

Commercial catch sampling for length and age of John dory in JDO 1, grey mullet in GMU 1, red gurnard in GUR 1 and GUR 2, gemfish in SKI 2, and alfonsino in BYX 3, in the 2004–05 fishing year.

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Re	port Title	Commercial catch sampling for length and age of John dory in JDO 1, grey mullet in GMU 1, red gurnard in GUR 1 and GUR 2, gemfish in SKI 2, and alfonsino in BYX 3, in the 2004–05 fishing year.
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## 7. Objectives

## In QMA 1

- 8. To conduct sampling in fish processing sheds and determine the length and age composition of the commercial catch of red gurnard (*Chelidonichthys kumu*) in GUR 1 during the 2004/05 fishing year. The target coefficient of variation (c.v.) for the catch-at-age is 30% (mean weighted c.v. across all age classes).
- 9. To conduct sampling in fish processing sheds and determine the length and age composition of the commercial catch of John dory (*Zeus faber*) in JDO 1 during the 2004/2005 fishing year. The target coefficient of variation (c.v.) for the catch-at-age is 30% (mean weighted c.v. across all age classes).
- 10. To conduct sampling in fish processing sheds and determine the length and age composition of the commercial catch of grey mullet (*Mugil cephalus*) in GMU 1 during the 2004/2005 fishing year. The target coefficient of variation (c.v.) for the catch-at-age is 30% (mean weighted c.v. across all age classes).

## In QMA 2

11. To conduct sampling in fish processing sheds and determine the length and age composition of the commercial catch of gemfish (*Rexea solandri*) in SKI 2 during the 2004/2005 fishing year. The target coefficient of variation (c.v.) for the catch-at-age is 30% (mean weighted c.v. across all age classes).

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12. To conduct sampling in fish processing sheds and determine the length and age composition of the commercial catch of red gurnard in GUR 2 during the 2004/05 fishing years. The target coefficient of variation (c.v.) for the catch-at-age is 30% (mean weighted c.v. across all age classes).

## In QMA 3

13. To conduct sampling in fish processing sheds and determine the length and age composition of the commercial catch of alfonsino (*Beryx splendens*) in BYX 3 during the 2004/2005 fishing years. The target coefficient of variation (c.v.) for the catch-at-age is 30% (mean weighted c.v. across all age classes).

## 8. Executive summary

This report describes the sampling programme carried out on commercial landings of John dory (*Zeus faber*) in JDO 1, grey mullet (*Mugil cephalus*) in GMU 1, red gurnard (*Chelidonichthys kumu*) in GUR 1 and GUR 2, gemfish (*Rexea solandri*) in SKI 2, and alfonsino (*Beryx splendens*) in BYX 3, during the 2004–05 fishing year, and the subsequent estimates of catch-at-age for these fisheries. This report fulfils the reporting requirements of Objectives 8, 9, 10, 11, 12, and 13 of project INS2003/01.

John dory in JDO 1 is managed as a single stock, but it is believed it consists of two separate stocks, i.e., an east stock (JDO 1E) and west stock (JDO 1W). This report treats JDO 1 as two stocks. Sampling occurred between October 2004 and February 2005, and the target number of samples was achieved in both stocks. The mean weighted c.v.s over all age classes were 19% and 13% for the east and west stocks, respectively, both below the target c.v. of 30%. The JDO 1E trawl fishery was dominated by 2–5 year old fish, while 3–5 year old fish dominated the JDO 1W trawl fishery. This pattern is consistent with previous years.

Grey mullet in GMU 1 is managed as a single stock, but it is believed it consists of two separate stocks, i.e., an east (GMU 1E) and a west (GMU 1W) stock with a boundary at North Cape. However, most of the landings come from the west stock, and all the samples were taken in this area. Ten of the planned 15 samples were taken between January and April 2005. The mean weighted c.v. over all age classes was 12%, below the target c.v. of 30%. The GMU 1W fishery was dominated by 5–6 year old fish.

Red gurnard off the north and east coasts of the North Island are managed as two stocks: GUR 1 and GUR 2. However, GUR 1 is believed to consist of two separate stocks, i.e., an east stock (GUR 1E) and west stock (GUR 1W). This report treats GUR 1 as two stocks. Sampling occurred between October 2004 and April 2005, and the target number of samples (12) was achieved for GUR 1E and GUR 1W. Twelve of the planned 15 samples were achieved for GUR 2. The mean weighted c.v.s over all age classes were 19%, 25%, and 15% for GUR 1E, GUR 1W, and GUR 2, respectively, all below the target c.v. of 30%. The GUR 1E trawl fishery was dominated by 2–5 year old fish, while 3–6 year old fish dominated the GUR 1W trawl fishery. The catch in both areas, but particularly GUR 1W, is dominated by females. The GUR 2 trawl catch is dominated by 2–4 year old fish. These patterns are consistent with previous years.

Gemfish off the north and east coasts of the North Island are managed as two stocks (SKI 1 and SKI 2), but are believed to comprise a single biological stock. The SKI 2 fishery occurs primarily on non-spawning fish from October to April. The gemfish target fishery in SKI 2 during 2004–05 was of short duration; sampling occurred between October 2004 and January 2005. Twelve of the planned 15 samples were obtained. The mean weighted c.v. over all age classes was 31%, just above the target of 30%. The commercial fishery was dominated by fish aged between 5 and 8 years.

Alfonsino from BYX 3 were sampled between November 2004 and May 2005. Thirteen of the planned 15 samples were obtained, and a high proportion of the landed catch was sampled. The mean weighted c.v. over all age classes was 29.7%, lower than the target of 30%. Fish aged from 3 to 12 years were abundant in the catch, with the overall mode in 2004–05 at age 6.

Analyses were carried out to determine if the sampling that was carried out was representative of the temporal (month), spatial (statistical area) and the reported target species for each fishery. For the spatial and target species analyses it was concluded that the data collected in SKI 2 and BYX 3 are representative of the corresponding fisheries, the data collected in JDO 1, GMU 1, and GUR 1 may be representative of the corresponding fisheries, and the data collected in GUR 2 may not be representative of the corresponding fishery. For the temporal analyses the sampling was representative for the SKI 2 and BYX 3 fisheries but was probably not representative for the other fisheries.

## 9. Introduction

## Objective 9: Sampling of John dory for length, sex, and age.

The JDO 1 fishery is the largest John dory fishery in New Zealand. It extends around the North Island from Cape Runaway in the east to Tirua Point in the west, combining QMAs 1 and 9 (Figure 1). JDO 1 is thought to comprise an east (JDO 1E) and a west (JDO 1W) stock, with the boundary considered to be at North Cape (Horn et al. 1999, Hanchet et al. 2001). This analysis treats fish from the east and west coasts as being from separate stocks. In recent years, about 80% of landings off the west coast have been caught as single trawl bycatch. Off the east coast, about 70% of John dory have been taken by single trawl, with a further 20% caught by Danish seine. About 40% of the JDO 1E catch is targeted. Sampling of the commercial JDO 1 catch commenced in the 2002–03 fishing year (Phillips & Horn 2004) and continued in 2003–04 (Horn et al. 2004). This report presents the length and age structure of John dory caught in JDO 1 during the 2004–05 fishing year, and compares these results with the previous years.

## Objective 10: Sampling of grey mullet for length, sex, and age.

The GMU 1 administrative stock encompasses the northern half of the North Island, i.e., QMAs 1 and 9 (Figure 2). However, the east and west coast areas of GMU 1 are considered separate for stock assessment purposes. In 1997–98, approximately 80% of the GMU 1 catch came from the west coast (McKenzie et al. 1999). The most recent study of the species in GMU 1 (McKenzie et al. 1999) sampled west coast set net catches from the 1997–98 fishing year and concluded that samples comprised males and females aged between 3 and 12 years. Growth analysis showed that female grey mullet were consistently larger than males of the same age, and that females made up approximately two-thirds (by numbers) of the sample landings. Sampling of the commercial GMU 1 catch commenced in the 2003–04 fishing year (Manning & Shearer 2005). This report presents the length and age structure of grey mullet caught in GMU 1W during the 2004–05 fishing year, and compares these results with the previous year.

Objectives 8 and 12: Sampling of red gurnard for length, sex, and age.

GUR 1 is the largest red gurnard fishery in New Zealand. GUR 1 landings have been relatively stable since 1986–87, averaging around 1000 t or 40% of the total annual national landings. It is also an important species for recreational fishers with an estimated 100 t being taken annually in this area. GUR 1 is thought to comprise an east (GUR 1E) and a west (GUR 1W) stock, with the boundary considered to be at North Cape (Figure 3). On the west coast (GUR 1W), over half of the landed red gurnard catch is a bycatch of bottom trawlers targeting other species (mainly snapper and trevally).

On the east coast (GUR 1E), about half of the landed catch is caught by bottom trawl, with the remainder consisting of small bycatch landings by a variety of other methods (mainly bottom longline and Danish seine). Considerable efforts were made to sample east coast Danish seine landings of red gurnard in 2002–03, but landed catches only rarely exceeded 30 kg and were not considered sufficient to characterise the fishery. Sampling of the commercial GUR 1 catch commenced in the 2002–03 fishing year (Manning & Sutton 2004) and continued in 2003–04 (Manning & Sutton 2005). This report presents the length and age structure of red gurnard caught in GUR 1 during the 2004–05 fishing year, and compares these results with the previous years.

GUR 2 (Figure 3) is the third-largest red gurnard fishery in New Zealand. Landings have been relatively stable since 1986–87, at around 500 to 600 t. Currently the Ministry of Fisheries does not have a reliable way to monitor the GUR 2 stock. Red gurnard is a relatively ubiquitous species and, consequently, is present in a high proportion of catches from inshore trawl fisheries in QMA 2. It is taken throughout the year, but higher catches generally occur over spring and summer. Red gurnard is taken mostly as a bottom trawl target species, but is also taken as bycatch, mainly from the tarakihi target trawl fishery. Sampling of the commercial GUR 2 catch commenced in the 2003–04 fishing year (Phillips et al. 2005). This report presents the length and age structure of red gurnard caught in GUR 2 during the 2004–05 fishing year, and compares these results with the previous year.

## Objective 11: Sampling of gemfish for length, sex, and age.

Gemfish are caught in coastal waters around mainland New Zealand in depths ranging from 50 to 550 m. SKI 2 (Figure 4) supported an important trawl fishery through the late 1980s to early 1990s, with annual landings peaking at over 1200 t. The TACC was 1300 t in the early 1990s, but this was reduced first in 1997–98, and again in 2000–01 to its current level of 240 t as the stock assessment indicated declining abundance. The SKI 2 fishery occurs primarily on non-spawning fish from October to April. Gemfish catches are minimal from May to September and it is assumed that adult fish migrate at this time to spawn in the northern waters of SKI 1 (Horn & Hurst 1999). Sampling of the commercial SKI 2 catch commenced in the 1995–96 fishing year, and has been conducted annually since then (Horn et al. 2004). This report presents the length and age structure of gemfish caught in SKI 2 during the 2004–05 fishing year, and compares these results with previous years.

#### Objective 13: Sampling of alfonsino for length, sex, and age.

Alfonsino are primarily associated with undersea structures such as the seamounts that occur off the lower east coast of the North Island (BYX 2) and on the Chatham Rise (BYX 3), in depths from 300–600 m (Figure 5). The TACC for BYX 3 was increased for the 1987–88 fishing year from 220 t to 1000 t, but annual landings remained low until 1993–94. Since 1995–96, landings have exceeded 900 t, reaching a peak of 1197 t in 2001–02. The marked increase in landings since 1994–95 is due mainly to the development of a target trawl fishery for the species, and the discovery of new grounds southeast of the Chatham Islands. Currently, most of the BYX 3 catch is taken from the target bottom trawl fishery comprising a small number of vessels fishing during the summer period. Sampling of the commercial BYX 3 catch commenced in the 2002–03 fishing year (Blackwell et al. 2004) and was continued in 2003–04 (Horn et al. 2004). This report presents the length and age structure of alfonsino caught in BYX 3 during the 2004–05 fishing year, and compares these results with the previous years.

## 10. Methods

## All species

For all the species and stocks analysed below, catch-at-age and catch-at-length estimates were produced using the 'catch-at-age' software developed by NIWA (Bull & Dunn 2002). The software scaled the length frequency of fish from each landing up to the landing weight for each stock, to yield length frequencies by stock. The age-length-sex data was used to generate an age-length-sex key for each stock, through which length data was passed to produce numbers-at-age by sex.

The precision of each length or age frequency for each stock was measured by the mean weighted c.v. This was calculated as the average of the c.v.s for the individual length or age classes weighted by the proportion of fish in each class. The c.v.s were calculated by bootstrapping: fish were re-sampled 300 times with replacement within each landing, and otoliths were randomly re-sampled from the entire set. Objective 9: Sampling of John dory for length, sex, and age.

It was proposed to sample 12 landings from each of the east and west coast bottom trawl fisheries; in the previous two years of sampling 10–12 samples from these two fisheries had produced catch-atage distributions with mean weighted c.v.s over all age classes ranging from 14% to 19% (Phillips & Horn 2004, Horn et al. 2004). Landings of John dory occur throughout the year, but are most common between October and February, when most trawling and Danish seining for target species such as snapper takes place. Consequently, sampling of the fishery was scheduled to occur from October to February. Samples from the two presumed stocks (i.e., JDO 1E and JDO 1W) were analysed separately. There was no stratification by area or time within each stock. All sampled landings were from bottom trawl trips targeting snapper.

From each sample, up to 200 fish were randomly selected, and measured to the nearest centimetre below the total length. Every fourth fish was also sexed and their otoliths taken (totalling 50 fish sexed and otoliths per sample). Only 25% of each sample was sexed as there was reluctance by the fish receivers to allow fish to be cut.

All collected otoliths were read whole and untreated, using the methods of Hanchet et al. (2001).

## Objective 10: Sampling of grey mullet for length, sex, and age.

It was proposed to sample 15 landings from off the west coast of the North Island. Fifteen samples in 2003–04 had produced a catch-at-age distribution with a mean weighted c.v. over all age classes of 24% (Manning & Shearer 2005). Landings of grey mullet occur throughout the year, but are more common in spring and summer. Sampling of the fishery was scheduled to occur from December to March. Collection of length and age data was restricted to periods of a few months, as fish growth blurs length and age distributions collected over too great a time interval. There was no stratification by area or time. All sampled landings were from setnet trips targeting grey mullet.

From each sample, at least 50 fish were randomly selected from each landing, and sampled for fork length (nearest centimetre below), sex, and otoliths.

The preparation of all available otoliths (514) followed the thin section method advocated by McKenzie et al. (1999). The sections were examined under transmitted light at a magnification of x25–50. Completely formed translucent zones were counted.

