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EXECUTIVE SUMMARY

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This report gives results of Ministry of Fisheries' research projects REC2003/02 and SNA2005/04. Both projects aimed to collect data on the size and release condition of snapper (*Pagrus auratus*) caught and released by recreational fishers in SNA 1. Recreational snapper length and other data were collected from the boat-based hook and line fishery by observers on recreational charter vessels and by recruiting recreational fishers leaving boat ramps to measure their own catch. This included data on the size of all fish caught and the observed condition of snapper returned to the sea. Boat ramp interviewers also remeasured some of the kept snapper of returning fishers.

Length frequencies collected by observers and fisher self-measured snapper are very similar within each region (Bay of Plenty, Hauraki Gulf and east Northland). There is evidence of some inaccuracies in the fisher supplied length data but overall the length frequency of kept fish measured at sea by fishers is very similar to fish remeasured at the boat ramp.

More than 19 000 recreationally caught snapper were measured at sea throughout SNA 1 in 2004–05 and 2005–06. The results for both years show regional and annual differences in recreational snapper length frequency. Released snapper comprised 58% of the total snapper catch sampled in 2004–05 and 59% in 2005–06. 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 probably reflects the large number of young fish in the SNA 1 snapper population. Strong year classes from 1999 and 2001 are seen in the commercial catch.

The mean weighted c.v.s derived from bootstrap estimates in each SNA 1 region ranged from 0.11 to 0.15 in 2005–06, which was an improvement over the c.v.s of 0.16 to 0.22 achieved in the 2004–05 pilot survey which had a smaller sample size.

Data on fish condition, hook type, hook size, where the fish was hooked, and water depth were also collected. Of the nearly 10 000 snapper released from charter and private vessels over the two sampling years, 95% were reported as swimming away with 5% either floating (3%) or dying (2%).

Data from the 2005–06 spring–summer commercial longline catch sampling programme was compared with recreational proportions at length for fish 28cm or larger. The selectivity of both methods seems quite similar for medium sized fish (31–36 cm) with fewer large fish taken by recreational fishers in Bay of Plenty and Hauraki Gulf. In east Northland a higher proportion of snapper over 36 cm are taken by recreational fishers than by longline. Results from 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 2005–06, 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 273 000 and 560 000 snapper in addition to the fish that were kept by recreational fishers. The additional mortality by weight is 87–182 t which is 3.6% to 7.5% 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

Regional and national marine recreational fishing surveys conducted since the early 1990s indicate that the SNA 1 stock supports the largest recreational fishery in New Zealand, both in numbers of participants and numbers of fish harvested. The SNA 1 fishery, located between North Cape and Cape Runaway, is one of the few New Zealand fisheries where the recreational harvest is a significant proportion of total fishing mortality.

Management of the recreational snapper fishery in SNA 1 has included both a minimum legal size (MLS) and daily bag limits since the 1980s. In June 1984 a bag limit of 50 finfish of all species combined (including snapper) was introduced for recreational fishers in the Hauraki Gulf controlled fishery. On 1 January 1985 a daily bag limit of 30 snapper per person and a MLS of 25 cm were introduced nationwide. In SNA 1 the daily bag limit was reduced to 20 in 1993. In 1994, the daily bag limit was further reduced to 15 fish per person and the MLS increased to 27 cm for recreational fishers. In October 1995 a reduced daily bag limit of 9 snapper was introduced for SNA 1 as part of the Minister of Fisheries implementing further sustainability measures for the overall fishery in SNA 1 (Ministry of fisheries Science Group 2006).

Minimum legal size (MLS) is one of the management tools used to try to improve the yield-per-recruit in a fishery. However, if there is significant discard mortality, the effect of a larger MLS may be detrimental to the stock rather than beneficial. In combination with MLS, a daily bag limit may also result in the high-grading of legal catch, adding further discard mortality. A recent review of amateur fishing regulations determined that legal sized fish may be returned to the water and do not count against the daily bag limit.

No research to study the impact of MLS regulations or bag limit regulations on the number of discards or discard mortality in the recreational snapper fishery accompanied the introduction of MLS or bag limit management measures when they were introduced. A pilot study to investigate the survival rate of recreationally caught and released snapper was conducted in 1995 by NIWA (McKenzie & Holdsworth 1997). A total of 216 fish between 17 and 33 cm were tagged and held in a net at Moturekareka Island in the Hauraki Gulf for 15 days. These snapper were caught in water depths between 14 and 20 m and the assumption was made that no additional mortality was induced by the holding net or tagging. The mortality of "lip hooked" fish which had the hook removed immediately was in the order of 5–10%. It was also estimated from the 41 "gut hooked" fish caught that mortality of these fish was 75–90% (McKenzie & Holdsworth 1997).

The 1995 mortality experiment also included two fish handling treatments. In the first treatment, fishers were told to handle the fish normally as if they were going to release it. In the second treatment fishers were given a list of instructions on how to handle the fish with care. The level of instruction given to fishers did not have a significant effect on the observed mortality (McKenzie & Holdsworth 1997). Effects that have been found to contribute to angler release mortality in other studies include: depth of capture; location of hook; type of hook; handling practices; fight time; fish size; angler experience; and water temperature (Muoneke & Childress 1994).

This report provides part of the reporting requirements of Ministry of Fisheries research contract SNA2005/04. It gives results of the size frequency of the recreational SNA 1 catch (both kept and released fish) and the size and condition of released snapper from field sampling in 2004–05 (Ministry of Fisheries project REC2003/02, referred to in this report as the 2004–05 survey) and in 2005–06 (Ministry of Fisheries project SNA2005/04, referred to in this report as the 2005–06 survey). The size frequency data from the 2005–06 survey are plotted against commercial longline data to give an indication of the selectivity of the recreational method for snapper in SNA 1.

The objectives of the two projects were broadly similar and are set out below.

REC2003/02

Overall objective

1. To determine the selectivity of recreational fisheries within specific fisheries.

Specific objective

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

SNA2005/04

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 methods

The 2004–05 survey was a pilot survey used to develop and test the efficacy of developing a sampling programme for determining the selectivity of the recreational snapper fishery. Data were collected over the peak fishing months, December to April. Within each region, two primary sampling approaches were adopted. The first method used boat ramp interviewers to recruit recreational fishers to measure their own snapper catch (both kept and released snapper) at sea and to provide data on fish condition. Fishers were re-interviewed and data sheets collected from them on their return to the boat ramp later in the day. The second method used observer staff deployed on recreational charter fishing vessels to measure snapper caught by fishers at sea and to collect data on factors that may affect the condition of released snapper such as water depth and hook location.

In 2004–05, a small number of 'frequent fishers' were also recruited from other sources to measure their own recreational snapper catch at sea over the course of several months. It was believed that recruiting frequent fishers might provide a more efficient way to collected data than daily recruitment at boat ramps. The data collected from frequent fishers were the same as those collected by recreational fishers recruited daily at boat ramps.

After a trial period and a review of the proposed methodology by the Ministry of Fisheries in early summer 2004, it was determined that half of the data within each region should be collected using observers on charter vessels and half using ramp interviews and frequent fishers. There were specific reasons for adopting two sampling methods. One was that there were a limited number of charter vessels in each region from which to sample. A second was an apprehension that the catch taken from charter vessels may not be representative of the overall recreational snapper fishery due to the more limited area of operation of most charter vessels and the small proportion of the total recreational harvest taken from charter vessels. Sampling the catch of recreational fishers directly by recruiting them to measure their own catch provided a higher degree of certainty that a representative sample would be obtained. Most of the recreational snapper harvest is taken by line fishing from private vessels. However, there were concerns about the accuracy of data supplied by fishers recruited to measure their own catch at sea. Released fish needed to be measured at sea. Given the relatively low catch rates in the recreational snapper fishery, it was not deemed either practicable or economic to place observers on recreational fishing vessels to measure fish.

Overall, the adoption of a sampling strategy using two sampling approaches was aimed at obtaining accurate data representative of the entire fishery while addressing the potential shortcomings of each. Data from one sampling approach could be compared to data from the other, allowing an assessment of any variation or inconsistency between them.

2.2 Survey design and sample sizes

Sampling was stratified by region within SNA 1 in order to address possible variation in population structure and recreational selectivity. The regions were defined as east Northland, Hauraki Gulf, and Bay of Plenty (Figure 1) to match the likely structure of the snapper stock assessment model. The 2004–05 survey was conducted between December and April as one temporal stratum. An overall sample size of 4500 snapper measurements was targeted, with 1500 per region, to be collected during the summer and autumn seasons of 2005, half of this number using observers on charter vessels and half using boat ramp sampling or frequent fishers. Boat ramp sampling locations within each region were chosen to provide a geographical spread representative of the fishery. Observer trips on charter vessels were spread across the charter fleet as far as practicable in order to cover trips to different fishing locations.

Following discussion of the 2004–05 pilot survey results with the snapper research planning group and the Ministry of Fisheries, the 2005–06 survey followed a similar but slightly modified design. Sampling was conducted over a full 12 months (four seasons: spring, summer, autumn, winter, commencing 1 October 2005) with sampling by region and season weighted by a proportion of recreational fishing effort. This weighting was based on aerial overflight counts of recreational fishing vessels from 2004–05 provided by NIWA (Bruce Hartill, NIWA, pers comm.). Fisher data forms were also simplified to improve accuracy and participation. Within each region and season the numbers of sampling sessions were apportioned equally between observer trips on charter boats and boat ramp interview sessions.

2.3 Data 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 combined data sheet and measuring scale printed on waterproof paper which was mounted on a backing board (Appendix 1). At the same time, fishers were shown how to measure snapper correctly and how to record the data. The datasheet 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 scale was in whole centimetres up to 59 cm for the snapper to be measured and recorded directly on the board (Appendix 1). Fishers were asked to enter data for each fish, including length rounded down to whole centimetres, fishing depth in metres, hook location, whether it 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 and conducted a follow up interview, asking for details of hook type used and verified the fishing location. When time allowed, the interviewer asked to remeasure any snapper retained on the boat. 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.

In 2004–05 a small number of frequent fishers were recruited through other sources to record information on snapper they caught on multiple fishing trips using an identical datasheet and

measuring board provided to fishers recruited at boat ramps. The data from the small subset of frequent fishers were combined with boat ramp collected data.

Sampling on charter vessels was undertaken by observer staff who recorded data from snapper caught by fishers on chartered boats. 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, and fish condition, and if the fish swam or floated if released for each fish. Interviewers at boat ramps also collected hook size and style information, 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 style 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 re-sampled catch by group within each region. A group is 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 28cm and above (Gilbert et al. 2000). For this project, data from the 2005–06 spring–summer commercial longline catch sampling programme in SNA 1 (Jeremy McKenzie, NIWA, pers comm.) was used as an approximation of the population length distribution for comparison with recreational landed catch. 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 (25 cm) and recreational caught fish (27 cm) 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 only the condition factors and length frequencies recorded by fishers in each region because charter boat catch makes 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 2005–06. Within each region the snapper length-weight regression (Paul 1976) and the proportion at length of kept fish from 2005–06 was used to derive the mean weight of kept fish. The assumed harvest estimate in kilograms for 2005–06 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 2005–06.

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 over four capture–depth ranges. These mortalities and the proportion of undamaged fish released within each depth range within each SNA 1 region were used to produce a number and weight estimate of released snapper possibly dying from barotrauma.

3. RESULTS

3.1 Sampling

A total of 5409 snapper lengths were recorded at sea from recreationally caught fish from December 2004 to May 2005 from locations within east Northland, Hauraki Gulf, and Bay of Plenty (Table 1): Table 2 gives a key to location and charter vessel codes in Table 1. Table 3 gives the number of people sampled and the number of fish measured in each season and region in 2005–06, with slightly over 3500 people sampled, generating an average of between three and four snapper measurements each.

Following a review of initial pilot sampling in December 2004 and January 2005, the Ministry of Fisheries gave approval for the 2004–05 survey. Full sampling commenced in February 2005 with the peak of data collected in March (Figure 2). Some sampling continued into April and a few frequent fishers reported catch in May. In 2005–06, with sampling extending over four seasons and a full 12 months, 13 750 snapper lengths were obtained (Table 1) from the three regions in SNA 1. The peak number of snapper lengths collected in the 2005–06 survey also occurred in March (Figure 2).

It proved more difficult to place observers and get consistent sample sizes from charter trips than expected with just 41% of all 2004–05 and 38% of 2005–06 snapper lengths coming from observers on charter vessels. This problem occurred in all areas, but especially in Northland where only about a quarter of snapper lengths were obtained from charter vessels in 2005–06.

3.2 Recreational snapper length distributions

The length distributions of recreationally caught snapper measured in each of the three regions in 2004–05 and 2005–06 are shown in Figures 3–8. The data collected by observers on charter boats and self measured fish by fishers recruited at boat ramps are plotted separately. As measuring boards issued to recreational fishers were only 59 cm long, snapper above that length are shown as 58+. Except for the Bay of Plenty in 2005–06, the proportions at length for self-measured snapper and observer measured snapper are much the same within regions in both years.

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. Therefore, we have plotted the length frequencies and cumulative length frequencies for self measured and remeasured snapper (Figures 9–11). These show only a small difference between the two sets of measurements overall and in each region. Recreational fishers tended to measure fish slightly longer on average than boat ramp interviewers. The estimated mean difference between fisher self-measured snapper at sea and snapper remeasured by staff at the boat ramp in 2004–05 was +0.623 cm (Holdsworth et al. 2006).

3.4 Regional length frequencies

The length frequencies of all snapper measured in each of the three SNA 1 regions in 2004–05 and 2005–06 are shown in Figures 12 and 13: Figure 14 shows the cumulative length frequencies of snapper measured in 2005–06. There are clear regional differences in length frequency within and between years. In 2004–05, the plot of snapper length distributions shows a strong mode of 26 cm fish in east Northland. There is a similar distribution of lengths in the Bay of Plenty although the Bay of Plenty mode is not as strong and is shifted slightly to the right. There is a much wider distribution of snapper lengths with no clear modal length in the Hauraki Gulf (Figure 12). Hauraki Gulf shows a secondary mode of small snapper less than 20 cm.

In 2005–06, the modes are not as peaked overall (Figure 13), with Bay of Plenty showing a modal length around 22–26 cm while Hauraki Gulf and Northland show a modal length about 26–28 cm. More small fish below 20 cm are present in Bay of Plenty and Hauraki Gulf than in Northland in 2005–06, with Hauraki Gulf again showing a secondary mode of small snapper less than 20 cm (Figure 13). The cumulative length frequencies presented in Figures 14 and 15 illustrate more clearly the annual and regional differences in recreational snapper catch length distributions.

3.5 Length frequency of kept and released snapper

The length frequencies of kept and released snapper in 2004–05 and 2005–06 are shown in Figures 16 and 17. The length distributions are very similar for both self measured and observer data. There is a small amount of overlap of released and kept snapper. Most snapper less than 28 cm were released while most snapper 29 cm or more were kept. Very few kept fish were recorded measuring less than the MLS of 27 cm. In total, recreational fishers released 66% of their catch in Northland, 57% in Bay of Plenty, and 51% in the Hauraki Gulf over the survey period in 2004–05. Despite the charter vessel catch having a similar size distribution to private vessels, fishers on charter trips tended to release a slightly higher proportion of their catch.

In the 2005–06 survey recreational fishers (boat ramp and charter) released 59% of their catch in Northland, 66% in the Bay of Plenty, and 54% in the Hauraki Gulf (Appendix 3). The large number of small snapper (20 to 26 cm) caught in a few charter trips in the Bay of Plenty in March and April 2006 tend to skew the plots of proportion at length to the left for that region in a number of the figures (see Figures 4, 13, 14, 17 and 19). Two of these trips recorded 310 and 288 snapper with a strong mode at 22 cm.

The combined kept and released snapper length frequencies are plotted separately by region for 2004–05 and 2005–06 in Figures 18 and 19 respectively, together with c.v.s. The mean weighted c.v.s derived from bootstrap estimates were 0.22 for Bay of Plenty, 0.20 for the Hauraki Gulf, and 0.16 for east Northland in 2004–05. Over twice as many snapper lengths

were collected in 2005–06 with mean weighted c.v.s of 0.13 for Bay of Plenty, 0.11 for the Hauraki Gulf, and 0.15 for east Northland. The coefficient of variation for both years indicate survey precision is at acceptable levels.

