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Entomophagy and Power

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RESEARCH ARTICLE

Abstract

Edible insects are being framed as a panacea for health, resource and climate challenges, and the 'entomophagy movement' is growing rapidly. Yet as the insect 'solution' is scaled up, there is a greater focus on technical innovation and less on the structural inequalities that govern who produces within, who controls, and who benefits from the edible insect trade. We ask: To what extent is the promotion of 'entomophagy' challenging or reproducing power relations in global food systems? Drawing on evidence from academia, industry, and the local insect trade in Southeast Asia we critically investigate the rising interest in insects as food. We conducted a systematic literature review, a systematic company and product review of products available online, and fieldwork in Thailand where the edible insect market is growing. Our analysis suggests that the emerging edible insects movement is – generally but not exclusively – reinforcing the existing power relations that many of its actors suggest it could challenge. We conclude our paper with recommendations for further research to investigate the disparity between the claims and consequences of this 'quick-fix' approach to food systems. Beyond relying on solely technical and market-based solutions, we recommend more 'power-aware' approaches in academia and business, accountability and transparency in research and trade, more detailed critical research in different contexts, and the inclusion of marginalised actors in the discourse, as means to realise the potential of edible insects in a democratic way.

Keywords: edible insects, food security, global economy, social inequality, Thailand

1. Introduction

Insects have been identified as a potential 'food of the future' (DeFoliart, 1992). While local 'traditional' practices of eating insects are anything but new (McGrew, 2014), serious global interest has added a new dimension to the topic. Of 98 companies known to offer insects as human food or animal feed, 73 were founded during 2013-2015 (Dossey *et al.*, in press). Clearly, an international edible insect 'movement' is emerging. Insects are claimed to be an alternative source of nutritious, protein-rich food (Halloran *et al.*, 2015; Van Huis, 2013; Van Huis *et al.*, 2013). If embraced by Western markets, it has been argued that insects could replace conventional meat and thereby alleviate the devastating effects of conventional livestock (Stehfest *et al.*, 2009; Steinfeld, 2006; Van Huis *et al.*, 2013), and even provide a solution to global problems such as world hunger, environmental and resource degradation (Van Huis *et al.*, 2013; Vantomme *et al.*, 2014). Additionally it is often implied that entomophagy may have a democratic potential: insects are small and easy to breed, without much investment capital and land needed. This could empower the poor and other marginalised groups such as women and the rural poor to produce their own food, thus contributing to global food security (Durst *et al.*, 2010; Kelemu *et al.*, 2015; Van Huis *et al.*, 2013; Vantomme *et al.*, 2014).

Concerns with edible insects as a panacea have been raised from perspectives such as food safety, health, economic feasibility, consumer acceptance and sustainability (Lundy and Parella, 2015; Payne *et al.*, 2015; Rumpold and Schlüter, 2013a,b; Tan *et al.*, 2015; Yen, 2015). Some

are beginning to call for further necessary differentiation of the 'insect-as-food' category (Evans *et al.*, 2015), and others have addressed some of the movements' inconsistencies (Deroy *et al.*, 2015; Yates-Doerr, 2015). What has been underappreciated thus far, however, is that global issues such as food insecurity, ecological crises and food systems fragility are extremely complex and inextricably bound up in social inequality, exploitative dynamics and uneven power relations (Edelman, 2014; McMichael, 2009; Sen, 1981; Ziegler and Kober, 2012), and edible insects are no exception. While barriers to insect collecting and farming may be lower compared to other forms of agriculture, they are not absent, and may become more influential once the market grows.

With this paper we hope to re-politicise the field of insects as food – because its democratic potential *has* been widely acknowledged (e.g. Durst *et al.*, 2010; Van Huis *et al.*, 2013) – by highlighting the role of power, against the broader backdrop of re-politicising food issues in general (Goodman, 2004; Goodman and DuPuis, 2002). Our main objective is to begin to shed light on where claims and practices concerning insects as food align, and where they do not. We apply our methodological approach at different complementary levels of analysis. Through tracing empirically the role of power in academia, in industry, and in local practices of insect production, we ask: To what extent is the promotion of 'entomophagy' challenging or reproducing power relations in global food systems?

Entomophagy

'Entomophagy' is the scientific term describing the consumption of insects by humans, yet it is an ambiguous and problematic word. Firstly, the category 'insects' itself is ambiguous, and in different contexts can refer to different taxa: Insecta, arthropods, all invertebrates, and others. Secondly, its Greek formulation is usually reserved for diagnosing inappropriate or pathological behaviour, which reproduces historical-cultural norms and power relations, for example around identification of the primitive 'other' (Evans *et al.*, 2015). This exemplifies how 'entomophagy' is ultimately and always tied in with questions of power. We thus avoid the term where possible as it reproduces more power relations than it challenges, and otherwise use it only when quoting others or when invoking its issues as outlined above.

Power

Power is a complex, ambiguous, and highly contested term. Introducing 'power' into the conversation means focussing not primarily on the insects themselves, but at least as much on the relations between people who consider and use them as food. Max Weber defines power as 'any opportunity within a social relationship to enforce one's own will, even against resistance, and regardless of the basis on which this opportunity rests' (translation from Weber, 1922). In addition, power is not a fixed property which one can unilaterally impose on others, but is relational, both dynamic and omnipresent (Foucault, 1982; Smart, 1994). This fluidity does not mean that power relations are arbitrary – it is possible and necessary to distinguish between actors with more or fewer opportunities to carry out their will, based on unequal access to material and symbolic resources and the corresponding reproduction of social inequality (Bourdieu, 1984). Power thus operates on an interplay of agent-bound and structural aspects, resulting in a diversity of outcomes rather than a single universal one (Foucault, 1982). The realm of edible insects in particular is characterised by dynamic and potentially mutable power relations between various actors, who may not be related personally but by structural links.

Hegemony

Cultural hegemony highlights an aspect of power which is not based on explicit domination, but on more indirect means of producing consent and legitimacy (Gramsci, 1972). The worldview of social groups occupying higher power positions often becomes 'common sense' or 'truth' perceived as natural and fair, even though it is also itself ideology. The hegemonic status quo hides specific material interests while justifying structural inequalities and the historical processes that led to them (Gramsci, 1972; Smart, 1994).

The West

A frequently-cited article holds that 'The Western attitude is important because acculturation toward Western lifestyles tends to cause a reduction in the use of insects...' (DeFoliart, 1999: 22). This claim is particularly pertinent in the context of colonial history, the legacy of which may continue to suppress certain insect-eating practices (Defoliart, 1999; Meyer-Rochow, 2010). But it presupposes an oversimplified geographic and politico-cultural congruency of 'the West' (A. Müller, unpublished data). Though it almost certainly comes with ambiguities of its own, we refer to 'the West' as a geographic entity encompassing Europe, North America and Australia. To refer to the often-implied meaning of the West as a dominant actor in the global arena, we instead use the UN Human Development Indices (UNDP, 2015) and terms such as 'privilege' and 'power'.

2. Methods

Literature review

We chose to conduct a systematic review of the literature on insects as human food, in order to understand trends in academic research during the past 15 years. Our key research questions were:

- Whose voices are being heard?
- What is the status (farmed or wild) of the insects being researched?
- Which areas of the world are most represented?
- From which sources is this emerging field receiving its financial support?

