

## Small-scale fishing households facing COVID-19: The case of Lake Victoria, Kenya

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### ABSTRACT

Small-scale fisheries underpin the aquatic food supply, and are facing acute challenges in the wake of the COVID-19 pandemic. The study aimed to examine how small-scale fishing households, including fishers and fish traders, are responding to COVID-19 and associated movement restrictions around Lake Victoria, Kenya. We conducted phone interviews with 88 households in three riparian communities around Lake Victoria to examine shifts in fish consumption, fishing activities, price changes, and coping strategies. We found that households are consuming less fish, perceiving high fish prices, and coping by more often selling than eating fish. Most fishers and traders reported spending less time fishing and trading, and concern about being infected with COVID-19 was high. Our findings suggest movement restrictions and COVID-19 concern, along with high lake levels in the region, may limit fishing activities and fish access. Controlling COVID-19 and supporting opportunities for fishers and traders to safely return to their livelihood activities will be paramount to the recovery of small-scale fishing communities today. Our findings can also support planning to mitigate the impacts of future crises on small-scale fishing communities.

### 1. Introduction

COVID-19 is an acute shock with global ramifications, including for small-scale fishing households. Some 10 % of the global population depends on small-scale fisheries for their livelihoods (FAO, 2014, 2016), and fishing communities' diets often rely heavily on fish to meet protein, fatty acid, and micronutrient needs (FAO, 2020). COVID-19 is laying bare existing vulnerabilities within small-scale fisheries (Knight et al., 2020) and threatening the well-being of small-scale fishing households as it disrupts fish supply and demand, fish distribution, labor, and production (Love et al., 2020).

Early research projecting the effects of COVID-19 on small-scale fisheries around the world has highlighted a range of concerns (Bennett et al., 2020), and preliminary results are emerging in several fisheries. In Bangladesh, interviews with fishers and experts have shown rising food insecurity among fishing communities (Sunny et al., 2021). In Sabah, Malaysia, researchers found that mobility control measures are negatively affecting fish trading and thereby small-scale fishers

(Jomitol et al., 2021). At the same time, crowding at fish landing sites in Ghana suggested the potential for the spread of COVID-19 within the fisheries sector (Okyere et al., 2020).

This early evidence of COVID-related impacts within individual fisheries is part of a much larger pattern of vulnerability for small-scale fisheries. Fish are widely traded (Gephart and Pace, 2015) and the reliance of many small-scale fishers on global markets leaves small-scale fishing livelihoods uniquely vulnerable when global supply chains falter or prices drop (Kolding et al., 2019). Furthermore, broad ecological and climate forces are driving global declines in fish catch (Free et al., 2019), jeopardizing critical income and micronutrient access for large swaths of low- and middle-income populations (Golden et al., 2016). Erratic rainfall, warming temperatures and harmful algal blooms form the backdrop for fishery-dependent communities during the COVID-19 pandemic (Aura et al., 2020a; Roegner et al., 2020; Simiyu et al., 2018; Thiery et al., 2017).

The study aims to extend understanding of the COVID-19 pandemic's early impacts on fishery-dependent communities through an

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examination of data at the household-level. To do this, we use a phone survey with small-scale fishing households around Lake Victoria, Kenya who are facing the COVID-19 pandemic and associated policies that restrict movement. Our study is one of the first efforts to examine how COVID-19 is shifting a) fish consumption within small-scale fishing communities, while also investigating changes in b) fish prices and c) fisher and fish trader activities.

