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Results of a questionnaire to commercial harvesters on historical and current unaccounted catches of Atlantic cod in NAFO areas 3Pn4RS

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Foreword

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

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ABSTRACT

Accurate accounting of fishery removals is a cornerstone of reliable stock assessment. When the magnitude of unaccounted catches varies over time, important assessment parameters can become more inaccurate and the relative roles of fishing and time-varying natural mortality can be harder to disentangle, resulting in poorer science advice in support of sustainable fishery management. Questionnaire–based surveys of fishery resource users are increasingly being used to estimate plausible magnitudes of past and present unaccounted catches. A survey of current and former commercial Atlantic cod harvesters in the northern Gulf of St. Lawrence (NAFO 3Pn,4RS) was undertaken in early 2021 to gather information on four specific categories of unaccounted catch of cod: discards in the directed fishery, unreported catch (including discards) of cod in fisheries directed at other species, unreported personal use of fish by harvesters, and catches in the recreational fishery. Furthermore, the questionnaire was structured according to epochs over the period from the mid-1950s to present that characterized the fishery, such as to place temporal guideposts to aid in recall by questionnaire respondents, and to provide for temporal variation in elicited catch amounts according to key periods in the fishery that were likely to influence those amounts. This document presents the results of the harvester survey which will support the elicitation of catch bounds to be used as part of a revised assessment framework for NAFO 3Pn4RS cod currently being developed.

1. INTRODUCTION

Accurate accounting of the amount and demographic composition of removals is a cornerstone of reliable stock assessment. When the magnitude of unaccounted catches varies over time, important assessment parameters can become more inaccurate, resulting in poorer science advice in support of sustainable fishery management (Rudd and Branch 2017). Furthermore, uncertainty about the magnitude of fishery removals can hinder disentangling the relative roles of changes in natural mortality and fishing pressure, which is important for understanding the causes stock collapse and failure to rebuild despite apparent reductions in fishing mortality of many groundfish stocks in Atlantic Canada (e.g., Swain et al. 2019; Neuenhoff et al. 2018; Swain et al. 2011).

Until recent decades, quantitative assessment of groundfish stocks in Atlantic Canada was based on virtual (sequential) population analysis (VPA), essentially an accounting method that treats official landings statistics as fully accurate. Statistical catch at age (SCA) models, have become more commonly used since the late 2000s. These models treat catches as random variables, thereby allowing for error in both catch amounts and catch composition as a function of age or length (Megrey 1989). While these models represent an important improvement over VPA, they neglect the fact that errors in catch amounts are not symmetrical, but rather reported catches tend to underrepresent, and sometimes over represent, true removals. SCA models incorporating censored catch likelihoods account for catch observations that are likely to be lower bounds on removals (Hammond and Trenkel 2005; Bousquet et al. 2010; Cadigan 2016a). Such models are now used for the assessments of Northern cod (NAFO 2J3KL), NAFO 3Ps cod, and the northern contingent of the NW Atlantic mackerel population (Cadigan 2016b; Doniol-Valcroze et al. 2019). While censored catch models can reduce bias in stock assessments, their utility depends on eliciting reasonable expected bounds for annual catches (Van Beveren et al. 2017). Questionnaire and interview based surveys of resource users have become an important means for eliciting bounds on catch underreporting (e.g., Duplisea 2016; 2018; Van Beveren et al. 2019). In addition to providing information on catches, resource users are able to provide important information on the economic and social context of the fisheries that would otherwise be difficult to obtain and which constitute an important part of best available information for the science and management of these fisheries (Stephenson et al. 2016; Hind 2014).

Unreported catches in Gulf of St. Lawrence commercial fisheries directed at cod (NAFO 4Tvn stock) and redfish in the 1980s and early 1990s are estimated to have constituted an important component of removals from these populations, particularly redfish (Bousquet et al. 2010; Duplisea 2018; Neuenhoff et al. 2019). Similar information has not previously been available for the NAFO 3Pn4RS cod stock in the northern Gulf of St. Lawrence (nGSL). Important improvements in fishery monitoring since 1990, including the implementation of dockside monitoring and a certain level of mandatory at-sea observer coverage in Gulf groundfish and shrimp fisheries (Benoît and Allard 2009), and the adoption of the Nordmore grate in the shrimp fishery in the 1990s, has likely considerably reduced the frequency and magnitude of unreported and unaccounted catches from commercial fisheries in the Gulf. However, 3Pn4RS cod are subject to a recreational fishery in the nGSL for which there has been no routine or structured accounting of catches. Catches in recreational cod fisheries elsewhere in Newfoundland are estimated to constitute a high proportion (> 25%) of total removals of the NAFO 2J3KL stock in at least some years (DFO 2011, 2013), and it is reasonable to assume that this may be true also for 3Pn4RS cod.

An interview-based survey of longstanding commercial harvesters in the nGSL using a structured questionnaire was used to qualify, and ideally quantify, plausible bounds on

unaccounted catches of 3Pn4RS cod from the beginning of the industrial fishery in the early 1960s to the present. The questionnaire was structured such as to elicit amounts for four specific categories of unaccounted catch: discards in the directed fishery, unreported catch (including discards) of cod in fisheries directed at other species, unreported personal use of fish by harvesters, and the recreational fishery. Furthermore, the questionnaire was structured according to epochs that characterized the fishery such as to place temporal guideposts to aid in recall by questionnaire respondents, and to provide for temporal variation in elicited catch amounts according to key periods in the fishery that were likely to influence those amounts. Interviews of 34 harvesters were conducted in January and February 2021. This document presents the results of the harvester survey which will support the elicitation of catch bounds to be used as part of a revised assessment framework for NAFO 3Pn4RS cod being developed in 2021.

2. METHODS

2.1. THE QUESTIONNAIRE

The questionnaire is presented in Appendix I. It was structured according to thirteen principal questions, some of which involved multiple parts. All but the first three questions requested a separate response for each of a maximum of five defined epochs (termed periods hereafter) in which the respondent was active in commercial fishing. These were defined based on the following key milestones for the 3Pn4RS cod fishery:

1977: Extension of jurisdiction and quota imposition.

1990: Beginning of the dockside monitoring program.

1994-1996: Moratorium on directed cod fishing and exclusion of the mobile gear groundfish sector, the latter which persist today with the exception of the redfish index fishery.

From 1996: Introduction of mandatory logbooks.

2003: Moratorium on directed cod fishing.

2009-2020: Low quota period.

Specifically, the questionnaire defined the following periods:

- Period 1 (P1): Prior to the 200 mile limit and imposition of a quota (pre-1977).
- Period 2 (P2): To the first moratorium (1977-1994).
- Period 3 (P3): Inter-moratorium period (1996-2002).
- Period 4 (P4): Post moratorium period (2004-2008).
- Period 5 (P5): Low quota period (2009-2020).

These periods define timespans of approximately homogenous fishery management and monitoring, and were expected to provide handy sign-posts to aid respondents in situating their responses along the historical timeline for the stock and fishery.

The first eight questions aimed to obtain a description of the roles of the respondents and their contribution to commercial fisheries in the nGSL. The responses to these questions could potentially be used as strata according to which responses concerning catch amounts in subsequent questions could be summarized. Specifically, the questions were:

1. What is your home port?

2. In what year did you begin fishing cod commercially?
3. Do you still fish for cod commercially? If no, in which year did you stop?
4. During each period, what was your main role in the fishery (the one to which you devoted the longest time)?
5. During each period, was cod the main species you fished; in other words did it represent the majority of your fishing income? If not, what was?
6. During each period, how far did you fish from your home port on average? What was the main area (region, zone) in which you fished (open answer)?
7. What was the main fishing gear you used to catch cod commercially during each period?
8. How big was the main vessel you used to fish cod commercially during each period?

The subsequent questions addressed the potential for, and approximately magnitude of, unaccounted catch in each period in which a respondent was active in the fishery.

Question 9 sought responses as to the frequency and type of fishery monitoring. The implicit assumption behind this question is that error or bias in catch is likely to be greater in the absence of regulated monitoring, and may vary depending on the type of monitoring (Beauchamp et al. 2019; Allard and Benoît 2021). Respondents were asked to provide an indicator of monitoring frequency using a common Likert scale for frequency of events: **never, not often** (1 or 2 out of every 10 trips), **sometimes** (3 to 7 out of 10), **often** (8 or 9 out 10), **always** (every trip).

Question 10 sought responses on the frequency, magnitude, and motivation for cod discarding. Frequency was quantified using the Likert scale described above and magnitude was assessed as the percentage of cod catch, when discarding occurred. The intent was to allow estimation of discard amounts as a product of frequency and magnitude, in a manner analogous to estimating risk as a product of a likelihood and a consequence. The intent was to avoid having respondents trying to average events, such as infrequent but high magnitude discarding events. Respondent were asked to provide the main reasons underpinning discarding of cod without prompting with respect to specific causes to avoid biasing the responses.

Question 11 referred to unreported catches of cod in fisheries directed at other species. Respondents were asked to provide an estimate of cod catches as a percentage of reported landings of cod, such as to have reference for the amounts in question. A Likert scale for percentage magnitude was defined as follows: 0-**none**, 1-**negligible** (<1%), 2-**much smaller** (1-25%), 3-**smaller** (25-75%), 4-**about the same** (75-125%), 5-**larger** (>125%). Respondents were also allowed to comment on the magnitude and to provide examples.

