The role of wild host plants in the abundance of lepidopteran stem borers along altitudinal gradient in Kenya

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Abstract. Presence of wild host plants of stem borers in cereal-growing areas has been considered as reservoirs of lepidopteran stem borers, responsible for attack of crops during the growing season. Surveys to catalogue hosts and borers as well as to assess the abundance of the hosts were carried out during the cropping and non-cropping seasons in different agro-ecological zones along varying altitude gradient in Kenya. A total of 61 stem borer species belonging to families Noctuidae (25), Crambidae (14), Pyralidae (9), Tortricidae (11) and Cossidae (2) were recovered from 42 wild plant species. Two noctuids, *Busseola fusca* (Fuller), *Sesamia calamistis* Hampson, and two crambids, *Chilo partellus* (Swinhoe) and *Chilo orichalcociliellus* (Strand) were the four main borer species found associated with maize plants. In the wild, *B. fusca* was recovered from a limited number of host plant species and among them were *Sorghum arundinaceum* (Desvaux) Stapf, *Setaria megaphylla* (Steudel) T. Durand & Schinz, *Arundo donax* L. and *Pennisetum purpureum* Schumacher. In contrast, the host range of *C. partellus* was considerably wider [13 for *S. calamistis*]. However, the number of larvae of these species was lower in the wild compared to cultivated fields, thus the role of natural habitat as a reservoir for cereal stem borers requires further studies. Importance of the wild host plants as well as borer diversity along the altitudinal gradient is discussed.

Résumé. Le rôle des plantes hôtes sauvages dans l'abondance des lépidoptères foreurs de graminées selon un gradient altitudinal au Kenya. La présence de plantes hôtes sauvages de foreurs autour des parcelles cultivées a toujours été considérée comme préjudiciable à la production des céréales dans la mesure où elles constituent des réservoirs pour les foreurs. Des enquêtes ont été menées au Kenya, pendant et en dehors des périodes culturales, selon un gradient altitudinal, afin de déterminer le rôle de ces plantes hôtes sur les populations de ravageurs. Soixante et une espèces de lépidoptères foreurs appartenant aux familles des Noctuidae (25), Crambidae (14), Pyralidae (9), Tortricidae (11) et Cossidae (2) ont été récoltées sur 42 plantes hôtes sauvages. Les principales espèces de foreurs associées au maïs sont *Busseola fusca* (Fuller) et *Sesamia calamistis* Hampson (Noctuidae) et *Chilo partellus* (Swinhoe) et *Chilo orichalcociliellus* (Strand) (Crambidae). Dans les habitats sauvages, *B. fusca* a été trouvé sur un nombre restreint de plantes hôtes sauvages telles que *Sorghum arundinaceum* (Desvaux) Stapf, *Setaria megaphylla* (Steudel) T. Durand & Schinz, *Arundo donax* L. and *Pennisetum purpureum* Schumacher. A l'inverse, *S. calamistis* et *C. partellus* ont été trouvées associées à plus de plantes hôtes sauvages [*S. calamistis* (13), *C. partellus* (5)]. Toutefois, le nombre total de chenilles de ces quatre espèces de ravageur trouvé dans les habitats sauvages est très inférieur à celui trouvé dans les parcelles cultivées, aussi le rôle des habitats sauvages en tant que réservoir pour les lépidoptères foreurs de céréales requiert des études plus approfondies. L'importance de la diversité des lépidoptères foreurs dans les plantes hôtes sauvages en fonction du gradient altitudinal est discutée.

Keywords: Stem borer, *Pennisetum purpureum*, *Arundo donax*, Lepidoptera, Africa.

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Lepidopteran stem borers are among the most important insect pests infesting maize and sorghum in sub-Saharan Africa (Schulthess *et al.* 1997; Overholt *et al.* 2001; Guofa *et al.* 2002). In East and Southern Africa, *Chilo partellus* (Swinhoe 1884) and *Busseola fusca* (Fuller 1901) are the most important species while *Eldana saccharina* Walker 1865 and *Sesamia calamistis* Hampson 1910 constitute the minor species (Seshu Reddy 1998; Kfir 1997). With the exception of *C. partellus*, which is native to Asia, the other borer species are indigenous to Africa and are assumed to have co-evolved with some native grasses and sedges (Nye 1960; Polaszek & Khan 1998; Overholt *et al.* 2001). Understanding the interactions between these pests and their cultivated and native hosts has been thought of as a prerequisite for developing sustainable management strategies (Bowden 1976).

