UNIVERSIDADE
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Faculdade de Agronomia e Engenharia Florestal

MONITORING REPORT OF *Zeugodacus cucurbitae* IN MOZAMBIQUE



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I. INTRODUCTION

1.1 Background

The melon fly, *Zeugodacus cucurbitae* (Coquillett) (Diptera: Tephritidae), is one of approximately 250 tephritid species of economic importance worldwide (Vayssiéres, 1998; Virgílio *et al*., 2015). Native to India and invasive in Africa, it is considered one of the main pests attacking cucurbits such as cucumber, watermelon, melon, and squash. In Africa, it has been detected in countries such as Benin, Burkina Faso, Seychelles, Democratic Republic of Congo, Ethiopia, Malawi, Cameroon, Burundi, Gambia, Guinea, Ivory Coast, Mali, Niger, Nigeria, Senegal, Togo, Kenya, Sudan, Tanzania, Uganda, and Mozambique (De Meyer e*t al*., 2007; Cugala *et al*., 2013; De Meyer *et al*., 2015).

In Mozambique, the species was first detected in 2013 in the village of Mocimboa da Praia in Cabo Delgado province near the border with Tanzania, with four individuals identified (Cugala *et al*., 2013). When present in cucurbit production fields, the melon fly can cause punctures in the fruits which serve as entry points for bacteria and fungi which can cause premature fruit drop, resulting in yield losses (both in quality and quantity) estimated at 53-100% (Abro *et al*., 2017, Ekesi *et al*., 2016, De Meyer *et al*., 2015).

The movement of cucurbit fruits from regions where *Zeugodacus cucurbitae* occurs is the main type of dispersal to previously unaffected areas, which is why the country is currently facing an imminent threat of the species dispersion. Additionally, *Z. cucurbitae* is a quarantine species in several countries, and as such, phytosanitary barriers are imposed that prevent the importation of the melon fly host products from areas with confirmed occurrence of the pest, leading to restrictions on the export of plant products from areas where the species occurs (De Meyer *et al*., 2015).

Since 2013, no studies have been conducted to update data on the dispersion of *Zeugodacus cucurbitae* in the country. Therefore, within the framework of the projects (1) "Establishment and maintenance of fruit production areas free and with low prevalence of fruit flies in Southern Africa" funded by the Standards Trade Development Facility (STDF) and (2) Agroecological methologies for vegetable crops (Agroveg) funded by the Belgium Directorate General Development Cooperation (DGD), monitoring activities for the melon fly were carried out throughout the country, and the results are reported in this document.

This information is useful to alert decision-makers and producers about the possible need to develop control measures to prevent economic damage to horticultural crops and negative impacts on their trade, as they are known to be part of the list of crops attacked by the melon fly.

1.2 Objectives

1.2.1 Overall Objective

- Describe the distribution of *Zeugodacus cucurbitae* in Mozambique.

1.2.2 Specific Objectives

- Estimate the absolute and relative abundance of the melon fly (*Zeugodacus cucurbitae*).
- Determine the population density of the melon fly (*Zeugodacus cucurbitae*).
- Determine the percentage of positive occurrences of *Zeugodacus cucurbitae* throughout the sampling months.

II. THEORETICAL FRAMEWORK

2.1. Generalities

Zeugodacus cucurbitae belongs to the Kingdom: Animal, Phylum: Arthropoda, Subphylum: Hexapoda, Class: Insecta, Order: Diptera, Family: Tephritidae, Genus: Zeugodacus, and Species: cucurbitae.

The life cycle of *Zeugodacus cucurbitae* consists of four different stages of development, namely: egg, larva, pupa, and adult (Figure 1). In tropical climates such as Mozambique, its life cycle has an average duration of 21 to 30 days (Ekesi and Billah, 2007). The eggs are laid beneath the fruit's skin, from which whitish larvae hatch (after 1-3 days) and feed on the pulp of the host fruit, causing it to decay with the aid of bacteria and fungi that infest the tissues around the oviposition site. About 10 days later, the larvae leave the fruit and pupate in the soil under the host plant for 7-13 days. After pupation, the adults emerge, reaching sexual maturity approximately 10-12 days later.

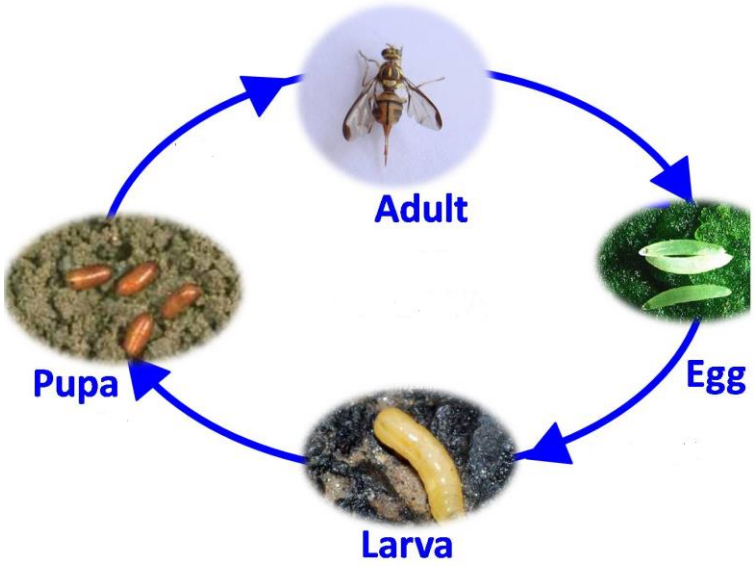
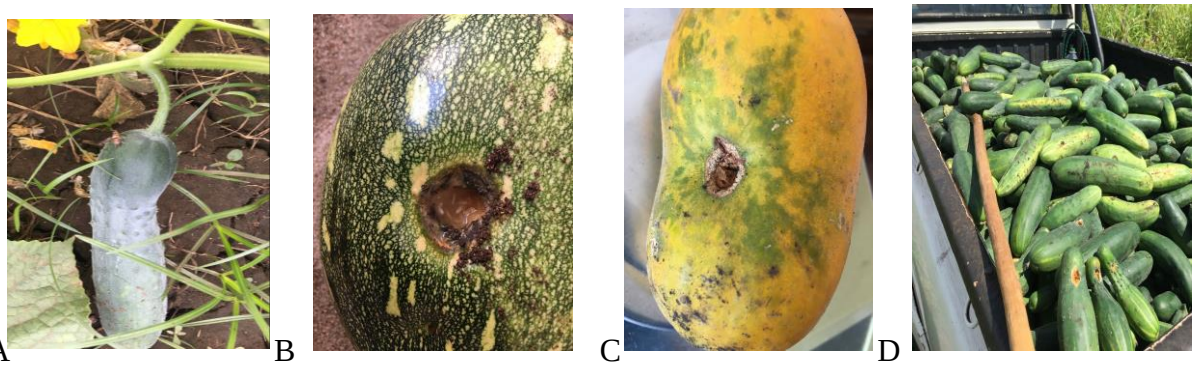


Figure 1. Diagram representing the development stages of cucurbit fruit flies

The adult is a fly, with characteristic wing patterns and the thorax displaying light yellow spots (Figure 2). They are strong fliers and feed on decomposing fruit juices, nectar, bird feces, and plant sap (De Meyer *et al*., 2015).

Figure 2. Adult the melon fly, *Zeugodacus cucurbitae* (Source: Flickr).

Infested fruits exhibit oviposition holes, larvae inside the fruit, and the surrounding tissue around the oviposition site decays (Figure 3). Under these conditions, the fruit loses its commercial quality.



A B C D

Figure 3. Fruit fly infesting cucumber (a); different cucurbits infested by fruit flies (b and c); cucumber with symptoms of fruit fly infestation (d).

Nasiruddin *et al.* (2004) found that the degree of susceptibility to fruit fly infestation varies depending on the species of cucurbit being considered. Infestation studies on cucurbits in Kenya demonstrated that *Momordica charantia* had the highest infestation rate at 66.8%, followed by other cucurbits such as *Citrullus lanatus* (60.6%), *Cucumis sativus* (30.2%), *Cucurbita maxima* (28.8%), *Cucurbita moschata* (16.2%), *Cucurbita pepo* (12.8%), and *Cucumis melo* (10.4%) (Kambura, 2016).

In Cameroon, the infestations were more significant in *Sechium edule* (72.49%), *Cucurbita moschata* (34.18%), *Cucumis sativus* (31.18%), and *Cucumis melo* (31.15%) in Yaoundé, and in *S. edule* (37.08%), *Citrullus lanatus* (59.66%), *Cucumis melo* (55.59%), *Cucumis sativus* (42.30), and *Cucurbita moschata* (30.25%) in Koutaba (Mokam *et al*., 2018). According to

Nasiruddin *et al*. (2004), the incidence of melon fly attack can reach high infestation indices, ranging from 88 pupae/kg to 325.3 pupae/kg of fruit in cucumber, 179 pupae/kg to 718.25 pupae/kg in zucchini, and 333 pupae/kg to 681.92 pupae/kg in pumpkin (Kambura, 2016, and Kambura *et al*., 2018).