We searched the databases Web of Science, Scopus and PubMed on 08.09.2015, 09.09.2015 and 14.09.2015, respectively, for records published in the years 2000-2015 using the following search strategies:

- *Web of Science:* Title: (edible insect* OR entomophagy OR eating insects OR insect consumption OR insects as food);
- *PubMed:* (((entomophagy[Title/Abstract]) OR eating insects[Title/Abstract]) OR edible insect*[Title/Abstract]) OR insect consumption[Title/Abstract];
- *Scopus:*(TITLE (edible insect*) OR TITLE (entomophagy) OR TITLE (eating insects) OR TITLE (insect consumption)) AND DOCTYPE (ar).

We also searched the reference lists of published articles, and used Google Scholar to identify later articles that cited the papers identified by our initial search. We scanned the title and abstract of articles and selected those that we expected to be relevant. We then read the full text of each article, and recorded the: first author; title; mode of procurement (farmed/semi-farmed/wild-harvested); consumption (human food/both human food and animal feed); location of research; location of institution of first author; funding source; number of citations (using Google Scholar); impact factor of journal. The human development index (HDI) for each country was recorded based on the 2015 United Nations Human Development Report. A higher HDI score reflects longer life expectancy at birth, longer education period, and higher per capita income, for the average citizen of the country (UNDP, 2015). The resulting database can be found in Supplementary Material S1. All statistical analyses were performed using Stata 13.1 (Stata, 2013).

Company and product review

In order to question whether the marketing terms of insect products available online in the West are met, and to identify where incongruences occur, we conducted a systematic company and product review. Our key research questions were:

- Which edible insect products are easily available (online) in the West?
- What are the features of these products and their respective companies, with regard to how and where they procure their insects and market their products?
- Under which conditions are they produced, traded and consumed?

We compiled a list of companies offering insects as human food between 03.08.2015-09.10.2015, using Google search engines, and other sources. Full details can be found in Supplementary Material S2.

We included companies offering products that were: made of or containing edible insects; explicitly advertised as human food; currently available to order online by end consumers; branded by the company itself (or at least not clearly produced by another company already in the list); accompanied by contact details of the company/seller. For each company, we recorded the: company name; URL of company website; number of total products; founding year; country in which company is based; source of starting capital; owner's gender; owner's nationality. The resulting database is in Supplementary Material S3.

We collected data on up to five products per company between 10.10.2015-03.01.2016, using either: (1) the top five 'best sellers' (according to the website); or (2) if these were not explicitly stated, the first five products in the total product list. We excluded products that were: not (yet/any more) available for purchase; explicitly advertised as animal feed only; explicitly for wholesale only; branded by another company; not advertised in English; not available via online order. For each product, we (as far as available) recorded the: product name; URL of product website; unit weight; price per unit; self-produced or external supplier; geographical origin of insects; culinary context (e.g. sold as a snack, ingredient, or meal substitute); processing method; procurement (e.g. farmed, semi-cultivated or wild-harvested). We standardised weight into grams wherever possible, and calculated the price equivalent in USD for all edible insect products using www.xe.com. The resulting database is in Supplementary Material S4.

We copied the marketing text from all company websites, including that of the products. We defined categories and codes for textual analysis, detailed in Supplementary Material S5. For example, the following codes comprised the category Environment: 'feed conversion ratio', 'CO_2/greenhouse gas emissions', 'organic', 'sustainable', 'sustainability', 'environment', 'local/locality', 'regional', 'water', 'ecology/ecosystem', 'resources'.

Fieldwork

Fieldwork was conducted in Thailand, recognised as a global edible insects hotspot (Durst and Hanboonsong, 2015) with long traditions of use, especially in rural areas (Hanboonsong, 2010). There is also a resurgence of insect-eating in many cities (Yen, 2015), which likely began in the wake of Thailand's economic and industrial boom in the 80s and 90s when many people from rural areas left their agricultural backgrounds and moved to the cities to find work (Rigg, 1998). Qualitative data was collected in Thailand over a total of 10 months in 2011, 2012 and 2015, with a focus on the north-eastern region of Isan and in Bangkok as indicated in Figure 1.

Ethnographic and qualitative sociological methods were used including participatory observation, non-participatory observation, artefact analysis (Lueger, 2000) and unstructured and semi-structured interviews, including about 50 formal interviews plus numerous informal conversations. Interviewees were initially selected (i.e. local experts) in the course of general preliminary research. Once in the field, he also directly approached people and used snowball sampling in order to gain an extensive understanding of the subject matter. Interviewees and informants were of different ages, gender and social status, but most were involved in the edible insects sector in some way. The interview questions were developed and refined in feedback with his data collection, a reflexive research process that involved continuously testing specific theoretical interests and empirical details against each other. As is typical in qualitative fieldwork, methodical guidelines were useful and important, but had to be adapted to the specific situation (Albuquerque *et al.*, 2014). Whenever possible, data was recorded as written notes, audio recordings and photographs. The language barrier and difficult access to some sites and information were countered to some degree with invaluable assistance from local guides and translators. The data was analysed following hermeneutic approaches such as the documentary method (Bohnsack, 2014). Informants' statements have been condensed for concision while maintaining their voice as far as the act of translation allows. Basic demographic facts about informants are limited to gender, age and nationality, and age was usually estimated. Thai Baht were converted into US dollars (using www.oanda.com) according to the exchange rate for the respective time the data refer to.

Figure 1. Map of Thailand (excluding the south) showing locations of relevant fieldwork sites.

3. Results

Literature review

Figure 2 summarises the search process. We located 162 articles using the initial database search, and a further 31 articles based on references and citations. A total of 75 articles were excluded. Of these, 19 were excluded because they were not available in English, and 29 were excluded because they were not peer reviewed. Overall, our search identified 118 articles that we could use for our review.

There is a notable rise in the number of papers on this topic during 2000-2015. Of 118 articles, 9 were published between 2000-2005, 24 between 2005-2010 and 85 between 2010-2015. Figure 3 shows the number of articles by publication date. There is a clear trend towards increasing numbers of publications during this period (quadratic regressions, $P \leq 0.01$, $R^2=0.824$).

It is only in the latter half of this period, however, that articles about farmed insects have been published. Figure 4 shows the number of publications that represent research into farmed insects, and those that represent research on non-farmed (wild or semi-farmed) insects.

Figure 5 shows the funding source for all included articles. 53.85% (n=63) of articles do not declare their source of funding. Of those that do, the majority (n=47) were fully funded by public money.

Figure 6 shows the global distribution of the institutions of first authors, and of the research itself (where applicable), by continent. South America and Australasia are notably underrepresented in this field in terms of both authors and research. Researchers based in North America, Europe and Asia have greater representation than research conducted in these continents, and the opposite is true for Africa.