In East and Southern Africa, populations of Noctuidae and Crambidae often occur as a community of species with overlapping spatial and temporal distribution. In Kenya, *B. fusca* and *C. partellus* are the main pests of maize [*Zea mays* L.] and sorghum [*Sorghum bicolor* (L.) Moench] (Ong'amo 2005). While *B. fusca* dominates the high altitude areas, *C. partellus* is recorded mainly in the lowlands and mid-altitudes (Seshu Reddy 1983; Overholt *et al.* 2001; Ong'amo *et al.* 2006). Crop residues have been reported as responsible for re-establishment of pest populations early in the cropping season (Ingram 1958; Nye 1960). However, information on the role of wild hosts in carry-over of pest populations is scanty.

Stem borers occur in large numbers in maize and sorghum plants during cropping seasons (Songa *et al.* 1998), and their populations survive in wild hosts or in crop stubbles as diapausing larvae during crop free periods (Ingram 1958; Nye 1960; Polaszek & Khan 1998; Haile & Hofsvang 2001). Alternative hosts in the vicinity of the crop fields and crop residues enhance survival of borers during off-season, and thereby are responsible for pest attacks on crops in the subsequent season (Polaszek & Khan 1998). In contrast, oviposition preference studies showed certain wild grasses to be highly attractive to ovipositing moths, though larval survival and adult fecundity are generally low (Haile & Hofsvang 2002). Based on these interactions, hypotheses has been created and validated with field and laboratory trials for *S. calamistis* and *E. Saccharina* (Shanower *et al.* 1993; Schulthess *et al.* 1997). Low borer incidences in maize fields in the forest zones of Cameroon, Ivory Coast and Ghana were partly attributed to abundant wild grasses in the surrounding fields (Schulthess *et al.* 1997). These views appear to differ either because generated hypotheses have not been fully tested or because of differences in borer species. This study was initiated to catalogue hosts and borers in Kenya, and estimates their abundance along different altitudinal gradients.

Materials and methods

Description of the surveyed gradients

Surveys were made during 2003/2004 cropping and non-cropping seasons in 31 localities randomly selected in maize producing areas in Kenya (fig. 1). Localities were grouped in three altitudinal gradients [< 1000, 1000-1500 and >1500 m above sea level (asl)]. Both 1000-1500 and >1500m asl zones are characterized by extensive maize monocultures producing about 80% of the crop consumed in Kenya (De Groote 2002). The other zone (< 1000 asl) is mainly occupied by subsistence farmers who produce approximately 20% of the total maize consumed in the country.

Rainfall in these zones is highly variable and generally bimodal in distribution. This allows for two annual cropping seasons, the first lasting from March - April to May - August (long rainy growing season) and the second from October to December (short rainy season). Most farmers regard long rainy season as the most important season as it is more reliable.

Cultivated host (maize)

Ovipositing noctuids are reported to have a strong preference for pre-tasseling crops and thus attack plants early in the season. There is one or two stem borer generations during the short rainy season depending on the crop cycle and the duration of pre-tasseling unlike during the long rainy season where there are two generations. Long rainy season populations are thought to either come from adjacent earlier planted crops or wild habitats. This study thus aimed at capturing the first generation of the long rainy season. Several maize farms within a radius of 400m of each survey locality were sampled. Visits were made during four to six weeks after germination of maize during the long rainy season. In each session, 100 randomly selected maize stems were inspected for stem borer infestation. Infested stems were cut and dissected for larval and pupal recovery. Other cultivated graminaceous crop-hosts such as *S. bicolor, Saccharum officinarum* L., and *Eleusine corocana* L. were also sampled. However these hosts were sampled in very few localities and are presented together with the wild host plants (tab. 2).

