Operation Maxi

Investigation Report

1. Introduction

1.1.1. Operation Mini

In September 2004 Operation Mini was commenced as a result of information supplied by observers that had completed consecutive trips onboard the Korean flagged vessel the s 9(2)(b)(ii) This vessel had been fishing in the West Coast South Island (WCSI) hoki fishery.

Observers reported the following:

- large numbers of small hoki caught irrespective of midwater or bottom trawling method – small hoki were likely to be more evident due to poor catches;
- hoki HGT processing specifications for the s 9(2)(b)(ii) are provided in Table 1:

Grade	No. fish/block	Piece weight
2L	1-13	1 kg - 13 kgs
L	14-18	720g -1000g
M	19-25	520g -720g
S	26-45	290g -520g

Table 1 – vessel processing specifications for hoki HGT.

- Grade S hoki HGT were normally greater than 60cm in overall length;
- Initially small hoki less than 50 cm in length were packed green (i.e. the fish was not processed at all and was packed straight into a pan) and recorded as hoki green block (HOK GRE BLO);
- s 9(2)(b)(ii) later elected to discard the small and damaged hoki authorised by the observer(s);
- Small hoki 50 cm, and less, were not processed as these size fish did not meet the vessel specifications for "S" grade hoki once processed;
- Small hoki 50 cm, and less, were either packed green for subsequent mealing on land or legally discarded at sea as authorised by the observers;
- generally no hoki less than 65 cm were processed as there was an apparent absence of hoki between 50-65 cm in overall length;
- 90-95% of authorised hoki discards related to hoki less than 65 cm in overall length.
- There was no incentive for the master to land hoki green as it takes effort to pack & freeze with no financial benefit to the company, master and/or crew. In fact in the majority of cases it would cost the company to land i.e. cost of unloading, storage and payment to shore based mealing plant;
- for the second trip, observer(s) indicated that authorised hoki discards ranged between 2-22% of all hoki caught (by weight) per tow; and
- At all times the s 9(2)(b)(ii) operated within sight of the s 9(2)(b)(ii) (all chartered by the same company) typically following the same contour. This is

depicted in Figure 1 which illustrates the area fished by the observed vessel and one of the suspect vessels.

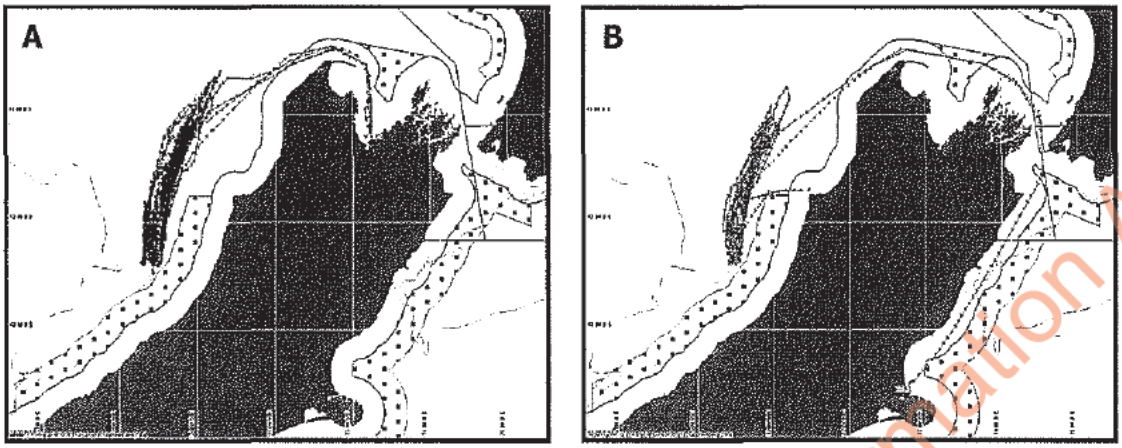

Figure 1 – A depicts the vessel positions of the observed vessel. B depicts the vessel positions of 1 of the suspect vessels. Positions from VMS.

Analysis of observer catch log books showed that between 7-8% of the total hoki caught (by weight) by the s 9(2)(b)(ii) (in respect of the 2 trips conducted in the West Coast South Island Hoki fishery) related to hoki packed green and landed, together with authorised hoki discards.

In light of the information obtained from observers the Serious Offences Unit (SOU) were concerned about the potential level of highgrading by vessels operating in the WCSI hoki fishery which were not carrying observers. In particular those vessels that were of greater concern were those that did not have meal plants. Instead of converting unwanted hoki to meal these vessels would have to retain and land unwanted hoki in green block form thereby taking up valuable hold space and attracting costs associated with packing, unloading and onshore mealing.

Given that the s 9(2)(b)(ii) were scheduled to land in Wellington shortly after that s 9(2)(b)(ii) it was decided that Fishery Officers would conduct vessel inspections in order to obtain copies of the vessels processing specifications for hoki and to establish the quantity, and examine the contents, of green block declared and landed associated with their trips to the WCSI hoki fishery.

At the completion of the August inspections it was found that the 2 vessels had packed to the same processing specifications to that of the s 9(2)(b)(ii) Both vessels had reported no 'S' grade hoki and very little green block hoki in unload manifests and in vessel returns. FI s 9(2)(a) was advised by the ships agent that the green block contained small and damaged hoki and was deemed to be 'industrial shit fish'. The green block accounted for between 0.1% and 0.3% of total hoki catch by weight declared by the 2 vessels, compared to between 7-8% by weight as recorded by observers on the s 9(2)(b)(ii)

In late September 2004 the 2 s 9(2)(b) vessels landed in Dunedin. Fishery Officers in Dunedin were requested to conduct vessel inspections of the 2 vessels in order to examine the hoki green block and to obtain copies of unload manifests. The unload manifests reported very little "S" grade HGT hoki (smallest grade) as well as small amounts of hoki green block. The combined weights of the 'S' grade HGT hoki and the green block accounted for < 0.5% of total hoki catch, by weight, declared by the two vessels.

As a result of findings at that stage Operation Mini was commenced as the Investigation team were highly suspicious that the s 9(2)(b)(ii) were highgrading substantial

quantities of small hoki taken as a direct consequence of fishing in the WCSI hoki fishery during the 2004 winter spawn.

At that stage all hoki product landed by the two vessels was detained in order to draw a random sample from the hoki HGT by grade. Following the release of the remaining HGT product an extensive 2 week examination was conducted in relation to the sample of hoki HGT product as well as all of the hoki green block landed. Evidence obtained during the examination process confirmed that small and damaged hoki were in the main exclusively packed within the green block and not intermixed within the HGT cartons. It is useful to note here that proxy measurements were used to determine the presence of small hoki within HGT grades, therefore where the examining officer was in doubt regarding size a count was made as if the block contained a small hoki, this approach was taken in order to be conservative and give every allowance to the vessel. The reason for doing this was that in the event that the product was seized as a result of forming reasonable grounds been formed to believe an offence had been committed, then destructive testing of the HGT product would have enabled the absolute quantification of small hoki. This was important as it was necessary to eliminate any defence that the small hoki were simply packed within the larger grades. The Investigation team were reasonably confident that small hoki would not be packed within the larger grades since this is not considered normal industry practice as buyers would ultimately reject the product or refuse to pay full price.

Figure 2 below illustrates examples of hoki processed to grades '2L' and 'M'. You can see from these photos that the hoki are packed uniformly and are thus easy to count. Counting the number of fish per block was important in order to test that packing specifications were adhered to. The examination process confirmed that packing specifications were in fact adhered to in respect of numbers of fish per block.

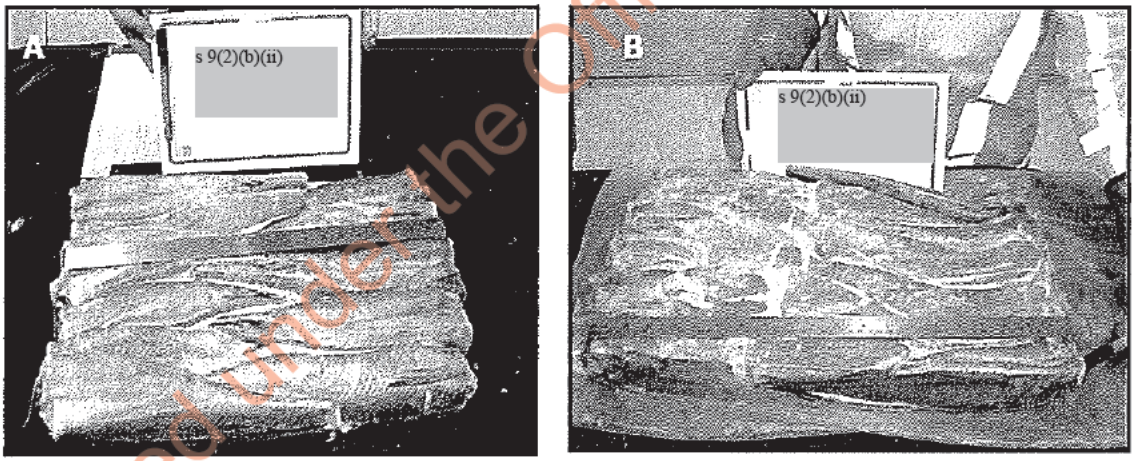

Figure 2 – A depicts Hoki HGT 2L grade. B depicts Hoki HGT M grade.

