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J. C. Holdsworth
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J. C. Holdsworth[1]
R. O. Boyd[2]

[1]Blue Water Marine Research Ltd
P O Box 402081
Tutukaka 0153

[2]Boyd Fisheries Consultants Ltd
1 Baker Grove
Wanaka 9305

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EXECUTIVE SUMMARY

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This report provides the results of Ministry of Fisheries research project SNA2006/04. The project collected data on the selectivity of the snapper recreational fishery in SNA 1, the quota management area covering the northeast of the North Island, and on the size and condition of snapper caught and released by recreational fishers.

Sampling was stratified and weighted by region and season using the most recent recreational harvest estimates for SNA 1. Information on length, fish condition, hook site, and hook type were collected by observers on recreational charter vessels and from recreational fishers recruited at boat ramps. This survey follows on from a 2004–05 pilot survey and a 2005–06 survey in the three SNA 1 sub-regions, Bay of Plenty, Hauraki Gulf, and east Northland.

More than 9400 recreationally caught snapper were measured at sea throughout SNA 1 in 2006–07. Released snapper comprised 54.2% of the catch recorded by trailer boat fishers and 60.1% of the catch recorded by observers on charter boats. For all data combined, 56.2% of snapper were released. Most of the released snapper were smaller than the minimum legal size of 27 cm. The high proportion of small snapper in the recreational catch may reflect the large number of small fish currently in the SNA 1 snapper population.

Data on fish condition, hook type, hook size, where the fish was hooked, and water depth were also collected. Of the 1887 snapper recorded by observers in charter boats 92% were reported as swimming away and not bleeding, and a further 6.2% swam away but showed signs of bleeding from a wound other than one caused by a hook in the jaw. Just 1.8% of released snapper observed on charter boats were reported as either floating or dying; however, 24% showed some sign of barotrauma, hook damage, or did not swim away.

The selectivity of the recreational line fishing method from boats can not be directly estimated as there is no current stock assessment model. However, we can infer the shape of the curve relative to a reasonably well understood selectivity curve from SNA 1 commercial longline catch in the same fishing year. The proportion of snapper at length (28 cm or over) landed by recreational fishers in 2006–07 is remarkably similar to fish kept by longliners in the Hauraki Gulf and east Northland. Recreational catch in the Bay of Plenty has a higher proportion of small fish than the longline catch. The data collected in this project could be used to estimate the selectivity of the recreational fishing method in the next SNA 1 stock assessment model.

There is potential for significant release mortality in SNA 1 due to the high proportion of the recreational catch that is released. Assuming that the estimated harvest weight of snapper from the 2004–05 aerial overflight survey is also a reasonable prediction of the landed recreational catch in 2006–07, then the data from the present survey can be used to estimate the potential release mortality in the SNA 1 recreational fishery. We estimate this release mortality at between 211 000 and 617 000 snapper in addition to the fish that were kept by recreational fishers. The additional mortality by weight is 65–198 t which is 2.7% to 8.2% of additional mortality on top of the estimated 2004–05 recreational snapper harvest of 2420 t.

However, these estimates involve a number of untested assumptions and should be considered as preliminary. We suggest recreational fishers should be encouraged to reduce the fishing induced mortality of small fish they catch by using larger hooks and bait, using circle hooks, and moving away from locations where small fish are prevalent.

1. INTRODUCTION

This report provides the results of sampling recreational catches of snapper *(Pagrus auratus)* in SNA 1 in 2006–07 aimed at determining the selectivity of the recreational fishery and the size and condition of recreationally caught snapper that are returned to the water. Data from the 2006–07 sampling programme are presented and the selectivity and release condition results are discussed. The 2006–07 results are discussed in relation to those from similar sampling undertaken in 2005 and 2006.

Snapper is an iconic species for all sectors (commercial, customary, and recreational) around the North Island and the top of the South Island. The largest commercial and non-commercial catches of snapper in New Zealand are taken from the Hauraki Gulf, Bay of Plenty, and east Northland regions, that together comprise the SNA 1 stock (Ministry of Fisheries, Science Group 2007).

Holdsworth & Boyd (2008) summarised the history of minimum legal size and daily bag limits used in the recreational snapper fishery in SNA 1 since the 1980s. Minimum legal size (MLS) is one of the management tools used in fisheries management to improve the yield-per-recruit in a fishery. However, if discard mortality is high, the effect of a larger MLS may end up being detrimental to the stock rather than beneficial. In combination with a MLS, reducing the daily bag limit may potentially result in the highgrading of legal catch, adding further discard mortality.

Obtaining accurate data on the size frequency of the recreational snapper catch (both kept and released fish) and the size and condition of released snapper can be used to determine the full recreational size selectivity catch curve for snapper. This information is also required for estimating mortality rates of snapper released by recreational fishers.

The objectives for this project are set out below.

Overall objective

1. To determine the selectivity and post-release mortality of snapper targeted by recreational fisheries in SNA 1.

Specific objectives

1. To determine the selectivity of recreational catches for snapper in SNA 1.
2. To determine the size and condition of snapper returned to the water by recreational fisheries in SNA 1.

2. METHODS

2.1 Sampling approach

Determining the selectivity of recreational catches of snapper and their size and condition on release requires sampling at sea. Sampling was limited to the recreational hook and line fishery from boats because most of the recreational snapper catch is taken using this method and because sampling other methods is both logistically difficult and expensive.

Two primary sampling methods were adopted to obtain at-sea samples. The first used boat ramp interviewers to recruit recreational fishers to measure their own snapper catch at sea (both kept and released snapper). They were issued with a combined measuring scale and data

sheet mounted on a reusable backing board. The data sheet was printed on water proof paper and was collected by interviewers from fishers at the end of their trip.
The second method used trained observers on recreational charter fishing vessels to measure snapper caught by fishers at sea. They also recorded data on factors that may affect the condition of released snapper such as water depth, hook location, and signs of barotrauma. These two methods were also used for selectivity sampling in the recreational snapper fishery in the summer of 2004–05 and in 2005–06. The use of two sampling methods was aimed at obtaining accurate data representative of the entire fishery (Holdsworth & Boyd, 2008).

2.2 Survey design

Sampling was stratified by region and season. Three regions were adopted to address possible variation in population structure and recreational selectivity between these three areas: east Northland, Hauraki Gulf, and Bay of Plenty. These three regions coincide with the likely structure of the snapper stock assessment model (Ministry of Fisheries, Science Group 2007). Two seasonal strata were adopted: summer/autumn from 1 December 2006 to 30 April 2007 and winter/spring from 1 May to 30 November 2007.

The most recent data on recreational snapper harvests in SNA 1 by region and season were given by Hartill et al. (2006) who undertook an aerial and boat ramp recreational harvest estimation survey. Their results represent the most recent data on the distribution of the recreational snapper catch by area and season. Sampling effort in the snapper selectivity survey was weighted by region and season using the proportion of snapper catch in each stratum estimated by the 2004–05 aerial survey (Hartill et al. 2006).

Within each region and season the numbers of sampling sessions were apportioned equally between observer trips on charter boats and boat ramp interview sessions. We assumed that the selectivity of recreational snapper fishing does not change between weekends and weekdays, so sampling effort was focused mainly on weekend and public holidays with reasonable weather in order to increase the number of fishers encountered and the amount of data collected.

2.3 Sample collection

Boat ramp surveys were conducted by trained interviewers who collected data for each session including date, location, environmental conditions, and session time. Interviewers recruited fishers before their fishing trip and asked if they would record the length of all the snapper they caught during that trip, including the lengths of snapper that they released. Each fishing party on a vessel was provided with a data sheet and measuring board printed on waterproof paper which was mounted on a backing board. At the same time, fishers were shown how to measure snapper correctly and how to record the data. All snapper measurements were recorded as fork length, in centimetres rounded down to the whole centimetre below.

The datasheet provided to fishers had fields for general information about the trip, number of fishers on the boat, the length of the boat, duration of the trip, and fishing location. The measuring sheet was scaled in whole centimetres up to 59 cm for the snapper to be measured and recorded directly on the board (Appendix 1). The 59 cm maximum length of the data boards was limited by the available width of waterproof paper sheets. Fishers were asked to enter data for each fish including fork length rounded down to whole centimetres, fishing depth in metres, hook location, whether the fish was kept or released, and comments about fish condition. Only fishers with boats having depth sounders were recruited. When the fishers returned to the boat ramp, the interviewer retrieved the data board with its measuring

sheet and conducted a follow up interview. The interviewer asked to remeasure any kept snapper retained on the boat, asked for details of hook size and type used, verified the fishing location, and made sure the fisher data sheets were filled in as completely as possible. The duration of some fishing trips exceeded the length of the interview session and a drop box was provided at the boat ramp for fishers to leave their data boards in if they returned after the interviewer had left the ramp.

Sampling on charter vessels was undertaken by observer staff who measured fish and recorded data for snapper caught by fishers on chartered boats. The measuring boards they used were 100 cm long. Observers recorded the location of fishing, depth, and environmental conditions at each fishing location during each trip on data sheets (Appendix 2). With the cooperation of the vessel master, observers requested that all snapper caught during the charter trip be given to them to be measured. They also recorded hook size and type (if possible), hook location, fish condition, and if the fish swam or floated if released for each fish. Interviewers at boat ramps also collected hook size and type, but this could only be related to individual fish in the catch when the boat ramp fishers reported using only a single hook size and type for all of the snapper caught on that trip.

2.4 Data analysis

An Access data base was designed with the same table structure as used in the MFish recreational fishing database (rec_data). All data were tabulated and summarised after checking for errors. Length frequencies or proportions at length were plotted by fishing year, region, and by survey method for both released and retained snapper. Coefficients of variation (c.v.s) were calculated from 1000 bootstrap replicates of resampled catch by group within each region. A group was defined as all the data from a single trip by a private boat or all the data from each location fished during a charter boat trip. The number of groups resampled in each replicate was similar to the number of groups in the database for each region.

An estimate of the snapper population length frequency distribution is needed to estimate the selectivity of snapper harvested in the recreational line fishery from boats. Ideally selectivity could be estimated within a stock assessment model. The most recent SNA 1 stock assessment was completed in 2000. However, commercial longline selectivity is high for most lengths 28 cm and above (Gilbert et al. 2000). Shed sampling for random age frequencies in SNA 1 was conducted throughout the 2006–07 fishing year. The unweighted length frequency from the commercial longline catch sampling programme in SNA 1 (Cameron Walsh, Stock Monitoring Services Ltd, pers. comm.) was used as an approximation of the population length distribution and to produce a relative selectivity index.

The comparison of longline and recreational catch at length is for fish 28 cm and longer because of the different minimum legal size for commercial and recreational caught fish and because most 27 cm snapper are released by recreational fishers. Recreational length frequencies were smoothed for this comparison using a rolling average of the frequency of the length and the length above it. The 59 cm size class and the plus group of fish 60 cm and larger were not smoothed. This method was shown to significantly improve the fit of fisher measured lengths and remeasured lengths in a subset of paired data from 2004–05 (Holdsworth et al. 2006).

Estimates of snapper release mortality were made using the condition factors and length frequencies recorded by fishers only because charter boat catch make up a relatively small proportion of the total snapper harvest. The most recent recreational harvest estimates by region in SNA 1 (Hartill et al. 2006) were used to obtain a scaled number at length of snapper kept and released by recreational fishers. A major assumption with this method is that the snapper harvest estimate from 2004–05 is a reasonable predictor of the landed recreational

catch by region in 2006–07. Within each region the snapper length weight regression (Paul 1976) and the proportion at length of kept fish from 2006–07 was used to derive the mean weight of kept fish. The assumed harvest estimate in kilos for 2006–07 was divided by the mean weight to estimate the total number of fish kept that year and hence the total number released. The total number of fish caught in each region was multiplied by the proportion at length of fish kept and released to estimate the numbers of fish caught at length. The number at length multiplied by the weight at length and summed gave the estimated weight of fish kept and released by region in 2006–07.

The proportion of these fish damaged on release, taken from condition comments recorded by fishers, was used to provide an estimated gear related mortality in numbers of fish at length. The SNA 1 length weight regression (Paul 1976) was then used to produce a weighted estimate from the estimated mortality by length. Stewart (2008) reported the proportion of snapper mortalities of trap caught fish over four depth ranges. These and the proportion of undamaged fish released within each depth range within each region were used to produce a number and weight estimate of snapper possibly dying from barotrauma.

3. RESULTS

3.1 Sampling

The main survey access points were spread across the SNA 1 quota management area from Whangaroa to Whakatane (Figure 1). The number of snapper lengths collected by month is shown in Figure 2. Sampling peaked in April at the end of the summer/autumn period and again in November at the end of the winter/spring period. This was because lower than expected sampling rates meant catch up sessions were needed at the end of both seasonal strata to meet sampling session targets.

A total of 9449 snapper lengths were recorded at sea from recreationally caught fish from December 2006 to November 2007 from locations within east Northland, Hauraki Gulf, and Bay of Plenty (Table 1): Table 2 gives a key to the Ministry of Fisheries recreational fishing area codes used in Table 1. The main survey access points are identified on the map in Figure 1. Most snapper were measured in the Hauraki Gulf (65%) followed by Bay of Plenty (21%) and east Northland (14%). Overall, 66% of fish were measured by fishers on trailer boats and 34% were measured by observers on charter vessels.

The number of people sampled and the number of fish measured in each stratum in 2006–07 are shown in Table 3. Observers on charter boats measured 3233 snapper from 650 fishers and 2287 boat ramp recruited fishers measured 6216 snapper. Therefore the average catch recorded in this survey was 5 snapper per person per charter trip and 2.7 snapper per trip for private fishers.

3.2 Recreational snapper length distributions

The length distributions of recreationally caught snapper measured in each of the three regions by survey method in 2006–07 are shown in Figures 3–5. As measuring boards issued to recreational fishers were only 59 cm long, snapper above that length are shown as 60+. The proportions at length for fisher measured snapper and observer measured snapper are much the same within regions, and the Hauraki Gulf has a broader distribution of fish sizes, above and below the MLS, than in east Northland and Bay of Plenty. Fish self-measured by recreational fishers tend to be rounded to even numbers and in the Hauraki Gulf there are distinct peaks in the length distribution at 20 and 30 cm.

