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Short Communication

Incorporating carbon footprints into seafood sustainability certification and eco-labels

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ABSTRACT

The seafood industry has become increasingly interconnected at a global scale, with fish the most traded commodity worldwide. Travel to the farthest reaches of the oceans for capture is now common practice, and subsequent transport to market can require hundreds to thousands of miles of travel by sea and air. Refrigeration of seafood products is generally required at all stages of the journey from ocean to dinner plate, resulting in substantial energy expenditure. Energy input for aquaculture (including mariculture) products can also be high, namely due to the large amounts of feed required to support fish growth. As a result of these factors, the seafood industry has a substantial carbon footprint. Surprisingly, however, carbon footprints of seafood products are rarely integrated into assessments of their sustainability by eco-labels, sustainability certification, or consumer seafood sustainability guides. Suggestions are provided here for how carbon footprints could be incorporated within seafood sustainability schemes.

1. Introduction

The seafood industry has become increasingly interconnected at a global scale [1], with fish the most traded commodity worldwide [2]. Travel to the farthest reaches of the oceans for capture is now common practise [3], and subsequent transport to market can require hundreds to thousands of miles of travel by sea and air. Refrigeration of seafood products is generally required at all stages of the journey from ocean to dinner plate, resulting in substantial energy expenditure. Energy input for aquaculture (including mariculture) products can also be high, namely due to the large amounts of feed required to support fish growth (Fig. 1). As a result of these factors, the seafood industry has a substantial carbon footprint [4]. Surprisingly, however, carbon footprints of seafood products are rarely integrated into assessments of their sustainability by eco-labels, sustainability certification, or consumer seafood sustainability guides. Suggestions are provided here for how carbon footprints could be incorporated within seafood sustainability schemes.

2. How big is the seafood carbon footprint problem?

A seafood product's carbon footprint represents the amount of greenhouse gas (GHG) emissions released during its production, transport and consumption, calculated as carbon dioxide equivalent (CO_2e), calculated via established methodologies (e.g., life cycle assessments [LCA] [4]). Carbon footprints vary widely among seafood products (Fig. 1). A study of more than 20 Norwegian seafood products delivered to various endpoints globally found a range of carbon footprints from 0.7 to 14.0 kg CO_2e per kilogram edible product [4]. In addition to fuel use in fishing and feed production in aquaculture, key inputs to carbon production in this study were refrigerants used on fishing vessels, product yield, and by-product use [4] (Fig. 1). These findings demonstrate that seafood products can have carbon footprints that are extremely large (i.e., up to 14 times that of the product's own weight) and, importantly, that some seafood products have much lower carbon footprints than others – a characteristic that could potentially be selected for by consumers and/or sustainability certification criteria (Fig. 2a). The seafood industry's carbon emissions may contribute to an adverse positive feedback loop whereby climate change-induced changes to marine ecosystems and fisheries stocks lead to decreased catchability of some species [5] and increased energy input needed to produce a given amount of seafood [6].

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3. Incorporating carbon footprints into seafood sustainability

In recent years, sustainability certification, labels and guides, collectively referred to as "seafood awareness campaigns" [7], have become increasingly popular as a means of encouraging more sustainable industrial methods and consumer choices (Fig. 2b). These programs set voluntary sustainability standards for industries and/or provide sustainability standards against which consumers and businesses can make choices. In the seafood industry, sustainability standards typically evaluate three key aspects of fisheries: (1) the level of harvesting pressure and fish stock relative to "safe" levels, (2) the use or exclusion of environmentally harmful fishing practices, and (3) the effectiveness of the fisheries' management system(s) [8].

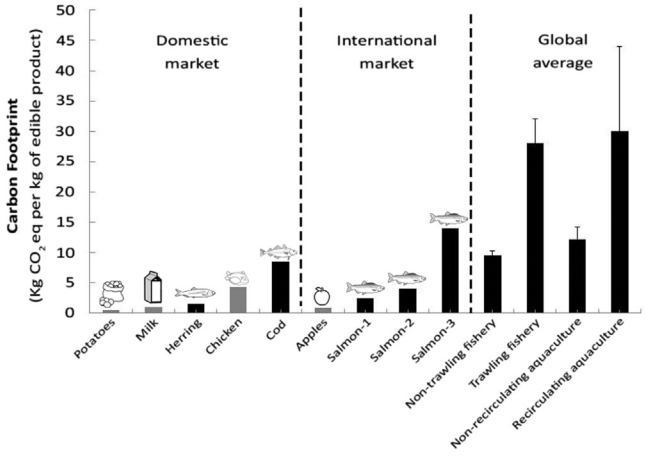

Fig. 1. Examples of carbon footprints for common seafood (black) and non-seafood (grey) products of Norway and Sweden (sections "Domestic market" and "International market") and examples of global averages of various seafood industries (section "Global average"). Apples were imported from overseas by boat. Salmon products were all from aquaculture that underwent export from Norway via different transport methods: 1=to Paris via truck; 2=to Shanghai via boat; and 3=to Tokyo by airfreight. Scandinavian data sourced from [4,20] and global averages from [21].