As previously mentioned the unload schedules recorded nil to very little "S" grade HGT product in respect of the 2 trips completed by the two vessels. The 'S' grade HGT product (total of 37 cartons) was unable to be examined as the product had been unloaded immediately into containers and shipped to Busan Korea. The investigation team were not convinced that this grade would contain many small hoki given that the maximum number of hoki packed within this grade was 45 which equated to an average processed piece weight of 290gm. A processed piece having weight of 290 g equates to a total length of between 530mm and 540mm, see section 1.1.1.2 for details on length weight relationships. However, since the 'S' grade HGT could not be examined the maximum number of hoki associated with this grade was allowed for in all analysis in order to give the 2 vessels every possible allowance thereby taking a conservative and reasonable approach.

Following the examination phase it became quite clear to the investigation team that the 2 vessels had landed insufficient small hoki, and that substantial quantities of hoki ≤ 550mm in overall length had been returned to, or abandoned in the sea illegally. Critical to the case was the ability for the investigation team to answer the following questions:

- How many small hoki should each of the suspect vessels have landed? and
- How many small hoki did each of the suspect vessels actually land?

The investigation team had previously been advised by s 9(2)(a) that once you knew the size frequency distribution of the hoki population in the WCSI you could then predict how many small fish should have been landed from the number of large fish landed.

To test this theory s 9(2)(a) analysed observer length frequency data collected from 527 tows from vessels operating within the WCSI spawning fishery for that year. s 9(2)(a) found that the size frequency curve of the hoki population was distinctly bimodal with the majority of fish caught in commercial trawls being > 750 mm in total length, but with about 15% being ≤ 550mm, and with few fish in the gap in between. This confirmed what observers had stated regarding the distinct absence of hoki between 500mm and 600mm. The bimodal distribution associated with the observer collected length frequency data is illustrated in figure 3 below.

Although the investigation team accepted that there would be high variation in the numbers of small hoki present between trawls and that it may well be possible to have some trawls with no small hoki caught they did not consider it probable that an entire trip would have little to no small hoki caught as suggested by the vessels landings.

Typically one would expect a vessel's catch to closely approximate the length frequency distribution, as measured by observers which is illustrated in figure 3.

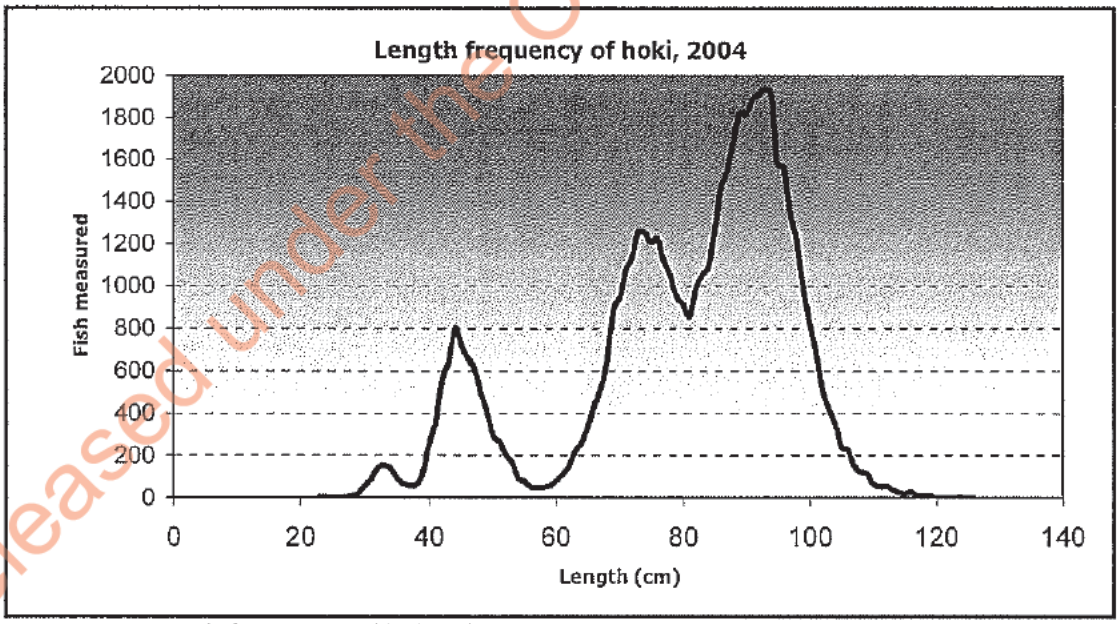

Figure 3 – Length frequency of hoki taken from observer data collected during 2004. Distribution is distinctly bimodal.

The analysis completed by s 9(2)(a) made 4 assumptions about the data in order that each tow could be viewed as a separate sample drawn from the same population. The assumptions were:

1 Whilst on the WC grounds the vessel was fishing within the area trawled by the observed vessels, and with the same range of depths; and

2 The vessel was not using a cod end of unusually large mesh size – i.e. small hoki could not escape more easily from the net of the vessel than from other vessels.
3 The observer length frequency samples collected from the observed trips are unbiased samples of the catches in the sampled tows.
4 There are no small fish contained within the other grades and that there are no misgraded cartons of small fish.

s 9(2)(a) findings were critical in determining what proportion of the 2 vessels landed hoki catch should have been ≤ 550mm in overall length and be declared in the vessels returns as green block.

s 9(2)(a) concluded that a best point estimate of the number of small hoki that had not been landed by s 9(2)(b)(ii) was 14,585 fish (equivalent to approximately 4.5 tonne) and 22,012 fish (equivalent to approximately 7 tonne) respectively.

In light of these figures the investigation team should have expected to see between 133-193 small hoki per block landed by the s 9(2)(b)(ii) and between 176-263 small hoki per block landed by the s 9(2)(b)(ii) in order to account for the discrepancy. By contrast the green block examination showed that between 10 and 45 hoki were packed within this product for both of the vessels. Clearly insufficient small hoki had been landed by the two vessels and that the only conclusion could be to account for the discrepancy was that small hoki ≤ 550mm had been illegally returned or abandoned in the sea.

1.1.1.1. Predicting total length of processed and damaged hoki using proxy measurements

As mentioned above one would expect the length frequency distribution, of the landed hoki caught by the two vessels, to look normal, that is, it should have approximated the observer measured length frequency distribution, with a sudden truncation at the bottom end of the length distribution relating to vessel processing specifications.

If there were unexpected gear effects then the length frequency distribution would be expected to also affect the larger grades which would result in their length frequency distribution looking quite abnormal.

In order to establish the length frequency distribution of hoki landed by the two suspect vessels it was necessary to convert the HGT hoki, and damaged hoki, to total length. In order to identify a predictor for total length it was necessary to use the best control data possible which in this instance was the whole intact hoki contained within the green block landed by the 2 suspect vessels.

Three sets of standard morphometric measurements were taken in order to determine which would provide the best predictor for the total length of processed HGT and damaged hoki. The anatomical landmarks used are shown in figure 4.

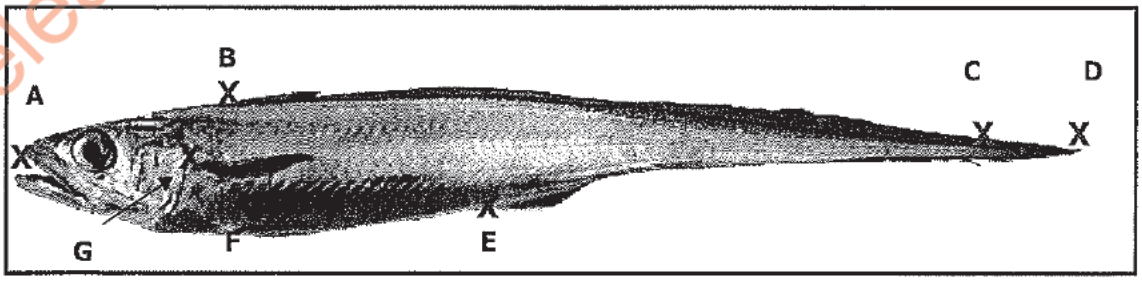

Figure 4 – Anatomical landmarks of potential use to predict total length of HGT and damaged hoki. Key: A (Snout), B (origin of dorsal fin), C (Last vertebrae), D (tailtip), E (origin of anal fin), F (Origin of pelvic fin) and G (Origin of pectoral fin).