## Objectives 8 and 12: Sampling of red gurnard for length, sex, and age.

It was proposed to sample 12 landings taken by bottom trawl from each of the GUR 1 east and west coast fisheries, and 15 landings from the GUR 2 bottom trawl fishery. In previous years, 10–13 samples from the GUR 1 fisheries had produced catch-at-age distributions with mean weighted c.v.s over all age classes ranging from 15% to 28% (Manning & Sutton 2004, 2005).

Landings of red gurnard in GUR 1 occur throughout the year, but are most common between October and February, when most trawling for target species such as snapper takes place. Collection of length and age data was restricted to periods of a few months, as fish growth blurs length and age distributions collected over too great a time interval. Consequently, sampling of the fishery was scheduled to occur from October to February. Samples from the two presumed stocks (i.e., GUR 1E and GUR 1W) were analysed separately. There was no stratification by area or time within each stock. All sampled GUR 1 landings were from bottom trawl trips targeting snapper.

Landings of red gurnard in GUR 2 also occur throughout the year, but for the reasons described above for GUR 1, sampling was scheduled to occur from October to February. There was no stratification by area or time. Stratification by vessel type (as described by Phillips et al. 2005) was carried out; a group of 19 high-catch vessels comprised the "BT1" stratum, with all other vessels in the "OTH" stratum. All sampled GUR 2 landings were from bottom trawl trips.

From each sample in GUR 1 and GUR 2, at least 50 fish were randomly selected from each landing, and sampled for total length (nearest centimetre below), sex, and otoliths.

All collected otoliths were prepared and read using the methods of Sutton (1997), i.e., bake, embed in resin, and cross-section.

## Objective 11: Sampling of gemfish for length, sex, and age.

The catch sampling programme aimed to collect 15 samples from the SKI 2 fishery. This number of samples had previously produced catch-at-age distributions for SKI 1 and SKI 2 with mean weighted c.v.s over all age classes lower than the target of 30% (Dunn et al. 2001). Within each sample, at least 50 fish were randomly selected, measured to the nearest centimetre below fork length, sexed, and otoliths taken. Gonad development was classified using a 5-stage macroscopic scale (Table 1).

Sampling strata were based on vessels catches. A set of ten trawlers that had previously accounted for around two thirds of the SKI 2 catch was identified and allocated as a single stratum ("BT1"); ten samples were planned for this stratum. All other vessels catching gemfish by any method were collectively grouped as a single stratum ("OTH"); five samples were planned for this stratum.

Ageing of 560 fish was completed using the method of Horn & Hurst (1999), i.e., whole, untreated otoliths were read immersed in water. Otoliths (from each sex separately) from each 1 cm length class were selected approximately proportionally to their occurrence in the scaled length frequency, with a constraint that at least one otolith from each length class was selected. In addition, all otoliths from fish in the extreme right-hand tail of the scaled length-frequency (constituting about 2% of the otolith sample) were fully selected.

## Objective 13: Sampling of alfonsino for length, sex, and age.

The catch sampling programme aimed to collect 15 samples from the BYX 3 fishery. In each sample, 50 randomly chosen fish were measured to the nearest centimetre below fork length, sexed, and had their otoliths removed. In previous years, a small number of vessels had taken the bulk of the BYS 3

catch over a short summer period (Blackwell et al. 2004, Horn et al. 2004). This trend was again apparent in the 2004–05 year, so a single sampling stratum was defined.

All collected otoliths were read using the using the method of Massey & Horn (1990), i.e., whole, untreated otoliths were read immersed in water.

## 11. Results

#### Objective 9: Sampling of John dory for length, sex, and age.

The landed catch from each of JDO 1E and JDO 1W was determined from an extract provided by the Ministry of Fisheries. In the 2004–05 season, 567 t was landed, of which 54% (306 t) was taken by trawl vessels fishing in JDO 1E, 30% (170 t) was taken by trawl vessels fishing in JDO 1W, and 12% (71 t) was taken by Danish seine vessels fishing in JDO 1E. The remaining 4% of landings was taken by bottom longline in JDO 1E (10 t), and other methods in JDO 1E (3 t) and JDO 1W (7 t).

The scheduled 24 samples were collected; JDO 1E samples were from October and November 2004, JDO 1W samples were from October 2004 to February 2005 (Table 2). The total weight of John dory sampled from the east coast stock represented 2.2% of the east coast landings. The total weight of John dory sampled from the west coast stock represented 6% of the west coast landings. This resulted in a total of 4929 fish measured, and 1208 fish sampled for otoliths and sex for both stocks combined (Table 2).

Each sampled landing in the two stocks was matched with the corresponding trip number in the MFish catch-effort and landings database. All landings in the fishery for each stock (defined here to be all trips by bottom-trawl vessels where fishing effort was recorded in statistical areas valid for each stock and where a positive, non-zero landing of JDO 1 was recorded; referred to as "BT-OTH" below) were also identified. The total landed catch by all vessels, by all vessels in the BT-OTH fishery, and the sampled landed catch are plotted by month of the fishing year in Figure 6. The proportions of fishing effort (number of trawl shots) and estimated John dory catch in all fishing events associated with the sampled trips and for all trips in the fishery were computed by recorded statistical area and target species and overlaid on separate plots for each stock (Figure 7 for JDO 1E and Figure 8 for JDO 1W).

Figure 6 suggests that the sampled landings may not be representative of the distribution of catch in the BT-OTH fishery by month in both stocks, but Figures 7 & 8 suggest that the proportions calculated for the sampled landings are generally close to those calculated for the BT-OTH fishery as a whole in both stocks. This suggests that the sampled landings may be representative of the fishery in both stocks, although both effort and John dory catch in statistical area 005 in JDO 1E and effort and John dory catch when snapper is targeted in both areas are over-represented in the sampled landings in both areas compared with the fishery as a whole in each area.

Length frequencies for the unsexed fish from the east and west stocks for 2004–05 are shown in Figure 9. The distribution ranges from about 20–54 cm for both stocks. The west stock is more normally distributed than the east stock, with the mode at 36 cm. The east stock also has a mode at 36 cm, but a secondary juvenile mode appears truncated at 25 cm. The east distribution has more large and small fish than the west distribution.

Estimated catch-at-age, by sex, for both stocks in 2002–03, 2003–04, and 2004–05 are plotted in Figures 10–11, and listed (for 2004–05 only) in Tables 3 and 4. In the east stock, ages 2–5 dominated both the male and female distributions, with 3-year-old fish tending to be the most abundant age class. For the west stock, ages 3–5 dominated both the male and female distributions, with 3-year-old

fish being the most abundant age class. There are no clear year class progressions between years. However, the relatively abundant 4-year-old fish apparent in both stocks in 2004–05 does follow on from a mode of 3-year-olds in the previous year.

The mean weighted c.v.s across all age classes were 19% and 13% for the east and west stocks, respectively (Tables 3 and 4). Both of these values were under the target c.v. of 30%.

#### Objective 10: Sampling of grey mullet for length, sex, and age.

The landed catch from GMU 1 was determined from an extract provided by the Ministry of Fisheries. In the 2004–05 season, 1145 t was landed, with no clear seasonality apparent. About 85% of landings were from FMA 9, and virtually all landings (99%) were targeted. Setnet fishing accounted for 42% of landings, but a greater percentage (50%) was taken by ring net. Danish seine (7%) and beach seine were the other significant fishing methods.

Ten of the scheduled 15 samples were collected between January and April 2005. The total weight of grey mullet sampled from the west coast stock represented 0.8% of the west coast landings. This resulted in a total of 514 fish measured and sexed, and 514 otoliths (Table 5).

All but one sampled landing was matched with the corresponding trip number in the MFish catcheffort and landings database, although effort data appears to exist in the database for only seven of these trip numbers. Also, although all sampled landings were reportedly from vessels targeting grey mullet with setnets, of the seven sampled landings which could be matched and for which effort data appears to exist, four trips used exclusively ringnet gear, one used a mixture of ringnet and setnet gear, and only two used exclusively setnet gear. There is an obvious inconsistency between the two data sources.

All landings in both the ringnet and setnet target fisheries in the west stock (defined here to be all trips by both ringnet and setnet vessels where grey mullet was targeted and where a positive, non-zero landing of catch in GMU 1 was recorded; referred to as "RN-GMU" and "SN-GMU" below) were also identified in the database. The total landed catch by all vessels, by all vessels in the SN-GMU and RN-GMU fisheries and the sampled landed catch are plotted by month of the fishing year in Figure 12. The proportions of fishing effort (number of ringnet shots in the RN-GMU fishery and the total amount of net set in the SN-GMU fishery) and estimated GMU catch in all fishing events associated with the sampled trips and for all trips in both fisheries were computed by recorded statistical area, target species, and fishery and overlaid on the same plot (Figure 13).

Figure 12 suggests that the sampled landings may not be representative of the distribution of catch in the SN-GMU and RN-GMU fisheries by month and account for a very low proportion of the catch in these fisheries by weight. However, Figure 13 suggests that the proportions calculated for the sampled landings are generally close to those calculated for both the RN-GMU and SN-GMU fisheries in the west stock. This suggests that the sampled landings may be representative of the fisheries in this area, although effort and grey mullet catch in the SN-GMU fishery in statistical area 044 (the Kaipara Harbour) is over-represented in the sampled landings compared with the fishery as a whole.

Length frequencies for male and female fish from the 2004–05 catch are shown in Figure 14. Most males range between 32 and 38 cm fork length; females are relatively common to a length of 44 cm. The catch is dominated by female fish (78% by number). There are clear modes; 35 cm for males and 37 cm for females.

Estimated catch-at-age, by sex, from the GMU 1W fishery in 2003–04 and 2004–05 are plotted in Figure 15, and listed (for 2004–05 only) in Table 6. The 2004–05 catch is dominated by 5 and 6 year

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old fish. It is possible that the strong 4 and 5 year old age classes in 2003–04 had progressed into the 2004–05 fishery.

The mean weighted c.v.s across all age classes was 12%, lower than the target c.v. of 30%.

#### Objective 8: Sampling of red gurnard (GUR 1) for length, sex, and age.

The landed catch from each of GUR 1E and GUR 1W was determined from an extract provided by the Ministry of Fisheries. In the 2004–05 season, 1363 t was landed, 57% (773 t) from GUR 1W, and 43% (590 t) from GUR 1E. In GUR 1W, 87% of the catch was taken by bottom trawl, with Danish seine and setnet accounting for virtually all the remaining landings. About 46% of the landings were targeted. In GUR 1E, 48% of the catch was taken by bottom trawl, with Danish seine and bottom longline each accounting for about 25% of the landings. About 25% of the landings were targeted, but 53% were taken as a by-catch of snapper target fisheries.

The scheduled 24 samples were collected; GUR 1E samples were from October 2004 to February 2005, GUR 1W samples were from October to November 2004 (Table 7). The total weight of red gurnard sampled from the east coast stock represented 2.1% of the east coast landings. The total weight of red gurnard sampled from the west coast stock represented 5.0% of the west coast landings. Sampling produced 1458 measured and sexed fish, and 1418 otoliths, from both stocks combined (Table 7).

Each sampled landing in the two stocks was matched with the corresponding trip number in the MFish catch-effort and landings database. All landings in the fishery in each stock (defined here to be all trips by bottom-trawl vessels where fishing effort was recorded in statistical areas valid for each stock and where a positive, non-zero landing of GUR 1 was recorded; referred to as "BT-OTH" below) were also identified. The total landed catch by all vessels, by all vessels in the BT-OTH fishery, and the sampled landed catch are plotted by month of the fishing year in Figure 16. The proportions of fishing effort (number of trawl shots) and estimated red gurnard catch in all fishing events associated with the sampled trips and for all trips in the fishery were computed by recorded statistical area and target species and overlaid on separate plots for each stock (Figure 17 for GUR 1E and Figure 18 for GUR 1W).

Figure 16 suggests that the sampled landings may not be representative of the distribution of catch in the BT-OTH fishery by month, but Figures17 and 18 suggest that the proportions calculated for the sampled landings are generally close to those calculated for the BT-OTH fishery as a whole in both stocks. This suggests that the sampled landings may be representative of the fishery in both stocks, although both effort and red gurnard catch in statistical area 005 in GUR 1E and in statistical area 042 in GUR 1W and when snapper was targeted in GUR 1W are over-represented in the sampled landings in both areas compared with the fishery as a whole in each area.

Length frequencies for male and female fish from the east and west stocks for 2004–05 are shown in Figure 19. Most males range between 25 and 35 cm total length; females are relatively common to a length of 44 cm. The catch in both areas is dominated by female fish; 92% (by number) of the GUR 1W landings, and 78% of the GUR 1E landings are females. There is no clear male mode for GUR 1W, but GUR 1E males have a mode at 30 cm. GUR 1E females also have a mode at 30 cm, while for GUR 1W females the mode is 1 cm higher. There is a greater proportion of larger fish in the west population.

Estimated catch-at-age, by sex, for both stocks in 2002–03, 2003–04, and 2004–05 are plotted in Figures 20–21, and listed (for 2004–05 only) in Tables 8 and 9. In the east stock, ages 2–5 dominated both the male and female distributions, with 2 and 3-year-old fish being the most abundant age classes. For the west stock, ages 3–6 dominated the distributions, with 3-year-old fish generally being the most abundant age class. There are no clear year class progressions between years. However, the

relatively abundant 3-year-old fish apparent in the GUR 1W stock in 2002–03 may have progressed through the two following years.

The mean weighted c.v.s across all age classes were 19% and 25% for the east and west stocks, respectively (Tables 8 and 9). Both of these values were under the target c.v. of 30%.

#### Objective 12: Sampling of red gurnard (GUR 2) for length, sex, and age.

The landed catch from GUR 2 was determined from an extract provided by the Ministry of Fisheries. In the 2004–05 season, 719 t was landed. Almost 99% of the catch was taken by bottom trawl, with setnet accounting for virtually all the remaining landings. About 71% of the landings were targeted, with a further 22% taken as a bycatch of the tarakihi trawl fishery.

Fifteen samples were planned but 12 samples were collected from October 2004 to April 2005 (Table 7). The total weight of red gurnard sampled represented 9.5% of the GUR 2 landings. This resulted in a total of 574 fish being measured and sexed, and 574 otoliths (Table 7). The eight sampled trips from the BT1 stratum were all taken from statistical areas 013 and 014 adjacent to Hawke Bay. Reported target species for these trips were red gurnard (3 trips), tarakihi (4 trips), and snapper (1 trip). The four "OTH" trips were from statistical areas 013, 014, and 015, and they targeted tarakihi (3 trips) and snapper (1 trip).

Eleven of the twelve sampled landings in the stock were matched with the corresponding trip number in the MFish catch-effort and landings database. All landings in the fishery (defined here to be all trips by bottom-trawl vessels where fishing effort was recorded in statistical areas valid for the stock and where a positive, non-zero landing of GUR 2 was recorded; referred to as "BT-OTH" below) were also identified. The total landed catch by all vessels, by all vessels in the BT-OTH fishery and the sampled landed catch are plotted by month of the fishing year in Figure 22. The proportions of fishing effort (number of trawl shots) and estimated red gurnard catch in all fishing events associated with the sampled trips that could be matched and for all trips in the fishery were computed by recorded statistical area and target species and overlaid on separate plots for each stock (Figure 23).

