(Ríos, 1991). Similarly, in Honduras, pheromone trapping has shown larger grain borer to be widespread along both northern and southern coasts (Novillo, unpublished data), as well as in maize-producing valleys in the interior (Hoppe, 1986).

PEST STATUS AND LOSS ASSESSMENT

Severe losses of stored foods (especially maize and cassava), attributable to larger grain borer, have been well documented following major pest outbreaks in Africa (as reviewed by Hodges, 1986). Locally, losses as high as 34% (dry weight) were recorded in Tanzania over a short storage period, averaging 9% (Hodges *et al.*, 1983a). Comparison with earlier published data in the region suggests a major increase in losses following the introduction of larger grain borer (Laborius *et al.*, 1989). The status of the pest in a number of African countries was reported to a review meeting at Arusha, Tanzania (Anonymous, 1988b & c; Schulten & Toet, 1988). In the same region of Tanzania, particularly severe losses were reported, averaging 17.9% after six months and 41.2% after eight months (Keil, 1988). The most intensive and specifically-targeted survey of losses to date was carried out in Togo (Pantenius, 1987, 1988 & undated) where dry weight losses after six months' storage increased from an average of 7.1% before the advent of larger grain borer to 30.2% afterwards. After 8 months losses averaged 44.8% and affected cobs were unfit for human consumption; Pantenius (1988) therefore concluded real losses to be some 10% higher. Indeed damage to the grain was so severe that in both the Tanzania (Keil, 1988) and Togo studies (Pantenius, 1987, 1988) the authors concluded that standard count-and-weigh or volumetric methods were no longer satisfactory; losses were estimated by comparison with undamaged baseline samples taken at the beginning of storage.

The situation in the Neotropics has been the subject of considerable debate. Weight losses of 40% after 24 weeks occurred with a heavy infestation of larger grain borer in Nicaragua (Giles, 1977) and this species is mentioned as a major pest in a number of early reports from Mexico (Barnes *et al.*, 1959; Ramírez, 1959 & 1960b). More recently, locally serious losses of over 30%, particularly associated with heavy *P. truncatus* infestation, were reported from Honduras (Hoppe, 1986). However, the impression persists that losses are generally lower in the Neotropics than in Africa (Boeye *et al.*, 1988; Laborius *et al.*, 1989; Laborius, 1990a). This has led to interest in the possibility of using classical biological control of the pest in Africa and, with it, the need to assess more critically the situation in Mexico and Central America. In the course of ecological studies related to the biological control effort, weight losses averaging 5% after six months, and reaching 13% after 8 months, were recorded at three sites in Costa Rica (Böye [=Boeye], 1988). Losses reached 8.5% and 31.6% after eight months in successive years in an experimental store in Honduras (Novillo, 1991) and reached over 14% during 10 months storage in the central highlands of Mexico (Ríos, 1991). In the last two instances, the progress of damage was closely correlated with the increase in larger grain borer populations.

Although larger grain borer is usually regarded as a pest of maize stored on-farm under traditional management, it is interesting to note that the pest has been recorded as a major pest in large-scale stores of shelled grain (Barnes *et al.*, 1959). A more recent study, in Michoacan State of Mexico, showed that the species can still occur widely in such systems (Luévano, 1985).

The dramatic potential of larger grain borer to cause severe losses has been amply demonstrated in laboratory studies (as reviewed by Hodges, 1986). As Hodges points out, much of the damage results from the boring activity of the adults, rather than consumption by the insects during the course of development. The relative importance of adult tunnelling, as compared with consumption during development, in promoting losses was also documented in bioenergetic terms by Demianyk and Sinha (1988), who report that a single adult larger grain borer destroys the equivalent of five maize kernels. The relationship between adult tunneling, reproduction and resulting damage has been critically investigated by Li (1988) in the course of studies of the life history strategies of larger grain borer. The hardness of grains of particular varieties slowed tunnelling, to which females reacted by laying larger groups of eggs (which in turn increased larval competition and mortality). Since total lifetime fecundity was also reduced, grain hardness had a considerable impact on reproductive potential and resulting damage.

Storage insects, in addition to causing weight loss, can also reduce the quality of infested grain (in particular the protein content and germination rate), especially if they feed preferentially on the embryo. As noted by Hodges (1986), there is conflicting evidence of such behavior in the case of larger grain borer which has not been resolved by more recent studies. Demianyk and Sinha (1988) reported that 'most' larvae burrowed into the germ and that larvae which burrowed into the harder endosperm developed considerably more slowly than the average. Direct damage to the germ and reduced germination, combined with changes in microbial activity, were