Question 12 pertained to cod caught commercially but kept for personal use. Given the nature of the amounts sought, respondents were asked to provide a quantitative amount in pounds as this should be straightforward for them. Respondents were also asked to specify as to whether personally used cod were recorded in official landing statistics. Cases in which they were not constitute unaccounted catch.

Finally, question 13 pertained to the recreational fishery. Respondents were asked to quantify the amount of recreational fishing in their home community. While they were provided the choice of responding with an estimated number of annual recreational fishing trips or an estimate of the annual weight of cod caught by members in their community, all respondents provided answers to both questions. Categorical responses for the number of annual trips were sought based on the following five categories: none (0), 1 to 50, 50 to 150, 150 to 200, and over 200. Meanwhile responses on catch amounts, in pounds, were quantitative.

At the end of the interviews, participants were asked whether they would like to make additional comments.

2.2. SELECTION OF RESPONDENTS AND INTERVIEWS

An approximate stratification scheme was used to select respondents and obtain responses that were roughly geographically representative (Figure 1). Respondents were selected separately across 10 communities in Quebec's (QC) lower north shore (Côte Nord area, CN) and across 17 communities in Newfoundland and Labrador (NL) bordering the Gulf of St. Lawrence. The much more populous NL area was further subdivided according to NAFO subarea boundaries, to reflect different sizes of communities and access to different fishing grounds. Specifically, potential participants were selected in communities roughly representing each of NAFO subdivisions 3Pn, 4Ra, 4Rb, 4Rc, 4Rd (Figure 2) and the Labrador Straits (LS; Strait of Belle Isle), and in each, participants representative of different gear/fleet sectors were contacted. The following table provides a summary of the number of participants that were contacted in each area of NL, whether that contact was successful, and whether a survey was completed in the affirmative. This type of information was not available for QC participants.

Table summarizing information on the number of people who responded to the survey, those who refused to respond and the number of people not reached by sub-division for the Newfoundland and Labrador Region.

Subdivision	Completed the survey	Refused to participate	Unable to reach the potential respondent
LS	4	1	2
4Ra	6	1	6
4Rb	4	1	4
4Rc	1	0	2
4Rd	1	2	1
3Pn	4	0	1

In all cases, respondents with at least two decades of experience in commercial groundfish fisheries were targeted. A total of 14 respondents in QC and 20 in NL completed the survey, in all cases providing answers to all questions. Collectively, these respondents fished throughout the nGSL and more broadly the GSL and neighboring areas, landing their catches across a number of ports (Figure 3).

Interviews in QC were undertaken by the Association des Pêcheurs de la Basse-Côte-Nord, while those in NL by the Fish, Food and Allied Workers Union. In both cases, this was done under contract to Fisheries and Oceans Canada (DFO). Results of the questionnaires were provided to DFO in a database format, stripped of any information that could specifically identify individual respondents. The tabulation of results in this report was also undertaken such as to protect the identity of respondents.

2.3. TABULATION OF RESULTS

Results of the survey are first presented as simple tabulations of numbers of responses, without any particular analysis or synthesis. Results are presented by period and according to strata, where this appeared pertinent. The only exceptions were cases where a finer resolution in the presentation of results might identify a particular respondent or associate specific opinions to them.

Following the tabulation of results, we present some very basic syntheses as relates to unaccounted catches, providing rough estimates of catch amounts by category (discards, unreported, recreational fishing) and period. The methods employed in each case are described below, along with the results.

3. RESULTS

3.1. SURVEY RESULTS

3.1.1. Characteristics of respondents and the fisheries

The most experienced respondent, from a port along Newfoundland`s northern peninsula, began fishing commercially in 1960 (Figure 4). This was just a few years after the introduction of bottom-trawling in the fishery in 1954 and coincided with the advent of the large scale fishery on the stock (Wiles and May 1968). Just under half the participants entered the commercial fishery during the first period (before extension of jurisdiction in 1977), with the remainder entering during the second period, at least three years prior to the 1994 moratorium. All respondents are still active commercial harvesters. Career span was roughly similar across geographic areas (Figure 4).

A majority of respondents worked as helpers or crew aboard commercial vessels during period 1, while nearly all worked at least some of the time as captains during periods 3 to 5, reflecting a natural career progression with experience gained (Table 1).

Three quarters of respondents (12 of 16) active in period 1 identified cod as their main target species (Table 2). The proportion fishing cod as their main species declined progressively over subsequent periods: 70% in period 2, 35% in period 3, 32% in period 4, and 26% in period 5. The important reduction between periods 1 and 2, and 3 and 5 very likely reflects important changes in the status of the cod stock and associated changes in quotas. These factors, along with a diversification to other species, may also explain the less pronounced yet consistent declines over periods 3 to 5. Although respondents were asked to indicate a single main species fished, many identified two or more species. A tabulation of those responses shows a diversification of species targeted across periods (Table 3).

Most respondents fished within 20 miles of their home port in all periods, and in period 1 it was all but one respondent (Figure 5). Nonetheless, in all periods there was at least a small number of respondents that fished over 100 miles from their home port. During period 2, the number fishing further afield was relatively elevated. These habits were such that respondents in NL fished principally in areas along the Newfoundland and Labrador coast prior to 1994 (periods 1 and 2), while respondents from QC fished principally along the Quebec north shore and Labrador coast (Table 4). The diversity of areas fished increased after 1996, however unsurprisingly respondents from QC did not fish in NAFO 3Pn, nor in 2J, while few respondents from NL indicated fishing in 4S.

Respondents were asked to indicate the main gear type they used to fish cod. Many provided more than one, indicating either a change in gear during the period or the simultaneous use of

multiple gears. Overall the responses did not permit distinguishing these possibilities. In both provinces and across periods, the principal gear types used to fish cod were gillnets, longlines and both longlines and handlines, identified as 'hooks' in Table 5. Cod traps were employed by eight of the respondents at least some time prior to 1994, but this gear type was no longer used after the first moratorium (Table 5). Although attempts were made to find survey respondents that had fished mobile gear, bottom trawls and seines, as their principal gear during periods 1 and 2, there were only two respondents that used mobile gear sometimes. Note that mobile gear has not been permitted in commercial groundfish fisheries in the nGSL since the first moratorium. Difficulties finding respondents that principally fished mobile gear prior to 1994 is very likely related to the elapsed time and the relatively larger number of fixed versus mobile gear harvesters in the fishery at the time. This outcome is also consistent with a similar one for a recent survey of GSL redfish fishermen (Duplisea 2016). It nonetheless creates a certain deficiency for this survey for periods 1 and 2, during which landings of cod by the mobile gear sector were at least equal to and often (much) greater than those by the fixed gear sector (Brassard et al. 2020).

Across all periods, the majority of respondents from NL used vessel <35' to fish cod commercially, with many fewer employing vessels up to 65' (Table 6). In contrast, other than during period 1 and to a lesser extent period 2, there was a more equitable split across three vessel classes below 65'. No respondents employed vessels >65'.

3.1.2. Catch monitoring

Prior to 1977, respondents indicated that their catches were never monitored, or at least not often (Table 7). One respondent indicated always being monitored, but given the absence of structure catch monitoring programs at the time this response suggests they may have misunderstood the question. The introduction of the dockside monitoring program in 1990 intersects period 2, consistent with 6 respondents indicated that catch monitoring went from never to always during the period. Overall though, the majority of respondents indicated being monitored never or not often, indicating that they likely responded as an average of sorts for the period. Since 1996, 84% or more of respondents indicated having all their landings monitored, the remainder, with one exception, indicating that monitoring was frequent.

Since 1996, most respondents have been monitored exclusively by dockside monitoring or by a mix of dockside monitoring and authorization numbers (Tables 8, 9). Authorization numbers are a form of self reporting used only in NL in which the harvester must call to report their landings at the time of landing. Presently in the fishery, harvesters must hail in before coming to port and it is at that time that they are advised as to whether their catch will be monitored at the wharf or whether they will report using an authorization number. The decision to assign a dockside monitor is made by a certified independent third party and is based on monitor availability and a sampling scheme that is stratified according to the size and importance of ports.

Catch reporting/monitoring of respondents was exclusively done by purchase slips in period 1 (Table 9). One respondent from the Labrador Straits area reported monitoring by dockside monitoring, but this program was not available at that time. During period 2, reporting was exclusively by purchase slips in QC (CN area), and a mix of slips, dockside monitoring and authorization numbers across areas in NL. Since 1996 (periods 3 to 5), all respondents in QC and the 3Pn area were monitored by dockside monitoring, while in other areas respondents reported a mix of dockside monitoring and authorization numbers.

3.1.3. Characteristics of catches

3.1.3.1. Unaccounted catches in the directed fishery

Across all periods, and in both provinces, the majority of respondents indicated that discarding of cod in the directed fishery did not occur often (Table 10). Overall, respondents from NL were more likely to indicate that discarding never occurred (~25% of respondents across all periods) compared to respondents from QC (~8%). Conversely, as a proportion of all respondents in the respective provinces, respondents from QC were more likely to indicate that discarding occurred sometimes (3 to 7 trips out of 10), and in period 2 one respondent indicated it occurred often (8 or 9 trips out of 10). When discarding of cod did occur, respondents reported consistently that the percentage discarded was small, regardless of the period (Figure 6). The median percentage discarded was around 1% across all periods and the third quartile was 1.5%, with a maximum response of 5% by one participant in each of periods 2 and 3. Note that many respondents indicated that <1% was discarded and for the purpose of summarizing the data these responses were associated a value of 0.33%, arbitrarily set to be below values of 0.5% reported by some.