Figure 22 suggests that the sampled landings may not be representative of the distribution of catch in the BT-OTH fishery by month. Figure 23 suggests that there are some large differences in the proportions calculated for the sampled landings compared with BT-OTH fishery as a whole in the stock. Estimated catch in statistical area 013 is under-represented in the sampled landings compared with the entire BT-OTH fishery, although effort in this statistical area is only slightly under-represented in the sampled landings compared with the entire BT-OTH fishery. More troublesome is the under-representation of both effort and red gurnard catch when red gurnard is targeted and over-representation of both effort and catch when tarakihi is targeted in the sampled landings compared with the fishery as a whole. These results suggest that fishing practices in the sampled landings may not be representative of the fishery.

Length frequencies for male and female fish from GUR 2 in 2004–05 are shown in Figure 254. Most males range between 27 and 41 cm total length; females are relatively common to a length of 47 cm. The catch is dominated by female fish (69% by number). There is a clear male mode at 30 cm, and a secondary mode at 36–37 cm. There is no clear mode in the female distribution.

Estimated catch-at-age, by sex, for GUR 2 in 2003–04 and 2004–05 are plotted in Figure 245, and listed (for 2004–05 only) in Table 10. The catch in both years is dominated by 2–4 year old fish. No year class progressions are apparent. The mean weighted c.v. across all age classes was 15%, lower than the target c.v. of 30%.

Objective 11: Sampling of gemfish for length, sex, and age.

The landed catch from SKI 2 was determined from an extract provided by the Ministry of Fisheries. In the 2004–05 season, 264 t was landed, of which 84% (221 t) was taken by BT1 vessels, and 16% by OTH vessels (Table 11). The SKI 2 target fishery during the 2004–05 fishing year was of short duration, with most of the catch being taken between November and February.

Fifteen samples were planned, but 12 were collected between 14 October 2004 and 18 January 2005 (Table 11). The target number of BT1 samples was achieved, but landings by these vessels were sometimes small (i.e., less than 1 tonne). Samples from OTH vessels were difficult to obtain; landings from these vessels were often less than 50 fish, so were not sampled. The samples were collected from the ports of Auckland, Napier, Gisborne, Wellington, Picton, and Nelson. The total weight of gemfish sampled (53 t) from SKI 2 represented 20% of the total SKI 2 landings. A total of 611 fish were measured and sexed, and 611 otoliths (Table 11).

Each sampled landing in the stock was matched with the corresponding trip number in the MFish catch-effort and landings database. All landings in the target gemfish fishery (defined here to be all trips by fishing vessels where bottom or midwater trawls were used to target gemfish in statistical areas valid for the stock and where a positive, non-zero landing of SKI 2 was recorded; referred to as the "BT-MW-SKI" fishery below) were also identified. The total landed catch by all vessels, by all vessels in the BT-MW-SKI fishery and the sampled landed catch are plotted by month of the fishing year in Figure 26. The proportions of fishing effort (number of trawl shots) and estimated gemfish catch in all fishing events associated with the sampled and all trips in the fishery were computed by recorded statistical area and target species and were overlaid on the same plot (Figure 27).

Figure 26 suggests that the sampled landings may be representative of the distribution of catch in the BT-MW-SKI fishery by month and appear to represent a fair proportion of catch in this fishery by weight. Figure 27 suggests that the proportions calculated for the sampled landings are generally close or very close to those calculated for the BT-MW-SKI fishery as a whole in the stock. These results suggest that the sampled landings are representative of the fishery.

The gonad stages are summarised in Table 12. A total of 135 males and 470 females were staged. 47% of males and 37% of females sampled were in the immature/resting stage (stage 1). All the remaining males, and most of the remaining females, were maturing/developing (stage 2). A few females (0.5%) were spent (stage 5).

Length frequencies from SKI 2 for 2004–05 are shown in Figure 28. The distribution ranges from 31-117 cm, with broad modes at around 64 cm and 70–75 cm for males, and 66 cm and 75–80 cm for females. The catch is dominated by females (75% by number).

The estimated catch-at-age, by sex, for 2004–05 is listed in Table 13. Plots of the age frequencies from the 1995–96 to 2004–05 fishing years are presented in Figure 29. A relatively strong class of 4-year-old fish apparent in 2002–03 (i.e., the 1998 year class) has progressed into the distributions for the current year. However, no exceptionally strong or weak year classes are apparent in the current population. Most captured fish appear to be less than 9 years old, which is expected given that the SKI 2 fishery targets non-spawning gemfish, including young, immature fish.

The mean weighted c.v. across all age classes was 31%, just higher than the target c.v. of 30%.

## Objective 13: Sampling of alfonsino for length, sex, and age.

Catch sampling for alfonsino from BYX 3 was carried out on landings at the ports of Nelson and Wellington. Fifteen samples were planned but 13 were collected between 24 November 2004 and

20 May 2005. A total of 433 t (41% of the total landings), were sampled. The samples produced a total of 650 measured and sexed fish and 650 otoliths (Table 14).

Each sampled landing in the stock was matched with the corresponding trip number in the MFish catch-effort and landings database. All landings in the target alfonsino fishery (defined here to be all trips by fishing vessels where bottom or midwater trawls were used to target alfonsino in statistical areas valid for the stock and where a positive, non-zero landing of BYX 3 was recorded; referred to as the "BT-MW-BYX" fishery below) were also identified. The total landed catch by all vessels, by all vessels in the BT-MW-BYX fishery and the sampled landed catch are plotted by month of the fishing year in Figure 30. The proportion of fishing effort (number of trawl shots) and estimated alfonsino catch in all fishing events associated with the sampled and all trips in the fishery were computed by recorded statistical area and target species and were overlaid on the same plot (Figure 31).

Figure 30 suggests that the sampled landings may be representative of the distribution of catch in the BT-MW-BYX fishery by month and appear to represent a large proportion of catch in this fishery by weight. Figure 31 suggests that the proportions calculated for the sampled landings are generally close or very close to those calculated for the BT-MW-BYX fishery as a whole in the stock. These results suggest that the sampled landings are representative of the fishery although estimated catch in statistical area 051 is slightly over-represented and 049 slightly under-represented in the sampled landings compared with the entire BT-MW-BYX fishery.

Length-frequency distributions, scaled to represent the sampled catch, show the male length range to be 26-45 cm FL and the female range to be 24-49 cm FL (Figure 32). The male length mode (34-35 cm) is similar than the female mode (34-37 cm).

The age-frequency distributions from the 2002–03, 2003–04, and 2004–05 fishing years differ between years (Figure 33, Table 15). The sampled catch was dominated by 7–10 year old fish in the first two years, but by 4–8 year old fish in the most recent year. However, there is some evidence of year class progression. A mode of 5 and 6 year old females in 2003–04 progressed to dominate the 2004–05 female distribution as 6 and 7 year olds.

The mean weighted c.v. across all age classes was 30%, just on the target c.v. of 30%.

## 12. Conclusions

Estimated catch-at-length and catch-at-age from samples of the commercial catch from various Fishstocks in QMAs 1, 2, and 3 are presented above. All samples extended existing series of catch-at-age for these species. The targeted number of samples was met in two fisheries (JDO 1 and GUR 1) and was almost met for the other species which all had a target of 15 samples, i.e., 10 samples achieved for GMU 1, 12 for GUR 2, 12 for SKI 2, and 13 for BYX 3.

Matching the sampled landings with the corresponding trip numbers stored in the MFish catch-effort and landings database and investigating the distributions of estimated catch and effort by statistical area and target species separately for the sampled landings and each fishery as a whole and comparing the results for each fishstock suggested that the data collected in SKI 2 and BYX 3 are representative of the corresponding fisheries, the data collected in JDO 1, GMU 1, and GUR 1 may be representative of the corresponding fisheries, and the data collected in GUR 2 may not be representative of the corresponding fishery. Matching the sampled landings and the distributions of estimated catch by month for the sampled landings and each fishery as a whole and comparing the results for each fishstock suggested that data collected was representative for the SKI 2 and BYX 3 fisheries but was probably not representative for the other fisheries.

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The existing sample regime is therefore probably adequate for the BYX 3 and SKI 2 fisheries, may be adequate for the JDO 1, GMU 1, and GUR 2 fisheries, and probably is not adequate for the GUR 2 fishery. An adequate sampling regime should be devised for the GUR 2 fishery and the previous sampling regimes for the JDO 1, GMU 1, and GUR 1 fisheries should be revised to ensure that future sampling of these fisheries produces data that represent the spatial and temporal nature of the sampled fisheries. A more in-depth and quantitative consideration of this subject is beyond the scope of this report.

The mean weighted c.v. for the calculated catch-at-age distribution was on or below the target of 30% for all fisheries except SKI 2 (its c.v. was 31%), although we note that such precision in the presence of bias (i.e., sampling non-representivity) is meaningless. Only gemfish exhibited strong year-class progression patterns (although this species is aided by having by far the longest data series). All other species exhibited weak or no progressions.

## 13. Publications

Nil.

## 14. Data storage

All catch sampling data used in the analyses presented above are stored on the *market* database, and all age data are stored on the *age* database. Both databases are administered by NIWA for the Ministry of Fisheries.

#### 15. Acknowledgements

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Table 1: 1	Macroscopic	gonad	stages	for	gemfish.
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Stage	Name of stage	Description			
		Female	Male		
1	Immature/resting	Oval, transparent	Threadlike		
2	Developing	Granular, cells/oocytes visible	Hard with edge		
3	Maturing	Some hyaline (transparent) eggs	Viscous milt if cut		
4	Running ripe	Hyaline eggs, running	Running milt		
5	Spent	Bloody, flabby	Blotchy, bloody, hard		

Table 2: Summary of catch sampling for John dory from JDO 1 in the 2004–05 fishing year.

			Samples	Num	ber of fish		Catch (t)
Stock	Method	Planned	Achieved	Measured	Otoliths	Sampled	Landed
JDO 1E	Bottom trawl	12	12	2 422	605	8.5	392
JDO IW	Bottom trawl	12	12	2 507	603	10.5	175

Table 3: Scaled catch-at-age (numbers and percentage) and calculated c.v.s from catch sampling in JDO 1E in 2004–05. The numbers of fish aged by sex, and the estimated mean weighted c.v. for both sexes, are also presented. –, no data.

			Male			Female
Age	Number	%	c.v.	Number	%	c.v.
1	1 276	0.29	1.191	1 276	0.29	1.172
2	33 032	7.55	0.228	12 391	2.83	0.411
3	72 416	16.55	0.237	56 672	12.95	0.216
4	82 685	18.89	0.101	55 215	12.62	0.108
5	36 690	8.38	0.134	42 397	9.69	0.154
6	11 425	2.61	0.254	27 152	6.20	0.201
7	1 937	0.44	0.594	3 058	0.70	0.515
8	0	0.00	-	0	0.00	-
Total aged			317			287
Mean weigl	hted c.v. (bo	th sexes)				18.7

Table 4: Scaled catch-at-age (numbers and percentage) and calculated c.v.s from catch sampling in JDO 1W in 2004–05. The numbers of fish aged by sex, and the estimated mean weighted c.v. for both sexes, are also presented. –, no data.

			Male			Female
Age	Number	%	c.v.	Number	%	c.v.
1	142	0.07	1.394	142	0.07	1.328
2	4 246	2.04	0.397	2 970	1.43	0.432
3	48 688	23.42	0.114	31 388	15.10	0.120
4	44 894	21.60	0.082	33 771	16.24	0.089
5	13 757	6.62	0.150	16 142	7.76	0.136
6	5 972	2.87	0.210	3 140	1.51	0.321
7	1 033	0.50	0.604	1 232	0.59	0.496
8	369	0.18	1.136	0	0.00	_
Total aged			319			282
Mean weigh	nted c.v. (bo	th sexes)				13.3

Table 5: Summary of catch sampling for grey mullet from GMU 1 in the 2004–05 fishing year.

			Samples	Num	<u>ber of fish</u>	<u> </u>	Catch (t)
Stock	Method	Planned	Achieved	Measured	Otoliths	Sampled	Landed
GMU IW	Set or ring net	15	10	515	514	7.6	973
GMU IE	-	0	0	0	0	0	172

Table 6: Scaled catch-at-age (numbers and percentage) and calculated c.v.s from catch sampling in GMU 1 in 2004–05. The numbers of fish aged by sex, and the estimated mean weighted c.v. for both sexes, are also presented. –, no data.

			<u>Male</u>			<u>Female</u>
Age	Number	%	c.v.	Number	%	c.v.
1	0	0.00	-	0	0.00	
2	0	0.00	0	2 443	0.24	0.883
3	7 363	0.74	0.667	23 520	2.35	0.404
4	9 237	0.92	0.689	61 389	6.13	0.272
5	88 980	8.89	0.383	348 558	34.83	0.119
6	102 081	10.20	0.347	323 289	32.30	0.106
7	3 370	0.34	0.861	14 599	1.46	0.388
8	3 126	0.31	1.177	6 787	0.68	0.673
9	1 489	0.15	1.382	2 312	0.23	1.066
10	0	0.00	_	0	0.00	_
11	0	0.00	-	2 276	0.23	1.657
Total me	easured		119			396
Total aged			119			393
Mean w	eighted c.v. (by	v sex)	41.5			15.4
Mean w	eighted c.v. (bo	oth sexes)				12.2

Table 7: Summary of catch sampling for red gurnard from GUR 1 and GUR 2 in the 2004–05 fishing year.

			Samples	Num	<u>ber of fish</u>		Catch (t)
Stock	Stratum	Planned	Achieved	Measured	Otoliths	Sampled	Landed
GUR 1E	Bottom trawl	12	12	730	714	12.3	590
GUR 1W	Bottom trawl	12	12	728	704	38.4	773
GUR 2	BT1	10	8	398	398	3.9	584
	OTH	5	4	176	176	2.9	136

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Table 8: Scaled catch-at-age (numbers and percentage) and calculated c.v.s from catch sampling in GUR 1E in 2004–05. The numbers of fish aged by sex, and the estimated mean weighted c.v. for both sexes, are also presented. –, no data.