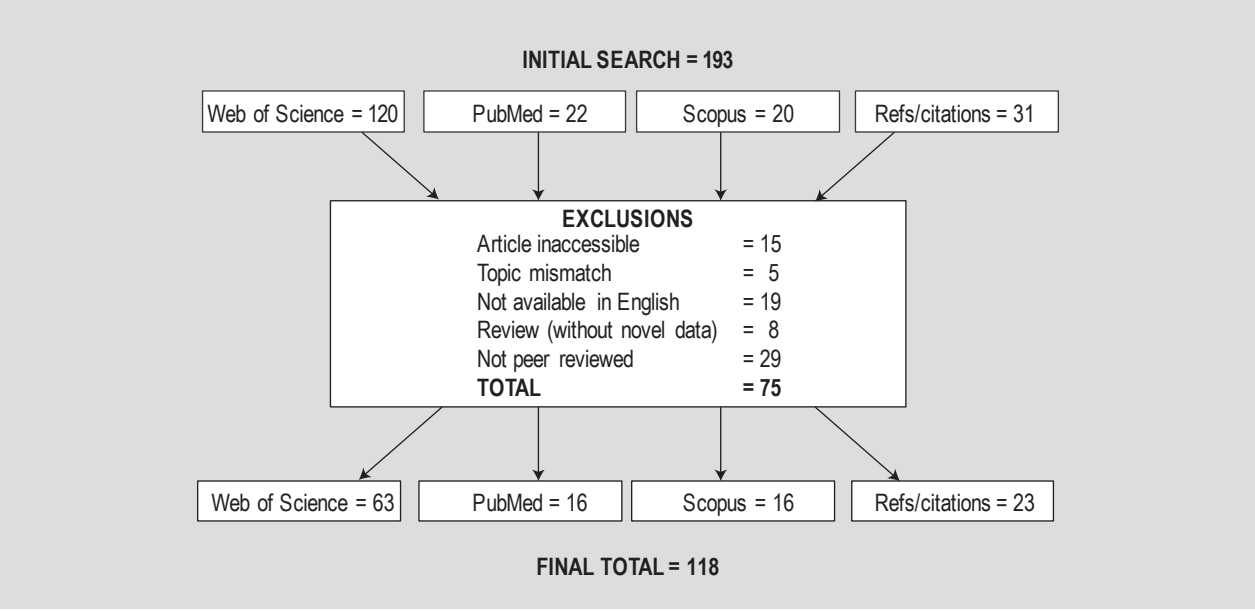

Figure 2. Flow chart showing the search strategy, number of articles scanned at each stage, and reasons that articles were excluded. Searches were done in the order: Web of Science; PubMed; Scopus; Ref/citations. Duplications were eliminated during the process and are therefore omitted from this figure. Of the 15 articles excluded for being 'inaccessible', 11 were picked up by search engines but we could not locate the article or the authors' contact details; 4 were located and authors were contacted for a full text manuscript but did not reply.

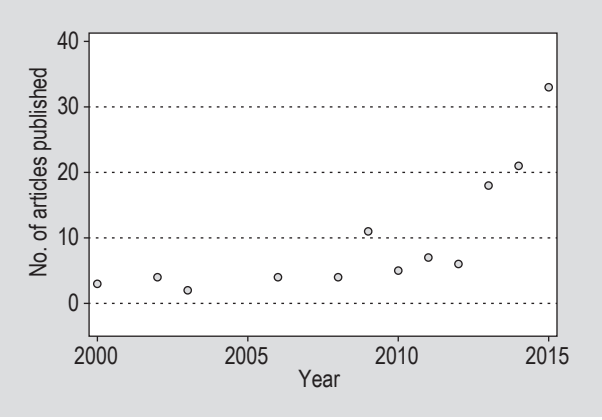

Figure 3. Scatter plot showing the number of articles by year of publication.

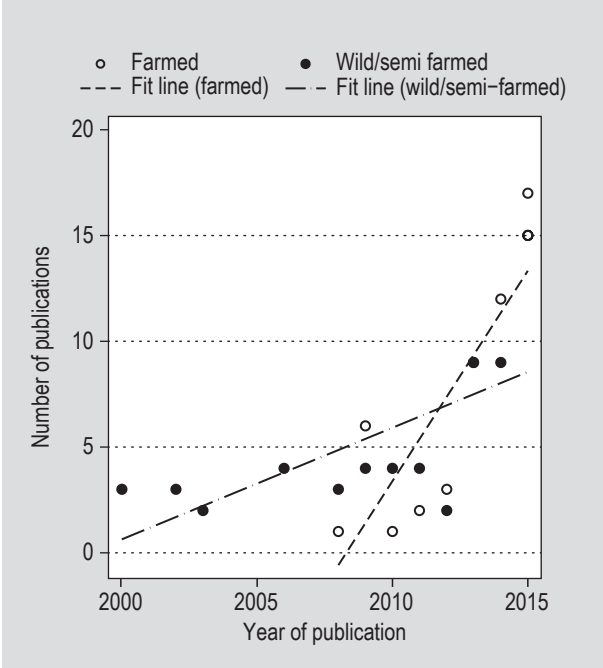

Figure 4. Scatter plot showing the number of articles that describe research on farmed insects and on wild or semi-farmed insects, by year of publication. The lines of best fit were calculated using linear regression analysis (farmed: *P*=0.01, R^2=0.692; wild/semi-farmed: *P*=0.018, R^2=0.446). If an article described both wild and farmed insects it was included in the 'farmed' category. Articles that did not specify the mode of procurement of insects are not included in this graph.

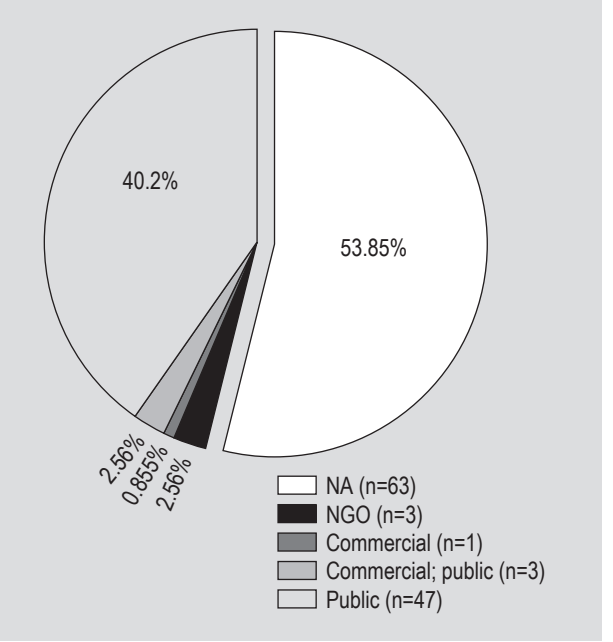

Figure 5. Pie chart showing the funding source for all articles. 'Public' refers to funding provided by governmental or university research grants. 'NA' denotes articles that did not acknowledge their source of funding.

Figure 7 shows the impact factor of the journal, and the average number of citations annually, by the HDI score of the country of the first author. Authors from countries with a higher HDI published in journals with significantly higher impact factors (Welch's t-test, P=0.0002), but their work was not more frequently cited (Welch's t-test, P=0.28).