The selectivity of the recreational line fishing method from boats can not be directly estimated from the data available at this time. The best we can do is to infer the shape of the curve relative to a reasonably well understood selectivity curve, from commercial longline, in the same fishing year. Landed longline catch is randomly sampled for length and age each year in SNA 1. The proportion at length of snapper landed in this fishery (over 27 cm) from spring and summer 2005–06 was compared to the proportion a length distribution of snapper kept by recreational fishers (over 27 cm) (Figure 20). The selectivity of both methods seems quite similar for medium sized fish (31–36 cm), with fewer large fish taken by recreational fishers in Bay of Plenty and Hauraki Gulf. In east Northland a higher proportion of larger fish (over 36 cm) are taken by recreational fishers than by longline. Comparisons between regions are shown as the smoothed proportions at length of recreational kept snapper over 27 in Figure 21.

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. Snapper condition comments reported by fishers were not always consistent and could not always be standardised with condition categories or comments used by observers.

Overall in both surveys of the 9746 released snapper where comments were recorded 95% were reported as swimming away and 5% were reported as either floating (3%) or dying (2%). No condition information was provided for 1163 (10.7%) of all released snapper. Figures 22 and 23 show the condition of released snapper by length from the 2004–05 and 2005–06 surveys.

In 2004–05 a total of 58% (3117) of the snapper for which length and condition data were collected in this study were released by fishers. Of the 2735 released snapper where comments were recorded, 2628 (96%) were reported as swimming away and 4% were reported as either floating (3%) or dying (1%). No condition information was provided for 382 (12.2%) of all released snapper.

The condition of released snapper recorded by fishers and observers in 2005–06 is shown in Figure 24. Condition categories reported by fishers and observers are different, with observers providing more detailed observations. For example, the condition information provided by observers indicates that of the snapper that swam away, 6.6% were bleeding and may be less likely to survive. Of the fish that floated, 7.2% were recorded as bleeding. The proportion of fish that floated on release is influenced by the water depth being fished and handling, while the proportion recorded as bleeding will be influenced by hook location. Overall, the condition information provided by fishers and observers is consistent in spite of the use of different categories for recording this information.

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 25. J-hooks were the predominant hook type used with very few Kahle hooks. In both 2004–05 and 2005–06 a high proportion of fish were lip hooked with all three types of hooks used, although a much smaller proportion of fish were hooked externally or deep hooked using circle hooks than J or Kahle hooks. 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. In the 2005–06 survey J hooks caught 90% of snapper by the lip, 6% externally (foul hooked), and 4% deep.

A wide range of hook sizes from 1/o to 10/o were used by recreational fishers. The numbers of released snapper caught by hook size and hook location recorded by observers on charter vessels for 2005–06 is shown in Figure 26. Most hooks used fell into the size range 4/o to 6/o. A higher proportion of fish caught on 5/o and 6/o hooks were deep hooked than with most other hook sizes.

3.8 Capture depth and snapper condition

There were distinct differences in the snapper capture depths recorded by private vessels (Figure 27) and observers on charter vessels (Figure 28) in 2005–06. Overall, snapper were caught in much shallower waters from private vessels compared to the capture depths recorded by observers on charter vessels. 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 70 m or more.

The condition of released snapper by depth recorded by observers on charter vessels in 2004–05 is plotted in Figure 29 and for 2005–06 in Figure 30. Most fish were caught in water between 10 and 49 m deep. In 2004–05 there was an increase in the proportion of dying fish recorded from deeper water and more fish floated in medium depths of 30–49 m. In 2005–06 the occurrence of dying and floating fish was more evenly spread over a greater range of depths. Snapper barotrauma injuries recorded for released snapper by observers on charter vessels are shown in Figure 31. Barotrauma injuries occurred at all capture depths of 10 m or more, with these injuries apparent in the greatest proportion of snapper caught between 20–49 m depth. Extreme barotraumas were highest at capture depths of 50 m or more. In 2004–05 79% indicated no visible barotrauma, 14% had the stomach everted in the mouth, 5.3 % had ruptured at the anus, and 1.7% were recorded as extreme. In 2005–06, 78% indicated no visible barotrauma, 8% had the stomach everted in the mouth, 12% had ruptured at the anus, and 2% were recorded as extreme.

3.9 Combinations of snapper condition factors

From the detailed data collected by observers on charter boats in 2005–06 most snapper (69.4%) released were lip hooked, showed no outward signs of damage, and swam away (Table 4). A further 16.1% were lip hooked and showed some signs of barotrauma but were able to swim back down. Some lip hooked fish (4.2%) were recorded as swimming away bleeding either with or without barotrauma. The hook damage on externally hooked fish varied from quite minor puncture wounds to damage to the eye or cuts on the body. A further 3.9% 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 6.5% of those observed (Table 4). These proportions come from the 2005–06 observer data only because the condition factors were more reliably and consistently recorded by trained observers.

3.10 Estimated total mortality

Estimates of the fishery wide release mortality can be made based on 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 2005–06; that the snapper length weight regression derived by Paul (1976) applies to recreationally caught snapper in 2005–06; 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 reported on capture depth mortality for snapper reported by Stewart (2008) that indicate there is 0% mortality in snapper captured in 8–20 m, 2% mortality in 21–29 m, 39% in 30–44 m, and 55% in 45–60 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 conducted in New Zealand (Gilbert & 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 and the recorded fish condition data and capture depths collected by trailer boat fishers only as this method accounts for 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, but all others do. The estimates of release mortality due to these visible factors at the time of release is highest in the Hauraki Gulf at 11.9% in numbers of fish and 4.1% by weight in 2005–06 (Table 5, top). Scaling this to the 2004–05 harvest estimate gives additional mortality of about 179 000 fish (56 t). Similarly, the additional mortality in the Bay of Plenty was 10% in numbers of fish and 3.6% by weight. Scaled to the harvest estimates would add about 60 000 fish (19 t) to the catch. In east Northland additional mortality was lower, 7.3% in numbers and 2.3% by weight. This equates to about 34 000 fish (13 t). The low mortality estimate for all of SNA 1 totals more than 273 000 fish (10.6%). The additional mortality by weight is 87 t (3.6%) compared to the 2004–05 recreational snapper harvest of 2420 t.

Our high estimate of mortality is based on an assumption of additional unobserved post-release mortality due to internal damage caused by handing or barotrauma. To estimate this we used the proportions of fish captured at depth by region which swam away not bleeding in our survey 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 5, bottom). Most of the snapper caught in the Hauraki Gulf were caught in depths of less than 30 m so capture depth mortality has a lesser impact. The Hauraki Gulf is the largest component of the overall SNA 1 recreational fishery and the snapper release mortality estimate for the Hauraki Gulf using these assumptions is 277 700 fish and 86.2 tonnes (Table 5). Using our assumptions, the high estimate of recreational snapper release mortality for all of SNA 1 in 2005–06 is 182 t (21.7%) over and above the recreational harvest estimate. However, the number of fish involved is large because most released fish are small. There would be about 560 000 snapper mortalities in addition to the estimated number of fish kept (Table 5, bottom).

4. DISCUSSION

The objectives of the snapper selectivity projects in 2004–05 and 2005–06 centred on determining the size and condition of snapper and recreational snapper selectivity in the hook and line recreational SNA 1 fishery. Determining selectivity and condition of the catch required sampling at sea before any discards occurred. Sampling at sea presented some difficulties in obtaining representative and accurate data. Therefore, two sampling approaches were adopted and a pilot study was undertaken at the start of the 2004–05 survey to test the effectiveness of the two approaches. Trained observers were used on charter vessel trips to help ensure accurate data, and fishers were recruited at boat ramps to self-measure their snapper catch to help obtain a more representative sample of the recreational fishery.

Charter vessels tended to focus their fishing efforts on fewer locations than trailer boats and launches and there is some risk in sampling only from charter vessels when this sector takes only a small proportion of the recreational catch. However, more detailed and consistent information on fish condition and hook size was obtained from using trained observers on charter vessels. Comparison of observer with fisher length data allowed an indirect check on the accuracy of fisher measurements by comparing length frequencies. Although it was not possible to directly observe the accuracy of fisher measurements, a further check on their accuracy was possible by having boat ramp interviewers remeasure the kept snapper when fishers returned to boat ramps from some vessels and comparing these with the self measured lengths.

There are some assumptions in these approaches. These include that charter vessels and private fishers were fishing populations with a similar length distribution, using similar fishing gear and techniques, and that there was no shrinkage or expansion of snapper lengths of remeasured snapper between their initial measurement and remeasurement.

Overall, the results from each survey and region consistently show that the length frequencies of snapper caught from private vessels (snapper which fishers had measured themselves) are very similar to the length frequencies of fish measured by trained observers on charter vessels. This is true for both kept and released snapper. The principal exception to this result is a different length frequency for observer and fisher measured snapper in Bay of Plenty in 2005–06. This difference did not occur in 2004–05 and appears to be a result of a few Bay of Plenty charter trips where large numbers of small fish were caught.

Remeasurement data show relatively small differences between fisher and remeasurement lengths. An attempt to generate paired length data from the 2004–05 survey estimated that the mean length of snapper from self-measured catches is about 0.6 cm more than when remeasured by boat ramp interviewers (Holdsworth et al. 2006). Fishers also appeared to prefer recording even lengths. Measurement accuracy probably varied between fishers. Possible sources of error in fisher-measured data include not spreading the tail to find the base of the fork, and not rounding the length down but instead rounding up to the nearest whole centimetre. Both errors would result in overestimates of length. There is also a suggestion that under some conditions fish in rigor after death may not measure as long as when they were fresh. However, the results indicate that while there may be some measurement error by fishers, the error appears to be relatively small.

The results for both years show regional and annual differences in recreational snapper length frequency. As charter and private vessel length frequencies are similar (with the previously noted exception in 2005–06 in the Bay of Plenty), it appears appropriate to combine these data to increase the effective overall sample size in estimating recreational hook and line snapper selectivity. Although there is some overlap in the length frequencies of released and kept snapper, the overlap is small. There were few kept snapper smaller than the 27 cm MLS and few snapper released larger than 30 cm.

Well over half of the recreational snapper catch measured in both years was released (58% in 2004–05 and 59% in 2005–06) and almost all of these were less than the MLS. This demonstrates the impact of the MLS in the recreational fishery and emphasises the importance of attempting to determine any subsequent mortality of released snapper.

The mean weighted c.v.s derived from bootstrap estimates range from 0.11 to 0.22 over the two sampling years and were improved in the second year by the increased sample size used.

The selectivity of the recreational line fishing method for snapper from boats can be generated from these data in the next SNA 1 stock assessment model. For now, it is possible to compare the 2005–06 recreational snapper data to the commercial longline proportions at length from within the same fishing year for fish 28 cm and over. The selectivity of both methods seems quite similar for medium sized fish (31–36 cm) with fewer large fish taken by recreational fishers in Bay of Plenty and Hauraki Gulf. In east Northland a higher proportion of larger fish (over 36 cm) are taken by recreational fishers than by commercial longline. However, the longline sample in 2005–06 from east Northland was not typical as it contained many smaller fish caught mainly in the Bream Bay area. Very few longline landings were sampled from the far north area of Northland which generally produces much larger fish.

As well as recording the condition of released snapper, sample data obtained in the surveys included capture depth, hook type, hook size, and hook site. These data are aimed at creating a database incorporating some of the factors that may affect the survival of released snapper. Some possible trends are evident in this data although the data base is limited in scope to observations that can be made during the short period of handling and release. Observations made by fishers are also less detailed than those by trained observers.

Released snapper less than 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. They are more likely to keep small legal fish that are injured. Deep hooked snapper are more likely to sustain injuries resulting in mortality than when lip hooked (McKenzie & Holdsworth 1997). In a pilot experiment, 216 recreationally snapper caught in 14–20 m of water were tagged by injecting small coded wire tags and placed in a holding net in the Hauraki Gulf in the summer of 1995. Holding time on the tagging vessel was a factor in snapper mortality. A two parameter mixed model was used to regress estimates of mortality relative to hook location against holding time. The mortality proportions for a holding time of zero minutes were 74% for deep hooked fish and 4% for lip hooked fish (McKenzie & Holdsworth 1997).

Hook type and size appeared to affect the condition of released fish. Circle hooks had a greater tendency to hook snapper in the mouth than J-hooks and Kahle hooks. This is consistent with trends observed in other studies (Muoneke & Childress 1994). Observer data showed that 70% of snapper were lip hooked and swam away with no visible signs of damage, while a further 20% of released fish were lip hooked and swam away with signs of barotrauma or bleeding.

The high proportion of small snapper in the recreational catch probably reflects the large number of young 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 is showing up in the commercial catch sampling data (Walsh et al. 2007). The proportion of fish released by recreational fishers may change as this cohort grows. There are indications from the Bay of Plenty and east Northland data that another strong year class is entering the fishery in 2005–06.

Overall, the study showed 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. Although trained observers were able to provide better quality data on fish condition and related information, most recreational fishing takes place from private vessels so that sampling approaches need to include sampling private vessel catches where possible to ensure a representative sample is collected.

Due to the high proportion of the recreational snapper catch that is released there is potential for a large number of fish to die following release by recreational fishers in SNA 1. This mortality is in addition to fish kept. A low estimate of mortality in SNA 1 from observed damage was 10.6% by number and 3.6% 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 was 21.7% by number and 7.5% by weight. By scaling the release data to the 2004–05 aerial overflight SNA 1 harvest estimates we calculate that between 273 000 and 560 000 snapper (87–182 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 very preliminary.

In a simulation study on unaccounted release and escapement mortality Harley et al. (2000) found that the commercial and recreational snapper fishery in the Hauraki Gulf was quite efficient, especially for line fisheries. However, as there was no data available Harley et al. (2000) made assumptions about recreational selectivity, which was domed and steeply ascending between 20 and 25 cm, and assumed mortality of released fish was 25%. The results presented in this report provide 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, discard sizes, and mortality. However, the results from this study provide only limited information on discard mortality. Some immediate post-release mortality was observed but total release mortality requires experiments such as holding released fish for a period to observe any subsequent mortality. The results 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 released snapper which should be built into any such experiments.

It is clear from the 2004–05 and the 2005–06 surveys that recreational fishers catch and release a significant number of small snapper. We suggest that recreational fishers be encouraged to reduce the fishing induced mortality of small fish by using larger hooks and bait, using circle hooks, and moving from locations where small fish are prevalent.

5. ACKNOWLEDGMENTS

This research was undertaken under contract to the Ministry of Fisheries as projects REC2003/02 and SNA2005/04. Thanks to Tim Sippel for survey support and analysis during the 2004–05 survey and Pete Saul for reviewing this paper. Thanks are also due to Francisco Blaha who assisted with the 2004–05 survey. We acknowledge with thanks the assistance of Shelton Harley who provided the methodology for scaling mortality estimates to total catch. 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 are Melanie Blundell, Oliver Kraft, Cate McGrath, Steven Moore, and Wayne Robinson.

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Table 1: Number of snapper measured in 2004–05 and 2005–06 by region, location and method.

		2004–05			2005–06		
Region	Location	Fisher	Observer	Total	Fisher	Observer	Total
Bay of Plenty	MAY	18		18	26	3	29
	KUA		84	84			
	MAK	282	253	535	874	4	878
	MEB		127	127	373	33	406
	MEI		56	56			
	MII	138		138	616	497	1 113
	OPO				3		3
	PAP	271	51	322	663	1 337	2 000
	POR				50		50
	PUK					87	87
	TEP	81		81	378		378
	Blank		19	19	91		91
	BOP total	790	590	1 380	3 074	1 961	5 035
Hauraki Gulf	COL				19		19
	COR		118	118	173	176	349
	FIR	14		14	299	6	305
	LIT		84	84		236	236
	MID	17	7	24	15		15
	MOT	243	551	794	285	1 324	1 609
	NOI	92	13	105	507	449	956
	RAN	488	69	557	597	364	961
	TAM	34		34	508	26	534
	TIR	127		127	209	71	280
	WAI	45		45	87		87
	Blank		140	140	877		877
	Gulf total	1 060	982	2 042	3 576	2 652	6 228
Northland	BLA	20	361	381	173	140	313
	BRE	226		226	94		94
	BRT	5		5			
	CAV					15	15
	HEN	43		43	57		57
	KER				88		88
	MOK	20		20			
	OAK	23	45	68		30	30
	RUS				8		8
	PKI	2	24	26			
	RAW	7		7			
	TAI	290		290	162	54	216
	TAK				371	342	713
	TUT	462	101	563	542	12	554
	WEI	234	85	319	308	52	360
	WGA		39	39			
	Blank				39		39
	NLD total	1 332	655	1 987	1 842	645	2 487
SNA1 Total		3 182	2 227	5 409	8 492	5 258	13 750

Table 2: Key to sample location codes.