			Male			Female
Age	Number	%	c.v.	Number	%	c.v.
1	9 929	0.59	0.980	63 662	3.81	0.522
2	141 767	8.48	0.347	355 512	21.27	0.207
3	100 276	6.00	0.333	301 161	18.02	0.126
4	30 187	1.81	0.366	185 444	11.10	0.126
5	44 747	2.68	0.375	153 662	9.19	0.134
6	11 768	0.70	0.686	93 531	5.60	0.182
7	19 854	1.19	0.485	63 909	3.82	0.223
8	11 007	0.66	0.577	62 718	3.75	0.209
9	0	0.00	_	12 292	0.74	0.427
10	1 751	0.10	1.181	1 898	0.11	1.032
11	0	0.00	-	1 249	0.07	1.593
12	0	0.00	-	1 837	0.11	1.150
13	0	0.00	-	0	0.00	
14	0	0.00	-	0	0.00	
15	3 172	0.19	1.235	0	0.00	-
Total measured			139			591
Total ag	ed		134			567
Mean w	eighted c.v. (by	sex)	40.1			18.8
Mean w	eighted c.v. (bo	th sexes)				18.9

Table 9: Scaled catch-at-age (numbers and percentage) and calculated c.v.s from catch sampling in GUR 1W in 2004-05. The numbers of fish aged by sex, and the estimated mean weighted c.v. for both sexes, are also presented. –, no data.

			Male			<u>Female</u>
Age	Number	%	c.v.	Number	%	c.v.
1	0	0.00	_	0	0.00	
2	5 985	0.35	0.778	43 772	2.58	0.630
3	10 472	0.62	0.590	266 651	15.72	0.447
4	19 759	1.16	0.446	243 578	14.36	0.336
5	15 261	0.90	0.508	321 945	18.98	0.149
6	20 208	1.19	0.455	282 542	16.66	0.113
7	7 501	0.44	0.640	115 564	6.81	0.235
8	22 577	1.33	0.492	92 940	5.48	0.177
9	14 627	0.86	0.511	78 540	4.63	0.211
10	10 037	0.59	0.613	54 029	3.19	0.319
11	1 389	0.08	1.108	44 773	2.64	0.367
12	6 722	0.40	0.808	8 497	0.50	0.728
13	0	0.00	-	3 431	0.20	0.845
14	2 106	0.12	1.435	2 455	0.14	0.988
15	0	0.00	_	0	0.00	-
16	0	0.00		929	0.05	1.394
Total me	asured		114			614
Total age	ed		111			600
Mean we	eighted c.v. (by	sex)	56.0			26.7
Mean we	eighted c.v. (bo	th sexes)				24.8

Table 10: Scaled catch-at-age (numbers and percentage) and calculated c.v.s from catch sampling in GUR 2 in 2004–05. The numbers of fish aged by sex, and the estimated mean weighted c.v. for both sexes, are also presented. –, no data.

			Male			Female
Age	Number	%	c.v.	Number	%	c.v.
1	2 548	0.17	2.461	2 657	0.18	1.053
2	184 153	12.63	0.326	307 805	21.10	0.200
3	141 998	9.74	0.250	347 270	23.81	0.163
4	59 129	4.05	0.298	138 511	9.50	0.159
5	30 034	2.06	0.388	79 938	5.48	0.194
6	16 184	1.11	0.446	53 124	3.64	0.257
7	8 499	0.58	0.603	26 338	1.81	0.332
8	6 924	0.47	0.615	28 193	1.93	0.334
9	1 100	0.08	1.522	9 858	0.68	0.561
10	0	0.00	-	2 838	0.19	1.042
11	4 638	0.32	0.838	0	0.00	_
12	0	0.00	_	744	0.05	1.723
13	0	0.00	_	2 094	0.14	1.333
14	1 947	0.13	1.074	0	0.00	_
15	0	0.00	_	1 939	0.13	1.286
Total m	easured		191			383
Total ag	ged		179			373
Mean w	eighted c.v. (by	/ sex)	34.0			20.5
Mean w	reighted c.v. (bo	oth sexes)				15.2

Table 11: Summary of catch sampling for gemfish from SKI 2 in the 2004–05 fishing year.

			Samples	Number of fish		Catch (t)	
Stratum	Period	Planned	Achieved	Measured	Otoliths	Sampled	Landed
BT1	Oct-May	10	10	510	510	51.4	221
OTH	Oct-May	5	2	101	101	1.3	43

Table 12: Gonad stage (%) of male and female gemfish from SKI 2. n, number of fish staged.

Stage	Male	Female
1	64	172
2	71	278
3	0	0
4	0	0
5	0	20
Ν	135	470

Table 13: Estimated catch-at-age (numbers and percentage) and calculated c.v.s from catch sampling in SKI 2 in 2004–05. The numbers of fish measured and aged, and the estimated mean weighted c.v.s, are also presented. –, no data.

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			Male			Female
Age	Number	%	c.v.	Number	%	c.v.
2	125	0.17	1.594	681	0.92	1.310
3	568	0.77	1.037	500	0.68	1.075
4	3 598	4.87	0.490	9 284	12.58	0.292
5	3 434	4.65	0.568	10 851	14.70	0.200
6	3 323	4.50	0.384	9 063	12.28	0.261
7	2 638	3.57	0.517	9 696	13.14	0.287
8	1 384	1.87	0.636	2 659	3.60	0.341
9	1 042	1.41	0.891	3 877	5.25	0.338
10	728	0.99	0.761	2 498	3.38	0.363
11	396	0.54	1.110	602	0.82	0.647
12	232	0.31	1.126	742	1.01	0.608
13	107	0.14	1.359	1 607	2.18	0.351
14	0	0.00	_	89	0.12	0.843
15	351	0.48	1.370	1 656	2.24	0.422
16	386	0.52	1.905	333	0.45	0.600
17	0	0.00	_	177	0.24	0.672
18	18	0.02	2.347	492	0.67	0.495
19	0	0.00	_	173	0.23	1.004
20	0	0.00	-	145	0.20	0.978
21	297	0.40	1.487	31	0.04	1.528
22	0	0.00	-	31	0.04	1.441
Total measured			141			470
Total aged			127			433
Mean weighted c.v. (by sex)			64.7			32.1
Mean w	eighted c.v. (bo	th sexes)				30.9

Table 14: Summary of catch sampling for alfonsino from BYX 3 in the 2004–05 fishing year.

		Samples		Nur	nber of fish	Catch (t)	
Stratum	Period	Planned	Achieved	Measured	Otoliths	Sampled	Landed
All vessels	Nov–May	15	13	650	650	433	1 062

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Table 15: Estimated catch-at-age (numbers and percentage) and calculated c.v.s from catch sampling in BYX 3 in 2004–05. The numbers of fish measured and aged, and the estimated mean weighted c.v.s, are also presented. –, no data.

			Male			Female
Age	Number	%	c.v.	Number	%	c.v.
ĩ	7	0.00	1.744	0	0.00	_
2	6 846	0.67	1.221	6 984	0.68	1.375
3	38 712	3.78	0.728	47 984	4.69	0.827
4	33 508	3.27	0.364	67 640	6.61	0.391
5	52 448	5.12	0.263	63 322	6.19	0.266
6	53 642	5.24	0.283	86 660	8.47	0.231
7	48 365	4.72	0.296	84 002	8.21	0.218
8	66 491	6.50	0.258	54 108	5.29	0.236
9	28 085	2.74	0.317	30 290	2.96	0.276
10	24 842	2.43	0.346	35 915	3.51	0.249
11	29 299	2.86	0.361	30 105	2.94	0.311
12	7 302	0.71	0.566	36 204	3.54	0.294
13	14 931	1.46	0.402	21 309	2.08	0.425
14	3 062	0.30	0.935	19 705	1.92	0.403
15	5 439	0.53	0.800	7 711	0.75	0.571
16	624	0.06	1.720	9 568	0.93	0.566
17	0	0.00	_	2 143	0.21	1.018
18	0	0.00	-	6 390	0.62	0.779
Total measured			257			392
Total aged			254			379
Mean weighted c.v. (by sex)			37.6			35.2
Mean w	eighted c.v. (bo	th sexes)				29.7



Figure 1: Definitions for the JDO 1 fishery used in this report. JDO 1W is in QMA 9, and JDO 1E is in QMA 1.



Figure 2: The boundaries of grey mullet fishstocks (solid black lines). The 250 and 1000 m depth contours are overlaid (solid grey lines). GMU 1 is divided into GMU 1(E) and GMU 1(W) along the line separating fisheries management areas 1 (AKE) and 9 (AKW) (dashed black line).



Figure 3: Map of the New Zealand EEZ showing the boundaries of red gurnard fishstocks (solid black lines). The 250 and 1000 m depth contours are overlaid (solid grey lines). GUR 1 is divided into AKE (GUR 1E) and AKW (GUR 1W) along the line separating QMAs 1 and 9 (dashed black line).



Figure 4: Definitions for the northern gemfish fisheries used in this report.



Figure 5: Definitions for the alfonsino fisheries used in this report.

(a) JDO 1 (AKE)



Figure 6: Summaries of fishing and sampling activity in (a) JDO 1 (AKE) and (b) JDO 1 (AKW) during the 2004–05 fishing year. Histograms of the total reported landed catch (dark-grey bars), total reported landed catch by vessels in the BT-OTH fishery (Fleet, light-grey bars) and the sampled (white bars) catch are overlaid on each plot. Numbers of landings by each group are also overlaid for comparison with the sampled landings.



Figure 7: Comparing the total reported estimated catch by (a) statistical area and (b) target species for the BT-OTH fishery in JDO 1 (AKE) during the 2004–05 fishing year. The catches for all sampled landings and the BT-OTH fishery as a whole are plotted separately and overlaid.

Figure 8: Comparing the total reported estimated catch by (a) statistical area and (b) target species for the BT-OTH fishery in JDO 1 (AKW) during the 2004–05 fishing year. The catches for all sampled landings and the BT-OTH fishery as a whole are plotted separately and overlaid.







Figure 10: Estimated age-frequency distributions of male and female John dory from the JDO 1E bottom trawl fishery, from the 2002–03 to 2004–05 fishing years.



Figure 11: Estimated age-frequency distributions of male and female John dory from the JDO 1W bottom trawl fishery, from the 2002–03 to 2004–05 fishing years.



Figure 12: Summaries of fishing and sampling activity in GMU 1 (AKW) during the 2004–05 fishing year. Histograms of the total reported landed catch (dark-grey bars), total reported landed catch by vessels in the SN-GMU plus the RN-GMU fisheries (Fleet, light-grey bars) and the sampled (white bars) catch are overlaid on each plot. Numbers of landings by each group are also overlaid for comparison with the sampled landings.

#### (a) statistical area



Figure 13: Comparing the total reported estimated catch by (a) statistical area and (b) target species for the SN-GMU and RN-GMU fisheries in GMU 1 (AKW) during the 2004–05 fishing year. The catches for all sampled landings and for the SN-GMU or RN-GMU fisheries as a whole are plotted separately and overlaid.



Figure 14: Scaled length-frequency distributions of male and female grey mullet from GMU 1(W), in the 2004–05 fishing year.



Figure 15: Estimated age-frequency distributions of male and female grey mullet from the GMU 1W fishery, in the 2003–04 to 2004–05 fishing years.

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(a) GUR 1 (AKE)



Figure 16: Summaries of fishing and sampling activity in (a) GUR 1 (AKE) and (b) GUR 1 (AKW) during the 2004–05 fishing year. Histograms of the total reported landed catch (dark-grey bars), total reported landed catch by vessels in the BT-OTH fishery (Fleet, light-grey bars) and the sampled (white bars) catch are overlaid on each plot. Numbers of landings by each group are also overlaid for comparison with the sampled landings.



Figure 17: Comparing the total reported estimated catch by (a) statistical area and (b) target species for the BT-OTH fishery in GUR 1 (AKE) during the 2004–05 fishing year. The catches for all sampled landings and the BT-OTH fishery as a whole are plotted separately and overlaid.

Figure 18: Comparing the total reported estimated catch by (a) statistical area and (b) target species for the BT-OTH fishery in GUR 1 (AKW) during the 2004–05 fishing year. The catches for all sampled landings and the BT-OTH fishery as a whole are plotted separately and overlaid.



Figure 19: Scaled length-frequency distributions of male and female red gurnard from the bottom trawl fisheries in GUR 1E and GUR 1W, in the 2004–05 fishing year.



Figure 20: Estimated age-frequency distributions of male and female red gurnard from the GUR 1E bottom trawl fishery, from the 2002–03 to 2004–05 fishing years.



Figure 21: Estimated age-frequency distributions of male and female red gurnard from the GUR 1W bottom trawl fishery, from the 2002–03 to 2004–05 fishing years.



Figure 22: Summaries of fishing and sampling activity in GUR 2 during the 2004–05 fishing year. Histograms of the total reported landed catch (dark-grey bars), total reported landed catch by vessels in the BT-OTH fishery (Fleet, light-grey bars) and the sampled (white bars) catch are overlaid on each plot. Numbers of landings by each group are also overlaid for comparison with the sampled landings.



Figure 23: Comparing the total reported estimated catch by (a) statistical area and (b) target species for the BT-OTH fishery in GUR 2 during the 2004–05 fishing year. The catches for all sampled landings and the BT-OTH fishery as a whole are plotted separately and overlaid.



Figure 24: Estimated age-frequency distributions of male and female red gurnard from the GUR 2 bottom trawl fishery, from the 2003–04 and 2004–05 fishing years.


Figure 25: Scaled length-frequency distributions of male and female red gurnard from the bottom trawl fisheries in GUR 2, in the 2004–05 fishing year.



Figure 26: Summaries of fishing and sampling activity in SKI 2 during the 2004–05 fishing year. Histograms of the total reported landed catch (dark-grey bars), total reported landed catch by vessels in the BT-MW-SKI fishery (Fleet, light-grey bars) and the sampled (white bars) catch are overlaid on each plot. Numbers of landings by each group are also overlaid for comparison with the sampled landings.



Figure 27: Comparing the total reported estimated catch by (a) statistical area and (b) target species for the BT-MW-SKI fishery in SKI 2 during the 2004–05 fishing year. The catches for all sampled landings and the BT-MW-SKI fishery as a whole are plotted separately and overlaid.



Figure 28: Scaled length-frequency distributions of male and female gemfish from SKI 2, in the 2004–05 fishing year.



Figure 29: Estimated age-frequency distributions, by sex, of the gemfish catch from SKI 2 in fishing years 1995–96 to 1999–2000.



Figure 30: Summaries of fishing and sampling activity in BYX 3 during the 2004–05 fishing year. Histograms of the total reported landed catch (dark-grey bars), total reported landed catch by vessels in the BT-MW-BYX fishery (Fleet, light-grey bars) and the sampled (white bars) catch are overlaid on each plot. Numbers of landings by each group are also overlaid for comparison with the sampled landings.



Figure 31: Comparing the total reported estimated catch by (a) statistical area and (b) target species for the BT-MW-BYX fishery in BYX 3 during the 2004-05 fishing year. The catches for all sampled landings and the BT-MW-BYX fishery as a whole are plotted separately and overlaid.

(a) statistical area



Figure 32: Scaled length-frequency distributions of male and female alfonsino from BYX 3, in the 2004–05 fishing year.



Figure 33: Estimated age-frequency distributions of male and female alfonsino from the BYX 3 trawl fishery, from the 2002–03 to 2004–05 fishing years.

# Commercial catch sampling for length and age of John dory in JDO 1, grey mullet in GMU 1, red gurnard in GUR 1 and GUR 2, gemfish in SKI 2, and alfonsino in BYX 3, in the 2004–05 fishing year.

