Fryxell and Hoare during the early season, extensive blue-green algal mat community appeared relatively flat. By January, mats were lifting off in large pieces (figures 2 and 3). This biological phenomenon is significant not only to the present geochemistry of the dry valley lakes but also because the accumulation of mat pieces frozen in the ice may reduce light penetration in the water column and thus phytoplankton production. This significance has not been previously recognized.

An artificial substrate system (Cairns et al., 1969) was used to study colonization rates and composition of planktonic and benthic microfaunal communities. The length of times required to reach 99-percent species equilibrium in both lakes was considerably shorter in the benthic mats than in the limnetic zone. In addition, Lake Hoare had fewer species at equilibrium than did Lake Fryxell and took longer to reach equilibrium than Lake Fryxell. In comparable temperate studies (Cairns, Kuhn, and Plafkin, 1979), colonization was found to take longer in oligotrophic systems than in eutrophic lakes. This also emphasizes the greater productivity of Lake Fryxell. The protozoan colonization rate of the artificial substrates fits the hypothetical model for island colonization proposed by McArthur and Wilson (1963). Small particle feeders dominated the microfaunal communities indicating an organically rich substrate. Studies of chlorophyll *a* levels from the artificial substrates also showed increases during the season as a result of an increase in phytoflagellate density. The increase in these densities may have been related to increased solar radiation and nutrient inputs from surrounding meltstreams.

We are grateful for support of this research through National Science Foundation grant DPP 76–23996. Also, we would like to acknowledge the other members of our field research team: Dale Andersen, John Baggerly, Debbie Biesemeyer, Jim Gillcrist, Lita Proctor, Mike Van Brunt, and Martha Wolfe.

References

Cairns, J., Jr., M. L. Dahlberg, K. L. Dickson, N. Smith, and W. T. Waller. 1969. The relationship of freshwater protozoan communities to the MacArthur-Wilson equilibrium model. *The American Naturalist,* 103: 439–54.

Cairns, J., Jr., D. L. Kuhn, and J. L. Plafkin. In prep. Protozoan colonization of artificial substrates.

Fogg, G. E., and A. J. Horne. 1970. Algal physiology. In *Antarctic Ecology*, ed. M. W. Holdgate, 2: 639–50. London: Academic Press.

Holm-Hansen, O. 1963. Viability of blue-green and green algae after freezing. *Physiologia Plantarum,* 16: 531–40.

MacArthur, R. H. and E. O. Wilson. 1963. An equilibrium theory of insular zoogeography. *Evolution,* 17: 373–87.

Parker, B. C. and G. M. Simmons, Jr. 1978. Ecosystem comparisons of oasis lakes and soils. *Antarctic Journal of the United States*, 13(4): 168–69.

Wilson, A. T. 1965. Escape of algae from frozen lakes and ponds. *Ecology*, 46(3): 376.

Sex ratio in *Belgica antarctica*

JOHN S. EDWARDS

Department of Zoology
University of Washington
Seattle, Washington 98195

JOHN G. BAUST

Department of Biology
University of Houston
Houston, Texas 77004

PATRICK SUGG

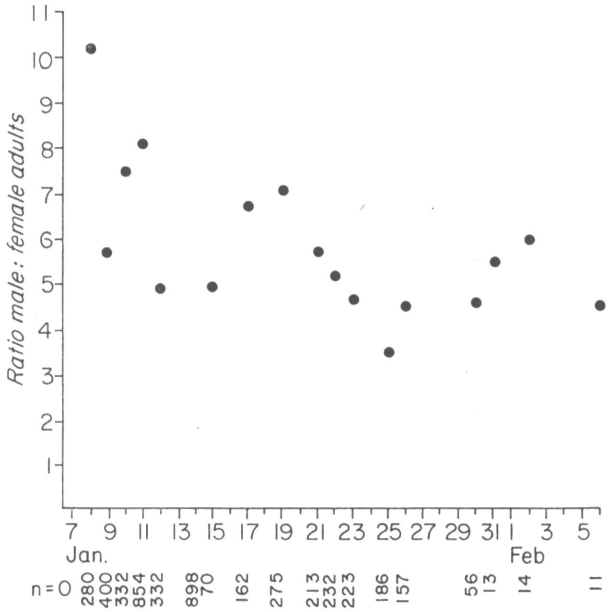
Department of Zoology
University of Washington
Seattle, Washington 98195

During the austral summer of 1978–79, we continued our 1977–78 studies on sex ratio in populations of the wingless chironomid fly *Belgica antarctica* in the vicinity of Palmer Station, Anvers Island, in conjunction with studies of low-temperature tolerance (Baust, Edwards, and Brown, 1979; Baust and Edwards, 1979).

It is a basic tenet of population genetics that, as shown by Fisher (1930), the sex ratio of bisexually reproducing animals should approximate 1:1. Departures from equality, as in facultatively parthenogenetic insects (e.g., Chironomidae, Lindberg, 1971), favor females. Therefore, reports of male predominance in populations of *B. antarctica* (Strong, 1967; Peckham, 1971) are of exceptional evolutionary interest.