In Mozambique-Manica province the highest infestation indices were verified in *Cucurbita moschata* (butternut) (58.1 pupae/kg), *Cucurbita pepo* (zucchini) (55.4 pupae/kg) and *Cucumis sativus* (cucumber) (26.1 pupae/kg), respectively. *Cucurbita maxima* and *Citrullus lanatus* were the least infested hosts (Mussumbe *et al*., 2023). From this reared cucurbit emerged 14 species where *D. ciliatus* and *D. bivittatus* was the most abundant in all host, especially in cucumber. So far, specimes of *Z. cucurbitae* were only captured in traps.

2.2. Hosts

Melon fly is considered a pest for more than 125 fruit species (table 1 and see the list of hosts in Annex 1). However, plants belonging to the Cucurbitaceae family are considered the preferred host, particularly melon (*Cucumis melo*), cucumber (*Cucumis sativus*), pumpkin (*Cucurbita spp.*), and a variety of gourds (e.g., Coccinia and Momordica spp.) (Ekesi & Billah, 2007).

Table 1. Main Host plants of melon fruit fly, *Zeugodacus cucurbitae*, reported from Africa

Family	**Scientific name**	**Common name**	**Reference**
Anacardiaceae	*Anacardium occidentale* L.	Cashew	Vayssières et al. 2007
Anacardiaceae	*Mangifera indica* L.	Mango	Mwatawala et al. 2010; Quilici and Jeuffrault 2001
Annonaceae	*Annona senegalensis* Pers.	Wild Custard Apple	Vayssières et al. 2007
Cucurbitaceae	*Citrullus colocynthis* (L.)	Bitter cucumber	Vayssières 1999; Quilici and Jeuffrault 2001
Cucurbitaceae	*Citrullus lanatus* (Thunb.)	Watermelon	Vayssières et al. 2007; Mwatawala et al. 2010; Vayssières 1999; Quilici and Jeuffrault 2001
Cucurbitaceae	*Coccinia grandis* (L.) Voigt	Ivy Gourd	White 2006; Copeland et al. 2009; Mwatawala et al. 2010; Vayssières 1999; Quilici and Jeuffrault 2001
Cucurbitaceae	*Cucumeropsis mannii Naud.*	White seed melon	*Vayssières et al. 2007*
Cucurbitaceae	*Cucumis anguria* L.	Maroon cucumber	Vayssières 1999; Quilici and Jeuffrault 2001
Cucurbitaceae	*Cucumis dipsaceus* Ehrenb. ex Spach	Arabian cucumber	White 2006; Copeland et al. 2009; Mwatawala et al. 2010
Cucurbitaceae	*Cucumis ficifolius* A. Rich	Cucumis?	Copeland et al. 2009
Cucurbitaceae	*Cucumis melo* L.	Melon	Vayssières et al. 2007; Mwatawala et al. 2010; Vayssières 1999; Quilici and Jeuffrault 2001

Cucurbitaceae	*Cucumis sativus* L.	Cucumber	White 2006; Copeland et al. 2009; White 2006; Mwatawala et al. 2010; Vayssières et al. 2007; Sookar et al. 2012; Vayssières 1999
Cucurbitaceae	*Cucurbita maxima* Duchesne ex Lam.	Pumpkin	Vayssières et al. 2007; Sookar et al. 2012; Vayssières 1999
Cucurbitaceae	*Cucurbita moschata* Duchesne	Butternut squash	Tanzania: Mwatawala et al. 2010
Cucurbitaceae	*Cucurbita pepo* L.	Courgette, zucchini	Vayssières et al. 2007; Sookar et al. 2012; Vayssières 1999
Cucurbitaceae	*Cyclanthera pedata* (L.) Schrader	Caigua	Vayssières 1999; Quilici and Jeuffrault 2001
Cucurbitaceae	*Diplocyclos palmatus* (L.)	Native bryony, Striped cucumber.	White 2006; Copeland et al. 2009
Cucurbitaceae	*Kedrostis leloja* (J.Gmel.) C.Jeffrey	baboon cucumber?	White 2006; Copeland et al. 2009
Cucurbitaceae	*Lagenaria leucaritha* (Dush) Pusby	Calabash	Quilici and Jeuffrault 2001
Cucurbitaceae	*Lagenaria sphaerica* (Sond.) Naudin	Wild melon	Quilici and Jeuffrault 2001; Vayssières 1999
Cucurbitaceae	*Lagenaria siceraria* (Molina) Standl.	Bottle Gourd, Calabash Gourd	Vayssières et al. 2007; Mwatawala et al. 2010; Vayssières 1999
Cucurbitaceae	*Luffa acutangula* (L.) Roxb.	Angled Loofah, Ridged Gourd, Chinese Okra	Mwatawala et al. 2010;Quilici and Jeuffrault 2001; Vayssières 1999
Cucurbitaceae	*Luffa cylindrica* M.Roem.	Vegetable Sponge Gourd	Vayssières et al. 2007; Quilici and Jeuffrault 2001;Vayssières 1999
Cucurbitaceae	*Momordica charantia* L.	Bitter melon, Bitter Gourd	White 2006; Vayssières et al. 2007; Mwatawala et al. 2010; Quilici and Jeuffrault 2001; Vayssières 1999
Cucurbitaceae	*Momordica foetida* Schumach.	Gifappel	White 2006; Copeland et al. 2009; Mwatawala et al. 2010
Cucurbitaceae	*Momordica rostrata* A. Zimm.	Snake fruit?	Copeland et al. 2009; Mwatawala (pers.observations)
Cucurbitaceae	*Momordica trifoliata* Hook. f.		White 2006; Copeland et al. 2009; Mwatawala et al. 2010
Cucurbitaceae	*Sechium edule* (Jacq.) Sw	Chayote, Vegetable pear, Mango Squash	Quilici and Jeuffrault 2001; Vayssières 1999
Cucurbitaceae	*Trichosanthes cucumerina* L.	Snake Gourd	Quilici and Jeuffrault 2001; Vayssières 1999
Cucurbitaceae	*Telfairia occidentalis* Hook	fluted gourd, fluted pumpkin	Vayssières et al. 2007
Cannellaceae	*Warburgia ugandensis* Sprague	Ugandan greenheart	Munro 1984
Caricaceae	*Carica papaya* L.	Papaya	Mwatawala et al. 2010
Passifloraceae	*Passiflora edulis* Sims	Passion Fruit	Vayssières 1999; Quilici and Jeuffrault 2001
Rutaceae	*Citrus reticulata* Blanco	Mandarin orange	Vayssières et al. 2007
Rutaceae	*Citrus sinensis* Osbeck	Sweet orange	Vayssières et al. 2007
Solanaceae	*Capsicum annuum* L. var. *longum* DC	Bell pepper	Mwatawala et al. 2010.
Solanaceae	*Capsicum frutescens* L.	Chilli Padi	Vayssières et al. 2007
Solanaceae	*Solanum lycopersicum* L.	Tomato	Vayssières 1999; Mwatawala et al. 2010

Solanaceae	*Solanum aethiopicum* L.	Ethiopian eggplant, The Bitter Tomato	Mwatawala et al. 2010
Solanaceae	*Solanum anguivi* Lam.	Forest bitterberry	Mwatawala et al. 2010
Solanaceae	*Solanum macrocarpon* L.	African eggplant	Mwatawala et al. 2010
Solanaceae	*Solanum nigrum* L.	Black nightshade	Mwatawala et al. 2010

Main source: De Meyer *et al*., 2015

Although the low preference for hosts outside the cucurbit family has a limited impact on observed losses, the mere presence of commercial hosts such as mango (*Mangifera indica* L.) and citrus (*Citrus spp*.) in areas infested by *Z. cucurbitae* can result in export restrictions on certain agricultural products (De Meyer *et al*., 2015).

III. METHODOLOGY

Traps for monitoring melon fly were installed in the following provinces and districts: Maputo (Matutuíne, Boane, Namaacha, Moamba, Manhiça, and Maputo city), Gaza (Bilene, Xai-xai, and Mandlakaze), Inhambane (Zandamela, Zavala, Inharrime, Maxixe, Jangamo, Morrubene, Vilanculo, Govuro, and Inhassoro), Manica (Chimoio, Messica, Manica, Barue, Vanduzi, Guro, Sussundenga, Macate, and Gondola), Sofala (Caia, Dondo, Beira, Nhamatanda, Chibabava, Caia, Chemba, Gorongosa, and Machanga), Tete (Tete, Moatize, Angonia, Changara), Zambézia (Quelimane, Nicoadala, Milange, Namacura, and Mocuba), Niassa (Lichinga, Chimbonila, Ngauma, Mandimba, Lago, and Cuamba), Nampula (Malema and Ribaue), Cabo Delgado (Pemba, Montepeuz, Metuge, Ancuabe, and Chiure) (Figure 4 and Annex 2 - sampling points and their coordinates).