3.3 Remeasured snapper

Where possible, boat ramp interviewers sought to remeasure snapper kept by fishers when fishers returned to boat ramps. This allowed a comparison of the lengths recorded by fishers with those by trained staff. It was not possible to accurately pair each remeasurement with the original fisher measurement for each snapper (unless the fisher/vessel had only one kept snapper), as the recording system used by fishers did not provide unique identification for each fish in the catch. The length frequencies and cumulative length frequencies for self measured and remeasured snapper are only slightly different (Figures 6–7). Recreational fishers tended to measure fish slightly longer on average than boat ramp interviewers. There is a strong mode in both measured and remeasured kept snapper at 30 cm.

3.4 Regional length frequencies

The length frequencies of all snapper measured in each of the three SNA 1 regions with observer and fisher lengths combined are shown in Figure 8. The length frequency in the Hauraki Gulf has a weaker mode than east Northland and Bay of Plenty. When plotted as a cumulative proportion, the Hauraki Gulf and Bay of Plenty catch at length distributions are very similar up to 26 cm, and then Hauraki Gulf and Northland have similar distributions from 26 to 36 cm (Figure 9). There was a higher proportion of fish longer than 36 cm recorded in east Northland.

The cumulative proportions at length of fish compared between seasons and within regions shows variability in the proportion of small fish (18 to 30 cm) across the 3 years (Figure 10). In Hauraki Gulf the proportions are quite stable between years, while in Northland there is variability in the proportion of medium sized fish (27–40 cm) between years, but no consistent shift in the plots between years (Figure 10).

3.5 Length frequency of kept and released snapper

The length frequencies of kept and released snapper by region are shown in Figure 11. In 2006–07 trailer boat fishers tended to catch fewer small fish (17–26 cm) and caught and kept more medium sized fish (30–40 cm) than fishers on charter trips. There is some overlap of released and kept snapper, mainly in the size range of 27–32 cm. This overlap is similar on private and charter trips with about equal numbers of 28 cm fish being released as being retained. In total, 46% of all recreational snapper measured were less than the 27 cm MLS. Recreational fishers released 64% of their catch in Northland, 63% in Bay of Plenty, and 55% in the Hauraki Gulf over the survey period in 2006–07.

More than 9400 recreationally caught snapper were measured at sea throughout SNA 1 in 2006–07. Released snapper made up 54.2% of the catch recorded by trailer boat fishers and 60.1% of the catch recorded by observers on charter boats. For all data combined 56.2% of snapper were released. Most of the released snapper were smaller than the MLS of 27 cm.

Snapper as small as 10 cm were caught, although most fish (96%) were 18 cm or more in length. There were very few snapper smaller than the 27 cm MLS kept by recreational fishers (8 in total or 0.2% of the catch). However, a significant proportion of the legal catch was released, comprising 21% of the legal catch and 12% of all snapper measured (Figure 11). Almost all of the discards larger than the minimum legal size were smaller than 30 cm.

The length distribution of Bay of Plenty snapper is very similar between observer and fisher lengths in 2006–07, though most medium sized fish 32–42 cm were taken by trailer boat fishers. In the Hauraki Gulf trailer boat fishers tended to release more snapper between 27 and 30 cm than fishers on charter boats (Figure 11).

The combined (kept and released) snapper length frequencies and associated c.v.s are plotted separately by region in Figure 12. The mean weighted c.v.s derived from bootstrap estimates were 0.14 for Bay of Plenty, 0.11 for the Hauraki Gulf, and 0.22 for east Northland: c.v.s indicate survey precision is at acceptable levels, but better where sample sizes are highest.

The selectivity of the recreational line fishing method from boats can not be directly estimated as there is no current stock assessment model. However, we can infer the shape of the curve relative to a reasonably well understood selectivity curve from SNA 1 commercial longline catch in the same fishing year. The length distribution of snapper 28 cm and over landed in 2006–07 is remarkably similar for fish kept by longliners and recreational fishers in the Hauraki Gulf and east Northland (Figure 13). Comparisons of the 2006–07 smoothed proportions at length of kept recreational fish between regions is shown in Figure 14. There is a higher proportion of small fish kept in the Bay of Plenty fishery, more medium sized fish (34–41 cm) in the Hauraki Gulf, and larger fish in east Northland.

3.6 Condition of released snapper

Information on snapper condition, hook type, hook location, hook size, and water depth was recorded by both observers and fishers for released snapper. Observers on charter vessels were able to consistently record hook type and size, where the fish was hooked (hook location), and standardised fish condition information for individual fish. Interviewers at boat ramps also collected hook information from fishers, but hook type and size could be related to individual fish only when fishers reported using only one hook size and style for all snapper measured during their trips.

Comments on condition were recorded for 5150 released snapper. Where release condition was recorded, 97.4% were reported as swimming away and 2.6% as either floating (2%) or dying (0.6%). No condition information was provided for 276 (5%) of all released snapper. Figure 15 shows the condition of released snapper by length and that there are fewer of the larger fish recorded as floating or dying. However, the sample sizes for these length classes is relatively low.

The condition of released snapper recorded by fishers and observers in 2006–07 Is shown in Figure 16. Condition categories reported by fishers and observers were broadly similar but with observers recorded more detailed information. Of the 1887 snapper released from charter vessels where comments on condition were recorded by observers, 92% were reported as swimming away and not bleeding, and a further 6.2% swam away but showed signs of bleeding from a wound other than one caused by a hook in the jaw. Just 1.8% of snapper observed on charter boats were reported as either floating or dying.

3.7 Hook location, hook types, and hook sizes used in released snapper

The hook location by hook type of released snapper recorded by observers on charter vessels is shown in Figure 17. J-hooks were the predominant hook type used with about 40% of fish caught on circle hooks (see hook classifications in Appendix 3). The category 'deep hooked' included fish that were hooked in the gut or gills and fish where the eye of the hook was not visible when the mouth was closed. The most reliable and complete data on hook location, type, and size comes from observers who were trained and used standard categories for

recording this information. No obvious regional differences are apparent in the hook location data. The 2006–07 observer data for released fish recorded that J-hooks caught 91% of snapper by the lip, 6% externally (foul hooked), and 3% deep. Circle hooks caught 97% of snapper by the lip, 2.5% externally, and 0.5% deep (Figure 17).

3.8 Capture depth and snapper condition

There were differences in the snapper capture depths recorded by private vessels (Figure 18) and observers on charter vessels (Figure 19). In all regions, private vessels caught most of their snapper in the depth ranges 10–19 or 20–29 m, as did charter vessels in Hauraki Gulf. Charter vessels in Northland and Bay of Plenty recorded most of their snapper catch in depths exceeding 30 m. Few snapper were recorded as being caught in depths of 80 m or more.

The condition of released snapper by depth recorded by observers on charter vessels in 2006–07 is plotted in Figure 20. Most fish were caught in water between 10 and 49 metres deep. Interpretation of the proportion of adverse condition factors for fish over this depth may suffer from low sample size, but generally more that 80% swam away with little outward sign of barotrauma. Almost no fish from depths over 50 m floated (although some dying fish may float) indicating that air from the burst swim bladder had vented. The fish that were mast likely to float came from 20 to 30 m and were most likely to show external signs of barotrauma. Snapper barotrauma injuries recorded for released snapper by observers on charter vessels are shown in Figure 21. Visible barotrauma injuries occurred in fish from all depths, with these injuries apparent in the greatest proportion for snapper from between 20 and 49 m depth. In 2006–07 85% of released fish showed no visible barotrauma, 5% had the stomach everted in the mouth, 9% had ruptured at the anus, and 1% were recorded as extreme. This is a lower barotrauma rate than in the previous survey (Holdsworth & Boyd 2008). The mortality of snapper brought to the surface then returned to the bottom from different depths was reported by Stewart (2008). Some fish without visible signs of barotrauma died in the first 24 hours, especially fish caught deeper than 30 m.

3.9 Combinations of snapper condition factors

From the detailed data collected by observers on charter boats in 2006–07 (Table 4) most released snapper were lip hooked, showed no outward signs of damage, and swam away (76.2%). A further 11.1% were lip hooked and showed some signs of barotrauma but were able to swim back down. Some lip hooked fish (5.1%) were recorded as swimming away bleeding either with or without barotrauma. The hook damage on externally hooked fish varies from quite minor puncture wounds to damage to the eye or cuts on the body. A further 3.4% of the fish released were foul hooked and swam away with no barotrauma. Fish that were gut hooked, foul hooked with signs of barotrauma, floating, or dying on release accounted for the remaining 4.2% of those observed (Table 4). These proportions come from the observer data only because the condition factors were more detailed and more consistently recorded.

3.10 Estimated total mortality

Estimates of the fishery-wide release mortality can be made from the data obtained in the surveys. These estimates rely on the following assumptions: that the most recent recreational harvest estimate in SNA 1 by region in 2004–05 (Hartill et al. 2006) is a reasonable predictor of the landed recreational catch by region in 2006–07; that the length weight regression (Paul 1976) applies to recreationally caught snapper in 2006–07; and that the length, condition, and depth of snapper recorded by trailer boat fishers that were sampled is representative of all

recreational snapper catches in SNA 1. We have also used results on capture depth mortality for snapper reported by Stewart (2008) that indicate there is 0% mortality in snapper captured from 8 to 20 m, 2% mortality from 21 to 29 m, 39% from 30 to 44 m, and 55% from 45 to 60 m). The mortality rates of fish from depths over 30 m seem higher than we would expect based on the survival of tagged snapper in the mortality experiments in New Zealand (Gilbert and McKenzie 1999).

Two estimates of capture and release mortality are made; low and high. To make the estimates we have used the proportions at length for kept and released snapper by region, recorded fish condition data, and capture depths collected by trailer boat fishers only as they represent the largest proportion of catch.

For the low mortality estimate we assume that only those snapper that are recorded as gut hooked, floating, or dying do not survive (Table 5), but all others do. The estimates of mortality in addition to those kept by fishers due to these visible factors at the time of release are highest in the Bay of Plenty at 12.0% in numbers of fish and 4.1% by weight in 2006–07 (Table 6, top). Scaling this to the 2004–05 harvest estimate gives additional mortality of about 72 000 fish (21 t). Similarly the additional mortality in the Hauraki Gulf was 7.5% in numbers of fish and 2.6% by weight. Scaled to the harvest estimates this would add about 144 000 fish (19 t) to the catch. In east Northland additional mortality was lower, 5.6% in numbers and 1.7% by weight. This equates to about 24 000 fish (13 t). The low mortality estimate for SNA 1 totals more than 211 000 fish (8.2%). The additional mortality by weight is 65 t (2.7%) compared to the 2004–05 recreational snapper harvest of 2420 t.

Our high estimate of mortality is based on an assumption of unobserved pos-release mortality due to internal damage caused by handling or barotrauma. To estimate this we used the proportions of fish captured at depth by region which swam away not bleeding in our survey (Table 5) together with capture-depth mortality rates for snapper observed by Stewart (2008). This additional mortality was added to the low estimate described above to generate a high estimate of total release mortality (Table 6, bottom). Most of the snapper caught in the Hauraki Gulf were caught in depths less than 30 m, so capture depth mortality has a lesser impact. The Bay of Plenty produced the highest mortality estimates using these assumptions of 250 000 fish and 72.9 tonnes (Table 6, bottom). Using our assumptions, the high estimate of recreational snapper release mortality for SNA 1 in 2006–07 is 198 t (8.2%) over and above the harvest estimate. This equates to about 617 000 (24.0%) snapper mortalities in addition to the estimated number of fish kept (Table 5, bottom).

4. DISCUSSION

A key finding of this study is that more than half of the recreational hook and line snapper catch sampled in this series of surveys was released. In 2006–07, 56% of the recreational hook and line snapper catch sampled in SNA 1 was returned to the water. A slightly higher proportion of the catch was released from charter vessels (60%) than from private vessels (54%). This finding confirms the results of similar sampling programmes in 2004–05 (58% of snapper released) and 2005–06 (59% released) reported by Holdsworth & Boyd (2008).

The sampling design and sampling methods were aimed at obtaining accurate data representative of the year-round recreational SNA 1 fishery in 2006–07. Therefore the sampling results should give a reliable estimate of the size distribution and selectivity of the recreational hook and line snapper fishery in SNA 1. The mean weighted c.v.s of the length frequencies derived from bootstrap estimates ranged from 0.11 in the Hauraki Gulf, where samples sizes were largest, to 0.22 for east Northland.

The results from the 2006–07 survey confirm those of previous surveys using this methodology (Holdsworth & Boyd, 2008) that the length frequencies of snapper measured by fishers themselves are very similar to the length frequencies by region of fish measured by trained observers on charter vessels. This is true for both kept and released snapper in all regions. The difference between length distribution of snapper measured by fishers at sea and remeasured by project field staff on their return to boat ramps is small. An attempt to generate paired length data from remeasurements in the 2004–05 survey estimated that the mean length of fisher measured snapper is about 0.6 cm more than when the fish are remeasured by boat ramp interviewers (Holdsworth et al. 2006). Fishers appeared to prefer recording even lengths. Possible sources of error in fisher-measured data include not spreading the tail to find the base of the tail fork, and not rounding the length down, but instead rounding up to the nearest whole centimetre. Both of these errors would result in slight overestimates of length. Irrespective of the reasons, the results in 2006–07 are consistent with the earlier survey results that indicate length measurement errors by fishers are small on average and that data from charter boats and trailer boat forms can be pooled.

The selectivity of the recreational line fishing method for hook and line caught snapper from boats can be generated from these data in the next SNA 1 stock assessment model. At present, we can compare the 2006–07 recreational snapper data to the commercial longline proportions at length from within the same fishing year. The assumptions about recreational snapper selectivity made during the last stock assessment (in 2000) seem to be reasonable especially for Bay of Plenty and Hauraki Gulf. However, relative proportions of recreationally caught snapper for some medium and large size classes (34 cm and larger) in east Northland seem to be equal to or greater than the proportions estimated in the commercial longline catch.

This study also provides information on the condition of released snapper as well as data on capture depth, hook type, hook size, and hook site. These are all potential factors affecting mortality of released fish. Bartholomew & Bohnsack (2005) reviewed 53 release mortality studies and found that mean mortality varied greatly between species. Within species their review showed that the anatomical hook location was the most important factor leading to mortality, although there were several other significant mortality factors. These included the use of natural bait, removal of hooks from deeply hooked fish, hook type, depth of capture, and water temperature.