Region	Code	Location
Bay of Plenty	KUA	Kuatotuna
	MAK	Matakana Island (Tauranga)
	MAY	Mayor Island
	MEB	Mercury Bay
	MEI	Mercury Islands
	MII	Motiti Islands
	OPO	Opotiki
	PAP	Papamoa Beach
	POR	Port Charles
	PUK	Pukehina Beach
	TEP	Te Puna Inlet (SE half of Tauranga Harbour)
Hauraki Gulf	COL	Cape Colville
	COR	Coromandel Islands (Wilsons Bay North)
	FIR	Firth of Thames
	LIT	Little Barrier
	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
	BRE	Bream Bay
	BRT	Cape Brett (Oke Bay round to Home Point)
	CAV	Cavalli Islands (and adjacent coast)
	HEN	Hen and Chicken Islands
	KER	Kerikeri inlet
	MOK	Mokohinau Islands
	OAK	Oakura (Home Point to Mimiwhangata)
	PKI	Poor Knights Islands
	RAW	Rawhiti Inlet
	TAI	Taiharuru
	TAK	Takau Bay
	TUT	Tutukaka (Mimiwhangata to Motutara Point)
	WEI	Whangarei Harbour
	WGA	Whangaroa Harbour

Table 3: Number of people interviewed and fish measured by season, region, and sample session type in 2005–06.

		Bay of Plenty		Hauraki Gulf		Northland		Total	
Season	Session type	People sampled	Snapper measured	People sampled	Snapper measured	People sampled	Snapper measured	People sampled	Snapper measured
Spring	Boat ramp	295	511	239	612	222	570	756	1 693
	Charter	26	10	80	356	34	295	140	661
Summer	Boat ramp	275	951	538	2 341	278	731	1 091	4 023
	Charter	76	633	142	1 304	52	176	270	2 113
Autumn	Boat ramp	274	952	120	455	163	456	557	1 863
	Charter	63	901	123	789	33	140	219	1 830
Winter	Boat ramp	180	472	90	194	92	195	362	861
	Charter	48	416	62	156	31	66	141	638
Total		1 236	4 846	1 394	6 207	905	2 629	3 535	13 682

Table 4: The percentage of released snapper with combinations of hook location and condition factors recorded by observers on recreational charter vessels in 2005–06 (n=3244).

Hook location	Comment id	None	Mouth	Anus	Extreme	Total
Lip	Swam not bleeding	69.53	5.87	9.46	0.75	85.61
	Swam bleeding	2.44	0.62	0.94	0.16	4.15
	Floated not bleeding	0.50	0.44	0.41	0.03	1.37
	Floated bleeding	0.03				0.03
	Dying or sank	0.34	0.06	0.06	0.28	0.75
Lip Total		72.84	6.99	10.86	1.22	91.91
External	Swam not bleeding	2.53	0.09	0.44	0.03	3.09
	Swam bleeding	1.16	0.09	0.22	0.03	1.50
	Floated not bleeding	0.03				0.03
	Floated bleeding					0.00
	Dying or sank	0.06	0.06		0.06	0.19
External Total		3.78	0.25	0.66	0.12	4.81
Deep	Swam not bleeding	0.69	0.09	0.16	0.06	1.00
	Swam bleeding	0.47	0.06	0.12	0.03	0.69
	Floated not bleeding	0.31	0.16	0.06	0.03	0.56
	Floated bleeding	0.06	0.03		0.03	0.12
	Dying or sank	0.59	0.06	0.09	0.16	0.91
Deep Total		2.12	0.41	0.44	0.31	3.28
Total		78.74	7.65	11.96	1.65	100.00

Table 5: 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 (no. of snapper)	Estimated mortality (t)	% additional mortality numbers of fish	% additional mortality by weight
Bay of Plenty	Visible damage	59 642	18.5	10.0	3.6
Hauraki Gulf	Visible damage	179 418	55.7	11.9	4.1
East Northland	Visible damage	34 083	12.7	7.3	2.3
SNA 1 total	Low estimate of release mortality	273 143	86.9	10.6	3.6
Bay of Plenty	Visible + barotrauma	154 361	48.0	25.8	9.3
Hauraki Gulf	Visible + barotrauma	277 690	86.2	18.4	6.4
East Northland	Visible + barotrauma	127 489	47.4	27.2	8.5
SNA 1 total	High estimate of release mortality	559 541	181.6	21.7	7.5

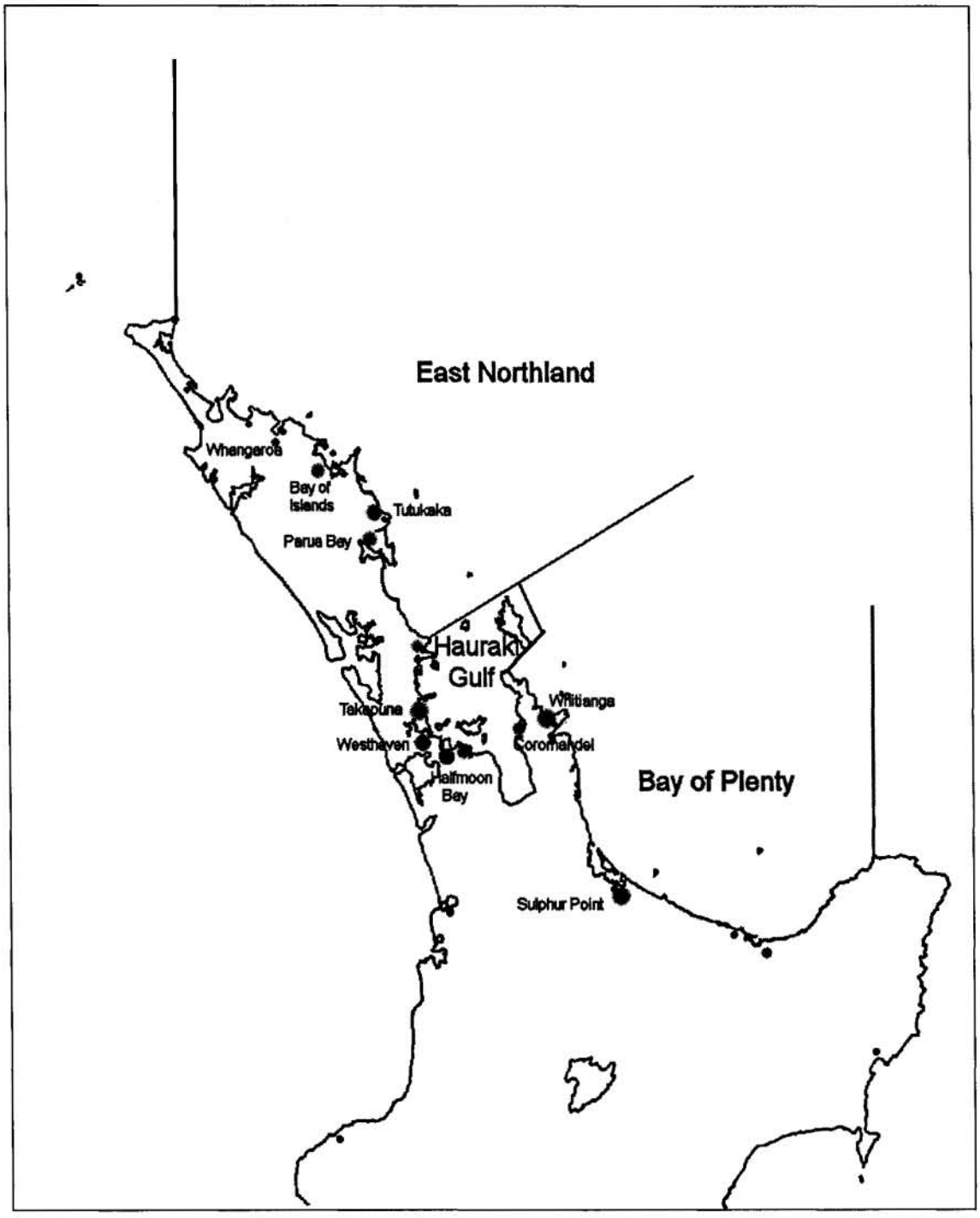


Figure 1: Location of boat ramps and boundaries of regions in SNA 1.

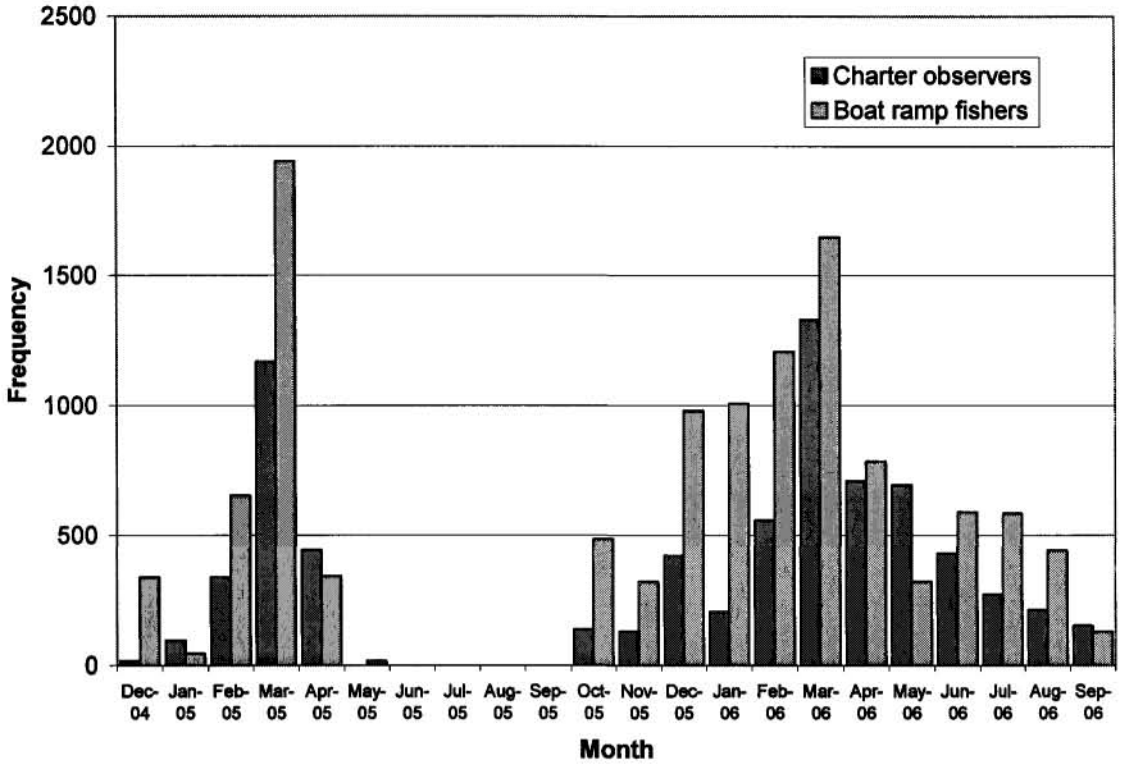


Figure 2: Number of snapper lengths collected by sample type and month in 2004–05 and 2005–06.

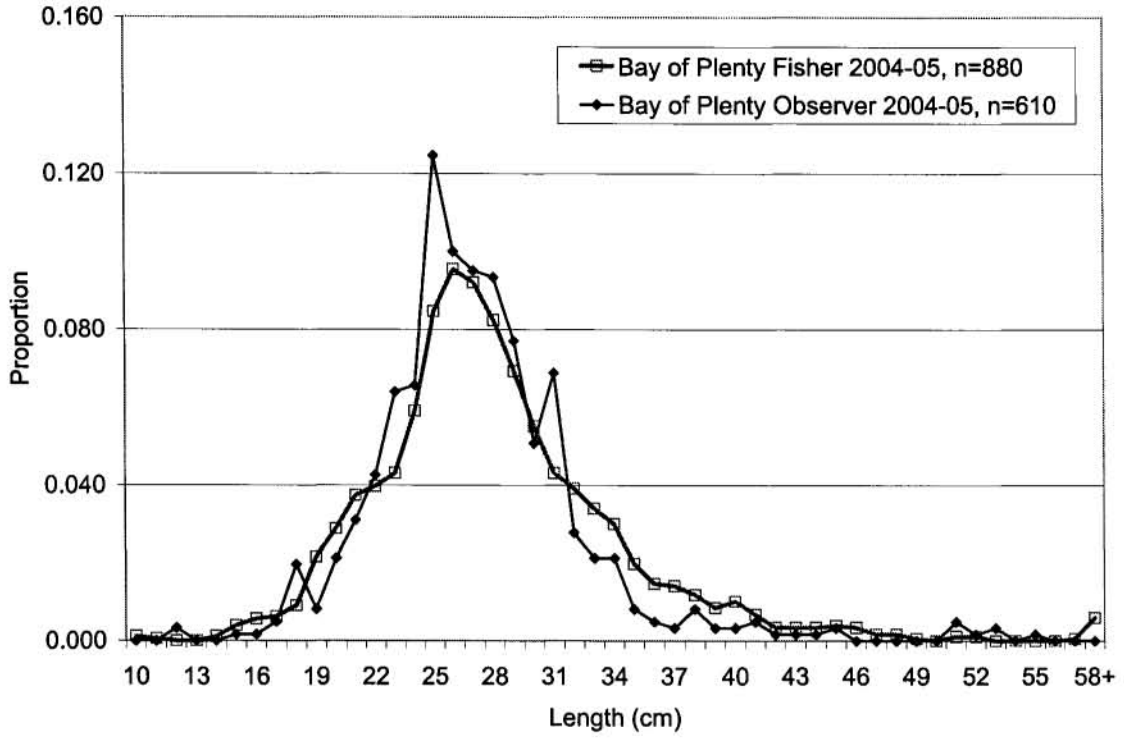


Figure 3: Proportions at length of 2004–05 Bay of Plenty recreational snapper catch at length (kept and released) measured by fishers and by observers.

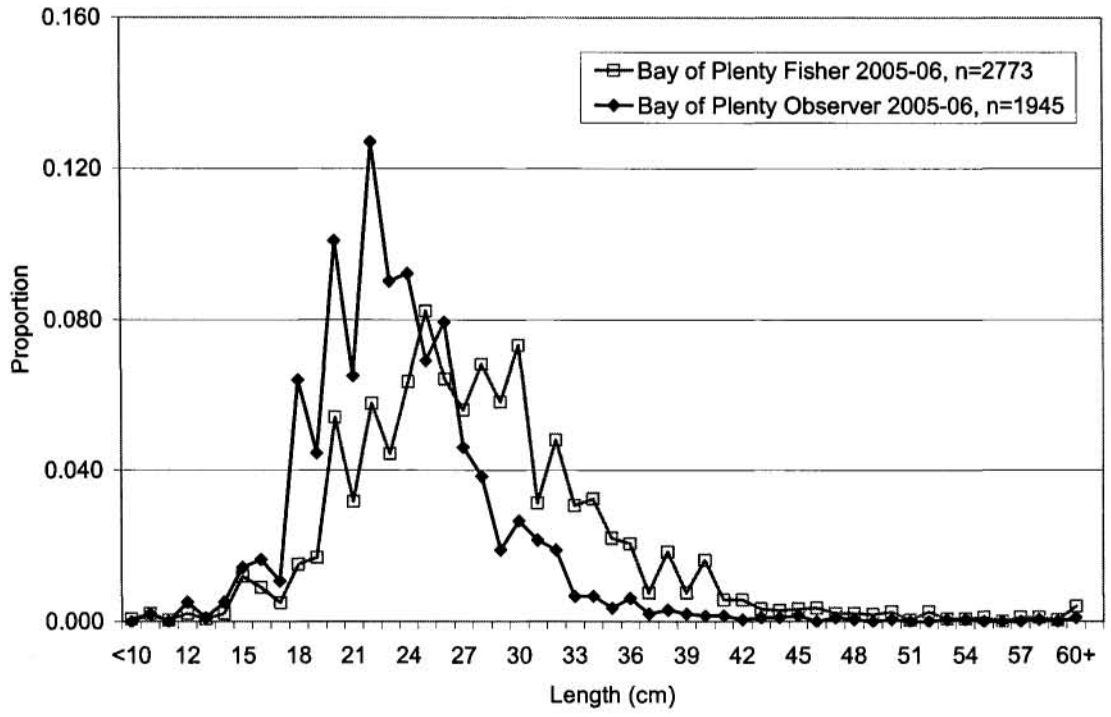


Figure 4: Proportions at length of 2005–06 Bay of Plenty recreational snapper catch at length (kept and released) measured by fishers and by observers.

