Fisheries New Zealand
Tini a Tangaroa

The utility of an online panel for recruitment to a national harvest survey

New Zealand Fisheries Assessment Report 2025/36

A.G. Gray

ISSN 1179-5352 (online)
ISBN 978-1-991380-70-8 (online)

August 2025

Te Kāwanatanga o Aotearoa
New Zealand Government

Disclaimer

Enquiries should be directed to:

Fisheries Science Editor
Fisheries New Zealand
Ministry for Primary Industries
PO Box 2526
Wellington 6140
NEW ZEALAND

Email: Fisheries-Science.Editor@mpi.govt.nz
Telephone: 0800 00 83 33

This publication is also available on the Ministry for Primary Industries websites at:
http://www.mpi.govt.nz/news-and-resources/publications
http://fs.fish.govt.nz go to Document library/Research reports

Please cite this report as:
Gray, A.G. (2025). The utility of an online panel for recruitment to a national harvest survey. *New Zealand Fisheries Assessment Report 2025/36.* 26 p.

Contents

PLAIN LANGUAGE SUMMARY

This document reports on whether an online panel could be used to recruit fishers to a national harvest survey by marine recreational fishers. These national surveys have been carried out in 2011–12, 2017–18, and 2022–23 using screening for a fisher within a household. The households are sampled using a standard probability-based sampling scheme using Census meshblocks as the first stage of sampling and dwellings within the meshblock as the second stage of sampling. Recruitment like this contributes about half the cost of running a harvest survey. In contrast, market research companies recruit people to online panels typically from reward programmes. This study used a sample of 1000 people from the *Omnijet* online panel survey run by Verian. Respondents who identified as fishers were asked questions about their fishing behaviour. The demographic characteristics of these fishers and their behaviour was compared to those of the most recent national harvest survey. The online panel sample was materially different from the national harvest survey sample. The conclusions of this study are that in order to be comparable to the previous surveys, an online panel should therefore not be used for recruitment.

EXECUTIVE SUMMARY

Gray, A.G.[1] (2025). The utility of an online panel for recruitment to a national harvest survey. ***New Zealand Fisheries Assessment Report*** **2025/36. 26 p.**

This study examined whether an online panel could be used to recruit fishers to a future national harvest survey by marine recreational fishers. National harvest surveys have been carried out in 2011–12, 2017–18 and 2022–23 using screening for a fisher within a household. These households are randomly sampled using a standard probability-based sampling scheme using Census meshblocks as the first stage of sampling and dwellings within the meshblock as the second stage of sampling. These on-site screening/ recruitment surveys account for about half the cost of running a harvest survey.

Market research companies recruit people to online panels typically from reward programmes. This study used a sample of 1000 people from the *Omnijet* online panel survey run by the Verian market research company. Respondents who identified as fishers were asked questions about their stated fishing behaviour. These included frequency of fishing in the last year; species targeted; platform used and where they fished. Finally, they were asked whether they would be prepared to participate in a fishing survey lasting a year.

The demographic characteristics of these fishers and their behaviour was compared to those of the most recent National Panel Survey (NPS) in 2022–23. Note that the Online panellist provides *stated* responses. In the NPS *actual* data is given to the questions asked of the Online panellists (for example, how often they actually fished in the previous year). This *stated* versus *actual* nature of the responses provides some limitations on the analysis.

To understand the scale of the impact that Online panel demographic differences, and the areas they fished in have may on harvest estimates, the Online panellists who fished had a harvest imputed from the NPS. Specifically, an exchangeable bootstrap was used where an NPS fisher in a group was randomly sampled and their harvest used for each Online panellist in that group. The catch reported by each panellist throughout the year was weighted by the inverse of their sampling probability (the panellist's calibrated weight) and these combined weighted catches were the summed across all panellists to provide national harvest estimates. This was repeated 10 000 times to ensure that the mean of the estimate of the key species had coefficients of variation similar to those of harvest estimates from the NPS.

The results of the comparison were:

- The Online panel sample was materially different from the NPS with respect to demographics:
    - almost twice the proportion of people in the 20–24 and 25–34 age groups fished in the last year;
    - a much lower proportion in the 55–64 and 65–74 age groups fished in the last year;
    - more females and more non-Māori who fished in the last year;
    - There were more who fished in the last year in the Auckland, and Wellington Regions but fewer in the Bay of Plenty and Tasman Regions.
- With respect to fishing behaviour:
    - fewer fished in FMA 1; more (probably) fished in FMA 2;
    - fewer fished from a boat; more fished from both shore and boat;
    - fewer caught general finfish; fewer caught other marine species except rock lobster and paua; more (probably over three times as many) caught lobster or paua.
- The Online imputed harvests were different from the NPS, significantly so in some cases:
    - Generally finfish estimates were higher especially in FMA 1.

[1] Statistics Research Associates.

- Rock lobster estimates were higher in FMA 7 and paua estimates were higher in FMAs 2, 3, and 5.

In order to be comparable to the previous surveys, an online panel should therefore not be used for recruitment of panellists.

1 INTRODUCTION

Understanding the level and composition of recreational harvest is an important aspect of managing shared fisheries, to inform total removals in stock assessments, guide the allocation of catch limits, and to manage allowances that have been set.

1.1 Current Situation

Fisheries New Zealand currently undertakes a National Panel Survey (NPS) every 5 or 6 years to estimate harvest in New Zealand's substantive recreational fisheries. This survey recruits fishers through a face-to-face screening survey of households. These households are sampled using a standard probability-based sampling scheme using Census meshblocks as the first stage of sampling and dwellings within the meshblock as the second stage of sampling. The meshblocks are stratified by Territorial Authority (TA) and the allocation of the sample uses a Kish allocation which samples more meshblocks in smaller TAs and fewer in larger TAs (Heinemann & Gray 2024). In addition, there is an ongoing programme of monitoring at boat ramps around the country to monitor trends between these national surveys (Maggs et al. 2024).

The current design of the National Panel Survey recruits a panel of around 6000 putative recreational fishers from a screening survey of more than 36 000 dwellings. This is a hit-rate of about 1 in 6. At the face-to-face interview, residents 15 years and older are asked how often they fish in an average year and one of these is randomly sampled to be a panel member. This panel member is then contacted by text weekly (or less frequently depending on the number of times they fished in an average year – their avidity) to see whether they have fished in the last period. If they have fished, then a phone interview is conducted to collect fishing data. Not unsurprisingly the panel recruitment accounts for about half of the budget of the survey.

There is only a small correlation between actual avidity and stated avidity. In the 2022–23 NPS less than half (47%) of recruited fishers actually fished in the coming year.

Table 1: Column percentages (unweighted) of actual avidity for some stated avidity categories from the 2022–23 NPS.

	Stated Avidity		
Actual Avidity	B	C	D
A – not fished	71	51	29
B – fished 1–3 times per year	25	36	34
C – fished 4–9 times per year	4	12	26
D – fished 10 or more times per year	0	2	11
Total	100	100	100

Given this attrition rate ideally one would want to sample double the number of households to improve the accuracy of the harvest estimates, especially for the less commonly caught species.

1.2 Alternative recruitment?

A number of market research companies within New Zealand maintain online survey panels which typically have sizes in the order of a 100 000 or more. Would this be a potentially cost-effective alternative approach for recruiting a national panel of marine recreational fishers and potentially provide a final sample of actual fishers as large as currently, or even larger?

There are risks using online panels.

- Online panels offer rewards for participation in surveys, introducing the risk of *false positives* or even more stated avidity Bs, Cs, or Ds being actual avidity As.
- Online panels are generally not the union of probability-based samples. For example they can be recruited from rewards programmes such as the defunct *Flybuys*, or *AA Rewards*; or from *Social Media* such as *Facebook* or *Instagram*.
- So even their socio-demographic characteristics will be different from a probability-based sample which is correctly weighted. Typically, they are dominated by middle aged people, women and have low Māori or Pasifika membership.
- They recruit people 18 and over whereas the NPS recruits people 15 and over.
- Their response rates are typically low, at around 30%. The NPS rates were 85% screened and 92% enrolled in 2017; and 79% screened and 86% enrolled in 2022.
- Although there are some examples of online panels being used for longitudinal studies such as the NPS (e.g., VUW Vaccine Hesitancy Study over one year quarterly; MBIE Immigration Study over 4–5 years annually) this is not usual.
- Both the above studies had wave dropout rates of around 20%. So by the end of the study they would have about 40% to 30% of the original sample compared to the NPS in 2017 having about 84% and in 2022 about 62% of respondents at the end of the survey.
- The contact method is single mode via email and web-based survey questionnaires so the respondent may answer only part of the questionnaire and give up because of the time already taken, or the complexity of the questionnaire, or lack of interest, etc. This partial response might increase. For example, MBIE run the International Visitor Survey with recruitment of email addresses and a link to a web-based questionnaire. Around 10% – 15% who respond to the main questionnaire do not respond to the Visitor Experience Module section of the questionnaire.
- These online panels generally do not have quota groups at fine regional level, typically at the Regional Council level. They collect postcode data so some fine-scale targeting is possible, but not as fine as StatsNZ's meshblock or New Zealand census statistical area 1 geographies (as applied in the NPS).

However, there are positive features with using online panels. They usually have more socio-economic data from the panellists than is collected in the NPS. For example:

- Marital status;
- Household Composition e.g., Couple with kids;
- Personal Income;
- Household IncomeThese might be useful in an analysis of the impact of fishing by different socio-economic groups.

2 METHODS

Fisheries New Zealand and Statistics Research Associates had a meeting with Verian (previously known as Kantar) to discuss online panels. Some of the information we obtained is included in the Introduction above.

Within budget constraints, a pilot study submitting questions asking information about fishing behaviour (anticipated sample of 1000 responding panellists) was proposed. While the fishing behaviour reported by panellists would be stated behaviour as opposed to the actual behaviour reported from the NPS, it was considered that this would provide enough information to judge the quality of the data from the online panellists compared with the NPS data.