### 1.1. COVID-19 around Lake Victoria, Kenya

Lake Victoria supports the largest lacustrine fish harvest in the world and some 30 million people living in the Lake Victoria basin (FAO, 2016). Lake Victoria fish have a global reach, particularly to markets in Europe and the Middle East, making them profitable yet also vulnerable to global market forces (Marshall and Mkumbo, 2011). Nile perch (*Lates niloticus*), *dagaa*, a native sardine-like species (*Rastrineobola argentea*) as well as tilapia (*Oreochromis niloticus*), are the key commercial species of Lake Victoria, with native cichlids and a range of endemic species also contributing to local harvests (Aura et al., 2020a). Lake Victoria fisheries have undergone nearly a century of ecological change following the introduction of non-native Nile perch and continuous shifts in fishery dynamics in response to intense demand and eventually resulting declines in catch, and connections to global markets (Johnson, 2010). Moreover, Lake Victoria faces a suite of vulnerabilities related to contemporary climate and ecological change (Aura et al., 2020a).

In Kenya, like much of the world, COVID-19 prompted quickly-evolving policies aiming to restrict population behavior and movement. The ministry of health confirmed the first case of COVID-19 case on March 12, 2020 (Kenya Ministry of Health, 2020). All schools closed on March 15; a nationwide social distancing order with a ban of social gatherings, including religious gatherings, began on March 23; flights

were grounded on March 25; a nationwide mandatory curfew from 7:00PM-5:00AM began March 27; and cessation of movement in and out of Nairobi Metropolitan Area, and Mombasa, Kilifi, and Kwale Counties (which did not include regions around Lake Victoria) began April 6–8 (Kenya Ministry of Health, 2020). While efforts to stop the spread of the virus were on-going, several presidential directives aimed to provide reprieve to economically vulnerable sectors, including 100 % suspension of taxes for low income earners in addition to pay-as-you-earn and value-added tax reductions (Mbae, 2020) and private sector measures such as reduced fees for mobile Mpesa transfers. By early July, domestic restrictions began lifting and domestic and international flights resumed on July 15 and August 1, respectively (Ministry of Health 2020). These measures potentially contributed to changes in the market destinations of fish and affected all aspects of fish value chains through impacts on jobs, incomes, and food security risk (Aura et al., 2020b).

When our survey took place, during the week of June 5, 2020, Kenya's official average daily infection rate had climbed to 85 people infected per day (Oluoch, 2020), though actual infection rates are unknown. Following the lifting of movement restrictions, official case counts continued to climb sharply and by July 25, 2020, there were 16,643 reported COVID-19 infections in Kenya (Ministry of Health, 2020).

## 2. Methods

We conducted an in-person survey that focused on perceptions of harmful algal blooms and patterns of fish consumption in small-scale fishing communities from March 12–20, 2020. For this survey, we purposively selected 8 fishing communities representing high or low exposure to harmful algal bloom intensity based on satellite data and local knowledge of harmful algal bloom patterns. Within selected communities, we randomly sampled 30 households from complete



Fig. 1. Map showing study communities at Lela, Kananga, and Dunga on Lake Victoria's Nyanza Gulf.

household listings for each community. The survey was halted due to COVID-19, after we completed data collection with three communities (Dunga, Kananga, Lela; Fig. 1). These three communities are all exposed to high intensity of algal blooms, which largely stems from city effluent. Dunga is near Kisumu, Kenya's third largest city, while Kananga and Lela are near Homa Bay, a regional city in Homa Bay County. To collect data to understand the impact of COVID-19 in fishing communities, we began follow-up phone interviews with the 90 previously surveyed households in Dunga, Kananga, and Lela on June 5th, 2020.

In our follow-up survey, the objective was to build on our recent contact with the survey households to examine how the COVID-19 pandemic and the policies associated with disease control impacted fishing households. The phone survey followed up on households' fish consumption from the in-person survey, and asked new questions about coping strategies, fishing and trading activities, prices, and included an open-ended question about COVID-19 impacts. We were able to interview 88 of 90 originally-interviewed households (1 original household was unable to be located, 1 respondent had died before the follow-up of unknown causes presumed unrelated to COVID-19). In our original study we sampled broadly and aimed to include both itinerant fishers and more permanent residents. We might expect that fishers who are more likely to migrate might have departed for another place during the COVID-19 restrictions, but as we had very little attrition among our study population it is possible that our population was largely comprised of more resident individuals.