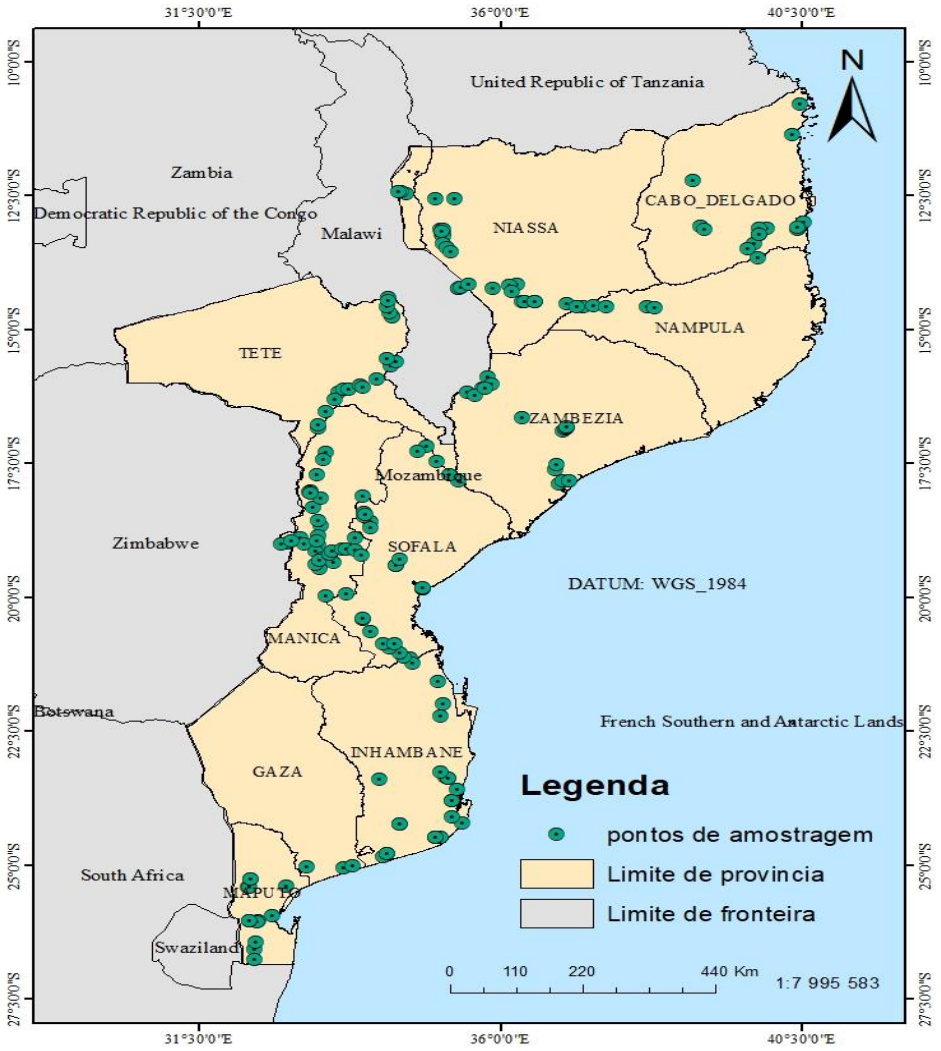


Figure 4. Map showing the sampling points in Mozambique.

The monitoring activities were conducted from May 2021 to May 2023 to assess the presence or absence of *Z. cucurbitae* at each sampling location, as well as its abundance and density. The monitoring was performed according to the procedures described by the International Atomic Energy Agency (IAEA, 2003) and ISPM No. 26 (FAO, 2006).

The selection of trap placement points was based on the criteria of high to medium risk of invasion by *Z. cucurbitae*, focusing on fruit production areas, fruit trading areas (markets), villages, main roads, border entry points, and natural vegetation. At each location, 1 to 3 "Tephri" traps were installed, containing a cuelure pheromone (CUE) and an insecticide stip of DDVP: 2,2-dichlorovinyl dimethyl phosphate to kill any attracted insects (Figure 5). The cuelure pheromone (CUE) allows for the capture of a large number of species from the Bactrocera and Dacus genera.

Figure 5. Tephri trap baited with cuelure hanged in a potential host fruit tree.

A total of 197 traps were installed throughout the country and inspected once a month in the provinces of Maputo, Gaza, Inhambane, Manica, and Sofala due to either the absence of melon fly captures or low captures. In areas with high captures, monitoring was conducted only once (Tete, Zambézia, Cabo Delgado, Nampula). During the monitoring, the captured insects were removed from the traps and placed in vials containing 70% ethanol. At the same time, the attractant and insecticide were replaced, in the cases of regular monitoring.

The specimens were identified in the Entomology laboratory of the Faculty of Agronomy and Forestry Engineering, with the assistance of a magnifying glass and the dichotomous key of Ekesi & Billah (2007), which is based on morphological characteristics.

The identified specimens were separated by species, counted, and the following parameters were determined:

(a) Total abundance (total number of individuals of species X)

(b) Relative abundance (proportion of species X relative to the total number of captured adults)

(c) For melon flies only, the population density, which is the average number of flies per trap per day (MAD) was calculated (Equation 1). This indicates the average number of target species flies captured per trap per day during a specific period in which the trap was exposed in the field (IAEA, 2018). The purpose of this population index is to provide a comparative measure of the adult pest population size in a specific space and time.

$$MAD=\frac{M}{DxA}$$ **Equation 1**

Where:

MAD = fly/trap/day;

M = total number of flies captured;

A = total number of evaluated traps;

D = time interval (days) that the trap was in the field.

MAD indicates different levels of fruit fly infestation in a given location. When MAD > 1, the area is considered infested; 1 < MAD > 0 indicates an area of low prevalence, and MAD = 0 indicates an area free of or not infested by the species in question (Cugala, 2008).

(d) The percentage of positive occurrences of *Z. cucurbitae* per month was obtained by the proportion between the number of *Z. cucurbitae* detections (districts with density greater than zero) and the total number of sampled districts.

IV. RESULTS

During the fieldwork period, the traps with cuelure attracted 15 species of fruit flies, belonging to 2 genera: Dacus (14) and Zeugodacus (1). Among these, only *Zeugodacus cucurbitae* is invasive in Africa and Mozambique, accounting for 4.08% (3462 adults) of the total captured species (Figure 6).

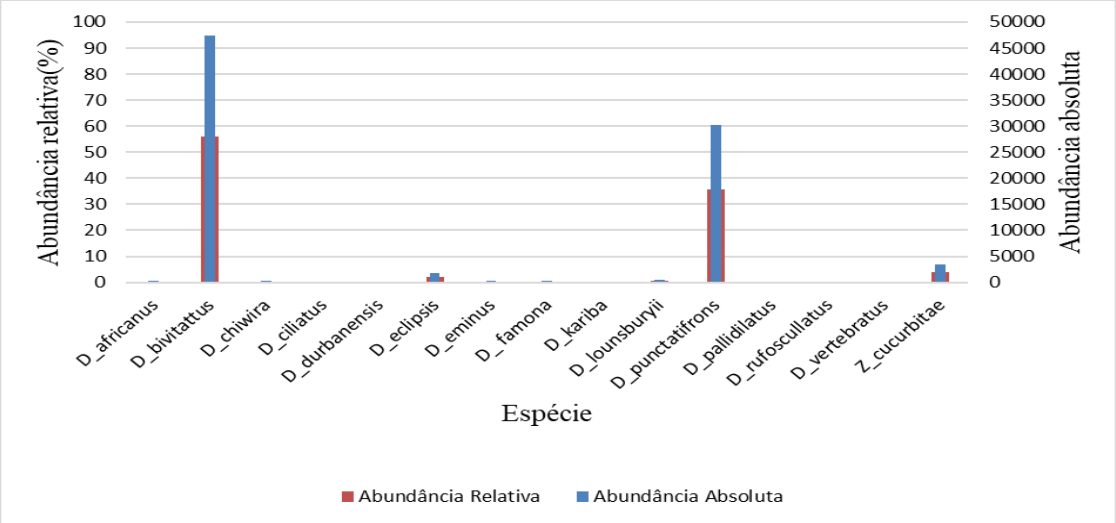


Figure 6. Relative abundance of cuelure attracted species.

Z. cucurbitae, was detected in Cabo Delgado, Niassa, Nampula, Zambezia, Tete, Manica and Sofala provinces (table 2).

Table 2. *Z. cucurbitae* detection points from April 2021 to May 2023.

Province	District	Locality
Cabo delgado	Montepuez	Mapupuilo
		Sede
		Ninuapa
Niassa	Lagos	Metangula
	Cuamba	Macoropa
		Rio Lurio
Nampula	Malema	Malema
		Muesse
		Mutuale
Zambezia	Mocuba	Alto Benfica
	Milange	Sede
		Chitambo
		Chitambo sede
		Zalimba
		Vulalo
Tete	Tete	Cidade
	Moatize	N'condezi
		Sede
		Caunge
		Cateme
		Mussacama
		Zobue

	Angonia	Ulongue
	Changara	Sede
Manica	Gondola	Zimpinga
		Inchope*
	Messica	Sede
	Manica	Sede
	Manica	Machipanda
	Manica	Penhalonga
	Vanduzi	Sede
	Barue	Honde
		Catandica
	Guro	Sede
	Macate	Zembe
Sofala	Sena	sede
	Chiramba	Chiramba sede
	Gorongosa	Pungue

The highest capture density was observed in Niassa province, specifically in Lago district, followed by Tete province in Moatize district (Table 3).

