Global Environmental Change 35 (2015) 116–124

Contents lists available at ScienceDirect

Global Environmental Change

journal homepage: www.elsevier.com/locate/gloenvcha

Wasted seafood in the United States: Quantifying loss from production to consumption and moving toward solutions

Dave C. Love[a,b,*], Jillian P. Fry[a,b], Michael C. Milli[a], Roni A. Neff[a,b,c]

[a] Center for a Livable Future, Johns Hopkins University, Baltimore, MD, USA
[b] Department of Environmental Health Sciences, Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD, USA
[c] Department of Health Policy and Management, Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD, USA

ARTICLE INFO

Article history:
Received 3 March 2015
Received in revised form 23 August 2015
Accepted 28 August 2015
Available online xxx

Keywords:
Aquaculture
Bycatch
Fisheries
Food systems
Food waste
Food loss
Nutrition
Seafood
Sustainability

ABSTRACT

Based on the average level of seafood consumption in the United States (U.S.), the 2010 Dietary Guidelines for Americans encourages citizens to double their intake to improve the health of their diets. The future availability of seafood, however, is threatened by overfishing, unsustainable seafood farming practices, ocean pollution and acidification, and other factors. The growing global population and advancing ecological threats such as climate change are placing increasing demands and constraints on U.S. and global seafood supplies. Waste reduction has the potential to support increased seafood consumption without further stressing aquatic resources. It is essential to quantify waste levels in order to effectively target and design waste reduction interventions. Accordingly, we used previous multi-country regional research and updated datasets to calculate a country-specific (U.S.) estimate of seafood loss for the years 2009–2013. We estimate that 40–47% of the edible U.S. seafood supply went uneaten in this period. The greatest portions of this loss occurred at the levels of consumers (in and out of home) (51–63% of loss attributed to consumption), bycatch discarded by commercial fishers (16–32%), and in distribution and retail operations (13–16%). Based on conservative estimates, this waste represents 208 billion grams of protein, 1.8 trillion mg of eicosapentaenoic (EPA) and docosahexaenoic (DHA) acids (i.e., omega-3 fatty acids), and 1.1 trillion kilocalories. The seafood that is lost could fill 36% of the gap between current consumption and U.S. Department of Agriculture-recommended levels. As another way of understanding the magnitude of loss, this lost seafood could provide the total yearly target quantity of protein for 10.1 million men or 12.4 million women, EPA + DHA for 20.1 million adults, and calories for 1.5 million adults. The lost nutrition estimates we provide are meant to be illustrative of the issue's significance and magnitude. While a significant portion of the loss could be prevented or recovered for human consumption, we do not intend to suggest that all of it could or should become food for humans. Bycatch is generally best left in the water; some seafood loss is not culturally acceptable, marketable, nutritious or safe; and a portion of loss is also unavoidable. Instead, we discuss waste prevention strategies involving governments, businesses, and consumers that can be employed to reduce seafood loss and create a more efficient and sustainable seafood system..

1. Introduction

Fish, crustaceans, and shellfish (which we refer to as seafood or fish) play an important role in human nutrition as a source of protein and healthy fats (Gormaz et al., 2014). Historically, fish were an abundant source of food for many civilizations, though overfishing and habitat destruction over several hundred years have greatly reduced global fish stocks and damaged aquatic ecosystems (Jackson et al., 2001; Lotze et al., 2006). While global harvests of wild seafood have remained static since the 1990s, certain fisheries have collapsed and no longer provide a significant food source for humans (FAO, 2014b). For fish populations to rebound, it is necessary to reduce or avoid harvesting some fish species for a period of time (among other approaches) (Worm et al., 2009), thereby significantly reducing the amount of harvested wild seafood. Despite these challenges, global availability of seafood per capita has risen in recent decades due to growth in aquaculture production (FAO, 2014b).

Aquaculture, the rearing of aquatic plants and animals in controlled settings, grew at an annual rate of 8.6% from 1980 to

* Corresponding author at: 615 North Wolfe Street, Room W7010, Baltimore 21205, MD, USA. Fax: +1 410 502 7579.
E-mail address: dlove8@jhu.edu (D.C. Love).

http://dx.doi.org/10.1016/j.gloenvcha.2015.08.013

2012, and now provides about half of all seafood consumed globally (FAO, 2014b). Aquaculture production methods vary greatly around the world and by species, and some methods are associated with ecological and/or public health concerns, including use of wild fish in aquaculture feed, occupational health risks, release of pollutants into the surrounding environment, disease transfer between farmed and wild animals, and fish escapes (Fry et al., 2014; Gormaz et al., 2014; Love et al., 2011). Seafood available to United States (U.S.) consumers (i.e., the edible seafood supply) includes a variety of wild caught and aquacultured species, both from domestic sources and imported from as many as 138 nations (Kirkley et al., 2006). Five of the top-ten most consumed species in the U.S. are sourced mostly from aquaculture (National Fisheries Institute, 2014; NOAA, 2013b).

