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Population dynamics of horn fly, *Haematobia irritans irritans* (L.) (Diptera: Muscidae), on Hereford cattle in Uruguay

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Abstract

Abundance of adult horn flies, *Haematobia irritans irritans* (L.), was monitored on 25 untreated Hereford cows in Tacuarembó Department, Uruguay, during three consecutive grazing seasons, from October 1999 to May 2002. The population showed a variable pattern of abundance during three years, with peaks in late summer-early fall of each year. Adult flies were continuously present, although in very low numbers in intervening winters. Numbers of flies per cow rarely exceeded a reference level of 200 flies per animal during the grazing season. Degree-day calculations indicated that approximately 12 generations were possible each year. Time series analysis of mean densities among consecutive generations indicated that population growth was governed by simple, direct density-dependence, with additional effects of seasonally varying weather. Response surface regressions confirmed that intergenerational growth was inversely related to mean density, and directly related to temperature. Stochastic simulations with the response surface model suggested that within the range of temperatures observed in our study, horn fly populations on Hereford cattle will tend toward densities of approximately 150 flies per animal in summer, and exceed a nominal level of 200 flies per cow one or more times in about 65 of every 100 grazing seasons.

Keywords: Horn fly; Population dynamics; Density-dependence; Weather effects; Modeling; South America

1. Introduction

The horn fly, *Haematobia irritans irritans* (L.) (Diptera: Muscidae), is an important ectoparasite of cattle in North America, and recently spread into the southern cone of South America (Honer et al., 1990; Luzuriaga et al., 1991; Carballo and Martínez, 1991). Adult horn flies reside on cattle, pierce their skin to obtain blood, and can reduce their growth (see Kunz et al., 1990), lactation (see Jonsson and Mayer, 1999) and leather quality (Guglielmone et al., 1999).

Female horn flies lay eggs exclusively in fresh cattle dung pats, where larvae develop and ultimately pupate in or under their natal pats. Development from egg to adult may require 8 or more days during a grazing

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season, depending on temperature (Lysyk, 1992). As temperature declines and development time increases, larvae are stimulated to enter diapause (Lysyk and Moon, 2001), overwinter as pupae, and emerge when temperatures become permissive the following spring. Daily mortality rates of females on cattle in Iowa, USA, ranged from 0.09 to 0.34 per day, depending on year and estimation method (Krafsur et al., 1992), which equates to an expected adult lifespan of 6.6 days or less.

We conducted the present study to assess population dynamics of a horn fly population in subtropical northern Uruguay, in preparation for development of a strategic control program. Benefits of horn fly control for increased cattle productivity in northern temperate regions are well known, and proposed treatment thresholds range from 25 to 200 flies per brood cow (see Kunz et al., 1990; Jonsson and Mayer, 1999). Research in South American grazing systems has documented benefits of control in some cases (Suárez and Busetti, 1996; Suárez et al., 1996; Bianchin and Alves, 2002; Bianchin et al., 2004), but not in others (Castro, 2001). Goals of the present research were to document patterns of seasonal abundance in Uruguay, and to test hypotheses that population growth is governed by density-dependence and aspects of weather as recorded in the study area. For purposes of evaluating abundance patterns, we adopted a reference level of 200 flies per cow to judge when populations were above or below a certain level. This level served simply as a reference, and should not be interpreted as a threshold for control treatments. Estimation of economic injury levels and economic thresholds for cattle in South American grazing systems will require further study.

2. Materials and methods

2.1. Study site and animals

The study was conducted on a commercial cattle ranch in northeastern Uruguay, near Ansina in Department of Tacuarembó (31°42.7′S, 55°59.5′W, 134 m a. s. l.). The ranch was populated by 200 Hereford cows, 5 bulls, 120 calves, 180 heifers and 165 steers. No insecticide or acaricide was used anywhere on the ranch during the study. The study began on 22 October 1999, and continued until 5 May 2002. For simplicity, we will refer to seasons as winter (July–September), spring (October–December), summer (January–March) and autumn (April–June), and refer to a spring–autumn interval as a grazing season, numbered by calendar year in which it began.

2.2. Meteorological data

Daily precipitation was measured at the Ansina ranch during most of the study, with exception of autumn–winter 2000, when missing records were replaced with those from a meteorological station at Tacuarembó, approximately 50 km west of the study site. Records of daily extreme temperatures (minimum, maximum, °C) throughout the study were obtained from the same Tacuarembó station.

2.3. Fly counts

The horn fly population on the study herd was censused at roughly 2-week intervals in a first series of observations during grazing season 1999 from 22 October 1999 to 6 April 2000. A second series was made through the next two grazing seasons from 22 October 2000 to 5 May 2002. Observations between the two series were interrupted in autumn–winter, 2000, when labor was unavailable. On each occasion, flies were counted between 07:00 and 11:00 a.m. by two observers standing on opposite sides of 25 naturally infested cows as they passed through a chute (Castro et al., 2005). Each observer counted flies visible on each animal's upper body, from poll to tailhead, and ventrally to a line between elbow of foreleg and knee of hind leg. Paired counts from the two observers were added together to estimate total on both sides of each animal.

2.4. Generational time scale

To facilitate analysis, calendar time scale was converted to a generational time scale, using a 2-step development model that compensated for effect of seasonally varying temperature on time required by horn flies to complete a generation. First, we assumed that newly emerged females residing on host cattle required 5 days, regardless of temperature, to complete their first gonotrophic cycle and lay their first eggs (Krafsur et al., 1992). Second, we estimated time from egg to adult using a degree-day model, based on analysis of data extracted from seven published laboratory and field studies (Larsen and Tomsen, 1940; Depner, 1961; Thomas et al., 1974; Miller, 1977; Palmer et al., 1981; Lysyk, 1992; Barros, 2002), where egg-adult development times were reported for horn flies reared at different temperatures. Development rates (proportion of total per day) in laboratory and field studies combined were linearly related to ambient temperature, with total development requiring $K = 193$ (±S.E. = 4.2, d.f. = 130) degree-days above a lower development threshold of $k = 10$ °C (±0.36).