The most frequent reasons for discarding cod in the directed fish, expressed as a percentage of responses, were due to damage caused by scavengers (Table 11). Bad weather was also a frequent cause, implying that fixed gear was left to soak longer than intended, hence exposing the catch to damage by scavengers. Jointly this means that poor quality (freshness) of the catch was cited 95% of the time as the cause of discarding of cod. Of the remainder, a mix of regulatory (i.e., excess bycatch, undersized fish) and market conditions (potentially including undersized fish) was cited.

In their comments, respondents indicated the reasons for their reported low frequency and magnitude of cod discarding in the directed fishery. These responses were sometimes period specific and are summarized here:

- 1977-1994: not much discard as there were different grades for salted fish, including small cod, and otherwise cod were kept for personal used (3 respondents).
- Historically [period not defined by the respondents] there was never a need to discard as there was always a buyer somewhere (1 respondent).
- 1996-2020: little discarding as there have been limits on the amount of gear used and daily harvest (6 respondents).
- There used to be some discarding in the gillnet fishery due to delays in hauling gear caused by weather, but now nets are not set in bad weather and they are checked often (7 respondents).

One respondent specifically indicated that for period 2 there was often discarding in the mobile gear sector due to small fish (about 3% of catch). Another respondent felt that the winter mobile gear fishery in NAFO 3Pn off Port-aux-Basques during the 1980s (period 2) contributed to the collapse of the stock; however, it is not clear from their response whether they were referring specifically to unaccounted catches in this fishery, or to catches of cod more generally.

Cod retained for personal use was not always declared prior to the first moratorium, but was always part of reported catch subsequently (Figure 7). On average, respondents reported individually keeping 62 and 57 kg of undeclared cod annually in periods 1 and 2.

3.1.3.2. Unaccounted catches in other commercial fisheries

Cod captured in other groundfish fisheries has always been available to be sold, and since the early 1990s, harvesters have been obligated to land them. It is therefore not surprising that a

large majority of respondents indicated that there was no or negligible unreported catch of cod in other fisheries (Table 12). A small number of respondents in each period felt that discards in other fisheries would be more than negligible, but generally smaller or much smaller than directed landings of cod. One respondent from the 3Pn area felt that in period 2 they may have been about the same magnitude.

In general, however, respondents had difficulty answering these questions. In their comments, multiple respondents from NL (6 of 20) and QC (4 of 14) indicated that they could not provide an example, one respondent noting that “You wouldn’t know of unreported catch, if you weren’t there”. The four respondents who specifically commented on discarding in the 1980s and 1990s indicated, for example, that “there was a lot [of discarding] back in the 90’s when the otter trawl [caught] smaller fish, throwing it all away and then hauling again and getting bigger fish.” Three of these respondents provided quantitative estimates in their comments, indicating 40% discarding in the 1990s, 10-50% in the 1980’s when there was an abundance of small fish, or between 50-75% of otter trawl catch in the 1980s.

3.1.3.3. Recreational cod fishery

Recreational fishing for cod was reported to be inexistent or at least infrequent prior to 1994, although one respondent indicated frequent trips for period 2 (Table 13). The amounts of cod caught recreationally in individual communities in those years as estimated by the respondents were very small, although two respondents estimated amount around 2 to 3 metric tons (Figure 8). The number of recreational fishing trips was greater for periods 3 to 5. For most areas, respondents felt that in their communities there were on average 1 to 50 trips annually, although for the CN area (QC) more than half of the respondents felt that there were more or much more than 50 trips per year (Table 12). The median annual community catch reported by respondents was around 1000 kg, while the mean was around 2500 kg annually in QC and slightly greater and increasing over periods in NL. In each period since 1996, at least three of the 34 respondents felt that their community caught and retained at least 5000 kg of cod annually.

As part of their general comments, many respondents commented on the recreational fishery (Appendix II). In all but a few cases, respondents felt that the recreational fishery was a problem and potentially harmful to the stock. Several respondents felt that there were more cod taken in the recreational fishery than in the directed fishery. Some suggested that it should be better regulated. A few respondents indicated that there was high-grading (discarding of small fish) in that fishery. This may result in removals from the population above those summarized in the preceding paragraph if survival of discarded fish is not high.

3.1.4. Other comments

While the majority of free-form comments provided by respondents pertained to the recreational fishery, there were others concerning the pertinence of the present surveys, the status of the cod stock, including the current state and the causes underlying it, and the management of the fishery. These comments are presented in Appendix II. Concerning the pertinence of this survey, two respondents felt that it did not meet their expectations. They felt that a questionnaire on the opinions of harvesters as relates to the status, and perhaps the management, of the stock would have been much more pertinent.

3.2. SYNTHESIS AND IMPLICATIONS FOR CATCH BOUNDS

To estimate catch amounts based on survey responses, we used the lower, upper and midpoint values of the Likert scales used to qualify catches in separate analyses, thereby providing a range of estimates for the survey overall. In all cases, estimates are provided by period and in some cases, where there were difference in responses, by province. The estimates themselves

are not necessarily intended to represent catch bounds, but will inform these bounds along with other information such as estimation of discards based on at-sea observer reports and formal recreational fishing surveys.

3.2.1. Discards in the directed fishery

Estimating discards in the directed fishery involved multiplying the frequency of discarding, with the discard amount (in %). The two values were multiplied for each respondent before summing over respondents. Because respondents in the two different provinces fished different areas, the values were summed by province such that the values for QC respondents could be related to directed landings in 4S, and those for NL respondents to landings in 3Pn and 4R. In period 5, we provide separate estimates excluding and including (identified with *) the respondent that indicated that 50% of catch was discarded half of the time.

The results of these calculations are presented in Table 14. Clearly these values represent very little unaccounted catch. However, as indicated above respondents were often uncertain of their answers and some provided comments that indicate levels during period 2 and possibly period 1 that are much higher, potentially two orders of magnitude greater than those in Table 14.

3.2.2. Cod personal use in the directed fishery

With an average reported undeclared personal use of around 60 kg annually, unaccounted catches from this source could have represented from around 60 to 600 tonnes during period 1 and 2, assuming the number of people involved ranged from 1,000 to 10,000. Landings over these periods averaged over 72,000 tonnes annually (Brassard et al. 2020). Consequently, these unreported catches would have represented at most 0.8% catch additional to the reported landings.

3.2.3. Discards in other fisheries

Based on the responses summarized in Table 11, estimates for discards of cod in other fisheries ranged between about three to nine percent of total cod landings in period 1, six to thirteen percent in period 2 and one to five percent during the last three periods (Table 15).These values are clearly much larger than those reported above for unreported catches in the cod directed fishery.

3.2.4. Removals in the recreational fishery

Estimating removals from the recreational fishery involved scaling up from the communities that were represented by respondents to the survey, to all communities on the shores of the nGSL and which would have access to the recreational fishery. To approximate this relationship, we used the population numbers in each community represented by a respondent (Figure 1), and the total population of people living on the coast. This was done by province. For QC, based on 2011 census data, there were 2,903 people living in the respondent's communities out of a total population of around 11,000. For NL, and based on 2016 census data, there were 7,901 people living in the respondent's communities out of a total of 78,008 along the shores, including Corner Brook, which itself had a population of 31,917. Having no respondents from Corner Brook in this survey, and assuming that a smaller percentage of its inhabitants fish cod recreationally, we assumed rather arbitrarily that 10% of that city's residents fished. This results in a target coastal NL population of around 49,300. The calculations that follow assume that recreational fishing patterns in the respondent's communities are representative of the broader communities along the coasts, with the exception of Corner Brook for which an adjustment is

made as noted above. This key assumption could not be validated when this report was completed.

There were respondents from 10 communities in QC, from which we estimate an ‘effective’ number of communities as:

10 communities x 11,000 residents total / 2,903 residents in respondent communities = 37.9

There were respondents from 17 communities in NL, from which we estimate an ‘effective’ number of communities as:

17 communities x 49,300 residents total / 7,901 residents in respondent communities = 106.1

From the responses provided concerning the amount of cod taken annually in each community (summarized in Figure 8), we estimated that around 50 tonnes or less were taken annually in the recreational fishery in periods 1 and 2 (Table 16). These amounts increased considerably in subsequent periods: 360 t in period 3, 380 t in period 4 and 480 t in period 5. Around 20% of the estimated catch was made by QC harvesters during these last three periods.

An estimate of removals in the recreational fishery was also derived using the number of trips reported by respondents. This was based on the effective number of communities, the lower, mid and upper ranges for the categories representing the number of trips (assuming for the 200+ trip category values of 200, 250 and 350 for upper, mid and upper values), a mean weight of cod in the recreational fishery of 2.02 kg (DFO 2007) and arbitrarily assuming that the number of cod taken per trip for low, mid and upper values were respectively three, nine and fifteen. The latter upper value was chosen based on a daily limit of five cod per person, assuming an average of three participants per trip.

The results are presented in Table 17. The estimated total values are of similar magnitude to those based on amounts of cod reported by respondents, and the upper values correspond reasonably well. This provides some validation for the catch amounts proposed by respondents. Estimates for Quebec represent a much larger proportion of the total compared to the estimates based on reported amounts. This results from the fact that a relatively large number of respondents from Quebec reported that there were 150 or more recreational fishing trips annually in their community in recent periods. In contrast few respondents from Newfoundland reported such high numbers.