2.1 Questionnaire

Fisheries New Zealand and Statistics Research Associates developed a preliminary set of questions. These were discussed with Verian and the final draft questions sent to the MAFWG for further feedback.

The final version of the questions was:

1. *Have you participated in any of the following outdoor leisure activities in the last 12 months? Tick any that apply.*
   - *Tramping/hiking*
   - *Sailing or kayaking*
   - *Sea fishing*
   - *Freshwater fishing*
   - *Hunting (deer, pigs, goats etc.)*
   - *Surfing/Body boarding, paddle boarding or sea swimming*
   - *None*

2. *How often did you go sea fishing in the last 12 months?*
   - *Not more than 3 times a year*
   - *About 4–9 times a year*
   - *10 times a year or more*

3. *When sea fishing, what are you targeting? Tick any that apply*
   - *General finfish (snapper, kingfish, kahawai, blue cod etc.)*
   - *Rock lobster*
   - *Paua*
   - *Other (please specify)*

   .
4. *When sea fishing, do you fish from*
   - *The shore*
   - *A boat (including kayak, jet ski etc)*
   - *Both*

5. *When sea fishing, in what region do you most frequently fish? Tick the most frequently fished area.*
   - *East Northland, Hauraki Gulf, Coromandel and Bay of Plenty.*
   - *East coast from East Cape, Hawke's Bay, Wairarapa and the Wellington coast to Titahi Bay.*
   - *East coast of South Island from Kaikoura region down to Waikawa.*
   - *South coast of South Island from Waikawa around to Big Bay, north of Fiordland.*
   - *West coast of the South Island north of Fiordland round to Golden Bay, Tasman Bay and the Marlborough sounds.*
   - *Lower West coast of North Island from Titahi Bay, up the Kapiti coast, around Taranaki and up to Marokopa.*
   - *Upper West coast of North Island, north from Marokopa (including all the harbours) and along the North coast to North Cape.*

6. *Would you be willing to participate in an ongoing monthly fishing activity survey for a 12 month period?*
   - *No*
   - *By telephone*
   - *Online*
   - *Either*

Because, as mentioned above, panellists are given rewards or incentives to respond, Question 1 was asked to reduce *false positives*: the people who might respond just to get the rewards. Only panellists responding *yes* to *Sea fishing* progressed to the remaining questions.

Question 2 is to assess the panellist's stated fishing avidity. It asks for last year, unlike in the NPS screening survey which asks for an average year, but it is very likely that when asked about an average year people will just think of the last year.

Question 3 is a proxy for the actual harvest which is reported in the NPS. This is the same for question 4 and Question 5.

Question 5 is a broad description of the Fishing Management Areas (FMAs). Ideally for an operational survey, panellists would have access to maps which would show the 54 recreational fishing reporting areas so that harvest for Quota Management Areas (QMA) could be calculated. However, whether this is feasible or how accurate the assignment to area is, would need to be tested.

Question 6 was asked to judge the willingness of panellists to stay on a year-long panel.

In the fishing context there is some previous data available regarding using online panels to assess this type of activity. National Research Bureau Ltd (NRB) were contracted by Fisheries New Zealand to run a trial of online monitoring of national marine recreational harvest trialling self-complete questionnaires using online questionnaire or an app-based questionnaire (Heinemann et al. 2021). NRB used panellists from the 2017–18 NPS who had agreed to be contacted for new fishing surveys. The conclusions of that study were

- Online self-complete surveying is feasible, if the sample who participate is comparable in fishing method, platform and areas fished.
- However, a proportion offer incomplete/partial interviews, with data on days fished and the high catches are under-represented, and the peak summer months are not comparably represented.

Another reason for asking Question 1 is that we have a comparison with SportNZ's Active NZ Sports and Activities Survey which is an ongoing survey sampling from the electoral roll and using online or postal self-completion.

Participation in different activities from the SportNZ survey is shown in Figure 1 (participation in the last 12 months, surveys from 2017 to 2023, the latest data available when the project started). The noticeable features are:

- Clearly COVID-19 had an impact but generally there is some fall off in participation.
- Marine fishing has dropped from 15% to 10% over this 6-year period. However, as identified at the MAFWG presentation of this study, the respondents to the Active NZ Survey may not consider gathering shellfish as marine fishing and so the reported percentages could be lower for that reason.
- This decline in fishing participation is similar to that observed in the NPS. The percentage of the eligible members in the initial dwelling sample stating they had fished in the last year were 20.7% in 2017–18 and 17.6% in 2022–23.
- The decline in *actual* fisher participation is likely much more as shown in Table 1, as *actual* fishers were about half the *stated* fishers recruited to the panel.

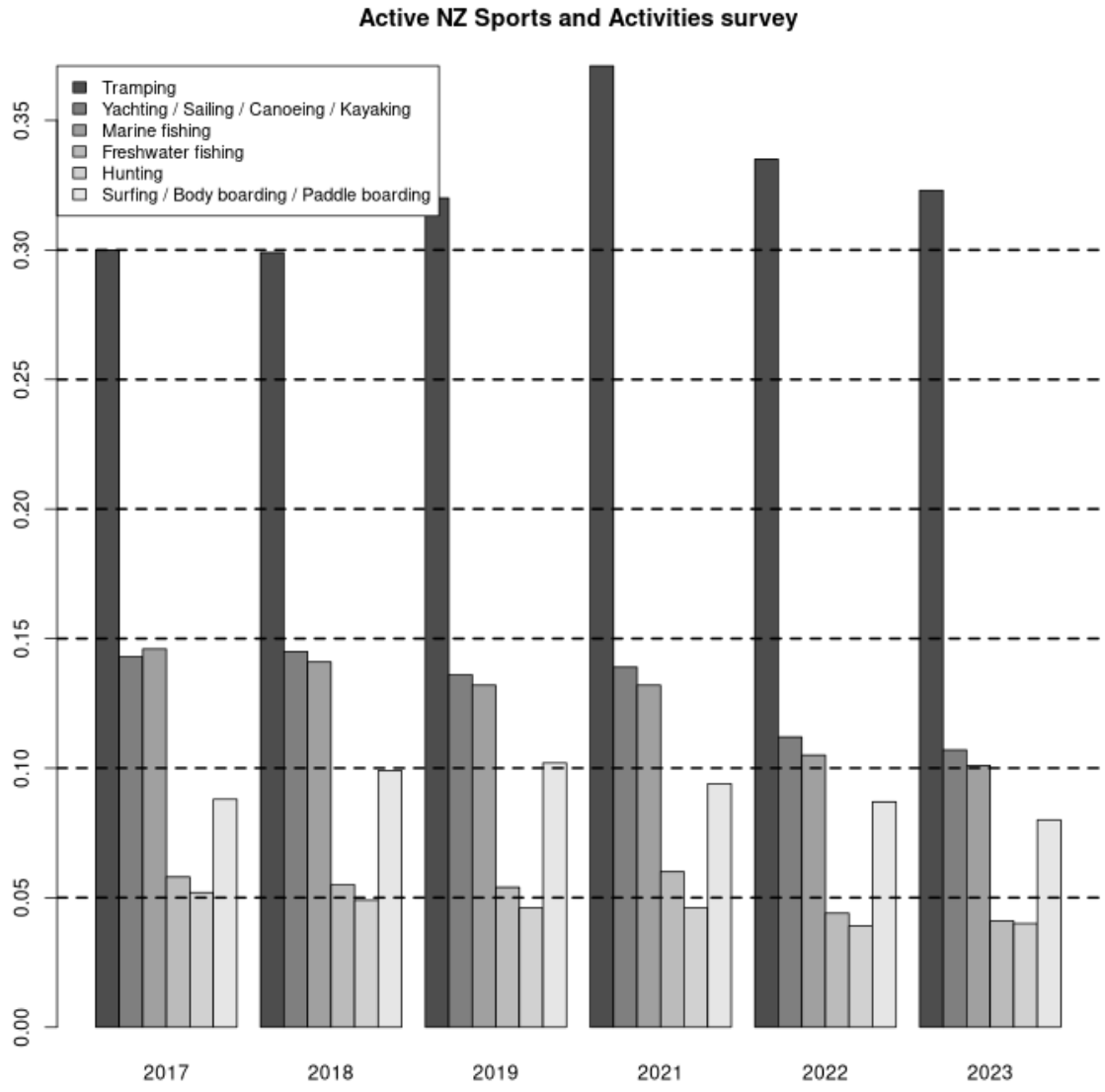

Figure 1: Participation in various sports and activities in the last 12 months as estimated from the SportNZ Active New Zealand Sports and Activities Survey.

2.2 Online Panel

Discussions between Fisheries New Zealand and Verian led to the choice of their *Omnijet* survey as a cost-efficient test of an online panel. This survey samples people using sampling quotas to reflect the demographic composition of the NZ population. It has an achieved sample size of 1000.

The panel for the *Omnijet* can be drawn from 100 000 members. Hence given a response rate of around 30%, potentially a similar number of people could be screened for fishing as the NPS.

Our questions were run during the second full week of February 2025. Ideally, we would have run the survey at the same time as the NPS does its recruitment which is in August and September before the start of the new fishing year but logistical constraints prevented this.

3 RESULTS

Following completion of the survey Verian supplied Statistics Research Associates with a spreadsheet with the results tabulated by some socio-economic variables and also an SPSS file of the unit record data. Preliminary checks were undertaken to ensure that the summarised tables could be reproduced from the SPSS data files.

Verian use 2018 Census counts to weight their sample. The data were reweighted to the Estimated Resident Population as at March-June 2022 which was used for the NPS. This was to ensure that any differences subsequently identified between the online and NPS surveys were not due to different population estimates.

The data were then categorised to the same tables as in the NPS:

- age groups by gender by Māori/non-Māori;
- Regional Council.