Wild host plants

Surveys in wild host habitats in the vicinity of crop fields were done during both cropping and non-cropping seasons. Since borer densities on wild hosts plants are considerably lower than on cultivated cereals (Nye 1960; Schulthess *et al.* 1997), selective sampling was adopted to increase the chances of finding borers. In each locality, all potential hosts belonging to the Poaceae, Cyperaceae and Typhaceae families found within 200-300 m from the border of cultivated maize field were carefully examined for symptoms of stem borer damage. Damaged plants were cut at the bases and dissected for recovery of larvae and pupae. Plants from which the larvae or pupae were collected were identified. In cases where identities of the infested plants were not known, voucher specimens were taken to the East African herbarium in Nairobi for identification.

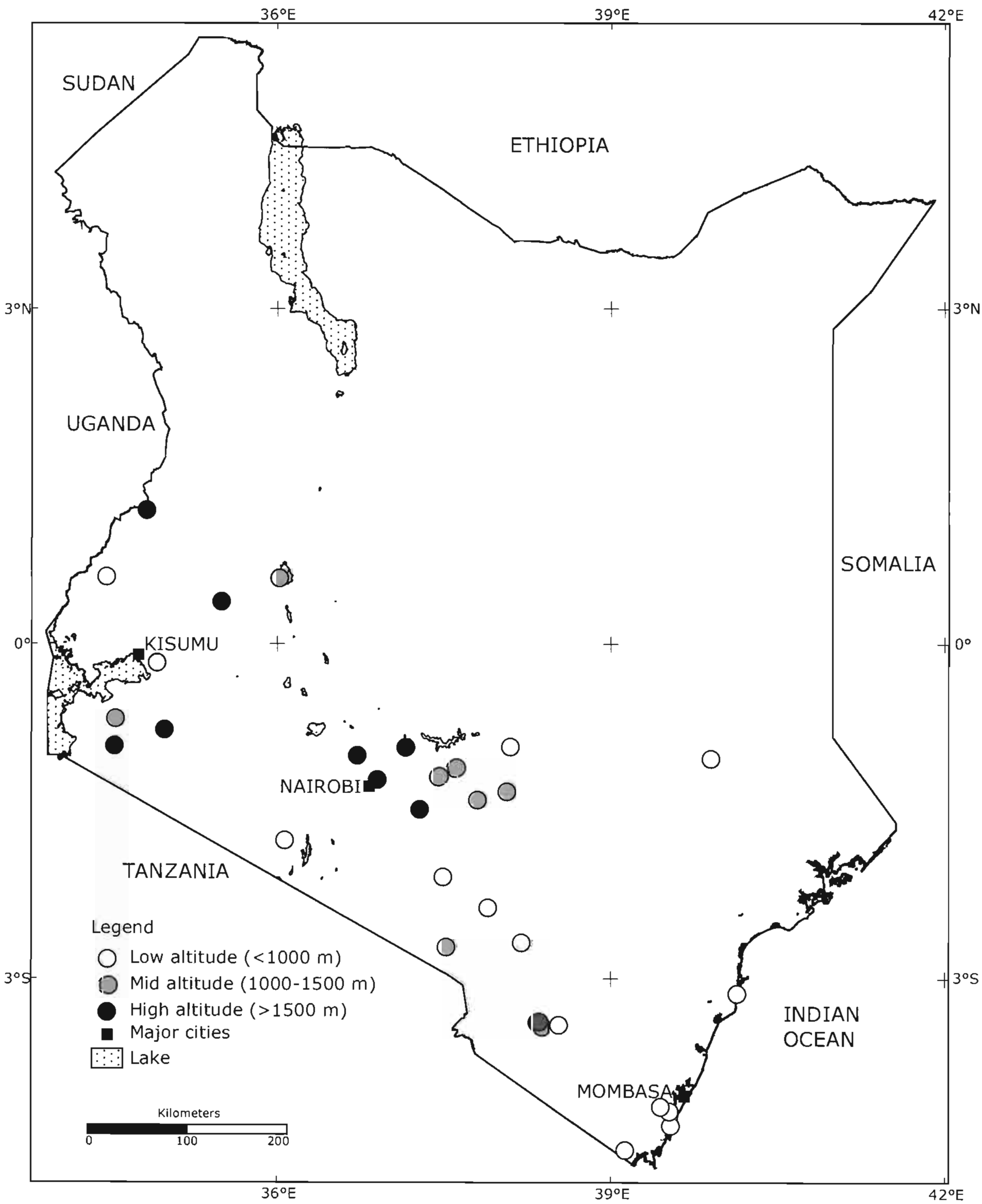

Figure 1
Map of Kenya outlining localities surveyed for stem borer infestation in both maize and wild hosts during the study.