Linear regression (which attempts to explain the relationship with a straight line fit, where r^2 = 1.00, to the data) showed excellent correlations between measurements taken and total length. These relationships are expressed below and were all shown to be statistically significant.

- Snout to last verterbra (VL) v's Snout to tailtip (TL) r^2 = 0.998
- Dorsal anterior origin to anal anterior origin (DOAO) v's total length (TL) r^2 = 0.97
- Pelvic fin to anal origin (PFAO) v's total length (TL) r^2 = 0.97

The measurement between the dorsal anterior origins to anal anterior origin was used as the best predictor for total length where r^2 = 0.97. The reason for this was because in many instances the pelvic fin was either partially or completely missing in the HGT hoki and therefore would not be able to be used in many instances. The measurements made for dorsal anterior origin to anal anterior origin (DOAO) v's total length (TL) are illustrated in Figure 5.

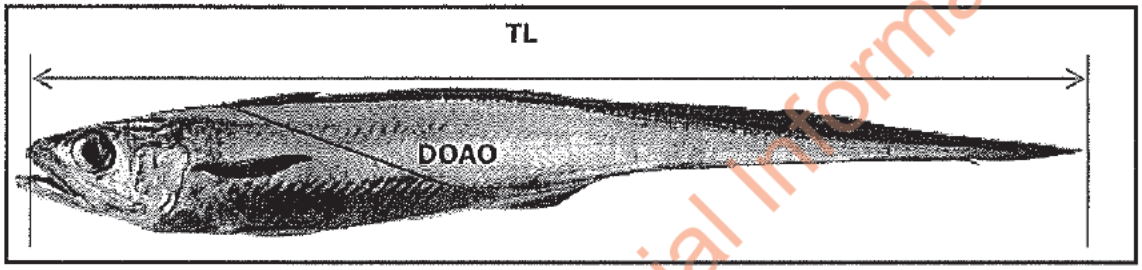

Figure 5 – Measurements used for DOAO (dorsal origin to anal origin) and TL (total length).

As discussed above the relationship between the DOAO and TL of hoki was found to be statistically significant where r^2 = 0.97. This is illustrated by the straight line fit in figure 6 below. This means that 97% of the variance is explained by the fitted regression line.

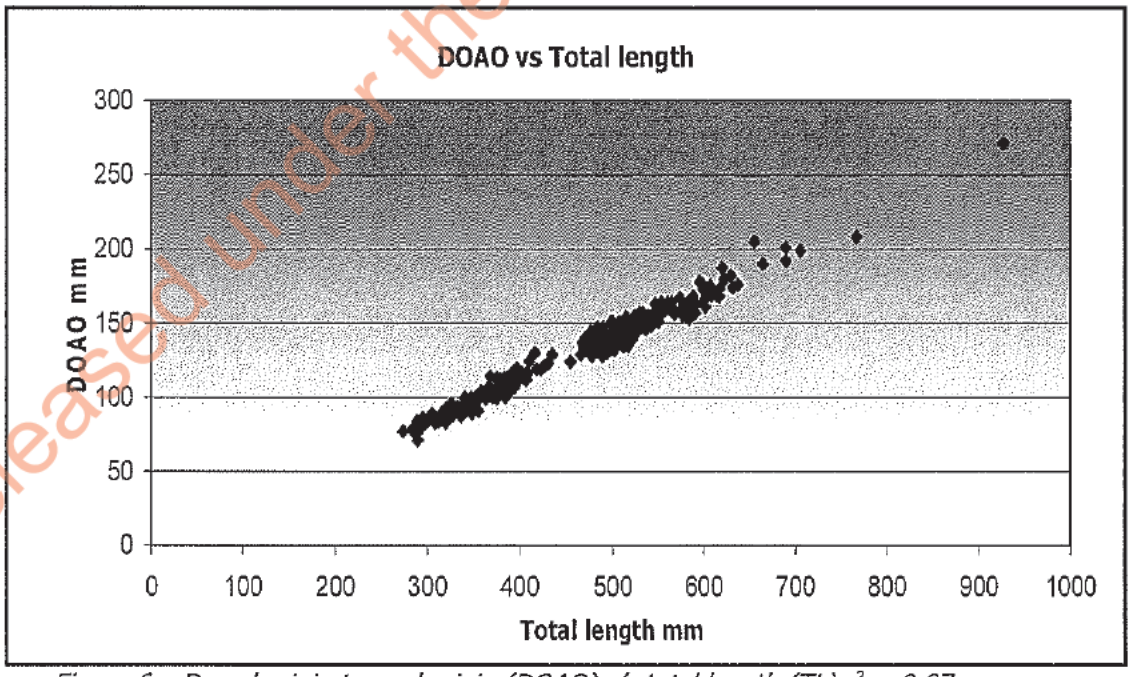

Figure 6 – Dorsal origin to anal origin (DOAO) v's total length (TL) r^2 = 0.97

It is not unusual for relationships as good as this to exist in nature. In fact less obvious relationships have been found. One such example is that found in spiny oreo dory where a

significantly significant relationship was found to exist between eye diameter and fork length where $r^2 = 0.811$ (Crane et al, 1987).

1.1.1.2. Predicting total length of processed and damaged hoki using weight

In Operation Mini hoki length frequency data collected at sea by Mfish observers (on a tow by tow basis) was used to predict the minimum number of small fish vessels must catch in the West Coast hoki fishery over the course of an entire trip.

Since commercial fishers are not required to report numbers of fish, but rather are legally bound to report fish weights, this data is not directly comparable with the observer data collected in respect of fish lengths.

Despite this however, the length/weight relationship for hoki is well known and documented by Francis (2003).

This relationship is illustrated in figure 7. Based on over 35,000 hoki measurements, Francis concluded that there is a seasonal cycle, with fish being about 10% heavier in autumn and winter than they are in summer; but that there are no consistent diffferences between the sexes or between the eastern and western substocks. His average curve has the formula:

$$\text{Weight (g)} = 0.00479 \times \text{length (cm)}^{2.89}$$

The length/weight relationship found during Operation Mini is very similar and is also plotted on figure 7 to illustrate this. The curves are effectively identical however because there were not many fish in the green blocks over about 650 mm in length, the upper part of the curve is somewhat speculative.

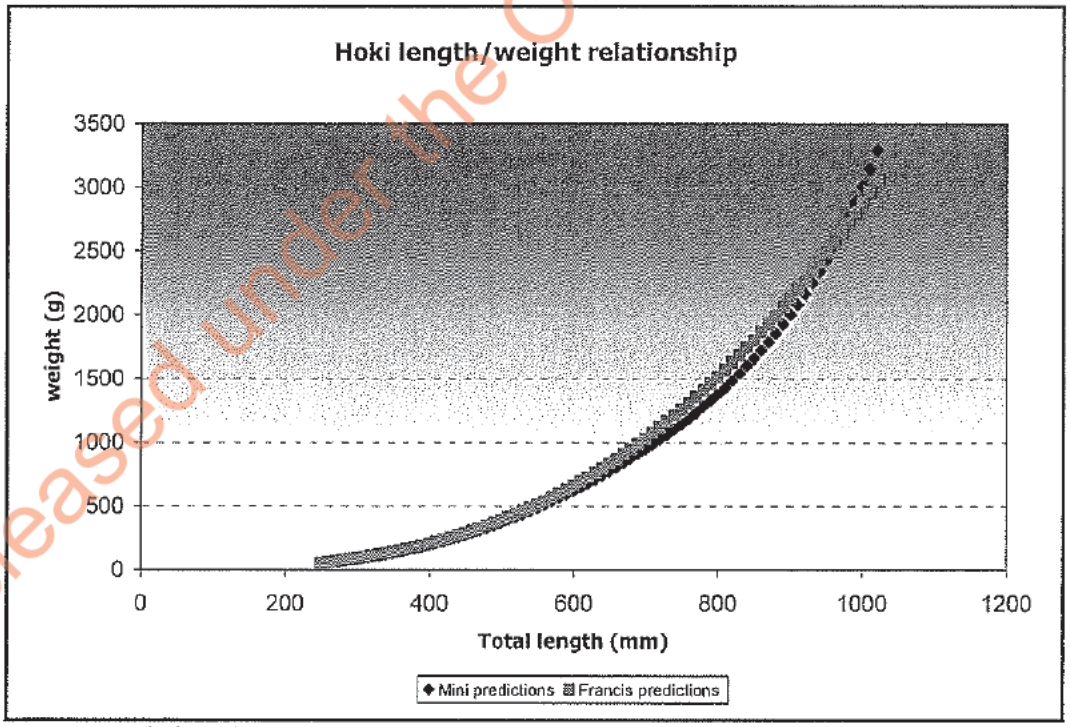

Figure 7 – Hoki length weight relationship as described by Francis predictions and Op Mini predictions.