The results of the present study show some possible trends in the condition data mainly based on observations that can be made during the period of handling and release. Overall, fishers on private boats reported that 97% of released snapper swam away and 3% floated or were dying. Observers on charter boats reported 92% of released snapper swimming away and not bleeding, 6% that were bleeding, and only 2% not swimming away and floating. These observations suggest that a high proportion of released snapper may initially survive, although any subsequent mortality is unknown.

In Port Philip Bay, Victoria, Conron et al. (2004) found low overall mortality rates (5%) in experiments using angler hook and line caught snapper (*Pagrus auratus*), with deep hooking the main factor associated with mortality. They reported fewer snapper caught with wide-gape hooks were deep hooked and attributed the low overall mortality rate to the fact that 85% of the snapper were lip hooked. An experiment with snapper in New Zealand also found that deep hooked snapper are more likely to sustain injuries resulting in mortality than fish which are lip hooked (McKenzie & Holdsworth, 1997 unpublished results).

The results of the present study show that released snapper under 27 cm showed a greater tendency for being deep hooked (hooked in the throat, gills or gut) than released fish 27 cm or longer. Fishers are generally aware that gut hooked fish are less likely to survive and may be more likely to retain small, legal fish that show obvious signs of injury.

Hook type and size were factors that appeared to affect the condition of released fish. Circle hooks had a greater tendency to hook snapper in the mouth than J-hooks. This is consistent with trends observed in other studies (Muoneke & Childress 1994). Observer data showed that 76% of snapper were lip hooked and swam away with no visible signs of damage while a further 16% of released fish were lip hooked and swam away with signs of barotrauma or bleeding.

In a cage mortality experiment in New South Wales, Stewart (2008) found that the short term mortality of snapper increased with capture depth. Very low mortality of less than 2% was observed over 24 hours from capture depths shallower than 30 m but about 45% mortality was observed from capture depths of 30 m or deeper using commercial baited traps. Hook damage was not a contributing factor to this mortality result.

The high proportion of the catch that is released in SNA 1 demonstrates the effect of the MLS in the recreational snapper fishery and therefore the importance of determining any subsequent mortality of released snapper. There is an implicit assumption with the use of MLS as a fishery management tool that the vast majority of released fish will survive, grow, and ultimately breed. If the mortality rate is high enough, this assumption will not be met and there may be lost productivity. It is therefore important to estimate both selectivity and mortality.

The length frequency of the hook and line snapper catch is most likely a reflection of the size of snapper most abundant in the main SNA 1 recreational fishing areas. In the Hauraki Gulf, adult and juvenile snapper are most abundant in waters less than 30 m depth (Paul 1976, Langley 1993). Capture depth data recorded in this survey show that most of the recreational snapper catch in SNA 1 comes from waters between 10 and 20 m deep in the Hauraki Gulf and from 20 to 40 m deep in Northland and Bay of Plenty. Decreasing the MLS to reduce catch and release may not significantly cut down the discard rate as fishers may still choose to return legal sized fish. In this study, 21% of all legal sized fish were released, with 81% of these legal sized releases made up of the smallest three size classes (27–29 cm). The length frequency distributions described in this study clearly indicate that raising the MLS would increase the proportion of the recreational snapper catch that is released.

Management options to reduce the discard rate in the recreational fishery may be limited. In a simulation study on MLS in the snapper hook and line fishery, Harley et al. (2000) found that increasing the MLS would increase the exploitation rate and the level of unaccounted for fishing mortality. However, Harley et al. (2000) made assumptions about recreational selectivity and mortality of released fish as no data were available. This study provides some of the data that were not available for the simulation study and it may be worth repeating the simulations with real data on selectivity. However, the results from this study provide only limited information on discard mortality. Some immediate post-release mortality was observed, but the estimation of total release mortality requires experiments such as holding released fish caught at different depths for a period to observe any subsequent mortality. The data on capture depth, hook type, hook size, and hook site from this study provide useful information on some of the key factors potentially affecting the mortality of snapper released by recreational fishers which should be built into any such experiments.

The high proportion of small snapper in the recreational catch undoubtedly reflects the large number of small fish currently in the snapper population. A very strong 1999 year class and in some areas a strong 2001 year class has been reported and these are now showing up in the commercial catch sampling data (Walsh et al. 2007). The degree to which strong cohorts might affect the size frequency of the recreational catch is uncertain. Some recreational fishers fishing from boats prefer sheltered waters where small snapper are most abundant and therefore vulnerable to the fishery. The influence of strong or weak cohorts of pre-adult fish

may not have a large influence on the overall size frequency of the recreational catch from such areas.

The results of this project confirm the results of two earlier projects on snapper selectivity reported by Holdsworth & Boyd (2008). Large numbers of snapper are caught and released in the SNA 1 recreational fishery. Overall, the study results show that both observers on charter vessels and private fishers recruited at boat ramps can provide at-sea data on the selectivity and condition of recreationally caught snapper, including fish that are released.

Some assumptions about snapper release mortality can be made. A low estimate of mortality in SNA 1 from observed damage in 2006–07 is 8.2% by number and 2.7% by weight. A high estimate of additional mortality that includes assumptions on the unobserved post-release mortality due to internal damage caused by handing or barotrauma is 21.7% by number and 7.5% by weight. These estimates of mortality are slightly lower than those generated using the same methodology from data collected in 2005–06.

By scaling the 2006–07 release data to the 2004–05 aerial overflight harvest estimates for SNA 1 we calculate that between 211 000 and 617 000 snapper (65–198 t) may not have survived recreational catch and release in 2005–06. However, these estimates involve a number of untested assumptions and should be considered as preliminary.

A fairly recent development in the recreational hook and line fishery is the use of artificial soft (plastic) baits, which many fishers are now using in preference to conventional fish baits. This study and the two that preceded it did not record bait type and it is possible that there may be some changes in size selectivity with the use of soft baits compared to natural fish baits. The use of soft baits may also reduce the rate of deep hooked fish, particularly in the smaller size classes that are regularly released. We therefore recommend that any similar future study should collect information on bait type.

5. ACKNOWLEDGMENTS

This research was undertaken under contract to the Ministry of Fisheries as project SNA2006/04. We acknowledge with thanks the assistance of Shelton Harley who provided the methodology for scaling mortality estimates to total catch. Thanks to Peter Saul for reviewing this report. The contribution of interviewers, charter vessel operators, observer staff, and of the many recreational fishers who agreed to measure their catch must be acknowledged as the project could not have been completed without their assistance. Interviewers and observers who have made a particularly worthy contribution in 2006–07 are Melanie Blundell, Cate McGrath, Wayne Robinson, Paula Vincent, and William Wilson.

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Table 1: Number of snapper measured in 2006–07 by region, location and method.

Region	Location code	Observer	Fisher	Total
Bay of Plenty	MAK	147	580	727
	MAY	20	27	47
	MEB	37	112	149
	MEI	1	1	2
	MII	74	317	391
	OTA	3	41	44
	PAP	443	441	884
	PUK	7	49	56
	TEK	13		13
	TEP		23	23
	Blank		16	16
	Bay of Plenty total	745	1 607	2 352
Hauraki Gulf	COL		24	24
	COR	200	1389	1 589
	FIR	104	26	130
	KAW	52	5	57
	MID	53	19	72
	MOT	870	850	1 720
	NOI	265	762	1 027
	RAN	184	451	635
	TAM		92	92
	TIR	5	67	72
	WAI	107	9	116
	Blank		195	195
	Hauraki Gulf total	1 840	3 889	5 729
East Northland	BLA	361	121	482
	HEN		4	4
	OAK	70		70
	PKI		11	11
	TAI	83	55	138
	TAK	44	252	296
	TUT	66	149	215
	WEI	24	35	59
	Blank		93	93
	E Northland total	648	720	1 368
Total		3 233	6 216	9 449

Table 2: Key to sample location codes.

Region	Code	Location
Bay of Plenty	MAK	Matakana Island (Tauranga)
	MAY	Mayor Island
	MEB	Mercury Bay
	MEI	Mercury Islands
	MII	Motiti Islands
	OTA	Offshore Tauranga (new code)
	PAP	Papamoa Beach
	PUK	Pukehina Beach
	TEK	Te Kaha
	TEP	Te Puna Inlet (SE half of Tauranga Harbour)
Hauraki Gulf	COL	Cape Colville
	COR	Coromandel Islands (Wilsons Bay North)
	FIR	Firth of Thames
	KAW	Kawau (includes Motuora Island)
	MID	Middle Hauraki Gulf
	MOT	Motuihe Channel
	NOI	Noises Group (includes northern Waiheke Island)
	RAN	Rangitoto Channel
	TAM	Tamaki Strait
	TIR	Tiri
	WAI	Waitemata Harbour
Northland	BLA	Black Rocks
	HEN	Hen and Chicken Islands
	OAK	Oakura (Home Point to Mimiwhangata)
	PKI	Poor Knights Islands
	TAI	Taiharuru
	TAK	Takau Bay
	TUT	Tutukaka (Mimiwhangata to Motutara Point)
	WEI	Whangarei Harbour

Table 3: Number of people interviewed and fish measured by season, region and sample session type in 2006–07.

Season	Session type	Bay of Plenty		Hauraki Gulf		Northland		Total	
		People sampled	Snapper measured	People sampled	Snapper measured	People sampled	Snapper measured	People sampled	Snapper measured
Summer /Autumn	Boat ramp	452	1 164	641	1 841	228	483	1 321	3 488
	Charter trip	86	545	233	1 253	58	388	377	2 186
Winter /Spring	Boat ramp	263	443	586	2 048	117	237	966	2 728
	Charter trip	83	200	140	587	50	260	273	1 047
Total		884	2 352	1 600	5 729	453	1 368	2 937	9 449

Table 4: The percentage of released snapper with combinations of hook location and condition factors recorded by observers on recreational charter vessels in 2006–07 (n=1887).

Hook location	Comment id	None	Mouth	Anus	Extreme	Grand Total
Lip	SN Not bleeding	76.15	4.66	6.31	0.21	87.33
	SB Bleeding	2.86	0.48	1.59	0.21	5.14
	FN Not bleeding	0.16	0.05	0.05	0.00	0.26
	FB bleeding	0.00	0.00	0.00	0.00	0.00
	Dying	0.48	0.00	0.00	0.00	0.48
Lip Total		79.65	5.19	7.95	0.42	93.22
External	SN Not bleeding	3.39	0.05	0.26	0.00	3.71
	SB Bleeding	0.58	0.11	0.21	0.00	0.90
	FN Not bleeding	0.16	0.00	0.00	0.00	0.16
	FB bleeding	0.00	0.00	0.00	0.00	0.00
	Dying	0.11	0.00	0.00	0.00	0.11
External Total		4.24	0.16	0.48	0.00	4.88
Deep	SN Not bleeding	0.69	0.00	0.05	0.00	0.74
	SB Bleeding	0.16	0.00	0.11	0.00	0.26
	FN Not bleeding	0.21	0.00	0.21	0.00	0.42
	FB bleeding	0.05	0.00	0.05	0.00	0.11
	Dying	0.37	0.00	0.00	0.00	0.37
Deep Total		1.48	0.00	0.42	0.00	1.91
Total		85.37	5.35	8.85	0.42	100.00

Table 5: The proportion of snapper with visible damage released by trailer boat fishers. The number of fish and proportion of undamaged fish (not recorded as floating, sinking or gut hooked) released by trailer boat fishers in 2006–07 by depth range and the estimated proportion of snapper mortality caused by barotrauma from Stewart 2008 (right).

Category or depth range	Bay of Plenty	Hauraki Gulf	East Northland	Est. additional. mortality from barotrauma
Damage on release	0.062	0.065	0.039	
n undamaged with depth	835	1673	373	
8–20 m	0.253	0.666	0.362	
21–29 m	0.359	0.206	0.174	0.02
30–44 m	0.364	0.102	0.263	0.39
45+ m	0.024	0.025	0.201	0.55

Table 6: Estimated release mortality in numbers of snapper and weight in tonnes for fish visibly damaged on release (recorded as floating, sinking or gut hooked) (top) and for fish visibly damaged plus barotrauma mortality by depth estimated from Stewart (2008) (bottom). Numbers and weights by region are scaled to the 2004–05 aerial overflight survey estimates of recreational harvest (Hartill *et al.* 2006). The percentage additional mortality is also relative to the harvest estimates.