Stem borer species

Upon dissection, recovered larvae were individually introduced into glass vials containing *B. fusca* diet (Onyango & Ochieng'Odero 1994) where they remained until pupation or emergence of natural enemies. Pupae were then individually transferred to separate plastic vials until adult emergence. Noctuid moths were shipped to Centre National de la Recherche Scientifique, Gif-sur-Yvette Cedex (France) where they were identified by one of us (Pascal Moyal). Apart from *C. partellus* and *E. saccharina*, identity of the crambids, pyralids, tortricids and cossids could not be confirmed and are thus presented in their tentative families. Specific characters used for identification of *Chilo* species appear to be very variable (Blezynski 1970) and more so for species close *Chilo orichalcociliellus* (Strand, 1911). To avoid risk of misidentification, materials close to *C. orichalcociliellus* are presented here as *C. orichalcociliellus* group. In addition, presentations of some materials in the text are limited to genera (Noctuidae family) and super-families (Pyraloidea, Tortricoidea and Cossoidea).

A correlation test was performed to estimate the relationship between the relative importance of stem borer species and altitude.

Results

Stem borer abundance in maize fields along the altitude

Busseola sp nr *phaia*, *Sciomesa piscator* Fletcher 1961, *Sesamia nonagrioides botanephaga* (Lefebvre 1827) and *Sesamia* sp nov 5 were found infesting maize in addition to *B. fusca*, *C. partellus*, *S. calamistis* and *C. orichalcociliellus* group which were the main pest species (tab 1). Pest species coexisted in most localities with varying densities along the altitudinal gradient ($F_{2,171}$ = 8.86; p = 0.0002). The highest density (1.39 larvae/plant) was recorded in mid altitude gradient followed by low altitude gradient

Table 1. Stem borer pests collected among maize plants in different localities along the altitudinal gradient.
In parenthesis along columns are the number of larvae collected among wild host plants; *B.f.* - *B. fusca*; *S.c.* - *S. calamistis*; *C.p.* - *C. partellus*; *C.o.* group - *C. orichalcociliellus* group.

	Localities	Latitude	Longitude	Altitude (m asl)	Larvae from cultivated crops			
					B. f.	*S. c.*	*C. p.*	*C. o.* group
Low altitude (<1000)	Malindi	S 03°08.054'	E 40°08.098'	33	0	112	774(2)	22(12)
	Mombasa 6	S 04°19.196'	E 39°32.471'	43	0	36(32)	295(30)	16(120)
	Mombasa 8	S 04°32.502'	E 39°07.831'	103	0	84(8)	676(6)	4(5)
	Shimba 1	S 04°11.463'	E 39°31.921'	111	1	76	287	75(9)
	Bura	S 01°02.007'	E 39°53.988'	148	0	9	357(36)	0
	Shimba 2	S 04°08.843'	E 39°26.963'	417	0	53	456(2)	83(96)
	Taita 3	S 03°24.917'	E 38°32.075'	610	0	1	976(210)	0
	Mombasa 7	S 02°40.627'	E 38°11.715'	739	10	81	487(201)	0(82)
	Rift Valley 3	S 01°45.837'	E 36°03.991'	914	4	17(3)	98(275)	0
	Mombasa 3	S 02°21.894'	E 37°53.528'	989	20	19(3)	387(78)	0(2)
	Garissa 2	S 00°55.672'	E 38°05.676'	994	2	13(3)	520(19)	0(379)
Mid altitude (1000 – 1500)	Rift Valley 6	N 00°35.168'	E 36°00.921'	1084	22	13(100)	0	0
	Kisumu 2	S 00°10.357'	E 34°54.804'	1143	128	16	1014	0
	Mombasa 2	S 02°05.453'	E 37°29.388'	1153	19	29	1400(372)	0
	Kitui1	S 01°24.114'	E 37°48.047'	1160	2	7	384	0
	Mt. Kenya 2	S 00°71.720'	E 37°26.730'	1179	88	66(23)	1726(494)	1
	Taita 2	S 03°26.292'	E 38°21.955'	1180	81	15	114(4)	0
	Homa Bay 1	S 00°40.382'	E 34°32.128'	1250	101	9	580	0
	Kisumu 4	N 00°35.775'	E 34°27.165'	1283	227	20	484	0
	Loitoktok	S 02°43.109'	E 37°31.169'	1331	20	68(2)	278(12)	0
	Kitui 2	S 01°19.482'	E 38°03.684'	1363	106(2)	47(31)	166	0
	Garissa 1	S 01°07.185'	E 37°35.879'	1363	2	65	833	0
High altitude (>1500)	Kakamega	N 00°22.530'	E 34°89.660'	1551	209(87)	3(16)	0	0
	Kisii 2	S 00°54.790'	E 34°31.740'	1583	60	1(9)	16	0
	ICIPE	S 01°13.209'	E 36°53.775'	1625	129	26(4)	41	0
	Mt. Kenya1	S 00°55.793'	E 37°09.343'	1639	595	92	639(2)	0
	Taita 1	S 03°23.626'	E 38°20.339'	1729	618	90	1	0
	Machakos	S 01°29.347'	E 37°16.611'	1978	707	7	0	0
	Kitale 2	N 01°11.738'	E 34°49.106'	2160	603(47)	1(7)	2	0
	Gatamaiyu	S 01°00.057'	E 36°43.022'	2181	297(2)	7	0	0
	Kisii 1	S 00°46.216'	E 34°58.788'	2223	279	3(9)	0	0