Table 3. Density of *Zeugodacus cucurbitae* from April 2021 to May 2023 (S/M= no service; P/D= under identification)

Provincia	Distrito	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21	Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23
Cabo Delgado	Pemba	S/M	0	S/M	0	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M
	Metuge	S/M	0	S/M	0	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M
	Ancuabe	S/M	0	S/M	0	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M
	Chiure	S/M	0	S/M	0	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M
	Montepuez	S/M	0.36029	S/M	0.5294	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M
Niassa	Lichinga	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	0	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M
	Chimbunila	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	0	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M
	Ngauma	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	0	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M
	Mandimba	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	0	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M
	Lagos	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	4.530303	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M
	Cuamba	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	0.464286	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M
Nampula	Malema	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	1.10381	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M
	Ribaue	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	0	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M
Zambezia	Quelimane	S/M	0	0	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M
	Nicoadala	S/M	0	0	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M
	Namacurra	S/M	0	0	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M
	Mocuba	S/M	0	0.027027	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M
	Milange	S/M	0.08352	0.115741	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M
Tete	Tete	S/M	S/M	S/M	1.5143	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M
	Moatize	S/M	S/M	S/M	2.8234	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M
	Angonia	S/M	S/M	S/M	0.0571	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M
	Changara	S/M	S/M	S/M	0.4714	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M
Manica	Chimoio	S/M	0	S/M	0	0	S/M	0	0	0	0	0	0	0	0	0	S/M	0	S/M	0	S/M	0	S/M	0	S/M	0	P/D
	Gondola	S/M	0	S/M	0	0	S/M	0	0	0	0	0	0	0	0	0	S/M	0	S/M	0	S/M	0	S/M	0.038462	S/M	0.003571	0.1
	Vanduzi	S/M	0	0.03	0	0.012346	S/M	0	0	0	0	0	0	0	0	0	S/M	0	S/M	0.006452	S/M	0	S/M	0.042424	S/M	0	P/D
	Manica	S/M	0.00833	S/M	0	0	S/M	0.004651	0	0	0	0.027273	0.028571	0.012903	0	0.015	S/M	0.021429	S/M	0	S/M	0.005	S/M	0.025362	S/M	0	P/D
	Barue	S/M	0	0.006667	0.0222	0.012346	S/M	0.016667	0	0	0	0	0.011905	0	0.005376	0	S/M	0.032164	S/M	0	S/M	0.358491	S/M	0.027778	S/M	0.015625	P/D
	Guro	S/M	0	0	0.0667	0	S/M	0.02	0	0.012195	0	0.018519	0.053571	0.064103	0.032258	0	S/M	0.131579	S/M	0	S/M	0	S/M	0.060606	S/M	0	P/D
	Macate	S/M	0	S/M	0	0	S/M	0	0	0	0	0	0	0	0	0	S/M	0	S/M	0.119048	S/M	0	S/M	0	S/M	0.011111	P/D
	Sussundenga	S/M	0	S/M	0	0	S/M	0	0	0	0	0	0	0	0	0	S/M	0	S/M	0	S/M	0	S/M	0	S/M	0	P/D
	Messica	S/M	0	0	0	0	S/M	0	0	0	0	0	0	0	0.029412	0	S/M	0	S/M	0.111111	S/M	0.08	S/M	0.086957	S/M	0.043478	P/D
Sofala	Caia (Sena)										S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	0.222222
	Gorongosa										S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	3.230769
	Chemba	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	0.087	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	0.230769
	Machanga	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	0	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M
	Chibabava	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	0	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M
	Nhamatanda	S/M	0	S/M	0	0	S/M	0	0	0	0	0	0	0	0	0	S/M	0	S/M	0	S/M	0	S/M	0	S/M	0	P/D
	Dondo	S/M	0	S/M	0	0	S/M	0	0	0	0	0	0	0	0	0	S/M	0	S/M	0	S/M	0	S/M	0	S/M	0	P/D
	Beira	S/M	0	S/M	0	0	S/M	0	0	0	0	0	0	0	0	0	S/M	0	S/M	0	S/M	0	S/M	0	S/M	0	P/D
Inhambane	Zavala	0	0	0	S/M	S/M	S/M	0	0	0	0	0	0	0	0	0	S/M	0	S/M	0	S/M	0	S/M	0	0	0	0
	Inharrime	0	0	0	S/M	S/M	S/M	0	0	0	0	0	0	0	0	0	S/M	0	S/M	0	S/M	0	S/M	0	0	0	0
	Jangamo	0	0	0	S/M	S/M	S/M	0	0	0	0	0	0	0	0	0	S/M	0	S/M	0	S/M	0	S/M	0	0	0	0
	Maxixe	0	0	0	S/M	S/M	S/M	0	0	0	0	0	0	0	0	0	S/M	0	S/M	0	S/M	0	S/M	0	0	0	0
	Morrumbene	0	0	0	S/M	S/M	S/M	0	0	0	0	0	0	0	0	0	S/M	0	S/M	0	S/M	0	S/M	0	0	0	0
	Vilankulo	0	0	0	S/M	S/M	S/M	0	0	0	0	0	0	0	0	0	S/M	0	S/M	0	S/M	0	S/M	0	0	0	0
	Govuro	0	0	0	S/M	S/M	S/M	0	0	0	0	0	0	0	0	0	S/M	0	S/M	0	S/M	0	S/M	0	0	0	0
	Inhassoro	0	0	0	S/M	S/M	S/M	0	0	0	0	0	0	0	0	0	S/M	0	S/M	0	S/M	0	S/M	0	0	0	0
Gaza	Mandlakaze	0	0	0	S/M	S/M	S/M	0	0	0	0	0	0	0	0	0	S/M	0	S/M	0	S/M	0	S/M	0	0	0	0
	Zandamela	0	0	0	S/M	S/M	S/M	0	0	0	0	0	0	0	0	0	S/M	0	S/M	0	S/M	0	S/M	0	0	0	0
Maputo	Matutuine	0	0	0	0	S/M	0	0	0	0	0	0	0	0	0	0	S/M	0	S/M	0	S/M	0	S/M	0	0	0	0
	Boane	0	0	0	0	0	S/M	0	0	0	0	0	0	0	0	0	S/M	0	S/M	0	S/M	0	S/M	0	0	0	0
	Namaacha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	S/M	0	S/M	0	S/M	0	S/M	0	0	0	0
	Moamba	0	0	0	S/M	S/M	S/M	0	0	0	0	0	0	0	0	0	S/M	0	S/M	0	S/M	0	S/M	0	0	0	0
	Maputo city	0	0	0	S/M	S/M	0	0	0	0	0	0	0	0	0	0	S/M	0	S/M	0	S/M	0	S/M	0	0	0	0
	Manhica	0	0	0	S/M	S/M	S/M	0	0	0	0	0	0	0	0	0	S/M	0	S/M	0	S/M	0	S/M	0	0	0	0
	Bilene	0	0	0	S/M	S/M	S/M	0	0	0	0	0	0	0	0	0	S/M	0	S/M	0	S/M	0	S/M	0	0	0	0
	Xai-xai	0	0	0	S/M	S/M	S/M	0	0	0	0	0	0	0	0	0	S/M	0	S/M	0	S/M	0	S/M	0	0	0	0

Districts with an average number of flies per trap per day (MAD) greater than 1 were considered infested areas, while a MAD ranging from 0 to 1 indicated areas with low prevalence. Maputo, Gaza, and Inhambane provinces had a MAD of 0, indicating that they were free or not infested areas (Table 4).

Tabela 4. Pest status de *Z. cucurbitae* in Mozambique

Provincia	**Distrito**	**Pest status**	**Last sampling date**
Cabo Delgado	Pemba	Pest free area	July 2021
	Metuge	Pest free area	July 2021
	Ancuabe	Pest free area	July 2021
	Chiure	Pest free area	July 2021
	Montepuez	Area of low pest prevalence	July 2021
Niassa	Lichinga	Pest free area	May 2022
	Chimbunila	Pest free area	May 2022
	Ngauma	Pest free area	May 2022
	Mandimba	Pest free area	May 2022
	Lagos	Infested area	May 2022
	Cuamba	Area of low pest prevalence	May 2022
Nampula	Malema	Infested area	May 2022
	Ribaue	Pest free area	May 2022
Zambezia	Quelimane	Pest free area	June 2021
	Nicoadala	Pest free area	June 2021
	Namacurra	Pest free area	June 2021
	Mocuba	Area of low pest prevalence	June 2021
	Milange	Area of low pest prevalence	June 2021
Tete	Tete	Infested area	July 2021
	Moatize	Infested area	July 2021
	Angonia	Area of low pest prevalence	July 2021
	Changara	Area of low pest prevalence	July 2021
Manica	Chimoio	Pest free area	April 2023
	Gondola*	Area of low pest prevalence	May 2023
	Vanduzi	Area of low pest prevalence	April 2023
	Manica	Area of low pest prevalence	April 2023
	Barue	Area of low pest prevalence	April 2023
	Guro	Area of low pest prevalence	April 2023
	Macate	Area of low pest prevalence	April 2023
	Sussundenga	Pest free area	April 2023
	Messica	Area of low pest prevalence	April 2023
Sofala	Chemba	Area of low pest prevalence	May 2023
	Caia	Area of low pest prevalence	May 2023
	Gorongosa	Infested area	May 2023
	Machanga	Pest free area	May 2022