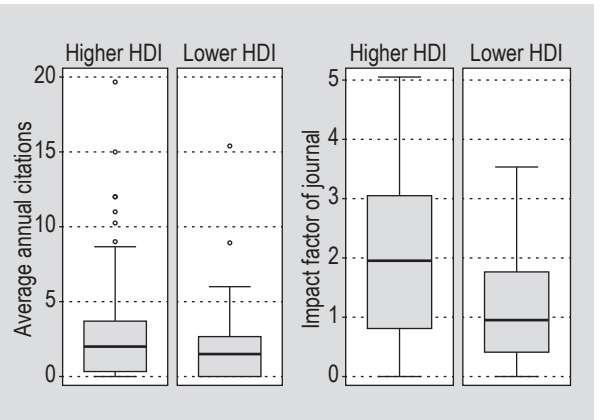

Figure 7. Graphs showing the impact factor of the journal (left), and the average number of citations annually (right), by the human development index (HDI) score of the country of the first author. 'Higher' HDI countries are those with an HDI classified as 'high' or 'very high'; 'lower' HDI countries are those with an HDI classified as 'medium' or 'low'.

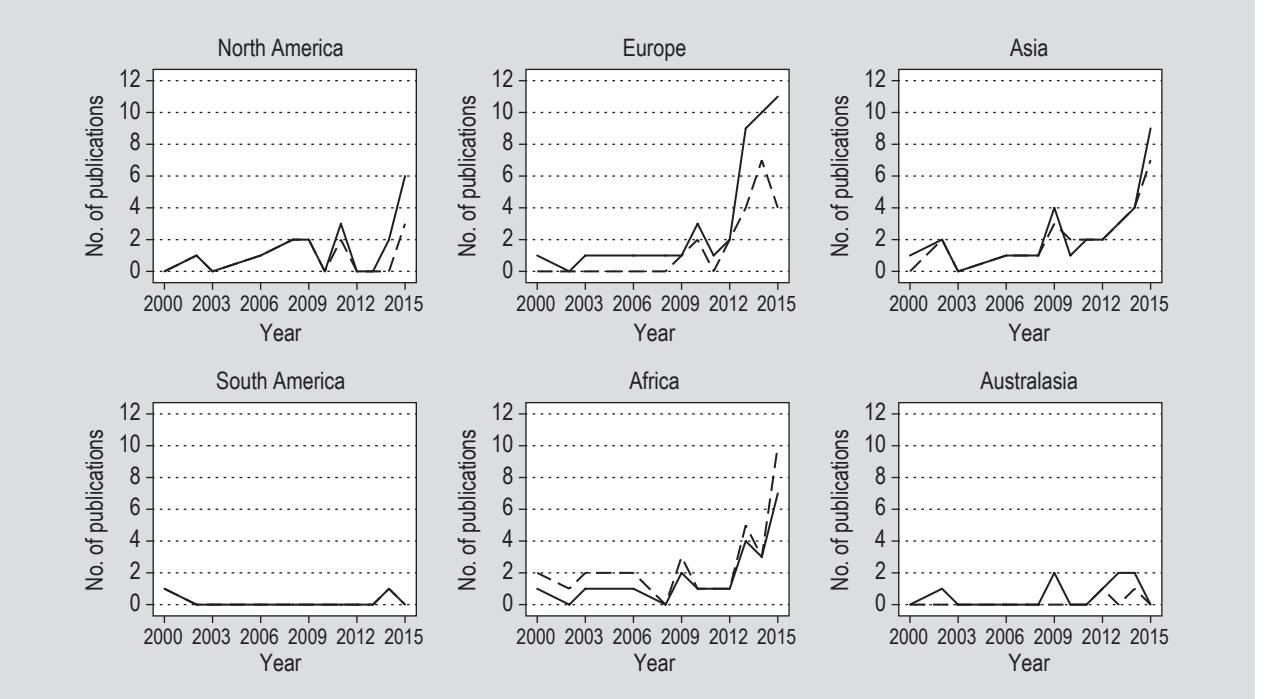

Figure 6. Graphs showing research publications by location of first author (solid line) and of the research itself (dashed line). Articles that cover research in multiple continents are not included in these graphs.

Company/product review

The total number of included companies was 43, and the total number of included products was 171. Raw data tables for all figures referenced here can be found in Supplementary Material S3 and S4 for company and product data, and Supplementary Material S6 for marketing claims results.

The majority of companies were based in North America (n=18, 42.9%) or Europe (n=18, 42.9%), and owned by North Americans (n=17, 48.6%) or Europeans (n=13, 37.1%). We could only determine the geographical origin of 93 products, the majority of which were sourced in North America (n=42, 45.2%), Asia (n=23, 24.7%) and Europe (n=20, 21.51%) (Figure 8). Furthermore, the majority (n=86, 94.51%) were from countries with a high or very high HDI score, 6 (6.45%) were from medium HDI countries, and none were from low HDI countries. 53.8% (n=92) of products had no accompanying information regarding whether the insects were farmed or wild harvested. Of the 79 (46.2% of total) that did specify how the insects were produced, 75 (94.9%) were farmed.

The majority of products were sold in a ready-to-eat form as snacks (n=128, 74.9%), with a few (n=6, 3.5%) marketed as potential meal supplements such as protein shakes and breakfast cereals. However, of these snack products, many (n=52, 30.4%) were unseasoned and could therefore also be used as an ingredient. Of all products, 20.5% (n=35) were dehydrated or freeze-dried, and nearly a fifth (n=37, 21.6%) were sold as an unseasoned 'ingredient' that required further processing before consumption, for example in flour or powder form. The mean price of products was 20.9 USD (n=171), and nearly half (n=78, 45.6%) of all products were sold at prices exceeding 10 USD. For those with adequate information about the weight of the product (n=131), the mean price for a serving of 30 g was 25.3 USD.

Figure 9 shows that the majority of marketing claims are about health/wellness (n=681, 34.4%). Over half of the codes in this category were 'protein' (n=361). This includes specific amounts of protein in the products, shown in nutritional information tables, but also emphasis on insects being a protein alternative to meat. For example: 'insects are healthy, nutritious alternatives to mainstream staples such as chicken, pork, beef and even fish' (company ID 6). The second most prominent category of marketing claims was Taste (n=375, 18.9%), over half of which were for the word 'taste' itself (n=194, 51.7% of 375). Claims related to foods and flavours assumed to be familiar to consumers, for example, 'our edible mealworms…taste a little like almonds' (company ID 2, product 2) and 'mealworms that taste like popcorn, buffalo worms that taste like bacon, nutty crickets and locusts that taste like walnuts!' (company ID 6). The popularity of familiar tastes and foods contrasts the result that Acceptance was the least-represented category (n=25, 1.2%), with novelty, the 'unknown' and exoticism being significantly less prevalent.