The estimated values for the recreational fishery for periods 3 to 5 (since 1996) represent one of the largest component of unaccounted catch estimated using the result of the survey. The values based on catch amounts reported by respondents correspond roughly to 6.2%, 7.3%, and 23.3% of official landings in periods 3, 4, and 5 respectively.

4. DISCUSSION

This survey provided broad representation of cod harvesters in the northern Gulf of St. Lawrence. However, the absence of mobile gear harvesters from periods prior to the first moratorium is a deficiency of this survey. The impact on the results for those periods are uncertain but has probably led to an underestimation of cod discards. The relatively low incidence of discarding and catch underreporting in the directed cod fishery in periods 1 and 2 contrasts sharply with discarding patterns in the Gulf redfish fishery (Duplisea 2018). The presence of a market for cod of a range of sizes and differences in catching capacity that may have created few gluts in processing capacity for cod may explain some of the differences between these fisheries. However, some respondents indicated in their comments that discarding was prevalent in the mobile gear fishery in the 1980s and early 1990s. Furthermore, members of the fishing industry have indicated to the authors of this report that these practices

were discussed with DFO Fisheries Management officials at the time during advisory council meetings. Efforts are underway to find copies of the minutes of those meetings in anticipation that these may provide information on the possible magnitude of discarding by the mobile gear fleet, which would fill an important gap left unfilled by the present questionnaire. It is nonetheless important to note that this uncertainty is not present for the subsequent time periods as mobile gear have been excluded from the fishery since the moratorium that began in 1994.

Based on the responses to the questionnaire we were able to derive some estimate of relative or absolute catch amounts. In some instances, we derived some boundaries on estimates but otherwise did not try to estimate estimation errors. Simply estimating standard errors from questionnaire responses would likely underestimate the true uncertainty to varying degrees as this uncertainty would also include unintentional recall errors, intentional response errors, errors in the interpretation of questions, and potentially non-representative selection of respondents, amongst other sources (Allard and Benoît 2021). The absence of estimates of uncertainty for unreported catches is not expected to adversely affect subsequent stock assessment modelling as these are not required for the censored catch approach.

The unaccounted catch amounts estimated do not account for discard survival, in the case of discard amounts, or mortality associated with high-grading in the case of the recreational fishery. In the case of discard survival, removals from the population may be overestimated if survival is high, while in the case of high-grading, poor discard survival will result in underestimated removals. Discard survival can vary considerably depending on conditions of capture, handling and release (ICES 2021). Nonetheless existing studies provide some indication of the potential magnitude. Benoît et al. (2012) estimated that survival of southern Gulf cod discarded from trawl fisheries, as they occurred prior to the 1994 moratorium, to be very low at around 5%. Consequently the risk of overestimating removals from discarding in the commercial trawl fishery is low. In contrast, survival of line caught cod released in recreational fisheries is estimated to be much higher, with average published values ranging generally between 80-90% (Capizzano et al. 2016; Weltersbach and Strehlow 2013). Provided that participants in the recreational fishery release cod in a manner that promotes survival and that the extend of high-grading is not too elevated, estimates of recreational fishery removals provided here may not constitute large underestimates.

The type and frequency of catch monitoring is well known to affect the accuracy of catch amounts (e.g., Beauchamp et al. 2019; Allard and Benoît 2019, 2021). In particular, reporting by purchase slips is generally felt to be of lower accuracy. It is tied to sales and therefore revenue, which may create incentives for misreporting, under-reporting to reduce tax burdens, and, in some instances, over-reporting in anticipation of the creation of individual catch shares based on catch history (Beauchamp et al. 2019). It is not clear in the present context how the prevalence of reporting via purchase slips affected errors in reported catches in periods 1 and 2, particularly prior to the imposition of dockside monitoring beginning in 1990.

5. ACKNOWLEDGEMENTS

Respondents to the survey provided detailed, forthright and constructive answers to both specific and open-ended questionnaire questions. We are grateful that they took the time to provide well considered answers that are certain to have improved our understanding of removals from the northern Gulf cod stock. We thank J. Ouellette-Plante for helping with the translation and D. Duplisea and C. Senay for reviewing the penultimate version of this document.

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7. TABLES

Table 1. Summary of the principal roles of the respondents in each of the five periods (P1-P5; Question 4).

Role	P1	P2	P3	P4	P5
Captain	4	17	29	31	31
Helper	12	10	2	1	1
Both		7	3	2	2
Total	16	34	34	34	34

Table 2. Summary as to whether cod was the main species fished by the respondents in each of the five periods (P1-P5; Question 5a).

	P1	P2	P3	P4	P5
Yes	12	24	12	11	9
No	4	10	22	23	25

Table 3. Summary of the other main species targeted by the respondents in each of the five periods (P1-P5; Question 5b). The number of responses and, in brackets, the percentage for the period are provided. Note that many respondents identified more than one species, hence the totals can be greater than the number of respondents.

	P1	P2	P3	P4	P5
Atl. Halibut	-	-	4 (10.3)	6 (12)	11 (18.0)
Crab	-	2 (20)	10 (25.6)	11 (22)	12 (19.7)
Capelin	-	-	-	2 (4)	5 (8.2)
Herring	-	-	1 (2.6)	5 (10)	8 (13.1)
Lobster	4 (80)	7 (70)	9 (23.1)	11 (22)	12 (19.7)
Lumpfish	-	-	1 (2.6)	-	1 (1.6)
Mackerel	-	-	-	1 (2)	3 (4.9)
Seal	-	-	-	1 (2)	-
Salmon	1 (20)	-	-	-	-
Scallop	-	1 (10)	4 (10.3)	1 (2)	1 (1.6)
Turbot	-	-	9 (23.1)	10 (20)	7 (11.5)
Whelk	-	-	-	1 (2)	1 (1.6)
Witch flounder	-	-	1 (2.6)	1 (2)	-
Total	5 (100)	10 (100)	39 (100)	50 (100)	61 (100)

Table 4. Summary of principal fishing areas as reported by the respondents by province and for each of the five periods (P1-P5; Question 6b).

Zone	NL					QC				
	P1	P2	P3	P4	P5	P1	P2	P3	P4	P5
3Pn	1	2	4	3	3	-	-	-	-	-
3Pn, 4R	2	1	-	2	2	-	-	-	-	-
4R	8	13	11	10	12	-	-	1	2	1
4R, 2J	-	1	-	-	-	-	-	-	-	-
4R, 3Pn, 2J	-	-	1	-	-	-	-	-	-	-
4R, 4RS	1	1	-	1	1	-	-	-	-	-
4RS	-	-	2	3	1	-	-	5	7	6
4RS, 2J	-	-	-	-	-	-	1	-	-	-
4S	-	-	1	2	1	5	7	7	5	7
4S, 2J	-	-	-	-	-	-	5	-	-	-
4S, 4RST, 3Pn	-	-	-	-	-	-	1	-	-	-
4Vs	-	1	-	-	-	-	-	-	-	-

Table 5. Summary of the principal fishing gears used by the respondents by province and during each of the five periods (P1-P5; Question 7).

	NL					QC				
	P1	P2	P3	P4	P5	P1	P2	P3	P4	P5
Gillnet	4	3	6	6	6	-	3	7	7	9
Longlines	3	6	7	7	7	-	-	-	-	-
Handline	-	-	-	-	-	-	-	-	-	-
Trap	2	3	-	-	-	3	-	-	-	-
Nets and hooks	1	2	5	5	6	-	2	7	7	5
Nets and traps	-	1	-	-	-	1	3	-	-	-
Hooks	1	2	2	2	-	-	-	-	-	-
Multiple fixed	-	2	-	-	1	1	5	-	-	-
Multiple fixed + mobile	-	1	-	-	-	-	1	-	-	-
Bottom trawl	-	-	-	-	-	-	-	-	-	-
Seine	-	-	-	-	-	-	-	-	-	-

Table 6. Summary of the size classes of vessels (in feet) used as the main fishing vessel to fish cod commercially, by province and period (P1-P5; Question 8). Responses indicating more than one class are tabulated separately.

vessel	NL					QC				
	P1	P2	P3	P4	P5	P1	P2	P3	P4	P5
<35’	9	16	17	15	16	5	8	5	5	5
35’- 44’11’’	1	3	2	3	2	-	5	6	5	4
45’ to 64’11’’	-	1	1	2	2	-	1	3	4	5
>65’	-	-	-	-	-	-	-	-	-	-
Multiple	-	3	1	1	0	-	5	1	2	3

Table 7. Summary of the frequency of independent catch monitoring in each period (P1-P5; Question 9b).

	P1	P2	P3	P4	P5
Always	1	2	27	29	30
Often	-	1	5	5	4
Sometimes	-	-	-	-	-
Not often	2	6	-	-	-
Never	12	18	1	-	-
Never -> Always	-	6	-	-	-

Table 8. Summary of the frequency of independent catch monitoring during the last three periods (since 1996) by monitoring type: dockside monitoring (DM), authorization number (A) or a mix of both. In some instances a range is provided where the number differed slightly between periods. One respondent indicated never being monitored during period 3, and consequently did not specify the type of monitoring available in their area.

