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Deceit with decapods? Evaluating labelling accuracy of crustacean products in South Africa

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ABSTRACT

Despite the high value of decapod crustaceans, relatively little research has focused on assessing the transparency in the marketing of these species. This study represents the first comprehensive evaluation of the quality of labelling, and the extent of mislabelling, of decapod crustacean products on the South African market. Data collected through surveys of supermarkets and seafood shops in three provinces (KwaZulu-Natal [KZN], Western Cape [WC] and Gauteng [GP]), indicated that the large majority of domestically available crustacean products were imported, but that 18% of these failed to comply with locally applicable country of origin labelling regulations. Voluntary information relating to the scientific name, production method (wild caught or farmed), and capture method of the species was supplied more frequently in supermarkets than in seafood shops, more frequently in the WC and GP than in KZN, and more frequently on shrimp products than on crab and lobster products. DNA sequencing of 77 products collected from the surveyed outlets revealed that 24 (31%) were misrepresented in some way. Species misrepresentations were most pronounced for shrimps, with *Litopenaeus vannamei* and *Pleoticus muelleri* being confirmed as the most common substitute species. One shrimp product was found to contain at least three different species, none of which matched the declared species, whereas a product labelled as crab turned out to be a member of the phylum Mollusca rather than the subphylum Crustacea. Overall, these findings demonstrate that the misrepresentation of crustaceans is commonplace on the South African market, signalling the need for a revision of the current seafood labelling and traceability legislation, as well as monitoring and enforcement efforts.

1. Introduction

Seafood serves as a primary source of protein for almost one billion people, supports the livelihoods of hundreds of millions, and is one of the most highly traded food commodities in the world (FAO, 2014). Among the staggering number of aquatic species used for human consumption, decapod crustaceans – including prawns, shrimps, crabs, lobsters and crayfish – underpin lucrative fisheries across the globe and deliver some of the highest prices per weight of any seafood. Due to the high demand for these species, the global production of decapod crustaceans has doubled since 2000, reaching over 12.5 million tonnes in 2013 and accounting for *ca.* 8% of total global fisheries production (FAO, 2016). Whereas wild decapod catches have remained relatively stable over the last decade, the rapid increase in the global supply largely reflects the dramatic growth in aquaculture production, predominantly in Asia (Bondad-Reantaso, Subasinghe, Josupeit, Cai, & Zhou, 2012). Prawns and shrimps[2] comprise the bulk of the world's decapod supply (63%, 7.8 million tonnes in 2013), about 44% of which are currently wild caught and 56% are farm raised (FAO, 2016). Three groups of shrimp have major economic importance, namely the Penaeoidea, including penaeid shrimps of the genera *Penaeus*, *Metapenaeus*, *Parapenaeopsis* and *Trachypenaeus*, the Caridea, including the genera *Pandalus* and *Heterocarpus*, and the paste shrimp (Sergestoidea) of the genus *Acetes* (Gillett, 2008). Nonetheless, the production of just one species – whiteleg shrimp (*Litopenaeus vannamei*, also called

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[2] The terms “shrimp” and “prawn” are applied variably and often inconsistently in different regions of the world, but have no definite reference to any known taxonomic group (Gillett, 2008). For simplicity, the term shrimp is used in this paper to include prawns as well, except when referring to specific names (e.g. giant tiger prawn).

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Penaeus vannamei) – contributed 42% of the global shrimp supply and 27% of the total decapod crustacean supply in 2013, the latter being derived almost exclusively (>99%) from aquaculture (FAO, 2016). The global trade in decapod crustaceans is extensive, totalling over 3 million tonnes (USD 29 billion) in 2013. China, Vietnam and India dominate exports, while the United States (US), Europe and Japan are the primary importers. Shrimps contributed >16% of global seafood export earnings in 2013 and, along with salmon, represent the most important internationally traded fishery products in value terms (FAO, 2016).