To explore the ways that COVID-19 and associated policies affected fisheries, we use the following methods. We checked fish consumption data for normality and outliers and then compared consumption before and during the COVID-19 pandemic using McNemar's test for paired samples. We report associated p-values and bold values where  $p < 0.05$ . We chose to use paired tests due to the limited sample size and primary goal of comparing before and after results. Respondent reports of price and livelihood behavior changes were captured only in the phone survey, and we express these findings through descriptive statistics. Note that fishing and trading activities were asked only of fishing ( $n = 46$ ) and fish trading households ( $n = 28$ ), therefore a subsample of phone survey respondents was used for this analysis.

We recognize several potential limitations in our data and methods. First, without a control group, it is not possible to know whether any changes we observe from our time point before to our time point during the pandemic were due to COVID-19, or to other factors that took place at the same time, such as other environmental changes, the shift in data collection from in-person to phone surveys, or something else. We thus cannot attribute changes to the COVID-19 pandemic. To reduce this concern, the ideal follow-up timing would also include a comparison to the same time period in 2019 to better understand seasonal differences. Second, phone surveys can be impersonal and vulnerable to bias related to network availability and battery charging limitations, or poor response rates due to unwillingness to answer unknown phone numbers. However, evidence suggests that some challenges are alleviated when the survey is conducted after an initial in-person contact has been made (Dillon, 2012). We credit our low attrition (2.2 %) to the rapport built by enumerators during initial interviews. Third, because the original in-person survey was interrupted by COVID-19, we were not able to interview the complete sample of households as originally intended. However, we were able to fully follow the sample selection protocol for the three villages interviewed, making our results valid for those three villages but further generalization should be made with caution. Finally, retrofitting an existing survey to investigate a new set of questions during a rapidly-evolving situation necessarily requires tradeoffs. We relied on respondent perceptions of COVID-19-related impacts, as well as pre-COVID-19 and during-COVID-19 observations of limited items. We cannot rule out the possibility of contemporaneous events influencing respondent perceptions of COVID-19 impacts; however, we believe that the experiences of fishers are a valid starting point for understanding initial impacts and guiding future research.

### 3. Results and discussion

The households in our study were closely linked to the Lake Victoria fishery. Among the 88 households, 64 % had a fisher, trader, or both. The remaining 36 % of households were not involved in fish production or trading, but a vast majority of them (87 %) consumed fish in the last 7 days, underscoring that the households in our sample are tightly linked to fisheries via production, consumption or both. At the same time, households also engaged in a range of other primary and secondary livelihoods, including agriculture, small business, and other professional roles (e.g., teacher, health care worker). Households were an average size of 5.6 people, with 37.8 % having at least one child under 5 years of age. Within households, the main respondents were on average 42 y old, mostly female (90 %), married (73 %) and had some form of education (90 %). Finally, this region is characterized by high poverty rates. Approximately 1/3 of people in the region studied experienced poverty in 2015, including 33.9 % in Kisumu County where Dunga is located and 33.5 % in Homa Bay County where Kananga and Lela are located (Kenya National Bureau of Statistics, 2018). The backdrop of food insecurity and poverty faced by households in the study communities may increase their vulnerability in the face of COVID-19 and associated disease control measures.

#### 3.1. Fish consumption

Households were significantly less likely to consume any fish during the COVID-19 pandemic in June, with 89.8 % consuming any fish in the past 7 days, compared to 97.7 % in March ( $p = 0.035$ ; Table 1). The types of fish consumed also shifted. Households consumed Nile perch and tilapia on fewer days, while consuming cichlids on more days (Table 1). Though the finding is not statistically significant at the  $p < 0.05$  threshold, we find some indication that households may be more likely to consume *dagaa* ( $p < 0.074$ ). In response to an open-ended question, households cited a related set of factors affecting their food access, namely increasing food prices (16 %), reduced income (61 %) and, more specifically, reduced fishing income (12.5 %).