	DM	A	DM-A
Always	21	3	3-6
Often	1-2	-	3

Table 9. Summary of the catch monitoring type employed in each period and area : D-dockside monitoring, S-purchase slips, A-authorization number.

	P1		P2						P3			P4			P5		
	D	S	D	S	D,A	S,A	S,D	S,D,A	D	A	D,A	D	A	D,A	D	A	D,A
3Pn	0	0	2	1	0	0	1	0	4	0	0	4	0	0	4	0	0
4Ra	0	2	0	1	1	1	0	1	2	1	2	2	1	3	2	1	3
4Rb	0	4	0	2	0	1	0	0	0	1	2	0	1	3	0	1	3
4Rc	0	0	1	0	0	0	0	0	1	0	0	1	0	0	0	0	1
4Rd	0	1	0	0	0	1	0	0	0	1	0	0	1	0	0	1	0
CN	0	5	0	14	0	0	0	0	14	0	0	14	0	0	14	0	0
LS	1	2	0	0	1	0	3	0	2	0	2	2	0	2	2	0	2

Table 10. Summary of the frequency of discarding of cod in the directed fishery, by province and by period (Question 10).

	QC					NL				
	P1	P2	P3	P4	P5	P1	P2	P3	P4	P5
Never	2	1	1	1	1	4	7	5	5	4
Not often	2	11	12	12	12	7	12	14	15	14
Sometimes	1	1	1	1	1	-	1	1	-	2
Often	-	1	-	-	-	-	-	-	-	-
Always	-	-	-	-	-	-	-	-	-	-

Table 11. Summary of the reasons for discarding cod in the directed fishery, expressed as a percentage of responses.

Reason	**%**
Scavengers	52.4
Sea lice	11.7
Seal depredation	11.7
Weather	19.3
Small fish	2.7
Excess bycatch	0.4
No market	1.8

Table 12. Summary of the magnitude of unreported catches of cod in other fisheries, relative to recorded landings in the directed fishery, by period (Question 11).

	P1	P2	P3	P4	P5
0-none	6	9	10	10	10
1-negligible (<1%)	2	5	12	12	12
2-much smaller (1-25%)	-	1	2	2	2
3-smaller (25-75%)	1	1	1	1	1
4-about the same (75-125%)	-	1	-	-	-
5-large (> 125%)	-	-	-	-	-

Table 13. Summary of the annual number of recreational cod fishing trips in the respondents' communities, by period and area (Question 13).

	Annual number of trips				
	0	1-50	50-150	150-200	200+
P1: pre-1977	12	2	-	-	-
P2: 1977-1994	22	4	-	-	1
P3: 1996-2002					
3Pn	0	1	0	0	1
4Ra	0	2	1	0	0
4Rb	0	2	0	0	0
4Rc	0	0	0	1	0
4Rd	0	1	0	0	0
CN	0	6	4	2	2
LS	0	2	1	0	1
P4: 2004-2008					
3Pn	0	1	0	0	1
4Ra	0	2	1	0	0
4Rb	0	3	0	0	0
4Rc	0	0	0	1	0
4Rd	0	1	0	0	0
CN	0	6	4	0	4
LS	0	2	1	0	1
P5: 2009-2020					
3Pn	0	0	0	0	2
4Ra	0	2	1	0	0
4Rb	0	3	1	0	0
4Rc	0	0	0	1	0
4Rd	0	1	0	0	0
CN	0	6	4	0	4
LS	0	2	0	1	1

Table 14. Discards in the directed fishery, expressed as a percentage of total directed cod landings.

	QC			NL		
	lower	mid	Upper	lower	mid	upper
P1	0.20%	0.32%	0.43%	0.10%	0.15%	0.20%
P2	0.32%	0.40%	0.48%	0.19%	0.30%	0.41%
P3	0.14%	0.21%	0.28%	0.17%	0.27%	0.37%
P4	0.14%	0.21%	0.28%	0.08%	0.12%	0.16%
P5	0.14%	0.21%	0.28%	0.12%	0.18%	0.25%
P5*	-	-	-	0.99%	1.64%	2.29%

Table 15. Discards of cod in non-directed fisheries, expressed as a percentage of total cod landings.

	Lower	Mid	Upper
P1	2.8%	5.7%	8.6%
P2	5.9%	9.7%	13.5%
P3	1.1%	3.3%	5.5%
P4	1.1%	3.3%	5.5%
P5	1.1%	3.3%	5.5%

Table 16. Estimates of cod taken annually (tonnes) in the recreational fishery in each province and by period based on responses on the amounts respondents felt were taken in their community.

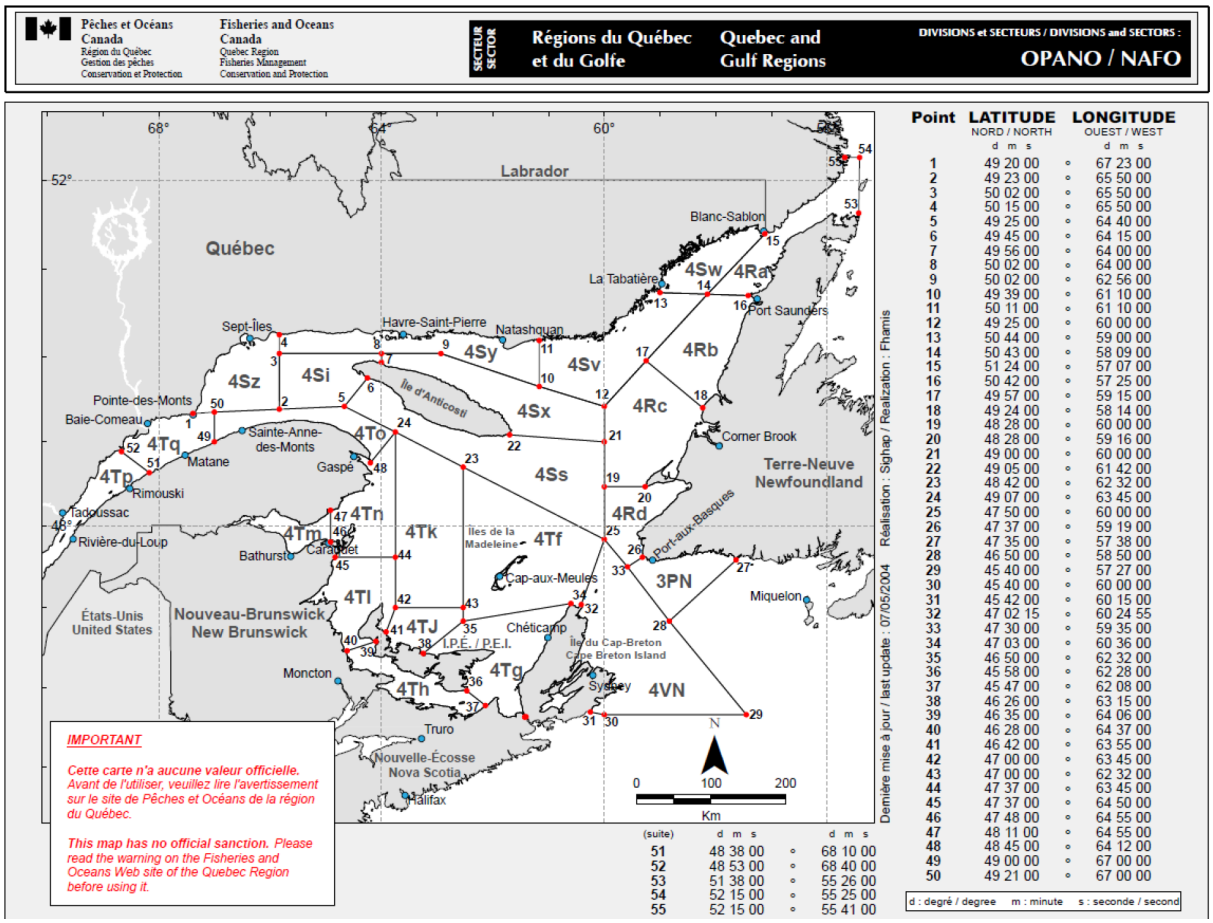
	P1	P2	P3	P4	P5
QC	0	0	73.8	91.1	91.1
NL	41.5	51.2	286.3	288.4	390.0
Total	41.5	51.2	360.1	379.5	481.1

Table 17. Estimates of cod taken annually (tonnes) in the recreational fishery in each province and by period based on responses on the number of recreational fishing trips made annually in respondents' communities. Lower, middle and upper estimate values were derived based on assumptions on the number of cod taken per trip and the value used to quantify trips in the trip categories (see text for details).

		P1	P2	P3	P4	P5
Lower	QC	0	0	59.4	66.0	66.0
	NL	0.2	14.4	46.5	43.2	61.7
	Tot	0.2	14.4	105.9	109.3	127.7
Mid	QC	0	0	91.8	101.6	101.6
	NL	5.1	24.7	75.9	72.2	91.8
	Tot	5.1	24.7	167.8	173.8	193.5
Upper	QC	0	0	131.2	150.9	150.9
	NL	10.2	38.8	113.0	108.3	131.6
	Tot	10.2	38.8	244.2	259.1	282.4

8. FIGURES

Figure 1. Locations of the communities in which the 34 questionnaire respondents reside.