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Final Research Report for Ministry of Fisheries Research Project INS2003-01

Objectives 8, 9, 10, 11, 12, & 13.

National Institute of Water and Atmospheric Research

November 2006

# Final Research Report Ministry of Fisheries Project INS2003-01, Objectives 8, 9, 10, 11, 12, & 13

Report Title		Commercial catch sampling for length and age of John dory in JDO 1, grey mullet in GMU 1, red gurnard in GUR 1 and GUR 2, gemfish in SKI 2, and alfonsino in BYX 3, in the 2004–05 fishing year.			
Au	thors	P.L. Horn, P.J. McMillan, M.J. Manning, C.P. Sutton			
1.	Date	27 November 2006			
2.	Contractor	National Institute of Water and Atmospheric Research Limited (NIWA)			
3.	Project Title	Sampling commercial catch in QMAs 1, 2, and 3			
4.	Project Code	INS2003-01			
5.	Project Leader	P.J. McMillan			
6.	<b>Duration of Project</b> Start Date Expected competition date	1 October 2003 31 March 2006			

# 7. Objectives

# In QMA 1

- 8. To conduct sampling in fish processing sheds and determine the length and age composition of the commercial catch of red gurnard (*Chelidonichthys kumu*) in GUR 1 during the 2004/05 fishing year. The target coefficient of variation (c.v.) for the catch-at-age is 30% (mean weighted c.v. across all age classes).
- 9. To conduct sampling in fish processing sheds and determine the length and age composition of the commercial catch of John dory (*Zeus faber*) in JDO 1 during the 2004/2005 fishing year. The target coefficient of variation (c.v.) for the catch-at-age is 30% (mean weighted c.v. across all age classes).
- 10. To conduct sampling in fish processing sheds and determine the length and age composition of the commercial catch of grey mullet (*Mugil cephalus*) in GMU 1 during the 2004/2005 fishing year. The target coefficient of variation (c.v.) for the catch-at-age is 30% (mean weighted c.v. across all age classes).

# In QMA 2

11. To conduct sampling in fish processing sheds and determine the length and age composition of the commercial catch of gemfish (*Rexea solandri*) in SKI 2 during the 2004/2005 fishing year. The target coefficient of variation (c.v.) for the catch-at-age is 30% (mean weighted c.v. across all age classes).

12. To conduct sampling in fish processing sheds and determine the length and age composition of the commercial catch of red gurnard in GUR 2 during the 2004/05 fishing years. The target coefficient of variation (c.v.) for the catch-at-age is 30% (mean weighted c.v. across all age classes).

# In QMA 3

13. To conduct sampling in fish processing sheds and determine the length and age composition of the commercial catch of alfonsino (*Beryx splendens*) in BYX 3 during the 2004/2005 fishing years. The target coefficient of variation (c.v.) for the catch-at-age is 30% (mean weighted c.v. across all age classes).

# 8. Executive summary

This report describes the sampling programme carried out on commercial landings of John dory (Zeus faber) in JDO 1, grey mullet (*Mugil cephalus*) in GMU 1, red gurnard (*Chelidonichthys kumu*) in GUR 1 and GUR 2, gemfish (*Rexea solandri*) in SKI 2, and alfonsino (*Beryx splendens*) in BYX 3, during the 2004–05 fishing year, and the subsequent estimates of catch-at-age for these fisheries. This report fulfils the reporting requirements of Objectives 8, 9, 10, 11, 12, and 13 of project INS2003/01.

John dory in JDO 1 is managed as a single stock, but it is believed it consists of two separate stocks, i.e., an east stock (JDO 1E) and west stock (JDO 1W). This report treats JDO 1 as two stocks. Sampling occurred between October 2004 and February 2005, and the target number of samples was achieved in both stocks. The mean weighted c.v.s over all age classes were 19% and 13% for the east and west stocks, respectively, both below the target c.v. of 30%. The JDO 1E trawl fishery was dominated by 2–5 year old fish, while 3–5 year old fish dominated the JDO 1W trawl fishery. This pattern is consistent with previous years.

Grey mullet in GMU 1 is managed as a single stock, but it is believed it consists of two separate stocks, i.e., an east (GMU 1E) and a west (GMU 1W) stock with a boundary at North Cape. However, most of the landings come from the west stock, and all the samples were taken in this area. Ten of the planned 15 samples were taken between January and April 2005. The mean weighted c.v. over all age classes was 12%, below the target c.v. of 30%. The GMU 1W fishery was dominated by 5–6 year old fish.

Red gurnard off the north and east coasts of the North Island are managed as two stocks: GUR 1 and GUR 2. However, GUR 1 is believed to consist of two separate stocks, i.e., an east stock (GUR 1E) and west stock (GUR 1W). This report treats GUR 1 as two stocks. Sampling occurred between October 2004 and April 2005, and the target number of samples (12) was achieved for GUR 1E and GUR 1W. Twelve of the planned 15 samples were achieved for GUR 2. The mean weighted c.v.s over all age classes were 19%, 25%, and 15% for GUR 1E, GUR 1W, and GUR 2, respectively, all below the target c.v. of 30%. The GUR 1E trawl fishery was dominated by 2–5 year old fish, while 3–6 year old fish dominated the GUR 1W trawl fishery. The catch in both areas, but particularly GUR 1W, is dominated by females. The GUR 2 trawl catch is dominated by 2–4 year old fish. These patterns are consistent with previous years.

Gemfish off the north and east coasts of the North Island are managed as two stocks (SKI 1 and SKI 2), but are believed to comprise a single biological stock. The SKI 2 fishery occurs primarily on non-spawning fish from October to April. The gemfish target fishery in SKI 2 during 2004–05 was of short duration; sampling occurred between October 2004 and January 2005. Twelve of the planned 15 samples were obtained. The mean weighted c.v. over all age classes was 31%, just above the target of 30%. The commercial fishery was dominated by fish aged between 5 and 8 years.

Alfonsino from BYX 3 were sampled between November 2004 and May 2005. Thirteen of the planned 15 samples were obtained, and a high proportion of the landed catch was sampled. The mean weighted c.v. over all age classes was 29.7%, lower than the target of 30%. Fish aged from 3 to 12 years were abundant in the catch, with the overall mode in 2004–05 at age 6.

Analyses were carried out to determine if the sampling that was carried out was representative of the temporal (month), spatial (statistical area) and the reported target species for each fishery. For the spatial and target species analyses it was concluded that the data collected in SKI 2 and BYX 3 are representative of the corresponding fisheries, the data collected in JDO 1, GMU 1, and GUR 1 may be representative of the corresponding fisheries, and the data collected in GUR 2 may not be representative of the corresponding fishery. For the temporal analyses the sampling was representative for the SKI 2 and BYX 3 fisheries but was probably not representative for the other fisheries.

# 9. Introduction

## Objective 9: Sampling of John dory for length, sex, and age.

The JDO 1 fishery is the largest John dory fishery in New Zealand. It extends around the North Island from Cape Runaway in the east to Tirua Point in the west, combining QMAs 1 and 9 (Figure 1). JDO 1 is thought to comprise an east (JDO 1E) and a west (JDO 1W) stock, with the boundary considered to be at North Cape (Horn et al. 1999, Hanchet et al. 2001). This analysis treats fish from the east and west coasts as being from separate stocks. In recent years, about 80% of landings off the west coast have been caught as single trawl bycatch. Off the east coast, about 70% of John dory have been taken by single trawl, with a further 20% caught by Danish seine. About 40% of the JDO 1E catch is targeted. Sampling of the commercial JDO 1 catch commenced in the 2002–03 fishing year (Phillips & Horn 2004) and continued in 2003–04 (Horn et al. 2004). This report presents the length and age structure of John dory caught in JDO 1 during the 2004–05 fishing year, and compares these results with the previous years.

## Objective 10: Sampling of grey mullet for length, sex, and age.

The GMU 1 administrative stock encompasses the northern half of the North Island, i.e., QMAs 1 and 9 (Figure 2). However, the east and west coast areas of GMU 1 are considered separate for stock assessment purposes. In 1997–98, approximately 80% of the GMU 1 catch came from the west coast (McKenzie et al. 1999). The most recent study of the species in GMU 1 (McKenzie et al. 1999) sampled west coast set net catches from the 1997–98 fishing year and concluded that samples comprised males and females aged between 3 and 12 years. Growth analysis showed that female grey mullet were consistently larger than males of the same age, and that females made up approximately two-thirds (by numbers) of the sample landings. Sampling of the commercial GMU 1 catch commenced in the 2003–04 fishing year (Manning & Shearer 2005). This report presents the length and age structure of grey mullet caught in GMU 1W during the 2004–05 fishing year, and compares these results with the previous year.

Objectives 8 and 12: Sampling of red gurnard for length, sex, and age.

GUR 1 is the largest red gurnard fishery in New Zealand. GUR 1 landings have been relatively stable since 1986–87, averaging around 1000 t or 40% of the total annual national landings. It is also an important species for recreational fishers with an estimated 100 t being taken annually in this area. GUR 1 is thought to comprise an east (GUR 1E) and a west (GUR 1W) stock, with the boundary considered to be at North Cape (Figure 3). On the west coast (GUR 1W), over half of the landed red gurnard catch is a bycatch of bottom trawlers targeting other species (mainly snapper and trevally).

On the east coast (GUR 1E), about half of the landed catch is caught by bottom trawl, with the remainder consisting of small bycatch landings by a variety of other methods (mainly bottom longline and Danish seine). Considerable efforts were made to sample east coast Danish seine landings of red gurnard in 2002–03, but landed catches only rarely exceeded 30 kg and were not considered sufficient to characterise the fishery. Sampling of the commercial GUR 1 catch commenced in the 2002–03 fishing year (Manning & Sutton 2004) and continued in 2003–04 (Manning & Sutton 2005). This report presents the length and age structure of red gurnard caught in GUR 1 during the 2004–05 fishing year, and compares these results with the previous years.

GUR 2 (Figure 3) is the third-largest red gurnard fishery in New Zealand. Landings have been relatively stable since 1986–87, at around 500 to 600 t. Currently the Ministry of Fisheries does not have a reliable way to monitor the GUR 2 stock. Red gurnard is a relatively ubiquitous species and, consequently, is present in a high proportion of catches from inshore trawl fisheries in QMA 2. It is taken throughout the year, but higher catches generally occur over spring and summer. Red gurnard is taken mostly as a bottom trawl target species, but is also taken as bycatch, mainly from the tarakihi target trawl fishery. Sampling of the commercial GUR 2 catch commenced in the 2003–04 fishing year (Phillips et al. 2005). This report presents the length and age structure of red gurnard caught in GUR 2 during the 2004–05 fishing year, and compares these results with the previous year.

#### Objective 11: Sampling of gemfish for length, sex, and age.

Gemfish are caught in coastal waters around mainland New Zealand in depths ranging from 50 to 550 m. SKI 2 (Figure 4) supported an important trawl fishery through the late 1980s to early 1990s, with annual landings peaking at over 1200 t. The TACC was 1300 t in the early 1990s, but this was reduced first in 1997–98, and again in 2000–01 to its current level of 240 t as the stock assessment indicated declining abundance. The SKI 2 fishery occurs primarily on non-spawning fish from October to April. Gemfish catches are minimal from May to September and it is assumed that adult fish migrate at this time to spawn in the northern waters of SKI 1 (Horn & Hurst 1999). Sampling of the commercial SKI 2 catch commenced in the 1995–96 fishing year, and has been conducted annually since then (Horn et al. 2004). This report presents the length and age structure of gemfish caught in SKI 2 during the 2004–05 fishing year, and compares these results with previous years.

#### Objective 13: Sampling of alfonsino for length, sex, and age.

Alfonsino are primarily associated with undersea structures such as the seamounts that occur off the lower east coast of the North Island (BYX 2) and on the Chatham Rise (BYX 3), in depths from 300–600 m (Figure 5). The TACC for BYX 3 was increased for the 1987–88 fishing year from 220 t to 1000 t, but annual landings remained low until 1993–94. Since 1995–96, landings have exceeded 900 t, reaching a peak of 1197 t in 2001–02. The marked increase in landings since 1994–95 is due mainly to the development of a target trawl fishery for the species, and the discovery of new grounds southeast of the Chatham Islands. Currently, most of the BYX 3 catch is taken from the target bottom trawl fishery comprising a small number of vessels fishing during the summer period. Sampling of the commercial BYX 3 catch commenced in the 2002–03 fishing year (Blackwell et al. 2004) and was continued in 2003–04 (Horn et al. 2004). This report presents the length and age structure of alfonsino caught in BYX 3 during the 2004–05 fishing year, and compares these results with the previous years.

## 10. Methods

# All species

For all the species and stocks analysed below, catch-at-age and catch-at-length estimates were produced using the 'catch-at-age' software developed by NIWA (Bull & Dunn 2002). The software scaled the length frequency of fish from each landing up to the landing weight for each stock, to yield length frequencies by stock. The age-length-sex data was used to generate an age-length-sex key for each stock, through which length data was passed to produce numbers-at-age by sex.

The precision of each length or age frequency for each stock was measured by the mean weighted c.v. This was calculated as the average of the c.v.s for the individual length or age classes weighted by the proportion of fish in each class. The c.v.s were calculated by bootstrapping: fish were re-sampled 300 times with replacement within each landing, and otoliths were randomly re-sampled from the entire set. Objective 9: Sampling of John dory for length, sex, and age.

It was proposed to sample 12 landings from each of the east and west coast bottom trawl fisheries; in the previous two years of sampling 10–12 samples from these two fisheries had produced catch-atage distributions with mean weighted c.v.s over all age classes ranging from 14% to 19% (Phillips & Horn 2004, Horn et al. 2004). Landings of John dory occur throughout the year, but are most common between October and February, when most trawling and Danish seining for target species such as snapper takes place. Consequently, sampling of the fishery was scheduled to occur from October to February. Samples from the two presumed stocks (i.e., JDO 1E and JDO 1W) were analysed separately. There was no stratification by area or time within each stock. All sampled landings were from bottom trawl trips targeting snapper.

From each sample, up to 200 fish were randomly selected, and measured to the nearest centimetre below the total length. Every fourth fish was also sexed and their otoliths taken (totalling 50 fish sexed and otoliths per sample). Only 25% of each sample was sexed as there was reluctance by the fish receivers to allow fish to be cut.

All collected otoliths were read whole and untreated, using the methods of Hanchet et al. (2001).

## Objective 10: Sampling of grey mullet for length, sex, and age.

It was proposed to sample 15 landings from off the west coast of the North Island. Fifteen samples in 2003–04 had produced a catch-at-age distribution with a mean weighted c.v. over all age classes of 24% (Manning & Shearer 2005). Landings of grey mullet occur throughout the year, but are more common in spring and summer. Sampling of the fishery was scheduled to occur from December to March. Collection of length and age data was restricted to periods of a few months, as fish growth blurs length and age distributions collected over too great a time interval. There was no stratification by area or time. All sampled landings were from setnet trips targeting grey mullet.