That 10 % of households reported they did not consume fish in the previous week suggests these households could be at risk of insufficient nutrient intake. Animal source foods are particularly important in diets because they are often key to differentiating diets that provide adequate nutrition for young children's growth and development from diets that do not (Headey et al., 2018). The most recent regional estimates indicate that 22.7 % of children were stunted in the provinces surrounding Lake Victoria in 2014 (Kenya National Bureau of Statistics and ICF Macro, 2015). Prior to the pandemic, despite Lake Victoria communities'

**Table 1**  
Fish consumption in the past 7 days (All households,  $n = 88$ ).

	Baseline Mean ± SD (n)	Follow-up Mean ± SD (n)	P-value <sup>1</sup>
Any fish consumption (all species) in past 7 days (%)	86 (97.73)	79 (89.77)	0.0348
Tilapia			
Any consumption (%)	35 (39.77)	26 (32.91)	0.2971
Mean # days consumed	1.80 ± 0.96	1.57 ± 0.86	<0.0001
Nile perch			
Any consumption	57 (64.77)	56(70.89)	0.414
Mean # days consumed	2.31 ± 1.61	2.05 ± 1.08	0.034
Dagaa			
Any consumption (%)	67 (76.14)	68(86.08)	0.074
Mean # days consumed	2.22 ± 1.25	2.45 ± 1.15	0.266
Cichlids/Fulu			
Any consumption (%)	14 (15.91)	19(24.05)	0.162
Mean # days consumed	1.36 ± 0.63	1.63 ± 1.38	0.045
Other fish	29 (32.95)	25(31.65)	
Mean # days consumed		1.96 ± 1.69	

<sup>1</sup> Comparisons were made using McNemar's test for paired samples. P-values in bold indicate statistically significant differences.

proximity to fishery resources, households were not necessarily able to access fish for their own consumption (Fiorella et al., 2014, 2017; Medard et al., 2015). Within this population, concurrent research has found that intake of other animal source foods other than fish is low and severe food insecurity, which was already very high in March (81 %), had expanded in June to 91 % (Okronipa et al., in preparation), and thus even small declines in fish consumption could exacerbate inadequate dietary intake of sufficient nutrients.

Alongside a decline in the frequency of fish consumption, we found changes in the fish species that households accessed. Higher-priced species (e.g., Nile perch and Tilapia) were consumed less often, while lower-priced species (e.g., *dagaa* and cichlids) were eaten more often (Table 1). The increase in consumption of lower-value fish does not necessarily have negative nutritional consequences as *dagaa* and cichlids confer similar nutritional benefits and may have higher levels of some key nutrients (Fiorella et al., 2017). This dynamic alongside households' reports of food access being affected by higher prices and reduced income suggests a downgrading of fish access, in which even low-value species may have already become unaffordable for some households. Yet another possible explanation, which may be simultaneously true, relates to the shelf life of fish preserved with different methods: *dagaa* and cichlids are often sold dried, while Nile perch and tilapia are typically sold fresh, fried, or smoked (Onyango et al., 2017). Adjustments in the fish species consumed may also address storage concerns, another key factor facing households during the COVID-19 pandemic when consumers are shopping less frequently.

Our findings within Lake Victoria fishing communities are situated in a global context where COVID-19 is projected to severely increase global food insecurity (Laborde et al., 2020) and child malnutrition (Fore et al., 2020; Headey et al., 2020). While we find moderate dietary impacts at this stage of the pandemic, existing rates of poverty, malnutrition, and food insecurity prior to the COVID-19 pandemic around Lake Victoria and many other small-scale fishing communities make them vulnerable (Kenya National Bureau of Statistics, 2018; Kenya National Bureau of Statistics and ICF Macro, 2015; Okronipa et al., 2021; Teh et al., 2020). Continued monitoring of changes in consumption patterns, as well as analysis of food insecurity and malnutrition, will be critically important going forward to determine whether such changes are a result of the COVID-19 pandemic and attend to increases in vulnerability.