Point	LATITUDE NORD / NORTH d m s	LONGITUDE OUEST / WEST d m s
1	49 20 00	67 23 00
2	49 23 00	65 50 00
3	50 02 00	65 50 00
4	50 15 00	65 50 00
5	49 25 00	64 40 00
6	49 45 00	64 15 00
7	49 56 00	64 00 00
8	50 02 00	64 00 00
9	50 02 00	62 56 00
10	49 39 00	61 10 00
11	50 11 00	61 10 00
12	49 25 00	60 00 00
13	50 44 00	59 00 00
14	50 43 00	58 09 00
15	51 24 00	57 07 00
16	50 42 00	57 25 00
17	49 57 00	59 15 00
18	49 24 00	58 14 00
19	48 28 00	60 00 00
20	48 28 00	59 16 00
21	49 00 00	60 00 00
22	49 05 00	61 42 00
23	48 42 00	62 32 00
24	49 07 00	63 45 00
25	47 50 00	60 00 00
26	47 37 00	59 19 00
27	47 35 00	57 38 00
28	46 50 00	58 50 00
29	45 40 00	57 27 00
30	45 40 00	60 00 00
31	45 42 00	60 15 00
32	47 02 15	60 24 55
33	47 30 00	59 35 00
34	47 03 00	60 36 00
35	46 50 00	62 32 00
36	45 58 00	62 28 00
37	45 47 00	62 08 00
38	46 26 00	63 15 00
39	46 35 00	64 06 00
40	46 28 00	64 37 00
41	46 42 00	63 55 00
42	47 00 00	63 45 00
43	47 00 00	62 32 00
44	47 37 00	63 45 00
45	47 37 00	64 50 00
46	47 48 00	64 55 00
47	48 11 00	64 55 00
48	48 45 00	64 12 00
49	49 00 00	67 00 00
50	49 21 00	67 00 00

(suite)	d m s	d m s
51	48 38 00	68 10 00
52	48 53 00	68 40 00
53	51 38 00	55 26 00
54	52 15 00	55 25 00
55	52 15 00	55 41 00

Figure 2. NAFO subdivisions in the Gulf of St. Lawrence.

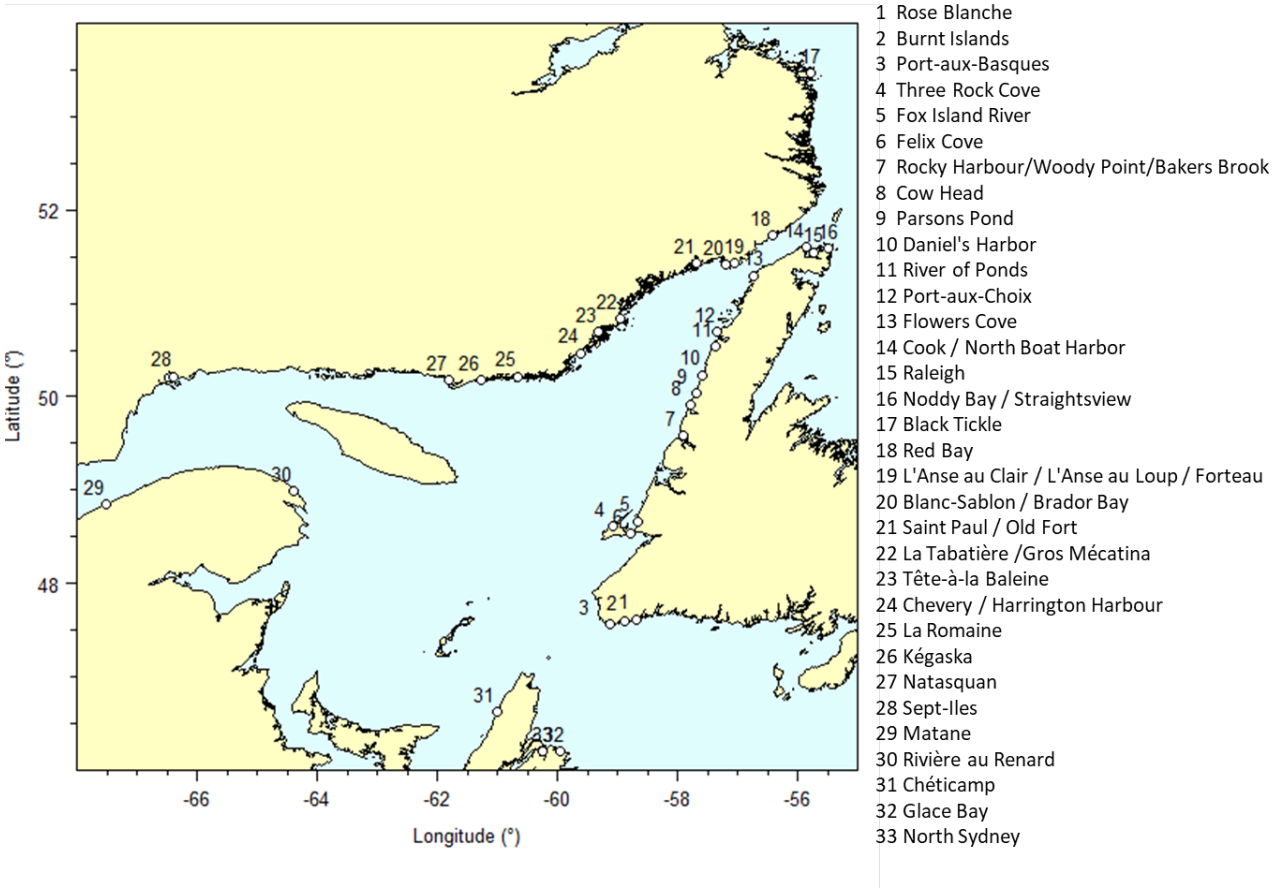


Figure 3. Principal landing ports identified by the ensemble of respondents for the five periods.

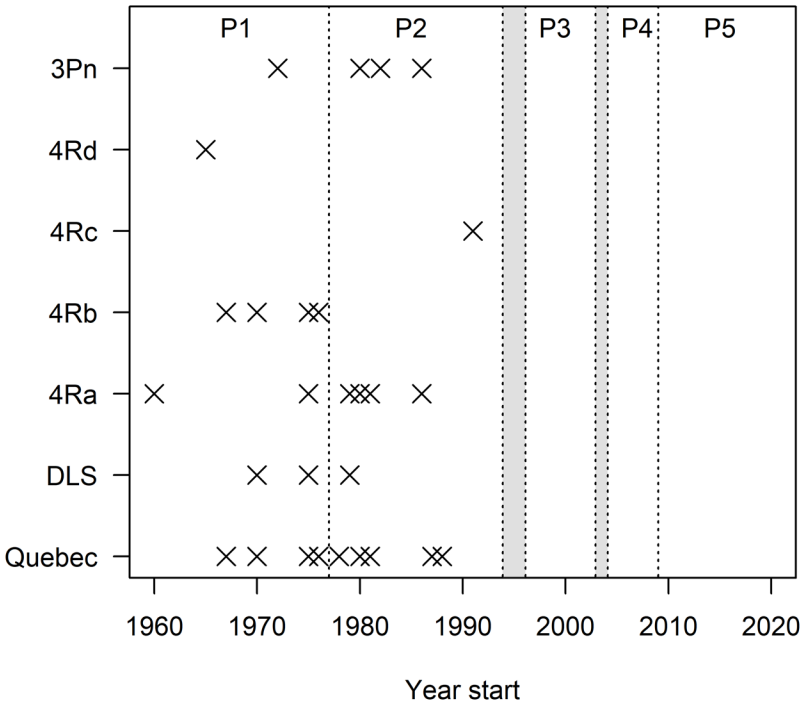


Figure 4. Year in which respondents began fishing commercially, as a function of areas (rows; where DLS is détroit du Labrador – Labrador Straits) and periods (P1-P5). All respondents are still active fish harvesters. Moratorium years are identified using grey shading.

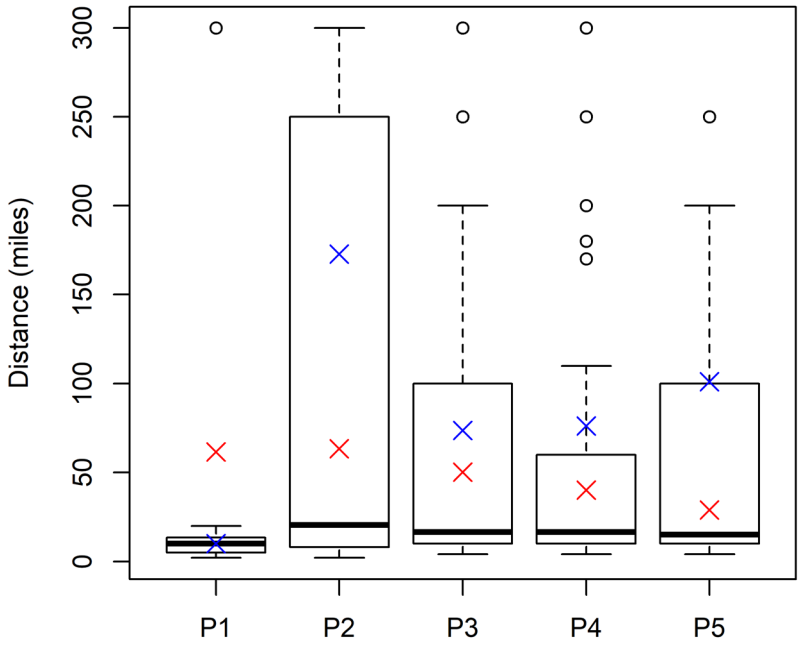


Figure 5. Boxplots of the average distance travelled by respondents from their home port to fish in each period. Note that the distance in many instances are right censored values as respondents indicated travelling at least that far. Average distance travelled by respondents in Quebec and Newfoundland and Labrador are shown using blue and red crosses respectively.