Figure 8 illustrates an example of hoki contained within a green block which was thawed as part of Operation Mini. You can see that there are a range of sizes present which enabled internal controls for length and weight predictors.

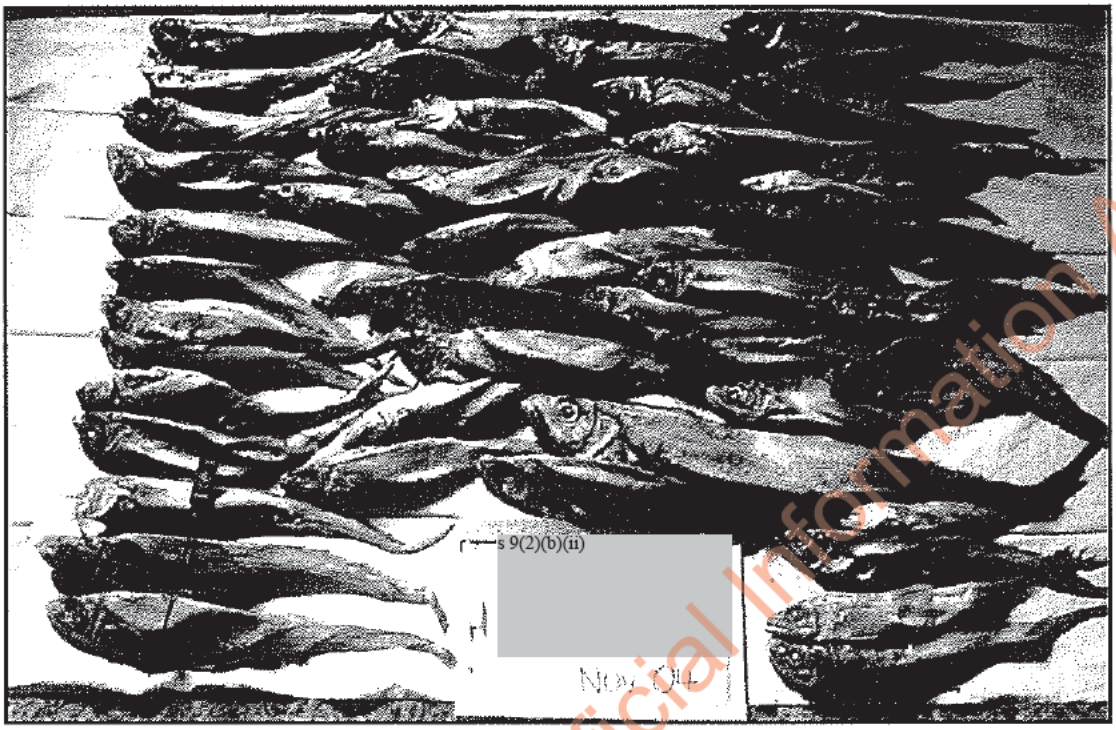

Figure 8 – Hoki length weight relationship as described by Francis predictions and Op Mini predictions.

By replacing the fish lengths with predicted fish weights in the observer length frequency data file the probabilities of various aggregate weights of small and large fish being landed is able to be calculated.

s 9(2)(a) did this with respect to hoki greater than and less than 50 cm in length, for the 2004 West Coast winter "outside the line" hoki fishery. s 9(2)(a) found that one could expect vessels to take an average of 2.7 % of their catch as fish less than 50 cm in length; and be 95% sure that something other than chance was at work if a trip of 45 tows resulted in less than 1.33% of the catch weight being fish under 50cm.

s 9(2)(a) noted that there is some uncertainty in the estimate due to the greenweight of the larger fish being calculated from the processed weight landed. However s 9(2)(a) considered that (i) we are entitled to rely on the official conversion factors *for all purposes (including any proceedings for an offence against this Act) ..... To determine the weight of any fish, aquatic life, or seaweed*; (ii) most conversion factor problems are due to vessels processing beyond a defined state and therefore undercalculating greenweight, which would reduce his estimate of the amount of small fish they should land; and (iii) if anyone is producing unusual states it will be obvious on inspection.

An example of using length weight predictions for hoki HGT is given below.

Using Francis' formula a Hoki processed to HGT with a weight of 310 grams equates to 511.5 gms greenweight (using the official conversion factor of 1.65). A greenweight of 511.5 gms has a predicted total length of 550mm.

For details illustrating the length weight predictions and associated weights for hoki processed to an HGT state refer to Annex A.

The investigation team noted that post mortem changes in hoki length may impact of any predictions made. Despite this however research in other fisheries indicates that body length in some fish species are reduced by up to 3%. However once rigor had resolved itself the fish species concerned had regained their original length. Other research states that fish species tested regained size within 1% of their original length.

The significance that freezing has on the length of a piece of processed fish is yet to be determined. Work has commenced in this area, using Mfish observers to test at sea, but at this stage this work has not been completed.

Given that rigor mortis causes a reduction in total length one would expect to see this across all sizes. Even with a 1-3% reduction in size, one would still expect the length frequency distribution of the catch to closely approximate the length frequency distribution as measured by Mfish observers on fresh hoki at sea. Certainly any reductions in length would be in favour of the vessel anyway, that is, more small hoki would be estimated as landed than may well have been.

1.1.1.3. Discontinuation of investigation

In mid October FI s 9(2)(a) Officer in charge of the file, formed reasonable grounds to believe that offences had been committed in respect of fishing trips undertaken by the s 9(2)(b)(ii) and s 9(2)(b)(ii) in that they had illegally returned small hoki to the sea and that in addition the s 9(2)(b)(ii) had made false statements in returns in recording hoki as HGT when it appeared to be processed beyond that state.

As a result of forming reasonable grounds product from both vessels was seized having a landed weight of approximately 49 tonne (of this 28 tonne was associated with product processed beyond the HGT state). The value of this product was worth approximately US$75,000 (of which US$48,000 was associated with 28 tonne incorrectly declared as HGT).

s 9(2)(h)

1.1.2. Highgrading

Highgrading is the action of grading the catch of a marketable species of fish by some attribute (usually length or weight) and discarding the unwanted or less profitable grades. In doing so this allows for the harvest of higher valued catch (Anderson, 1994).

It is well known that fish taken during a haul are not all worth the same value. Hence, fishers aiming at increasing their revenue are encouraged to discard the least valuable part of their catch in order to maximise their profit for that trip. It is estimated that world fisheries discard almost a third of their total catch (Rocket et al. 2005), which is of great concern to the sustainability of world fishstocks. With the depletion of fish stocks on the high seas there may be greater pressure on those fisheries managed within a countries Exclusive Economic Zone (EEZ). The impact that this might have on NZ fisheries in the future is yet to be realised.

NZ hoki taken from the WCSI hoki fishery are considered to be at risk of highgrading on the basis of length, with the smaller fish being discarded due to their low, or nil, economic value.

Growth in hoki is fairly rapid with juveniles reaching about 270-300 mm total length (TL) at the end of the first year. There is some variability in growth rates, but hoki reach about 400-450, 500-550 and 600-650 mm TL respectively in the following three years, this is summarized in the Table 2.

Year	Total Length (mm) *
1	270-300
2	400-450
3	500-550
4	600-650

Table 2 – provides a summary of Total length at end of year for hoki

Males appear to mature at 600-650 mm TL at 4-5 years, while females mature at 650-700 mm TL. From the age of maturity the growth of males and females differs. Males grow up to about 1150 mm TL, while females grow to a maximum of 1300 mm TL and up to 7 kg weight. The maximum age for hoki is between 20-25 years.

Generally speaking it is the 1, and 3 year old hoki most at risk of highgrading. The impact of removing these fish from the population may well have implications on future recruitment and ultimately the health and sustainability of the fishery.

It is important to note that there is no applicable size limit for hoki nor is hoki a species which may be legally returned to the sea, unless authorised by an Mfish observer of Fishery Officer. Therefore all hoki including hoki that is unsuitable for processing must be landed and reported on the appropriate returns in order for it to be counted against annual catch entitlement (ACE).

As has become evident that unwanted hoki to fall within one or more of the following categories:

- Packed green and reported accurately
- Mealed and/or minced and reported accurately
- Discarded under authority (if Mfish observer or FO onboard) and reported accurately

It is clear however that unwanted hoki is in the main discarded illegally and not reported or mealed and misreported as offal. In both instances no ACE would be utilized.