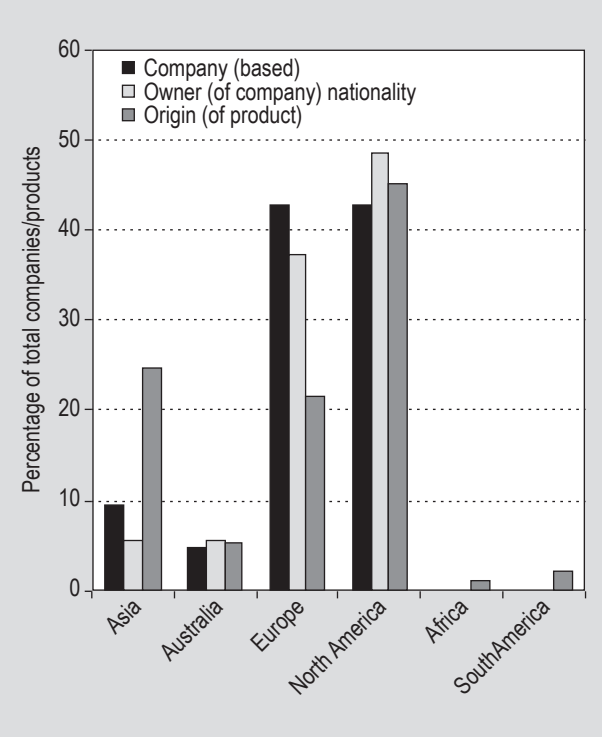

Figure 8. Bar plot showing the percentage of companies based in each continent, the percentage of company owners who are from each continent, and the percentage of products sourced in each continent.

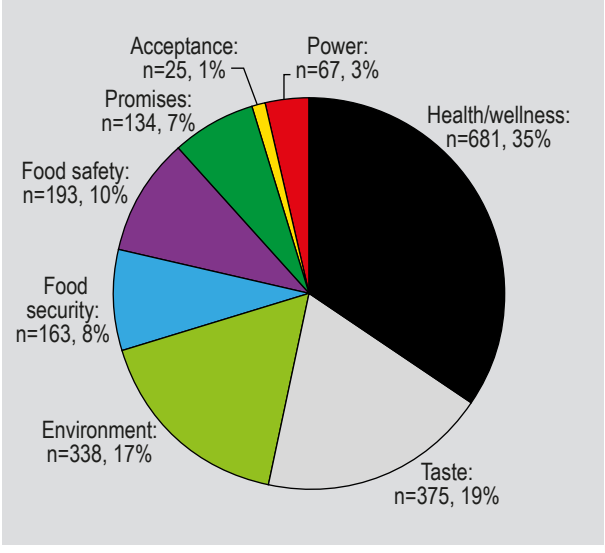

Figure 9. Pie chart showing the total number of codes per marketing category and their total percentage (rounded) of overall marketing claims for 43 companies and 171 products.

Environment-related claims were the third most popular marketing category (n=338, 17.1%). Marketing text often compared edible insect production with conventional livestock farming, especially in terms of natural resources, water and land: 'The production of meat consumes an incredible amount of water: a single kilogram of beef requires over 15,000 litres…Eating insects is an easy way to cut down on water footprints…The conclusion seems simple: replace meat with insects.' (company ID 33). Food safety accounted for 193 (9.7%) of claims, with 'quality' (n=62, 32%) and 'safe' (n=60, 31%) used to assure consumers about production and processing standards of edible insects. Food security comprised 8.2% of claims (n=163). The codes 'world' (n=112, 68.7% of 163), 'population' (n=22, 13.5% of 163) and '2050' (n=13, 7.98% of 163) were most common, often subsumed in a narrative around edible insects' future role as 'one of the only solutions to feed[ing] 9 billion by 2050' (company ID 12). Similar results were found in the promise/motivational category, accounting for 6.7% (n=134) of claims. 46 codes were 'future', with 26 related to the 'future of food'. For example: 'Bugs! Entomophagy! Future food! All these words describe what the future of food looks like.' (company ID 11). Power (n=67, 3.3%) was the second least-represented category before Acceptance. 21 (31.3%) results were for 'power' itself, yet related to edible insects being a 'power supply' or 'empowering' consumers: 'offer entomophagique adventure and help you discover the nutritional benefits of this power supply with six legs!' (company ID 47). 29 (48.3%) were about local farmers and collectors and 11 code results were for 'fair' and 'fairtrade', however there were no results for 'poverty', 'equality', 'inequality', 'democratic' or 'humanitarian'.

Fieldwork

In urban areas of Thailand, many people who eat insects came from Isan – a rural region with a pronounced culture of using certain insects as food – and spread the practice. A man who had migrated to the USA in the 70s and was on home leave in his birthplace of Bangkok was astonished: 'When I left you'd never come across insects, and now you can buy them everywhere!' (male, early 60s, Thai). This new trend is significantly although not exclusively driven by young people. A group of teenage boys eating insects in central Bangkok explained: 'They are tasty, and full of protein and vitamins – very healthy!' (male, late teens, Thai).

The urban revival has given rise to new 'modern' forms of eating insects. In the countryside, insects are mostly procured by subsistence-based wild harvesting or trade at local markets, and eaten as elements of main meals. The diversity of species eaten depends on local customs and on seasonal and regional availability, but overall it is very high (Jongema, 2015; Yhoung-aree and Viwatpanich, 2005). In urban areas, many insects are available year-round due to cold storage and deep-freezing, but the range of species is limited, and some are increasingly farmed rather than wild-harvested. They are usually purchased from street vendors or market stalls as ready-to-eat evening snacks (Figure 10). This modern mode of eating insects is directly connected to general trends of social transformation and an emerging economic sector with new opportunities (Halloran *et al.*, in press). For example, income generated by cricket farming has enabled some families to buy a car which they could not have afforded otherwise (Yhoung-aree *et al.*, 2014). The Thai insect industry is becoming increasingly supraregional and organised, and already encompasses a considerable business network of collectors, farmers, middlemen, wholesalers, street vendors, large superstores and other entrepreneurial actors. Some of them have been reported to earn up to 100 million Baht (~3 million USD) or even 600-700 million Baht (~16 million USD) per year (Kreutzberger and Thurn, 2014; Yhoung-aree and Viwatpanich, 2005). While interviewees' and informants' general replies often varied according to demographic parameters and social status, virtually everybody shared the opinion that the insect trade will continue to grow.

In Ban Sarng Sang, a village in Isan, smallholder farmers described their ambivalence regarding recent changes such as the necessity to grow cash crops and buy convenient food, due to lack of time and changes in their children's food preferences, and expressed that they regretted such developments. Asked for their thoughts about insects being sold as snacks in Bangkok, their initial reaction was interest in the type, preparation and taste of the insects. After a heated discussion with her husband, one woman said: 'I think it's a bad idea. If it becomes popular there, what does that mean for the future of our children? If those businesses need a lot of raw material, maybe they will buy many insects from the local people, and then the future generations will not have enough to eat any more. Nowadays, all kinds of natural resources are decreasing because people are collecting them for sale. If demand for insects increases like

Figure 10. Young customers of a modern insect stall in central Bangkok.

that as well, this would add to the destruction of ecosystems and burden the local people here' (Female, Thai, early 50s).

Talad Rong Kluea is a large market on the Thai side of the Cambodian-Thai border in the province of Sa Kaeo. It contains a hall built in circa 2009 specifically to serve the growing insect trade (Figure 11). The market shifts thousands of tonnes of insects each year, forming a nodal point of the international insect trade. Large quantities of different insect species are imported into Thailand every year from neighbouring countries such as Myanmar, Laos and Cambodia where they are mainly collected in the wild (A. Müller, unpublished data; Hanboonsong *et al.*, 2013). Most wholesalers are Thai. One Cambodian wholesaler reported: 'It is becoming increasingly difficult to enter higher positions without considerable starting capital, contacts and know-how. When I started in 2000 [as a labourer], 20,000 Baht (~500 USD) was all I had, but nowadays you need at least 200,000 Baht (~6,072 USD) for getting started. It's an unstable business, and if you don't know the right people, you have to pay a lot extra to get involved. And that is only if you manage to get a compartment, since the market [which is privately owned by a rich family] is fully hired out' (male, early 50s, Cambodian). He employs ~15 day labourers for his business, and their number fluctuates seasonally. This was true for most people transporting, washing, processing and shelving the insects at Talad Rong Kluea. According to the same wholesaler, 90% of them are Cambodian, because it's cheaper to hire migrants, and also they tend to negotiate less and work harder. They were paid at most 300 Baht (9.11 USD) per day and had no employment contract or social security.