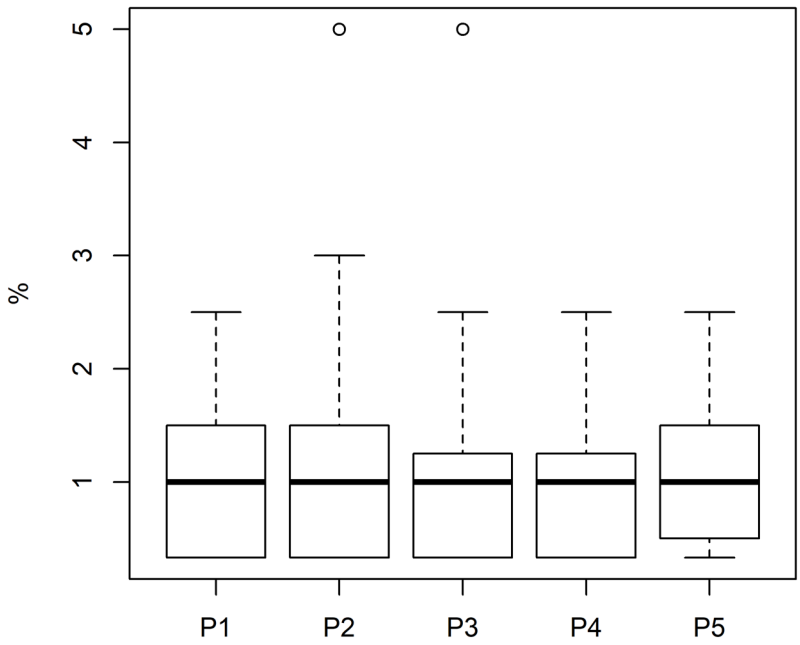


Figure 6. Boxplots of the percentage of catch discarded when discarding occurred, by period, as reported. Note that period 5 excludes one response that indicated 50% of catch discarded due to seals, said to occur 'sometimes' by a respondent in 4Rc.

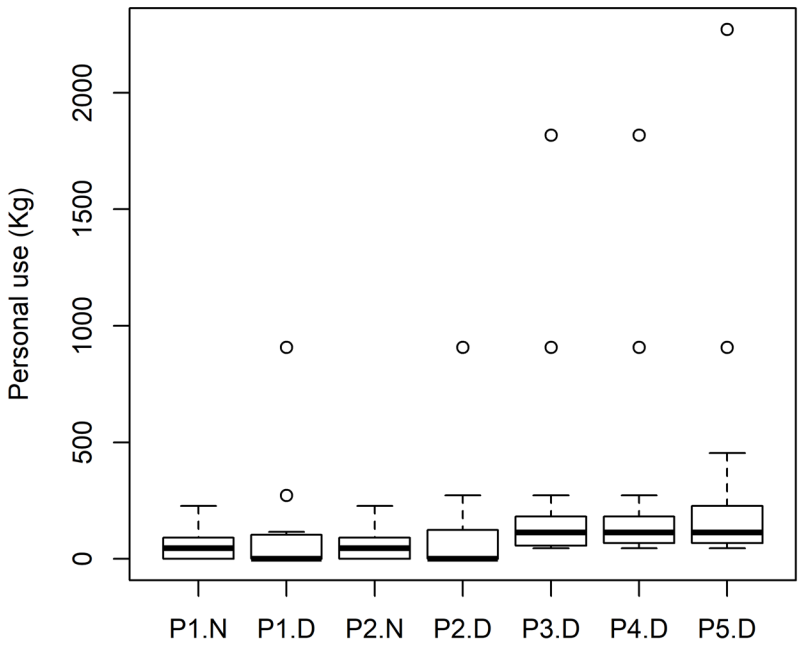


Figure 7. Boxplots of the mass (kg) of fish retained annually by the respondents for personal use in each period. Separate boxplots are provided for declared (D) and non-declared (N) catches.

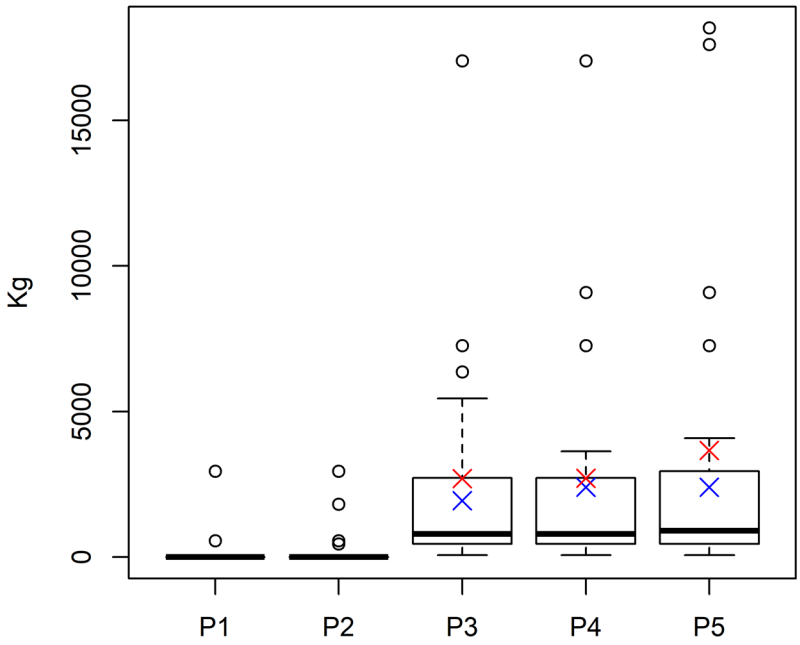


Figure 8. Boxplots of the estimated amount of cod taken annually in the respondents' communities as part of the recreational fishery, by period. Averages for respondents in Quebec and Newfoundland and Labrador are shown using blue and red crosses respectively for periods 3 to 5.

9. APPENDIX I

QUESTIONNAIRE ON UNACCOUNTED CATCHES OF NAFO 3PN4RS COD

Preamble

This questionnaire seeks information on the fishery for Atlantic cod in NAFO areas 3Pn4RS which may not be available in official catch statistics or may not be completely accurately reflected in those statistics. Fisheries and Oceans Canada (DFO) is undertaking a review of the science for 3Pn4RS cod and the information gathered using this questionnaire will provide a better understanding of the stock and fishery in the past and the information required to promote a healthy, profitable and sustainable fishery for the future. Your input will allow DFO Science to incorporate the best available information on the fishery into the assessment, not just the official data.

Your participation is voluntary. While we would greatly value your answers to all our questions, you can stop the questionnaire at any time. The privacy of your answer will be assured through a number of steps. First, your name or other personal identifiers will not be associated with your answers in the questionnaire database. Second, questionnaire results will be presented in an aggregated manner such that it will not be possible to guess who questionnaire respondents might be based on where they live, or when and where they fished, for example. Third, your name and contact details will only be shared with DFO if you request to receive a copy of the report that will be produced using the questionnaire results. That information will be provided to DFO separately from the questionnaire results.

Questions

1) What is your home port? _____

2) In what year did you begin fishing cod commercially? (approximate year is fine)

_____

3) Do you still fish for cod commercially? _____

   If no, in which year did you stop? _____

The questions in this questionnaire are asked with respect to specific periods in the fishery. The following years represent key milestones for the 3Pn4RS cod fishery :

1977 :extension of jurisdiction and quota imposition

1990: start of dockside monitoring

1994-1996 : moratorium and ongoing exclusion of the mobile gear sector

From 1996: use of logbooks

2003:moratorium

2009-2020: low quota period

These milestones define five periods that are relevant for the interview:

Prior to the 200 mile limit and imposition of a quota (pre-1977)

1977 to the first moratorium (1977-1994)

Inter-moratorium period (1996-2002)

Post moratorium period (2004-2008)

Low quota period (2009-2020)

Each question is asked for each period in which you were active in the fishery.

4) During each period, what was your main role in the fishery (the one to which you devoted the longest time)?

Period	1-captain	2-helper	3-plant worker	Other (specify)
pre-1977:				
1977-1994:				
1996-2002:				
2004-2008:				
2009-2020:				

5) During each period, was cod the main species you fished; in other words did it represent the majority of your fishing income? If not, what was?

Period	Fished cod (y/n)	Main target species (open answer)
pre-1977:		
1977-1994:		
1996-2002:		
2004-2008:		
2009-2020:		

6) During each period, how far did you fish from your home port on average? What was the main area (region, zone) in which you fished (open answer)?

Period	Average distance (miles)	Main area (open answer)
pre-1977:		
1977-1994:		
1996-2002:		

Period	Average distance (miles)	Main area (open answer)
2004-2008:		
2009-2020:		

7) What was the main fishing gear you used to catch cod commercially during each period?

Period	1-Gillnet	2-Longline	3-Handline	4-Trap	5-other fixed gear	6-bottom trawl	7-Seine	8-other mobile gear
pre-1977:								
1977-1994:								
1996-2002:								
2004-2008:								
2009-2020:								

8) How big was the main vessel you used to fish cod commercially during each period?