Region	Mortality factor	Estimated mortality number of fish	Estimated mortality (t)	% additional mortality number of fish	% additional mortality by weight
Bay of Plenty	Visible damage	72 475	21.0	12.0	4.1
Hauraki Gulf	Visible damage	114 360	34.8	7.5	2.6
East Northland	Visible damage	24 712	9.7	5.6	1.7
SNA 1 total	Low estimate of release mortality	211 547	65.5	8.2	2.7
Bay of Plenty	Visible + barotrauma	251 713	72.9	41.6	14.1
Hauraki Gulf	Visible + barotrauma	210 001	64.0	13.8	4.8
East Northland	Visible + barotrauma	155 344	60.9	35.0	10.9
SNA 1 total	High estimate of release mortality	617 057	197.8	24.0	8.2

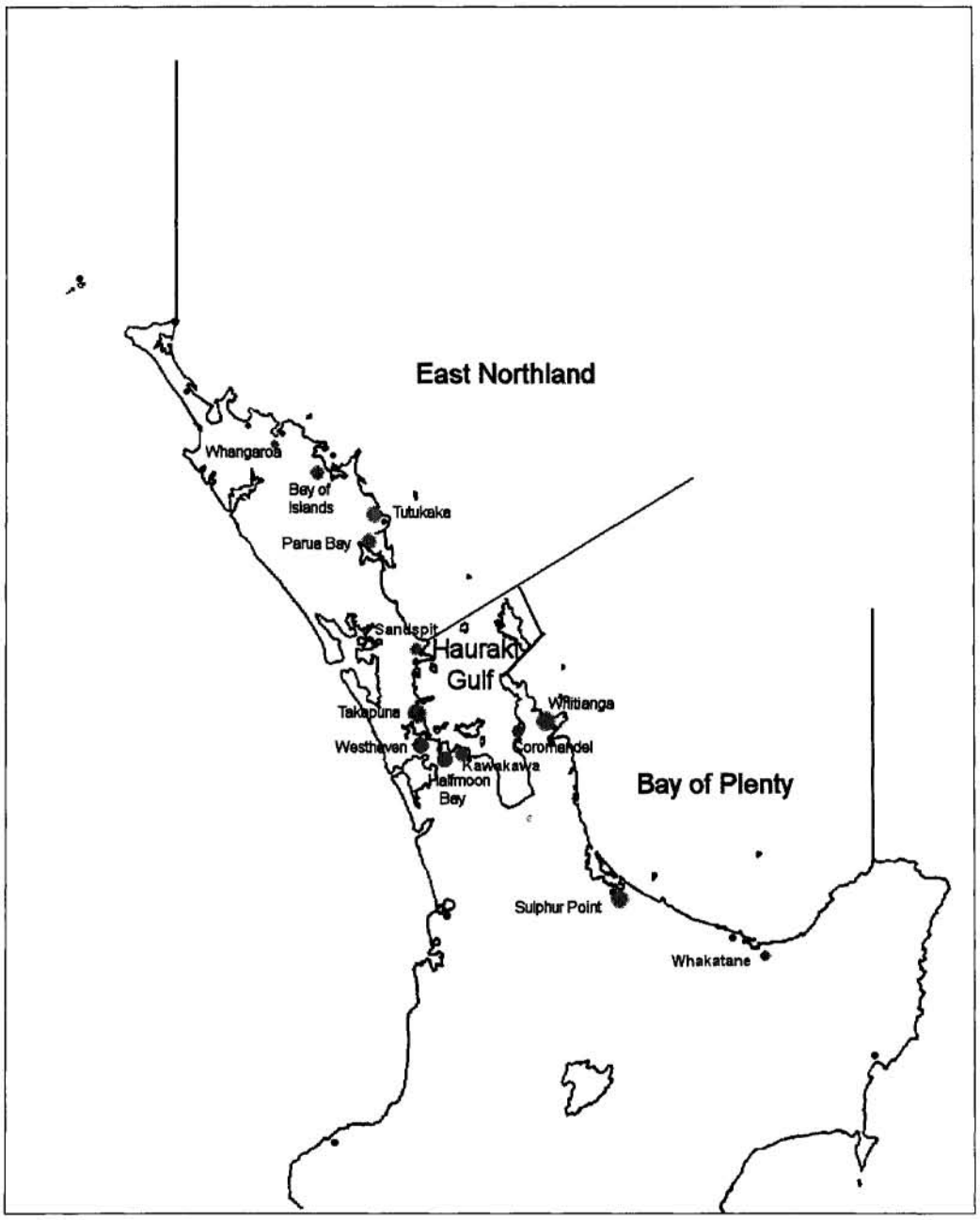


Figure 1: Location of boat ramps and boundaries of regions in SNA 1.

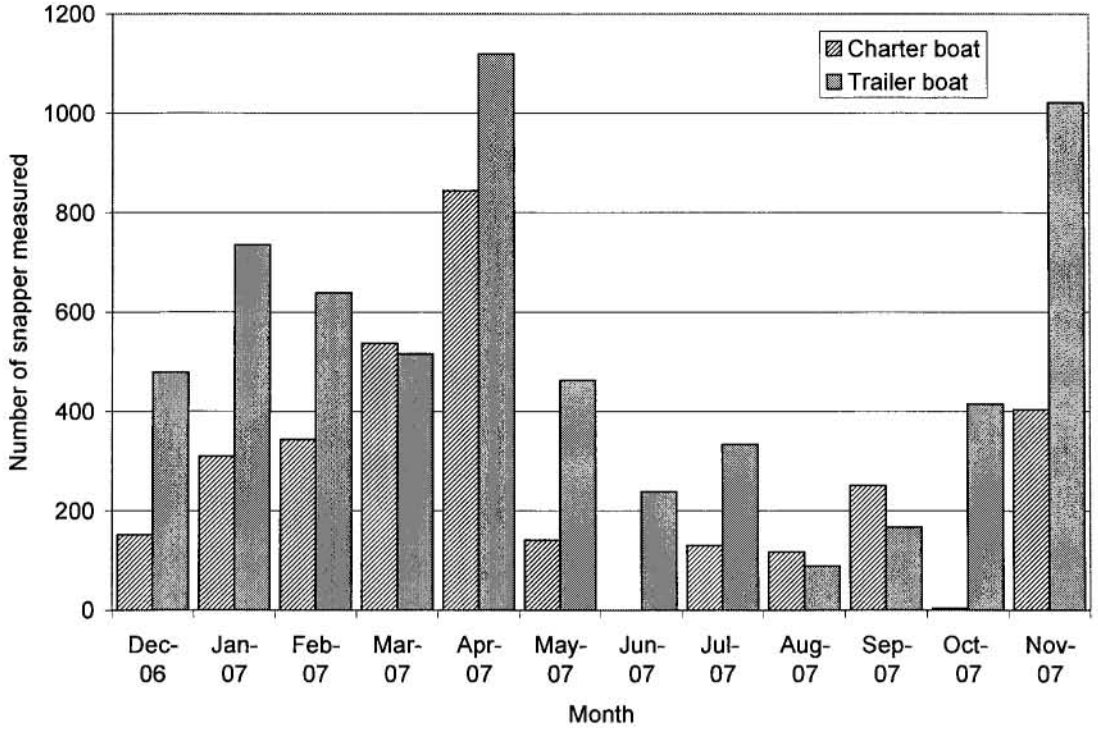


Figure 2: Number of snapper lengths collected by sample type and month in 2006–07, all regions combined.

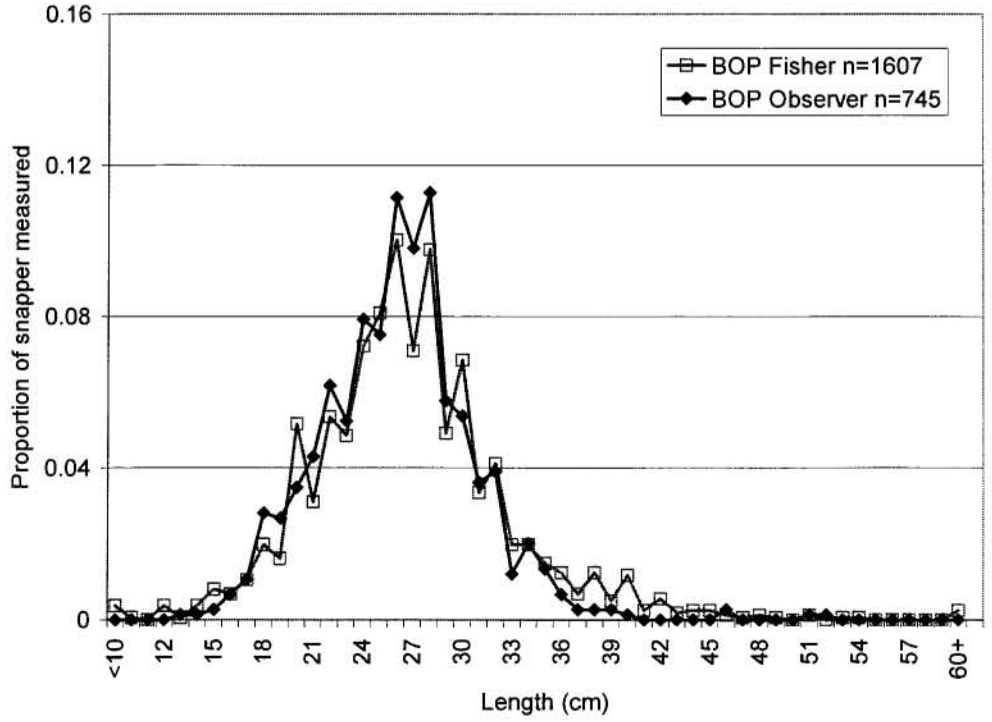


Figure 3: Proportions at length of 2006–07 Bay of Plenty recreational snapper catch at length (kept and released combined) measured by fishers and by observers.

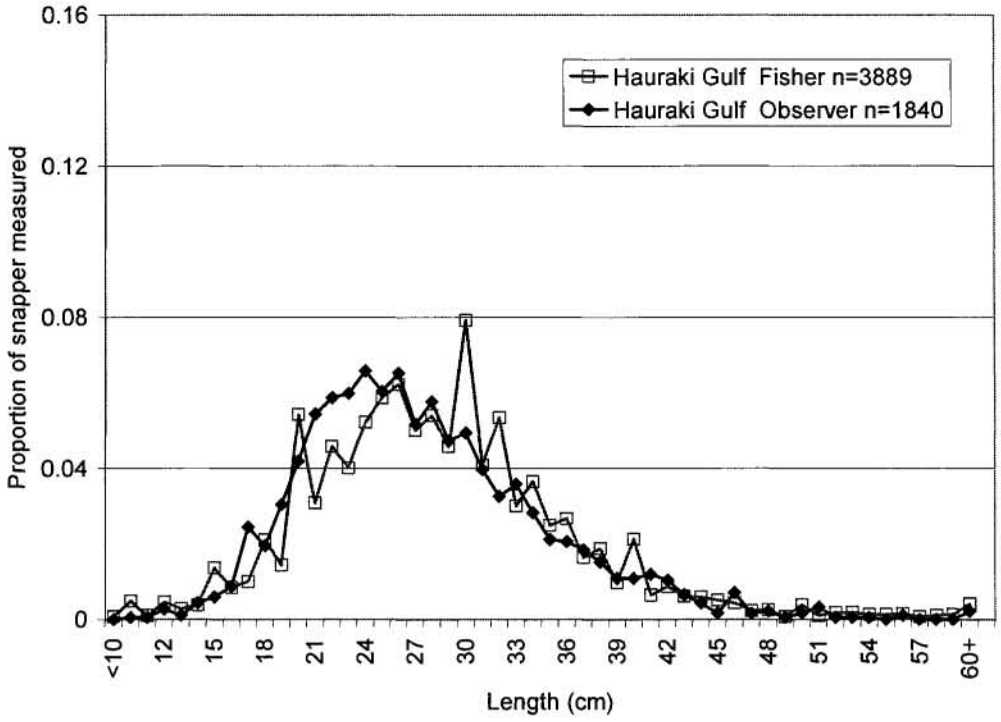


Figure 4: Proportions at length of 2006–07 Hauraki Gulf recreational snapper catch at length (kept and released combined) measured by fishers and by observers.

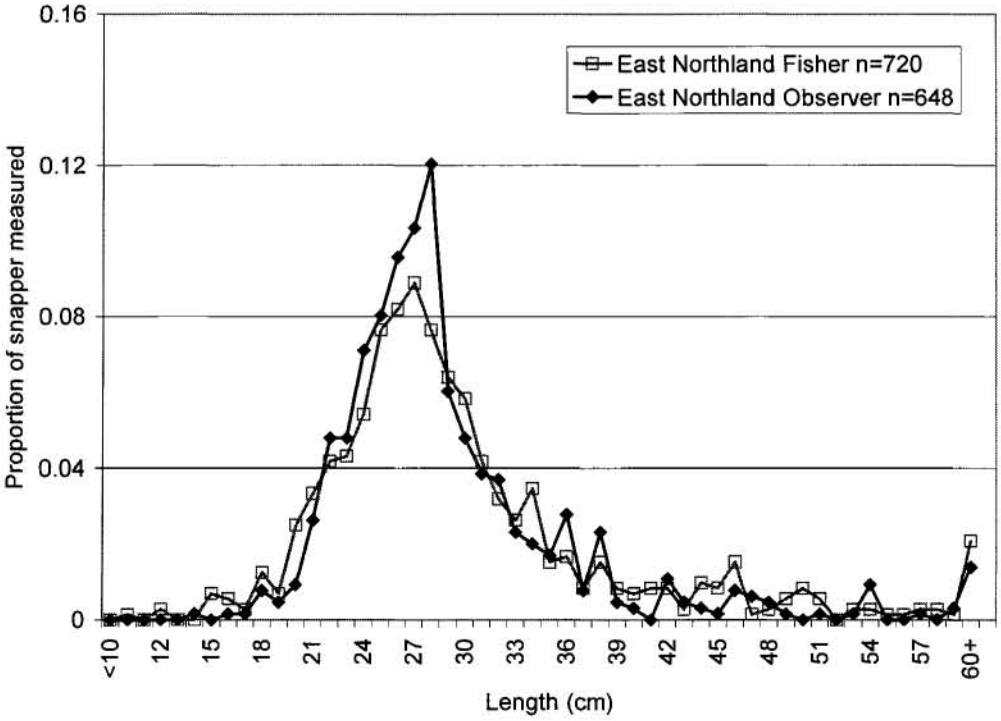


Figure 5: Proportions at length of 2006–07 Northland recreational snapper catch at length (kept and released combined) measured by fishers and by observers.

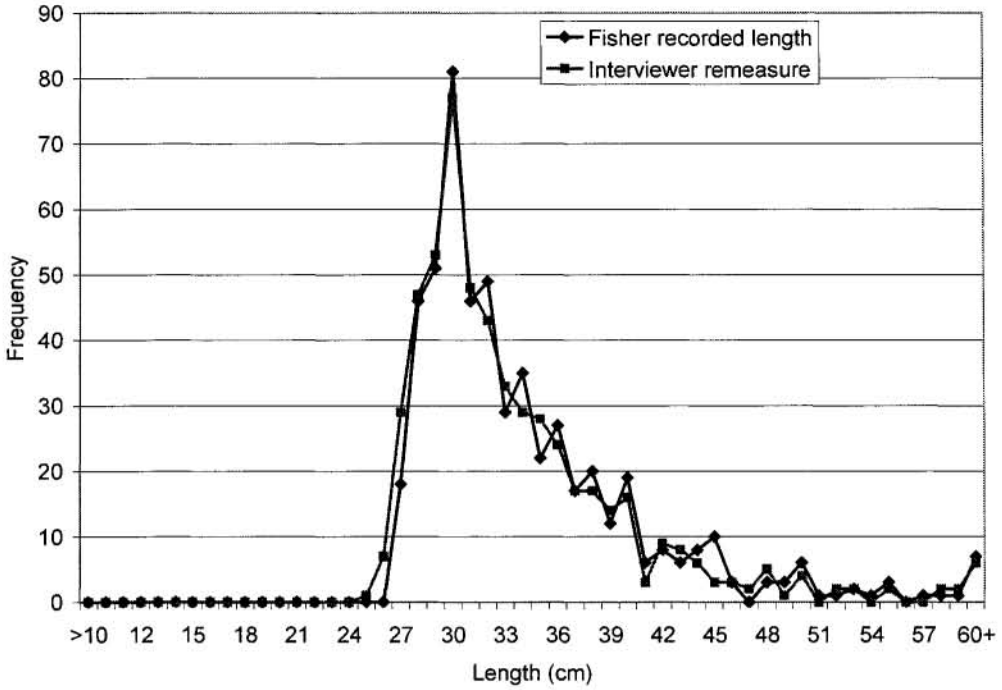


Figure 6: Length frequencies of kept snapper measured at–sea by fishers and remeasured by interviewers at boat ramps on their return for 2006–07 sample data for all SNA 1 regions.