In our fieldwork, to eliminate the possibility that previous reports of male-biased sex ratio reflected merely temporary deviations, we made collections of adult aggregations on moss rock and water surfaces throughout the emergence seasons. The sex ratio in samples taken during the 1977–78 season are shown in the accompanying chart. Similar results were obtained during 1978–79. The overall ratio of about 6 males (♂) to 1 female (♀) confirms earlier reports and further shows that the bias persists throughout the emergence season. The accentuated male bias early in the season may be an example of the protandry known in other chironomids (Danks and Oliver, 1972).

To eliminate possible sampling artefacts, a measure of sex ratio at adult emergence is essential. We obtained such a measure during the 1978–79 season by sampling cast pupal cuticles (exuviae). The pronounced sexual dimorphism of the exuviae allows unequivocal determination of sex. During warm periods groups of adults, which probably were cohorts derived from single egg



Sex ratio (male : female) in field samples of *Belgica Antarctica* taken on Bonaparte Point, Anvers Island, Antarctic Peninsula throughout emergence season 1978.

batches, emerged nearly simultaneously, and we collected 16 separate population samples. Of 1,586 exuviae, 47 percent were males, giving a sex ratio of 0.89 ♂:1♀. Thus, the sex ratio at emergence approximates unity.

The male predominance in surface samples of adult aggregates may have two causes—microhabitat choice and differences in longevity. We checked the first of these probable causes by collecting adults from subsurface spaces using a suction device that could be inserted into small cavities opened by dissection of the substratum. The sex ratio of the combined samples so obtained (168♂:129♀ or 1.3:1) more closely approximates sex ratio at emergence. In addition, preliminary data indicate that males may live twice as long as females, which expire shortly after the single bout of oviposition. Thus longevity also may contribute to the bias of surface samples.

It would appear then that the surface aggregations of *Belgica* do not signify an aberrant sex ratio but are the equivalent, for a flightless species, of the mating swarms of winged chironomids in which males predominate and from which females depart after insemination.

This work has been supported by National Science Foundation grant OPP 76–24205 to John G. Baust.

References

Baust, J., and J. S. Edwards. 1979. Mechanisms of freezing tolerance in an Antarctic midge, *Belgica antarctica*. *Physiol. Entomol.*, 4: 1–5.

Baust, J., J. S. Edwards, and R. Brown. 1979. Physiological basis of low temperature tolerance in antarctic insects. *Antarctic Journal of the United States*, 13(4): 164–66.

Danks, H. V., and D. R. Oliver. 1972. Seasonal emergence of some high arctic Chironomidae (Diptera). *Can. Ent.*, 104: 661–86.

Fisher, R. A. 1930. *The Genetical Theory of Natural Selection*. Oxford: Clarendon Press.

Lindberg, B. 1971. Parthenogenetic strains and unbalanced sex ratios in Tanytarsini (Diptera, Chironomidae). *Ann. Zool. Fennici*, 8: 310–17.

Peckham, V. 1971. *Notes on the Chironomid Midge,* Belgica antarctica *Jacobs at Anvers Island in the Maritime Antarctic.* In *Pacific Institute Monographs*, 25: 145–66.

Strong, J. 1967. Ecology of terrestrial arthropods at Palmer Station, Antarctic Peninsula. In Antarctic Research Series, 10: 357–71. Washington, D.C.: American Geophysical Union.

Insect landings on R/V *Hero* at sea off Argentina

JOHN S. EDWARDS

Department of Pathobiology
University of Washington
Seattle, Washington 98195

On 8 January 1979, numerous insects were collected as they landed on R/V *Hero*, which was en route from Montevideo to Palmer Station, Antarctica.

These landings occurred between 42°15′S/55°40′W and 44°40′S/56°12′W as the ship was proceeding southward at 9.5 knots. A steady wind of 12 to 14 knots was blowing from the north-northwest.

During the daylight hours, the insects landed at a rate of about six per hour; the highest rate was reached around 11:30 a.m. when there was one landing every 3 to 5 minutes. At sunset, 28 moths were present on the mainsail and 13 more on the foresail.

Through extrapolation of wind directions, it is estimated that the insects had been carried by the wind from a region of Argentina lying between Mar del Plata and Cabo Corrientes (38°S/57°30′W). Assuming constant wind conditions and airspeeds of up to 6 kilometers per hour, the insects would have been aloft for between 12 and 20 hours and would have traveled approximately 450 kilometers.

The collected material consists of numerous moths (family Noctuidae, 4 spp.; 1 unidentified family), two beetles (Coccinellidae, Carabidae), and one water bug (Notonectidae). The material has been submitted for identification.

My thanks to the captain and crew of R/V *Hero* and scientists on board for their enthusiastic assistance during the insect landings.

This work has been supported by National Science Foundation grant OPP 76-24205 to Dr. John G. Baust.