Behind the main insect hall at Talad Rong Kluea is a large cold storage room used to freeze and store wild insects from Cambodia. A supervisor reported: 'I'm officially employed, with a salary of 10,000 Baht per month (~306 USD) including social welfare. The other staff are Cambodians who get 200 Baht (6.07 USD) per day plus food and accommodation, without social security or anything like that. But if they get ill we organise medical treatment – because we need their labour. That rarely happens though, because they are incredibly resilient, while Thais couldn't and wouldn't want to do this kind of hard unrespected work involving extreme temperature fluctuations. Poor Thais prefer to work in factories where they have more security, rights and at least some social welfare. But these Cambodians here don't have much choice – and 200 Baht is not bad for them' (female, late 30s, Thai).

There was also a site at the end of the vast market area which seemed less visible and official, and was used as a workplace for the seasonal processing of fish, frogs and insects. In July 2012, dozens of Cambodian women and children were processing locusts manually by pulling off their wings (Figure 12). They were seasonal day labourers paid according to the amount of insects they managed to process: 5-6 Baht (0.16-0.19 USD) per kg, on average 100 Baht (3.15 USD) per day. One of the women said: 'we are glad about the job – it is not too hard physical work, and we get the money straight after work' (female, 30's, Cambodian). Many of the workers had small wounds on their hands, which came from the monotonous motion while 'de-winging' the locusts. A girl with plasters on her hands explained: 'it's a bit painful and annoying, especially for writing at school' (female, 12, Cambodian). Not all of the children attended school–especially not during the locust season. Usually, they work from 5 am until 5 pm (Sankharat, 2013). A woman explained: 'Where we come from there isn't any work at all, so it's better than nothing' (female, 40s, Cambodian). A mid-level employee at the same site said that 'the insect trade really is big business – my [female] boss has made about 25 million Baht (~800,000 USD) in three years, and the turnover will probably continue to increase' (Male, early 40s, Thai). An officer of the district office in charge of hygiene and safety at Talad Rong Kluea

Figure 11. Insect market hall at Talad Rong Kluea.

Figure 12. Cambodian day labourers pulling off locusts' wings.

said: 'The insect trade has grown very fast, and some people are becoming rich. The profit margin is extremely high and they have organised the business efficiently. For example insects are sold within franchise structures in many cities in Thailand. The entrepreneurs invest in a large number of carts, organise fresh insects from Rong Kluea market every day and employ retailers who get 500 Baht (15.18 USD) per working day (which is the minimum wage for Thai citizens). These people are usually seasonal workers from agricultural backgrounds' (male, 40s, Thai).

While Talad Rong Kluea may be the biggest insect trading spot in Thailand, there are other hubs as well. One of them is Talad Thai, a huge agricultural market near Bangkok. A young man employed there at an insect business owned by his mother earned a fixed monthly salary of 60,000 Baht (~1,836 USD). He said: 'I'm very happy with this job – it's a good stable income. Currently, we make about 100,000 Baht (~3,060 USD) per day, and expect that to increase further' (male, early 30s, Thai).

One reason for the expected growth of the insect sector are the continuous demand and rising prices of popular insects. Many species reach remarkably high prices, exceeding those of pork or beef many times over. Giant water bugs (*Lethocerus indicus*), for example, are valued because of the special aroma the males produce, and their market price has steadily been increasing, to up to 25 Baht (0.76 USD) per specimen. Most giant water bugs are still collected in the wild, but they have become relatively rare. Demand is not sufficiently met because of the bugs' decreasing natural occurrence in Thailand – which many informants explained was due to pesticide use in agriculture.

Consequences are a growing import from other countries, the production of artificial aroma and an increasing interest in farming potential. Breeding giant water bugs is a difficult and complicated procedure. The high school teacher Chatree Patisol (male, 60s, Thai) (Figure 13) was one of the first to develop a successful small-scale farming procedure and shares his knowledge with anybody who is interested: 'giant water bugs are predators, and need lots of fresh live prey. I usually feed them small frogs or fish which we also breed ourselves' (Figure 14). While commercial interest in such knowledge could grow in the future, Mr. Chatree does not see water bug farming primarily as a business idea, but integrated into the sustainable agricultural learning centre he runs. Everything is done manually with local organic inputs and outputs, reusing plastic waste, etc. (Figure 15). It is also a social project aiming to be inclusive and give underprivileged children the chance to gain knowledge within a safe environment. The pupils participate in the whole process of agricultural production and learn to sell their self-made products. They are allowed to keep the money they earn, in order to support their further education and as a basis for a better life.

Figure 13. Chatree Patisol in the agricultural learning centre he runs.

Figure 14. Giant water bug sucking a frog after stunning it.

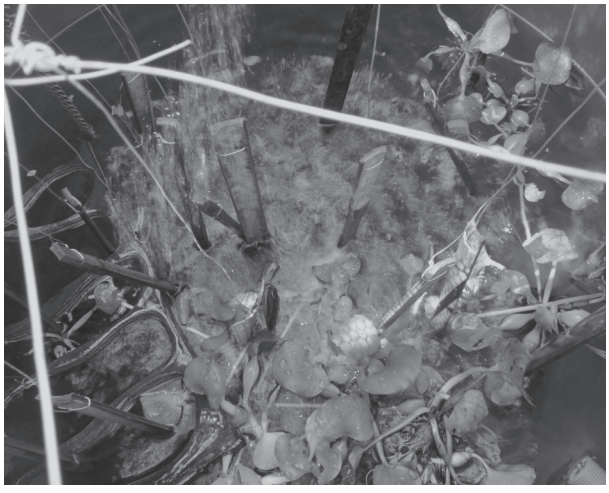

Figure 15. Small scale giant water bug breeding tank with plastic waste being reused.

4. Discussion

Limitations of this paper

First, this review presents a 'snapshot' of academic literature relating to edible insects during 2000-2015, of companies selling insect food products online during September-October 2015, and of the edible insect trade in Thailand during 2011-2015. It is by no means a comprehensive picture of the entire edible insect 'movement', and there are undoubtedly many power relations at play that we have not captured and that require further investigation. Second, for both our literature review and company/product review, we restricted data collection to information available online and in English, which excludes many people, communities, and important realities around the world, especially in lower-HDI countries, thereby not only biasing our results but also to some degree reproducing the very structures we critique. Specifically, the products that we review are limited to those that are available to consumers with internet access and a means of online payment. Third, we are guilty of some simplification: for example, we use the first author as a proxy for the entire author team; furthermore, we refer to nationality throughout, which does not necessarily and certainly not by itself determine how powerful or wealthy a person is; in addition, we use HDI as a measure, which does not capture inequalities within countries, but it does indicate crucial global differences in general privilege and wealth. We also acknowledge that the codes and categories used in marketing text analysis may be biased by our selection, that they are not exhaustive, and that codes may overlap between categories. These simplifications may introduce biases that we hope are countered to some degree by the qualitative data. Fourth, our search methods prevented us from reaching into hidden trade movements, such as cases where the insects are not produced by the company selling the products and possibly imported from other continents. Fifth, there are major parts of the edible insects movement we have not addressed in this paper, most notably the role of insects as feed, an important and growing part of the conversation. Overall, perhaps the primary limitation of our research lies in our own 'power positions': we ourselves benefit from the very power structures we hope to elucidate.