Period	1: <35’	2: 35’ to 44’11’’	3: 45’ to 64’11’’	4: >65’
pre-1977:				
1977-1994:				
1996-2002:				
2004-2008:				
2009-2020:				

9) Landings can be monitored using methods such as dockside monitors, authorization numbers, and sales slips.

a) What was your main cod landing port in each period?

b) How often was your catch monitored during each period? : never, not often (1 or 2 out of every 10 trips), sometimes (3 to 7 out of 10), often (8 or 9 out 10), always (every trip)

c) How was it mainly monitored? D- dockside monitoring, A-authorization number, S-sales slip, O-other

Period	Main cod port	Frequency	How monitored
pre-1977:			
1977-1994:			
1996-2002:			
2004-2008:			
2009-2020:			

10) Fish can be discarded at sea for a variety of reasons including: lack of market (poor price, no buyer), unmarketable size (e.g., too small), spoiled catch due to scavengers (e.g., hagfish, sea lice, seals).

a)On average, how often were cod discarded in each period: never, not often (1 or 2 out of every 10 trips), sometimes (3 to 7 out of 10), often (8 or 9 out 10), always (every trip)

b) if cod were discarded, what were the main reasons?

Period	frequency	Main reasons
pre-1977:		
1977-1994:		
1996-2002:		
2004-2008:		
2009-2020:		

c) On average, when cod were discarded, what percentage of your catch of cod was discarded in each period (indicate 0% if it was all landed). Put another way for every 100 pounds caught, how much was returned to the water when there were discarded cod.

Period	%
pre-1977:	
1977-1994:	
1996-2002:	
2004-2008:	
2009-2020:	

11) During each period, was there evidence or talk of unreported catches of cod in other fisheries, such as the redfish fishery, the Greenland halibut fishery, the Atlantic halibut fishery or another? Are you able to say how these catches would have compared to reported landings of cod in the cod fishery? 0-none, 1-negligible (<1%), 2-much smaller (1-25%), 3-smaller (25-75%), 4-about the same (75-125%), 5-larger (>125%)

Otherwise, can you comment on the amounts or provide an example?

Period	Magnitude	Comment (open answer)
pre-1977:		
1977-1994:		
1996-2002:		
2004-2008:		
2009-2020:		

12) During each period, on average how many pounds of cod did you or your crew keep annually for personal use? Was this personal use cod recorded in official monitoring (in logs, dockside monitoring, etc)?

Period	Pounds/year	Officially recorded (Y/N)?
pre-1977:		
1977-1994:		
1996-2002:		
2004-2008:		
2009-2020:		

13) Do people in your community participate in the recreational cod fishery? If yes, how many recreational fishing trips happen in an average year in your community?

Or

How many cod by weight are caught annually by the recreational fishery in your community for each period.

Period	Number of fishing trips				
	None	1-50	50-150	150-200	200+
pre-1977:					

Period	Number of fishing trips				
	None	1-50	50-150	150-200	200+
1977-1994:					
1996-2002:					
2004-2008:					
2009-2020:					

Or

Period	No recreational cod fishery	Cod catch /year (Pounds)
Pre- 1977:		
1977-1994:		
1996-2002:		
2004-2008:		
2009-2020:		

Closing comments

We thank you for taking the time to complete this questionnaire. We greatly value your input.

A report based on the results of this questionnaire will be prepared by the spring of 2021. If you would like to receive a copy of this report, please provide the interviewer with your email address for an electronic copy, or your mailing address for a paper copy.

10. APPENDIX II

COMPILATION OF RESPONDENT COMMENTS ROUGHLY SORTED BY THEME

This appendix provides a compilation of the free form comments provided by respondents as part of the questionnaire. The comments are presented as they were provided to the authors of this report and are largely unedited citations.

Pertinence of this questionnaire based survey

“These are not legitimate questions. Should have been more about the fishermen’s input and should be more about the fishermen’s experience and their input about back then and now from the ones who sees it and experiences it.”

“This survey had nothing to do with how much cod we are seeing. [I'm] disappointed on that there is no questions about what the fishermen are seeing and how much fish they are actually seeing compared to years ago. [I am] seeing more cod in my area in the last 6 years than I ever did before in my lifetime and [it's] staying around longer.”

Stock status (state and causes)

“After they opened after the moratorium the cod was real good for 2 to 4 years should have been more questions asked on what the fishermen thinks cause the office crew can't see what's going on from the office.”

“They need to somehow control the seal population cause they are really bad in this area. Some guys here are honest and only go out and get the fish they need and other guys will make several trips getting cod. There are lots of worms in the fish here and too many seals and never going to get any better with the seals. You can pull up a fish and take the hook out of his mouth and see the worms in the throat. The cod fishery is gone here. If I had to feed my family by cod money, we would all starve.”

“I think they can have a cod fishery there is enough cod. For the way the cod goes, you had to wait for the cod to come. Some days you wouldn't get any cause of weather. We always had good cod here: big fish [and] no time to catch the quota if your looking for good quality of fish. The capelin hasn't came to land so the fish ain't coming to the land because of the seiners. The last couple of years no cod left compared to years ago but you are still able to have a quota.”

“Just that the cod is getting pretty scarce. Nothing to eat and the capelin is gone. No capelin = no cod. The cod is starving to death.”

“I think the cod is still good out in deeper water, [it's] just not coming ashore cause no caplin coming in. The only thing I've seen here when they opened up from the moratorium there was a lot of fish cause then there was a lot of caplin. In the past 5 or 6 years the cod is not coming ashore like they did 8 or 10 years ago. You have to go to get them. The caplin stocks ain't like they once was.”

Management of the fishery

“Lots of cod bets took in the rec fishery. There needs to be more in-depth study required to understand the history and status of the Gulf cod”

“Here it seems like there is a bit of cod in the right time of the year. We can have a fishery more than 3 weeks if only hook n line and handline. Nobody sticks to 1 trip a day: at least couple trips a day same person for rec fishery. Keep gillnets and draggers away and you wouldn't have a problem.”

“The problem is whoever got the offshore is non stop the only ones is stopped is the inshore fishermen and seals are eating the fish and not doing nothing about the seal population. All I uses is hook n line. The only ones that are going to be in the fishery in 20 years is the offshore bigger companies. Small outports is going to be a thing of the past. Discards: hook n line was none, if nets than at least 50% or more if left for any amount of time in the water”

“Commercial should be only hook n line for few years because of bycatch in the nets. The cod fishery has went down but in the last few years it has been stable. I think they should shut down the capelin fishery for a few years for they can come back for the cod [then] the cod can have something to feed on not only for cod but for other species as well.”

The recreational fishery

“Everybody and their dog is out rec fishing several times a day. I dunno who's out fishing or not [because] I'm away fishing for the most part. The rec fishing is getting out of hand. The rec guys [are] making several trips a day and we['ve] got restrictions. They [are]taking advantage of the rec and we commercial fishermen and can only fish what we are allowed.”

“In the rec fishery the same boats coming and going all the time each day: several times a day, same boat, same people. There is just as much fish as there always was in the right time of the year that didn't change. Right now its the seals that enjoys them a good bit”

“Sometimes the weather wouldn't let them go anymore and if they got their 5 fish that was good enough for them and they were done.”

“There [are] no limits to the rec fish as far as I'm concerned. [It's] not being monitored enough. There is more fish being brought in in the rec fishery than the commercial fishery.”

“The rec fishery is just out of hand. One boat once a day 100lbs each day, for 39 days and [that's] 3900lbs there. Just for one boat and once a day. That's more than what we got for a quota. The rec fishing is a total destruction for the commercial fishermen.”

“Back then people could go and get what they whatever they wanted and sell if wanted to. Rec fishery people spends more time on the water than the commercial fishermen does. Rec fishery quotas are bigger than the commercial fishermen quotas.”

“Not many people to be fishing in my community only a few families here. There is just as much fish caught in the rec fishery as there is done in the commercial. “

Nobody sticks to 1 trip a day: at least couple trips a day same person for rec fishery.

Rec fishery brings in no small fish, only big ones. If there is choices, they will only bring in big ones but that is happening all the time, throwing back all the small dead fish and fish[ing] for bigger ones. Don't seem like DFO is really concerned what happens with or in the rec fishery. The quotas have drastically dropped, cod was a big source of income in some years.

Back then if a feller wanted a fish you would just go out and jig one. but there is still people who like to go. Probably, 10 boats here to do the rec fishing. Probably 6 of these boats they may make 10 trips a day.

The people go rec fishing everyday that it was open everyday they can go they are gone. I don't know anything at all about the rec fishery. I don't pay any attention to what they are doing cause I don't rec fish.

The rec fishery should be monitored more. [Even] a tagging system should be put in place. [There was] no rec fishery back in the early days anyone could go and catch whatever.

For the rec fishery there is a few people that does go out about half a dozen people and they make 8 or 10 trips a year.

Rec fishery [has] a lot of fishermen concerned cause its being abused. There is a lot of people abide by the rules and some don't follow the rules. Some got caught years ago with over fishing in the rec fishery. They should have some kind of monitoring system for the rec fishery. There is more destroyed by the rec fishery than the commerical. There was one feller told me he caught 50 fish and threw them back before he caught and kept one. The rec fishery is destroying it for us all.