	Chibabava	Pest free area	May 2022
	Nhamatanda	Pest free area	May 2022
	Dondo	Pest free area	May 2022
	Beira	Pest free area	May 2022
Inhambane	Zavala	Pest free area	April 2023
	Inharrime	Pest free area	April 2023
	Jangamo	Pest free area	April 2023
	Maxixe	Pest free area	April 2023
	Morrumbene	Pest free area	April 2023
	Vilankulo	Pest free area	April 2023
	Govuro	Pest free area	April 2023
	Inhassoro	Pest free area	April 2023
Gaza	Mandlakaze	Pest free area	April 2023
	Zandamela	Pest free area	April 2023
Maputo	Matutuine	Pest free area	April 2023
	Boane	Pest free area	April 2023
	Namaacha	Pest free area	April 2023
	Moamba	Pest free area	April 2023
	Maputo cidade	Pest free area	April 2023
	Manhica	Pest free area	April 2023
	Bilene	Pest free area	April 2023
	Xai-xai	Pest free area	April 2023

*Detection at vila de Inchope in May 2023. Other detection in Gondola was at Zimpinga (Amatongas centro in February of 2023).

The map below shows the representation of population density based on three infestation levels: i) green-colored areas symbolize infestation-free locations where no *Zeugodacus cucurbitae* captures were made, ii) yellow-colored areas represent low prevalence areas where the average number of flies captured per trap per day (MAD) falls within the range of 0 to 1, and iii) red-colored areas indicate infested locations where MAD was higher than 1 (figure 7).

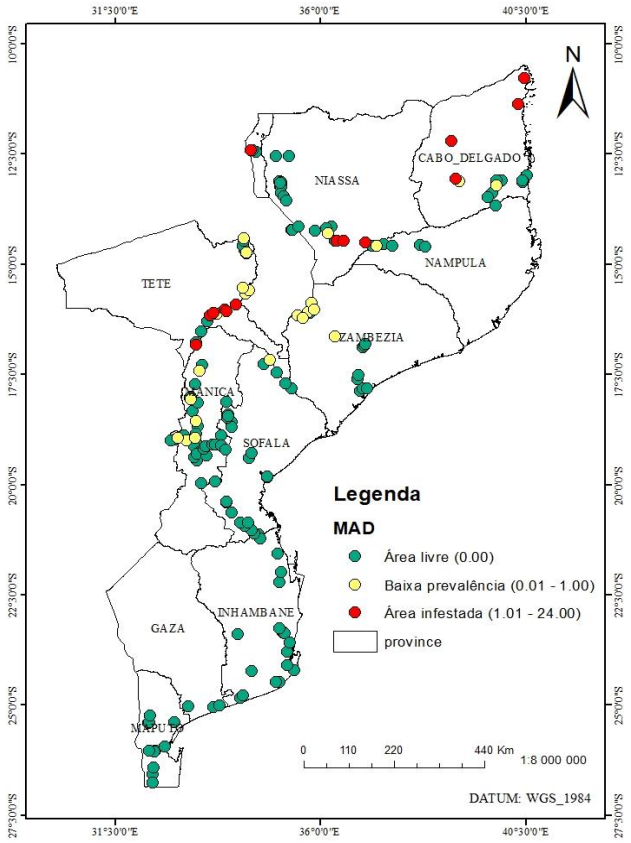
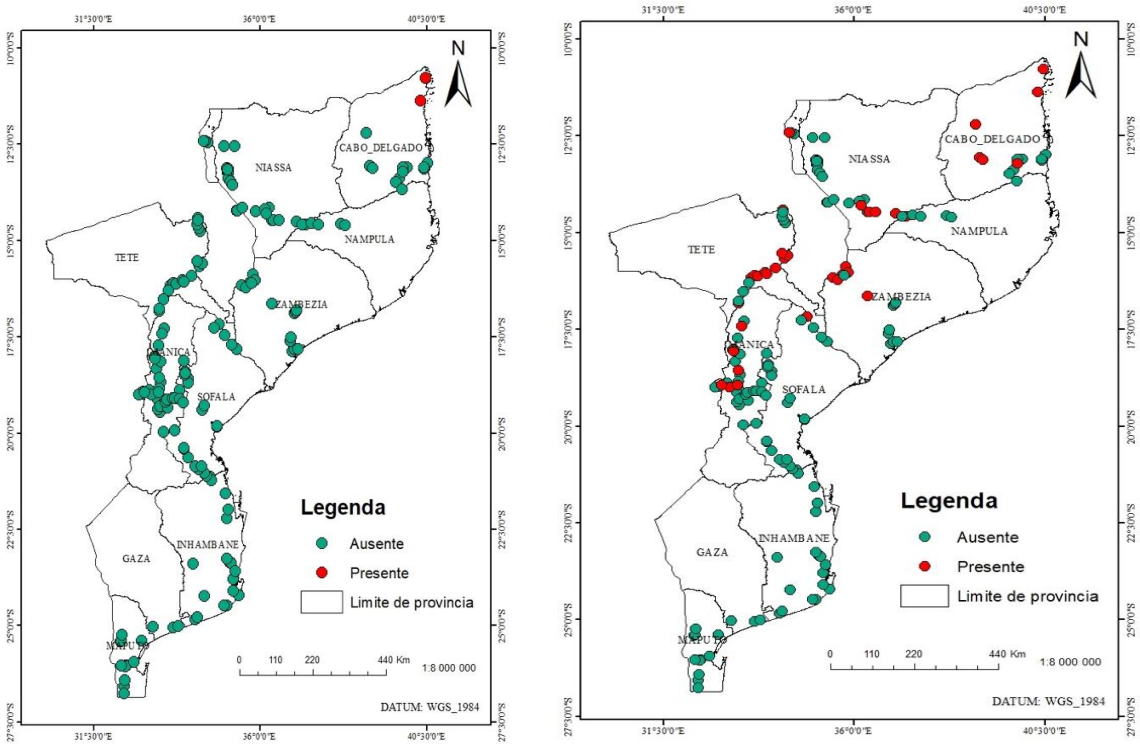


Figura 7. *Z. cucurbitae* pest status in Mozambique, until May 2023.

The evolution of *Z. cucurbitae* occurrence over time shows that the species, initially detected in Cabo Delgado province in the Mocimboa da Praia district, is spreading to other provinces and districts towards the southern part of the country (Figure 8).



2013 2023

Figure 8. Distribuição espacial de *Z. cucurbitae* em Moçambique de 2013 a 2023.

Regardless of the location of each trap, the months of June 2021, May 2022, February 2023, April 2023, and May 2023 showed positive cases (i.e., confirmed capture of *Z. cucurbitae*) in more than 20% of the sampled districts (Figure 9). Remarkably, the year 2023, although still in the first half, recorded a higher percentage of positive cases, providing further evidence of its increased dispersal.

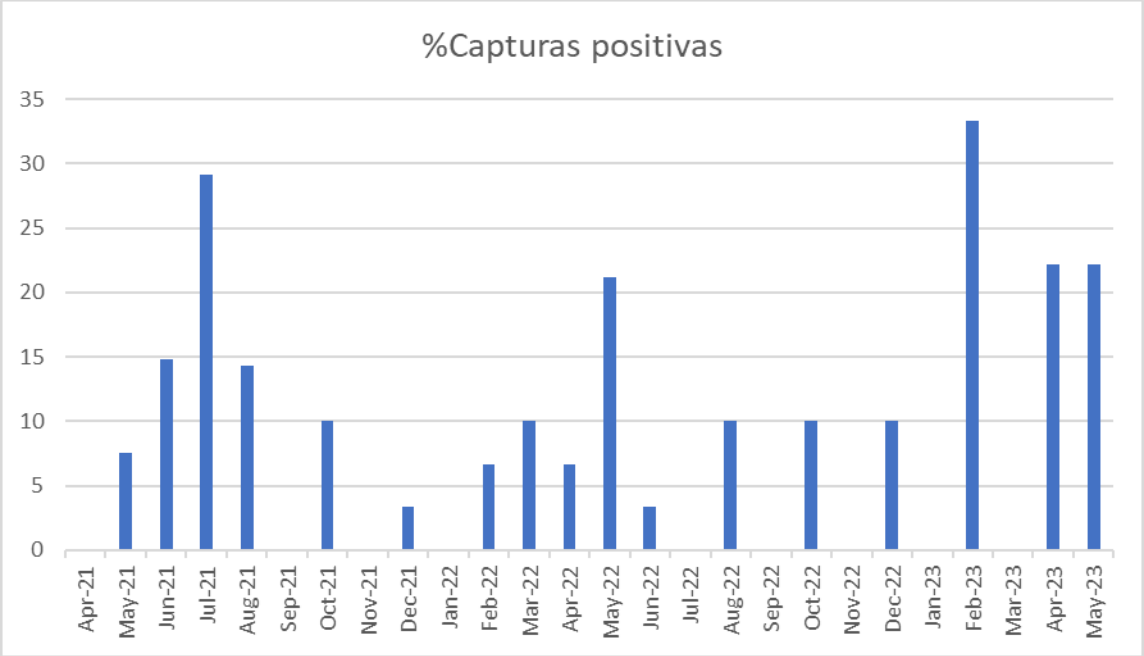


Figure 9. Percentage of positive detection of *Z.cucurbitae* when compared to the all sampled locations.

