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SEASONAL DRIFT OF *LETHOCERUS AMERICANUS* (HEMIPTERA: BELOSTOMATIDAE) IN A LAKE SUPERIOR TRIBUTARY[1]

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ABSTRACT

Drifting adult *Lethocerus americanus* were captured and retained by an inclined-screen smolt trap during two field seasons in the Bois Brule River, Wisconsin. Seasonal peaks of drift occurred in spring for 4 weeks following ice out and in autumn for 7–8 weeks from mid-September through ice formation, and may have continued under ice cover when our gear was not operated. These findings are consistent with the known movement pattern of these insects to fly from lentic habitats to streams to overwinter but also suggest longitudinal movement via drift, perhaps to reach specific overwintering sites. Drift was significantly correlated with declining water temperatures in 1989 but not in 1990. Most drift occurred at water temperatures less than 12°C. There was no correlation between drift and river discharge. Drift rates were consistently low with a maximum by volume of 9 animals per 10,000 m^3.

Giant water bugs (*Lethocerus americanus* [Leidy]) are generally found in lentic habitats of various types and sizes where they breed and sometimes overwinter (Hungerford 1920, Rankin 1935, Hilsenhoff 1984). Occurrence in streams is thought to be infrequent (Menke 1963). They are, however, known to fly to streams to overwinter and are frequently collected in late autumn and early spring along stream banks (Hilsenhoff et al. 1972, Hilsenhoff 1984). Hoffman (1924) found some hibernating adults in December about 15 cm deep in the disintegrated plant material of a Minnesota stream bottom, and others 6 to 8 cm deep among *Typha* roots near the stream edge. Although this general life history pattern involving riverine overwintering has been fairly well established, little information is available about drifting or other behavioral aspects of this species in lotic systems.

These insects are not often captured in drift nets, probably because they are relatively uncommon in streams. They may also be able to crawl out of many conventional drift nets. A smolt trap used to capture migrating salmonids proved to be effective in capturing and retaining drifting *L. americanus*. This paper reports on the spring and autumn drifting of these insects in the Bois Brule River, Wisconsin.

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STUDY LOCATION AND METHODS

The 79-km Bois Brule River drains a diverse and sparsely developed watershed of about 320 km^2 and flows north into the western end of Lake Superior. Discharge from this spring-fed, fourth-order river averages about 6 m^3/sec, and total alkalinity averages 58 mg/L $CaCO_3$. A more complete description of the Bois Brule River watershed was given by DuBois (in press).

L. americanus was sampled with an inclined-screen smolt trap [see DuBois et al. (1991) for design specifications and operational details] operated at a lamprey barrier about 11 km above the river's mouth. The trap was attached to the downstream face of the barrier dam. Water to be sampled (6 to 10% of the total river flow depending on river level) was shunted down an inclined screen made of parallel aluminum rods spaced 6.4 mm apart and flowed into a floating catch barge covered with a tarpaulin. Because of the covering and the large volume of water entering the trap, escape of giant water bugs from the trap by either crawling or flying out was unlikely. We assume that all *L. americanus* individuals entering the trap were retained until we removed the contents. Contents were removed with a dip net, and woody debris and leaves were examined carefully. Trap contents were removed at intervals ranging from 16 to 72 hours and always included at least one night. Operation of the trap extended throughout the ice-free season, beginning in late March or early April and extending through early to mid-November. In 1989 the trap was operated for 2,406 hours at an average of 78 hours per week. In 1990 operation was more frequent, totaling 4,348 hours and averaging 132 hours per week.

Water temperature and discharge were each examined for correlation with numbers of drifting *L. americanus* retained by the trap per hour by testing the null hypothesis that the Pearson correlation coefficient equaled zero (Snedecor and Cochran 1980). Additionally, we calculated a sampling efficiency of 15% for the trap (assumed to be constant for the duration of both sampling seasons). This was estimated by marking, with a spot of fingernail polish on the wing, 104 individuals caught by the trap at normal flow, releasing them at mid-channel about 125 m upstream of the trap, and recording the number (16) recaptured. This efficiency estimate provided only minimum estimates of total river drift because some of the released insects may have stopped along the bank above the barrier. These minimum estimates are used only to approximate the magnitude of total river drift. Because a partial guide fence was used to direct downstream-moving animals to the mouth of the trap, sampling efficiency was not directly related to the amount of the total river flow sampled.

RESULTS

Over two field seasons, 751 downstream-moving adults were captured and retained by our smolt trap showing spring and autumn peaks of movement (Fig. 1). During spring of each year, the period of substantial movement existed for 4 weeks beginning shortly after ice out (mid-March in 1990, the end of March in 1989). Autumn peaks of movement began in mid or late September and extended 7–8 weeks, which in 1989 included the day prior to permanent winter ice formation. Most of the drift sampled (70–80%) occurred during autumn.