Undertaking this makes the somewhat heroic assumption that the sample design is a stratified simple random sample and that

- the allocation is proportional (so the inclusion probability weights are equal);
- the sampling fraction within a stratum is the stratum proportion at the 2018 Census as Verian use the 2018 Census counts to set quotas.

The first difficulty with this approach is that the cell counts for Māori in the online survey are small (Table 2).

Table 2: Counts from online survey for age group, gender and Māori/non-Māori.

	Māori		Non-Māori	
	Gender		Gender	
Age group	Male	Female	Male	Female
18–19	1	2	15	14
20–24	5	4	39	34
25–34	8	7	78	88
35–44	6	1	80	70
45–54	5	4	60	76
55–64	6	4	77	83
65–74	2	3	42	38
75+	1	2	58	78

The smaller regions are also poorly sampled by the online survey. For example, Gisborne, Tasman, Nelson, Marlborough, and the West Coast have 6, 11, 12, 11 and 7 respondents respectively.

Despite the small cell counts for the table age group, by gender and by Māori/non-Māori classification, the agreement of the reweighted table to the population table was mostly within usual bounds of uncertainty of population the tables except for, the 18–19 Māori males.

Agreement of the reweighted region table to the population table is poor especially for the smaller regions.

As a consequence, the replicated panellist calibrated weights to produce harvest weights and sample errors for the online survey are not really controlled.

The panellist calibrated weight is very variable with a minimum weight of 2427 and a maximum weight of 17 519. The 1st quartile, median, and 3rd quartile are 3370, 3517, and 4061 respectively. Five percent of the weights are extreme by a common measure: being more than six times the interquartile range (IQR) above the median. For the people who responded *Yes* to the *Sea fishing* option in Question 1 this increased to seven percent.

The sums of the replicated calibrated weights should equal 3 963 350 which is the 18+ population.[2] However, the minimum, 1st quartile, median, and 3rd quartile, and maximum are 1st quartile, median, and 3rd quartile are 2 426 902, 3 369 771, 3 517 114, 3 965 026, 4 060 577, 17 488 303 respectively.

Hence any estimates of sample errors (or coefficients of variation [CVs]) will be at best approximate, not least because the sample is not a probability-based sample.

The above analysis compares differences relative to the usual normal approximation for proportions of two standard errors. This means some of the confidence intervals for the online estimates will have lower limits which are negative. Because of the small sample sizes a better confidence interval could be calculated e.g., one based on the Jeffreys non-informative Prior. However, given that the online survey is not a probability-based sample anyway, this was not considered to be necessary.

3.1 Results from Question 2 through Question 6

In this subsection Online panellist refers to a person who answered *Yes* to the *Sea fishing* option in Question 1. This group of the Online panel is very small; only 207 out of the 1000. This sample is further reduced to 152 by those unwilling to participate in a year-long fishing survey.

Table 3 provides the estimates of stated fishing avidity. For the Omnijet survey this was based on their fishing in the last year whereas for the NPS it was based on their fishing in an average year. For the Online panel the data has been recalibrated to fit the same population as the NPS was calibrated to (i.e. the estimated Resident population in the June Quarter 2022 rather than the 2018 Census population).

Table 3: Estimates of the proportion of the population who stated fishing at different avidity levels. In the column heading est refers to the estimate, SE to the Sample Error and CV to the Coefficient of Variation.

	NPS 2022–23			Omnijet Online 2025 (adjusted)		
	Estimate	SE	CV	Estimate	SE	CV
Fished in last year	17.6%	0.3%	0.02	21.1%	1.3%	0.06
Not more than 3 times a year	7.0%	0.2%	0.03	9.0%	1.0%	0.13
About 4–9 times a year	6.0%	0.2%	0.03	7.7%	1.0%	0.13
10 times a year or more	4.6%	0.2%	0.04	4.3%	1.0%	0.13

The estimate of the population who fished in the last year from the Online panel is twice that from the ActiveNZ survey in 2023. Their rate is 20% bigger than the NPS survey rate in 2022. The Online panel rate is higher than the NPS probably because the avidity B rate is larger. The difference in the Avidity C rates is also larger but within the sampling error. The CVs for the Online survey in this table are 3 to 4 times larger than those in the NPS. This is partly due to the smaller sample size and partly due to poor calibration discussed above.

This difference in CVs is similar across the various data to be presented. The comparisons of NPS and Online survey results are presented as barplots, with comments provided on the likely differences.

[2]The 15+ population which is used in the NPS is 4 159 100. This is a 4.7% difference.

The tables behind the barplots are given in Appendix 1. The first set of plots relates to the demographics of the panellists.

Figure 2 gives the percentages of those who stated that they fished by age group from the NPS and the Online panel. We cannot compare the first age group as for the NPS the first age group is 15–19 whereas for the Online panel it is 18–19. However the Online panel had almost twice the proportion of people in the 20–24 and 25–34 age groups fishing. The Online panel had a much lower proportion in the 55–64 and 65–74 age groups than the NPS.

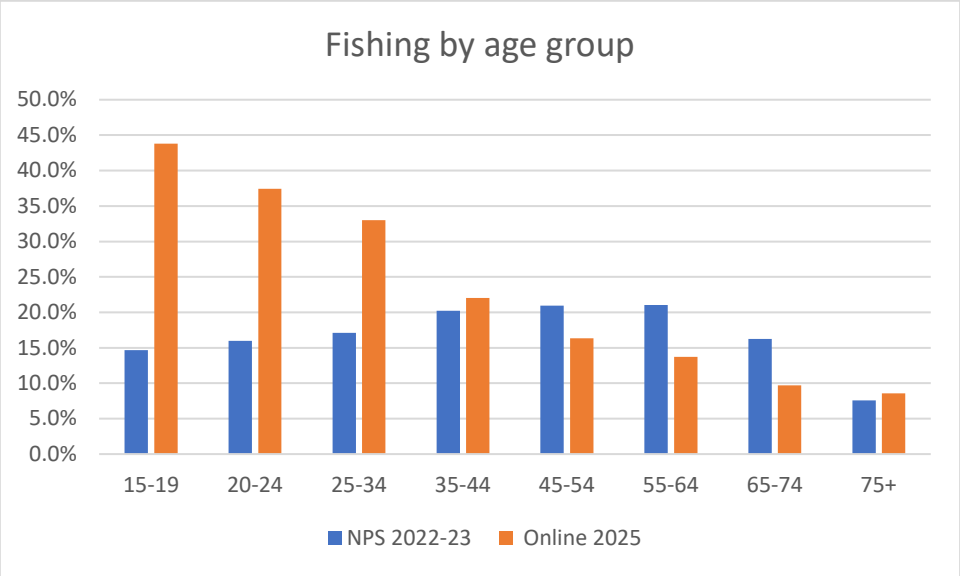

Figure 2: Proportion of participants who reported fishing in the last year (Online panel) or in an average year (NPS) by age group.

Figure 3 gives the percentages of those who stated that they fished by gender and by Māori/non-Māori from the NPS and the Online panels. The Online panel has more females fishing in the last year. The Online panel has more non-Māori fishing in the last year.

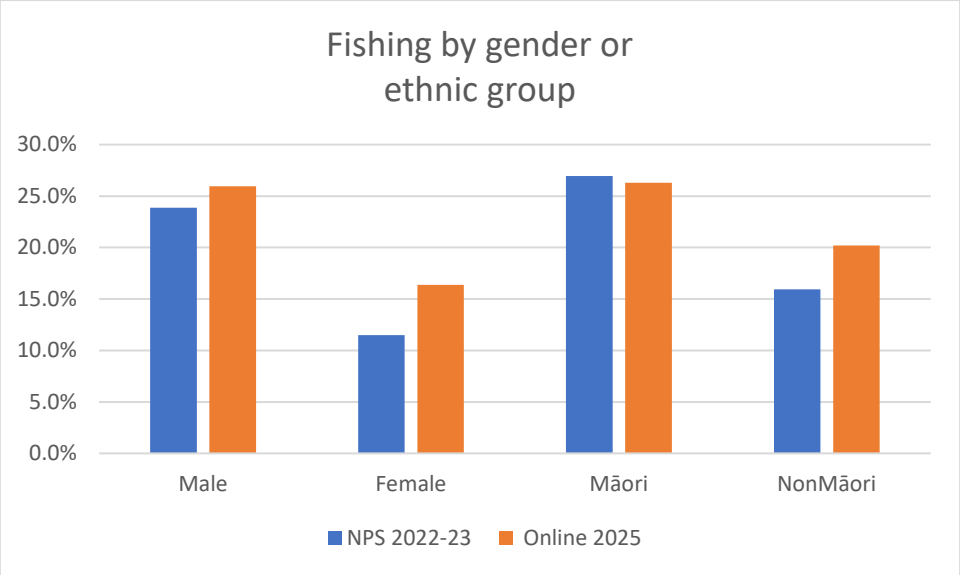

Figure 3: Proportion of participants who reported fishing in the last year (Online panel) or in an average year (NPS) by gender and ethnic group.

Figure 4 gives the percentages of those who stated that they fished by Regional Council region from the NPS and the Online panel. The Online panel recruited no panellists in the Gisborne Regional Council area who reporting fishing in the previous year. Clearly if an online panel were to be used, we would need a quota at the regional level or perhaps even finer at the Territorial Authority level. The Online panel has more participation in the Auckland, and Wellington Regions but less in the Bay of Plenty Region and Tasman Region.