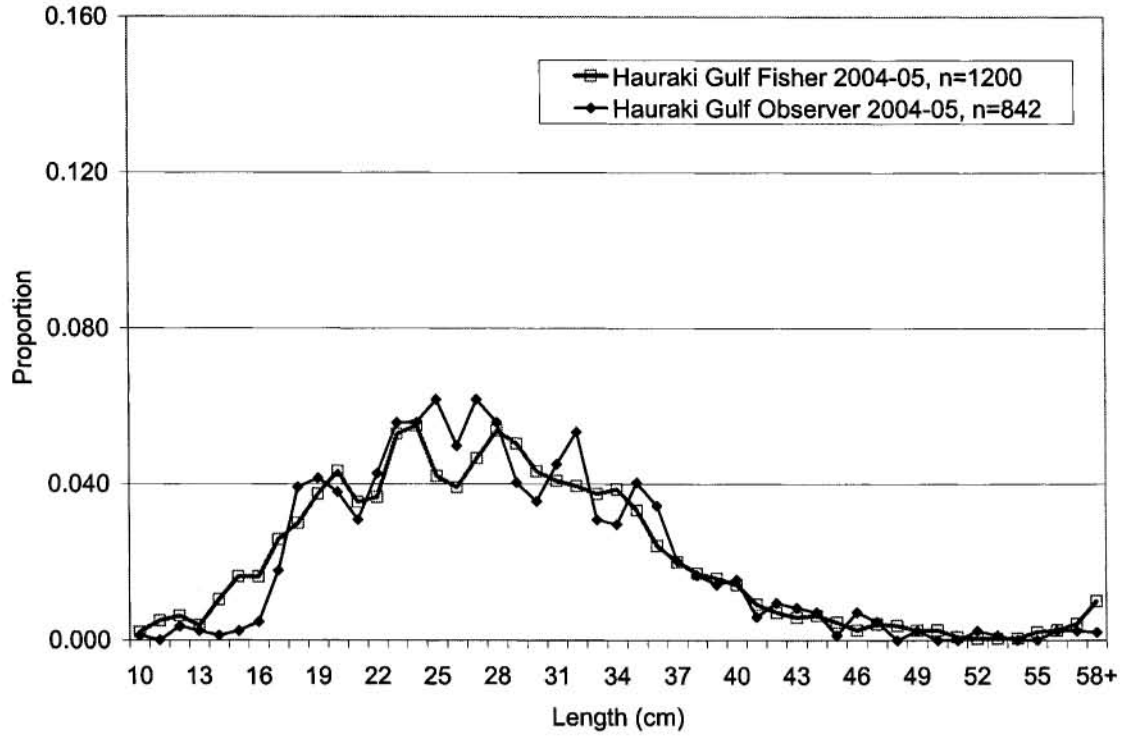


Figure 5: Proportions at length of 2004–05 Hauraki Gulf recreational snapper catch at length (kept and released) measured by fishers and by observers.

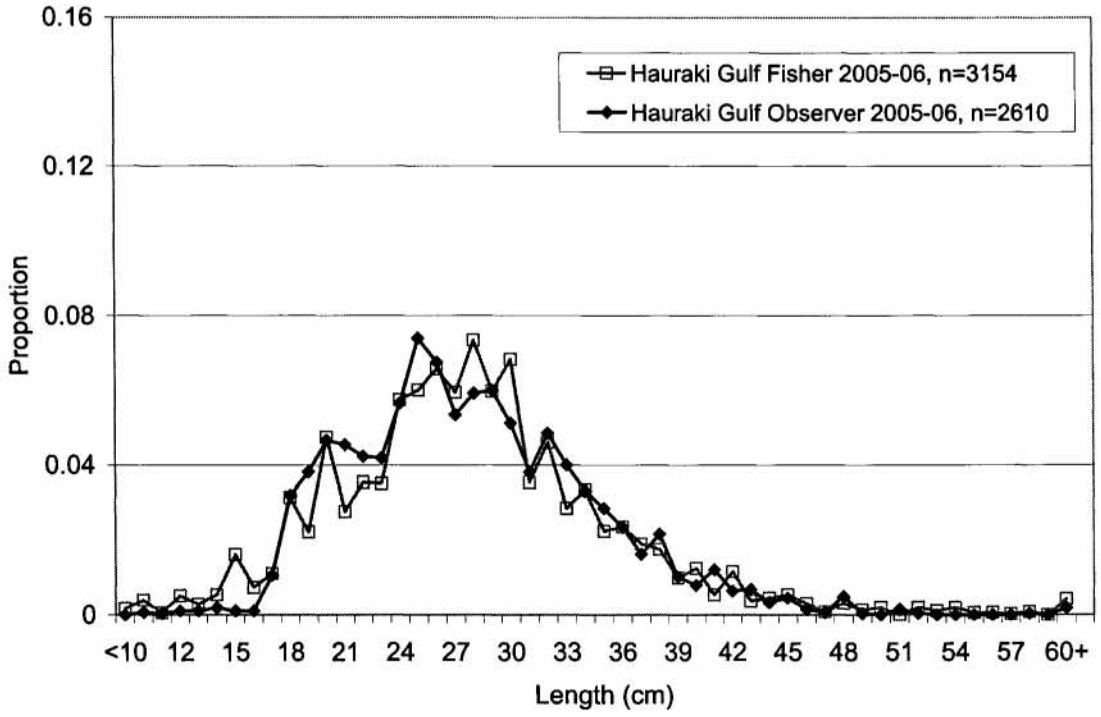


Figure 6: Proportions at length of 2005–06 Hauraki Gulf recreational snapper catch at length (kept and released) measured by fishers and by observers.

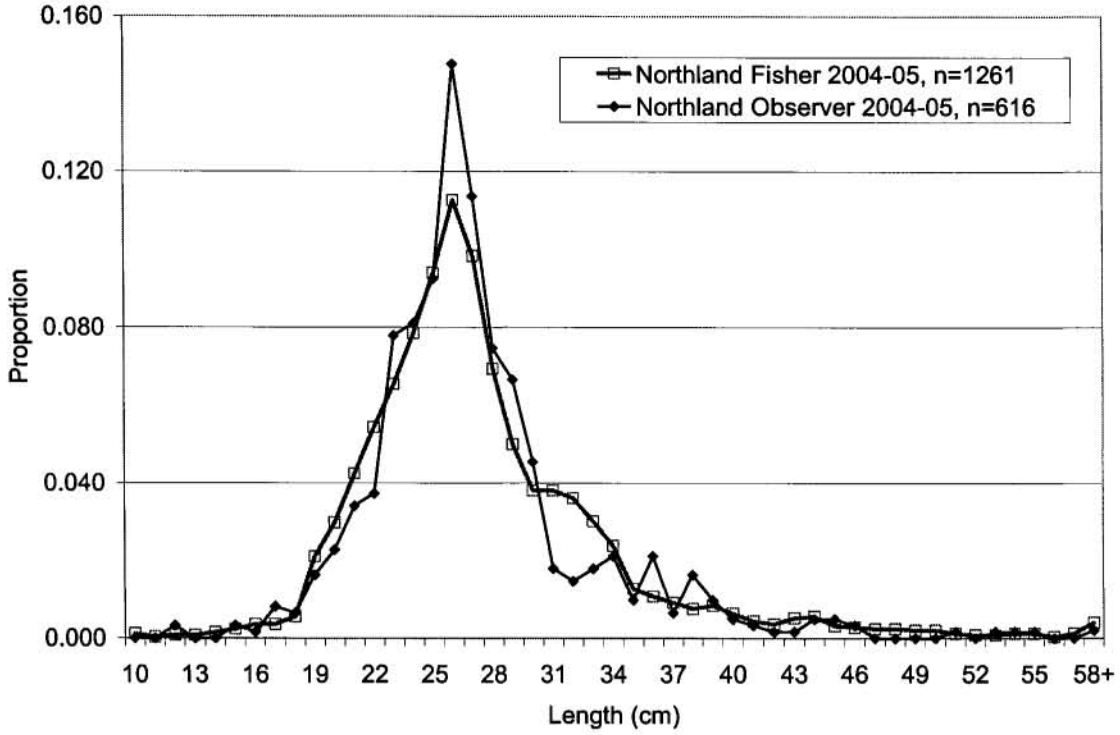


Figure 7: Proportions at length of 2004–05 Northland recreational snapper catch at length (kept and released) measured by fishers and by observers.

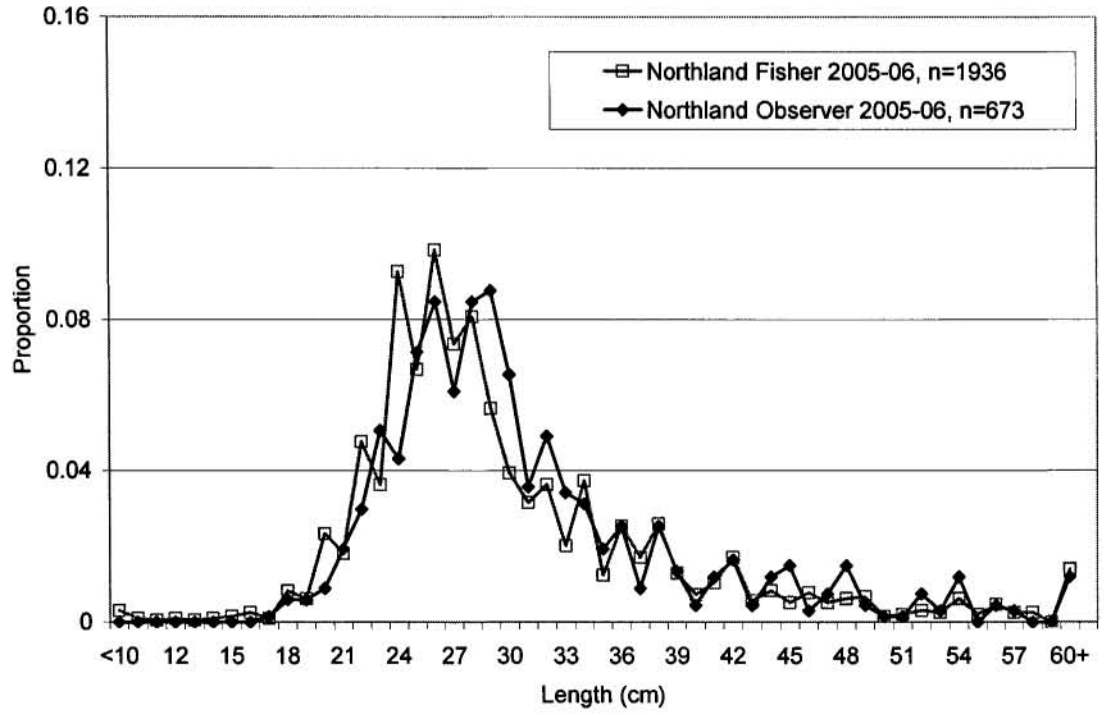


Figure 8: Proportion of 2005–06 Northland recreational snapper catch at length (kept and released) measured by fishers and by observers.

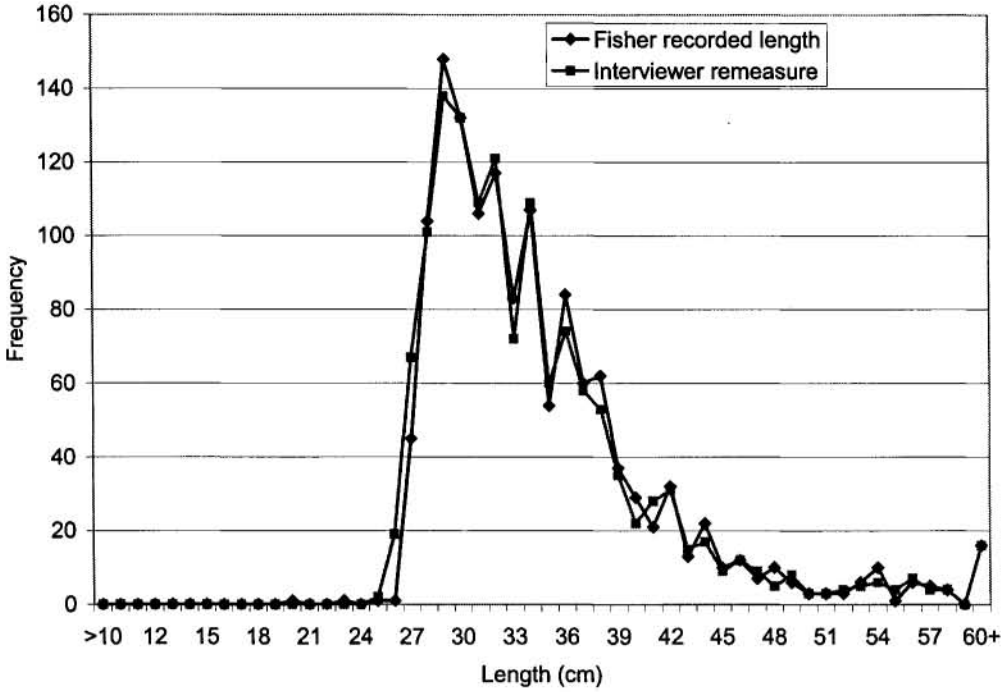


Figure 9: Length frequencies of kept snapper measured at–sea by fishers and remeasured by interviewers at boat ramps on their return for 2005–06 sample data for all SNA 1 regions.

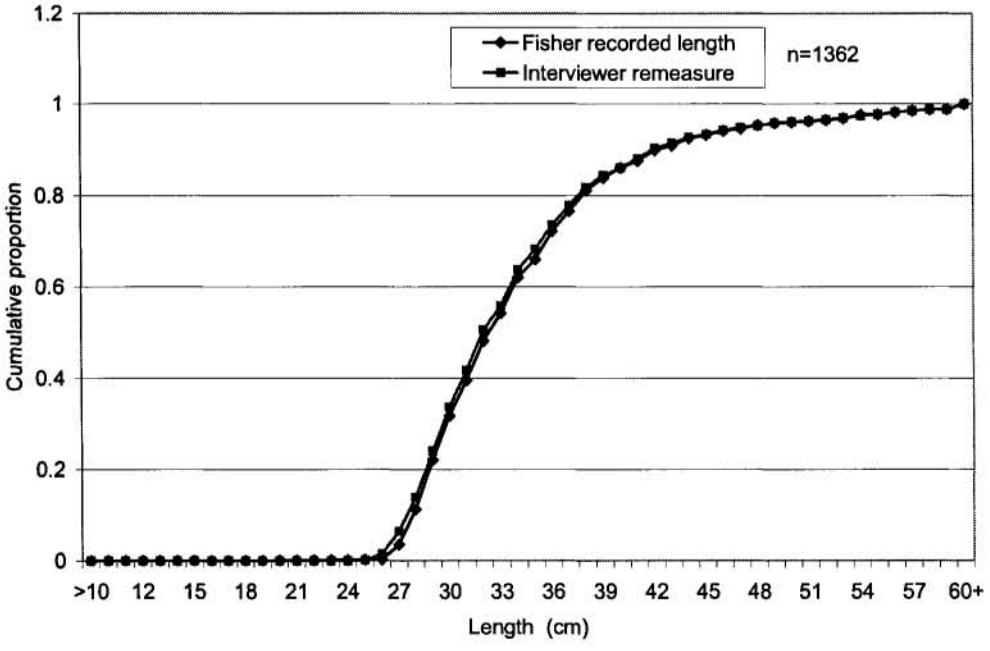


Figure 10: Cumulative length frequency of kept snapper measured by fishers at sea and remeasured by interviewers at boat ramps on fishers' return for 2005–06 sample data for all SNA 1 regions.

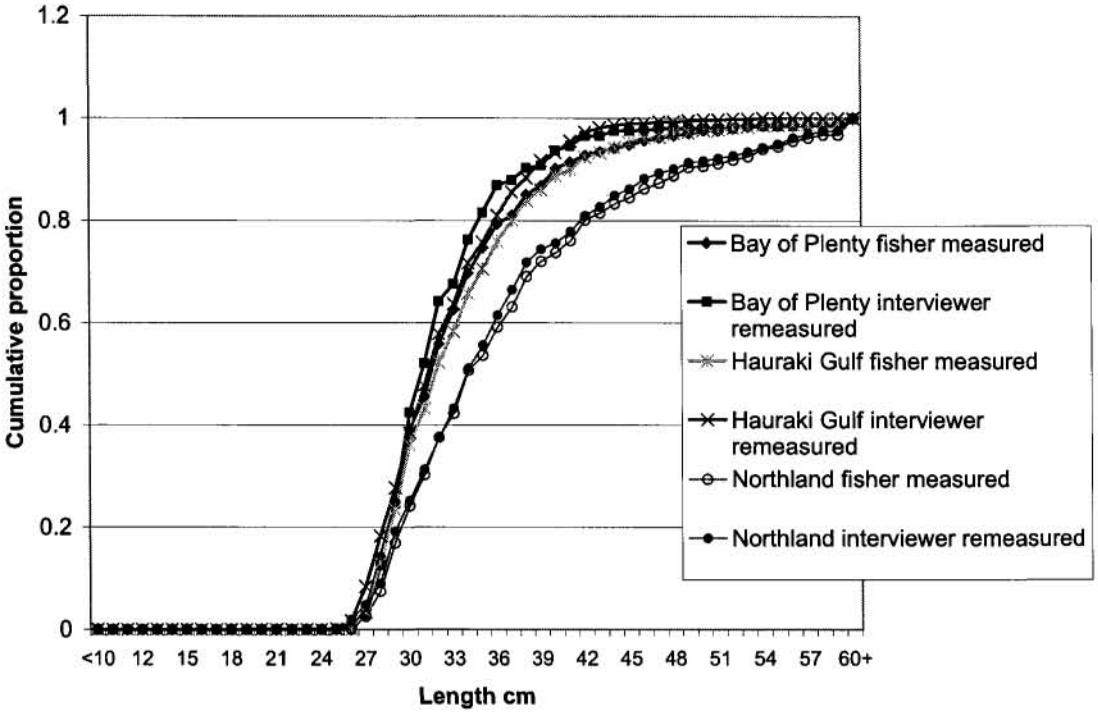


Figure 11: Cumulative length frequency of kept snapper measured by fishers at sea and remeasured by interviewers at boat ramps on fishers' return, in each SNA 1 region in 2005–06.