(0.84 larvae/plant), while the lowest density (0.80 larvae/plant) was recorded in high altitude gradient.

Stem borer community significantly varied along the altitudinal gradient ($F_{11,112}$ = 54.62; p < 0.0001). Distribution of *B. fusca* was strongly correlated to the increase in altitude ($F_{1,29}$ = 25.65; p < 0.001; r^2 = 0.42) with more larvae in high altitude zone (>1500 m) where it constituted about 85% of the community. A negative relationship was observed in the proportion of both *S. calamistis* ($F_{1,29}$ = 4.80; p < 0.05; r^2 = 0.14) and *C. orichalcociliellus* group ($F_{1,29}$ = 8.80; p < 0.05; r^2 = 0.23) with an increase in altitude though they constituted

Table 2. Host plants from which different stem borer super-families were recovered.

Family	Host plants	Noctuoidea	Pyraloidea	Tortricoidea	Cossoidea
Poaceae	*Arundo donax* L.	6	2	0	0
	Cymbopogon nardus (L.) Rendle	25	0	0	0
	Cynodon aethiopicus Clayton & Harlan	103	0	0	0
	Cynodon dactylon (L.) Persoon	13	0	0	0
	Cynodon nlemfuensis Vanderyst var. *nlemfuensis*	55	0	0	0
	Digitaria milanjiana (Rendle) Stapf	28	5	2	0
	Echinochloa pyramidalis (Lam.) Hitchc. & Chase	178	141	0	7
	Eleusine corocana L.	40	0	0	0
	Eriochloa fatmensis (Hochsttetter & Steudel) Clayt.	176	0	0	0
	Eriochloa meyerana (Nees) Pilger	64	2	0	0
	Euclaena mexicana Schrader	0	14	0	0
	Hyparrhenia papillides (Hochstetter) Stapf	4	4	0	0
	Hyperthelia dissoluta (Steudel) Clayton	4	4	0	0
	Panicum deustum Thunb	55	22	0	0
	Panicum maximum Jacquin	1189	547	0	0
	Panicum merkeri Mez	37	16	0	0
	Panicum porphyrhizos Steudel	31	0	0	0
	Paspalidium geminatum (Forskal) Stapf	29	0	0	0
	Pennisetum macrourum Trinius	41	0	0	0
	Pennisetum purpureum Schumacher	1569	146	0	0
	Pennisetum trachyphyllum Pilger	491	0	0	0
	Phragmites mauritianus Kunth	3	1	0	3
	Rottboellia cochinchinensis (Loureiro) Clayton	6	201	0	0
	Saccharum officinarum L.	49	0	0	0
	Schoenoplectus corymbosus (Roemer & Schultes)	0	0	13	0
	Setaria megaphylla (Steudel) T. Durand. & Schinz	742	0	0	0
	Sorghum arundinaceum (Desvaux) Stapf	162	1761	0	0
	Sorghum bicolor (L.) Moench	539	2330	0	0
	Vossia cuspidata (Roxburg) Griffith	24	0	0	0
	Zea mays L.	5862	13192	0	0
Cyperaceae	*Carex chlorosaccus* C.B. Clarke	0	14	0	0
	Cyperus latifolius Poiret	7	21	0	0
	Cyperus maculatus Boeck.	0	0	35	0
	Cyperus alopecuroides Rottboll	0	6	20	0
	Cyperus articulatus L.	12	0	55	0
	Cyperus dereilema Steudel	0	14	0	0
	Cyperus dichrostachyus A. Richard	19	37	0	0
	Cyperus distans L.	25	18	14	0
	Cyperus dives Delile	77	18	10	0
	Cyperus exaltatus Retzius	5	29	7	0
	Cyperus prolifer Lamark	0	0	24	0
Typhaceae	*Typha domingensis* Persoon	207	38	0	0