This study proposes another important way in which seafood awareness campaigns can be improved: through explicit consideration of the carbon footprint of seafood products. Including carbon footprints into their certification criteria would provide a more wholistic basis for consumers and businesses to assess the sustainability of seafood products. This proposition is in line with recent calls by leaders in the field for seafood awareness campaigns to include the full seafood-production process into sustainability assessments [9] and has been suggested as a useful next step for wild-caught seafood eco-labels [10]. Explicitly considering carbon footprints would allow these campaigns to have a potentially far more powerful net effect by not only helping to mitigate specific environmental impacts of each fishery, as many currently aim to do, but would broaden their impact to confronting the global-scale problem of climate change. Given the substantial per-unit-product carbon emissions of fisheries, this is an area of environmental sustainability in which consumer and business choices could potentially have a large impact.

While a number of "single-issue" carbon footprint eco-labels for other industries have been implemented – i.e., those that specify the exact or relative carbon footprint of a product and rank it on this basis only – it is suggested that this measure should be considered alongside other key sustainability criteria to generate a robust measure of a seafood product's overall sustainability. To our knowledge, only one

Fig. 2. Photos of (a) gummy shark *Mustelus antarcticus* being packed on ice for transport for the "fish and chip" industry; (b) popular seafood products found in Australian supermarkets containing sustainability certifications, including the Marine Stewardship Council's "Certified Sustainable Seafood" products; (c) small-scale fisheries in Indonesia selling fresh, locally-caught fish; and (d) flowers grown in Holland are air freighted to Hong Kong. Photo credits: Peter Macreadie.

international seafood awareness campaign, Friend of the Sea, explicitly incorporates carbon footprints into its selection criteria and one smaller-scale domestic seafood eco-label, Swedish KRAV [4], does so. While many campaigns have energy and pollution consideration built into their assessment criteria [9], none of the most widely recognized or scientifically rigorous campaigns, including the world's largest by far (Marine Stewardship Council, or MSC), incorporate climate effects in any explicit fashion. Nonetheless, the idea of incorporating carbon footprints into the criteria used in these campaigns has the support of at least one major international conservation NGO, the World Wildlife Fund (WWF; [11]). Likewise, Food and Water Watch, an environmental and consumer rights NGO organization, has identified this gap as a concern with existing seafood eco-labels [12]. Given recent calls for overhaul of, for example, the MSC certification programme [13], as well as calls for integrating other sustainability criteria (such as pre-emptive credits for fisheries that set aside no-take areas [8]), inclusion of carbon footprints into its criteria would seem an obvious and important step towards increasing its potential to ensure environmental sustainability.

4. Benefits and methods of integrating the carbon footprint

Inclusion of carbon footprints into seafood awareness campaigns could potentially have a number of key benefits on both the consumer and producer ends of the seafood industry. First, giving consumers and businesses (e.g., restaurants) information about the relative contribution to climate change that one product has versus another may promote lower carbon footprint products (e.g., by shifting buying towards locally-produced seafood (Fig. 2c)) or, conversely, towards imported products that have a lower carbon footprint than locally-sourced products (e.g., Fig. 2d). This could come about through a number of mechanisms. Limited evidence suggests that giving consumers access to information about other aspects of seafood sustainability can lead to preferential buying of lower-environmental impact products when presented with a range of choices varying in environmental impact [14]. Conversely, consumers' choices can be constrained through retailers stocking only “sustainable” seafood products. Evidence to date suggests that the latter mechanism may be more likely to have a substantial impact on consumption patterns, given that uptake of seafood eco-labels by a number of major retailers has already occurred and continues to grow [e.g., Wal-Mart, Whole Foods, Tesco (but see [18]); [9]]. By including carbon footprint criteria, these actions could potentially increase both consumer and industry awareness of the impact of the seafood industry on climate change, opening up the potential for specific fisheries to consider if and how they could modify operations to achieve lower carbon footprints and thus potentially greater demand by retailers and/or consumers.

