



Insects as food and feed source in the tropics: Opportunities and constraints of forage-based insect diets

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Introduction

- » Rapid population growth, climate change and environmental degradation have put food security and nutrition at risk, especially in the global tropics.
- » Need to feed a growing population: exploration of new food sources for humans and livestock, such as insects.
- » Human nutrition/animal feed: similar nutritional characteristics than other protein sources, but more resource-efficient production. Insects in human diets throughout history.
- » Rapid increase in patent registrations related to processing methods, growing number of companies in the field, research funds, and economic value of the sector.

Results and analysis

Insect farming as a food and feed source in the tropics

- Insect farming to produce food is a promising alternative to livestock production: 50–90% less land per kg protein; 40–80% less feed per kg edible weight; 1.2–2.7kg less greenhouse gas emissions and 1,000 liters less water per kg live weight gain.
- Global tropics: highest insect biodiversity, very favorable for insect production (throughout the year, constant conditions), no need to introduce new species (risk of biological invasion).
- Farmed insects at industrial scale: belong to only 12 edible species (out of 2,100), risk of diversity loss from overexploitation, risk of biological invasion in non-native regions and genetic erosion.
- Insects as animal feed: replacement of e.g., soybean or fishmeal; potential for cost reduction (feed makes up 60–70% of the animal production cost).