Very low number of larvea were recovered from *Setaria sphacelata* (Schumacher) Moss, *Echinochloa haploclada* (Stapf) Stapf, *Cenchrus ciliaris* L., *Cyperus rotundus* L. and *Cyperus involucratus* Rottboll and have thus been excluded from the table.

the minor proportion of the borer community in low altitude zone (8 and 3% respectively). Unlike the other species, frequencies of *C. partellus* did not vary with increase in altitude ($F_{1,29} = 3.92$; $p > 0.05$; $r^2 = 0.12$) though it dominated mid- and low altitude zones where it constituted 72 and 86% respectively.

Stem borer pests among wild host plants

Stem borer species recovered from maize plants were also obtained from wild host plants growing in the vicinity of crop fields. Their abundance varied among localities along the altitudinal gradient. *B. fusca* was recovered only from five localities on four Poaceae species, namely *Setaria megaphylla* (Steudel) T. Durand & Schinz (Kakamega) *Arundo donax* L. (Mt. Kenya 1), *Sorghum arundinaceum* (Desvaux) Stapf. (Kakamega, Kitui 2 and Kitale 2) and *Pennisetum purpureum* Schumacher (Gatamaiyu). These localities were situated in both the mid- (Kakamega and Kitui 2) and high altitude (Mt. Kenya 1, Kitale 2 and Gatamaiyu) zones. In contrast, *S. calamistis* was recovered in 14 localities from 13 different host plants belonging to Poaceae (9) and Cyperaceae (4) families (tab. 2). *S. calamistis* larvae were recovered mainly from *Cyperus distans* L., *Eleusine corocana* L., *Panicum porphyrhyzos* Steudel, *S. arundinaceum*, *Paspalidium geminatum* (Forskol) Stapf and *Vossia cuspidata* (Roxburg) Griffith. However, *S. arundinaceum* was found infested in many localities (Kitale 2, Mombasa 3, Mombasa 6, Mt. Kenya 2 and Rift valley 3) across all altitudinal gradients.

Like in maize, crambids *C. partellus* and *C. orichalcociliellus* group occurred mainly in low altitude localities. *C. partellus* was mainly collected from *S. arundinaceum*, *P. purpureum*, *Rottboellia cochinchinensis* (Loureiro) Clayton and *Panicum maximum* Jacquin. However, *S. arundinaceum* was frequently found infested by this species in both low and mid altitude localities. On the other hand, the *C. orichalcociliellus* group was found restricted to low altitude zone where it was recovered from seven different plants: *S. arundinaceum*, *P. purpureum*, *P. maximum*, *Digitaria milanjiana* (Rendle) Stapf, *Euclaena mexicana* Schrader, *P. deustum* Thunberg and *Hyperthelia dissoluta* (Steudel) W.D. Clayton. *P. maximum* was frequently found infested by this species in five localities. In some localities (Mombasa 3, Mombasa 6, Mombasa 7, Shimba 2 and Garissa 2), *C. orichalcociliellus* group immatures were more frequent on wild hosts compared to maize. *E. saccharina* was recovered from two localities on two Cyperaceae species namely *Cyperus dives* Delile and *Cyperus alopecuroides* Rottboll.

