (Darsie and Ward 1981). Larvae of *Ps. howardii* are most often found in temporary rainpools and are predacious on the immature stages of other mosquitoes utilizing the habitat (Carpenter and LaCasse 1955). Development is rapid and several generations are possible when rainfall is abundant during the breeding season (Siverly 1972).

On June 4, 1982, approximately twenty 3rd instar *Ps. howardii* were collected from a shaded rainpool in the Fishing Creek area of southern Cape May County, New Jersey by Cape May County Mosquito Commission personnel. The exact site is several miles east of the town of Villas and is south of the Delaware record of *Ps. howardii* reported by Lake (1963). Several

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specimens were reared to the adult stage for confirmation of species. An adult specimen has been deposited in the collection of the Headlee Research Laboratories at Rutgers University.

The most recent checklist of New Jersey mosquitoes included 52 species (Crans 1967). Since that time, additions have been made by Crans (1970), Zavortink (1972), Lesser et al. (1977) and Ehrenberg (1983). The addition of *Ps. howardii* brings the New Jersey list to 59, including the following species:

Genus *Aedes* Meigen

1. *Aedes abserratus* (Felt and Young)
2. *Aedes atlanticus* Dyar and Knab
3. *Aedes atropalpus* (Coquillett)
4. *Aedes aurifer* (Coquillett)
5. *Aedes canadensis canadensis* (Theobald)
6. *Aedes cantator* (Coquillett)
7. *Aedes cinereus* Meigen
8. *Aedes communis* (De Geer)
9. *Aedes dorsalis* (Meigen)
10. *Aedes dupreei* (Coquillett)
11. *Aedes excrucians* (Walker)
12. *Aedes fitchii* (Felt and Young)
13. *Aedes flavescens* (Müller)
14. *Aedes grossbecki* Dyar and Knab
15. *Aedes hendersoni* Cockerell
16. *Aedes implicatus* Vockeroth
17. *Aedes intrudens* Dyar
18. *Aedes mitchellae* (Dyar)
19. *Aedes provocans* (Walker)
20. *Aedes punctor* (Kirby)
21. *Aedes sollicitans* (Walker)
22. *Aedes spencerii spencerii* (Theobald)
23. *Aedes sticticus* (Meigen)
24. *Aedes stimulans* (Walker)
25. *Aedes taeniorhynchus* (Wiedemann)
26. *Aedes triseriatus* (Say)
27. *Aedes trivittatus* (Coquillett)
28. *Aedes vexans* (Meigen)

Genus *Anopheles* Meigen

29. *Anopheles atropos* Dyar and Knab
30. *Anopheles barberi* Coquillett
31. *Anopheles bradleyi* King
32. *Anopheles crucians* Wiedemann
33. *Anopheles earlei* Vargas
34. *Anopheles punctipennis* (Say)
35. *Anopheles quadrimaculatus* Say
36. *Anopheles walkeri* Theobald

Genus *Culex* Linnaeus

37. *Culex erraticus* (Dyar and Knab)
38. *Culex pipiens* Linnaeus
39. *Culex restuans* Theobald
40. *Culex salinarius* Coquillett
41. *Culex tarsalis* Coquillett
42. *Culex territans* Walker

Genus *Culiseta* Felt

43. *Culiseta inornata* (Williston)
44. *Culiseta melanura* (Coquillett)
45. *Culiseta minnesotae* Barr
46. *Culiseta morsitans* (Theobald)

Genus *Coquillettidia* Dyar

47. *Coquillettidia perturbans* (Walker)

Genus *Orthopodomyia* Theobald

48. *Orthopodomyia alba* Baker
49. *Orthopodomyia signifera* (Coquillett)

Genus *Psorophora* Robineau-Desvoidy

50. *Psorophora ciliata* (Fabricius)
51. *Psorophora columbiae* (Dyar and Knab)
52. *Psorophora cyanescens* (Coquillett)
53. *Psorophora discolor* (Coquillett)
54. *Psorophora ferox* (von Humboldt)
55. *Psorophora howardii* Coquillett
56. *Psorophora mathesoni* Belkin and Heinemann