### 3.2. Fish prices

The vast majority of households (91 %) reported that fish prices had increased, though a small proportion of households (7 %) reported a reduction in prices. That households largely perceived fish to be more expensive may reflect rising prices, diminished purchasing power as incomes fall, or both, and we were unable to disentangle these dynamics in the present study. Further, anecdotal reporting suggests that declines in Chinese imports of tilapia may have increased demand for Lake Victoria tilapia (Reuters Staff, 2020) and necessitate increasing local fish production to meet demand within Kenya (Business Daily Africa, 2020). These forces could also impact prices.

Fish consumers (97 % of our sample, prior to the pandemic) would suffer from price increases, while producers and traders (64 %) would benefit. However, the large share of households that both engage in fishing and consume fish (63 %) would experience contravening effects. Price changes would also influence overall fishing livelihoods and pressure as demand responds across the basin's more than 30 million residents. Moreover, the ties between global small-scale fisheries and export markets, as is the case for Lake Victoria, have emerged as uniquely problematic for small-scale fisheries amid the COVID-19 pandemic (Love et al., 2020). Sharp declines in international fish demand have dramatically reduced prices and negatively impacted small-scale fisheries (Knight et al., 2020), and further study of fish price changes around Lake Victoria would be valuable.

### 3.3. Fishing and trading activities

Prior to the COVID-19 pandemic, 46 % of the 90 households interviewed reported a fisher in their household, but during the pandemic, someone was fishing in only 32 % of the 88 households interviewed. Among those fishing at follow-up, 74 % of fishers reported that they were regularly fishing less than usual at certain times, and 43 % of fishers also reporting more fishing than usual at other times (categories are not mutually exclusive) (Fig. 2, Appendix A). Fishing households went fishing an average of  $3.72 \pm 2.5$  days in the last week, and spent  $4.63 \pm 2.9$  h per trip. Gill nets (54 %) and hook and line (20 %) were the predominant methods used, methods that all involve a team of multiple fishers going out in a single boat and put the group in close proximity and risk of COVID-19 transmission. Fishers reported that catch was markedly reduced compared to this time last year (93 %). Critically, fishers were likely to sell fish instead of eating it more often than usual (87 %; inclusive of 'always', 'often', and 'sometimes' responses), a dynamic that may be contributing to the decline in fish consumption observed. However, fish spoiled because it could not be sold slightly more than usual (32 %). Movement restrictions that made it difficult to get fish to market as well as reluctance among traders and consumers to visit markets (Okronipa et al., 2021) where crowding may put them at risk of COVID-19 transmission potentially impacted fish spoilage.

Fishers within this region reported largely targeting higher priced fish (e.g., Nile perch (37 %), juvenile Nile perch (26 %), and tilapia (35 %)), a pattern that likely predates the COVID-19 pandemic. Yet, fishers reported that they sold rather than ate fish more often than usual, which suggests that fishers may be coping with the COVID-19 pandemic in part by targeting and selling high-value fish in order to purchase less expensive fish to consume, if they are consuming fish at all.

Fisher traders reported that they were spending less time processing and selling fish than usual (73 %), with some also reporting more time processing and selling than usual (39 %). All fish traders and processors agreed that the quantity of fish was reduced compared to this time last year (100 %). Fish spoiled because it could not be sold slightly more than usual (47 %). Fish trading households processed fish an average of  $2.57 \pm 2.8$  days in the last week, and spent  $1.32 \pm 2.5$  h per day. They sold fish  $4.35 \pm 2.7$  days in the last week, and spent  $3.39 \pm 2.7$  h per day at markets where they risked coming in close contact with customers.