Technical problems and apolitical 'solutions'

The emphasis in both academia and in business is on apolitical solutions without adequately considering local social context. The literature review confirms that there has been a shift towards a more technical view of insects as food, with an emphasis on farmed insects, global environmental impact, consumer acceptance, nutritional properties and the importance of upscaling production. Questions of structural inequalities, justice, access and distribution are rarely considered. Even when these social and political factors are acknowledged, they tend not to be included in empirical research (Goodman and Watts, 1997; Phillips, 2006). For example, a widely cited FAO report (Van Huis *et al.*, 2013) holds that 'insect rearing and harvesting can contribute positively to equal participation and involvement in economic growth, especially for marginalised groups such as the landless' (p. 126), yet this remains a subjunctive claim not consistently pursued – how exactly this should work is not explained. Earlier publications, in comparison, did tend to address contextual and social concerns (DeFoliart, 1999; Durst *et al.*, 2010; Meyer-Rochow, 1975), and the historically-rooted eurocentric biases against eating insects (Bodenheimer, 1951; Holt, 1885). Instead of following up on such perspectives, contemporary literature shows a tendency of concentrating on an uncritical 'one world' approach (Yates-Doerr, 2015). Marketing claims are also usually framed in neutral 'technical' terms of a growing world population and resource scarcity. Thus the discourse in both academic literature and marketing is simplified, apolitical, and reproduces hegemonic Malthusian assumptions about food systems (Malthus, 1998 (originally 1798); Linnér, 2003). The 'elephant in the room' remains: the advantages of insects as food do not simply depend on technical and economic feasibility, but also on social and political context, power and inequality.

Global inequalities in academia

The results of our literature review show that structural (particularly geopolitical) power relations are reproduced in current academic literature about edible insects. High proportions of articles were unavailable in English, were inaccessible, and/or lacked peer-review, implying that a significant proportion of research on this topic does not conform to high academic standards – which themselves are entangled in mechanisms of social exclusion. Notably, the global distribution of authors working on edible insects is starkly different from the global distribution of insect eating practices. World regions without a tradition of eating insects, and researchers who are able to compete in and access an English-language professional academic context, dominate the current discourse. Thus, the movement is not empowering those with a culture of insect consumption. Nor is it empowering those in lower-HDI countries. Taking research impact as a proxy for power, our review shows that the 'voice' of authors in Higher HDI countries is more influential than those from lower-HDI countries. Again, the edible insects discourse is reproducing the power structures present in academia; this knowledge both reflects and influences broader societal, historical and political conditions and trends.

The marketing of edible insects

The predominant marketing strategy of many companies rely heavily on an abstract 'solution narrative'. Even when specific aspects such as water consumption and feed conversion ratios are cited, they are usually applied in a broad and diffuse way, rather than relating to the context of specific products for sale, using phrases such as 'easy way' or 'one of the only solutions'. The high occurrence of the code 'world' reflects the homogenising influence of the 'feed the world/one world' approach (Yates-Doerr, 2015), which simplifies global complexity into a singular, knowable, manipulable thing (Tsing, 2015). The relative absence of references to 'world hunger', 'malnutrition' and 'poverty', and the lack of codes in the 'power' category, suggest that the humanitarian and political context are side-lined. Perhaps since the intended customer base is highly privileged, references to food safety and quality surpass questions of food security (Belluco *et al.*, 2013). In marketing edible insects, companies subscribe to the Malthusian hegemony that food challenges are due to lack of food rather than structural inequalities of power and entitlement (Sen, 1981).

Edible insects are also marketed in a way that homogenises their diversity. For example, the predominance of the Health and Wellness category and 'protein' code suggests that insects' existing culinary variation and complexity is reduced to nutritionism (Pollan, 2006), promoting assumptions of insects' general 'healthiness'. The marketing of insects also frequently omits their geographical and ecological origin. Furthermore, edible insects are marketed as a meat alternative, yet in terms of both price and composition they cannot be considered as such. Insects sold online reach average prices that are far higher than everyday meat products, thereby excluding the majority of the global population from access to them. Furthermore, most products are presented in a 'snack context', providing supplements to a diet that, at least in the West, is already protein-saturated (USFDA, 2015). Insects are also sold as snacks in Thailand, although the 'solution narrative' is less obvious. Overall, the marketing of edible insects is at odds with their representation and accessibility.

Inequalities in global markets

Various structural inequalities are being reproduced by the commercialisation of edible insects, which at present largely benefits those in higher positions of power. Most companies considered in this paper are based in higher HDI countries, suggesting that control of edible insect products is in the hands of the privileged. Companies reveal little information about the social and ecological contexts of their products, suggesting that edible insects' production backgrounds are 'hidden' as they are scaled up into global markets – an effect known from other foodstuffs (R. Roberts and J.D. Evans, unpublished data; Hudson and Hudson, 2003; Weis, 2013). The majority of products in our review contained insects that were farmed in higher-HDI countries, yet wild-harvested insects originated from lower-HDI countries. Collecting wild insects may be more feasible in tropical countries, but the fact that these often happen to have lower HDI indices, in combination with most companies being owned by people from the West, suggests resource extraction not necessarily benefitting the people most threatened by food insecurity. Our data implies that control both of production and of value is shifting, as reflected by the marketing focus on what cultures of the West perceive as tasty, healthy and safe to eat (Guthman, 2002; Phillips, 2006).

While the market is certainly an important arena for implementing the potential of edible insects, there is little detailed information on the distribution of gains from edible insect trade. To assume that the global market is universally constructive and mutually advantageous is to dangerously neglect the power asymmetries that influence who actually benefits from trade with insects as food.

Universalised 'sustainability'

The idea that every insect species is universally sustainable is deceptive. Our research offers some insights into this matter. Firstly, the means of procurement is not always sustainable. In some cases, wild-harvesting may lead to over-exploitation of insects (Yen, 2015) – a threat feared by the Thai villagers quoted above. Secondly, not enough is known about the environmental impact of insect farming and it appears to be much more complex than suggested by the 'solution narrative'. For instance, farmed insects may be fed on a substrate with its own complicated sustainability status, shown by the example of the waterbug in Thailand, which requires additional resource use for the farming of its prey. The same issue applies to more commonly-farmed insects, which tend to be fed with cultivated grain that adds to the insects' environmental footprint such that scaled-up production is no more sustainable than conventional protein sources (Lundy and Parella, 2015). Thirdly, farmed insects for a consumer market require processing for preservation purposes, and are often subject to further processing to meet perceived consumer preference. When this is done on a large scale, common methods include grinding, dehydrating and freeze-drying (Supplementary Material S4), all of which use significant energy.