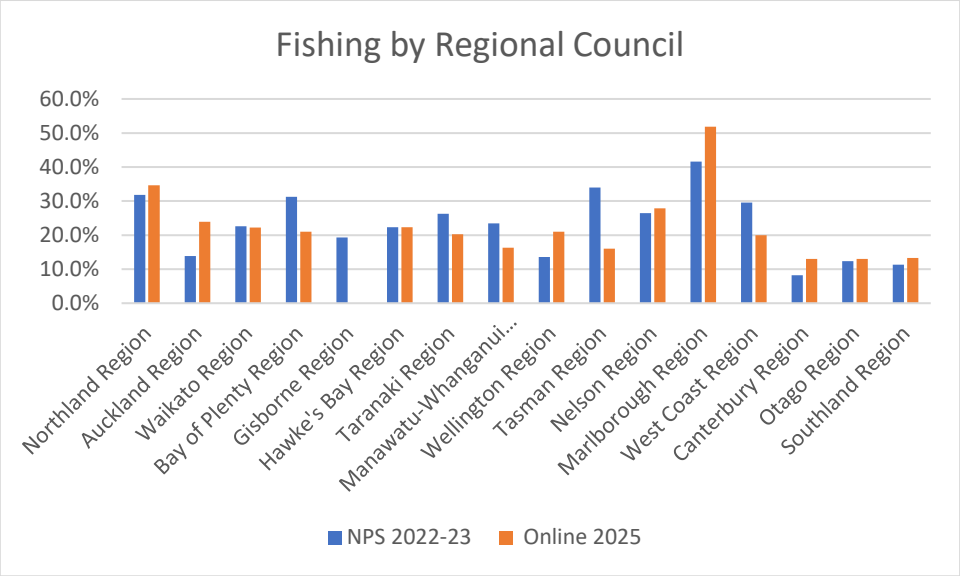

Figure 4: Proportion of participants who reported fishing in the last year (Online panel) or in an average year (NPS) by Regional Council.

The Online panel data had information about household composition (single, couple, couple with kids, other). Household size was derived from this so it could be compared with the NPS household / dwelling size. However, it was not clear what to do with the *Other* category from the Online panel data. It is likely that this could be people living in non-private dwellings such as a University hostel and so these have been treated as 1 person households. It was also necessary to approximate the household where there are school age children. Some of these children will be under 15 but it is assumed that all such households are households with 3 or more children age 15 and over. Figure 5 gives the barplot of the percentages. There are fewer 2 person households in the Online panel than the NPS and more 3+ households. But this may be an artefact of the approximation.

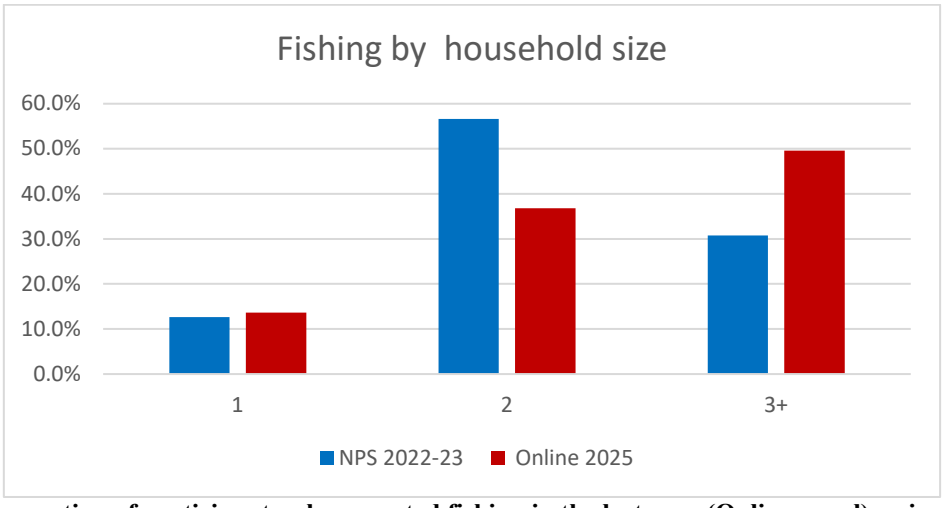

Figure 5: Proportion of participants who reported fishing in the last year (Online panel) or in an average year (NPS) by household size.

The next set of barplots look at fishing behaviour. It should be noted that the NPS data is actual fishing whereas the Online panellists are reporting their recollection of what happened in the previous year. We do not know which of these panellists would drop out or not fish in a current year, so the differences have an unknown measurement error.

Figure 6 gives the regions (FMAs) most frequently fished in in the last year from the NPS and the Online panels. The NPS data is actual harvest information. The Online panel is reporting that:

- fewer Online panellists fished in FMA 1 than in the NPS;
- more (probably) fished in FMA 2 than in the NPS.

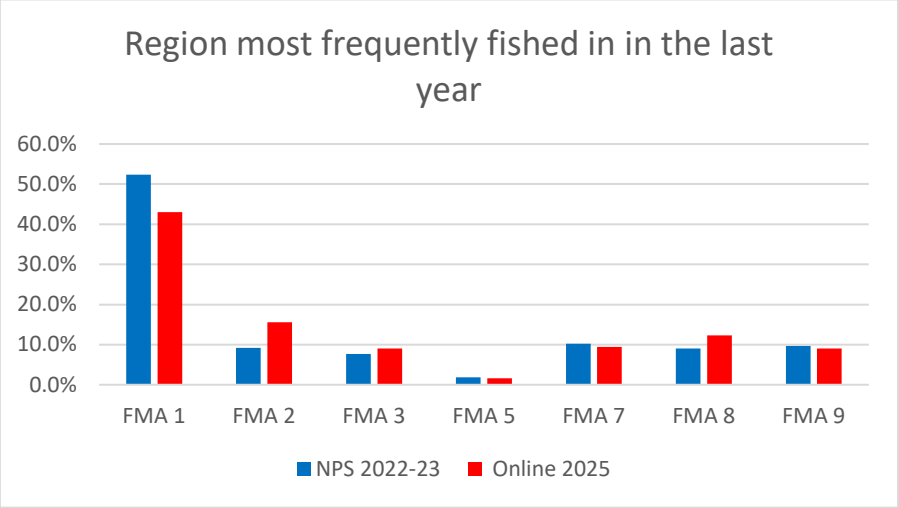

Figure 6: Region most frequently fished in in the last year from the NPS and the Online panels. The NPS data is actual harvest information whereas the Online panel data is recollection of the previous year.

Figure 7 gives the platform used for fishing in the last year for the NPS and the Online panels. Again, the NPS data is actual harvest information. The Online panel is reporting that:

- fewer Online panellists fished from a boat than occurred in the NPS;
- more fished from both shore and boat than occurred in the NPS.

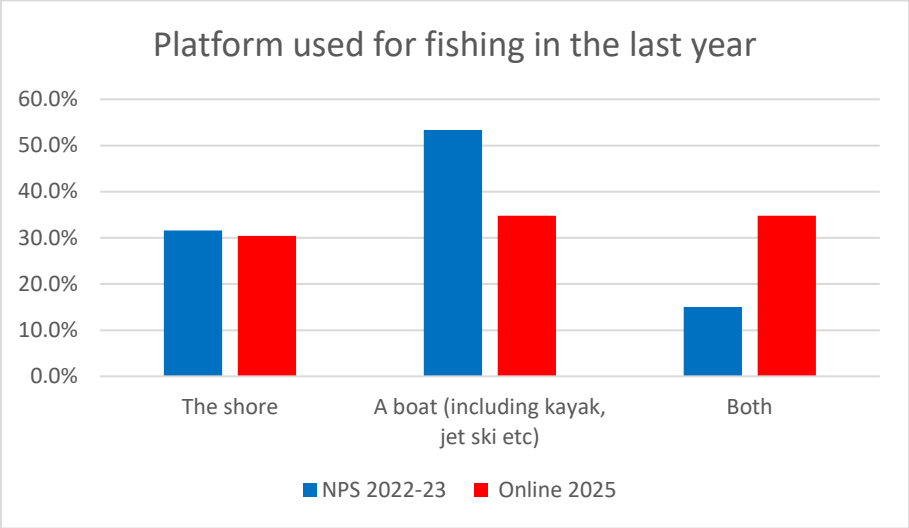

Figure 7: Platform using for fishing in the last year from the NPS and the Online panels. The NPS data is actual harvest information whereas the Online panel data is recollection of the previous year.

Figure 8 gives the species which were targeted in the last year for the NPS and Online panels. The NPS data is actual harvest information and so was caught rather than what was targeted. The Online panel is reporting that:

- fewer Online panellists reported targeting general finfish than were harvested in the NPS;
- fewer Online panellists reported targeting marine species (apart from lobster/paua) than were harvested in the NPS;
- more (probably over 3 times as many) Online panellists reported targeting lobster or paua than in the NPS.

This last result is considered to be very unlikely.

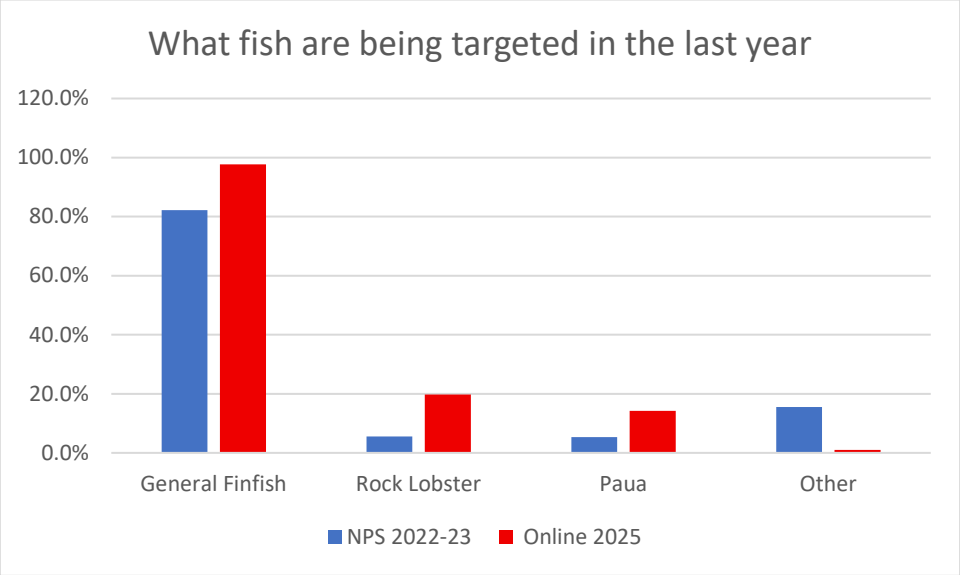

Figure 8: What fish are being targeted in the last year from the NPS and the Online panels. The NPS data is actual harvest information whereas the Online panel data is recollection of the previous year. Multiple responses are allowed.