1.1.3. Motive for highgrading

Anderson (1994) and Pitcher et al (2002) report that ITQ regimes provide incentives for fishers to maximise their return on quota by discarding fish that have no or low economic return.

Given the recent cuts in the TACC for hoki it is likely that highgrading has increased as a means of conserving ACE for prime product only. This is certainly encouraged under a system whereby the cost of quota and/or ACE is independent of fish size (price/tonne ranged from $303-$633.30 through out the 2004-05 fishing year). By comparison the sale of product does attract a price differential between large and small hoki. One example of this price differential, as sourced from industry, indicates that sales for 2L grade HGT achieves US$1950/tonne compared to US$1700/tonne for S grade HGT. In addition to this,

processing costs are inversely proportional to fish size in that costs are higher to produce one tonne of hoki S grade HGT compared to that of 2L grade HGT.

The expectation of masters is that better catches of larger more valuable fish will be caught in subsequent tows thereby replacing any small low value fish that were previously discarded. In addition to this there may be some incentive for fishers to carry forward underfishing entitlement into the next year in the expectation that the following season will bring better catches of high value hoki where low value hoki makes up a substantial part of the catch in the current year.

It is worth noting here that the TACC for hoki was overcaught by 4% in the 2004-05 fishing year. The likelihood that this would occur would very likely have been obvious to industry and hence the incentive to conserve ACE would have been paramount as the payment of deemed values associated with product of low or no value would impact on a companies end of year profit particularly in a climate of high fuel costs and a high NZ dollar. Table 3 illustrates interim and annual deemed values for HOK1 for the 2004-05 fishing year.

Price/kg						
Interim DV	Annual DV where catch is < 120% ACE	Annual DV where catch is > 120% but < 140% of ACE	Annual DV where catch is > 140% but < 160% of ACE	Annual DV where catch is > 160% but < 180% of ACE	Annual DV where catch is > 180% but < 200% of ACE	Annual DV where catch is > 200% of ACE
0.30	0.59	0.71	0.83	0.94	1.06	1.18

Table 3 - illustrates interim and annual deemed values for HOK1 for the 2004-05 fishing year.

There is no financial incentive to land green block and in many circumstances companies will have to pay $50/tonne for the product to be mealed on land. The absence of a financial benefit was reinforced during the interview of Captain s 9(2)(a) (master of the s 9(2)(b)(ii) – Operation Mini) who admitted that there was no financial gain in landing hoki in green block form.

The ability of the vessel to process small hoki is often dictated by the processing machinery used on the vessel. For example the use of some Baader machines determines the size of fish that are unsuitable for processing as they are difficult to hold in the machine and often become misaligned leading to quality issues and incorrect states. Therefore larger fish will take priority and smaller fish may either be converted to meal and/or discarded illegally due to the deterioration of quality and the inability of the machines to process to specification.

Employment contracts may well provide incentives to masters and crew to highgrade low or nil value fish species, particularly if there are costs associated with the landing of that product i.e. cost to unload, meal on land and cost attributed to utilisation of quota/ACE. During Operation Mini it became apparent that the collective employment contracts for the crew may well have encouraged the highgrading of fish. Crew wage was calculated at 26.5% of profit (profit = sales – expenses – foreign crew advance payments) which would be distributed amongst the crew. The distribution rate differed by crew member with the master and senior crew benefiting the most. In addition to the wage a bonus of 4.5% would be distributed between the master, chief engineer and radio operator if their performance target was met. As you can see from this the incentives to highgrade small hoki are substantial. The terms and conditions of this type of employment contract is questionable given the environment in which they operate.

In addition the employment contracts set out that the master and senior crew, including their guarantors, were liable for any breach of NZ regulations and if convicted would have to

compensate s 9(2)(b)(ii) for any loss attributed to the breach. To expect an admission to any offence committed by the master and/or senior crew would be foolish in light of this.

1.1.4. Operation Maxi

As a result of evidence obtained during Operation Mini, and armed with a number of tools to detect and investigate highgrading, the SOU decided to commence an all encompassing operation code named "Operation Maxi" which would target all vessels operating in the WCSI hoki fishery, outside of the 25-mile restricted fishing zone, during the 2005 winter season.

In March 2005 the investigation team had discussions with Mfish Senior Scientist s 9(2)(a) s 9(2)(a) advised the team that a strong 2003 year class (comprising largely 2 year olds between 450-500mm) was anticipated for the 2004-05 fishing year, in the WCSI hoki fishery. The investigation team felt that if this held true then one could expect a similar or greater occurrence of small hoki present within the WCSI hoki fishery during the 2005 winter spawn.

Therefore the primary reason for commencing operation Maxi was largely due to a belief that vessels operating within this fishery would unlawfully discard (highgrade) unwanted hoki and that consequently large quantities of small hoki would be misreported on Mfish returns.

The principal objective for this operation was to identify, investigate and successfully prosecute the worst offenders operating in this fishery.

To achieve this objective the operation consisted of three phases as listed below:

- Phase 1 - Observer coverage during 2004-05 WCSI hoki spawn
- Phase 2 – In port vessel inspections
- Phase 3 – At Sea Boardings (code named Operation Weka)

All three phases overlapped in respect of time. This was done to ensure that we obtained good coverage across the deepwater factory fleet operating within the area of interest.

Each phase had specific taskings in order to capture detailed information relevant to the operation. In particular the type of information collected during 1 or more of the phases included: processing & grading specifications for hoki, hoki length frequency data, quantification of authorised hoki discards (and in particular small hoki), net plans and specifications including mesh size, unload manifests recording all hoki product by state and grade.

Operation Maxi commenced on the 1st May 2005 in preparation for the June 2005 to September 2005 period. Substantial briefing documents were prepared in order to ensure that Mfish personnel deployed during each phase were provided with sufficient detail to carry out their duties. The information requirements for each phase were developed as part of a framework in which critical information would be collected in order that we would gain a comprehensive dataset covering the majority of the vessels operating within the WCSI hoki fishery.

Critical to the operation was the ability to answer the following questions in order to detect and investigate offences:

- How many small hoki should each of the vessels have landed (expressed by number of fish or weight)? And
- How many small hoki had each of the vessels actually landed (expressed by number of fish or weight)?

It was determined that the calculation of weights (rather than numbers of fish) would be a good way to analyse the observer length frequency data for ease of comparability with vessel declarations given that they record weight. It was determined that this information would enable a good estimate of the amount of small fish dumped or unreported, even for vessels with meal plants.

Details of the length weight relationship are described in section 1.1.1.2. This method at least would give the investigation team an excellent method for the early detection of offences, in that answers to the two questions central to this operation would be established, and may well have offered a means of reaching reasonable grounds, particularly if fish counts were impossible logistically.

2. Hoki fishery

Hoki (*Macruronus novaezealandiae*) is New Zealand's largest commercial fish species. In 2003 hoki was New Zealand's largest most valuable seafood export species, worth NZ$ 229 million. In 2004 hoki export earnings were worth NZ$ 189 million, down NZ$ 40 million on the previous year.

Annual catches of hoki peaked in 1997-98 at 269 000 t. Since then catches have declined which has lead to reductions in the total allowable commercial catch (TACC). Despite this Hoki is still New Zealand's largest fishery with a TACC of 100,000 tonne. The total allowable catch (TAC) is currently 101,040 tonne, of which 1,000 tonne provides for other mortality[1], and the remaining 40 tonne provides for customary and recreational harvest.

Hoki is managed as a single stock (HOK1), however in recent times it has been assessed as two stocks, western and eastern. For the 2004-05 fishing year the recommended tonnage to be extracted from western and eastern stocks was 40,000 t and 60,000 t respectively. The recommended catch limits, for the western and eastern stocks, were agreed to be managed by quota owners and are designated areas HOK1W and HOK1E.

Historically the West Coast South Island hoki fishery was the largest with over 90% of the total hoki catch taken during the spawning period. Over recent years this has reduced as a result of poor catches.

A major decline in hoki catches was reported during the 2002-03 fishing year and was largely associated with catches from the West Coast South Island (WCSI). Catches during that year for the WCSI were the lowest since 1995-96 with reported catch from the WCSI fishery accounting for only 40%. This decline in reported catch was despite similar levels of fishing effort to the 2001-02 fishing year. In 2003-04 a further decline in catch was reported for the WCSI with catches accounting for 33% of the total hoki catch.