How, then, can edible insects be 'sustainable'? The first problem, associated with over-exploitation of wild insect populations, may be partly addressed through their inclusion in initiatives to ensure the sustainable harvesting of wild resources. One such example could be the inclusion of insects in schemes such as the FairWild standard, which assesses the harvest and trade of wild edible plant species

(FairWild Foundation, 2010). The feed substrate issue is no less complicated. In Europe, for example, there is evidence that the environmental footprint of commonly consumed livestock such as ruminants may be greatly reduced if they were to be fed with organic waste in place of cultivated feed (Zu Ermgassen *et al.,* 2016), and the same has been argued for insects such as crickets and mealworms (Van Huis, 2013). However, evidence suggests that in the case of crickets, mortality rates may increase dramatically when organic waste is used as feed, thus possibly rendering this option unviable (Lundy and Parella, 2015). Overall, the reality of rearing insects on more sustainable substrates on a large scale is yet to be fully understood and may bring with it hidden environmental costs. The same certainly applies to the environmental costs of processing methods which tend to stay unmentioned in the marketing of insect products.

The arguments outlined above show the complexity regarding the sustainability of edible insects–yet all largely ignore the human dimension of sustainability. An approach such as Chatree Patisol's may provide a more holistic answer to how edible insects can be sustainable. In his position both as a teacher and as an insect farmer, he gives local underprivileged youth the chance to gain income and education. So far not even adequately measurable in the most complex multidimensional life cycle assessments (Muthu, 2015), these social components may be given less recognition but are highly relevant to implementing insects' full democratic potential as sustainable food.

Inequalities within the Thai insect trade

As edible insects are commercialised they become more and more subject to conventional market forces, which involves both new opportunities but also the reproduction of inequalities. The Thai edible insect market is still relatively open and accessible, and in some cases facilitates upwards social mobility. But those who benefit (are regularly employed, successfully run small to medium-size businesses, and/or make a considerable annual profit) usually enjoy certain privileges to begin with: for example, being Thai, a man, from a well-off family, having the right contacts, know-how and/or capital. The industrialisation of the insect trade is increasingly accompanied by a reinforcement of existing power relations. Labourers in the insect industry are subject to the same structural inequalities faced by workers in other sectors in Southeast Asia: many reside illegally and are subject to highly precarious working conditions–the women and children who pull off locusts' wings at Rong Kluea market, for example, where illegal migration, child labour, human trafficking and child prostitution are common (Sankharat, 2013). Their wage is vanishingly small relative to the turnover of the industry and the profits made by their supervisors. These work conditions reproduce more than challenge social and economic inequalities. Even if the day-labourers at Talad Rong Kluea state to be 'happy' about their jobs, they also know they don't really have a choice. It is highly unlikely that their role in the insect trade will substantially alter their position in society, while others retain their superior social status partly through benefitting from the growing insect business. Thailand also profits from insects imported from neighbouring countries (Myanmar, Laos and Cambodia), which have higher rates of malnutrition (Chaparro *et al.*, 2014; FAO, 2015). From a food security perspective it might make more sense if these insects were eaten locally where they are collected, rather than being further concentrated in the regional centre of economic power. Whether insects' commercialisation empowers the underprivileged will largely depend on the distribution of benefits within the trade chain. Currently, the popularity of insects among affluent urban milieux in Thailand and the subsequently rising prices mean that people who are used to enjoying certain insects as normal food can no longer afford them. Overall, the Thai insect trade creates opportunities for some, but is increasingly reproducing social inequalities.

Lack of transparency

The lack of transparency in business and academia shows that power relations are often hidden. We found that a great deal of information crucial for addressing our main research question was inaccessible. For example, most academic publications did not acknowledge their source of funding, which limits our understanding of the financial drivers of research, and by extension, hegemony. Similarly, many companies did not offer information about the owners' educational status, the ownership of farming sites, the exact origin and even species of insects, and the source of starting capital. The fact that many companies obtain their insects from external suppliers (Supplementary Material S4) suggests that details about their production background may not even be known to the owners themselves. It is therefore impossible to verify marketing claims, to investigate to what degree established power relations are being challenged, or for consumers, to fully comprehend the ecological, social, and other effects of their purchase.

5. Conclusions

The promotion of 'entomophagy' may both challenge and reproduce power relations at the same time. Whether edible insects are 'doing good' or not is therefore impossible to answer universally. But our research demonstrates that it is important and fruitful to ask: what are the general trends and the effects in specific contexts, and above all – who benefits from them?

On the one hand, the potential of insects as food remains. The informal local use of edible insects already contributes to food security in various ways. Growing markets for edible insects offer new low-threshold opportunities for innovative

entrepreneurs and small companies that could challenge current power structures, offer cheaper and accessible insect food products that will eventually be successfully marketed as meat alternatives, and facilitate trade that benefits the underprivileged. The increasing prominence of the topic in academia may also offer researchers in 'less developed' countries an opportunity to publish research that is internationally recognised.

However, much of our data suggests that these hopes and claims do not align with the current practices of the expanding edible insect trade and discourse. Our literature and company/product reviews indicate a dominance of 'developed' regions over structurally marginalised ones, both in academia and business. These patterns of social exclusion are also evident on a regional level in the Thai insect trade. Our data suggest that the current activities of the edible insects movement do not significantly benefit those who it claims to empower, and that this tendency may intensify with time.

To realise the potential of edible insects in a democratic way, we recommend more 'power-aware' approaches to all practices involving edible insects. We direct this conclusion to all actors within the field of edible insects such as consumers, media, and the broader public, and given the likely audience of this article we particularly address our recommendations to people and institutions of higher power positions in areas such as academia, business, and governance – as one may suspect that these actors possess the greatest capacity to enact them. Specifically, we recommend:

- the acknowledgment that deep structural inequalities and power imbalances exist and that they can and should be challenged;
- critical consideration of who produces, who controls, and who benefits, at the outset and throughout business and research initiatives;
- detailed research on the relationship between entomophagy and power involving other languages, regions, methods and contexts, and insects as feed;
- the inclusion of marginalised voices in research, business, and governance: not just speaking about people, but letting them speak for themselves;
- accountability and transparency in research, governance and trade.

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Author contributions

All authors were involved in developing the concept and research question, designing methods, collecting and analysing data, and writing and editing the manuscript. AM developed the original concept, conducted the fieldwork, and wrote the first draft of the manuscript; JE and CP took main responsibility for editorial oversight, CP for the literature review, AM and RR for the product and company review and RR for the marketing claims analysis. All authors contributed to incorporating reviewers' comments and making final revisions.

Supplementary material

Supplementary material can be found online at http://doi.org/10.3920/JIFF2016.0010.

Supplementary Material S1. Literature review database.

Supplementary Material S2. Search strategy for company and product data.

Supplementary Material S3. Product review database.

Supplementary Material S4. Product review database.

Supplementary Material S5. Table including the categories and codes used in an analysis of marketing claims from edible insect products.

Supplementary Material S6. Table showing marketing claims categories' code results for the total number of companies and products selling edible insects as food.

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