The final set of barplots looks at the demographics of those who answered Question 6.

For the Online panel 23% of panellists said they would not be willing to participate in a year-long fishing survey. As a comparison the estimate from the NPS was 17%. This is a significantly smaller proportion. However, for the NPS this estimate is for people who initially were sampled into the panel but who subsequently declined. For example, some of these may have been identified as eligible by a partner or other family member, but when approached themselves declined to participate. Also, the NPS estimate does not use the calibrated weight but rather the nonresponse adjusted selection weight as the calibrated weight excludes these people.

Figure 9 gives the percentage of panellists unwilling to participate in a year-long fishing survey by age group for the NPS and the Online panels. The NPS data is actual nonresponse information. For the Online panel the first age group is 18–19 not 15–19 so is not comparable.

For the age groups from 35–44 onwards there are big differences. These could be material because in the NPS the 55–64 age group catch about a quarter of the finfish and the 25–34 age group about an eighth of the finfish.

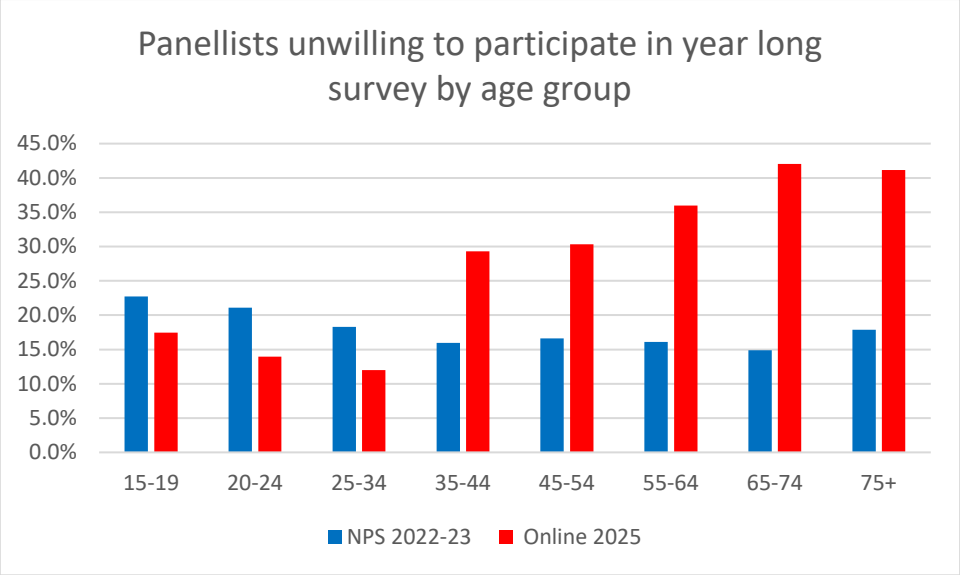

Figure 9: Panellists unwilling to participate in a year long fishing survey from the NPS and the Online panels. The NPS data is actual nonresponse information whereas the Online panel data is stated unwillingness to participate. For the Online panel the first age group is 18–19 not 15–19 so is not comparable.

Figure 10 gives the percentage of panellists unwilling to participate in a year-long fishing survey by stated avidity for the NPS and the Online panels. For the Online panel this is for the previous year; for the NPS it is an average year. The Online avidity B panellists are less willing to participate, whereas the avidity C and D panellists are more willing to participate. Again, this could be material as in the NPS the stated avidity C fishers caught 32% of the finfish and stated avidity D fishers caught 50% of the finfish.

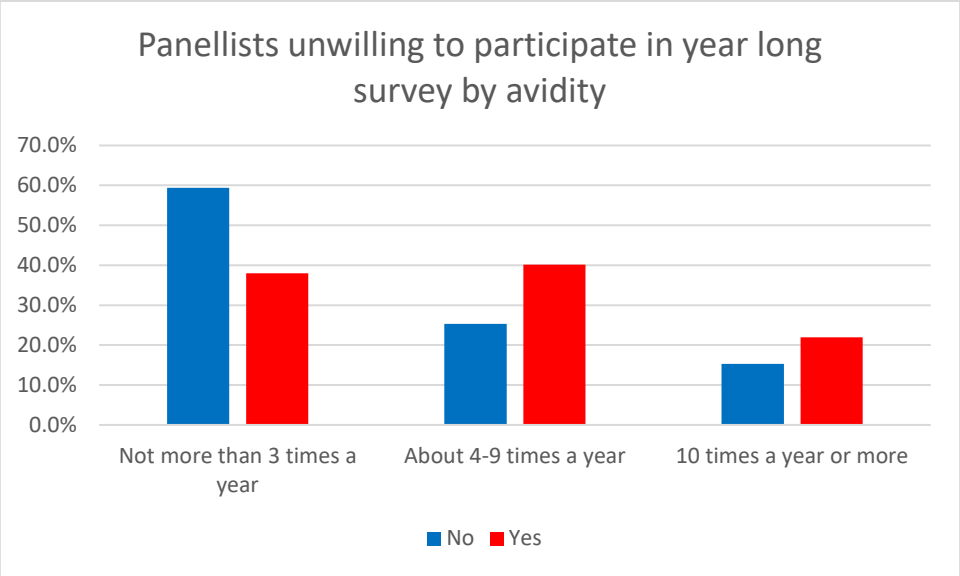

Figure 10: Panellists unwilling to participate in a year-long fishing survey by stated avidity for the NPS and the Online panels. For the Online panel this is for last year; for the NPS it is an average year.

Figure 11 gives the percentage of panellists unwilling to participate in a year-long fishing survey by gender and Māori/non-Māori for the NPS and the Online panels. For the Online panel this is for last year; for the NPS it is an average year. Online female panellists are less willing to participate as are Non-Māori. There are too few Māori in the online panel to be sure, but the point estimates for Māori suggest that they are less willing to participate.

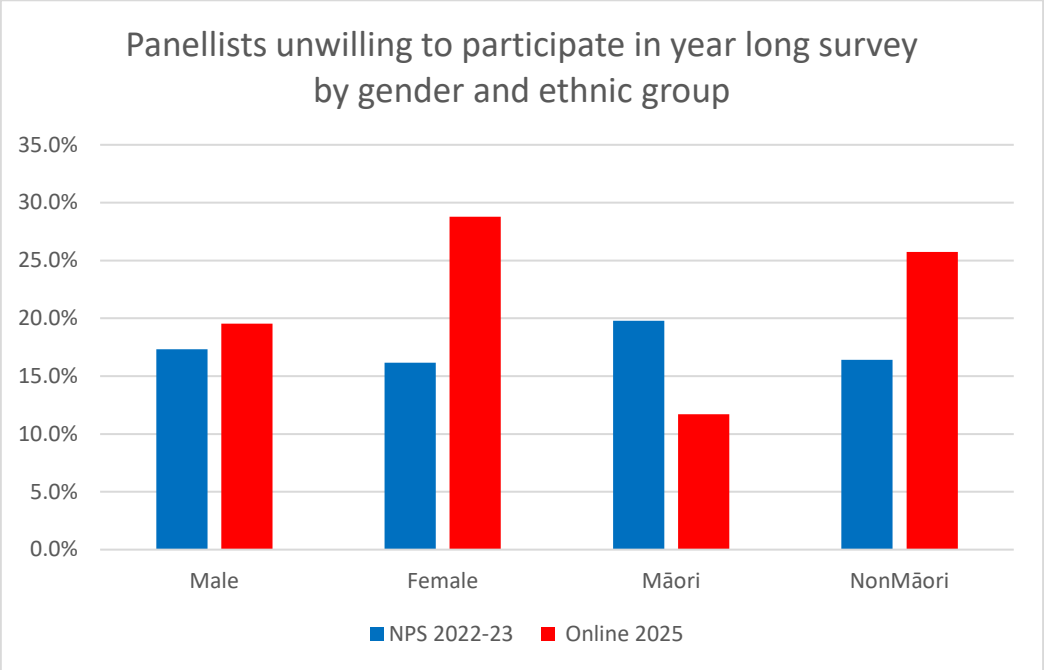

Figure 11: Panellists unwilling to participate in a year-long fishing survey by gender and ethnic group for the NPS and the Online panels. For the Online panel this is for last year; for the NPS it is an average year.

3.2 Estimating stock harvests for the Online panel

Could we estimate stock harvests from an Online panel? This subsection discusses a method and presents the results. The method is based on the work of Gray et al. (2004).

When considering imputing catch for Online panel members who went fishing, an exchangeable bootstrap procedure could be used. The imputation steps would be:

- Define some groups in the population who could be exchangeable.
- For each Online fisher in the group sample a fisher from the NPS panel (they might not have fished).
- Apply the harvest for the sampled NPS fisher to the online panel member.
- Use the Online panel member's calibrated weight and sum across the Online panel members to get a population estimate.
- Repeat *n* times to get an idea of variability.

An example of an exchangeable group might be Males 25–29 and non-Māori.[3]

[3] One reason statisticians prefer random samples is that each sample forms an exchangeable group within a population.

There are some problems in choosing exchangeable groups.

- The online sample is very small: 207 out of 1000 said they fished in the previous year and only 152 of these said that they would participate in an online panel over a year.
- Attrition in NPS leads to a small number of people available to be exchanged. The sampled people who fished in last year in a particular group are reduced to
    - those recruited to the panel (not all people identified as fishers by household members and sampled agree to be on panel) who are reduced to
    - fishers who actually fish during the year who are reduced to
    - fishers who responded sufficiently during the year.
- The actual behaviour of fishers may not be the same as their stated expected behaviour e.g., platform, catch, fishing area.
- There are limited explanatory variables to consider defining or forming groups:
    - the NPS and Online collects: respondents stated avidity, sex, age groups (NB NPS 15+, online 18+), Māori/non-Māori ethnicity, household size, region where they live;
    - NPS collects finer location (meshblock), number of fishers in household, actual avidity, fishing areas, catch, method, and platform;
    - Online collects personal income and household income.