From each sample, at least 50 fish were randomly selected from each landing, and sampled for fork length (nearest centimetre below), sex, and otoliths.

The preparation of all available otoliths (514) followed the thin section method advocated by McKenzie et al. (1999). The sections were examined under transmitted light at a magnification of x25–50. Completely formed translucent zones were counted.

## Objectives 8 and 12: Sampling of red gurnard for length, sex, and age.

It was proposed to sample 12 landings taken by bottom trawl from each of the GUR 1 east and west coast fisheries, and 15 landings from the GUR 2 bottom trawl fishery. In previous years, 10–13 samples from the GUR 1 fisheries had produced catch-at-age distributions with mean weighted c.v.s over all age classes ranging from 15% to 28% (Manning & Sutton 2004, 2005).

Landings of red gurnard in GUR 1 occur throughout the year, but are most common between October and February, when most trawling for target species such as snapper takes place. Collection of length and age data was restricted to periods of a few months, as fish growth blurs length and age distributions collected over too great a time interval. Consequently, sampling of the fishery was scheduled to occur from October to February. Samples from the two presumed stocks (i.e., GUR 1E and GUR 1W) were analysed separately. There was no stratification by area or time within each stock. All sampled GUR 1 landings were from bottom trawl trips targeting snapper.

Landings of red gurnard in GUR 2 also occur throughout the year, but for the reasons described above for GUR 1, sampling was scheduled to occur from October to February. There was no stratification by area or time. Stratification by vessel type (as described by Phillips et al. 2005) was carried out; a group of 19 high-catch vessels comprised the "BT1" stratum, with all other vessels in the "OTH" stratum. All sampled GUR 2 landings were from bottom trawl trips.

From each sample in GUR 1 and GUR 2, at least 50 fish were randomly selected from each landing, and sampled for total length (nearest centimetre below), sex, and otoliths.

All collected otoliths were prepared and read using the methods of Sutton (1997), i.e., bake, embed in resin, and cross-section.

## Objective 11: Sampling of gemfish for length, sex, and age.

The catch sampling programme aimed to collect 15 samples from the SKI 2 fishery. This number of samples had previously produced catch-at-age distributions for SKI 1 and SKI 2 with mean weighted c.v.s over all age classes lower than the target of 30% (Dunn et al. 2001). Within each sample, at least 50 fish were randomly selected, measured to the nearest centimetre below fork length, sexed, and otoliths taken. Gonad development was classified using a 5-stage macroscopic scale (Table 1).

Sampling strata were based on vessels catches. A set of ten trawlers that had previously accounted for around two thirds of the SKI 2 catch was identified and allocated as a single stratum ("BT1"); ten samples were planned for this stratum. All other vessels catching gemfish by any method were collectively grouped as a single stratum ("OTH"); five samples were planned for this stratum.

Ageing of 560 fish was completed using the method of Horn & Hurst (1999), i.e., whole, untreated otoliths were read immersed in water. Otoliths (from each sex separately) from each 1 cm length class were selected approximately proportionally to their occurrence in the scaled length frequency, with a constraint that at least one otolith from each length class was selected. In addition, all otoliths from fish in the extreme right-hand tail of the scaled length-frequency (constituting about 2% of the otolith sample) were fully selected.

## Objective 13: Sampling of alfonsino for length, sex, and age.

The catch sampling programme aimed to collect 15 samples from the BYX 3 fishery. In each sample, 50 randomly chosen fish were measured to the nearest centimetre below fork length, sexed, and had their otoliths removed. In previous years, a small number of vessels had taken the bulk of the BYS 3

catch over a short summer period (Blackwell et al. 2004, Horn et al. 2004). This trend was again apparent in the 2004–05 year, so a single sampling stratum was defined.

All collected otoliths were read using the using the method of Massey & Horn (1990), i.e., whole, untreated otoliths were read immersed in water.

# 11. Results

#### Objective 9: Sampling of John dory for length, sex, and age.

The landed catch from each of JDO 1E and JDO 1W was determined from an extract provided by the Ministry of Fisheries. In the 2004–05 season, 567 t was landed, of which 54% (306 t) was taken by trawl vessels fishing in JDO 1E, 30% (170 t) was taken by trawl vessels fishing in JDO 1W, and 12% (71 t) was taken by Danish seine vessels fishing in JDO 1E. The remaining 4% of landings was taken by bottom longline in JDO 1E (10 t), and other methods in JDO 1E (3 t) and JDO 1W (7 t).

The scheduled 24 samples were collected; JDO 1E samples were from October and November 2004, JDO 1W samples were from October 2004 to February 2005 (Table 2). The total weight of John dory sampled from the east coast stock represented 2.2% of the east coast landings. The total weight of John dory sampled from the west coast stock represented 6% of the west coast landings. This resulted in a total of 4929 fish measured, and 1208 fish sampled for otoliths and sex for both stocks combined (Table 2).

Each sampled landing in the two stocks was matched with the corresponding trip number in the MFish catch-effort and landings database. All landings in the fishery for each stock (defined here to be all trips by bottom-trawl vessels where fishing effort was recorded in statistical areas valid for each stock and where a positive, non-zero landing of JDO 1 was recorded; referred to as "BT-OTH" below) were also identified. The total landed catch by all vessels, by all vessels in the BT-OTH fishery, and the sampled landed catch are plotted by month of the fishing year in Figure 6. The proportions of fishing effort (number of trawl shots) and estimated John dory catch in all fishing events associated with the sampled trips and for all trips in the fishery were computed by recorded statistical area and target species and overlaid on separate plots for each stock (Figure 7 for JDO 1E and Figure 8 for JDO 1W).

Figure 6 suggests that the sampled landings may not be representative of the distribution of catch in the BT-OTH fishery by month in both stocks, but Figures 7 & 8 suggest that the proportions calculated for the sampled landings are generally close to those calculated for the BT-OTH fishery as a whole in both stocks. This suggests that the sampled landings may be representative of the fishery in both stocks, although both effort and John dory catch in statistical area 005 in JDO 1E and effort and John dory catch when snapper is targeted in both areas are over-represented in the sampled landings in both areas compared with the fishery as a whole in each area.

Length frequencies for the unsexed fish from the east and west stocks for 2004–05 are shown in Figure 9. The distribution ranges from about 20–54 cm for both stocks. The west stock is more normally distributed than the east stock, with the mode at 36 cm. The east stock also has a mode at 36 cm, but a secondary juvenile mode appears truncated at 25 cm. The east distribution has more large and small fish than the west distribution.

Estimated catch-at-age, by sex, for both stocks in 2002–03, 2003–04, and 2004–05 are plotted in Figures 10–11, and listed (for 2004–05 only) in Tables 3 and 4. In the east stock, ages 2–5 dominated both the male and female distributions, with 3-year-old fish tending to be the most abundant age class. For the west stock, ages 3–5 dominated both the male and female distributions, with 3-year-old

fish being the most abundant age class. There are no clear year class progressions between years. However, the relatively abundant 4-year-old fish apparent in both stocks in 2004–05 does follow on from a mode of 3-year-olds in the previous year.

The mean weighted c.v.s across all age classes were 19% and 13% for the east and west stocks, respectively (Tables 3 and 4). Both of these values were under the target c.v. of 30%.

#### Objective 10: Sampling of grey mullet for length, sex, and age.

The landed catch from GMU 1 was determined from an extract provided by the Ministry of Fisheries. In the 2004–05 season, 1145 t was landed, with no clear seasonality apparent. About 85% of landings were from FMA 9, and virtually all landings (99%) were targeted. Setnet fishing accounted for 42% of landings, but a greater percentage (50%) was taken by ring net. Danish seine (7%) and beach seine were the other significant fishing methods.

Ten of the scheduled 15 samples were collected between January and April 2005. The total weight of grey mullet sampled from the west coast stock represented 0.8% of the west coast landings. This resulted in a total of 514 fish measured and sexed, and 514 otoliths (Table 5).

All but one sampled landing was matched with the corresponding trip number in the MFish catcheffort and landings database, although effort data appears to exist in the database for only seven of these trip numbers. Also, although all sampled landings were reportedly from vessels targeting grey mullet with setnets, of the seven sampled landings which could be matched and for which effort data appears to exist, four trips used exclusively ringnet gear, one used a mixture of ringnet and setnet gear, and only two used exclusively setnet gear. There is an obvious inconsistency between the two data sources.

All landings in both the ringnet and setnet target fisheries in the west stock (defined here to be all trips by both ringnet and setnet vessels where grey mullet was targeted and where a positive, non-zero landing of catch in GMU 1 was recorded; referred to as "RN-GMU" and "SN-GMU" below) were also identified in the database. The total landed catch by all vessels, by all vessels in the SN-GMU and RN-GMU fisheries and the sampled landed catch are plotted by month of the fishing year in Figure 12. The proportions of fishing effort (number of ringnet shots in the RN-GMU fishery and the total amount of net set in the SN-GMU fishery) and estimated GMU catch in all fishing events associated with the sampled trips and for all trips in both fisheries were computed by recorded statistical area, target species, and fishery and overlaid on the same plot (Figure 13).

Figure 12 suggests that the sampled landings may not be representative of the distribution of catch in the SN-GMU and RN-GMU fisheries by month and account for a very low proportion of the catch in these fisheries by weight. However, Figure 13 suggests that the proportions calculated for the sampled landings are generally close to those calculated for both the RN-GMU and SN-GMU fisheries in the west stock. This suggests that the sampled landings may be representative of the fisheries in this area, although effort and grey mullet catch in the SN-GMU fishery in statistical area 044 (the Kaipara Harbour) is over-represented in the sampled landings compared with the fishery as a whole.

Length frequencies for male and female fish from the 2004–05 catch are shown in Figure 14. Most males range between 32 and 38 cm fork length; females are relatively common to a length of 44 cm. The catch is dominated by female fish (78% by number). There are clear modes; 35 cm for males and 37 cm for females.

Estimated catch-at-age, by sex, from the GMU 1W fishery in 2003–04 and 2004–05 are plotted in Figure 15, and listed (for 2004–05 only) in Table 6. The 2004–05 catch is dominated by 5 and 6 year

old fish. It is possible that the strong 4 and 5 year old age classes in 2003–04 had progressed into the 2004–05 fishery.

The mean weighted c.v.s across all age classes was 12%, lower than the target c.v. of 30%.

## Objective 8: Sampling of red gurnard (GUR 1) for length, sex, and age.

The landed catch from each of GUR 1E and GUR 1W was determined from an extract provided by the Ministry of Fisheries. In the 2004–05 season, 1363 t was landed, 57% (773 t) from GUR 1W, and 43% (590 t) from GUR 1E. In GUR 1W, 87% of the catch was taken by bottom trawl, with Danish seine and setnet accounting for virtually all the remaining landings. About 46% of the landings were targeted. In GUR 1E, 48% of the catch was taken by bottom trawl, with Danish seine and bottom longline each accounting for about 25% of the landings. About 25% of the landings were targeted, but 53% were taken as a by-catch of snapper target fisheries.

The scheduled 24 samples were collected; GUR 1E samples were from October 2004 to February 2005, GUR 1W samples were from October to November 2004 (Table 7). The total weight of red gurnard sampled from the east coast stock represented 2.1% of the east coast landings. The total weight of red gurnard sampled from the west coast stock represented 5.0% of the west coast landings. Sampling produced 1458 measured and sexed fish, and 1418 otoliths, from both stocks combined (Table 7).

Each sampled landing in the two stocks was matched with the corresponding trip number in the MFish catch-effort and landings database. All landings in the fishery in each stock (defined here to be all trips by bottom-trawl vessels where fishing effort was recorded in statistical areas valid for each stock and where a positive, non-zero landing of GUR 1 was recorded; referred to as "BT-OTH" below) were also identified. The total landed catch by all vessels, by all vessels in the BT-OTH fishery, and the sampled landed catch are plotted by month of the fishing year in Figure 16. The proportions of fishing effort (number of trawl shots) and estimated red gurnard catch in all fishing events associated with the sampled trips and for all trips in the fishery were computed by recorded statistical area and target species and overlaid on separate plots for each stock (Figure 17 for GUR 1E and Figure 18 for GUR 1W).

Figure 16 suggests that the sampled landings may not be representative of the distribution of catch in the BT-OTH fishery by month, but Figures17 and 18 suggest that the proportions calculated for the sampled landings are generally close to those calculated for the BT-OTH fishery as a whole in both stocks. This suggests that the sampled landings may be representative of the fishery in both stocks, although both effort and red gurnard catch in statistical area 005 in GUR 1E and in statistical area 042 in GUR 1W and when snapper was targeted in GUR 1W are over-represented in the sampled landings in both areas compared with the fishery as a whole in each area.

Length frequencies for male and female fish from the east and west stocks for 2004–05 are shown in Figure 19. Most males range between 25 and 35 cm total length; females are relatively common to a length of 44 cm. The catch in both areas is dominated by female fish; 92% (by number) of the GUR 1W landings, and 78% of the GUR 1E landings are females. There is no clear male mode for GUR 1W, but GUR 1E males have a mode at 30 cm. GUR 1E females also have a mode at 30 cm, while for GUR 1W females the mode is 1 cm higher. There is a greater proportion of larger fish in the west population.

Estimated catch-at-age, by sex, for both stocks in 2002–03, 2003–04, and 2004–05 are plotted in Figures 20–21, and listed (for 2004–05 only) in Tables 8 and 9. In the east stock, ages 2–5 dominated both the male and female distributions, with 2 and 3-year-old fish being the most abundant age classes. For the west stock, ages 3–6 dominated the distributions, with 3-year-old fish generally being the most abundant age class. There are no clear year class progressions between years. However, the

relatively abundant 3-year-old fish apparent in the GUR 1W stock in 2002–03 may have progressed through the two following years.

The mean weighted c.v.s across all age classes were 19% and 25% for the east and west stocks, respectively (Tables 8 and 9). Both of these values were under the target c.v. of 30%.

Objective 12: Sampling of red gurnard (GUR 2) for length, sex, and age.

The landed catch from GUR 2 was determined from an extract provided by the Ministry of Fisheries. In the 2004–05 season, 719 t was landed. Almost 99% of the catch was taken by bottom trawl, with setnet accounting for virtually all the remaining landings. About 71% of the landings were targeted, with a further 22% taken as a bycatch of the tarakihi trawl fishery.

Fifteen samples were planned but 12 samples were collected from October 2004 to April 2005 (Table 7). The total weight of red gurnard sampled represented 9.5% of the GUR 2 landings. This resulted in a total of 574 fish being measured and sexed, and 574 otoliths (Table 7). The eight sampled trips from the BT1 stratum were all taken from statistical areas 013 and 014 adjacent to Hawke Bay. Reported target species for these trips were red gurnard (3 trips), tarakihi (4 trips), and snapper (1 trip). The four "OTH" trips were from statistical areas 013, 014, and 015, and they targeted tarakihi (3 trips) and snapper (1 trip).