Non-pest stem borers among wild host plants

Stem borers varied in their distribution in wild host plants among different zones without any consistent pattern (tabs. 2 & 3). Some localities, particularly in the high altitude zone (Kakamega, Gatamaiyu, Kisii 1 and Kisii 2) had more larvae of "non-pest species" on wild hosts compared to maize (tab. 2). Similar results were recorded in the low altitude localities namely Mombasa 6, Mombasa 7, Rift Valley 3 and Garissa 2. About 22 non-pest borer species belonging to 7 different genera within the noctuid family have been identified. These genera varied in terms of species richness among which *Sesamia* Guenée 1852 had 9 species followed by *Sciomesa* Tams and Bowden 1953 (6), *Manga* Bowden 1956 (2) and *Busseola* Thurau 1904 (1). Three unknown species were also recovered

Table 3. Proportions (%) of stem borer genera and families in different altitudinal zones from wild host plants. Parenthesis along the genera column indicates the number of species.

Super-family	Family	Genera	<1000	1000–1500	> 1500
Noctuoidea	Noctuidae	*Busseola* (1)	1.5	0.1	14.7
		Carelis (1)	0	0.0	4.8
		Busseola sensu lato (3)	0	0.0	13.3
		Manga (2)	23.4	9.7	1.9
		Poeonoma (1)	0	0.0	15.8
		Sciomesa (6)	4.6	0.8	38.8
		Sesamia (9)	15.8	28.7	5.8
Pyraloidea	Crambidae	*Chilo* (5)	43.4	56.8	0.1
		Other crambid species (7)	1.8	0.5	3.1
	Pyralidae	*Eldana* (1)	0.1	0.1	0.3
		Other pyralid species (8)	6.9	0.3	0.3
Tortricoidea	Tortricidae	11 species	2.5	2.6	1.1
Cossoidea	Cossidae	2 species	0	0.4	0

and grouped within the unknown genera tentatively named *Busseola* sensu lato. The other genera, *Poeonoma* Tams and Bowden 1953 and *Carelis* Bowden 1956 respectively have one species each (tab. 3). Nonetheless, there was variation in distribution proportion among the genera along altitudinal gradient. The *Manga* genus dominated low altitude localities (< 1000m asl) where it constituted about 51% of noctuid larvae collected, followed by *Sesamia* (34%). *Sesamia* was the most important genus in the mid altitude zone, constituting about 72% of total noctuids collected, while *Sciomesa* was the most abundant genus in high altitude zones constituting about 40% of the total noctuids, followed by the genus *Poeonoma* with 16%.

Twenty-one species belonging to Crambidae and Pyralidae families were recovered (tab. 3). The most abundant among these was the Crambidae family where 2780 larvae belonging to 12 different species were identified. Important in this family was the *Chilo* genus, which had 5 species. Nine species were identified within the Pyralidae family of which *E. saccharina* constituted about 5% of the total collection. Tortricidae was second to Pyralidae in terms of species richness, and third in terms of the number of larvae collected. About 11 species were tentatively identified within Tortricidae from 180 specimens collected. The least number of larvae (10) as well as species (2) were collected from the Cossidae family.

Discussion

This findings support earlier reports on variations in the distribution of *Busseola fusca* and *Chilo partellus* according to altitude (Seshu Reddy 1983; Songa *et al.* 1998; Guofa *et al.* 2002). The difference Nye (1960) ascribed to climatic variations especially the temperature. However, pest populations were higher in maize fields compared to wild habitats. High pest occurrence in maize fields indicates better suitability of cultivated crops to support borer populations compared to wild grasses. Shanower *et al.* (1993) showed that survival of *Sesamia calamistis* and *Eldana saccharina* larvae was less than 10% in *Panicum maximum*, *Sorghum arundinaceum*, *Pennisetum purpureum* and *Pennisetum polystachion* (L.) Schultes, while larval survival in maize was between 19 and 30%. Low borer survival was thus ascribed to poor host quality.