V. CONCLUSIONS

The monitoring conducted in this study shows that the population of *Zeugodacus cucurbitae* has increased and spread to other locations beyond Cabo Delgado. Its presence has been detected in new areas, namely in the provinces of Niassa, Nampula, Zambezia, Tete, Manica, and Sofala. The southernmost detection was reported in the Gondola district, Inchope village, with a density of 0.1 *Z. cucurbitae*/trap/day. Since the beginning of the monitoring activities in April 2021 until the present moment in May 2023, no adult *Z. cucurbitae* have been captured in the provinces of Inhambane, Gaza, and Maputo. Therefore, these data have provided sufficient evidence to declare those provinces as areas free from *Z. cucurbitae*. However, it is urgent to implement control measures to prevent its spread to these free areas.

IV. RECOMMENDATIONS

- Design a national action plan.
- Official notification of the occurrence of *Z. cucurbitae*.
- Establish a national monitoring program for *Z. cucurbitae*.
- Implement control/eradication measures for *Z. cucurbitae*.

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APPENDICES

Annex 1- Host list of *Zeugodacus cucurbitae* in tropical and subtropical regions

Specie	**Family**	**Specie**	**Family**
Allium cepa	Rutaceae	*Cyphomandra crassicaulis*	Solanaceae
Annona senegalensis	Annonaceae	*Dimocarpus longan*	Sapindaceae
Annona muricate	Annonaceae	*Dracontomelon dao*	Anacardiaceae
Annona reticulata	Annonaceae	*Dracontomelon sp.*	Anacardiaceae
Annona squamosa	Annonaceae	*Eriobotrya japonica*	Rosaceae
Artocarpus heterophyllus	Moraceae	*Feijoa sellowiana*	Myrtaceae
Brassica juncea	Brassicaceae	*Ficus carica*	Moraceae
Brassica oleracea	Brassicaceae	*Fragaria chiloensis*	Rosaceae
Cajanus cajan	Fabaceae	*Junglans hindsii*	Junglandaceae
Calophyllum inophyllum	Clusiaceae	*Lablab purpureus*	Fabaceae
Capsicum annuum	Solaneceae	*Lagenaria siceraria*	Cucurbitaceae
Capsicum frutescens	Solaneceae	*Luffa acutangular*	Cucurbitaceae
Carica papaya	Caricaceae	*Luffa aegyptiaca*	Cucurbitaceae
Casimiroa edulis	Rutaceae	*Lycopersicum esculentum*	Solaneceae
Chrysophyllum caimito	Sapotaceae	*Malus domestica*	Rosaceae
Chrysophyllum oliviform	Sapotaceae	*Malus pumila*	Rosaceae
Citrullus colocynthis	Cucurbitaceae	*Mangifera indica*	Anacardiaceae
Citrullus lanatus	Cucurbitaceae	*Momordica balsamina*	Cucurbitaceae
Citrus limon	Rutaceae	*Momordica calanthe*	Cucurbitaceae
Citrus maxima	Rutaceae	*Momordica cochinchinensis*	Cucurbitaceae
Citrus reticulata	Rutaceae	*Musa x paradisiaca*	Musaceae
Citrus sinensis	Rutaceae	*Passiflora edulis*	Passifloraceae
Citrus x paradisi	Rutaceae	*Passiflora foetida*	Passifloraceae
Clausena lansium	Rutaceae	*Passiflora laurifolia*	Passifloraceae
Coccinia grandis	Cucurbitaceae	*Passiflora sp.*	Passifloraceae

Cucumis melo	Cucurbitaceae	*Passiflora quadrangularis*	Passifloraceae
Cucumis metuliferus	Cucurbitaceae	*Phaseolus lanatus*	Fabaceae
Cucumis sativus	Cucurbitaceae	*Phaseolus vulgaris*	Fabaceae
Cucurbita maxima	Cucurbitaceae		
Cucurbita moschata	Cucurbitaceae	*Phoenix dactylifera*	Arecaceae
Cucurbita pepo	Cucurbitaceae	*Prunus ameniaca*	Rosaceae
Cydonia oblonga	Rosaceae	*Prunus persica*	Rosaceae
Sechium edule	Cucurbitaceae	*Psidium guajava*	Myrtaceae
Sesbania grandiflora	Fabaceae	*Psidium littorale*	Myrtaceae
Solanum incanum	Solanaeceae	*Pyrus communis*	Rosaceae
Solanum melongena	Solanaceae	*Syzygium samarangense*	Myrtaceae
Strychnos nux-vomica	Loganiaceae	*Trichosanthes pallens*	Cucurbitaceae
Syzygium aqueum	Myrtaceae	*Trichosanthes dioica*	Cucurbitaceae
Triphasia trifolia	Rutaceae		

Annex 2. Sampling points and its gps coordinates

NEW TRAP NUMBER	LAT_DD	LONG_DD	ALT_M	COUNTRY	PROVINCE	DISTRICT
MOZZC001	-24.58403	32.059389	27	MOZAMBIQUE	MAPUTO	MATUTUINE
MOZZC002	-26.43603	32.33975	24	MOZAMBIQUE	MAPUTO	MATUTUINE
MOZZC003	-26.77394	32.335389	25	MOZAMBIQUE	MAPUTO	MATUTUINE
MOZZC004	-26.04467	32.386639	1	MOZAMBIQUE	MAPUTO	BOANE
MOZZC005	-26.06428	32.362056	18	MOZAMBIQUE	MAPUTO	BOANE
MOZZC006	-26.04872	32.254694	40	MOZAMBIQUE	MAPUTO	NAMAACHA
MOZZC007	-26.04178	32.246194	55	MOZAMBIQUE	MAPUTO	NAMAACHA
MOZZC008	-25.41278	32.236583	3	MOZAMBIQUE	MAPUTO	MOAMBA
MOZZC009	-25.40817	32.259972	91	MOZAMBIQUE	MAPUTO	MOAMBA
MOZZC010	-25.25417	32.266083	74	MOZAMBIQUE	MAPUTO	MOAMBA
MOZZC011	-25.25478	32.268389	73	MOZAMBIQUE	MAPUTO	MOAMBA
MOZZC012	-25.95166	32.6032	2	MOZAMBIQUE	MAPUTO	MAPUTO CITY
MOZZC013	-25.40356	32.809778	22	MOZAMBIQUE	MAPUTO	MANHIÇA
MOZZC014	-25.03006	33.101861	36	MOZAMBIQUE	GAZA	BILENE
MOZZC015	-25.05711	33.662167	30	MOZAMBIQUE	GAZA	XAI-XAI
MOZZC016	-25.01706	33.790194	63	MOZAMBIQUE	GAZA	XAI-XAI
MOZZC017	-24.84903	34.253694	100	MOZAMBIQUE	GAZA	MANDLAKAZE
MOZZC018	-24.79519	34.304444	74	MOZAMBIQUE	INHAMBANE	ZANDAMELA
MOZZC019	-24.79519	34.304444	140	MOZAMBIQUE	INHAMBANE	ZAVALA
MOZZC020	-24.47706	35.027222	31	MOZAMBIQUE	INHAMBANE	INHARRIME
MOZZC021	-24.47708	35.027083	78	MOZAMBIQUE	INHAMBANE	INHARRIME
MOZZC022	-24.09731	35.272333	31	MOZAMBIQUE	INHAMBANE	JANGAMO
MOZZC023	-23.79681	35.275083	7	MOZAMBIQUE	INHAMBANE	MAXIXI
MOZZC024	-23.79664	35.275194	15	MOZAMBIQUE	INHAMBANE	MORRUMBENE
MOZZC025	-23.58958	35.346111	43	MOZAMBIQUE	INHAMBANE	MORRUMBENE
MOZZC026	-23.26847	35.116861	57	MOZAMBIQUE	INHAMBANE	VILANCULO
MOZZC027	-21.12381	34.649528	41	MOZAMBIQUE	INHAMBANE	GOVURO
MOZZC028	-21.23386	34.697	62	MOZAMBIQUE	INHAMBANE	GOVURO
MOZZC029	-21.56897	35.069222	-10	MOZAMBIQUE	INHAMBANE	INHASSORO
MOZZC030	-21.99658	35.14625	23	MOZAMBIQUE	INHAMBANE	VILANCULO
MOZZC031	-19.19114	33.456626	705	MOZAMBIQUE	MANICA	CHIMOIO
MOZZC032	-19.13611	33.48798333	711	MOZAMBIQUE	MANICA	CHIMOIO
MOZZC033	-19.08978	33.648572	400	MOZAMBIQUE	MANICA	GONDOLA
MOZZC034	-19.08736	33.70741667	598	MOZAMBIQUE	MANICA	GONDOLA
MOZZC035	-19.11317	33.8289	464	MOZAMBIQUE	MANICA	GONDOLA
MOZZC036	-19.2054	33.9297	275	MOZAMBIQUE	MANICA	GONDOLA
MOZZC037	-19.82964	34.84086111	146	MOZAMBIQUE	SOFALA	NHAMATANDA