Eleven of the twelve sampled landings in the stock were matched with the corresponding trip number in the MFish catch-effort and landings database. All landings in the fishery (defined here to be all trips by bottom-trawl vessels where fishing effort was recorded in statistical areas valid for the stock and where a positive, non-zero landing of GUR 2 was recorded; referred to as "BT-OTH" below) were also identified. The total landed catch by all vessels, by all vessels in the BT-OTH fishery and the sampled landed catch are plotted by month of the fishing year in Figure 22. The proportions of fishing effort (number of trawl shots) and estimated red gurnard catch in all fishing events associated with the sampled trips that could be matched and for all trips in the fishery were computed by recorded statistical area and target species and overlaid on separate plots for each stock (Figure 23).

Figure 22 suggests that the sampled landings may not be representative of the distribution of catch in the BT-OTH fishery by month. Figure 23 suggests that there are some large differences in the proportions calculated for the sampled landings compared with BT-OTH fishery as a whole in the stock. Estimated catch in statistical area 013 is under-represented in the sampled landings compared with the entire BT-OTH fishery, although effort in this statistical area is only slightly under-represented in the sampled landings compared with the entire BT-OTH fishery. More troublesome is the under-representation of both effort and red gurnard catch when red gurnard is targeted and over-representation of both effort and catch when tarakihi is targeted in the sampled landings compared with the fishery as a whole. These results suggest that fishing practices in the sampled landings may not be representative of the fishery.

Length frequencies for male and female fish from GUR 2 in 2004–05 are shown in Figure 254. Most males range between 27 and 41 cm total length; females are relatively common to a length of 47 cm. The catch is dominated by female fish (69% by number). There is a clear male mode at 30 cm, and a secondary mode at 36–37 cm. There is no clear mode in the female distribution.

Estimated catch-at-age, by sex, for GUR 2 in 2003–04 and 2004–05 are plotted in Figure 245, and listed (for 2004–05 only) in Table 10. The catch in both years is dominated by 2–4 year old fish. No year class progressions are apparent. The mean weighted c.v. across all age classes was 15%, lower than the target c.v. of 30%.

#### Objective 11: Sampling of gemfish for length, sex, and age.

The landed catch from SKI 2 was determined from an extract provided by the Ministry of Fisheries. In the 2004–05 season, 264 t was landed, of which 84% (221 t) was taken by BT1 vessels, and 16% by OTH vessels (Table 11). The SKI 2 target fishery during the 2004–05 fishing year was of short duration, with most of the catch being taken between November and February.

Fifteen samples were planned, but 12 were collected between 14 October 2004 and 18 January 2005 (Table 11). The target number of BT1 samples was achieved, but landings by these vessels were sometimes small (i.e., less than 1 tonne). Samples from OTH vessels were difficult to obtain; landings from these vessels were often less than 50 fish, so were not sampled. The samples were collected from the ports of Auckland, Napier, Gisborne, Wellington, Picton, and Nelson. The total weight of gemfish sampled (53 t) from SKI 2 represented 20% of the total SKI 2 landings. A total of 611 fish were measured and sexed, and 611 otoliths (Table 11).

Each sampled landing in the stock was matched with the corresponding trip number in the MFish catch-effort and landings database. All landings in the target gemfish fishery (defined here to be all trips by fishing vessels where bottom or midwater trawls were used to target gemfish in statistical areas valid for the stock and where a positive, non-zero landing of SKI 2 was recorded; referred to as the "BT-MW-SKI" fishery below) were also identified. The total landed catch by all vessels, by all vessels in the BT-MW-SKI fishery and the sampled landed catch are plotted by month of the fishing year in Figure 26. The proportions of fishing effort (number of trawl shots) and estimated gemfish catch in all fishing events associated with the sampled and all trips in the fishery were computed by recorded statistical area and target species and were overlaid on the same plot (Figure 27).

Figure 26 suggests that the sampled landings may be representative of the distribution of catch in the BT-MW-SKI fishery by month and appear to represent a fair proportion of catch in this fishery by weight. Figure 27 suggests that the proportions calculated for the sampled landings are generally close or very close to those calculated for the BT-MW-SKI fishery as a whole in the stock. These results suggest that the sampled landings are representative of the fishery.

The gonad stages are summarised in Table 12. A total of 135 males and 470 females were staged. 47% of males and 37% of females sampled were in the immature/resting stage (stage 1). All the remaining males, and most of the remaining females, were maturing/developing (stage 2). A few females (0.5%) were spent (stage 5).

Length frequencies from SKI 2 for 2004–05 are shown in Figure 28. The distribution ranges from 31-117 cm, with broad modes at around 64 cm and 70–75 cm for males, and 66 cm and 75–80 cm for females. The catch is dominated by females (75% by number).

The estimated catch-at-age, by sex, for 2004–05 is listed in Table 13. Plots of the age frequencies from the 1995–96 to 2004–05 fishing years are presented in Figure 29. A relatively strong class of 4-year-old fish apparent in 2002–03 (i.e., the 1998 year class) has progressed into the distributions for the current year. However, no exceptionally strong or weak year classes are apparent in the current population. Most captured fish appear to be less than 9 years old, which is expected given that the SKI 2 fishery targets non-spawning gemfish, including young, immature fish.

The mean weighted c.v. across all age classes was 31%, just higher than the target c.v. of 30%.

Objective 13: Sampling of alfonsino for length, sex, and age.

Catch sampling for alfonsino from BYX 3 was carried out on landings at the ports of Nelson and Wellington. Fifteen samples were planned but 13 were collected between 24 November 2004 and

20 May 2005. A total of 433 t (41% of the total landings), were sampled. The samples produced a total of 650 measured and sexed fish and 650 otoliths (Table 14).

Each sampled landing in the stock was matched with the corresponding trip number in the MFish catch-effort and landings database. All landings in the target alfonsino fishery (defined here to be all trips by fishing vessels where bottom or midwater trawls were used to target alfonsino in statistical areas valid for the stock and where a positive, non-zero landing of BYX 3 was recorded; referred to as the "BT-MW-BYX" fishery below) were also identified. The total landed catch by all vessels, by all vessels in the BT-MW-BYX fishery and the sampled landed catch are plotted by month of the fishing year in Figure 30. The proportion of fishing effort (number of trawl shots) and estimated alfonsino catch in all fishing events associated with the sampled and all trips in the fishery were computed by recorded statistical area and target species and were overlaid on the same plot (Figure 31).

Figure 30 suggests that the sampled landings may be representative of the distribution of catch in the BT-MW-BYX fishery by month and appear to represent a large proportion of catch in this fishery by weight. Figure 31 suggests that the proportions calculated for the sampled landings are generally close or very close to those calculated for the BT-MW-BYX fishery as a whole in the stock. These results suggest that the sampled landings are representative of the fishery although estimated catch in statistical area 051 is slightly over-represented and 049 slightly under-represented in the sampled landings compared with the entire BT-MW-BYX fishery.

Length-frequency distributions, scaled to represent the sampled catch, show the male length range to be 26-45 cm FL and the female range to be 24-49 cm FL (Figure 32). The male length mode (34-35 cm) is similar than the female mode (34-37 cm).

The age-frequency distributions from the 2002–03, 2003–04, and 2004–05 fishing years differ between years (Figure 33, Table 15). The sampled catch was dominated by 7–10 year old fish in the first two years, but by 4–8 year old fish in the most recent year. However, there is some evidence of year class progression. A mode of 5 and 6 year old females in 2003–04 progressed to dominate the 2004–05 female distribution as 6 and 7 year olds.

The mean weighted c.v. across all age classes was 30%, just on the target c.v. of 30%.

#### 12. Conclusions

Estimated catch-at-length and catch-at-age from samples of the commercial catch from various Fishstocks in QMAs 1, 2, and 3 are presented above. All samples extended existing series of catch-at-age for these species. The targeted number of samples was met in two fisheries (JDO 1 and GUR 1) and was almost met for the other species which all had a target of 15 samples, i.e., 10 samples achieved for GMU 1, 12 for GUR 2, 12 for SKI 2, and 13 for BYX 3.

Matching the sampled landings with the corresponding trip numbers stored in the MFish catch-effort and landings database and investigating the distributions of estimated catch and effort by statistical area and target species separately for the sampled landings and each fishery as a whole and comparing the results for each fishstock suggested that the data collected in SKI 2 and BYX 3 are representative of the corresponding fisheries, the data collected in JDO 1, GMU 1, and GUR 1 may be representative of the corresponding fisheries, and the data collected in GUR 2 may not be representative of the corresponding fishery. Matching the sampled landings and the distributions of estimated catch by month for the sampled landings and each fishery as a whole and comparing the results for each fishstock suggested that data collected was representative for the SKI 2 and BYX 3 fisheries but was probably not representative for the other fisheries. The existing sample regime is therefore probably adequate for the BYX 3 and SKI 2 fisheries, may be adequate for the JDO 1, GMU 1, and GUR 2 fisheries, and probably is not adequate for the GUR 2 fishery. An adequate sampling regime should be devised for the GUR 2 fishery and the previous sampling regimes for the JDO 1, GMU 1, and GUR 1 fisheries should be revised to ensure that future sampling of these fisheries produces data that represent the spatial and temporal nature of the sampled fisheries. A more in-depth and quantitative consideration of this subject is beyond the scope of this report.

The mean weighted c.v. for the calculated catch-at-age distribution was on or below the target of 30% for all fisheries except SKI 2 (its c.v. was 31%), although we note that such precision in the presence of bias (i.e., sampling non-representivity) is meaningless. Only gemfish exhibited strong year-class progression patterns (although this species is aided by having by far the longest data series). All other species exhibited weak or no progressions.

#### 13. Publications

Nil.

## 14. Data storage

All catch sampling data used in the analyses presented above are stored on the *market* database, and all age data are stored on the *age* database. Both databases are administered by NIWA for the Ministry of Fisheries.

#### 15. Acknowledgements

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Table 1: Macroscopic gonad stages for gemfish.

Stage	Name of stage	Description			
		Female	Male		
1	Immature/resting	Oval, transparent	Threadlike		
2	Developing	Granular, cells/oocytes visible	Hard with edge		
3	Maturing	Some hyaline (transparent) eggs	Viscous milt if cut		
4	Running ripe	Hyaline eggs, running	Running milt		
5	Spent	Bloody, flabby	Blotchy, bloody, hard		

Table 2: Summary of catch sampling for John dory from JDO 1 in the 2004-05 fishing year.

			Samples	Num	ber of fish	Catch (t)	
Stock	Method	Planned	Achieved	Measured	Otoliths	Sampled	Landed
JDO 1E	Bottom trawl	12	12	2 422	605	8.5	392
JDO 1W	Bottom trawl	12	12	2 507	603	10.5	175

Table 3: Scaled catch-at-age (numbers and percentage) and calculated c.v.s from catch sampling in JDO 1E in 2004–05. The numbers of fish aged by sex, and the estimated mean weighted c.v. for both sexes, are also presented. –, no data.

			Male			<u>Female</u>
Age	Number	%	c.v.	Number	%	c.v.
1	1 276	0.29	1.191	1 276	0.29	1.172
2	33 032	7.55	0.228	12 391	2.83	0.411
3	72 416	16.55	0.237	56 672	12.95	0.216
4	82 685	18.89	0.101	55 215	12.62	0.108
5	36 690	8.38	0.134	42 397	9.69	0.154
6	11 425	2.61	0.254	27 152	6.20	0.201
7	1 937	0.44	0.594	3 058	0.70	0.515
8	0	0.00	_	0.	0.00	
Total aged			317			287
Mean weig	hted c.v. (bo	th sexes)				18.7

Table 4: Scaled catch-at-age (numbers and percentage) and calculated c.v.s from catch sampling in JDO 1W in 2004–05. The numbers of fish aged by sex, and the estimated mean weighted c.v. for both sexes, are also presented. –, no data.

			Male			Female
Age	Number	%	c.v.	Number	%	c.v.
1	142	0.07	1.394	142	0.07	1.328
2	4 246	2.04	0.397	2 970	1.43	0.432
3	48 688	23.42	0.114	31 388	15.10	0.120
4	44 894	21.60	0.082	33 771	16.24	0.089
5	13 757	6.62	0.150	16 142	7.76	0.136
6	5 972	2.87	0.210	3 140	1.51	0.321
7	1 033	0.50	0.604	1 232	0.59	0.496
8	369	0.18	1.136	0	0.00	_
Total aged			319			282
Mean weighted c.v. (both sexes)						13.3

Table 5: Summary of catch sampling for grey mullet from GMU 1 in the 2004–05 fishing year.

			Samples	Num	<u>ber of fish</u>		Catch (t)
Stock	Method	Planned	Achieved	Measured	Otoliths	Sampled	Landed
GMU 1W	Set or ring net	15	10	515	514	7.6	973
GMU 1E	-	0	0	0	0	0	172

Table 6: Scaled catch-at-age (numbers and percentage) and calculated c.v.s from catch sampling in GMU 1 in 2004–05. The numbers of fish aged by sex, and the estimated mean weighted c.v. for both sexes, are also presented. –, no data.

			Male			Female
Age	Number	%	c.v.	Number	%	c.v.
1	0	0.00	_	0	0.00	_
2	0	0.00	0	2 443	0.24	0.883
3	7 363	0.74	0.667	23 520	2.35	0.404
4	9 237	0.92	0.689	61 389	6.13	0.272
5	88 980	8.89	0.383	348 558	34.83	0.119
6	102 081	10.20	0.347	323 289	32.30	0.106
7	3 370	0.34	0.861	14 599	1.46	0.388
8	3 126	0.31	1.177	6 787	0.68	0.673
9	1 489	0.15	1.382	2 312	0.23	1.066
10	0	0.00	_	0	0.00	-
11	0	0.00	-	2 276	0.23	1.657
Total m	easured		119			396
Total ag	ged		119			393
Mean w	eighted c.v. (by	v sex)	41.5			15.4
Mean weighted c.v. (both sexes)						12.2

Table 7: Summary of catch sampling for red gurnard from GUR 1 and GUR 2 in the 2004–05 fishing year.

			<u>Samples</u>	Num	<u>ber of fish</u>		Catch (t)	
Stock	Stratum	Planned	Achieved	Measured	Otoliths	Sampled	Landed	
GUR 1E	Bottom trawl	12	12	730	714	12.3	590	
GUR 1W	Bottom trawl	12	12	728	704	38.4	773	
GUR 2	BT1	10	8	398	398	3.9	584	
	OTH	5	4	176	176	2.9	136	

Table 8: Scaled catch-at-age (numbers and percentage) and calculated c.v.s from catch sampling in GUR 1E in 2004–05. The numbers of fish aged by sex, and the estimated mean weighted c.v. for both sexes, are also presented. –, no data.