Hence, attempts at imputing harvest of particular species will not be particularly reliable.

In the end, using a classification and regression tree analysis the following groups were chosen as exchangeable groups to borrow the NPS data from: gender, age, stated avidity.

The number of replications n=10 000 was chosen so that the CVs of the means of the replicates would be about the same as the NPS estimates. In fact the replicated estimates stabilized after around 1000 replicates.

For the Online panel imputed sample and NPS the harvest is in tonnes rounded to integers. The tables are in Appendix 1. Barplots for six important species are presented (Figure 12 to 17) but harvest estimates have been calculated for all species recorded in the NPS (saved to project archive). The NPS CVs are given so differences can be assessed as important.

The original (as estimated in September 2022) panellist calibrated weight for the NPS has been used, as opposed to the final panellist calibrated weights (used in the final NPS analysis) which account for panel members who didn't respond sufficiently during the year or who stopped responding, and so the estimates will not agree with estimates from the final dataset (Heinemann & Gray 2024). The reason for this choice of weights is that for the online panel we do not know what the nonresponse will be like over the year, and so it is more appropriate to use the weights determined at the beginning of the panel year.

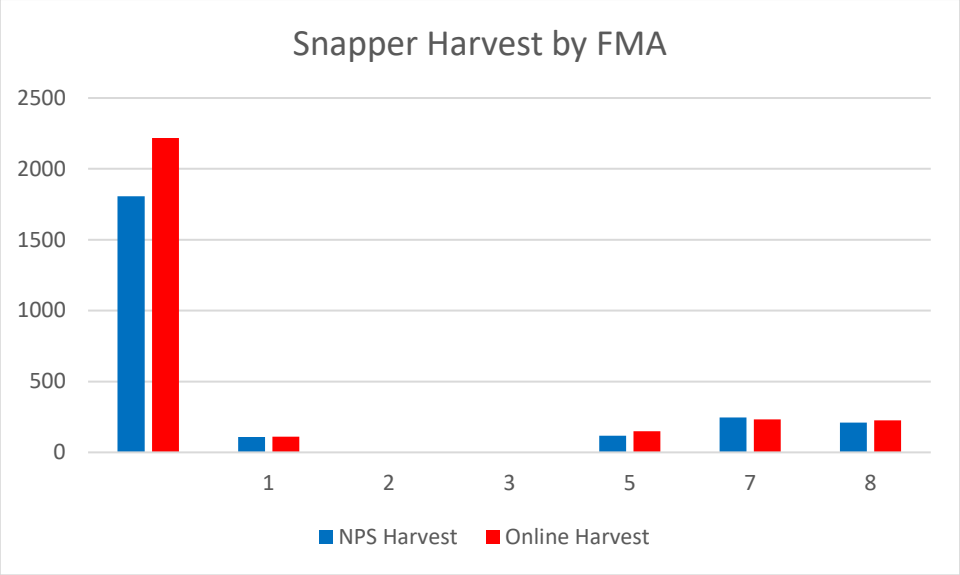

Figure 12: Harvest estimates for snapper by FMA. The NPS estimate is actual harvest data using original calibrated weight. The Online panel estimate is from imputed data. The estimates are in tonnes.

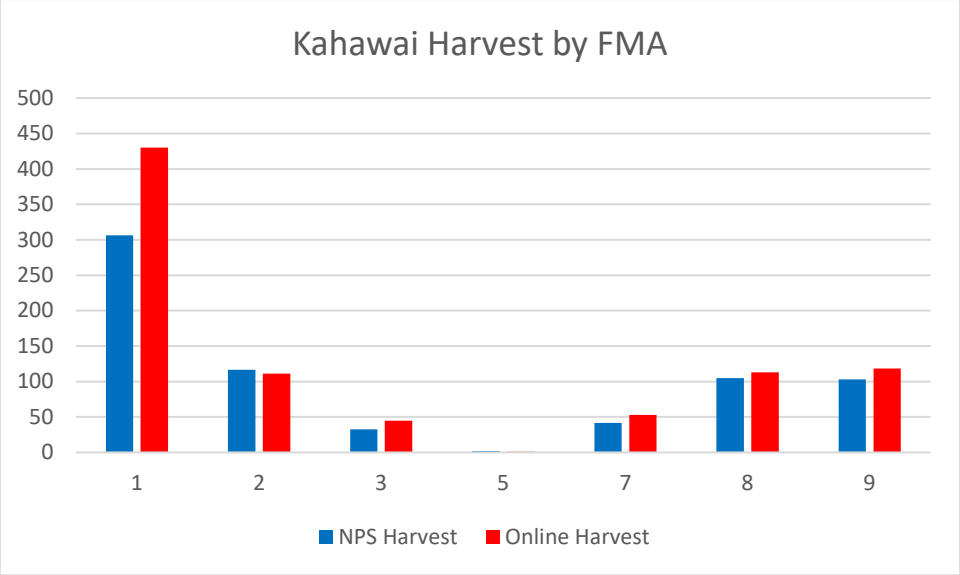

Figure 13: Harvest estimates for kahawai by FMA. The NPS estimate is actual harvest data using original calibrated weight. The Online panel estimate is from imputed data. The estimates are in tonnes.

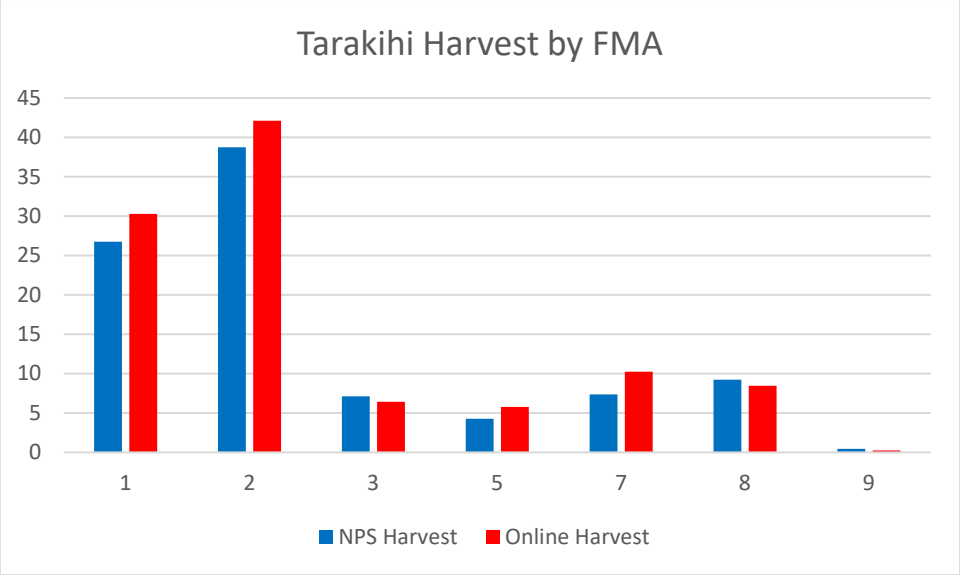

Figure 14: Harvest estimates for tarakihi by FMA. The NPS estimate is actual harvest data using original calibrated weight. The Online panel estimate is from imputed data. The estimates are in tonnes.

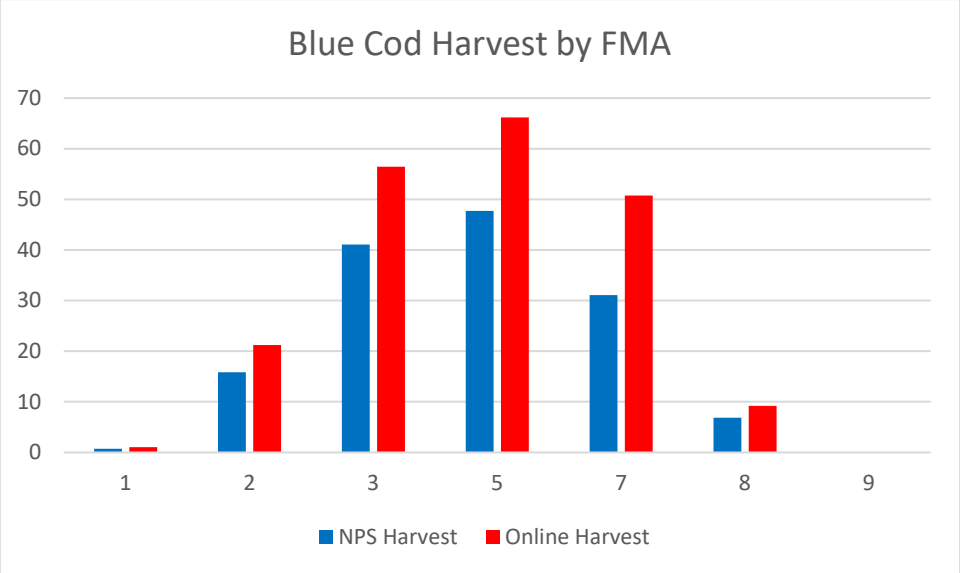

Figure 15: Harvest estimates for blue cod by FMA. The NPS estimate is actual harvest data using original calibrated weight. The Online panel estimate is from imputed data. The estimates are in tonnes.