Our findings reflect reduced engagement with fishing activities and perceptions of below-normal quantities of fish in June 2020. While this may be in part related to uniquely high rainfall and rising lake levels in 2020 (BBC, 2019), pulling back from fishing livelihood engagement would also be a reasonable response to fear of contracting COVID-19 as fishing and trading typically require close contact with others. Further corroborating this finding, 84 % of households reported they currently work or earn less at any livelihood activity due to fear of contracting COVID-19. In addition to the implications of COVID-19 risk, travel restrictions may also play a role in fishers' and traders' activities as Lake Victoria typically hosts both migrant and resident fishers and traders (Nunan, 2010). Though our data do not extend to larger migration patterns, curtailed fisher movement could reduce fishing pressure and competition among fishers, or compliance with fisheries regulations. Thus, COVID-19 control measures; changes in fish demand, prices and availability; environmental pressures; or interactions among these complex forces are likely contributing to reduced livelihood engagement.

## 4. Conclusion

Overall, our findings suggest slight declines in fish consumption and perceived negative effects of COVID-19 on livelihoods in response to the COVID-19 pandemic. As policymakers plan their response to the COVID-19 pandemic in small-scale fishing communities, they should consider the following: First, small-scale fishers are often both fish sellers and fish buyers. Shifts in prices and fish availability may be driven by divergent

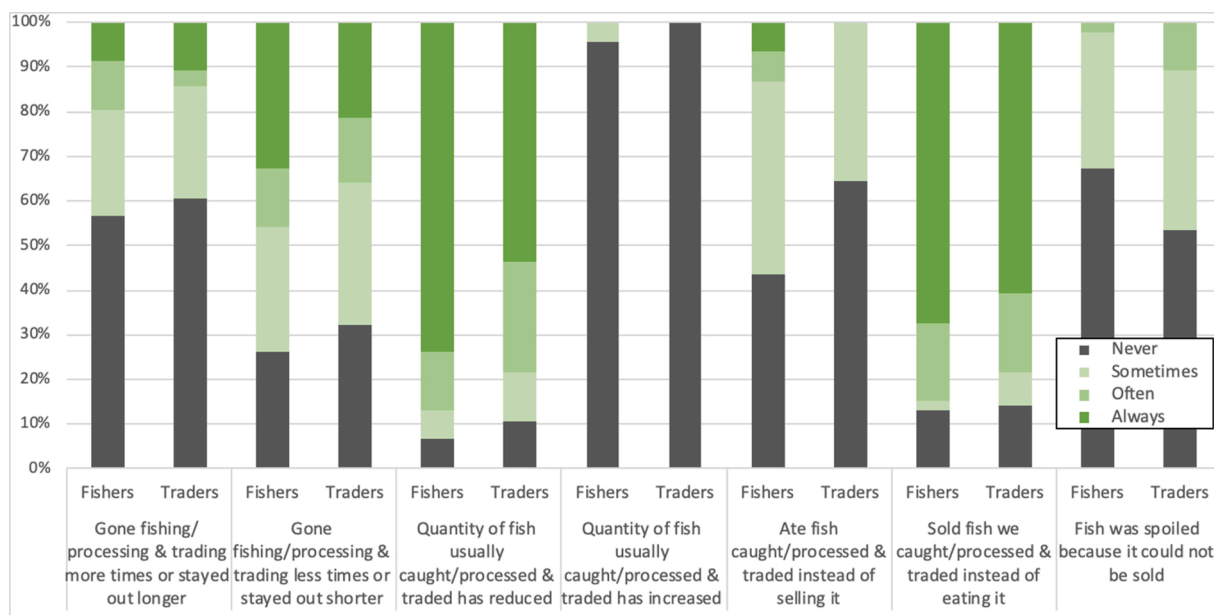


Fig. 2. Fisher and fish processor/trader activities in response to COVID-19.

forces including international market linkages and local purchasing power, and affect livelihoods and consumption differently and in complex ways. Efforts to address declines in fishery imports with support for aquaculture production, including some measures for wild fisheries, are already underway in Kenya (Business Daily Africa, 2020). Policy makers should carefully consider the potential for unintended consequences of price-related interventions across different populations.