While the crustacean sector undoubtedly contributes meaningfully to food security, employment and foreign exchange revenue in many countries (Gillett, 2008), the insatiable demand for these products has come at a high cost. Wild shrimp resources are strongly exploited in all target fishing areas, being fully exploited in the Atlantic Ocean, and showing signs of overexploitation in the Indian Ocean (primarily *Penaeus monodon*) and in the Eastern Central Pacific (Bondad-Reantaso et al., 2012). Trawl gear is a major characteristic of most large-scale fisheries employed to capture wild shrimp, the use of which can have serious ecological impacts on the seabed and benthic fauna (Gillett, 2008). Moreover, shrimp trawlers produce exceptionally large amounts of bycatch, including turtles, marine mammals and several hundred teleost species, which may outweigh the shrimp catch by more than 20 to 1 (Eayrs, 2007). With limited storage capacity, these vessels account for over 25% of total world discards (*ca.* 1.8 million tonnes annually), not only wasting important aquatic food protein sources, but also jeopardising heavily exploited, endangered or rare species (Bondad-Reantaso et al., 2012; Kelleher, 2005). Furthermore, illegal, unreported and unregulated (IUU) fishing poses a serious threat to sustainable crustacean fisheries, potentially involving 10–45% of crab products entering world markets from Asian regions, 20–45% of shrimp entering from some South American regions, and 2–5% of lobster entering from Canada (Pramod, Nakamura, Pitcher, & Delagran, 2014). Poaching and illegal laundering of rock lobster has also been an ongoing problem in South Africa, contributing to considerable stock declines (Hauck & Kroese, 2006; SSA, 2013). Similar controversy surrounds the ever-expanding crustacean aquaculture industry, with major environmental issues (past and present) including the clearance of mangroves to make way for aquaculture ponds, pollution of coastal waters by aquaculture-pond effluent, reliance on fish meal for farmed crustacean diets, collection of post-larvae or broodstock from the wild for farming operations, as well as the escape of cultured species into the wild and subsequent establishment of non-native populations (Gillett, 2008). High stocking densities in crustacean aquaculture ponds have also led to the proliferation of numerous viral and bacterial diseases, accompanied by the often indiscriminate or unregulated use of antibiotics and other chemical agents to manage this threat (Holmström et al., 2003; Stentiford et al., 2012). In addition, disturbing reports have surfaced documenting a myriad of human rights abuses in the shrimp supply chain and wild capture fisheries used to generate shrimp feed. Exposed abuses include human trafficking, child labour, forced and bonded labour, low and/or withheld wages, excessively long working hours, hazardous working conditions, physical violence, sexual harassment, and even murder (EJF, 2013; 2014; 2015).

Given the aforementioned environmental and human rights concerns, today's increasingly socially-conscious consumers may wish to choose their crustacean products more wisely. In order to make informed selections, however, consumers ultimately rely on the provision of comprehensive and accurate information on seafood at the point of sale. Yet, in spite of many countries enacting stringent legislation relating to the labelling of seafood products, several studies have highlighted the lack of supplier compliance with prevailing regulations and the dearth of information available on seafood packaging to facilitate sustainable purchasing decisions (Cawthorn, Steinman, & Witthuhn, 2011; Meloni, Piras, & Mazzette, 2015; Warner et al., 2014). Moreover, the mislabelling of seafood products, as increasingly being documented in the scientific literature (Pardo, Jiménez, & Pérez-Villarreal, 2016), may prevent proactive consumers from making educated choices in spite of their good intentions.

This study aimed to assess the information that consumers are typically provided with, and to compare this with what they actually receive, when purchasing crustacean products in South Africa; the latter being a country that imports half (>156,000 tonnes annually) of its domestically consumed seafood and the majority of its crustacean products (>10,000 tonnes annually) (FAO, 2016; Kastern et al., 2014; UN Comtrade, 2016). Fulfilment of this aim involved surveying the labels of crustacean products in local retail outlets, identifying selected samples collected from these outlets by means of DNA sequencing and, in so doing, providing the first reliable depiction of the quality of labelling and the extent of mislabelling of crustacean products on the South African market.

2. Materials and methods

2.1. Study and sampling design

Three of the nine South African provinces were selected for labelling surveys and crustacean sample collection, namely the Western Cape (WC), KwaZulu-Natal (KZN) and Gauteng (GP). The WC and KZN were chosen since these are among the most populated provinces in South Africa, are both major fishing provinces and have access to a wide range of seafood species (Cawthorn et al., 2011). GP was additionally included to evaluate crustacean marketing practices in an inland province, as the latter represents an important seafood market, and has the highest population density and per capita income of all the South African provinces. Retail outlets were the focus of this study as these represent a primary channel through which consumers obtain seafood products in the country.

A chi-square power analysis was used to estimate the number of retail outlets to survey in the three provinces, as well as the number of market samples required for DNA-based species authentication, to ensure the statistical relevance of the results. Outlets in each province were designated for the study prior to the commencement of surveys and collections, with the intention of balancing sample sizes from high and low income regions. The outlets investigated included primarily supermarkets (stores selling a variety of food and grocery items) and to a lesser extent seafood shops (stores selling predominantly seafood), with the proviso being that these sell at least three different crustacean products. In order to standardise the survey protocol for supermarkets, six key national supermarket chains were identified that market a range of seafood products, and similar proportions of these supermarkets were visited in each province. Surveys and sample collections were carried out over a 9-month period (May 2015–January 2016).

2.2. Market surveys

A total of 78 retail outlets were surveyed, comprising 63 supermarkets and 15 seafood shops. In each outlet visited, all different chilled and frozen crustacean products were recorded, including single-species items, value-added items (battered, crumbed, breaded, in sauce, etc.) and mixed-species items (containing crustaceans and one or more separable mollusc or finfish species). For each product observed in a given outlet, the level of processing was noted, i.e. whether whole, portioned or processed