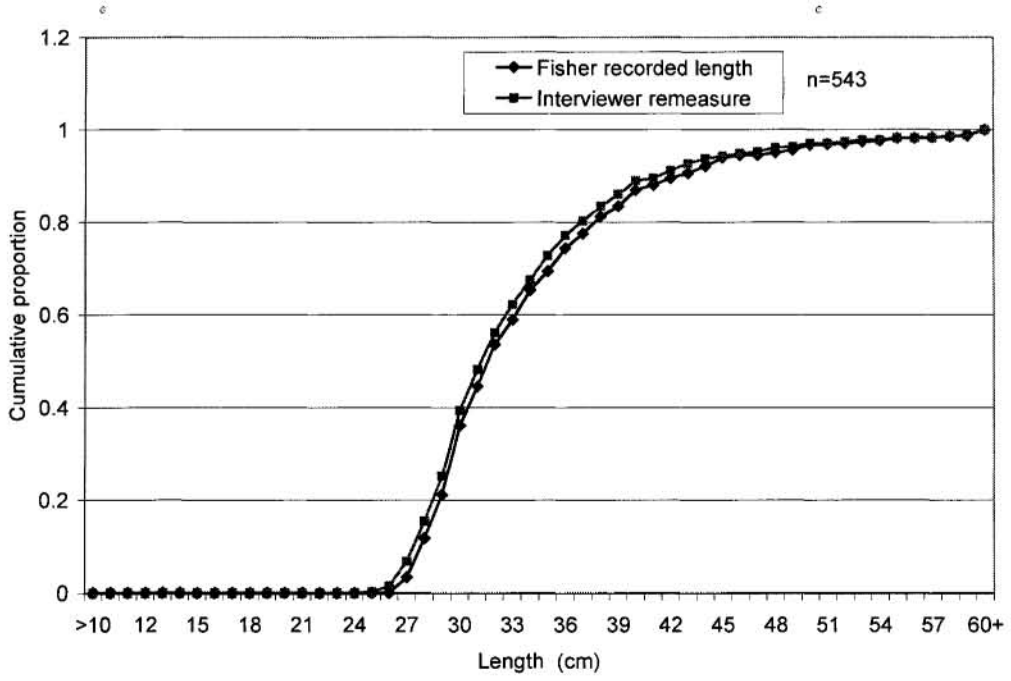


Figure 7: Cumulative length frequency of kept snapper measured by fishers at sea and remeasured by interviewers at boat ramps on fishers' return for 2006–07 sample data for all SNA 1 regions.

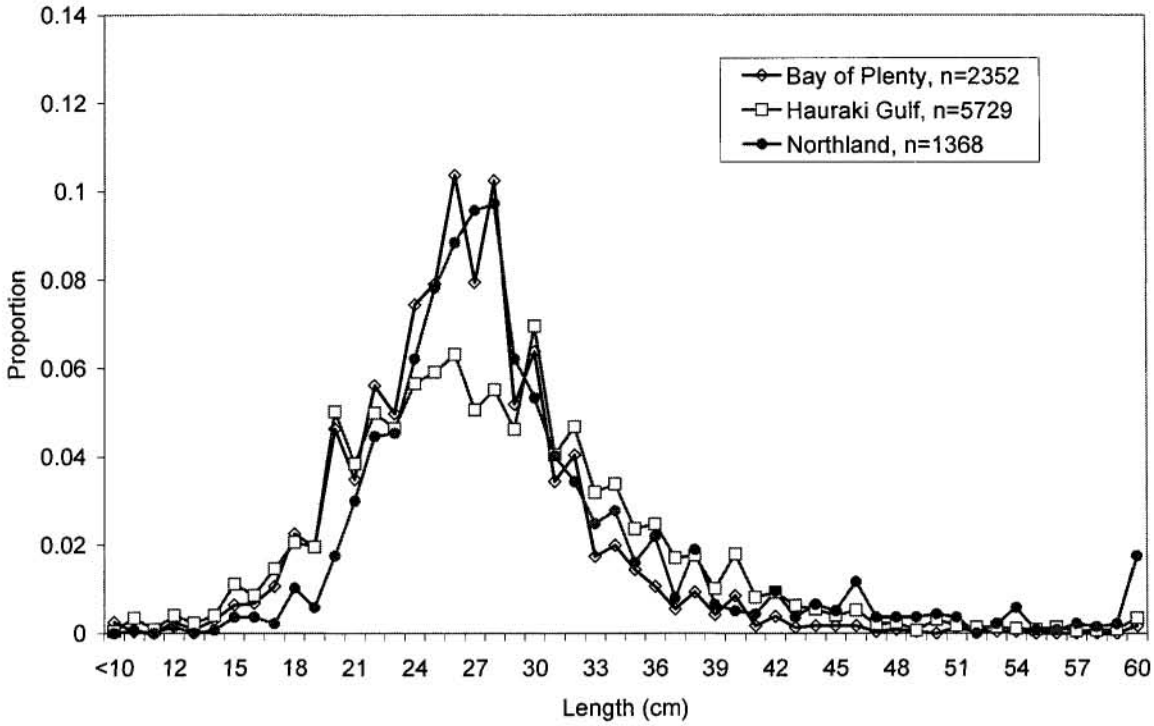


Figure 8: Length frequency of all snapper sampled in 2006–07 by region.

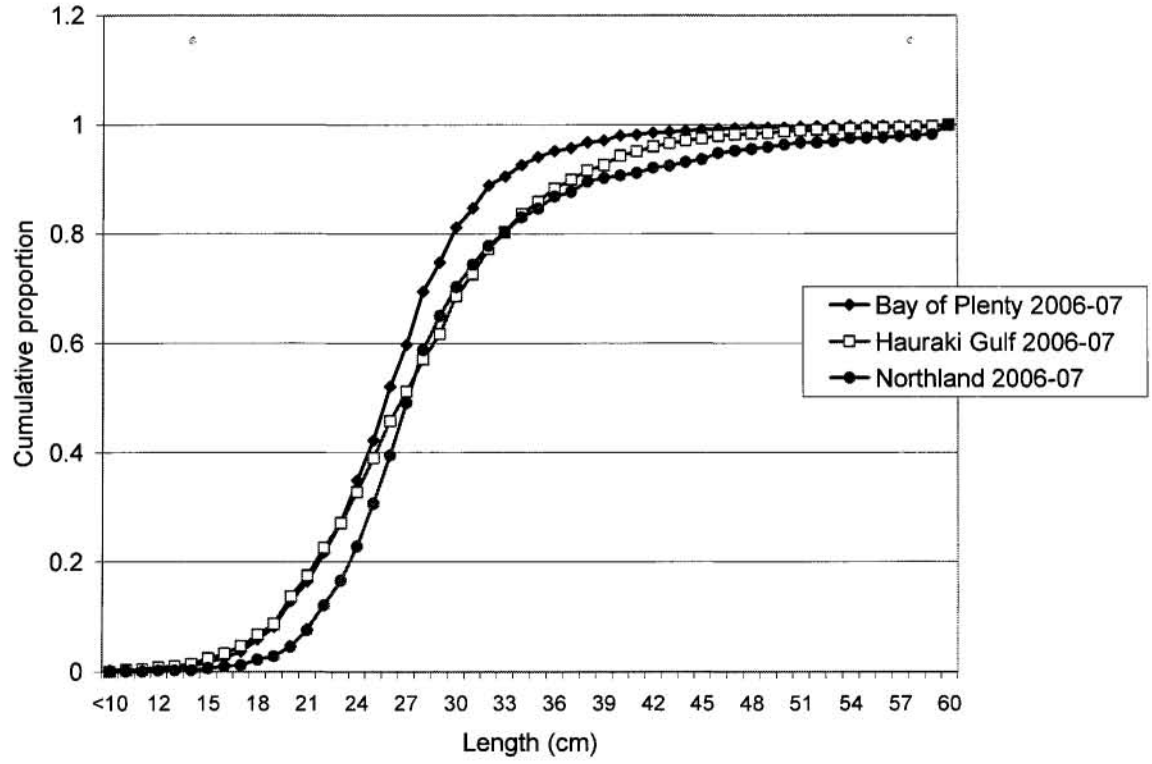


Figure 9: Cumulative length frequency of all snapper sampled in 2006–07 by region.

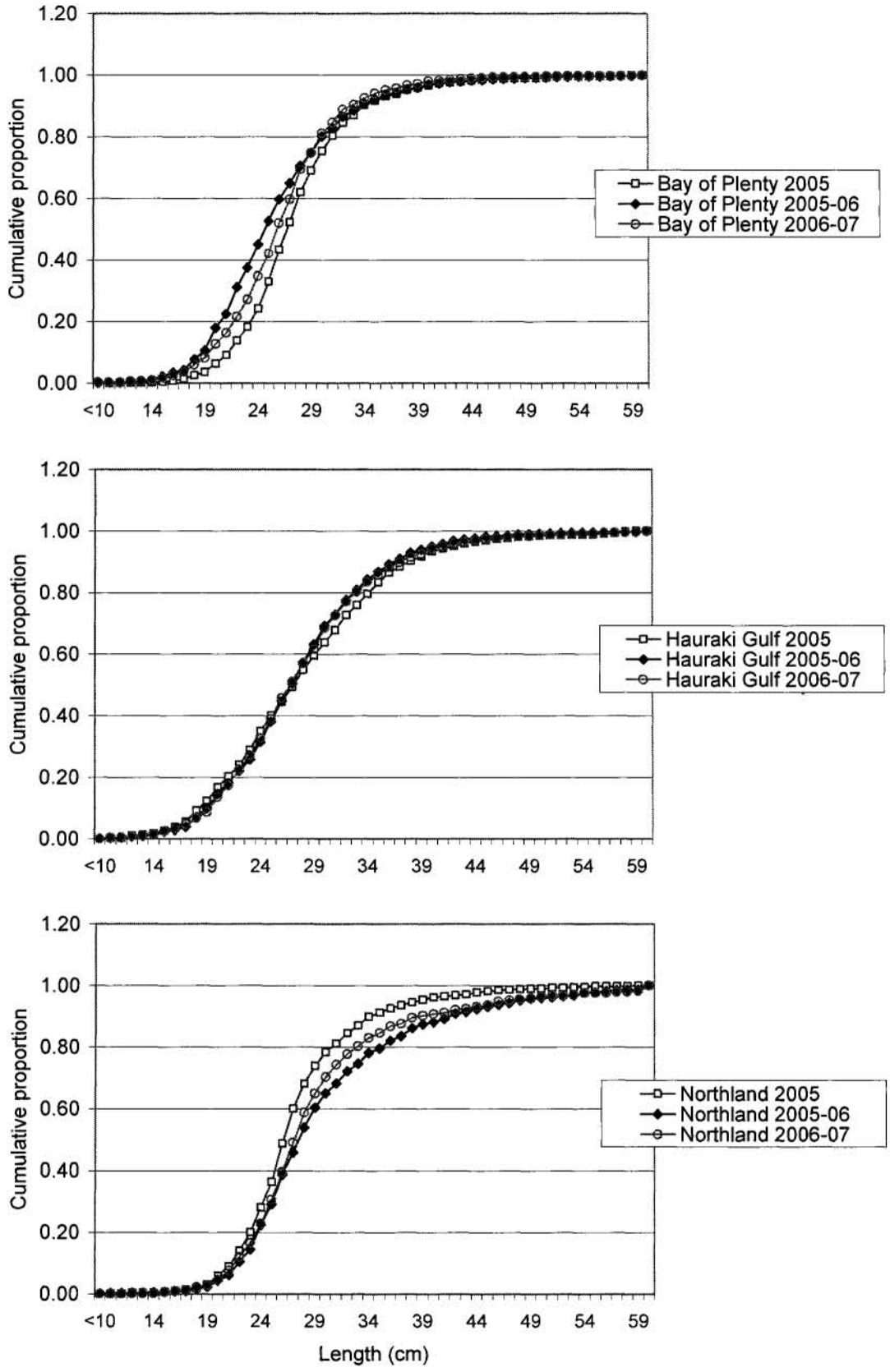


Figure 10: Cumulative length frequency of all snapper sampled in each SNA 1 region in 2004–05, 2005–06 and 2006–07.