---

[1] Other Sources of Mortality

1 MFish proposes a nominal allowance for other sources of fishing related mortality of 1% of the TACC for HOK 1. This proposal equates to an allowance of 1 400 tonnes under option 1, 1 200 tonnes for option 2, and 1 000 tonnes for option 3. *[option 3 was ultimately chosen by the Minister]*

2 The allowance is required as fishing is likely to cause a significant amount of hoki mortality that is not reported. An allowance needs to provide for net damaged hoki. Net damaged fish have been recorded in the west coast South Island fishery in some years. However, the extent of damage and resulting mortality is unknown. An allowance for burst and lost nets is also required. The discard and non-reporting of small fish in the HOK 1 fishery may also occur especially with the reduced TACC and the increased likelihood of high grading (the discard of small fish so bigger ones can be kept). The actual level of discards is unknown.

The western stock of hoki lives mainly on the Southern Plateau and migrates to spawn off the West coast of the South Island in winter. The spawning aggregations begin to concentrate in depths of 300-700 m around the Hokitika Canyon from late June, and further north off Westport later in the season. In some years fishing in this area continues into September. Fishing activity predominantly occurs within statistical areas 034 and 035 as illustrated in the Figure 9 on the following page.

The WCSI hoki fleet is typically made up of foreign chartered factory trawlers producing head and gut, or fillet product. These vessels are prohibited from fishing inside the 12 mile territorial sea. A 25-mile restricted fishing zone closes much of the hoki spawning area in the Hokitika Canyon and most of the area south to the Cook Canyon to all vessels larger than 46 m overall length. The primary reason for the 25-mile restricted fishing zone was to protect hoki spawning aggregations in the head of the Hokitika Canyon. The 25-mile restricted zone is illustrated in Figure 9.

In recent years there has been a increase in the number of 'Fresha' vessels (< 46m in total length) operating in the WCSI hoki fishery bringing back catches for onshore processing; these vessels generally operate within the 25-mile restricted fishing zone. Due to the quantities taken by these vessels there is now real concern that the spawning aggregations particularly in the Hokitika Canyon are now small enough to be more vulnerable to the effects of fishing than in the past (Sullivan et al, 2005).

In March 2001, the hoki fishery became the world's first large whitefish stock to achieve Marine Stewardship Council (MSC) certification. This eco-label gives endorsement that NZ hoki meets the MSC's guiding principals and criteria for a healthy, well-managed sustainable fishery. But is it?

Between 2000-01 and 2004-05 substantial reductions in the hoki TACC were made reducing the TACC from 250,000 tonnes to 100,000 tonnes. These reductions have largely been attributed to environmental factors. Do these reductions reflect a well-managed sustainable fishery? It seems that very little consideration, or allowance, has been given to the effect of illegal catch and in particular the act of highgrading (discarding). Discarding hoki is a criminal offence attracting substantial fines if proven. Despite this however illegal discarding is believed to occur extensively within the hoki fishery motivated by an ITQ regime where fishers want to maximise their return on ACE by discarding fish that have no or low economic value.

Some attempts have been made to estimate the extent of highgrading in the NZ hoki fishery. The methodology used was to extrapolate authorised discard rates recorded on observed vessels across the remainder of the fleet (Anderson et al 2001, Anderson & Smith 2005). This assumes that the presence of observer(s) onboard has no effect on crew behaviour and thus the level of discards. To date allowances for illegal discards have not been accounted for in the stock assessment. The 2005 stock assessment simply states that 'there may be some dumping of small fish but the level is unknown'.

As a result of findings from Operation Maxi it is anticipated that allowances for illegal catch could be built into the fisheries stock assessment for future years.

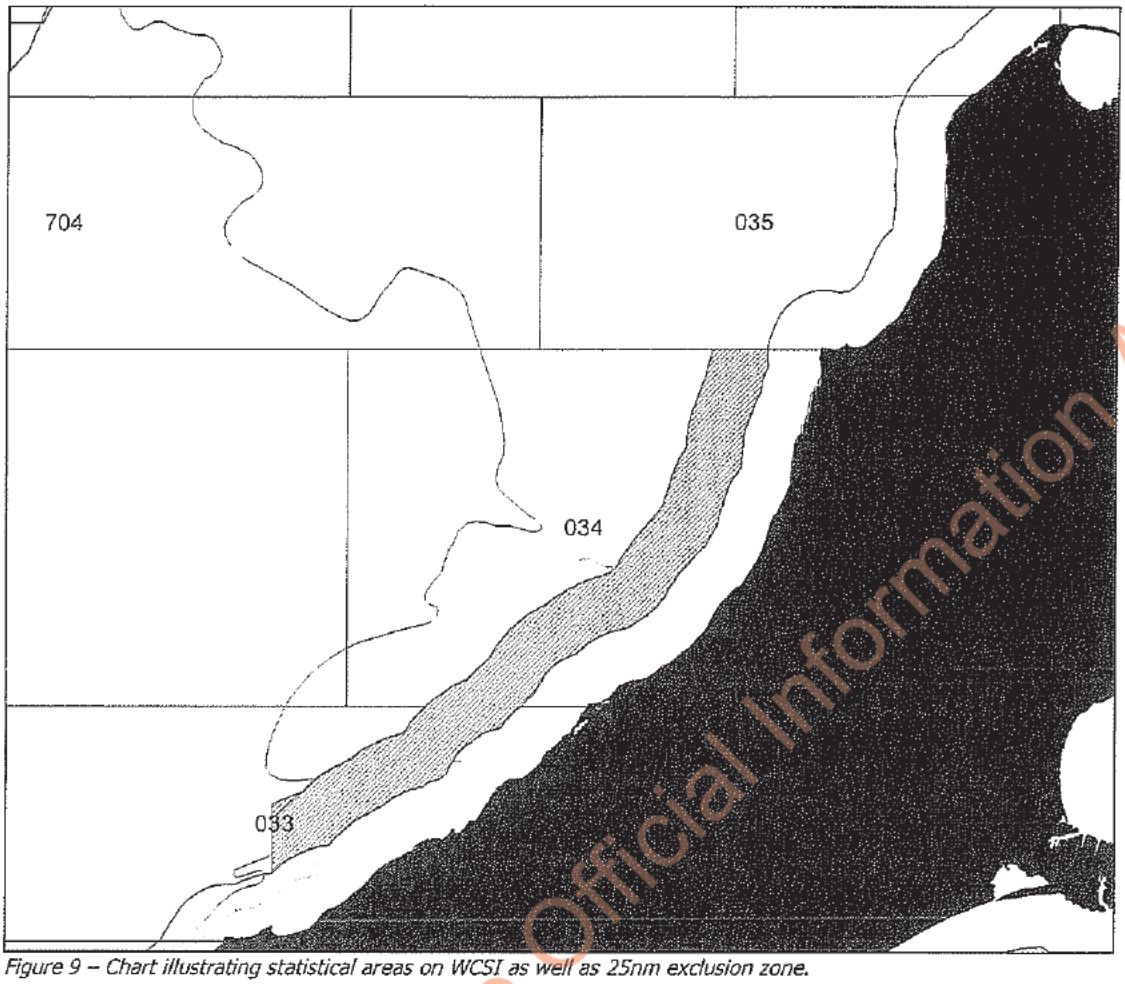

Figure 9 – Chart illustrating statistical areas on WCSI as well as 25nm exclusion zone.

25 mile restricted zone – prohibited to fishing vessels > 46m in overall length.

3. Total Hoki caught

During the 2004-05 fishing year approximately 32,641 tonne of hoki was estimated as taken from the WCSI, equating to 81% of the recommended catch limit. Of the quantity estimated as taken 25,042 tonne (or 76.7%) is attributed to catch taken outside of the 25-mile restricted fishing zone. The majority of this catch was taken by large factory processing trawlers capable of staying at sea for extended periods of time.

During the 2005 winter spawning season there were 36 factory trawlers fishing hoki outside of the 25-mile restricted fishing zone. The area they fished was approximately 130 nm long by 15 nm wide, typically fishing between the 200m and 500m contour.

Twenty six of the factory trawlers were foreign owned and crewed which accounts for 72% of the large factory vessels operating in this fishery. All twenty six foreign owned vessels were chartered to New Zealand companies.

Table 5 summarises the number of foreign charter vessels by flag state. The summary shows that the majority of the foreign charter fleet are Korean flagged, accounting for 46% of the vessels. The next largest group are flagged in the Ukraine and account for 19%. The remaining vessels in the charter fleet span across 6 flag states including Japan, Malta, Belize, Dominica, Panama and Vanuatu. With the exception of Japan the 5 other flag states listed are known as 'flags of convenience' and do not reflect the true ownership or crew nationality of the vessel.