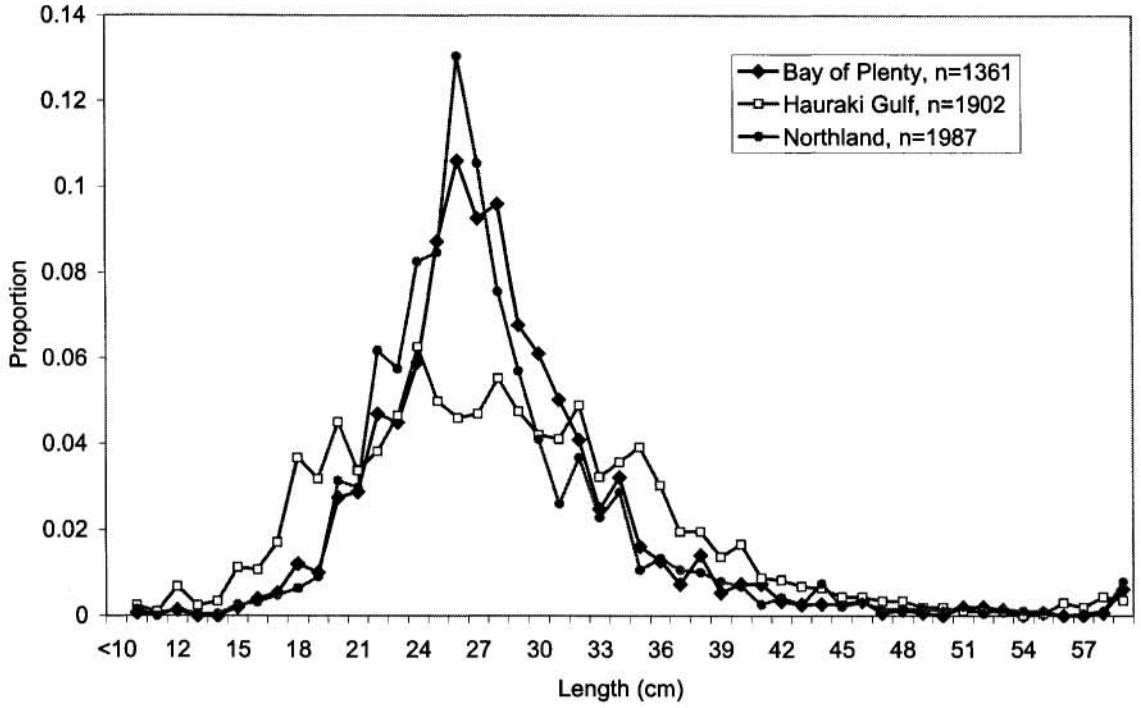


Figure 12: Length frequency of all snapper sampled in 2004–05 by region.

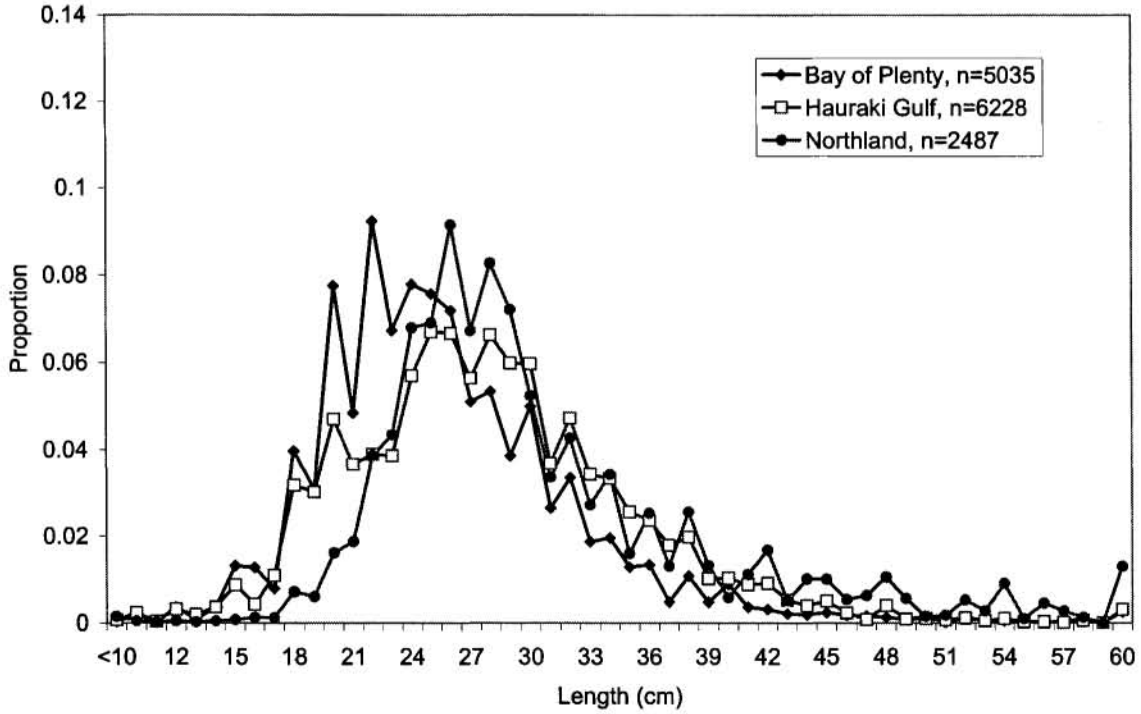


Figure 13: Length frequency of all snapper sampled in 2005–06 by region.

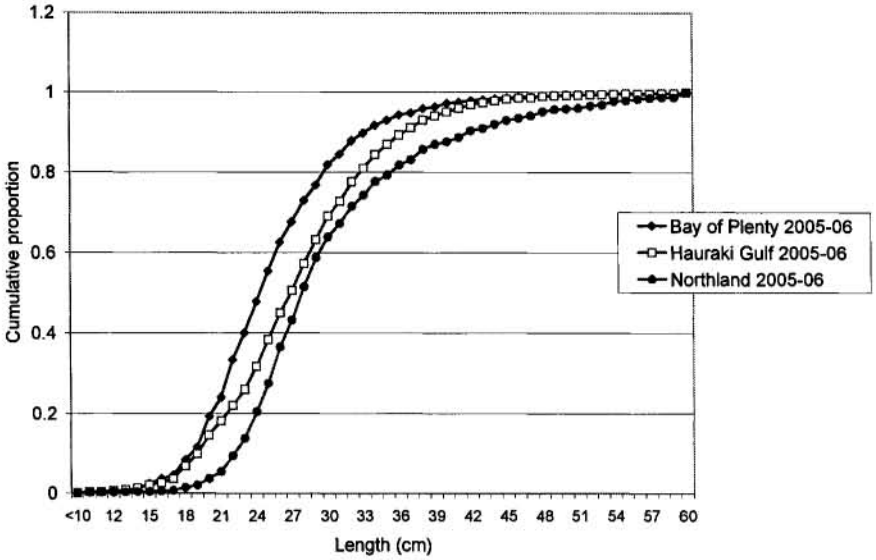


Figure 14: Cumulative length frequency of all snapper sampled in 2005–06 by region.

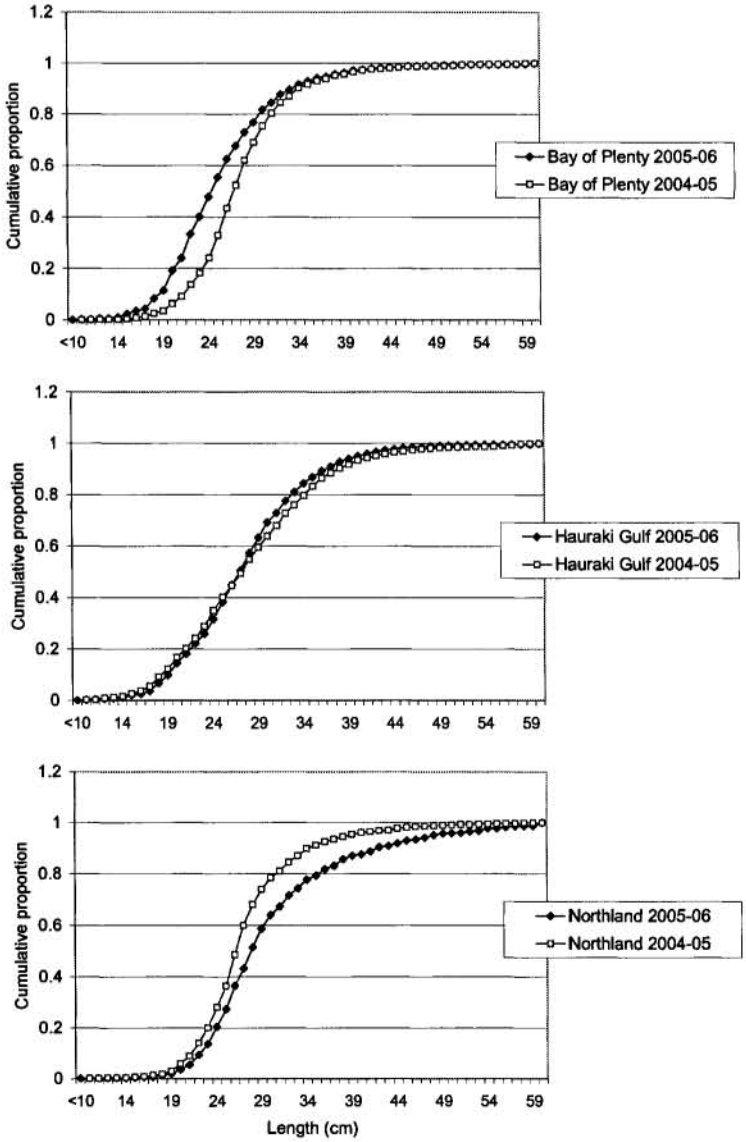


Figure 15: Cumulative length frequency of all snapper sampled in each SNA 1 region.

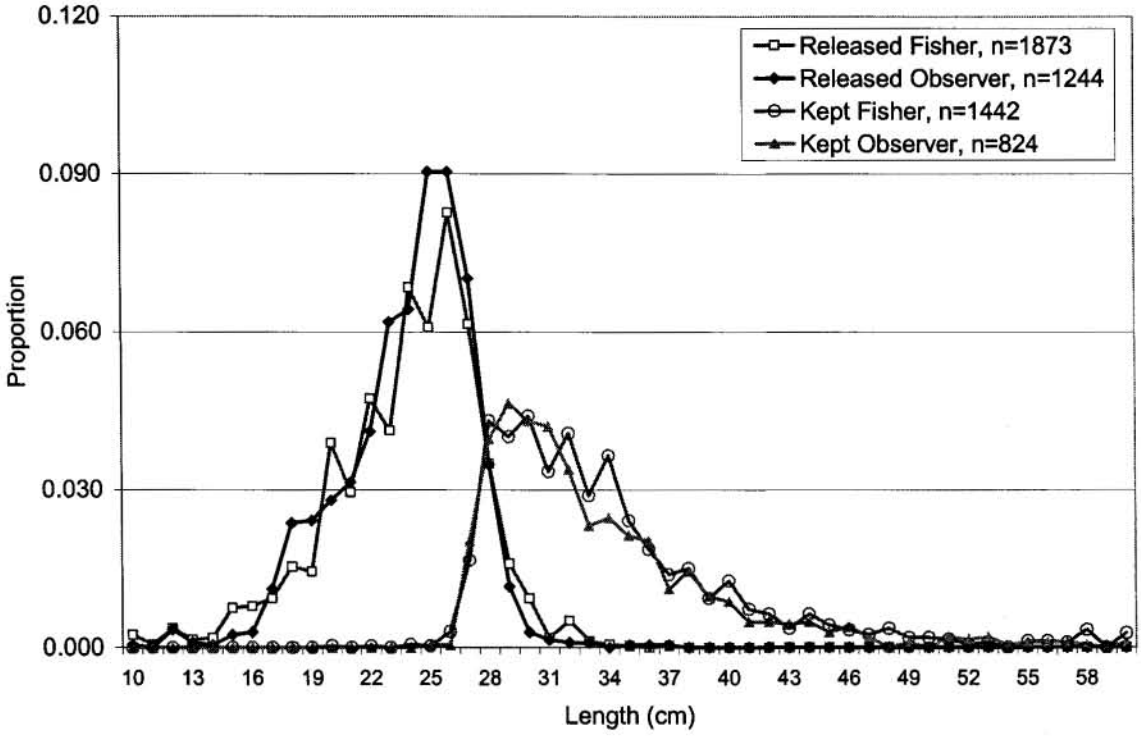


Figure 16: Proportion of released and kept snapper by length and sample method in 2004–05, all SNA 1 regions combined.

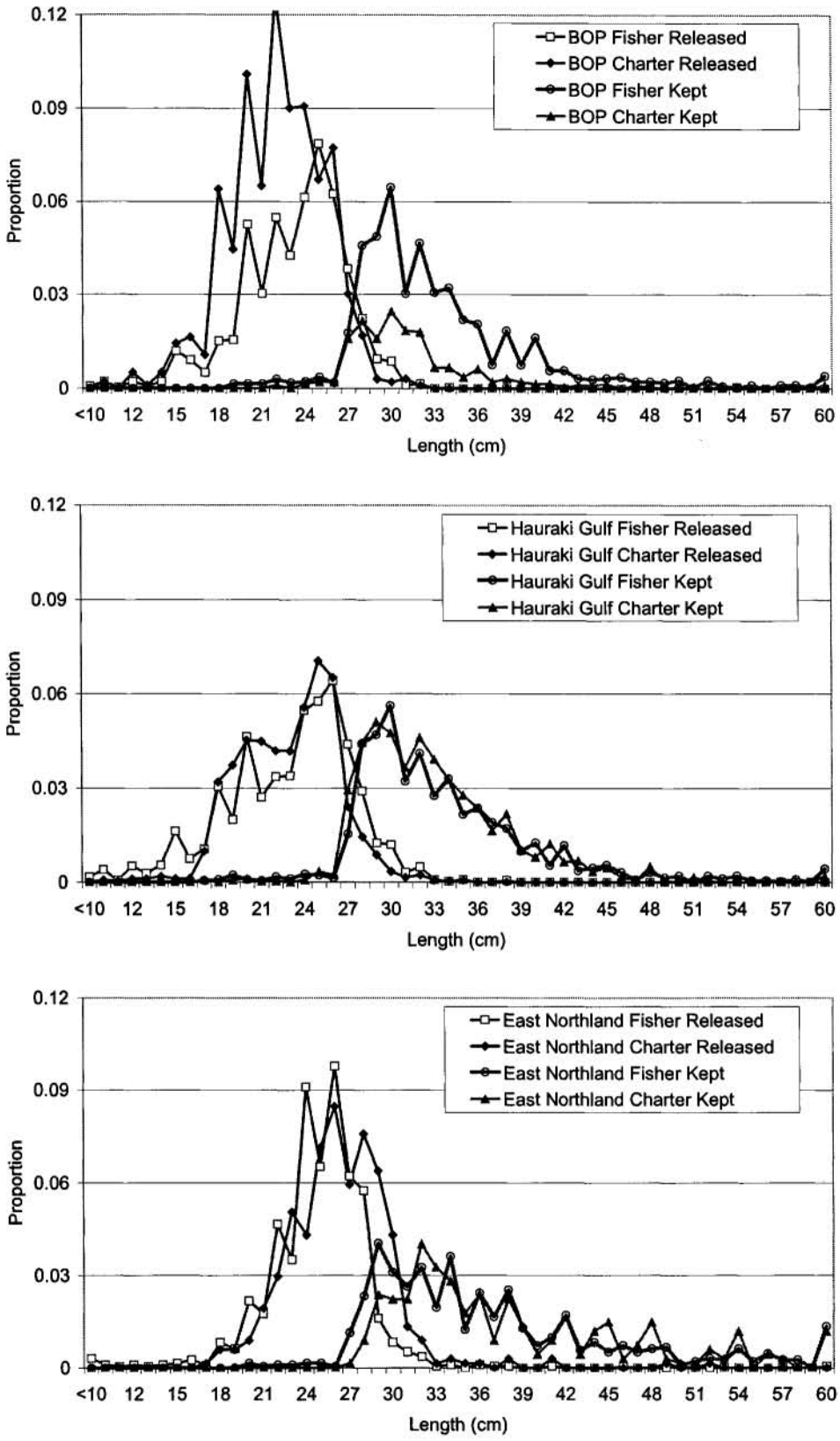


Figure 17: Proportion of released and kept snapper by length and sample method in 2005–06, all SNA 1 regions combined.