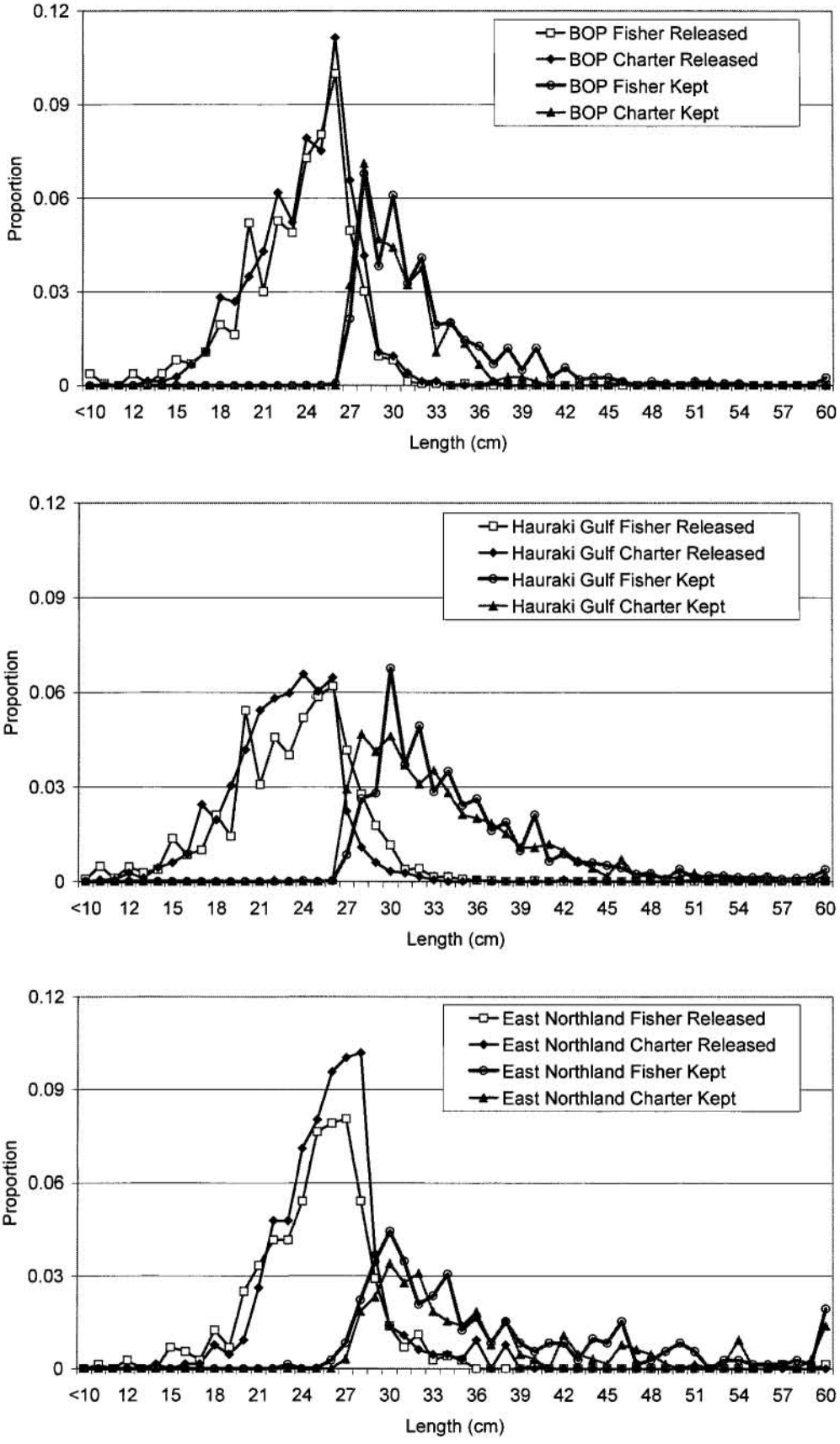


Figure 11: Proportion of released and kept snapper by length and sample method and by region 2006–07.

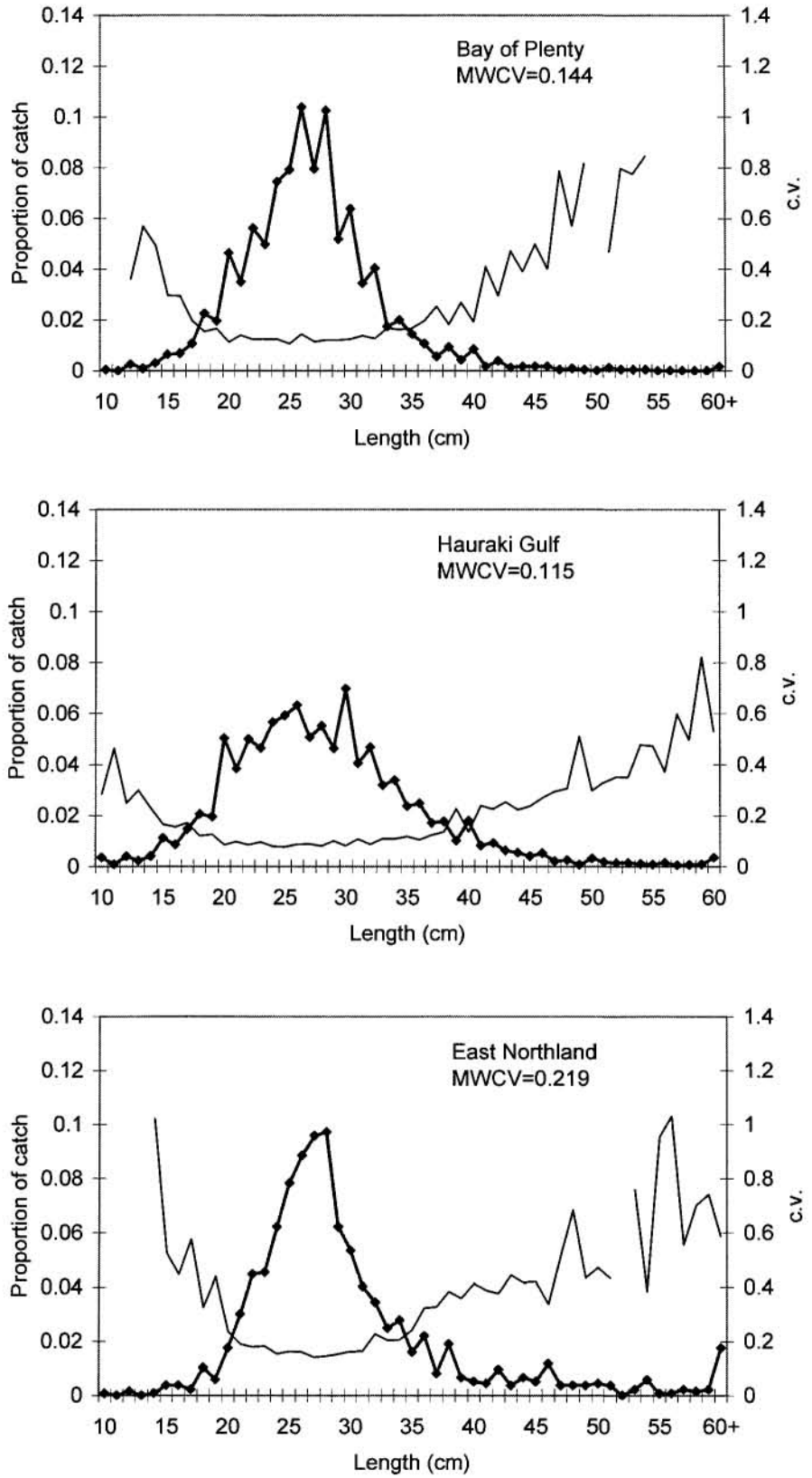


Figure 12. Proportion (left axis) and c.v.s (right axis) of recreationally caught snapper at length for kept and released snapper in each SNA 1 region from the 2006–07 survey.

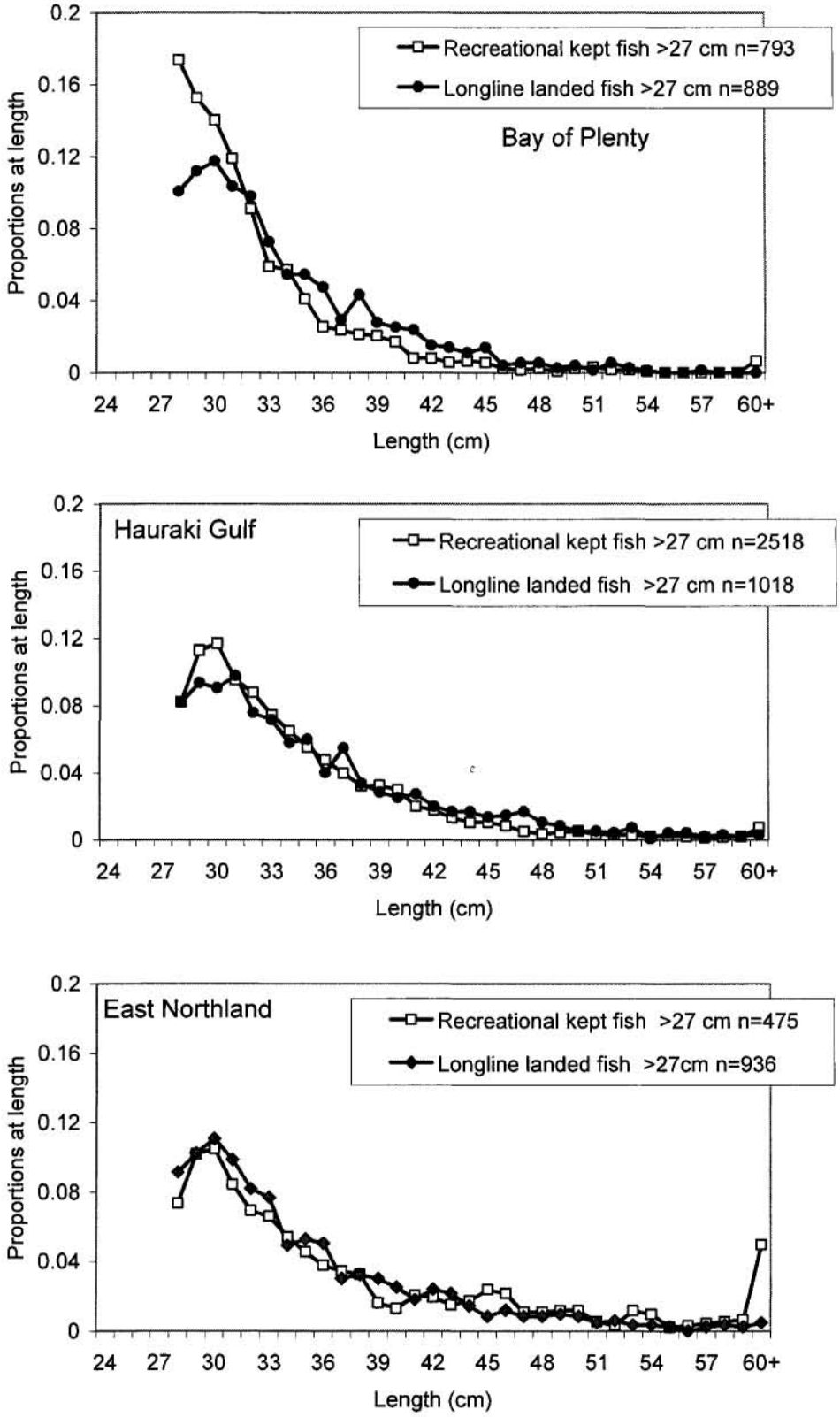


Figure 13: The smoothed proportion at length of recreationally caught snapper and kept snapper ≥28 cm compared with the proportion at length from longline market sampled fish ≥28 cm by region in 2006–07.

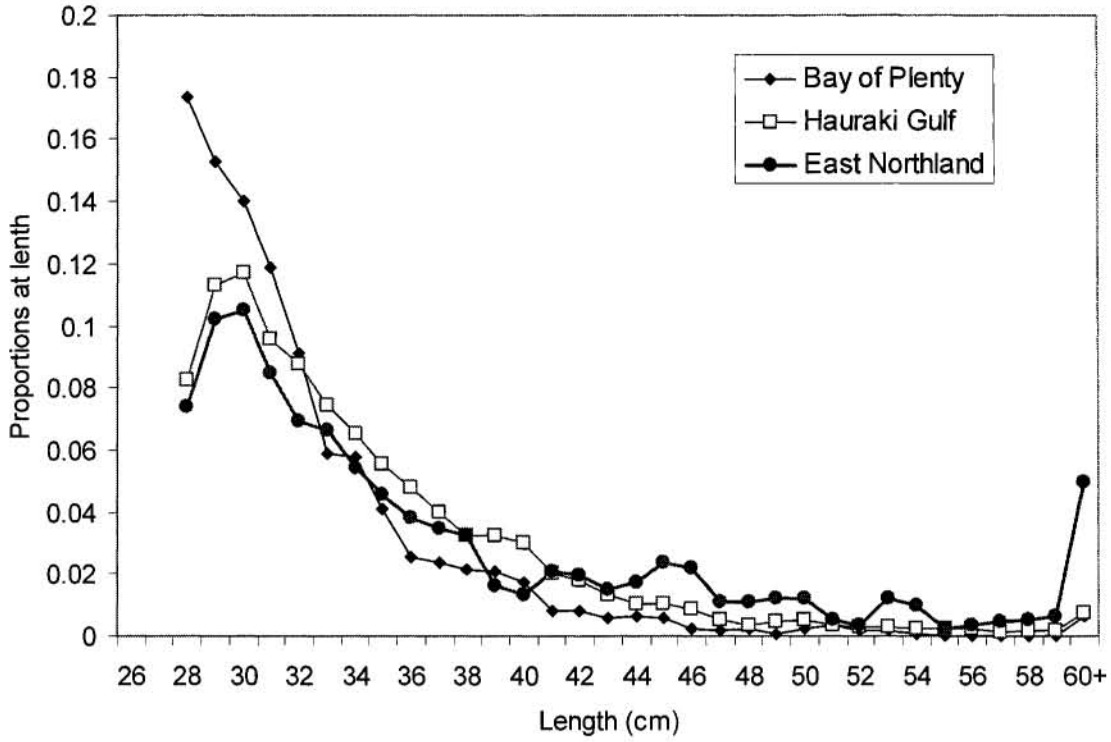


Figure 14: The smoothed proportions at length of recreationally caught and kept snapper for snapper ≥28 by region.