Vessels flag state	Number of vessels
Korea	12
Ukraine	5
Japan	2
Malta	2
Belize	1
Dominica	1
Panama	1
Vanuatu	2
Total	**26**

Table 5 - Summary of foreign charter vessels operating in WCSI hoki fishery

4. Information collected during 3 phases

It was important for the purposes of this operation that information was collected regarding the assumptions made by s 9(2)(a) in respect of Operation Mini. The assumptions were:

- Whilst on the WC grounds the vessel was fishing within the area trawled by the observed vessels, and with the same range of depths; and
- The vessel was not using a cod end of unusually large mesh size – i.e. small hoki could not escape more easily from the net of the vessel than from other vessels.
- The observer length frequency samples collected from the observed trips are unbiased samples of the catches in the sampled tows.
- There are no small fish contained within the other grades and that there are no misgraded cartons of small fish.

In testing for these assumptions the investigation team could gain a more comprehensive knowledge about the fishery.

In particular we needed to gain a better understanding of the way in which vessels packed hoki by grade (i.e. did vessels pack in accordance with processing specifications? Were small hoki intermixed within larger grades to make up the pan weight? What net configuration were the vessels using and most importantly what mesh size did the codend have?).

4.1 Observer coverage

Observers were tasked with collecting information in addition to their normal duties. The reason for this was in order for compliance to gain a comprehensive understanding of at sea fishing and processing operations. In summary the principal tasks requested of observers specific to this investigation were:

- Obtain vessel processing specifications for all hoki processed by state and grade;
- Ascertain whether or not sizes are intermixed within grades to make up pan weight or for any other reason e.g. small hoki unsuitable for processing used to make up pan weights;
- Quantify authorised hoki discard by size (hoki deemed unsuitable for processing due to small size) and damage (to include hoki that would otherwise have been processed);
- Quantify hoki meal by size (hoki deemed unsuitable for processing due to small size) and damage (to include hoki that would otherwise have been processed);
- Provide detailed reports on nets including obtaining net plans and obtaining measurements of codend mesh; and
- Obtain copies of vessel unload manifests (for entire trip) which record all hoki by state, grade, number of units and weight.

This is not a comprehensive list of taskings but rather a summary of the key areas of interest to the investigation team. For a complete list of taskings refer to briefing documentation for this phase.

4.1.1. Summary of observer information

A total of 14 trips, onboard 13 factory trawlers, were covered by observers during the 2004-05 WCSI hoki season. The vessels ranged in overall length from between 52m and 104m.

A total of 1,591 tows were observed in relation to these trips. Of the total tows observed 1,208 tows occurred whilst vessels were operating on the WCSI. Of the 1,208 tows observed on the WCSI 978 of these tows were related to targeting hoki. Of the 978 tows observed targeting hoki 512 were sampled by observers in order to collect length frequency data on hoki.

Observer Catch Effort Log Book (CELB) data shows that the total greenweight of hoki associated with exclusive targeting of hoki in the WCSI fishery was approximately 7,178 tonne which accounted for 80% of hoki caught during the 14 observed trips. The average quantity of 'S' grade hoki produced by weight was 10.6%, this was taken from unload manifests obtained by observers at the conclusion of the trip. Green block, meal and discards averaged 1.5% by weight. For a summary of observer CELB data and unload manifest information refer to Annex B.

Figure 10 illustrates some examples of the work undertaken by observers during this phase of the operation. The photos highlight small hoki destined for discard, the measuring of codend meshes, and vessel processing specifications as displayed in the factory.

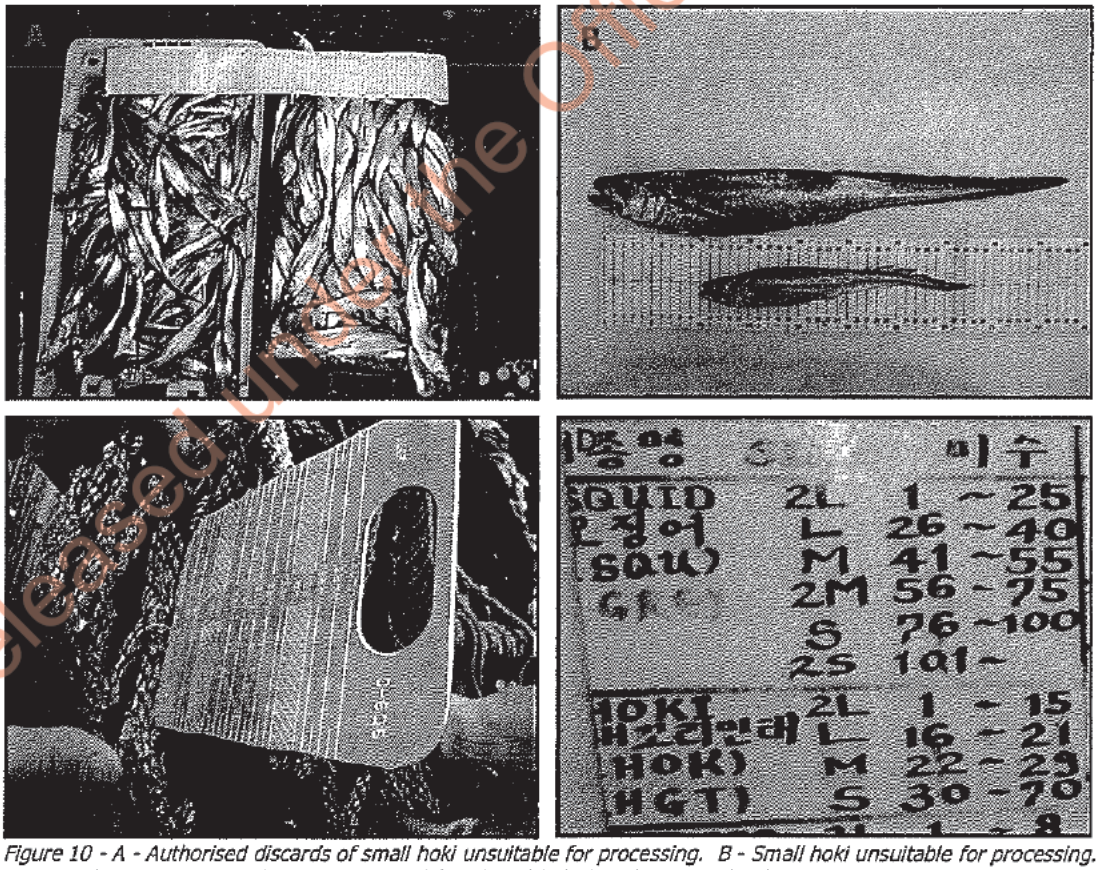

Figure 10 - A - Authorised discards of small hoki unsuitable for processing. B - Small hoki unsuitable for processing. C - Vessel processing specifications for Squid (GRE) and hoki (HGT). D - Codend mesh measurements using certified gauge.

By early September we had sufficient length frequency data, collected by Mfish observers, to use for the purposes calculating aggregate weights by length. The first cut of this data is represented in Figure 11.

Figure 11 shows the length frequency distribution of the fish measured and indicates that there were large numbers of small hoki, between 40-50cm and 50-70 cm, present in the WCSI hoki population. This is consistent with advice from Mfish Senior Scientist s 9(2)(a) in that a strong 2003 year class was anticipated in the WCSI hoki fishery comprising largely 2 year olds between 450-500mm in total length.