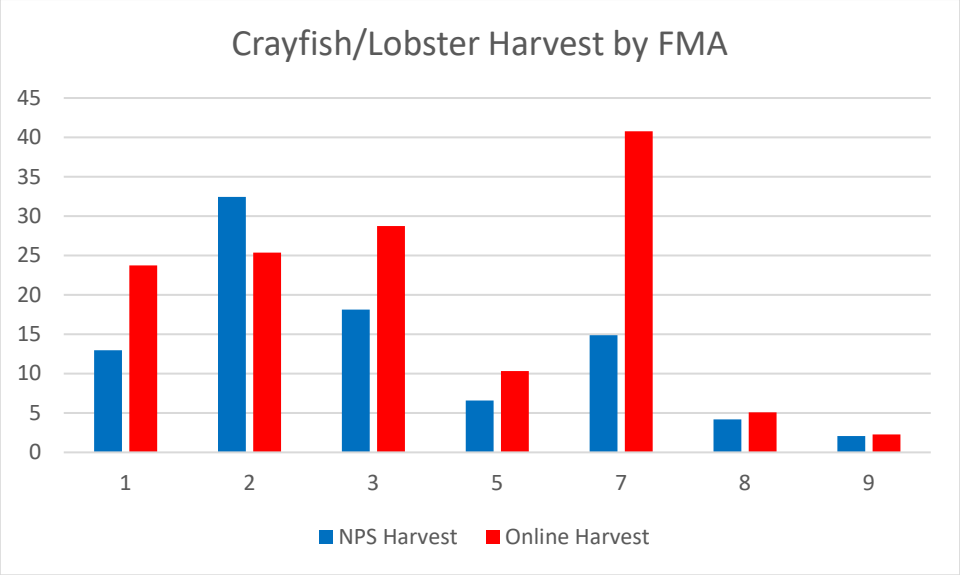

Figure 16: Harvest estimates for rock lobster by FMA. The NPS estimate is actual harvest data using original calibrated weight. The Online panel estimate is from imputed data. The estimates are in tonnes.

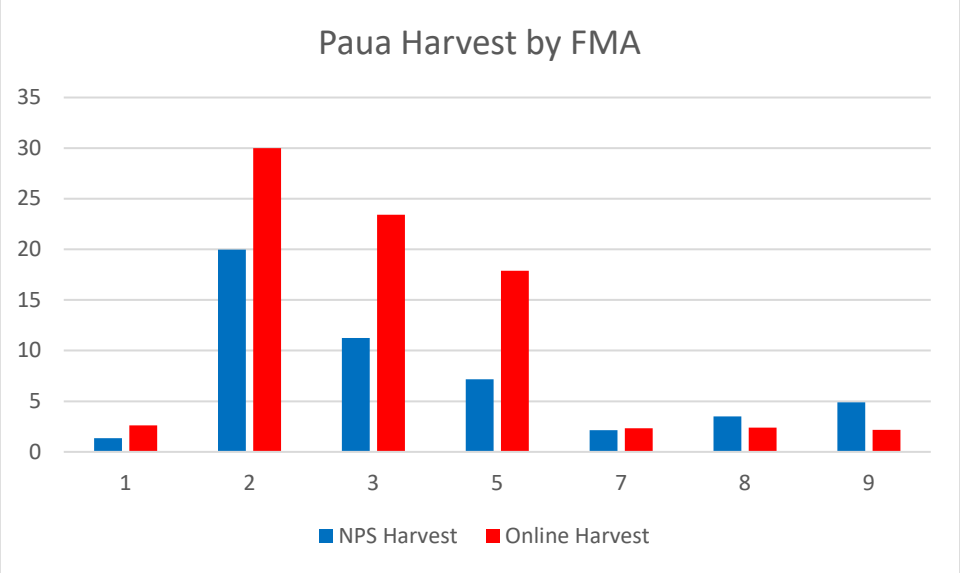

Figure 17: Harvest estimates for paua by FMA. The NPS estimate is actual harvest data using original calibrated weight. The Online panel estimate is from imputed data. The estimates are in tonnes.

The harvest results can be summarized as follows.

- For snapper, the Online estimates are all greater than the NPS, except for FMA 8. FMA 1 is much greater.
- For kahawai, the Online estimates are all greater than the NPS, except for FMA 2 and 5 although the latter has high CV. FMA 1 is much greater.
- For tarakihi, the Online estimates if higher are only marginally so.
- For blue cod, the Online estimates are all greater than the NPS. FMA 7 is much greater.
- For rock lobster, the Online estimates are all greater than the NPS, except for FMA 2. FMA 3 and 7 are much greater.

- For paua, the Online estimates are all greater than the NPS, except for FMA 8. FMA 2, 3 and 5 are much greater.

Allowing for the high CVs, for key fisheries, the Online estimates are typically higher than the NPS estimates of actual harvest.

4 DISCUSSION

The demographics of the Online panel are different from those we would expect from a random sample of the population. These differences can be accounted for by weighting the sample so that basic demographic variables such as gender, age, and ethnicity groups have the same representation as in the population. But what can we say about the effect of this reweighting on our variable(s) of interest such as the proportion of people who marine fish?

Superficially, this (re)weighting seems analogous to when we have nonresponse in a random sample and we assume that nonresponse is missing at random within these demographic groups and hence reweighting the responding sample provides low bias estimates. However, because the Online sample was not random, this analogy may not hold.

There is an extensive literature on inference from samples drawn by non-random methods. Two useful references are Smith (1983) and Deville (1991).

A probability-based sample starts off as being an exchangeable group of the population. That is unlikely for an Online sample and even more unlikely that it could be shown to be. As Deville says: "*... the quota method demands the formulation of hypothetical model to fit the data. On the other hand, a probabilistic survey does not, in principle, depend upon any model.*" The validity of the model underlying non-random sampling may be open to question, and difficult to verify.

Smith's paper uses a model-based approach. He gives technical conditions for drawing conclusions from a sample selected by non-random methods. He argues that the model-based approach is appropriate in situations like the following:

- there is a single client;
- the results are for the use only of that client, and will not be published more widely;
- the statistician and client agree that the required assumptions hold, at least approximately.

His summary is, "*... in the public sector ... there is no simple well-defined user and it is reasonable to ask that the sampling method used should have wide acceptability. Random sampling methods provide that wide acceptability.*"

The main motivation for investigating the utility of Online panels for recruiting respondents to a marine fishing panel survey is answering a cost-benefit question. In general, the costs of a non-random sample such as the Online panel will be much lower than a probability-based sample of the same size. In this regard, it is worth repeating the comment of Deming (Deming 1960) who wrote sternly, "*There is no way to compare the cost of a probability sample with the cost of a judgement sample, because the two types of sample are used for different purposes. Cost has no meaning without a measure of quality, and there is no way to appraise objectively the quality of a judgement sample as there is with a probability sample.*"

In this study we do have a good estimate of the subpopulation who marine fish through the NPS. In addition, because the survey has been run three times over a decade or so, we know the demographics and/or fishing behaviour of the nonrespondents and partial respondents. These characteristics are stable. Hence we have a good understanding of potential biases and their impact.

So we can judge how differently an Online panel or this Online panel represents this subpopulation of marine fishers, and whether this difference is material and how we might adjust for this difference. It might be thought that if we did have a benchmark like a recent NPS that we could reweight the Online panel using suitable variables from the benchmark. But we could not be sure that this reweighting was not just cosmetic and hiding significant biases.

The demographics of the Online panel who said that they fished are very different from the NPS panel. So too is the stated fishing behaviour of the online sample to actual behaviour as reported in the NPS. Of course, this difference could be a *stated* versus *actual* mismatch especially for which species are targeted. However, one could expect the correlation between *stated* and *actual* for people who fish, and what platform they used, to be high.

The *imputed* harvest data suggests that an Online panel might over-estimate catch because a higher percentage of respondents say they fished and because of the different demographics of these people. But the overall impact of these effects is complicated. For example, in the NPS the 55–64 age group catch about a quarter of the finfish; the 25–34 age group about an eighth. In the Online panel the 55–64 age group is under-represented by a third; the 25–34 age group over-represented by double. A back-of-the-envelope calculation shows that the impact on the total estimated catch is not so dramatic. The NPS catch by those two groups is 3/8 of the total. The imputed catch of those two groups would be $2/3 \times 1/4 + 2 \times 1/8 = 5/12$ of the total, which is bigger by 1/24.

The findings of this study are consistent with previous work undertaken for the Ministry of Transport (Gray 2014). The Ministry were considering recruiting a sample for their Household Travel Survey (HTS) from Online panels. In addition, they were interested in the feasibility of capturing travel data digitally through GPSs or mobile phone apps as compared to the current paper-based recall method.

The general principles identified by the study were:

- Existing nonprobability-based panels show both socio-economic and behavioural characteristics which are not controlled for by balancing on the usual demographic characteristics (sex, age, ethnicity, region, etc).
- Even if at one time a nonprobability-based sample matches a probability-based sample for key behaviours, this is very likely to change over time and needs ongoing monitoring, negating some of the gain from using an existing panel.
- Recruiting respondents from previous probability-based surveys seems to lead to a panel with different behaviour from a probability-based sample.[4]

So the conclusion from this recreational fisheries study is that recruiting a panel for a marine fishing survey lasting a fishing year is likely to produce different estimates from a survey using a panel recruited through probability-based sampling. Extensive modelling work would likely be needed to determine the quality of the estimates, and to make adjustments to these estimates as required.

An Online panel might have a use in providing indicator data between NPSs, but whether this would be better than the current approach (Maggs 2024) is beyond this study and requires further research. It should be remembered the existing boat ramp monitoring collects key data on fish size, which is less practical through off-site surveys.

[4] This is consistent with the NRB study mentioned in Section 2.1.

5 ACKNOWLEDGEMENTS

This work was completed under Fisheries New Zealand project SEA2024-09. I have had several useful discussions with Ian Tuck and Bruce Hartill who are the Fisheries New Zealand Project Scientists about the analysis of the Online panel data. I received some useful feedback at my presentation of the draft results to the Fisheries New Zealand Marine Amateur Fisheries Working Group. Andreas Heinemann from NRB also provided useful comments on this work at the development and results stages.

