

Mealworm predation rates in Biodiversity and Ecosystem Function in Tropical Agriculture (BEFTA) plots, Sumatra, Indonesia

Experimental design / sampling regime

The location for the research was three estates in Riau Province, Sumatra, Indonesia, owned by Pt Ivo Mas Tunggal: Ujung Tanjung, Kandista and Libo. These are estates planted 1987-1995 on mineral soils. The experimental set-up consists of 18 plots established in 2013 as part of a larger experiment on vegetation management (the Biodiversity and Ecosystem Function in Tropical Agriculture project, Foster et al., 2014). Ujung Tanjung and Kandista plots were planted 1987 to 1992 and can be considered as mature or over-mature oil palm, while Libo plots were replanted in 2014. See section 'Miscellaneous' for coordinates.

The plots are generally flat, between 10 and 30 m a.s.l., and away from settlements and major roads. The experimental area is 50 x 50 m, with 50 m separating the plot from the access tracks on three sides and approximately 1000 m to the track on the fourth side. Each palm within the experimental area is assigned a number, and three sampling positions established and marked on the edge of the plot at 45°, 165° and 285° from compass north.

Predation was measured three times in mature oil palm 2014 and six times in both mature and replanted oil palm during 2016-2017. The basic unit for the predation tests was six freshly-killed mealworms (larvae of darkling beetles, *Tenebrionidae* sp.) glued onto a piece of oil palm frond which had been trimmed so that ca. 10 cm of each of six leaflets remained. We then applied exclusion and stratum treatments in factorial combinations: caged and uncaged, canopy and ground. The exclusion treatment was designed such that most invertebrates could access the fronds but vertebrates could not: rat traps held closed with one frond unit inside and one tied to the outside. The traps were metal grid boxes approximately 35 x 20 x 14 cm, with no holes wider than 1cm. One was hoisted into the palm crown while the other was placed at the edge of the harvesting circle under the same palm, to test whether predation rates varied with vertical stratum. Three sets of treatment combinations were placed in each plot, using palms selected by random-number generator. Samples were placed out in the field for approximately 24 hours before being assessed.

Nature and units of recorded values

Total number of mealworms remaining. Half-worms were counted.

Quality control

Basic data checks were carried out (checks for impossible values, such as 7 of 6 mealworms remaining, dates outside the range, correct formatting of palm numbers and plot numbers). We have error-checked 50% of the data entry against the original field sheets, finding an acceptable error rate of <1% and correcting errors when we encountered them. All changes were recorded and that information remains with the dataset.

Format of stored data

Three csv files (comma-separated value, .csv): MealwormPredationRates_2013_2014.csv, MealwormPredationRates_2016_2017.csv, MealwormPredationRates_replants.csv. The first two refer to mature oil palm stands sampled before and during the NERC-funded El Nino project period

respectively. The data are stored in 'thin format', such that each line is a single observation. The dataset contains the following headings:

Name	Type	Description
Estate_abbrev	Char	The name of the estate: KNDE for Kandista, UTNE for Ujung Tanjung, LIBE for Libo.
"Triplet"	Char	The plots are in sets of three; each set has a number. It is possible to identify the data point from the Plot number but this extra information is useful for analysis.
"Plot_no"	Char	A three-character identifier, in the format C01 (Letter-number-number).
"Treatment"	Char	How the plot has been managed since February 2014. One of the following: reduced, normal, enhanced.
"Palm"	Char	<p>Which palm was used for the sample. Palms should be three numbers e.g. 057. If the number also has a B, they are additional palms on the plot boundary, and numbered in sequence using the same start number as the whole plot, i.e. 057 is not necessarily next to 057B.</p> <p>For the replanted plots, palms do not have unique numbers. The data are either presented as the compass bearing from the centre of the plot, or as a sequence of palms: R1 a random number of metres north and east from the southwest corner of the plot, R2 a random number of metres north and east of R1, and R3 R2 a random number of metres north and east of R2. Randomisation was generated by excel spreadsheet.</p>
"Period"	Char	The experimental period can be split into discrete sampling periods, which are recorded here.
"Date_set"	Date	The date the larvae were placed in the field.
"Time_set"	Date-time	The time the larvae were placed in the field.
"Date_coll"	Date	The date the larvae remaining were recorded.
"Time_coll"	Date-time	The time the larvae remaining were recorded.
"wormtreat"	Char	The treatment of the six mealworms, one of the following: "Remain_top_nocage" "Remain_top_cage" "Remain_base_nocage" "Remain_base_cage"
"worms_remaining"	Numeric	Out of six, how many mealworms were left at

		"Time_coll"
"Ants characteristic"	Char	Not always used. If the sample had many ants at the time of recording, what kind where they?
"Ants Quantity"	Numeric	Not always used. If the sample had many ants on it at the time of recording, how many were there approximately?
"All_notes"	Char	Any field or data entry observations, including changes made during the data checking stage. A Y in this field denotes that the data were checked against original field sheets in 2018.
"dayrain"	Numeric	The rainfall for that 24 hours (8am-8am) at the nearest weather station.
"distance"	Numeric	MealwormPredationRates_2016_2017.csv only. The distance to the palm at the centre of an ant enclosure experiment. The enclosure experiment used ant poison inside a 3-metre radius enclosure from July 2016 to August 2017, and a further 2m radius outside the enclosure from May 2017 to Sept. Any palm closer than 20m to the enclosure palm was excluded from analysis for any sampling period after May 2016.

Miscellaneous

The project funding reference was NE/P00458X/1. There are three files: one contains data from the BEFTA core plots (KNDE and UTNE estates) collected from 2013 to 2014, another contains data from the BEFTA core plots collected from 2016 to 2017 and funded by NERC, the third contains the data from the replanted stands (LIBE estate) collected from 2016 to 2017 and funded by NERC.

Plots in mature stands

E	N	Plot
101.27528	0.97703	C10
101.27789	0.97667	C11
101.28081	0.97623	C12
101.29562	0.98350	C17
101.29824	0.98320	C18
101.30066	0.98284	C19
101.32312	0.96154	D28
101.32561	0.96125	D29
101.32844	0.96093	D30
101.34056	0.95037	F04
101.34280	0.95025	F05
101.34576	0.95005	F06

101.36574	0.94023	G07
101.36887	0.94009	G08
101.37125	0.94001	G09
101.34609	0.94132	G14
101.34941	0.94113	G15
101.35187	0.94106	G16

Plots in replanted stands

E	N	Plot
101.19608	0.94810	C18
101.19496	0.94671	D19
101.19198	0.94677	D20
101.18577	0.93759	E22
101.18302	0.93753	E23
101.18118	0.93735	E24