Second, both fishers and traders' livelihoods entail some risk of COVID-19 exposure, and individuals are concerned about this risk. Fishing often requires close engagement with a fishing crew over relatively long periods of time and trading necessitates interacting with customers. Thus, measures that address the transmission risks fishers and traders encounter with personal protective equipment and social distancing strategies may be instrumental to supporting fishers and traders to safely reengage in their livelihoods, especially prior to widespread vaccination efforts.

Third, longer term studies are necessary to determine the full extent of this pandemic on fishers, and to disentangle the ways people and markets respond to COVID-19 control policies. Fishing communities are balancing risks of COVID-19 and food insecurity, and are also subject to seasonality, other environmental changes, and other factors that may shift fish consumption and food security; our data provide only a short-term window into changes and perceptions within fishing communities. The feedbacks between fear of contracting COVID-19, policies to control COVID-19 and other risks (e.g., food insecurity, flooding) also mean that

at this stage we are only able to ascertain the combined perceptions of these complex dynamics and small-scale fishing households' livelihoods and wellbeing, but are not able to disentangle these dynamics or make comparisons to other groups.

Small-scale fishers and their communities comprise 10 % of the global population. Understanding how they are responding to the current crisis is not only critical to safeguarding their welfare, but also to protecting the global supply of fish. In the long-term, unpacking the impacts of the COVID-19 pandemic will be fundamental to improving the resilience of our aquatic food systems and the households around the world that rely on them for nutrition and livelihoods. Addressing these fundamental issues of resilience in small-scale fishing communities will be critical to planning for and mitigating the impacts of future crises.

**Declaration of Competing Interest**

The authors report no declarations of interest.

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**Appendix A. Fisher and fish processor/trader activities in response to COVID-19**

	Fishers (n = 46)		Processor/Traders (n = 28)	
	n	%	n	%
Gone fishing/ processing & trading more times or stayed out longer than we usually do in response to COVID-19				
Always	4	8.70	3	10.71
Often	5	10.87	1	3.57
Sometimes	11	23.91	7	25.00
Never	26	56.52	17	60.71
Gone fishing/processing & trading less times or stayed out shorter than we usually do in response to COVID-19				
Always	15	32.61	6	21.43
Often	6	13.04	4	14.29
Sometimes	13	28.26	9	32.14

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	Fishers (n = 46)		Processor/Traders (n = 28)	
	n	%	n	%
Never	12	26.09	9	32.14
Quantity of fish usually caught/processed & traded has reduced compared to this time last year (in past 30 days)				
Always	34	73.91	15	53.57
Often	6	13.04	7	25.00
Sometimes	3	6.52	3	10.71
Never	3	6.52	3	10.71
Quantity of fish usually caught/processed & traded has increased compared to this time last year (in past 30 days)				
Always	–	–	–	–
Often	–	–	–	–
Sometimes	2	4.35	–	–
Never	44	95.65	28	100.00
Ate fish caught/processed & traded instead of selling it more often than usual (in past 30 days)				
Always	3	6.52		
Often	3	6.52		
Sometimes	20	43.48	10	35.71
Never	20	43.48	18	64.29
Sold fish we caught/processed & traded instead of eating it more often than usual (in past 30 days)				
Always	31	67.39	17	60.71
Often	8	17.39	5	17.86
Sometimes	1	2.17	2	7.14
Never	6	13.04	4	14.29
Fish was spoiled because it could not be sold more often than usual				
Always	–	–	–	–
Often	1	2.17	3	10.71
Sometimes	14	30.43	10	35.71
Never	31	67.39	15	53.57

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