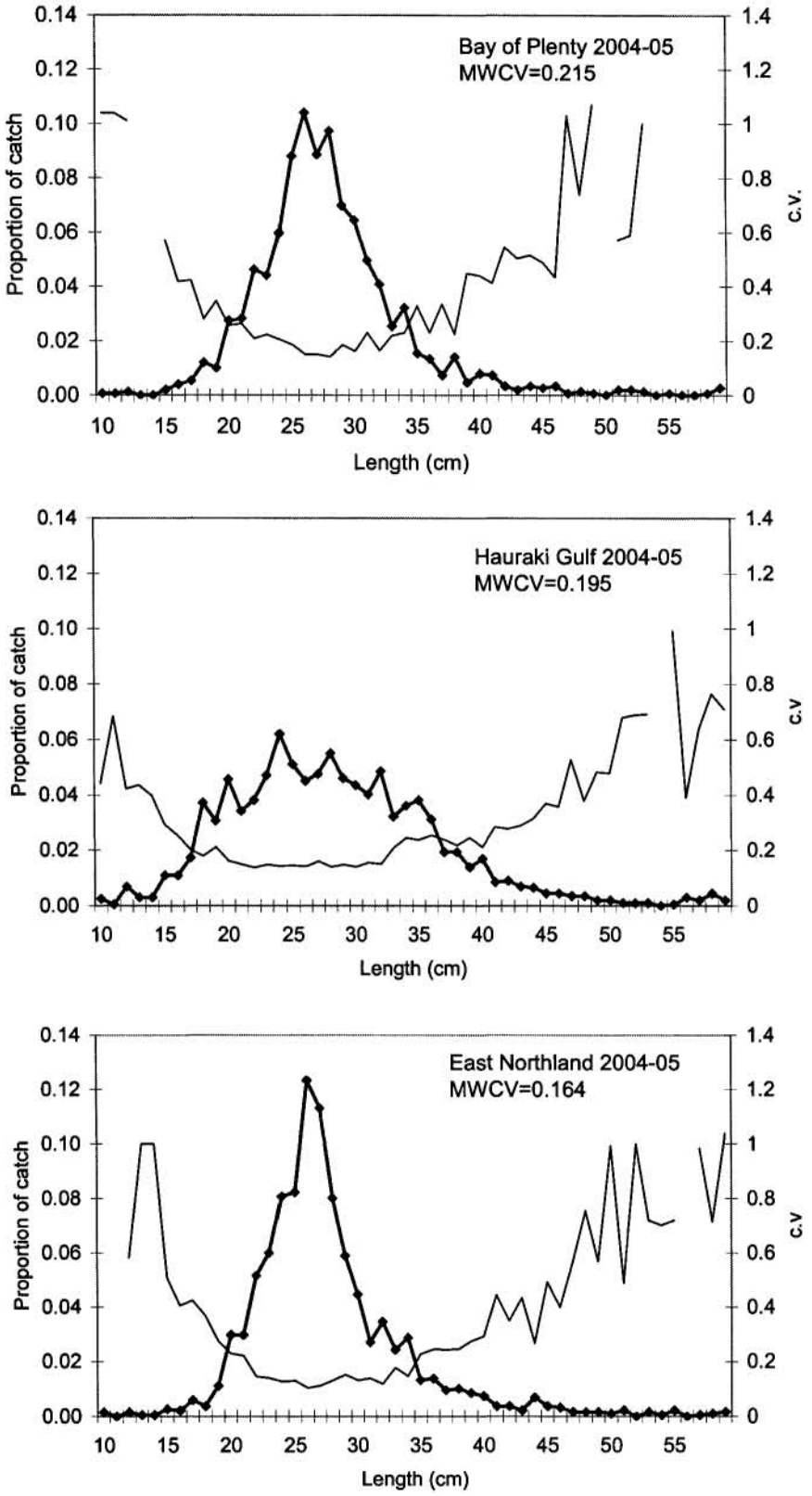


Figure 18: Proportion (left axis) and c.v.s (right axis) of recreationally caught snapper at length for kept and released snapper in each SNA 1 region from the 2004–05 sample survey.

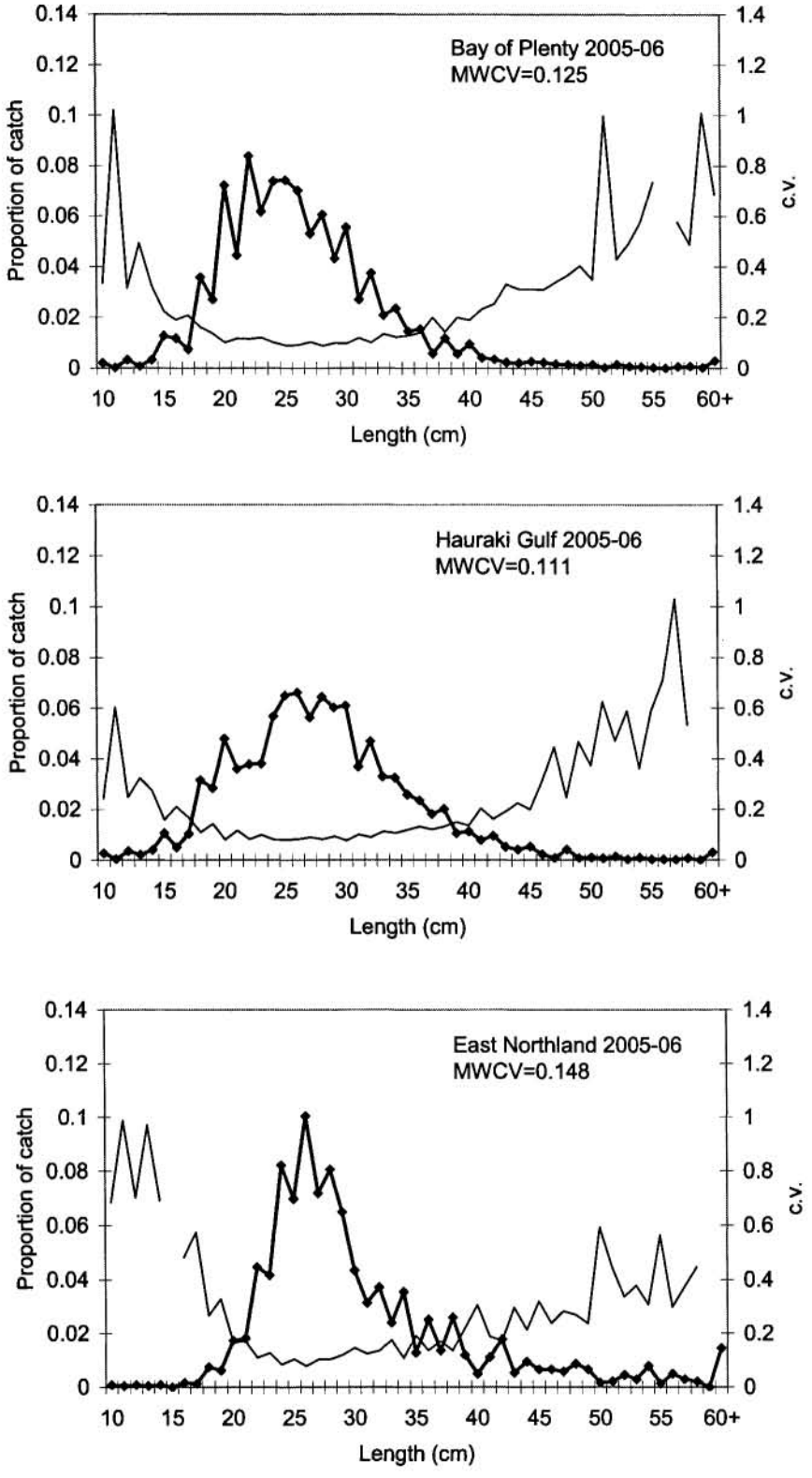


Figure 19: Proportion (left axis) and c.v.s (right axis) of recreationally caught snapper at length for kept and released snapper in each SNA 1 region from the 2005–06 survey.

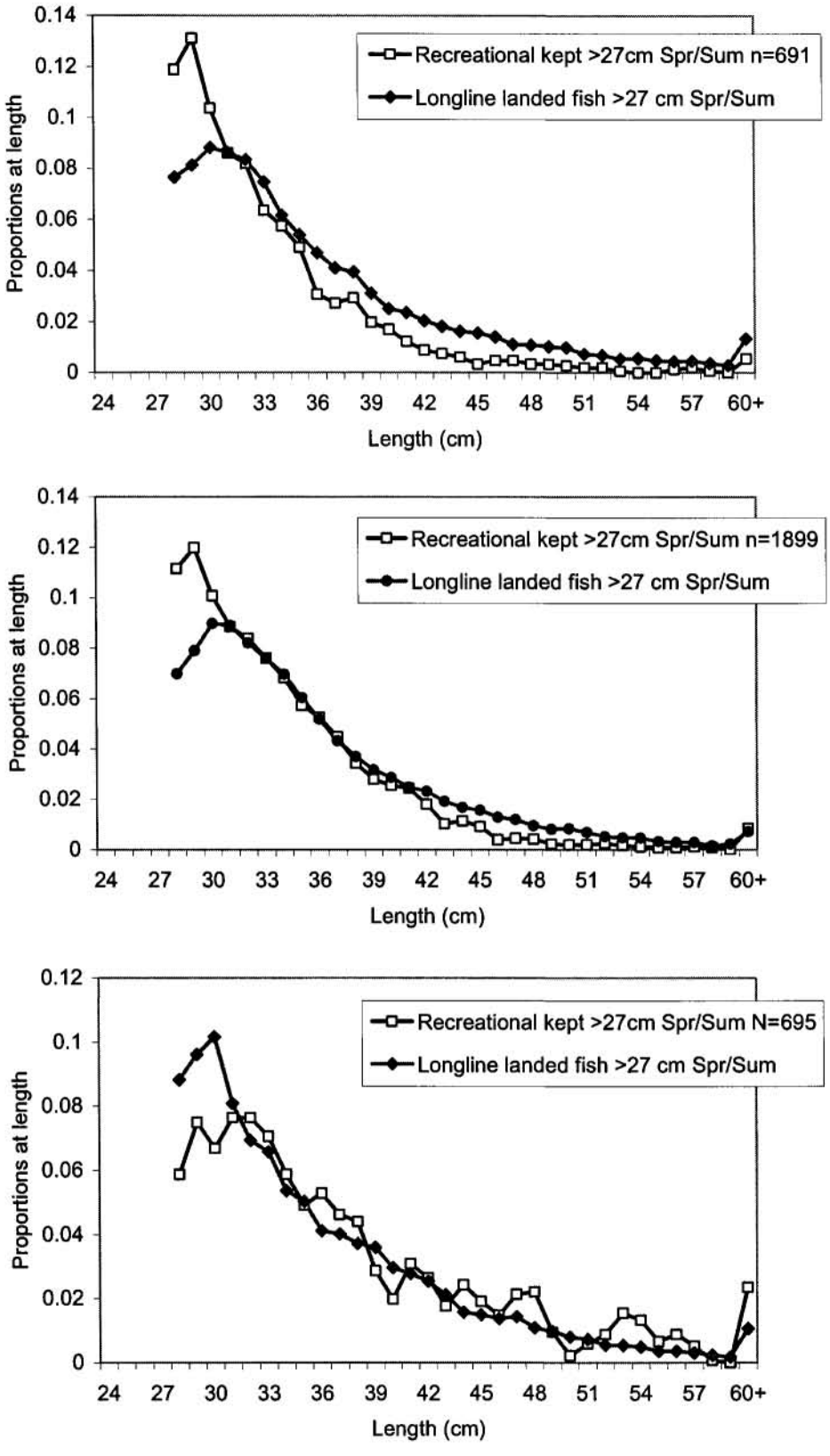


Figure 20: The smoothed proportion at length of recreationally caught snapper and kept snapper 28 cm and larger compared with the proportion at length from longline market sampled fish 28 cm or larger by region for October to March 2005–06.

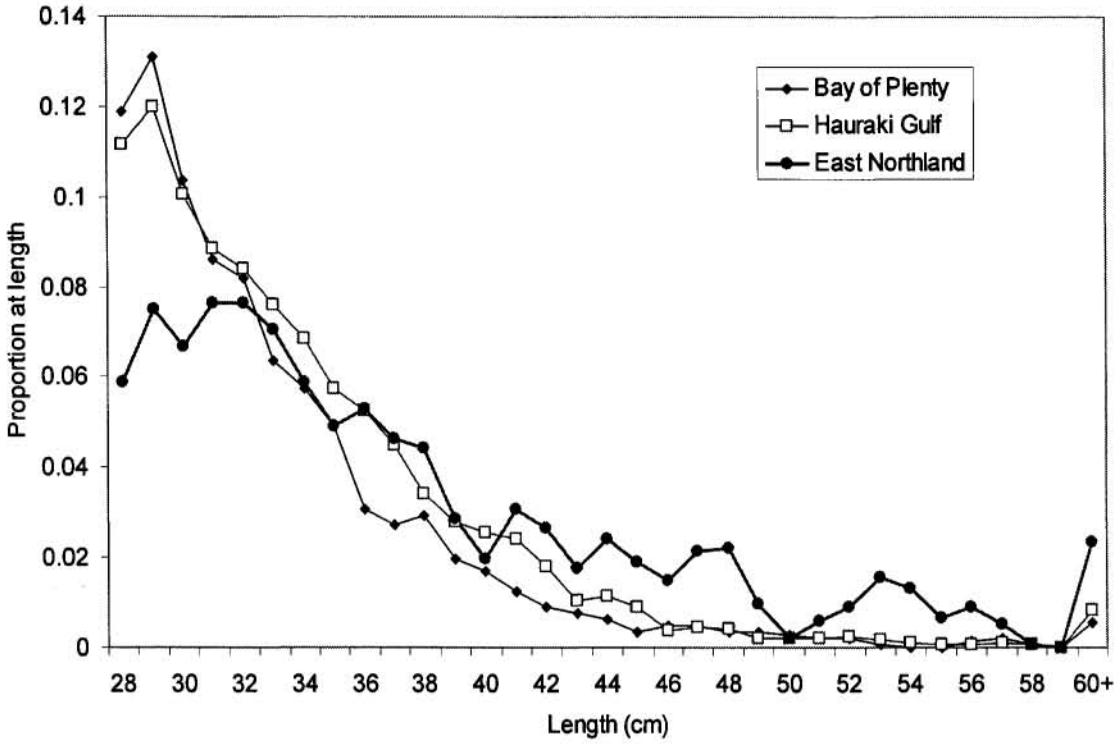


Figure 21: The smoothed proportions at length of recreationally caught and kept snapper for snapper over 28 cm by region.