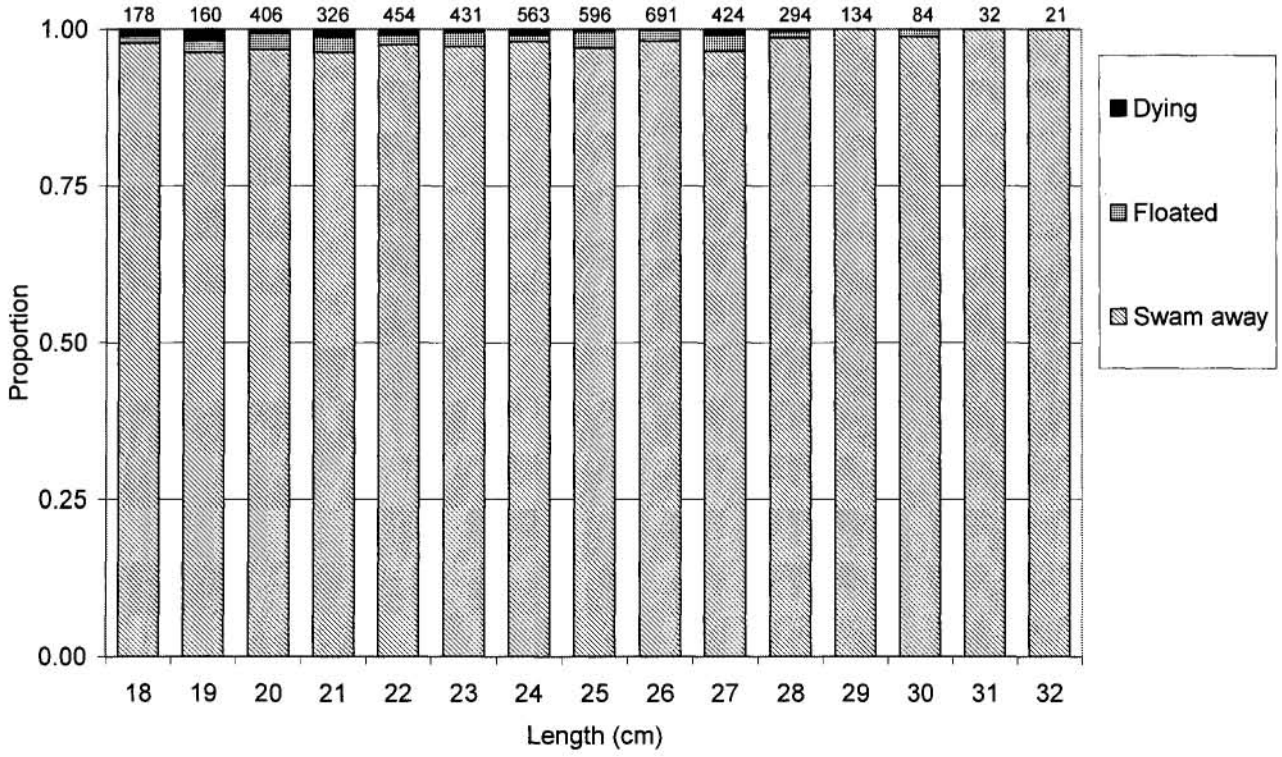


Figure 15: Condition of released snapper by length in the 2006–07 sample survey (fisher and observer data combined, proportions within each length class, sample size at the top of each column).

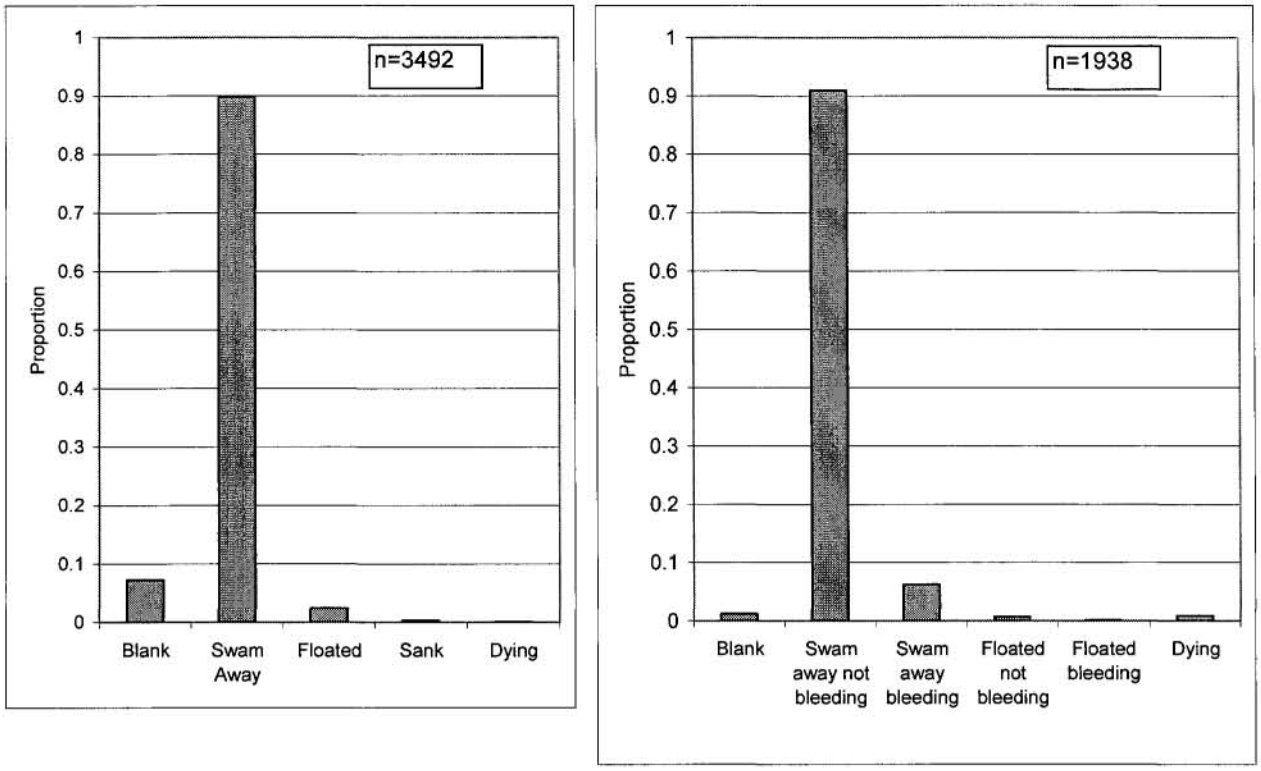


Figure 16: Proportion of condition factors for released snapper recorded by fishers (left, n=3492) and observers on charter boats (right, n=1938) in 2006–07.

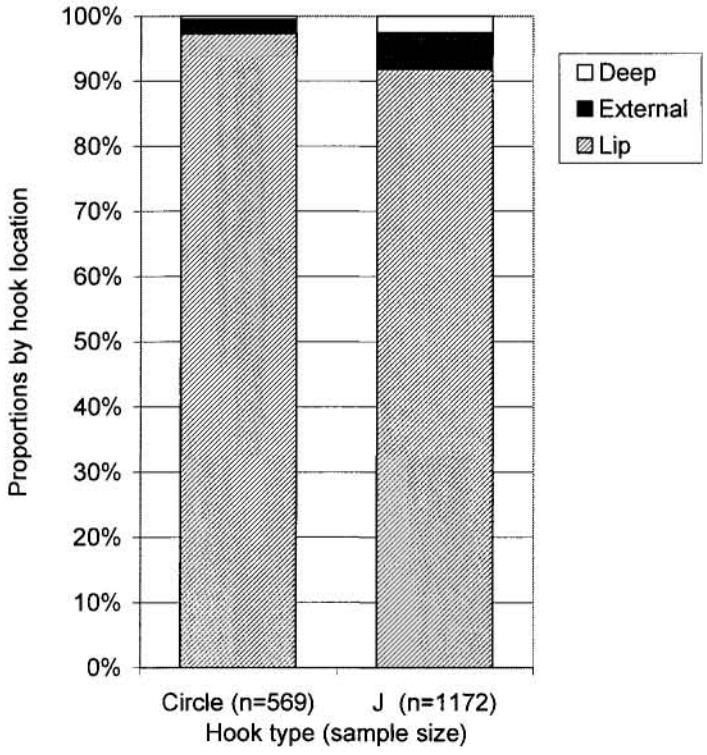


Figure 17: Proportion of released snapper by hook site for the main hook styles recorded by observers on charter vessels in the 2006–07.

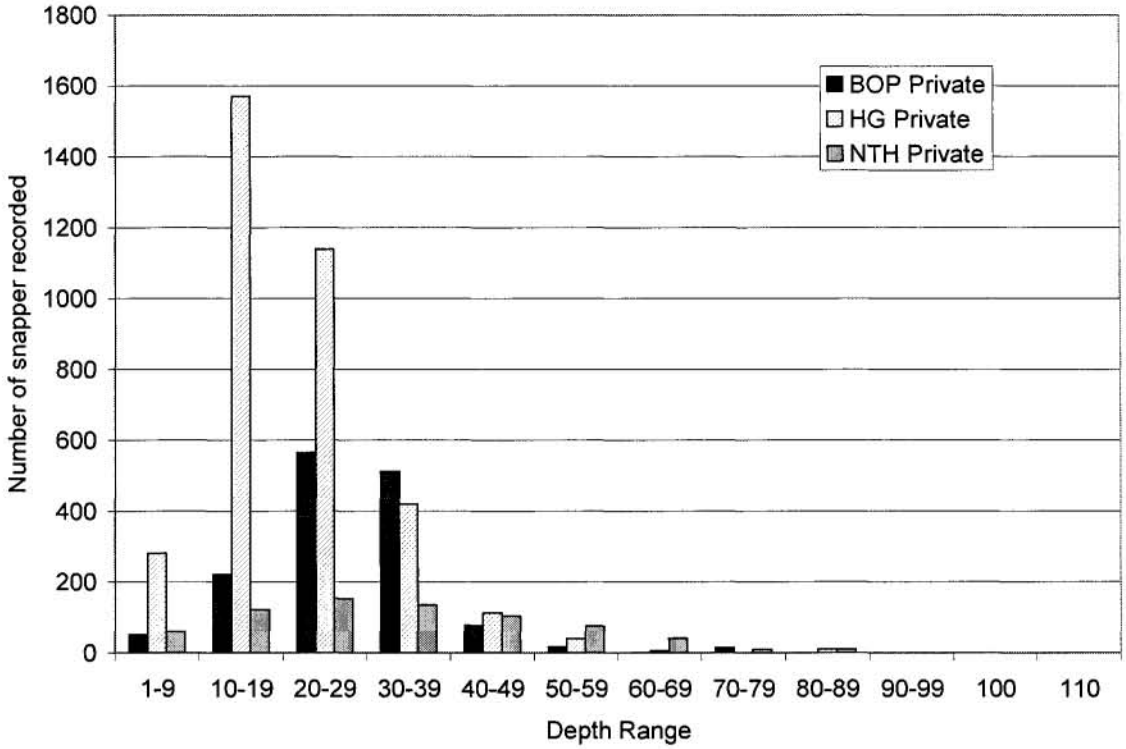


Figure 18: Number of snapper caught by depth (m) in each SNA 1 region in 2006–07 where depth information was recorded by fishers on boat ramp survey forms.

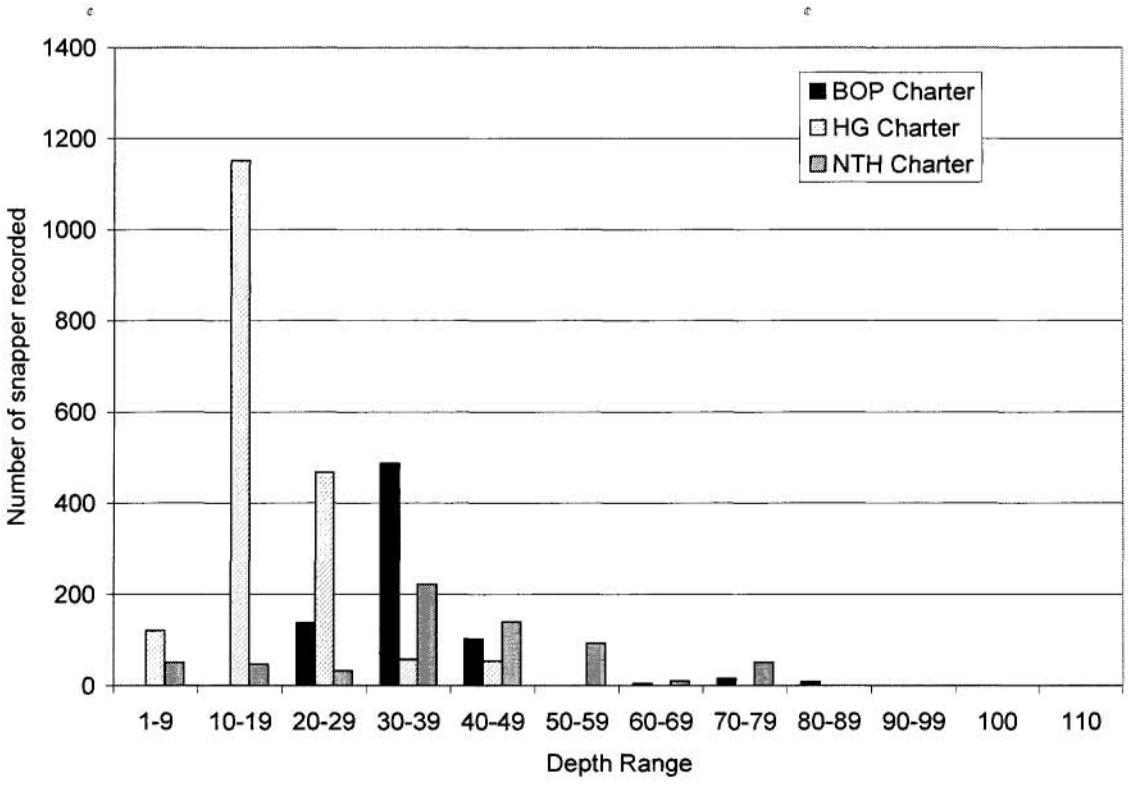


Figure 19: Number of snapper caught by depth (m) in each SNA 1 region in 2006–07 where depth information was recorded by observers on charter vessels.