Figure 1. Industry-scale farmed insects for food and feed

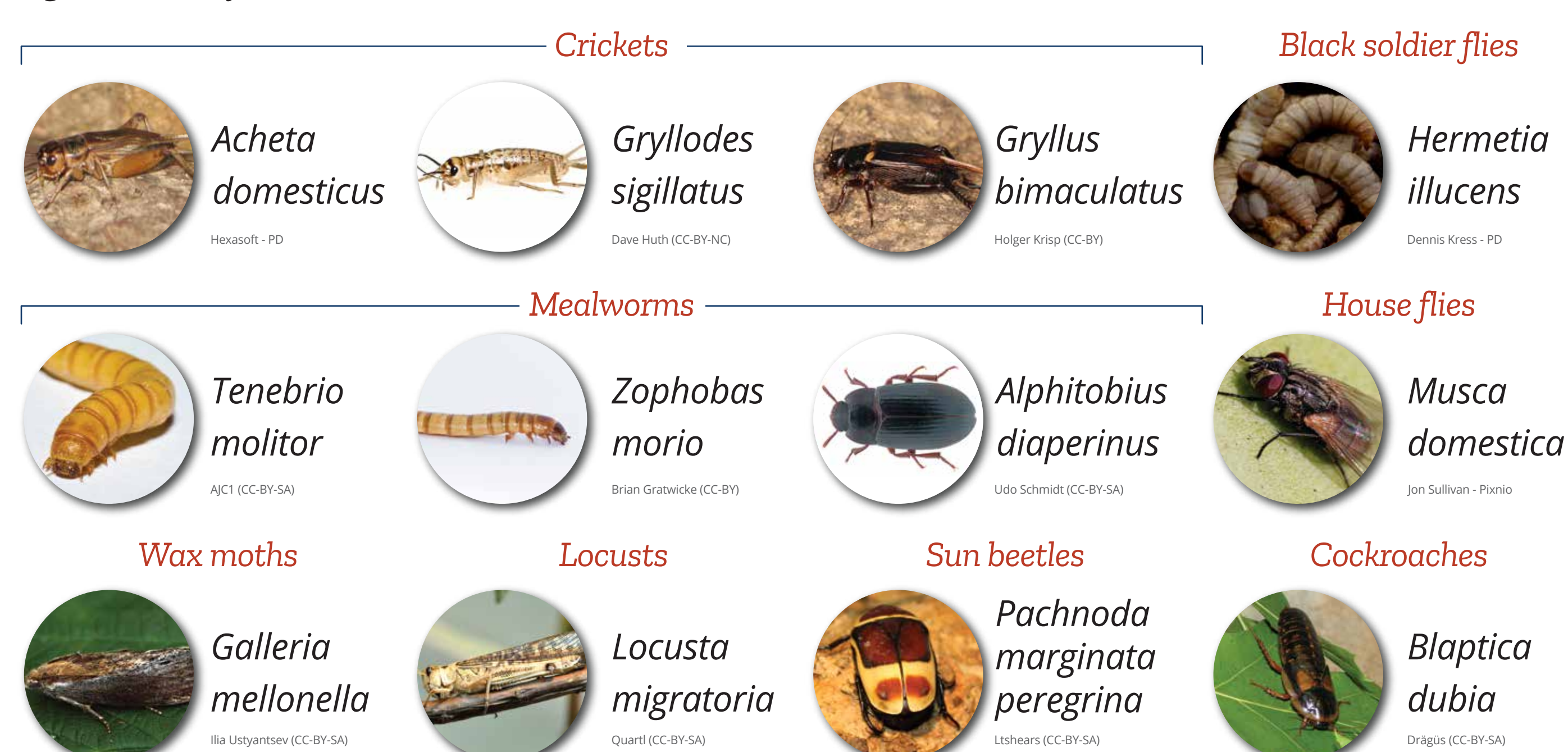


Table 1. Content of common diets use in large-scale insect industry and potential forage species as alternatives for insect feed

Common diets - nutritional content	Protein		Crude fiber		Species
	Source	Protein	Crude fiber	Protein	
Whole yellow corn flour	6.9	7.3	8.3	31.6	<i>Andropogon</i> spp.
Carrot, dehydrated	8.1	23.6	9.7	36.1	<i>Pennisetum purpureum</i>
Dry potato flour	8.3	6.6	9.8	31.3	<i>Cynodon dactylon</i> *
White wheat	11.3	12.2	11.2	37.3	<i>Megathyrsus maximus</i>
Crude wheat bran	15.5	42.8	14	34.2	<i>Stylosanthes</i> spp.
Alfalfa pellets	16	27	14.2	31.5	<i>Paspalum notatum</i>
Dry egg yolk	32.2	0	14.6	29.9	<i>Urochloa</i> spp.*
Whole soy flour	34.5	9.6	18.9	30.7	<i>Centrosema molle</i>
Dry milk, skim	36.2	0	20.6	26.1	<i>Cratylia argentea</i>
Baker's yeast	38.3	21	20.6	26.1	<i>Desmodium heterophyllum</i>
Brewer's yeast	53.3	20	21.4	27.3	<i>Arachis pintoi</i>
Dry beef liver	68	0	23.3	19.9	<i>Leucaena leucocephala</i>
			9.0	36.9	<i>Chloris gayana</i>
			7.7	38	<i>Setaria sphacelata</i>

*Cultivars and hybrids

Objectives and Methodology

- » To provide a viewpoint of how different tropical forage crops available from international gene banks and grown on farms, can support the current insect farming industry, and how their incorporation in insect diets has potential for addressing food safety concerns while maintaining the high nutritional quality of insects for human and animal nutrition.
- » Literature review and expert consultation.



Tropical forages as a feed alternative for farmed insects

- Provision of adequate diet essential for insect viability for human/animal diet.
- Small-scale farmed insects: mostly herbivores that rely on crop residues.
- Larger-scale insect farming: sometimes based on feeds that are in direct competition with human diets (e.g., maize, soybean, oats, wheat); associated environmental impacts.
- Tropical forages: often grown in places where other crops can't grow (low fertility, marginal soils), high biomass production, vegetative re-growth, steady feed supply, conservation potential.
- Tropical forages as insect feed source: can enhance nutritional content of insects (e.g., protein), better nutritional value and less microbial/chemical hazard as crop residue, preferred by insects (soft plant material), no competition with human food production, contribution to circular economies.
- Large genetic diversity of tropical forages: great variation in terms of forage yield, agricultural suitability, nutrient content, and production constraints; yet to be explored for insect diets.

Conclusions

- Insects are a viable option for supplying the growing demand for protein in the tropics, especially given the need to adapt to and mitigate climate change.
- This has led to the development of an emerging industry through initiatives based on black soldier fly production for fisheries in Kenya and Colombia, for example.
- Organic residues and substrates, commonly used for this purpose, may, however, represent a hazard for both fishery and human health.
- Integrating tropical forage-based diets in edible insect production systems has strong potential and yet untapped forage diversity in international gene banks and on farms can be explored for this purpose.
- Compared to commercial diets, tropical forages are a low-cost feed source for insects, with high dietary versatility, that provide opportunities for the transition to sustainable, circular economies.
- The main bottlenecks are the lack of specific regulations, the dependence on few species for large-scale industrial insect production, and consumer food safety.

Further reading

Espitia Buitrago PA; Hernández LM; Burkart S; Palmer N; Cardoso Arango JA. 2021. Forage-Fed Insects as Food and Feed Source: Opportunities and Constraints of Edible Insects in the Tropics. *Front. Sustain. Food Syst.* 5:724628. <https://doi.org/10.3389/fsufs.2021.724628>

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