MOZZC038	-19.40339	34.43319444	20	MOZAMBIQUE	SOFALA	NHAMATANDA
MOZZC039	-19.40375	34.43369444	43	MOZAMBIQUE	SOFALA	DONDO
MOZZC040	-19.82964	34.84086111	14	MOZAMBIQUE	SOFALA	BEIRA
MOZZC041	-19.82286	34.83536111	20	MOZAMBIQUE	SOFALA	BEIRA
MOZZC042	-19.02969	33.28683333	645	MOZAMBIQUE	MANICA	VANDUZI
MOZZC043	-19.00278	33.073	671	MOZAMBIQUE	MANICA	MESSICA
MOZZC044	-18.9355	32.87825	718	MOZAMBIQUE	MANICA	MANICA
MOZZC045	-18.97636	32.82547222	800	MOZAMBIQUE	MANICA	MANICA
MOZZC046	-19.00531	32.72452778	887	MOZAMBIQUE	MANICA	MANICA
MOZZC047	-18.8836	33.8338	746	MOZAMBIQUE	MANICA	MANICA
MOZZC048	-19.13775	33.24927778	631	MOZAMBIQUE	MANICA	VANDUZI
MOZZC049	-18.9523	33.2645	644	MOZAMBIQUE	MANICA	VANDUZI
MOZZC050	-18.6669	33.3162	515	MOZAMBIQUE	MANICA	VANDUZI
MOZZC051	-18.5556	33.2787	498	MOZAMBIQUE	MANICA	VANDUZI
MOZZC052	-18.3254	33.2023	580	MOZAMBIQUE	MANICA	BARUE
MOZZC053	-18.0574	33.1748	612	MOZAMBIQUE	MANICA	BARUE
MOZZC054	-17.7166	33.2548	675	MOZAMBIQUE	MANICA	BARUE
MOZZC055	-17.4218	33.3523	746	MOZAMBIQUE	MANICA	GURO
MOZZC056	-17.2854	33.404	692	MOZAMBIQUE	MANICA	GURO
MOZZC057	-18.01083	33.16755556	606	MOZAMBIQUE	MANICA	BARUE
MOZZC058	-18.03753	33.15336111	650	MOZAMBIQUE	MANICA	BARUE
MOZZC059	-18.15142	33.31172222	522	MOZAMBIQUE	MANICA	BARUE
MOZZC060	-18.84625	33.27313889	643	MOZAMBIQUE	MANICA	VANDUZI
MOZZC061	-19.27163	33.347506	560	MOZAMBIQUE	MANICA	MACATE
MOZZC062	-19.41311	33.29508333	589	MOZAMBIQUE	MANICA	SUSSUNDENGA
MOZZC063	-19.97603	33.39530556	294	MOZAMBIQUE	MANICA	SUSSUNDENGA
MOZZC064	-19.9345	33.69669444	396	MOZAMBIQUE	MANICA	SUSSUNDENGA
MOZZC065	-19.45511	33.30502778	318	MOZAMBIQUE	MANICA	SUSSUNDENGA
MOZZC066	-19.38465	33.24428	605	MOZAMBIQUE	MANICA	SUSSUNDENGA
MOZZC067	-19.3085	33.30383	579	MOZAMBIQUE	MANICA	MACATE
MOZZC068	-19.2829	34.4964	650	MOZAMBIQUE	MANICA	MACATE
MOZZC069	-19.1972	33.4513	653	MOZAMBIQUE	MANICA	MACATE
MOZZC070	-19.3358	33.5077	556	MOZAMBIQUE	MANICA	MACATE
MOZZC071	-18.87944	33.01427	735	MOZAMBIQUE	MANICA	MANICA
MOZZC072	-17.88303	36.88675	10	MOZAMBIQUE	ZAMBEZIA	QUELIMANE
MOZZC073	-17.81859	36.943563	25	MOZAMBIQUE	ZAMBEZIA	QUELIMANE
MOZZC074	-17.61389	36.825056	27	MOZAMBIQUE	ZAMBEZIA	NICOADALA
MOZZC075	-17.51364	36.842639	30	MOZAMBIQUE	ZAMBEZIA	NICOADALA
MOZZC076	-17.818592	37.027789	42	MOZAMBIQUE	ZAMBEZIA	NAMACURA
MOZZC077	-16.89428	36.942389	146	MOZAMBIQUE	ZAMBEZIA	MOCUBA
MOZZC078	-16.84256	36.981528	162	MOZAMBIQUE	ZAMBEZIA	MOCUBA
MOZZC079	-16.84078	36.98325	163	MOZAMBIQUE	ZAMBEZIA	MOCUBA
MOZZC080	-16.81533	36.993806	137	MOZAMBIQUE	ZAMBEZIA	MOCUBA
MOZZC081	-16.63622	36.320806	478	MOZAMBIQUE	ZAMBEZIA	MOCUBA

MOZZC082	-16.08108	35.738194	638	MOZAMBIQUE	ZAMBEZIA	MILANGE
MOZZC083	-15.88417	35.817833	731	MOZAMBIQUE	ZAMBEZIA	MILANGE
MOZZC084	-16.01972	35.86775	685	MOZAMBIQUE	ZAMBEZIA	MILANGE
MOZZC085	-16.16644	35.515694	592	MOZAMBIQUE	ZAMBEZIA	MILANGE
MOZZC086	-16.22067	35.622194	667	MOZAMBIQUE	ZAMBEZIA	MILANGE
MOZZC087	-16.098	35.766806	684	MOZAMBIQUE	ZAMBEZIA	MILANGE
MOZZC088	-12.98817	40.540139	-14	MOZAMBIQUE	CABO DELGADO	PEMBA
MOZZC089	-13.10553	40.454861	32	MOZAMBIQUE	CABO DELGADO	METUGE
MOZZC090	-13.12619	40.435139	23	MOZAMBIQUE	CABO DELGADO	METUGE
MOZZC091	-13.09247	40.442167	12	MOZAMBIQUE	CABO DELGADO	METUGE
MOZZC092	-13.10483	39.978556	331	MOZAMBIQUE	CABO DELGADO	ANCUABE
MOZZC093	-13.10475	39.872889	388	MOZAMBIQUE	CABO DELGADO	ANCUABE
MOZZC094	-13.38125	39.782167	313	MOZAMBIQUE	CABO DELGADO	CHIURE
MOZZC095	-13.47444	39.687167	382	MOZAMBIQUE	CABO DELGADO	CHIURE
MOZZC096	-13.66311	39.851389	209	MOZAMBIQUE	CABO DELGADO	CHIURE
MOZZC097	-13.21872	39.864111	251	MOZAMBIQUE	CABO DELGADO	CHIURE
MOZZC098	-13.21872	39.864222	474	MOZAMBIQUE	CABO DELGADO	MONTEPUEZ
MOZZC099	-12.20731	38.882667	481	MOZAMBIQUE	CABO DELGADO	MONTEPUEZ
MOZZC100	-13.05803	38.981389	429	MOZAMBIQUE	CABO DELGADO	MONTEPUEZ
MOZZC101	-13.11311	39.053917	518	MOZAMBIQUE	CABO DELGADO	MONTEPUEZ
MOZZC102	-16.16075	33.591861	139	MOZAMBIQUE	TETE	TETE
MOZZC103	-16.10797	33.661139	140	MOZAMBIQUE	TETE	MOATIZE
MOZZC104	-16.11572	33.729278	181	MOZAMBIQUE	TETE	MOATIZE
MOZZC105	-15.92192	34.152712	150	MOZAMBIQUE	TETE	MOATIZE
MOZZC106	-16.03097	33.917278	366	MOZAMBIQUE	TETE	MOATIZE
MOZZC107	-16.06947	33.952833	351	MOZAMBIQUE	TETE	MOATIZE
MOZZC108	-15.67122	34.360444	655	MOZAMBIQUE	TETE	MOATIZE
MOZZC109	-15.5945	34.436833	891	MOZAMBIQUE	TETE	MOATIZE
MOZZC110	-15.53089	34.3155	784	MOZAMBIQUE	TETE	MOATIZE
MOZZC111	-14.75506	34.376028	1206	MOZAMBIQUE	TETE	ANGONIA
MOZZC112	-14.73714	34.375722	1259	MOZAMBIQUE	TETE	ANGONIA
MOZZC113	-14.68125	34.339806	1309	MOZAMBIQUE	TETE	ANGONIA
MOZZC114	-14.57647	34.303694	1302	MOZAMBIQUE	TETE	ANGONIA
MOZZC115	-14.45956	34.319361	1504	MOZAMBIQUE	TETE	ANGONIA