A seafood product's carbon footprint can be measured through life cycle assessment [4]. This assessment results in a net carbon contribution of a specific product, from “cradle to grave”, for a given point of origination and point of sale (e.g., [4]). Carbon footprints could be integrated into existing sustainability certifications, eco-labels, and/or consumer guides via regionally-specific labels or guides. At least one major, scientifically-robust consumer guide (the Monterey Bay Aquarium's *Seafood Watch* guide) already produces regionally-specific guides for different areas that reflect the regional availability of different seafood products. Carbon footprint could be added as an additional criteria calculated as an average over spatial scales that match these existing regional guides, for example. Alternatively, campaigns could provide consumers, retail businesses and seafood producers with information tables of various products' estimated carbon footprints to cover various combinations of points of origin and sale. One seafood certification organization, Friend of the Sea, has done so partly by devising a carbon footprint calculator. This tool allows users to input distance travelled and method of transport and subsequently returns the product's transport-generated CO_2 emissions [15]. This organization further provides the option for fisheries to buy carbon offsets (through the organization), in turn receiving “credits” towards reducing their carbon footprints that are presumably reflected in their calculator. Various other possible methods of carbon footprint integration could be tailored to other existing seafood awareness campaigns or integrated from the outset in future campaigns.

5. Key considerations and limitations

As with any change to the status quo, a number of challenges must be considered with regard to incorporating carbon footprints into seafood awareness campaigns. Indeed, each stage of the carbon labelling process raises issues which must be addressed, such as agreeing upon a standard methodology for calculating carbon footprints (e.g., life cycle analysis, or LCA), collecting adequate and reliable data, establishing a trusted verification process, and determining how best to present carbon footprint information to consumers and businesses within a sustainability certification, eco-label, or consumer guide. In many cases, even with a standard methodology, a lack of product-chain information could hamper efforts to calculate a carbon footprint in the first place [16]. On a related note, as with the information given in most types of non-eco-labels, the accuracy of the carbon footprint component of any eco-label or sustainability guide would be difficult, if not impossible, for consumers to check. Another challenge faced would be how to weight the carbon footprint component of a given campaign against the other environmental measures it considers (e.g., fisheries' harvest sustainability and other environmental criteria [4] and social development and economic considerations [9]). One possible solution to this issue is for international campaigns to tailor the specific weighting of carbon footprint versus other criteria to individual countries or regions, as has been done with the Forest Stewardship Council's criteria [17]. Lastly, the cost of generating the carbon footprint information for any given product will be an important consideration for its ultimate feasibility. As an example, UK's supermarket-giant Tesco recently dropped its highly-publicized adoption of the Carbon Trust's carbon reduction label on many of its products, citing the prohibitive time and costs involved in researching products' carbon footprints [18]. Likewise, only a tiny fraction of small-scale fisheries from developing nations, which collectively make up the majority of fisheries worldwide [7], are currently certified by MSC [13] – a likely consequence of the prohibitively high cost of becoming certified. The cost of adding yet another certification criteria, such as carbon footprint, would need to be factored in so as not to further this imbalance.

6. Moving forward

This study has proposed that integrating carbon footprints into existing and future seafood awareness campaigns would create more holistic yardsticks by which the environmental impact of fisheries products can be assessed by consumers, retail businesses and producers. Emerging technologies and tools, such as the recently launched Global Fishing Watch (www.globalfishingwatch.org), will increasingly facilitate accurate calculation of specific seafood sectors' – and even potentially individual vessels' – carbon footprints. The debate surrounding the inclusion of carbon footprints into sustainability campaigns in other industries is recognized – namely, that inclusion of carbon accounting into existing sustainability certification programs may overshadow other

environmental and/or social objectives – and seafood awareness campaigns can learn from these industries' dialogues. The inherent interrelatedness of fishing pressure and climate change on fish stocks has led to calls for them to be addressed jointly [19]. This study proposes that seafood awareness campaigns provide one avenue for doing so. Importantly, both the scale of international fisheries trade (e.g., [3]) and the potential effects of future climate change on increasing variability in fisheries stocks [19] suggests that sustainability campaigns within the realm of the seafood industry have both substantial responsibility and incentive to be at the forefront of this new approach.

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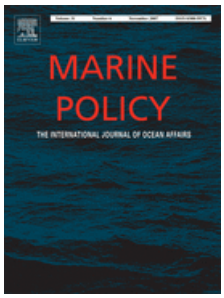

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