			Male			Female
Age	Number	%	c.v.	Number	%	c.v.
1	9 929	0.59	0.980	63 662	3.81	0.522
2	141 767	8.48	0.347	355 512	21.27	0.207
3	100 276	6.00	0.333	301 161	18.02	0.126
4	30 187	1.81	0.366	185 444	11.10	0.126
5	44 747	2.68	0.375	153 662	9.19	0.134
6	11 768	0.70	0.686	93 531	5.60	0.182
7	19 854	1.19	0.485	63 909	3.82	0.223
8	11 007	0.66	0.577	62 718	3.75	0.209
9	0	0.00		12 292	0.74	0.427
10	1 751	0.10	1.181	1 898	0.11	1.032
11	0	0.00	-	1 249	0.07	1.593
12	0	0.00	_	1 837	0.11	1.150
13	0	0.00	-	0	0.00	-
14	0	0.00	-	0	0.00	-
15	3 172	0.19	1.235	0	0.00	
Total m	easured		139			591
Total ag	ged		134			567
Mean w	eighted c.v. (by	sex)	40.1			18.8
Mean weighted c.v. (both sexes)						18.9

Table 9: Scaled catch-at-age (numbers and percentage) and calculated c.v.s from catch sampling in GUR 1W in 2004–05. The numbers of fish aged by sex, and the estimated mean weighted c.v. for both sexes, are also presented. –, no data.

			<u>Male</u>			Female
Age	Number	%	c.v.	Number	%	c.v.
1	0	0.00	-	0	0.00	-
2	5 985	0.35	0.778	43 772	2.58	0.630
3	10 472	0.62	0.590	266 651	15.72	0.447
4	19 759	1.16	0.446	243 578	14.36	0.336
5	15 261	0.90	0.508	321 945	18.98	0.149
6	20 208	1.19	0.455	282 542	16.66	0.113
7	7 501	0.44	0.640	115 564	6.81	0.235
8	22 577	1.33	0.492	92 940	5.48	0.177
9	14 627	0.86	0.511	78 540	4.63	0.211
10	10 037	0.59	0.613	54 029	3.19	0.319
11	1 389	0.08	1.108	44 773	2.64	0.367
12	6 722	0.40	0.808	8 497	0.50	0.728
13	0	0.00	_	3 431	0.20	0.845
14	2 106	0.12	1.435	2 455	0.14	0.988
15	0	0.00	_	0	0.00	-
16	0	0.00	_	929	0.05	1.394
Total me	easured		114			614
Total ag	ed		111			600
Mean we	eighted c.v. (by	sex)	56.0			26.7
Mean we	eighted c.v. (bo	th sexes)				24.8

Table 10: Scaled catch-at-age (numbers and percentage) and calculated c.v.s from catch sampling in GUR 2 in 2004–05. The numbers of fish aged by sex, and the estimated mean weighted c.v. for both sexes, are also presented. –, no data.

			Male			Female
Age	Number	%	c.v.	Number	%	c.v.
1	2 548	0.17	2.461	2 657	0.18	1.053
2	184 153	12.63	0.326	307 805	21.10	0.200
3	141 998	9.74	0.250	347 270	23.81	0.163
4	59 129	4.05	0.298	138 511	9.50	0.159
5	30 034	2.06	0.388	79 938	5.48	0.194
6	16 184	1.11	0.446	53 124	3.64	0.257
7	8 499	0.58	0.603	26 338	1.81	0.332
8	6 924	0.47	0.615	28 193	1.93	0.334
9	1 100	0.08	1.522	9 858	0.68	0.561
10	0	0.00	_	2 838	0.19	1.042
11	4 638	0.32	0.838	0	0.00	-
12	0	0.00	_	744	0.05	1.723
13	0	0.00	-	2 094	0.14	1.333
14	1 947	0.13	1.074	0	0.00	-
15	0	0.00	-	1 939	0.13	1.286
Total m	easured		191			383
Total ag	ged		179			373
Mean w	eighted c.v. (by	/ sex)	34.0			20.5
Mean weighted c.v. (both sexes)						15.2

Table 11: Summary of catch sampling for gemfish from SKI 2 in the 2004-05 fishing year.

		Samples		Num	<u>ber of fish</u>		Catch (t)	
Stratum	Period	Planned	Achieved	Measured	Otoliths	Sampled	Landed	
BT1	Oct–May	10	10	510	510	51.4	221	
OTH	Oct-May	5	2	101	101	1.3	43	

Table 12: Gonad stage (%) of male and female gemfish from SKI 2. *n*, number of fish staged.

Stage	Male	Female
1	64	172
2	71	278
3	0	0
4	0	0
5	0	20
Ν	135	470

Table 13: Estimated catch-at-age (numbers and percentage) and calculated c.v.s from catch sampling in SKI 2 in 2004–05. The numbers of fish measured and aged, and the estimated mean weighted c.v.s, are also presented. –, no data.

	<u></u>		Male	Female			
Age	Number	%	c.v.	Number	%	c.v.	
2	125	0.17	1.594	681	0.92	1.310	
3	568	0.77	1.037	500	0.68	1.075	
4	3 598	4.87	0.490	9 284	12.58	0.292	
5	3 434	4.65	0.568	10 851	14.70	0.200	
6	3 323	4.50	0.384	9 063	12.28	0.261	
7	2 638	3.57	0.517	9 696	13.14	0.287	
8	1 384	1.87	0.636	2 659	3.60	0.341	
9	1 042	1.41	0.891	3 877	5.25	0.338	
10	728	0.99	0.761	2 498	3.38	0.363	
11	396	0.54	1.110	602	0.82	0.647	
12	232	0.31	1.126	742	1.01	0.608	
13	107	0.14	1.359	1 607	2.18	0.351	
14	0	0.00	—	89	0.12	0.843	
15	351	0.48	1.370	1 656	2.24	0.422	
16	386	0.52	1.905	333	0.45	0.600	
17	0	0.00		177	0.24	0.672	
18	18	0.02	2.347	492	0.67	0.495	
19	0	0.00	-	173	0.23	1.004	
20	0	0.00	_	145	0.20	0.978	
21	297	0.40	1.487	31	0.04	1.528	
22	0	0.00		31	0.04	1.441	
Total measured		141			470		
Total ag	ged		127			433	
Mean w	eighted c.v. (by	sex)	64.7			32.1	
Mean w	eighted c.v. (bo	th sexes)				30.9	

Table 14: Summary of catch sampling for alfonsino from BYX 3 in the 2004–05 fishing year.

		Samples		Nur	nber of fish	Catch (t)	
Stratum	Period	Planned	Achieved	Measured	Otoliths	Sampled	Landed
All vessels	Nov–May	15	13	650	650	433	1 062

Table 15: Estimated catch-at-age (numbers and percentage) and calculated c.v.s from catch sampling in BYX 3 in 2004–05. The numbers of fish measured and aged, and the estimated mean weighted c.v.s, are also presented. –, no data.

			Male			Female
Age	Number	%	c.v.	Number	%	c.v.
Ĩ	7	0.00	1.744	0	0.00	
2	6 846	0.67	1.221	6 984	0.68	1.375
3	38 712	3.78	0.728	47 984	4.69	0.827
4	33 508	3.27	0.364	67 640	6.61	0.391
5	52 448	5.12	0.263	63 322	6.19	0.266
6	53 642	5.24	0.283	86 660	8.47	0.231
7	48 365	4.72	0.296	84 002	8.21	0.218
8	66 491	6.50	0.258	54 108	5.29	0.236
9	28 085	2.74	0.317	30 290	2.96	0.276
10	24 842	2.43	0.346	35 915	3.51	0.249
11	29 299	2.86	0.361	30 105	2.94	0.311
12	7 302	0.71	0.566	36 204	3.54	0.294
13	14 931	1.46	0.402	21 309	2.08	0.425
14	3 062	0.30	0.935	19 705	1.92	0.403
15	5 439	0.53	0.800	7711	0.75	0.571
16	624	0.06	1.720	9 568	0.93	0.566
17	0	0.00	_	2 143	0.21	1.018
18	0	0.00	-	6 390	0.62	0.779
Total m	easured		257			392
Total ag	ged		254			379
Mean w	eighted c.v. (by	sex)	37.6			35.2
Mean weighted c.v. (both sexes)						29.7

C



Figure 1: Definitions for the JDO 1 fishery used in this report. JDO 1W is in QMA 9, and JDO 1E is in QMA 1.



Figure 2: The boundaries of grey mullet fishstocks (solid black lines). The 250 and 1000 m depth contours are overlaid (solid grey lines). GMU 1 is divided into GMU 1(E) and GMU 1(W) along the line separating fisheries management areas 1 (AKE) and 9 (AKW) (dashed black line).



Figure 3: Map of the New Zealand EEZ showing the boundaries of red gurnard fishstocks (solid black lines). The 250 and 1000 m depth contours are overlaid (solid grey lines). GUR 1 is divided into AKE (GUR 1E) and AKW (GUR 1W) along the line separating QMAs 1 and 9 (dashed black line).



Figure 4: Definitions for the northern gemfish fisheries used in this report.



Figure 5: Definitions for the alfonsino fisheries used in this report.

(a) JDO 1 (AKE)



Figure 6: Summaries of fishing and sampling activity in (a) JDO 1 (AKE) and (b) JDO 1 (AKW) during the 2004–05 fishing year. Histograms of the total reported landed catch (dark-grey bars), total reported landed catch by vessels in the BT-OTH fishery (Fleet, light-grey bars) and the sampled (white bars) catch are overlaid on each plot. Numbers of landings by each group are also overlaid for comparison with the sampled landings.



Figure 7: Comparing the total reported estimated catch by (a) statistical area and (b) target species for the BT-OTH fishery in JDO 1 (AKE) during the 2004–05 fishing year. The catches for all sampled landings and the BT-OTH fishery as a whole are plotted separately and overlaid.

Figure 8: Comparing the total reported estimated catch by (a) statistical area and (b) target species for the BT-OTH fishery in JDO 1 (AKW) during the 2004–05 fishing year. The catches for all sampled landings and the BT-OTH fishery as a whole are plotted separately and overlaid.







Figure 10: Estimated age-frequency distributions of male and female John dory from the JDO 1E bottom trawl fishery, from the 2002–03 to 2004–05 fishing years.



Figure 11: Estimated age-frequency distributions of male and female John dory from the JDO 1W bottom trawl fishery, from the 2002–03 to 2004–05 fishing years.



Figure 12: Summaries of fishing and sampling activity in GMU 1 (AKW) during the 2004–05 fishing year. Histograms of the total reported landed catch (dark-grey bars), total reported landed catch by vessels in the SN-GMU plus the RN-GMU fisheries (Fleet, light-grey bars) and the sampled (white bars) catch are overlaid on each plot. Numbers of landings by each group are also overlaid for comparison with the sampled landings.

(a) statistical area



Figure 13: Comparing the total reported estimated catch by (a) statistical area and (b) target species for the SN-GMU and RN-GMU fisheries in GMU 1 (AKW) during the 2004–05 fishing year. The catches for all sampled landings and for the SN-GMU or RN-GMU fisheries as a whole are plotted separately and overlaid.






Figure 15: Estimated age-frequency distributions of male and female grey mullet from the GMU 1W fishery, in the 2003–04 to 2004–05 fishing years.

(a) GUR 1 (AKE)



Figure 16: Summaries of fishing and sampling activity in (a) GUR 1 (AKE) and (b) GUR 1 (AKW) during the 2004–05 fishing year. Histograms of the total reported landed catch (dark-grey bars), total reported landed catch by vessels in the BT-OTH fishery (Fleet, light-grey bars) and the sampled (white bars) catch are overlaid on each plot. Numbers of landings by each group are also overlaid for comparison with the sampled landings.



Figure 17: Comparing the total reported estimated catch by (a) statistical area and (b) target species for the BT-OTH fishery in GUR 1 (AKE) during the 2004–05 fishing year. The catches for all sampled landings and the BT-OTH fishery as a whole are plotted separately and overlaid.

Figure 18: Comparing the total reported estimated catch by (a) statistical area and (b) target species for the BT-OTH fishery in GUR 1 (AKW) during the 2004–05 fishing year. The catches for all sampled landings and the BT-OTH fishery as a whole are plotted separately and overlaid.











Figure 21: Estimated age-frequency distributions of male and female red gurnard from the GUR 1W bottom trawl fishery, from the 2002–03 to 2004–05 fishing years.



Figure 22: Summaries of fishing and sampling activity in GUR 2 during the 2004–05 fishing year. Histograms of the total reported landed catch (dark-grey bars), total reported landed catch by vessels in the BT-OTH fishery (Fleet, light-grey bars) and the sampled (white bars) catch are overlaid on each plot. Numbers of landings by each group are also overlaid for comparison with the sampled landings.



Figure 23: Comparing the total reported estimated catch by (a) statistical area and (b) target species for the BT-OTH fishery in GUR 2 during the 2004–05 fishing year. The catches for all sampled landings and the BT-OTH fishery as a whole are plotted separately and overlaid.



Figure 24: Estimated age-frequency distributions of male and female red gurnard from the GUR 2 bottom trawl fishery, from the 2003–04 and 2004–05 fishing years.



Figure 25: Scaled length-frequency distributions of male and female red gurnard from the bottom trawl fisheries in GUR 2, in the 2004–05 fishing year.



Figure 26: Summaries of fishing and sampling activity in SKI 2 during the 2004–05 fishing year. Histograms of the total reported landed catch (dark-grey bars), total reported landed catch by vessels in the BT-MW-SKI fishery (Fleet, light-grey bars) and the sampled (white bars) catch are overlaid on each plot. Numbers of landings by each group are also overlaid for comparison with the sampled landings.



Figure 27: Comparing the total reported estimated catch by (a) statistical area and (b) target species for the BT-MW-SKI fishery in SKI 2 during the 2004–05 fishing year. The catches for all sampled landings and the BT-MW-SKI fishery as a whole are plotted separately and overlaid.







Figure 29: Estimated age-frequency distributions, by sex, of the gemfish catch from SKI 2 in fishing years 1995–96 to 1999–2000.



Figure 30: Summaries of fishing and sampling activity in BYX 3 during the 2004–05 fishing year. Histograms of the total reported landed catch (dark-grey bars), total reported landed catch by vessels in the BT-MW-BYX fishery (Fleet, light-grey bars) and the sampled (white bars) catch are overlaid on each plot. Numbers of landings by each group are also overlaid for comparison with the sampled landings.



Figure 31: Comparing the total reported estimated catch by (a) statistical area and (b) target species for the BT-MW-BYX fishery in BYX 3 during the 2004–05 fishing year. The catches for all sampled landings and the BT-MW-BYX fishery as a whole are plotted separately and overlaid.



Figure 32: Scaled length-frequency distributions of male and female alfonsino from BYX 3, in the 2004–05 fishing year.



Figure 33: Estimated age-frequency distributions of male and female alfonsino from the BYX 3 trawl fishery, from the 2002–03 to 2004–05 fishing years.