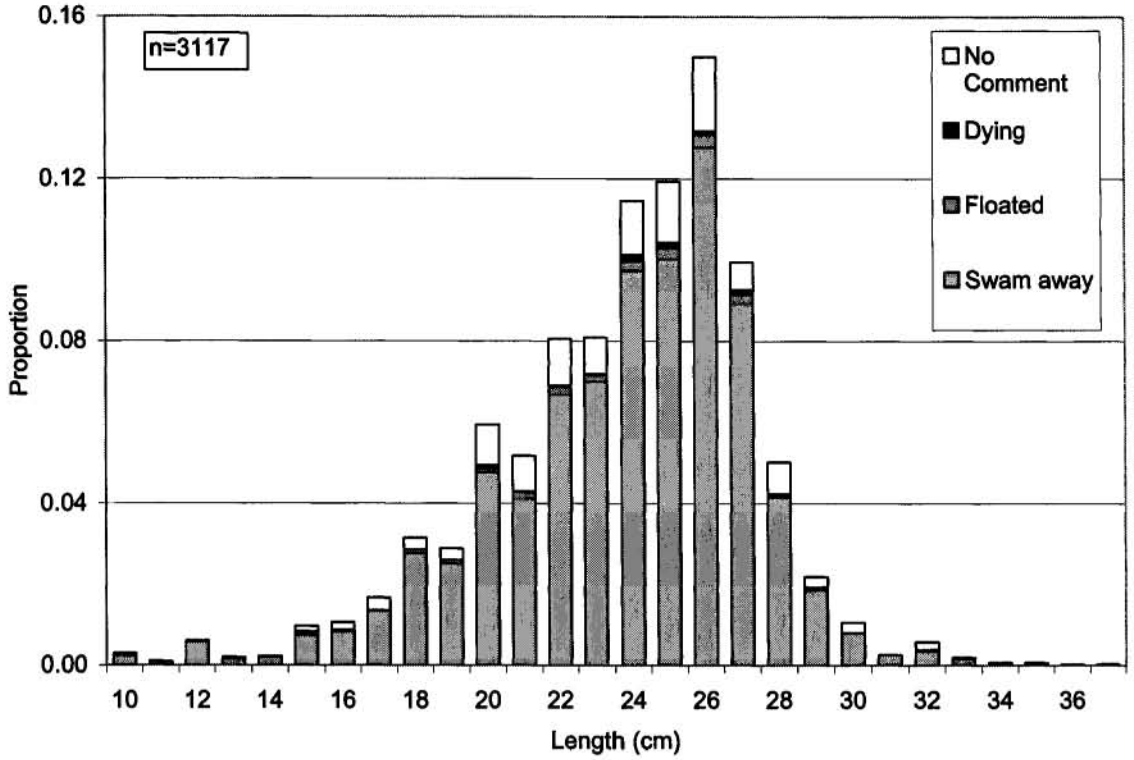


Figure 22: Condition of released snapper by length in the 2004–05 sample survey (fisher and observer data combined).

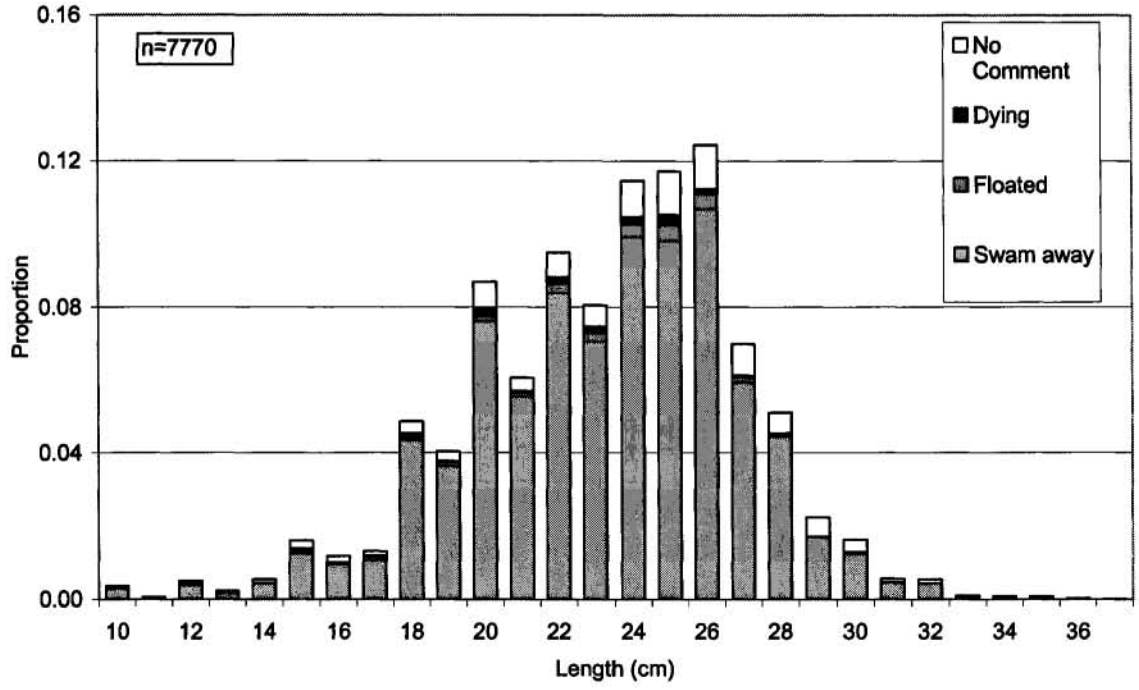


Figure 23: Condition of released snapper by length in the 2005–06 sample survey (fisher and observer data combined).

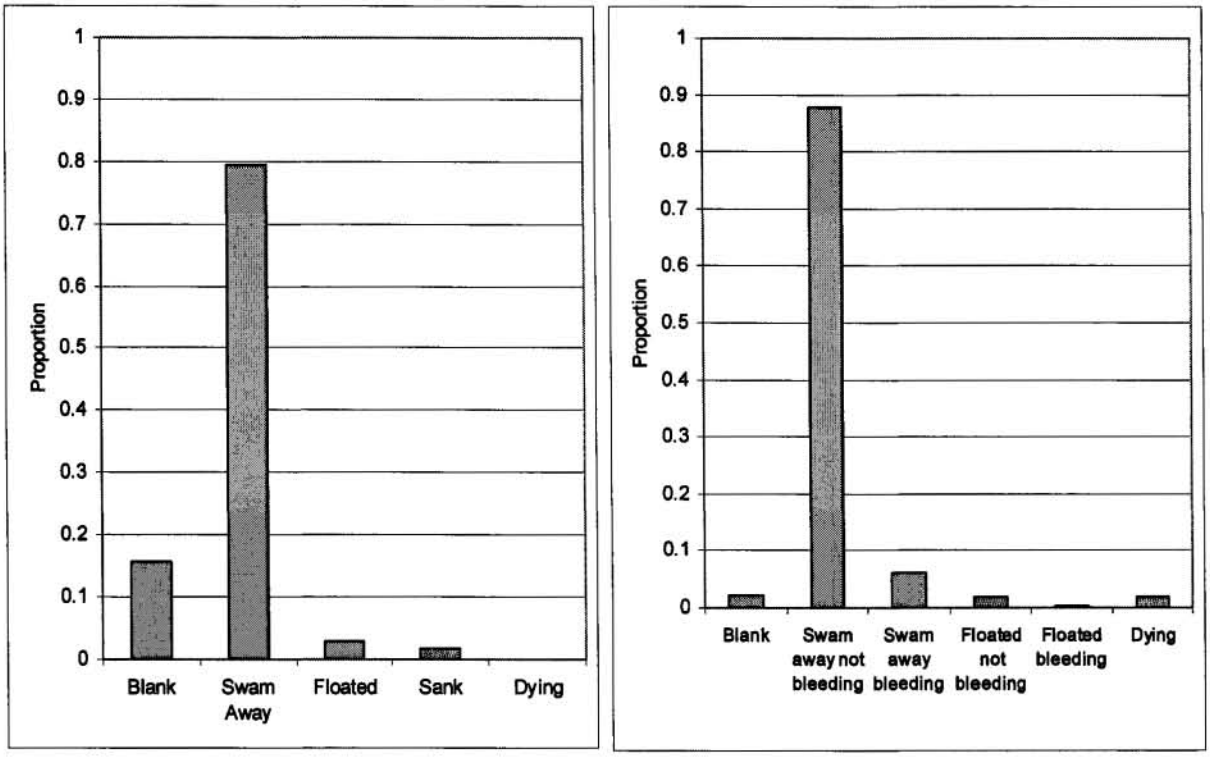


Figure 24: Proportion of condition factors for released snapper recorded by fishers (left, n=4419) and observers on charter boats (right, n=3368) in 2005–06.

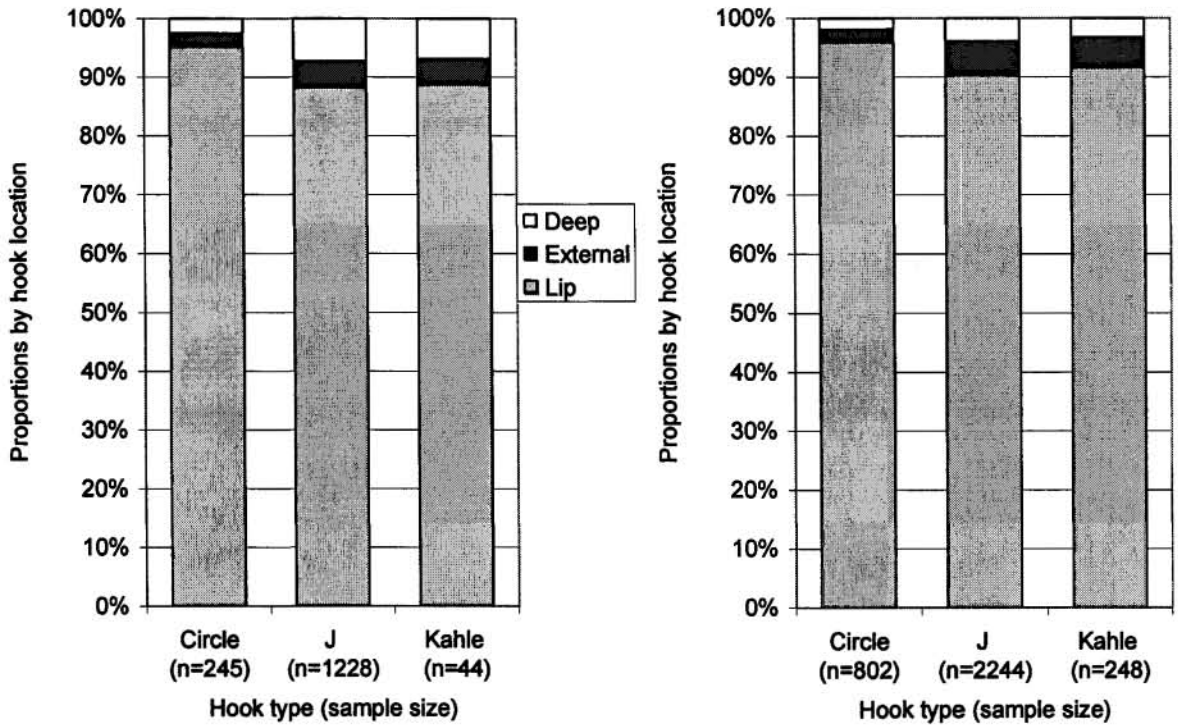


Figure 25: Proportion of released snapper by hook site for the main different hook styles recorded by observers on charter vessels in the 2004–05 (left) and 2005–06 (right) surveys.

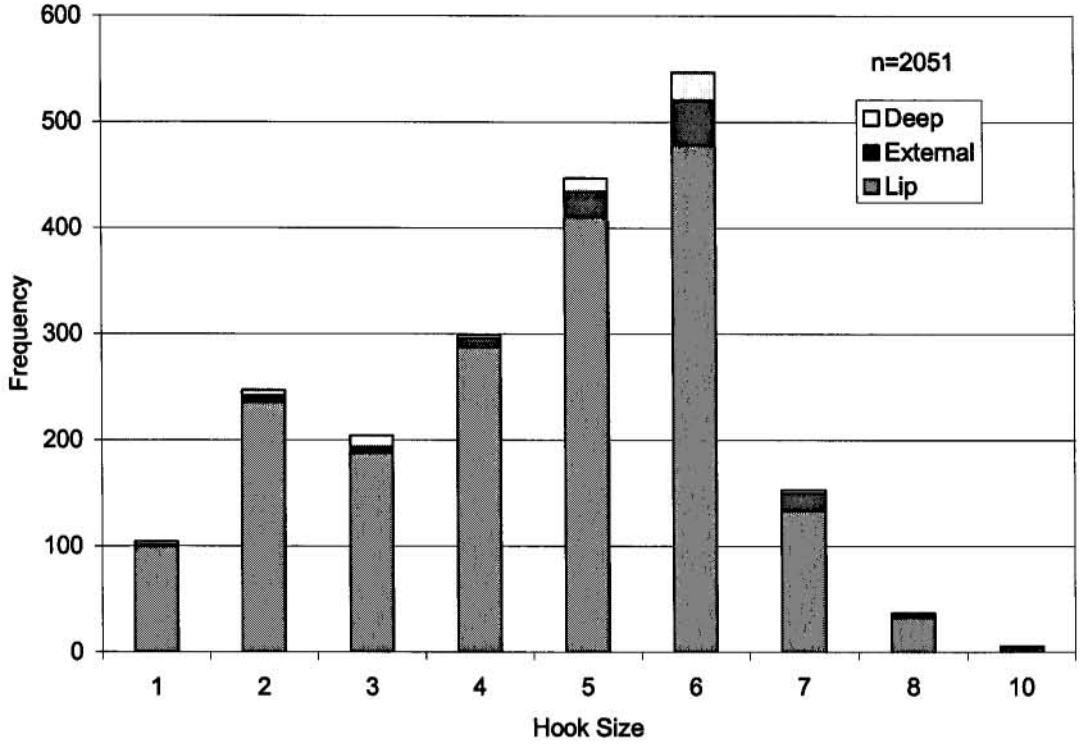


Figure 26: Number of released snapper caught by hook size and hook position recorded by observers on charter vessels in 2005–06.

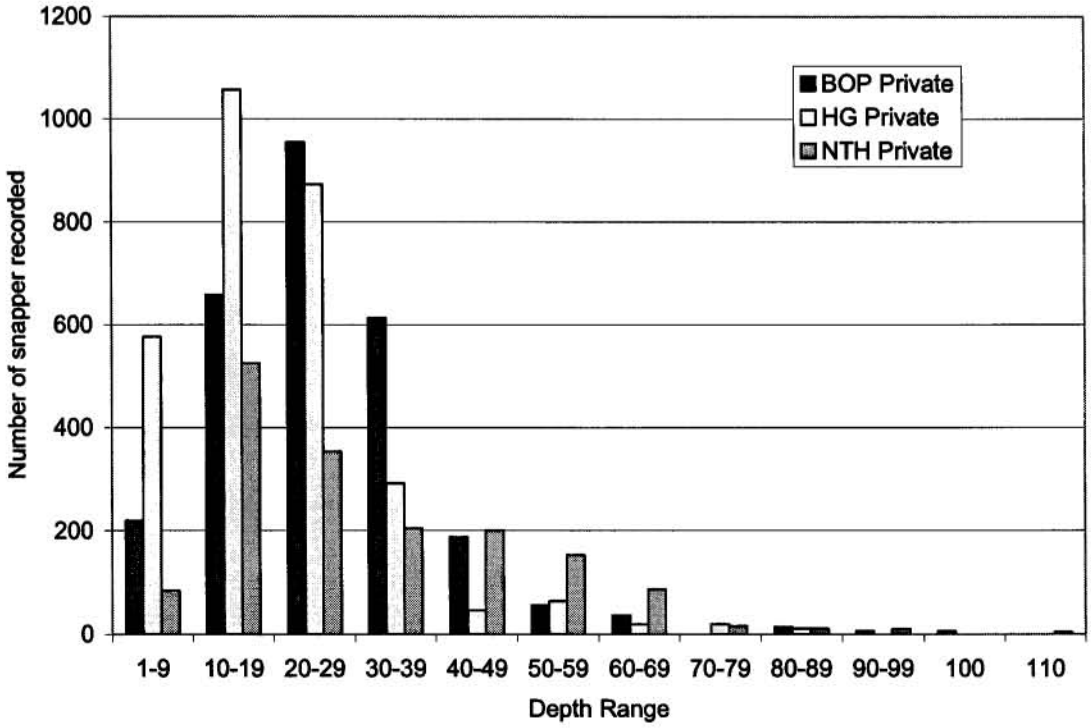


Figure 27: Number of snapper caught by depth (m) in each SNA 1 region in 2005–06 where depth information was recorded by fishers on boat ramp survey forms.