Genus *Toxorhynchites* Theobald

57. *Toxorhynchites rutilus septentrionalis* (Dyar and Knab)

Genus *Uranotaenia* Lynch-Arribálzaga

58. *Uranotaenia sapphirina* (Osten Sacken)

Genus *Wyeomyia* Theobald

59. *Wyeomyia smithii* (Coquillett)

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A METHOD FOR DETERMINING POND INUNDATION HEIGHT FOR USE IN SALT MARSH MOSQUITO CONTROL

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The addition of ditches provides effective long-term mosquito control in salt marsh management programs. However, economic and environmental costs (Resh and Balling 1983) associated with ditching require accurate determination of which ponds produce mosquitoes and should be ditched. Although regular monitoring of ponds for the presence of mosquito larvae is a reliable approach, it is impractical in marshes that contain numerous ponds. A cost-effective alternative is to use environmental factors that are correlated with mosquito presence to predict which ponds will produce mosquitoes. In a study of environmental factors that influence *Aedes dorsalis* (Meigen) and *Aedes squamiger* (Coq.) populations in San Francisco Bay salt marshes, pond inundation height, i.e. the minimum tidal height above mean lower low water (MLLW) necessary to inundate a marsh pond, was significantly correlated with occurrence and abundance of mosquito larvae (Balling and Resh 1983).

The pond inundation height is best determined by using surveying techniques from a nearby tidal benchmark. Unfortunately, there are often no nearby benchmarks, or there is reason to suspect that recorded benchmark elevations are no longer reliable due to land subsidence or mechanical disturbance. In lieu of surveying, an acceptable estimate can be obtained by using the height of a particular high tide (either taken from tide table predictions or, preferably, measured by a nearby tide gauge) as a reference datum from which heights of other ponds can be calibrated. This is possible because differences in inundation height within and between marshes are essentially constant (Marmer 1951). Although the following procedure was used to estimate pond inundation heights in marshes around the San Francisco Bay, this method is applicable in any area with recorded or predicted tidal heights.

DATA COLLECTION. *Marker construction.* Staple a strip of heavy-duty, waterproof tape (e.g. heating-duct tape) vertically, with the adhesive side exposed, to a long stake. Sprinkle potassium dichromate crystals or some other water-soluble, easily visible, non-toxic substance along the length of the tape. Dissolution of the potassium dichromate on the tape will give a measure of the local tidal height.

Marker placement. Prior to a series of inundating tides, and at a time when wind speeds are low, implant the stake in the pond; leave the upper portion of the stake sufficiently high above the marsh surface to exceed the height of the expected tide.

Measurements. After the tide has flooded the marsh and receded, allow sufficient time (12–24 hr) for the pond to drain down to, but not evaporate beyond, basin-full level. Then, measure the difference between the pond surface and the high water mark on the stake (the high tide reference datum), which is indicated by the line of undissolved potassium dichromate on the tape.

Replication. This procedure should be repeated for several different high tides to establish the most accurate estimate.

CALCULATION OF POND HEIGHT. The height of the tide (taken from tide tables or a tide gauge) minus the difference between the high water mark on the tape and the level of the pond surface will give an estimate of the pond inundation height equivalent to that obtained from surveying.

If tide tables are used, the inundation height must be adjusted for differences in diurnal tidal ranges (due to systematic differences in bay and channel morphometry) between the tidal reference station and the marsh. As an example, consider that a tide is 186 cm high (above MLLW) at the Golden Gate reference station in San Francisco Bay (where the tidal range is 174 cm) and 60 cm above the surface of a basin-full pond at Mud Slough (where the tidal range is 277 cm; for locations see Balling and Resh 1983, Fig. 1). The difference between the two tidal ranges indicates that the tide is higher at Mud Slough than at the Golden Gate; that is, a 1.0 unit increase in tidal height at the Golden Gate reference station corresponds to a 1.59 (277 cm/174 cm) unit increase at Mud Slough. Therefore, the 60 cm difference between the high water mark on the stake and the pond surface would be equivalent to a 38 cm difference (60 cm/1.59) at the Golden Gate reference station. After subtracting this 38 cm from the known height of the tide at the reference station (in this example, 186 cm), the