MOZZC116	-14.40219	34.323611	1580	MOZAMBIQUE	TETE	ANGONIA
MOZZC117	-16.30089	33.525667	385	MOZAMBIQUE	TETE	CHANGARA
MOZZC118	-16.52339	33.392167	189	MOZAMBIQUE	TETE	CHANGARA
MOZZC119	-16.77406	33.286583	248	MOZAMBIQUE	TETE	CHANGARA
MOZZC120	-16.83506	33.276333	256	MOZAMBIQUE	TETE	CHANGARA
MOZZC121	-22.20964	35.113028	44	MOZAMBIQUE	INHAMBANE	VILANCULO
MOZZC122	-21.12083	34.551111	70	MOZAMBIQUE	SOFALA	MACHANGA
MOZZC123	-21.04417	34.506111	70	MOZAMBIQUE	SOFALA	MACHANGA
MOZZC124	-20.9475	34.350833	62	MOZAMBIQUE	SOFALA	MACHANGA
MOZZC125	-20.85778	34.243333	49	MOZAMBIQUE	SOFALA	MACHANGA
MOZZC126	-20.87494	34.417722	67	MOZAMBIQUE	SOFALA	MACHANGA
MOZZC127	-20.64558	34.070333	67	MOZAMBIQUE	SOFALA	Chibabava
MOZZC128	-20.40167	33.947222	210	MOZAMBIQUE	SOFALA	Chibabava
MOZZC129	-20.38972	33.938611	220	MOZAMBIQUE	SOFALA	Chibabava
MOZZC130	**-13.33203**	**35.261111**	1379	MOZAMBIQUE	NIASSA	Lichinga
MOZZC131	**-13.37717**	**35.232917**	1254	MOZAMBIQUE	NIASSA	Lichinga
MOZZC132	**-13.42375**	**35.24375**	1236	MOZAMBIQUE	NIASSA	Lichinga
MOZZC133	**-13.64217**	**35.257889**	1213	MOZAMBIQUE	NIASSA	Chimbonila
MOZZC134	**-13.78325**	**35.343556**	1091	MOZAMBIQUE	NIASSA	Ngauma
MOZZC135	**-13.91408**	**35.419056**	1147	MOZAMBIQUE	NIASSA	Ngauma
MOZZC136	**-14.13972**	**35.47925**	972	MOZAMBIQUE	NIASSA	Mandimba
MOZZC137	-14.359254	35.646881	1236	MOZAMBIQUE	NIASSA	Mandimba
MOZZC138	**-14.35528**	**35.650556**	731	MOZAMBIQUE	NIASSA	Mandimba
MOZZC139	**-14.36908**	**35.620611**	758	MOZAMBIQUE	NIASSA	Mandimba
MOZZC140	**-14.36969**	**35.618889**	763	MOZAMBIQUE	NIASSA	Mandimba
MOZZC141	**-12.90631**	**35.055833**	1299	MOZAMBIQUE	NIASSA	Lichinga
MOZZC142	**-13.21569**	**35.219222**	1260	MOZAMBIQUE	NIASSA	Lichinga
MOZZC143	**-12.76222**	**34.991111**	1160	MOZAMBIQUE	NIASSA	Lagos
MOZZC144	**-12.69458**	**34.864806**	729	MOZAMBIQUE	NIASSA	Lagos
MOZZC145	**-12.69747**	**34.808028**	478	MOZAMBIQUE	NIASSA	Lagos
MOZZC146	**-13.25072**	**35.224139**	1318	MOZAMBIQUE	NIASSA	Lichinga
MOZZC147	**-12.90631**	**35.055833**	708	MOZAMBIQUE	NIASSA	Lagos
MOZZC148	**-14.35578**	**35.676611**	651	MOZAMBIQUE	NIASSA	Mandimba
MOZZC149	**-14.23617**	**35.875333**	628	MOZAMBIQUE	NIASSA	Mandimba
MOZZC150	**-14.23386**	**36.049278**	703	MOZAMBIQUE	NIASSA	Mandimba
MOZZC151	**-14.29936**	**36.227278**	662	MOZAMBIQUE	NIASSA	Mandimba
MOZZC152	**-14.48633**	**36.30475**	569	MOZAMBIQUE	NIASSA	Cuamba
MOZZC153	**-14.79997**	**36.534361**	558	MOZAMBIQUE	NIASSA	Cuamba
MOZZC154	**-14.79833**	**36.613111**	520	MOZAMBIQUE	NIASSA	Cuamba
MOZZC155	**-14.79528**	**36.853917**	643	MOZAMBIQUE	NIASSA	Cuamba
MOZZC156	**-14.95778**	**37.408889**	483	MOZAMBIQUE	NAMPULA	Malema
MOZZC157	**-14.79917**	**37.860556**	560	MOZAMBIQUE	NAMPULA	Malema
MOZZC158	**-14.83917**	**37**	560	MOZAMBIQUE	NAMPULA	Malema
MOZZC159	**-14.95561**	**37.240806**	625	MOZAMBIQUE	NAMPULA	Malema

MOZZC160	**-14.92333**	**37.648889**	641	MOZAMBIQUE	NAMPULA	Malema
MOZZC161	**-14.96639**	**37.981389**	488	MOZAMBIQUE	NAMPULA	Ribaue
MOZZC162	**-14.94083**	**38.321944**	657	MOZAMBIQUE	NAMPULA	Ribaue
MOZZC163	**-14.99972**	**38.512222**	630	MOZAMBIQUE	NAMPULA	Ribaue
MOZZC164	-18.48458	34.20613889	299	MOZAMBIQUE	Sofala	Gorongosa
MOZZC165	-18.43764	33.92905556	514	MOZAMBIQUE	Sofala	Gorongosa
MOZZC166	-18.49186	33.02513228	520	MOZAMBIQUE	Sofala	Gorongosa
MOZZC167	-18.62522	34.06708333	391	MOZAMBIQUE	Sofala	Gorongosa
MOZZC168	-18.68969	34.06991667	385	MOZAMBIQUE	Sofala	Gorongosa
MOZZC169	-18.18178	34.63316667	112	MOZAMBIQUE	Sofala	Gorongosa
MOZZC170	-18.11656	34.94358333	38	MOZAMBIQUE	Sofala	Gorongosa
MOZZC171	-18.04028	35.20222222	69	MOZAMBIQUE	Sofala	Chiringoma
MOZZC172	-17.83019	35.33777778	43	MOZAMBIQUE	Sofala	Caia
MOZZC173	-17.70169	35.20708333	37	MOZAMBIQUE	Sofala	Caia
MOZZC174	-17.45881	35.35380556	53	MOZAMBIQUE	Sofala	Sena
MOZZC175	-17.32583	34.947	76	MOZAMBIQUE	Sofala	Sena
MOZZC176	-17.16356	34.89166667	58	MOZAMBIQUE	Sofala	Chemba
MOZZC177	-17.16653	34.89408333	52	MOZAMBIQUE	Sofala	Chemba
MOZZC178	-16.94278	34.63447222	70	MOZAMBIQUE	Sofala	Chiramba
MOZZC179	-18.98439	34.10197222	147	MOZAMBIQUE	Sofala	Gorongosa
MOZZC180	-19.13719	34.08875	175	MOZAMBIQUE	Sofala	Nhamatanda
MOZZC181	-19.18917	33.99763889	127	MOZAMBIQUE	Sofala	Nhamatanda
MOZZC182	-18.93486	34.13419444	385	MOZAMBIQUE	Sofala	Gorongosa
MOZZC183	-21.12083	34.56252778	71	MOZAMBIQUE	Sofala	Machanga
MOZZC184	-21.04406	34.506	67	MOZAMBIQUE	Sofala	Machanga
MOZZC185	-20.94736	34.35105556	51	MOZAMBIQUE	Sofala	Machanga
MOZZC186	-20.40158	33.94744444	208	MOZAMBIQUE	Sofala	Muxungue
MOZZC187	-19.93342	33.82608333	52	MOZAMBIQUE	Sofala	Chibabava
MOZZC188	-19.76781	33.84419444	57	MOZAMBIQUE	Manica	Sussundenga
MOZZC189	-19.32864	33.83458333	146	MOZAMBIQUE	Manica	Gondola
MOZZC190	-12.32406	33.93463889	252	MOZAMBIQUE	Manica	Gondola
MOZZC191	-17.49111	36.56619	5	MOZAMBIQUE	Zambezia	Quelimane
MOZZC192	-17.36052	36.48552	11	MOZAMBIQUE	Zambezia	Nicoadala
MOZZC193	-17.3588	36.48914	11	MOZAMBIQUE	Zambezia	Nicoadala
MOZZC194	-17.35955	36.47821	14	MOZAMBIQUE	Zambezia	Nicoadala
MOZZC195	-17.35079	36.41297	16	MOZAMBIQUE	Zambezia	Nicoadala
MOZZC196	-17.40225	35.42965	171	MOZAMBIQUE	Zambezia	Mopeia
MOZZC197	-17.46624	35.2466	63	MOZAMBIQUE	Zambezia	Mopeia