

**PREDATION BY *ANISOGAMMARUS CONFERVICOLUS*  
(AMPHIPODA: GAMMARIDEA) ON *Aedes TOGOI*  
(DIPTERA: CULICIDAE).**

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*Aedes togoi* (Theobald) is native to the Pacific Coast of Asia where it breeds in saline rock pools. The first North American report of *Ae. togoi* was by Meredith and Phillips (1973) from Victoria, British Columbia, Canada. Subsequent surveyors have collected this mosquito from rock pools throughout the south western coast of Canada. The breeding sites in this study, at Lighthouse Park, West Vancouver, were supralittoral splash pools of salinity varying with precipitation and evaporation from 7 to 40 ppt.

While collecting *Ae. togoi* larvae at these rock pools we observed an amphipod crustacean, later identified as *Anisogammarus confervicolus* (Stimpson), capturing and feeding upon the mosquito larvae. The amphipod was found in most but not all of the pools containing *Ae. togoi* larvae and was observed from early June to late July. *A. confervicolus* was collected several times from pools with salinity of at least 37.5 ppt (YSI Model 33 salinity meter), although Levings *et al.* (1976) determined the optimum salinity for adult survival to be less than 29 ppt. Recorded temperatures during the observation period varied from 18 to 24°C, considerably higher than the optimum temperature range for adult survival of 3 to 10°C determined by Levings *et al.*

*Anisogammarus confervicolus* is the most common estuarine and brackish-water amphipod on the Pacific Coast of Canada. They are omnivorous, feeding opportunistically on any suitable organic matter of plant or animal origin (Bousfield, pers. comm.). The predacious nature of *A. confervicolus* was confirmed in the laboratory. Eleven adult amphipods were maintained in 0.8 l of non-aerated, 37.5 ppt. solution of aquarium salt and dechlorinated tap water at 23°C for 5 days. No food was provided during the first 24 h. Thirteen first- and second-instar *Ae. togoi* were introduced on the second day and these were partially or completely consumed in

less than 24 h. Six more first- and second-instar larvae were introduced on the fourth day. Of these, 1 second and 2 third instar larvae were alive after 24 h, suggesting that the smaller larvae were more readily preyed upon. The mosquito larvae appeared to be actively sought by the amphipods and were captured from above with a swimming-like motion of the amphipod's appendages and consumed head first. No amphipod mortality was observed. Cannibalism, reported by Levings *et al.*, was not observed in this study.

Other authors have reported on amphipods feeding on mosquito larvae in fresh water habitats. Baldwin *et al.* (1955) and James (1961) observed that *Aedes stimulans* and *Aedes trichurus* larvae in temporary woodland pools were preyed upon by *Crangonyx* sp. Affelbeck (1925) concluded that the most important natural enemies of larvae of *Anopheles bifurcatus* were the crustaceans *Gammarus pulex* and *Carinogammarus roeselli*, and he attributed the relative scarcity of *A. bifurcatus* in his study to the fact that it breeds in streams where these are abundant. Hinman (1934) experimented with a small unidentified amphipod which readily devoured *Aedes aegypti* larvae, and he speculated that it might be involved in regulating natural mosquito populations.

The potential of *A. confervicolus* as a predator of brackish-water Culicidae requires further consideration. In addition to its possible use as a biological control agent for *Ae. togoi*, a potential vector of Japanese B Encephalitis (McLintock and Iverson, 1975), this amphipod may be useful in controlling *Aedes dorsalis*, a salt marsh mosquito of considerable nuisance value in south-west British Columbia.

#### ACKNOWLEDGEMENTS

The authors thank Mark Gardiner for his technical assistance, Dr. E. L. Bousfield for identifying the amphipod, and Dr. C. D. Levings for his helpful comments.

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## PREDATOR RELEASE PROGRAM FOR BALSAM WOOLLY APHID, *ADELGES PICEAE* (HOMOPTERA: ADELGIDAE), IN BRITISH COLUMBIA, 1960-1969

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### RÉSUMÉ

Entre 1960 et 1969 on a importé et relâché dans le sud-ouest de la Colombie-Britannique des prédateurs du Puceron lanigère du Sapin (*Adelges piceae* [Ratz.]), ravageur introduit des *Abies* spp. *Laricobius erichsonii* Rosen. et *Pullus impexus* (Muls.) se sont établis et on en retrouvait encore en 1978. De plus, *Aphidoletes thompsoni* Mohn et *Cremifania nigrocellulata* Cz. se sont aussi établis, du moins brièvement. Ces parasites, ainsi qu'un complexe de prédateurs ont réduit ou éliminé quelques infestations de la tige n'ont pas réduit les ravages du Puceron dans les forêts.

### ABSTRACT

Predators of the balsam woolly aphid, *Adelges piceae* (Ratz.), an introduced pest of *Abies* spp., were imported and released into southwestern British Columbia from 1960 to 1969. *Laricobius erichsonii* Rosen. and *Pullus impexus* (Muls.) became established and were still found in 1978. *Aphidoletes thompsoni* Mohn and *Cremifania nigrocellulata* Cz. also became established, at least briefly. These and a complex of native predators reduced or eliminated some stem infestations but did not reduce aphid-caused forest damage.

### INTRODUCTION

The balsam woolly aphid, *Adelges piceae* (Ratzeburg), has been a serious pest of *Abies* species in eastern North America since the early 1900s and, more recently, in the western United States. In British Columbia, it was first noticed north of Vancouver in 1958 by the Forest Insect and Disease Survey, Canadian Forestry Service. The protected habitat of the aphid on the bark of the bole and crown made it difficult to attack by chemical means and, because it was a pest introduced without many of its natural enemies, early control efforts concentrated on importing these natural enemies from Europe and western Asia (McGugan and Coppel 1962).

The distribution of *A. piceae* over the tree is an important consideration in biological control. Heavy infestations on the lower bole are con-

venient release and assessment sites, but such concentrations of aphids occur only on a small number of trees scattered throughout a stand. Small numbers of woolly aphids, however, are spread throughout the crowns of many trees of an infected stand. The ideal predator or predator complex, therefore, must have a good searching ability for both crown and stem infestations, and must be able to maintain itself on alternate hosts in situations where the balsam woolly aphid has disappeared or is in very small numbers.

Most of the biological studies and releases were done in eastern Canada and the western United States by the respective forest services. Six species of predaceous Diptera and Coleoptera were established in eastern Canada (Clark *et al.* 1971) but they did not significantly reduce damage.