Catch rates per hour of *L. americanus* ranged from 0 to 0.45 (avg. 0.09) in 1989 and 0 to 1.11 (avg. 0.13) in 1990. The highest catch rates we recorded each year, by water volume, were 5 per 10,000 m^3 on 16 November 1989 and 9 per 10,000 m^3 on 22 October 1990. Drift of these insects was significantly correlated with declining water temperatures in 1989 ($p < 0.0001$), but not in

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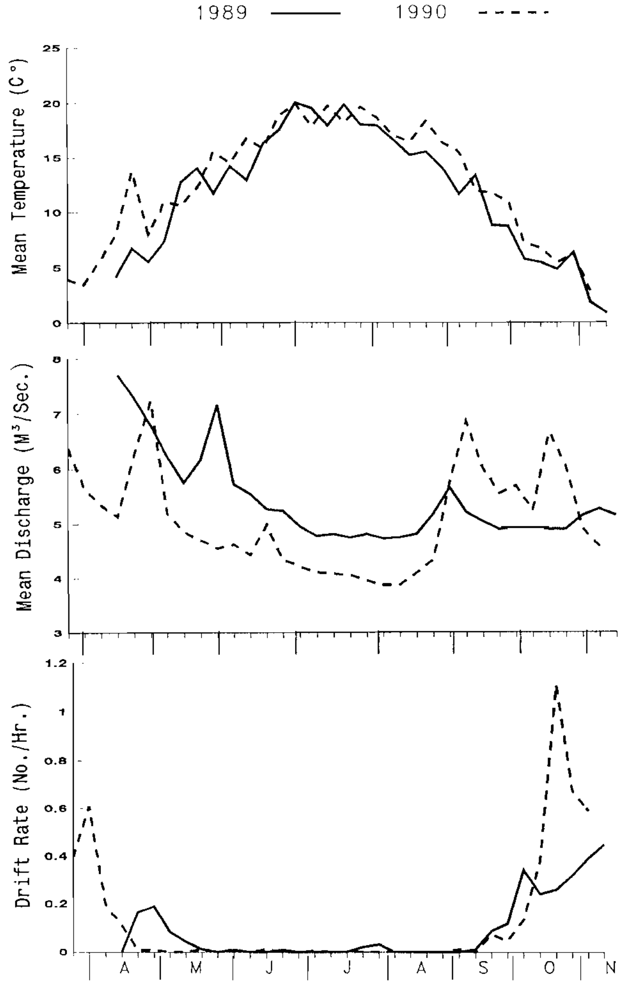

Figure 1. Mean weekly distribution of drifting *Lethocerus americanus*, river discharge, and water temperature for the Bois Brule River, 1989 and 1990.

1990 ($p = 0.259$). Most drift occurred at temperatures less than 12°C (Fig. 1). There was no correlation between drift and river discharge.

Total river drift rates based on the estimated sampling efficiency of our trap of 15%, although inexact for reasons stated in the Methods section, appear to have ranged from 0 to over 7 *L. americanus* per hour. Extending these estimates, total numbers of drifting adults during the ice-free seasons we sampled ranged from approximately 3,000 to 5,000 annually. Mean total length of *L. americanus* in October (N = 36) was 52 mm (range 45–59 mm) and mean total body width was 20 mm (range 18–23 mm).

DISCUSSION

Drift of *L. americanus* occurred primarily during late autumn, secondarily during early spring, and may have continued under ice cover when our gear was not operational. These seasonal aspects of drift are consistent with the known behavior pattern of adults flying to streams to overwinter. Several workers have referred to the strong flight ability of these insects (Hungerford 1920, Hoffman 1924, Menke 1963). The autumn peak of drift could represent a searching response for suitable overwintering areas by newly arrived adults. However, numerous observations we have made of this insect in slow-water sections of the upper Bois Brule River during summer and early autumn, as well as reports we have received from anglers, suggests year-round residency of at least some *L. americanus* in the Bois Brule River mainstem. Additionally, adults are frequently observed throughout the winter on raceway screens at the Brule Trout Rearing Station which is located at about the midpoint of the Little Brule River, a major Bois Brule River tributary (S. Plaster, pers. comm.). Because of the frequency of such observations, we speculate that year-round occurrence of this insect in low-gradient stream sections may be more common than previously thought. This idea is further supported by the paucity of significant lentic systems near the study area. The nearest lake is Lake Nebagamon (which is part of the Bois Brule watershed), located approximately 19 km to the south (about 48 km by river). Other lakes to the south and east are yet more distant. A few small ponds and swamps exist within a few miles of the trap, but the total surface area they contain is small (< 25 hectares).

The nearest likely overwintering area having a soft bottom and extensive riparian area resembling that described by Hoffman (1924) is located near the mouth of the Bois Brule River about 11 km downstream of the sampling device. However, the spring drift of *L. americanus* at the lamprey barrier is indicative of suitable overwintering habitat upstream as well, perhaps among roots of vegetation in small areas of reduced flow. Spring drift could thus be attributable to a post-dormant resumption of activity with some individuals subsequently being caught up in the drift.

This study is the first to report on drifting of *L. americanus*, which is not surprising considering that conventional aquatic insect drift studies do not usually sample enough water volume to collect more than a few of these animals. Smolt traps, by virtue of the large volumes of water they strain, can provide hard-to-obtain information on movement patterns of the larger, less-common aquatic insects and crustaceans as well as some reptiles and amphibians. We frequently captured *Pteronarcys dorsata* (Say) (Pteronarcidae) and *Ophiogomphus carolus* Needham (Gomphidae) larvae, and adults of *Belostoma flumineum* Say (Belostomatidae) and *Ranatra fusca* Palisot Beauvois (Nepidae) in addition to *L. americanus*. However, these other insects were more difficult to consistently find amid the leaf litter, woody debris, and other plant material typically retained by the catch barge (they were smaller and usually less active). Hence, we are not able to quantitatively report on the drift of these taxa.

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