6 REFERENCES

Deming (1960). *Sample design in business research.* Jon Wiley and Sons, New York. 517 p.

Deville, J. (1991). A theory of quota surveys. *Survey Methodology 17(2)*:163–181.

Gray, A. (2014). Analysis of the *Travel diaries mobile trial* run by TNS for the Ministry of Transport. Consultancy Report prepared for the Ministry of Transport.

Gray, A.; Haslett, S.; Kuzmicich, G. (2004). Confidence intervals for proportions estimated from complex sample designs. *Journal of Official Statistics 20 (4)*:705–723.

Heinemann, A.; Gray, A. (2024). National Panel Survey of Marine Recreational Fishers 2022–2023. *New Zealand Fisheries Assessment Report 2024/51. 116 p.*

Heinemann, A.; Wynne-Jones, J.; Gray, A. (2021). Ongoing monitoring of national marine recreational harvest: trials of self-complete, online approaches. *New Zealand Fisheries Assessment Report 2021/41.* 100 p.

Maggs, J.Q.; Armiger, H.; Evans, O.; Taylor, R; Davey, N.; Payne, G.; Miller, A.; Spong, K.; Parkinson, D.; Bian R.; Hartill, B.W. (2024). Trends in recreational boat effort and harvest from 2004–05 to 2022–23. *New Zealand Fisheries Assessment Report 2024/53.* 60 p.

Smith, T.M.F. (1983). On the validity of inferences from non-random samples. *Journal of the Royal Statistical Society A 146(4)*: 394–403.

7 APPENDIX 1

This appendix provides the data behind the barplots displayed in Section 3.

The first table is the responses to Question 1 and Question 2 by demographics, and Questions 3 through to Question 5. The right hand column is the estimates using the weight Verian supplied. Most differences between the Verian estimates using the 2018 Census and the estimates using the 2022 Q2 Estimated Resident Population estimates are within sample error. The sample errors are produced using a jackknife replication method. Both the NPS and Online samples are stratified so a JKn method has been used. For the NPS sample the jackknife deletes a primary sampling unit (a meshblock). For the Online sample the jackknife deletes an individual.

	NPS 2022-23			Kantar Online 2025 adjusted			Kantar Online 2025
	Estimate	SE	CV	Estimate	se	CV	Estimate
Fished in last year	17.6%	0.3%	0.02	21.1%	1.3%	0.06	20.8%
Not more than 3 times a year	7.0%	0.2%	0.03	9.0%	1.0%	0.13	9.5%
About 4-9 times a year	6.0%	0.2%	0.03	7.7%	1.0%	0.13	7.5%
10 times a year or more	4.6%	0.2%	0.04	4.3%	1.0%	0.13	3.8%
Fished in last year by demographics							
15–19	14.6%	0.8%	0.06	43.8%	7.6%	0.17	31.0%
20–24	16.0%	0.9%	0.06	37.5%	6.6%	0.17	35.6%
25–34	17.1%	0.6%	0.04	33.0%	3.8%	0.12	32.3%
35–44	20.2%	0.7%	0.03	22.0%	3.1%	0.14	22.7%
45–54	20.9%	0.6%	0.03	16.3%	3.2%	0.20	16.2%
55–64	21.0%	0.7%	0.03	13.7%	2.5%	0.18	14.9%
65–74	16.3%	0.7%	0.05	9.7%	3.6%	0.37	9.3%
75+	7.6%	0.6%	0.08	8.6%	2.4%	0.27	8.7%
Male	23.9%	0.5%	0.02	26.0%	2.2%	0.08	25.8%
Female	11.5%	0.3%	0.03	16.4%	1.8%	0.11	16.0%
Māori	27.0%	1.0%	0.04	26.3%	5.2%	0.20	28.3%
NonMāori	15.9%	0.3%	0.02	20.2%	1.3%	0.06	20.2%

	NPS 2022-23			Kantar Online 2025 adjusted			Kantar Online 2025
Northland Region	31.8%	2.4%	0.08	34.6%	9.3%	0.27	35.6%
Auckland Region	13.9%	0.6%	0.04	23.9%	2.7%	0.11	22.0%
Waikato Region	22.6%	1.6%	0.07	22.2%	5.3%	0.24	20.7%
Bay of Plenty Region	31.3%	1.5%	0.05	21.0%	6.1%	0.29	21.4%
Gisborne Region	19.3%	5.9%	0.30	0.0%	0.0%	-	0.0%
Hawke's Bay Region	22.3%	2.0%	0.09	22.3%	7.5%	0.34	21.0%
Taranaki Region	26.3%	2.0%	0.08	20.3%	8.3%	0.41	23.8%
Manawatu-Whanganui Region	23.4%	1.4%	0.06	16.3%	5.4%	0.33	19.3%
Wellington Region	13.5%	0.9%	0.06	21.0%	4.1%	0.19	22.2%
Tasman Region	34.0%	3.8%	0.11	16.0%	11.8%	0.74	18.2%
Nelson Region	26.5%	4.0%	0.15	27.8%	15.1%	0.54	24.9%
Marlborough Region	41.6%	3.2%	0.08	51.9%	17.2%	0.33	55.2%
West Coast Region	29.6%	2.8%	0.10	20.0%	21.4%	1.07	13.7%
Canterbury Region	8.2%	0.5%	0.07	13.0%	3.0%	0.23	14.0%
Otago Region	12.4%	0.9%	0.07	13.0%	5.2%	0.40	14.9%
Southland Region	11.4%	2.0%	0.17	13.3%	7.7%	0.58	15.0%
hhldsize1	12.6%	0.5%	0.04	13.6%	3.6%	0.10	13.9%
hhldsize2	56.6%	0.9%	0.02	36.8%	3.6%	0.10	20.4%
hhldsize3+	30.8%	1.0%	0.03	49.6%	3.6%	0.10	24.3%
FMA 1	52.4%	4.1%	0.08	43.0%	2.6%	0.16	41.4%
FMA 2	9.2%	2.7%	0.29	15.5%	2.6%	0.16	15.7%
FMA 3	7.7%	2.5%	0.33	9.0%	2.6%	0.16	10.9%
FMA 5	1.9%	1.2%	0.62	1.6%	2.6%	0.16	2.1%
FMA 7	10.2%	2.8%	0.28	9.5%	2.6%	0.16	9.7%
FMA 8	9.0%	3.0%	0.33	12.3%	2.6%	0.16	12.5%
FMA 9	9.6%	1.4%	0.14	9.1%	2.6%	0.16	7.7%
The shore	31.6%	1.8%	0.06	30.4%	3.9%	0.11	30.6%
A boat (including kayak, jet ski etc)	53.4%	1.9%	0.04	34.8%	3.9%	0.11	35.5%
Both	15.0%	1.1%	0.07	34.8%	3.9%	0.11	33.9%

	NPS 2022-23			Kantar Online 2025 adjusted			Kantar Online 2025
General Finfish	82.2%	0.9%	0.01	97.7%	1.1%	0.01	97.4%
Rock lobster	5.6%	0.6%	0.10	19.7%	2.9%	0.15	19.8%
Paua	5.4%	0.8%	0.16	14.3%	3.0%	0.21	14.0%
Other	15.6%	0.8%	0.05	1.0%	0.7%	0.71	1.0%

The second table is the response to Question 6 and by demographics.

	NPS 2022-23			Kantar Online 2025 adjusted		
	Estimate	SE	CV	Estimate	SE	CV
participate12mthsNo	17.0%	0.6%	0.03	23.2%	3.0%	24.7%
by demographics						
15-19	22.7%	2.8%	0.12	17.4%	10.4%	29.6%
20-24	21.1%	2.2%	0.10	14.0%	6.2%	16.5%
25-34	18.3%	1.4%	0.07	12.0%	4.1%	12.8%
35-44	15.9%	1.3%	0.08	29.3%	7.9%	28.2%
45-54	16.6%	1.2%	0.07	30.3%	9.7%	33.7%
55-64	16.1%	1.2%	0.07	36.0%	10.0%	36.7%
65-74	14.9%	1.3%	0.09	42.0%	21.6%	37.9%
75+	17.9%	2.9%	0.16	41.1%	15.5%	41.2%
Male	17.3%	0.7%	0.04	19.5%	3.5%	21.6%
Female	16.2%	1.0%	0.06	28.8%	5.5%	29.4%
Māori	19.8%	1.3%	0.07	11.7%	7.5%	15.1%
NonMāori	16.4%	0.6%	0.04	25.7%	3.3%	25.7%

The third data presented the imputed harvest estimates from the Online panel alongside the NPS actual Harvest estimates for key finfish species and the two important non finfish species.

Species	FMA	Online Harvest	NPS Harvest	NPS CV
Blue Cod	1	1	1	0.31
	2	21	16	0.26
	3	56	41	0.20
	5	66	48	0.24
	7	51	31	0.17
	8	9	7	0.21
	9	0	0	1.00
Kahawai	1	430	306	0.48
	2	111	117	0.07
	3	45	33	0.28
	5	1	2	0.38
	7	53	42	0.81
	8	113	105	0.19
	9	118	103	0.14
Snapper	1	2217	1806	0.82
	2	111	108	0.20
	3	1	1	0.75
	5	1	1	0.72
	7	148	118	0.16
	8	233	246	0.15
	9	226	210	0.13
Tarakihi	1	30	27	0.21
	2	42	39	0.36
	3	6	7	0.36
	5	6	4	0.41
	7	10	7	0.27
	8	8	9	0.39
	9	0	0	0.71

Species	FMA	Online Harvest	NPS Harvest	NPS CV
Crayfish/Lobster	1	24	13	0.24
	2	25	32	0.34
	3	29	18	0.23
	5	10	7	0.34
	7	41	15	0.40
	8	5	4	0.41
	9	2	2	0.48
Paua	1	3	1	0.15
	2	30	20	0.68
	3	23	11	0.17
	5	18	7	0.21
	7	2	2	0.24
	8	2	3	0.34
	9	2	5	0.44