Busseola fusca was found in maize in all localities in the mid and high altitude zones, but it was recovered from four wild host species in five localities only. Contrary to earlier reports (Polaszek & Khan 1998; Overholt *et al.* 2001), only two larvae of *B. fusca* were recovered from *P. purpureum*, which was found growing within a maize field. Laboratory studies demonstrated that *B. fusca* larvae were unwilling to bore in *P. purpureum* stems and that adult moths would not oviposit on that host plant (Wilkinson 1936, Calatayud *et al. in lit.*). Very likely reports of *B. fusca* on *P. purpureum* in Kenya may have been a result of the larvae moving from maize or sorghum onto *P. purpureum*, or misidentification. However, *B. fusca* was reported to be common on *P. purpureum* in Central Africa (Cameroon) (Ndemah *et al.* 2001a) and there may be agreement that host range of most insects is dynamic and often location and time-specific (Polaszek & Khan 1998). Unlike *B. fusca*, *S. calamistis* was recovered from many plant species confirming its polyphagy corroborating reports from West and Central Africa (Ndemah *et al.* 2001b). Though wild plants are attractive to ovipositing moths, larval survival and adult fecundity are generally low (Shanower *et al.* 1993), which may explain the low populations observed in maize fields surrounded by wild hosts in Benin and Cameroon (Schulthess *et al.* 1997; Schulthess *et al.* 2001; Ndemah *et al.* 2002).

Chilo partellus was found restricted to low and mid-altitude zones with high populations in maize and low population in the wild habitats. *C. partellus* populations were higher than that of other borers supporting earlier studies which suggested that this zone is ecologically suitable for its establishment. Suitable climatic conditions coupled with available alternative hosts are thought to have favoured *C. partellus* (Guofa *et al.* 2002). This can explain its rapid population build up that resulted in the displacement of indigenous *Chilo orichalcociliellus* (Seshu Reddy 1983). However, there was evidence of variation in niche occupation among these two species in the wild as most of the *C. partellus* larvae were found on *S. arundinaceum* while the *C. orichalcociliellus* group larvae were found mainly on *P. maximum*.

Recorded diversity is higher than previously reported. However, the distribution of some wild stem borers was found restricted to either a certain plant species or altitudinal zones. The *Manga* genus was commonly found on *P. maximum* in low altitude zones, while *Busseola* spp were found mainly in the high altitudes. Even with the observed variation in distribution with altitude, importance of wild stem borers as alternative hosts of natural enemies during the crop period cannot be ignored. Bonhof (2000) reported high diversity and abundance of natural enemies in maize fields at the Kenyan coast during the beginning of long rainy season. She ascribed this diversity to possible movement of natural enemies from wild habitats where they attack alternative host insects. Schulthess *et al.* (2001) reported relatively high parasitism of *S. calamistis* eggs by *Telenomous* spp (Hymenoptera: Scelionidae) during the dry season in the Inland valley in Benin and Cameroon. Wild habitats rich in alternative stem borers may attract and sustain populations of natural enemies that would eventually move to cultivated fields and suppress pest populations.

The presence and abundance of the "wild" stem borer species in different regions appear to be affected by the availability of suitable host plants. Borer species belonging to *Sesamia, Sciomesa, Busseola* genera as well as Crambids, Pyralids and Tortricids constituted an important proportion of the total collection made. Most of the wild stem borer species were recovered from limited number of hosts. According to Hermsmeier *et al.* (2001), such specialist species are more likely to adapt to the toxic compounds they encounter. Distribution and abundance of some wild stem borer species may thus be attributed to their adaptations to overcome plant defences. However, some of the wild borer species (*Busseola phaia* Bowden, 1956 and *Sciomesa piscator*) develop easily on maize stems exhibiting a potential to shift and become pests of cultivated cereals. The recent host switch of *E. saccharina* from sedges to sugar cane in South Africa where it became the key pest (Atkinson 1980) confirms this assumption. *E. saccharina* was only found on wild plants during this study though it is an important pest of maize in West Africa (Bosque-Perez & Mareck 1990). Nonetheless, it could be a major threat to maize crops in Kenya if it eventually shifts to cultivated fields.

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