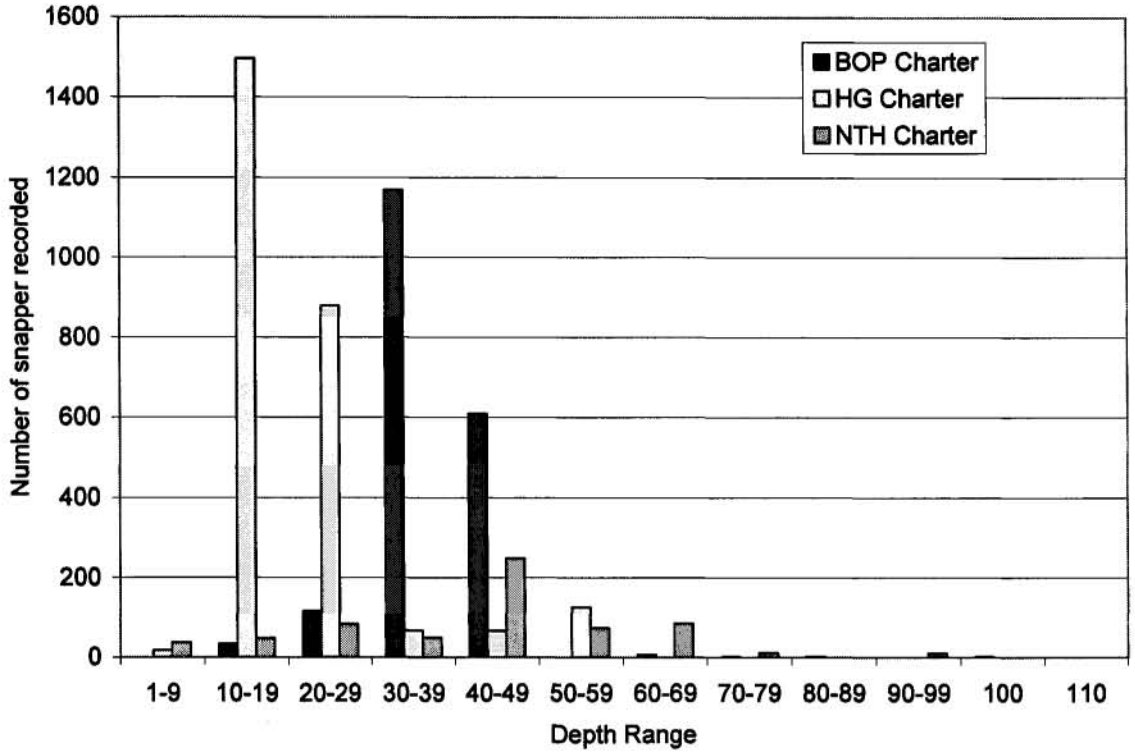


Figure 28: Number of snapper caught by depth (m) in each SNA 1 region in 2005–06 where depth information was recorded by observers on charter vessels.

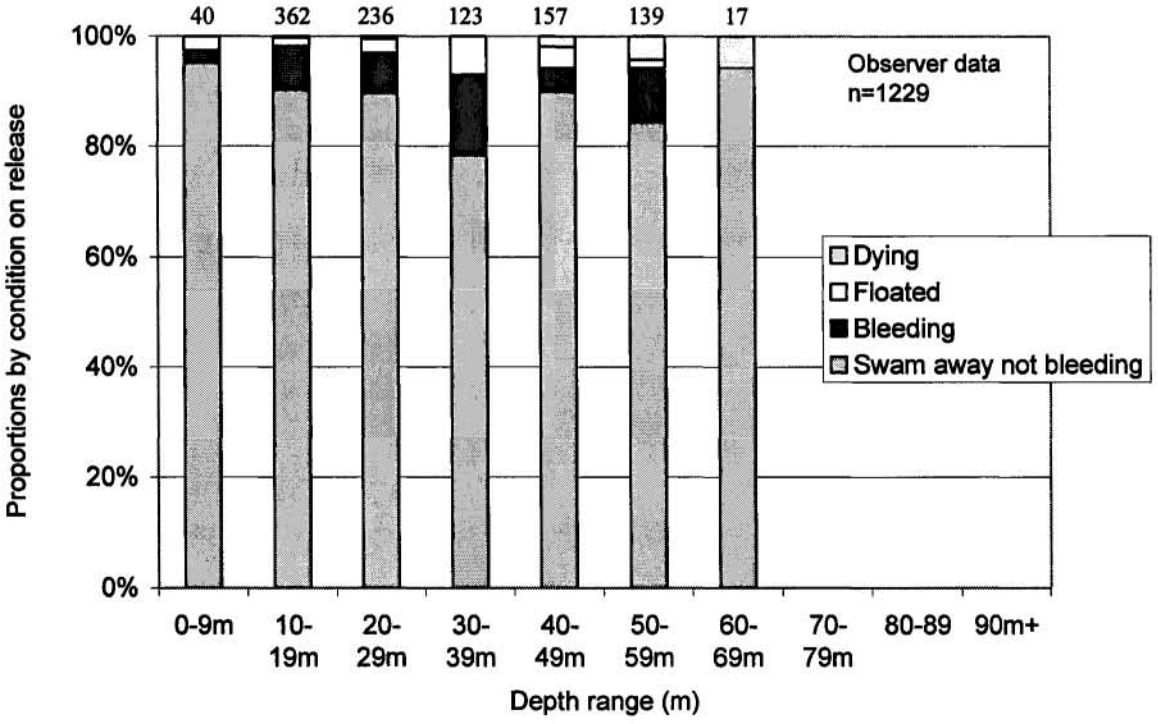


Figure 29: Condition of all released snapper by depth from charter vessels in 2004–05.

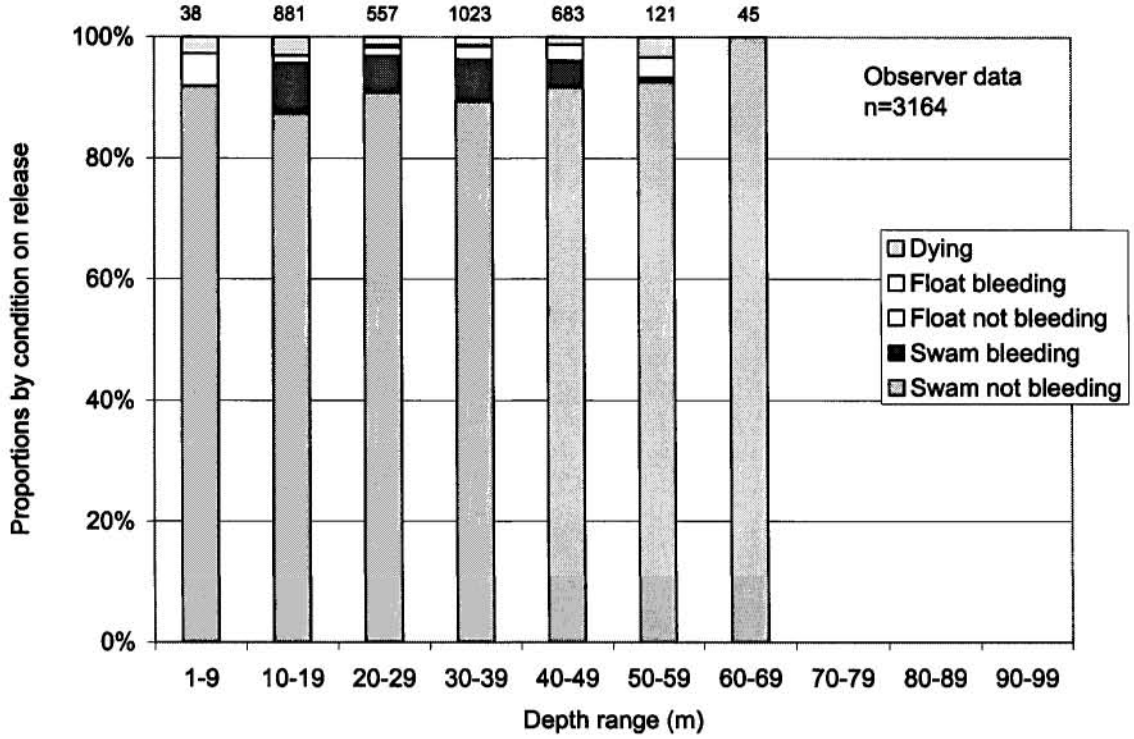


Figure 30: Condition of all released snapper by depth from charter vessels in 2005–06, sample size for each depth range above the column.

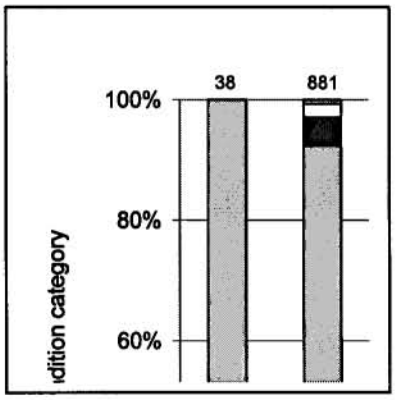


Figure 31: Barotrauma injury by depth for snapper released from charter vessels in 2005–06, sample size for each depth range above the column.

Appendix 1: Combined measuring and recording sheet used by recreational fishers to self measure their snapper catch in 2005–06.

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

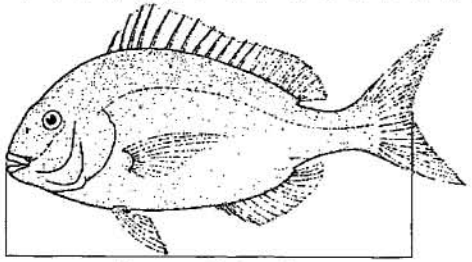
Date _____

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 2005–06.

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: Proportions at length, charter and fisher combined by region.

	Bay of Plenty				Hauraki Gulf			
	Kept	Released	Total	CV BOP	Kept	Released	Total	CV HGulf
<10	0	0.000416	0.000416	0.675164	0	0.002021	0.002021	0.343824
10	0	0.00208	0.00208	0.334425	0	0.002695	0.002695	0.243806
11	0	0.000208	0.000208	1.019153	0	0.000505	0.000505	0.604101
12	0	0.003328	0.003328	0.314614	0	0.003537	0.003537	0.248693
13	0	0.000832	0.000832	0.492732	0	0.002189	0.002189	0.323944
14	0	0.003328	0.003328	0.325224	0	0.004042	0.004042	0.27564
15	0	0.012687	0.012687	0.222268	0	0.01061	0.01061	0.158842
16	0	0.011855	0.011855	0.190198	0	0.005052	0.005052	0.211142
17	0	0.007488	0.007488	0.20806	0	0.010441	0.010441	0.16812
18	0	0.035774	0.035774	0.161524	0	0.03166	0.03166	0.110033
19	0	0.027038	0.027038	0.136576	0	0.028461	0.028461	0.143451
20	0.000208	0.071963	0.072171	0.101161	0	0.047996	0.047996	0.080732
21	0	0.044509	0.044509	0.116495	0.000168	0.035871	0.036039	0.116771
22	0	0.083819	0.083819	0.115459	0	0.037892	0.037892	0.082487
23	0	0.061772	0.061772	0.120313	0	0.038228	0.038228	0.099564
24	0	0.073835	0.073835	0.10127	0.000168	0.056585	0.056753	0.080656
25	0	0.074251	0.074251	0.089362	0.000168	0.064837	0.065005	0.079705
26	0.000624	0.069468	0.070092	0.091233	0.000674	0.06551	0.066184	0.082055
27	0.016847	0.03619	0.053037	0.103377	0.020209	0.036207	0.056416	0.090115
28	0.038686	0.021839	0.060524	0.087869	0.040754	0.023745	0.0645	0.082576
29	0.03619	0.007072	0.043261	0.099113	0.049006	0.011283	0.06029	0.093566
30	0.048877	0.006656	0.055532	0.097876	0.052206	0.008757	0.060963	0.077679
31	0.024958	0.00208	0.027038	0.119198	0.034187	0.002695	0.036881	0.100359
32	0.03619	0.001248	0.037438	0.101057	0.042944	0.004042	0.046986	0.090288
33	0.020799	0	0.020799	0.134663	0.032166	0.000842	0.033008	0.112147
34	0.023295	0.000208	0.023502	0.122219	0.031997	0.000505	0.032503	0.106647
35	0.014559	0	0.014559	0.128243	0.025093	0.000842	0.025935	0.119468
36	0.015391	0	0.015391	0.139075	0.023577	0	0.023577	0.13187
37	0.005824	0	0.005824	0.199912	0.018188	0	0.018188	0.120844
38	0.011855	0	0.011855	0.142912	0.019872	0.000337	0.020209	0.132029
39	0.005616	0	0.005616	0.199864	0.01061	0	0.01061	0.150386
40	0.009567	0	0.009567	0.189256	0.011283	0	0.011283	0.13598
41	0.00416	0	0.00416	0.23296	0.007915	0	0.007915	0.203791
42	0.003536	0	0.003536	0.25307	0.009599	0	0.009599	0.161903
43	0.002288	0	0.002288	0.329865	0.005221	0	0.005221	0.190351
44	0.00208	0	0.00208	0.311598	0.00421	0	0.00421	0.22533
45	0.002704	0	0.002704	0.311715	0.005389	0	0.005389	0.199811
46	0.002288	0	0.002288	0.308074	0.002189	0	0.002189	0.309976
47	0.001664	0	0.001664	0.338504	0.000842	0	0.000842	0.446915
48	0.001456	0	0.001456	0.366824	0.00421	0	0.00421	0.247909
49	0.00104	0	0.00104	0.404253	0.000842	0	0.000842	0.468318
50	0.001456	0	0.001456	0.348784	0.00101	0	0.00101	0.37353
51	0.000208	0	0.000208	0.9984	0.000674	0	0.000674	0.624635
52	0.001456	0	0.001456	0.428485	0.001347	0	0.001347	0.47073
53	0.000832	0	0.000832	0.493831	0.000337	0	0.000337	0.58915
54	0.000416	0.000208	0.000624	0.580986	0.00101	0	0.00101	0.362322
55	0.000208	0	0.000208	0.735033	0.000337	0	0.000337	0.588964
56	0	0	0		0.000337	0	0.000337	0.710114
57	0.000624	0	0.000624	0.576836	0.000168	0	0.000168	1.030043
58	0.000832	0	0.000832	0.488302	0.000674	0	0.000674	0.535005
59	0.000208	0	0.000208	1.009468	0	0	0	
60+	0.002912	0	0.002912	0.685928	0.003031	0	0.003031	1.045535
Total	0.33985	0.66015	1	15.20762	0.462614	0.537386	1	13.43803

Appendix 3: Continued

	East Northland			
	Kept	Released	Total	CV ENorth
<10	0	0	0	
10	0	0.000826	0.000826	0.685264
11	0	0.000413	0.000413	0.988489
12	0	0.000826	0.000826	0.702124
13	0	0.000413	0.000413	0.971143
14	0	0.000826	0.000826	0.690981
15	0	0	0	
16	0	0.001652	0.001652	0.482864
17	0	0.001239	0.001239	0.573863
18	0	0.007435	0.007435	0.26782
19	0	0.006196	0.006196	0.328515
20	0	0.017348	0.017348	0.165617
21	0	0.018174	0.018174	0.172468
22	0	0.04461	0.04461	0.109586
23	0	0.041718	0.041718	0.126929
24	0	0.082197	0.082197	0.084593
25	0.000413	0.069393	0.069806	0.104354
26	0	0.100372	0.100372	0.07812
27	0.008674	0.063197	0.071871	0.10402
28	0.018174	0.062371	0.080545	0.104101
29	0.035109	0.02974	0.064849	0.119686
30	0.026848	0.016522	0.043371	0.145382
31	0.02437	0.007022	0.031392	0.123831
32	0.032218	0.004957	0.037175	0.134969
33	0.023131	0.000826	0.023957	0.174632
34	0.034283	0.001239	0.035523	0.108105
35	0.012392	0.000413	0.012805	0.191949
36	0.023957	0.001239	0.025196	0.136723
37	0.013218	0.000413	0.013631	0.171204
38	0.024783	0.001239	0.026022	0.136336
39	0.011979	0	0.011979	0.220474
40	0.004957	0	0.004957	0.306467
41	0.009913	0.001239	0.011152	0.188231
42	0.017761	0	0.017761	0.172269
43	0.00537	0	0.00537	0.297521
44	0.0095	0	0.0095	0.213722
45	0.006609	0	0.006609	0.319709
46	0.006196	0.000413	0.006609	0.238472
47	0.005783	0	0.005783	0.283372
48	0.008674	0	0.008674	0.269532
49	0.006196	0.000413	0.006609	0.237892
50	0.001239	0.000413	0.001652	0.59326
51	0.002065	0	0.002065	0.444713
52	0.004131	0.000413	0.004544	0.337781
53	0.002891	0	0.002891	0.379478
54	0.007848	0	0.007848	0.308095
55	0.001239	0	0.001239	0.563974
56	0.004957	0	0.004957	0.298941
57	0.002891	0	0.002891	0.373222
58	0.002065	0	0.002065	0.446666
59	0	0	0	
60+	0.014044	0.000413	0.014457	0.677712
Total	0.413879	0.586121	1	15.35517