The 2010 U.S. Dietary Guidelines for Americans recommend increasing seafood consumption to 8 ounces per person per week, and consuming a variety of seafood in place of some meat and poultry (USDA, 2010). In fact, the National Health and Nutrition Examination Survey (NHANES) data suggest that adults consume a median of only 3.0 ounces per person per week (Papanikolaou et al., 2014) from a U.S. edible seafood supply of 4.5 ounces per person per week (NOAA, 2014a). Jahns et al. (2014) determined that 80–90% of Americans were not meeting seafood recommendations; and women, young people, and people with lower incomes consumed less seafood. Achieving government-recommended consumption levels would require doubling the U.S. seafood supply and nutrition programs targeting specific groups of consumers. The amount of seafood available to U.S. consumers, however, has remained relatively constant for four decades. Increasing this supply places greater burden on marine ecosystems, and could contribute to food insecurity in low-income countries and coastal communities (Brunner et al., 2009; Greene et al., 2013; Jenkins et al., 2009).

Accordingly, interventions are being considered to ensure the viability and continuity of U.S. and global seafood supplies. In the fisheries and aquaculture sectors, there is ongoing work to address overfishing, minimize the ecological and public health risks in aquaculture, adapt to climate change, and build resiliency into the food system, though there are significant barriers to addressing these challenges on a global scale (Cochrane et al., 2009; Gormaz et al., 2014; Troell et al., 2014; Worm et al., 2009).

Given the many challenges of increasing supply, reducing loss is an attractive way to incorporate additional seafood into the domestic supply. For the purpose of this study, we used the U.S. Department of Agriculture (USDA) definition of food loss as "the edible amount of food, postharvest, that is available for human consumption but is not consumed for any reason. It includes cooking loss and natural shrinkage (for example, moisture loss); loss from mold, pests, or inadequate climate control; and food waste" (USDA, 2014b). USDA defines food waste as "the component of food loss that occurs when an edible item goes unconsumed, as in food discarded by retailers due to color or appearance and plate waste by consumers," (USDA, 2014b) however for simplicity we refer to both food loss and waste as "food loss." Current estimates suggest that in the overall U.S. food system, 31–40% of the postharvest food supply is lost (Buzby et al., 2014; Hall et al., 2009). While a slightly higher proportion of seafood than of other food types is lost at the consumer level (Buzby et al., 2014), the total amountof loss from chicken, beef, or pork, for example, is larger due to a larger supply of these animal products (Fig. 1) (USDA, 2014a). We identified two prior estimates of lost seafood in the U.S., although those estimates were based on studies limited to certain segments of the supply chain, or representing larger geographic regions. Buzby et al. (2014) at the USDA estimated that at the retail and consumer levels, 39% of seafood in the U.S. is lost; they estimated per capita seafood loss based on this quantity (Fig. 1). Gustavsson et al. (2011) reported that the North America and Oceana region (Canada, U.S., Australia, and New Zealand) had the highest fraction of seafood loss (50%) of any region in the world. According to their research, losses were primarily attributable to bycatch (when fishers catch and discard non-target species) and consumers. Stakeholders and researchers have been using these regional estimates as a proxy for U.S. seafood loss (Gunders, 2012). Our study refines and extends our understanding of U.S. seafood loss by providing estimates focused on the entire U.S. supply chain, using the most recent fisheries data, reporting data variability and data quality, and estimating lost nutritional value. Developing improved loss quantifications provides a baseline that can be used to measure progress in loss reduction, establish valuable evidence to inform intervention design, and enable better-targeted loss prevention programs and policies.

Of all foods that are lost, we focus on seafood for multiple reasons. First, there was a need for improved country-specific data on seafood losses. We have described seafood's important nutritional role in the human diet, the limited availability of aquatic resources, and concerns about alternate strategies for increasing seafood supply, and the high proportion of wastage. In addition, seafood has several characteristics that may make it particularly prone to wastage. These include: (i) fishing methods (e.g., bottom trawling) that lead to bycatch (some of the non-target

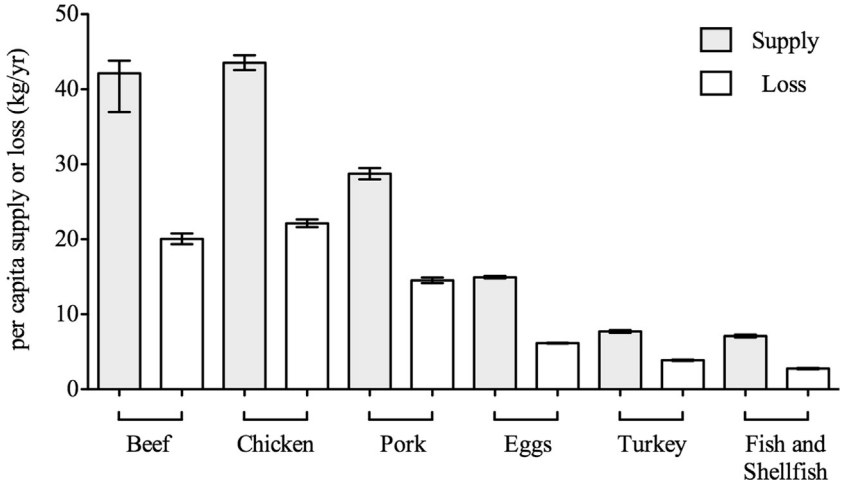

Fig. 1. Per capita meat supply (unadjusted for loss) and loss from 2000 to 2012 in the United States. Bars are median values and error bars are minimum and maximum values. Data from (USDA, 2014a).