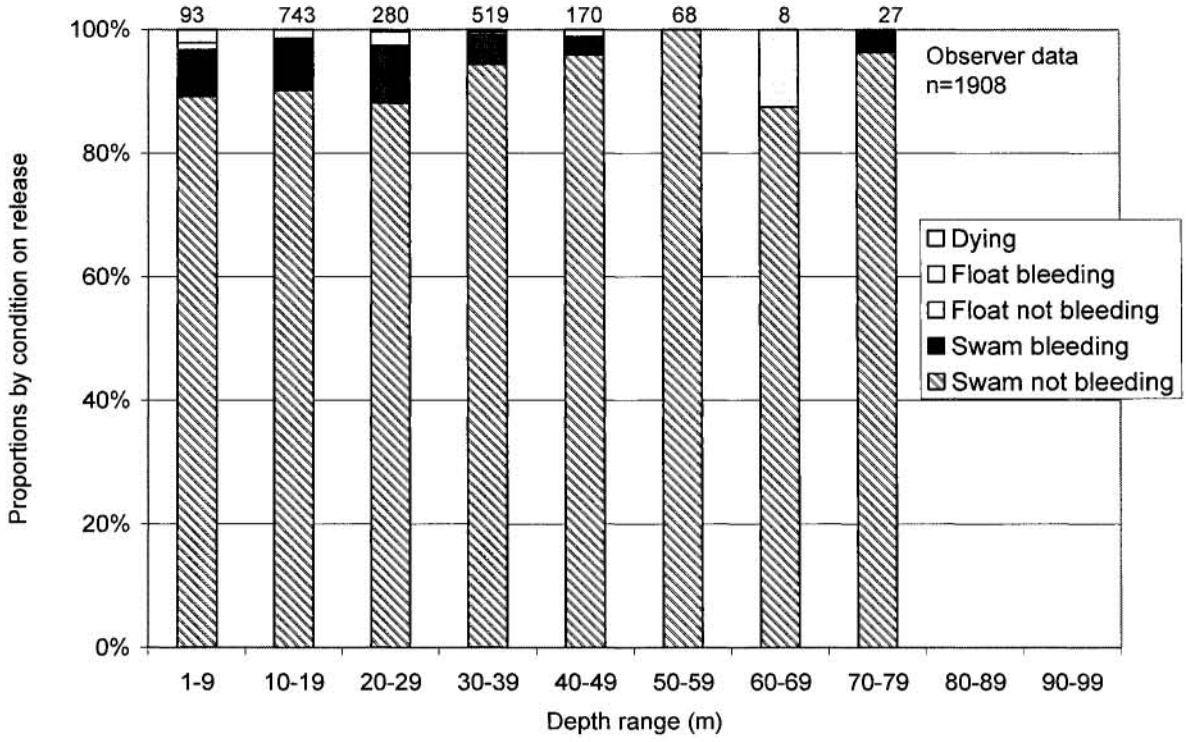


Figure 20: Condition of all released snapper by depth from charter vessels in 2006–07 (proportions within each depth range, sample size at the top of each column).

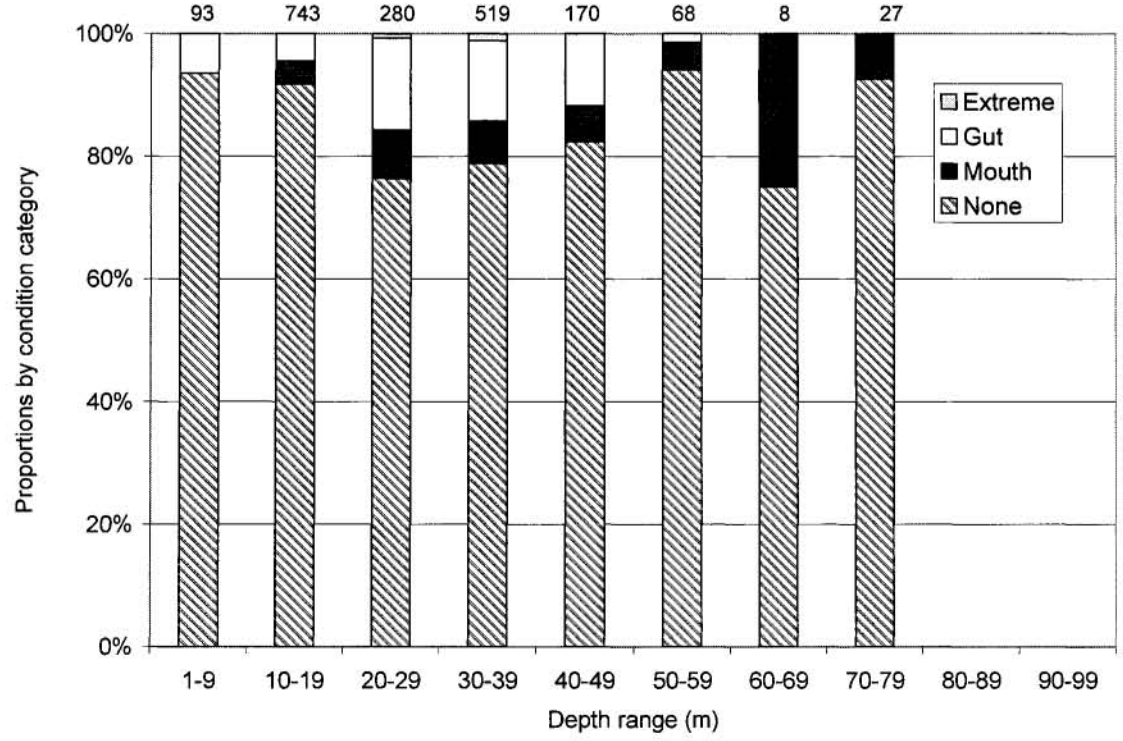


Figure 21: Barotrauma injury by depth for snapper released from charter vessels 2006–07 (proportions within each depth range, sample size at the top of each column).

Appendix 1: Combined measuring and recording sheet used by recreational fishers to self measure their snapper catch in 2006–07.

SNAPPER DATA SHEET

Instructions:

1 Please fill in all information on this form, complete records are very important
2 Fill in "TRIP DATA" section to the right
3 Measure every snapper you catch before releasing them or putting in chilly bin
4 Put nose of snapper at left end of board, spread the tail, note length at fork in tail, write length in centimeters (round length down to whole cm)
5 Write fishing depth, tick boxes for fish status, fish condition, hook location, hook type
6 Return databoard to interviewer or place databoard in drop box at boat ramp

TRIP DATA

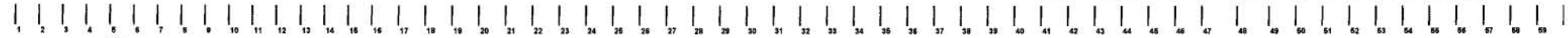
Date _____

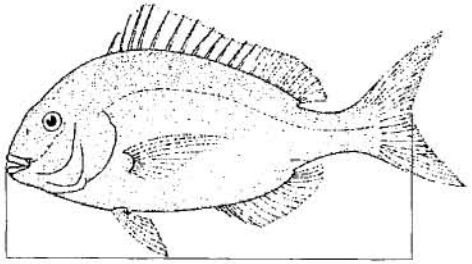
Fishing Location _____

Boat Name _____

Start Time _____ Finish Time _____

SNAPPER INFORMATION			Status		Fish Condition			Hook Loc.			Hook Type		
Fish #	Length (cm)	Depth (meters)	Kept	Released	Swam away		Floated Sank	Lip	Deep	External	J-Hook	Circle Hook	Other
NA	25	31		X			X		X		X		
1													
2													
3													
4													
5													
6													
7													
8													
9													





Measure this length

BLUE WATER MARINE RESEARCH LTD
THANKS YOU FOR PARTICIPATING IN THIS RESEARCH TO HELP BETTER UNDERSTAND RECREATIONAL SNAPPER FISHERIES!

Blue Water Marine Research
PO Box 402081
Tutukaka
09 434 3383 or 021 593 001

SNAPPER INFORMATION			Status		Fish Condition			Hook Loc.			Hook Type		
Fish #	Length (cm)	Depth (meters)	Kept	Released	Swam away		Floated Sank	Lip	Deep	External	J-Hook	Circle Hook	Other
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													

Appendix 2: Data form used by observers on charter vessels in 2006–07.

TRIP DATA **Observer name** _____

Date	Start Time	Finish Time	Page ..... of .....
Boat Name		Length of Boat in metres	
Session (trip) number		Location Code	Cloud Cover %
Location number			
Location name		Wind Strength	Wind Direction
Hours fished			
Number of people fishing		Hook Size eg.	Condition eg. Swam Bleeding SB /
Number SNA not measured		3 4 5 6 7 8	Floated no bleed FN / Dying D
Hk Loc Code: Lip L /Deep D /External E.		Gut Out Code: None 0 / Mouth 1 / Anus 2 / 3 Extreme.	

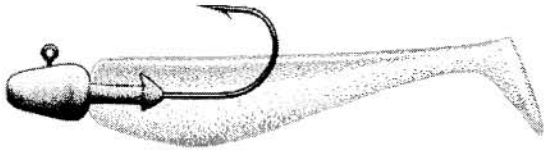
Fish #	Fish lgth (cm)	Water dpth (m)	Hk loc L/ D / E	Kpt Rel K / R	Hook J/C/K	Hook Size	Gut Out 0/ 1/ 2/ 3	Fish Condition SN, SB, FN, FB, D	
NA	27	31	D	R	J	5	1	FN	
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									

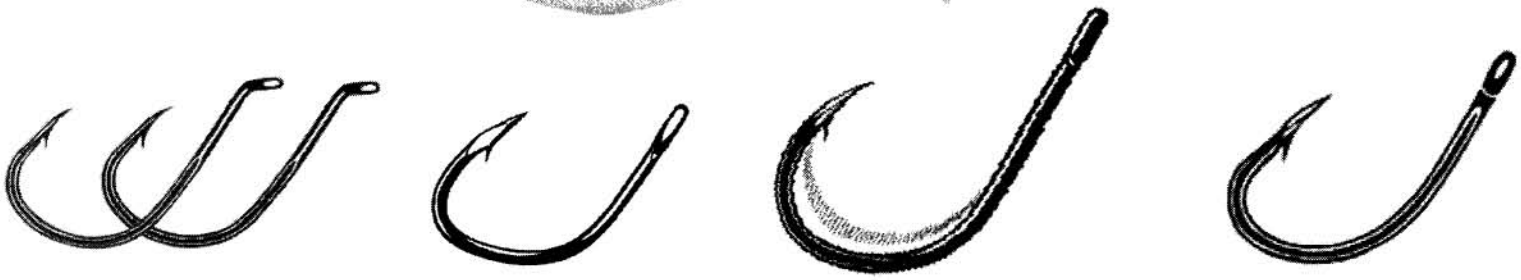
Appendix 3: Hook type sheet used by interviewers and observers

Circle Hooks

Kahle Hooks

J Hooks





Appendix 4: Snapper proportion at length from recreational catch by region and self measured lengths by fishers on trailer boats or observers on charter boats

	Bay of Plenty Fisher n=1607	Bay of Plenty Observer n=745	Hauraki Gulf Fisher n=3889	Hauraki Gulf Observer n=1840	East Northland Fisher n=720	East Northland Observer n=648
<10	0.0037	0.0000	0.0008	0.0000	0.0000	0.0000
10	0.0006	0.0000	0.0049	0.0005	0.0014	0.0000
11	0.0000	0.0000	0.0010	0.0005	0.0000	0.0000
12	0.0037	0.0000	0.0046	0.0027	0.0028	0.0000
13	0.0006	0.0013	0.0028	0.0011	0.0000	0.0000
14	0.0037	0.0013	0.0039	0.0043	0.0000	0.0015
15	0.0081	0.0027	0.0136	0.0060	0.0069	0.0000
16	0.0068	0.0067	0.0085	0.0087	0.0056	0.0015
17	0.0106	0.0107	0.0100	0.0245	0.0028	0.0015
18	0.0199	0.0282	0.0211	0.0196	0.0125	0.0077
19	0.0162	0.0268	0.0144	0.0304	0.0069	0.0046
20	0.0516	0.0349	0.0543	0.0418	0.0250	0.0093
21	0.0311	0.0430	0.0309	0.0543	0.0333	0.0262
22	0.0535	0.0617	0.0458	0.0587	0.0417	0.0478
23	0.0485	0.0523	0.0401	0.0598	0.0431	0.0478
24	0.0722	0.0792	0.0522	0.0658	0.0542	0.0710
25	0.0809	0.0752	0.0586	0.0603	0.0764	0.0802
26	0.1002	0.1114	0.0622	0.0652	0.0819	0.0957
27	0.0709	0.0980	0.0501	0.0516	0.0889	0.1034
28	0.0977	0.1128	0.0540	0.0576	0.0764	0.1204
29	0.0492	0.0577	0.0458	0.0473	0.0639	0.0602
30	0.0685	0.0537	0.0792	0.0495	0.0583	0.0478
31	0.0336	0.0362	0.0409	0.0397	0.0417	0.0386
32	0.0411	0.0389	0.0535	0.0326	0.0319	0.0370
33	0.0199	0.0121	0.0301	0.0359	0.0264	0.0231
34	0.0199	0.0201	0.0365	0.0283	0.0347	0.0201
35	0.0149	0.0134	0.0249	0.0212	0.0153	0.0170
36	0.0124	0.0067	0.0267	0.0207	0.0167	0.0278
37	0.0068	0.0027	0.0165	0.0185	0.0083	0.0077
38	0.0124	0.0027	0.0188	0.0152	0.0153	0.0231
39	0.0050	0.0027	0.0098	0.0109	0.0083	0.0046
40	0.0118	0.0013	0.0213	0.0109	0.0069	0.0031
41	0.0025	0.0000	0.0064	0.0120	0.0083	0.0000
42	0.0056	0.0000	0.0087	0.0103	0.0083	0.0108
43	0.0019	0.0000	0.0062	0.0065	0.0028	0.0046
44	0.0025	0.0000	0.0059	0.0043	0.0097	0.0031
45	0.0025	0.0000	0.0051	0.0016	0.0083	0.0015
46	0.0012	0.0027	0.0044	0.0071	0.0153	0.0077
47	0.0006	0.0000	0.0023	0.0016	0.0014	0.0062
48	0.0012	0.0000	0.0026	0.0022	0.0028	0.0046
49	0.0006	0.0000	0.0008	0.0005	0.0056	0.0015
50	0.0000	0.0000	0.0039	0.0016	0.0083	0.0000
51	0.0012	0.0013	0.0010	0.0033	0.0056	0.0015
52	0.0000	0.0013	0.0018	0.0005	0.0000	0.0000
53	0.0006	0.0000	0.0018	0.0005	0.0028	0.0015
54	0.0006	0.0000	0.0013	0.0005	0.0028	0.0093
55	0.0000	0.0000	0.0013	0.0000	0.0014	0.0000
56	0.0000	0.0000	0.0015	0.0011	0.0014	0.0000
57	0.0000	0.0000	0.0008	0.0000	0.0028	0.0015
58	0.0000	0.0000	0.0010	0.0000	0.0028	0.0000
59	0.0000	0.0000	0.0013	0.0000	0.0014	0.0031
60+	0.0025	0.0000	0.0041	0.0022	0.0208	0.0139