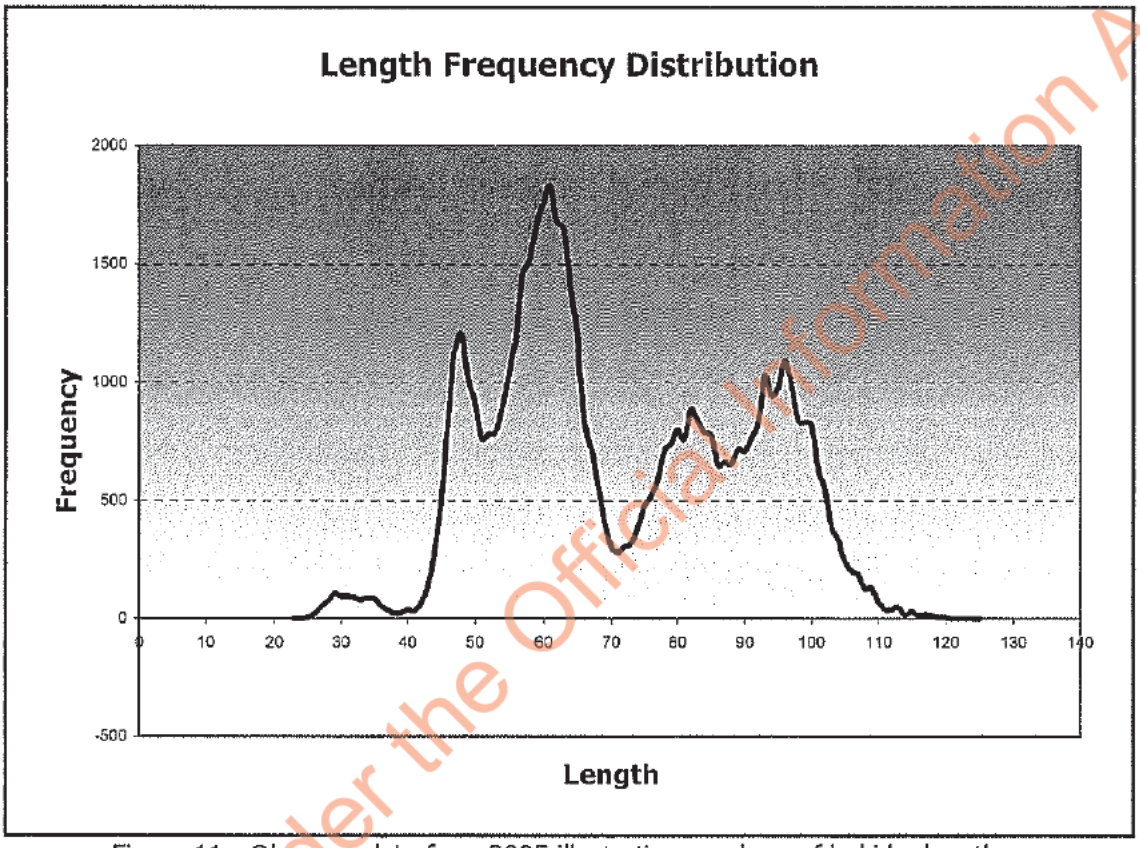

Figure 11 - Observer data from 2005 illustrating numbers of hoki by length.

Figure 12 shows the total weight of the fish measured by the observers at the various lengths. The weight distribution displayed here is what the investigation team should have expected to see mirrored (although somewhat imperfectly) with regard to the landed weights recorded by other vessels operating within the WCSI hoki fishery. That is the greenweight of the various grades should have reflected the area under the curve between their size boundaries.

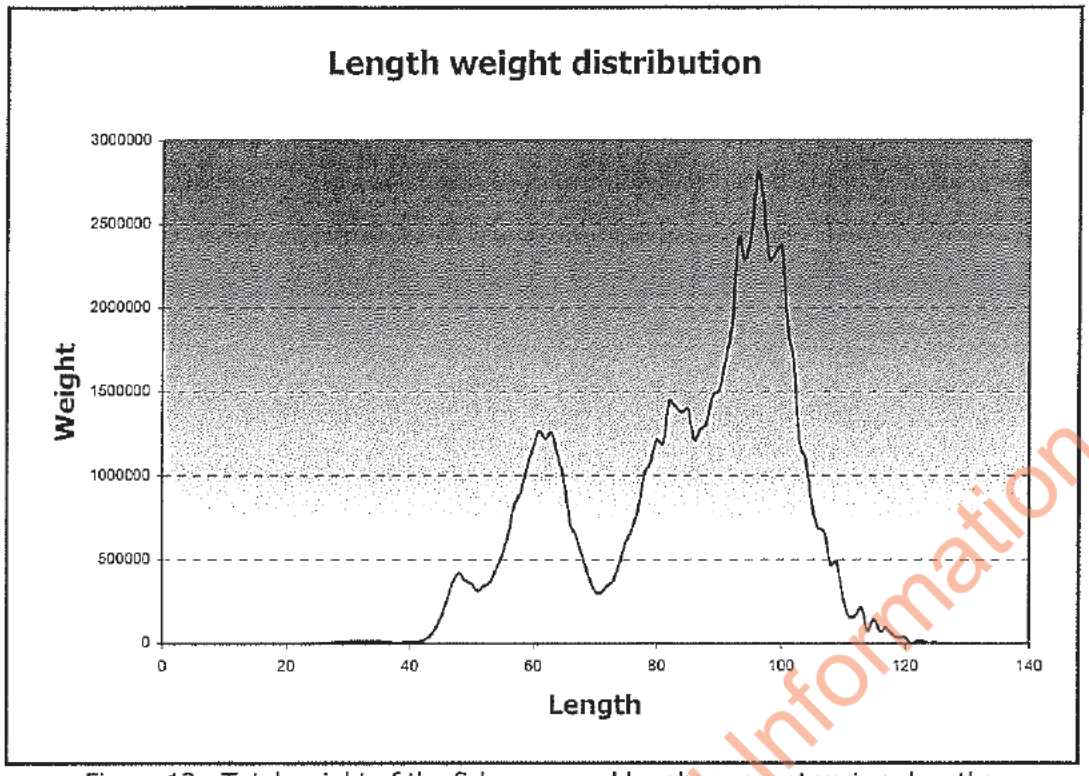

Figure 12 - Total weight of the fish measured by observers at various lengths.

The length frequency data collected by observers during this phase has been used in a length based analysis to determine the extent of highgrading in the WCSI hoki fishery. This analysis is described in more detail in section 5 of this report.

4.1.2. Observer statements

Statements were taken from each observer at the conclusion of their trip. This was done in order to ensure that any statements taken were at a time when the detail of that trip was fresh in the observers mind, and that important points relating to the fishery and/or the vessel were identified immediately and were able to be given due consideration. The information supplied by observers was to also go some way towards developing reasonable grounds in the event that an offence was detected and investigated.

The main points made by observers in their statements were the following, this has been categorised by vessel flag state:

Korean vessels

- Typcially fished between 41° S - 42° S and 170 ° E - 171 ° E;
- Unable to avoid small hoki this season. All tows higher % of smalls than in previous years;
- Predominance of hoki between 450mm and 500mm;
- Senior crew remarked too much small hoki being caught this year;
- Hoki considered too small for processing below 450-500mm (typically accounted for 6-13% of catch in haul). Was dependent on size of catch and who was sorting;
- Very small hoki considered of no value as no meal plant and prices for green hoki very low therefore these hoki were discarded;
- Observers believed that hoki was been processed to a smaller size than previously seen (this may have been for the benefit of the observers and Mfish i.e. change in behaviour due to presence of observers);

Ukraine vessels

- Fished in canyon;
- Processed down to between 460mm-550mm which was smaller than observed in the past and typically these sizes were smaller than smallest grade. Hoki smaller than this range would go to meal;
- Minimum size of hoki processed varied with crew and size of catch. For example one vessel processed down to 450mm if small catch (to maximise return) or above 500-570mm if good size catch;
- Crew remarked that hoki are smaller and there are more smalls this year than previous years;
- In previous seasons vessels processed down to between 550mm and 600mm;
- Targeting smaller than optimal size in order to maximise production due to low catch rates and predominance of small hoki;
- Hoki < 500mm ranged between 5% - 12% of catch;
- Want to produce piece sizes greater than 800gm as have greater financial return;
- Piece size less than 200gm and 300gm (this was at insistence of company observer – not always complied with) in weight go to meal;
- Distinct absence of large fish within the size range 700-900mm;
- Observers commented that they could not recall such a large proportion of small hoki being present since 1997/1998

NZ vessels

- Unable to avoid small hoki this season. All tows higher % of smalls than in previous years;
- Small hoki less than 550mm in length would not go through filleting machine, they would simply fall out;
- Processed down to 500mm which was smaller than vessel size grade 'S'. These were processed on Baader182.

4.2 *In port Inspections*

Fishery Officer's responsible for conducting in port inspections for this phase were tasked with specific requirements in order to compliment both the observer phase and the at-sea inspection phase. In summary Fishery Officers were tasked to collect the following information:

- Obtain copies of vessel processing specifications for all hoki processed by state and grade;
- Establish what hoki 'green block' contained (small and/or damaged hoki);
- Establish what hoki meal contains (small and/or damaged hoki);
- Complete detailed reports on nets including obtaining net plans and taking measurements of codend meshes;
- Establish destination of hoki product including where applicable shipping details for any exports, particularly where cartons loaded straight into containers for export;
- Obtain copies of vessels unload manifests for trip recording all hoki by state, grade, number of units and weight;
- Conduct carton checks of a random sample of hoki from each state and grade to determine number of hoki per block and size differential of hoki (particularly important for smallest grade produced);
- Where possible establish actual processing size cutoff. This may be done through discussions with master and/or factory manager; and
- Establish whether or not an industry observer was onboard for the trip been inspected.

This is not a comprehensive list of taskings but rather a summary of the key areas of interest to the investigation team. For a complete list of taskings refer to briefing documentation for this phase.

4.2.1 Summary of information

A total of 36 in port inspections were undertaken by Fishery Officers in relation to this phase of the operation. The vessels inspected ranged in overall length between 52m and 105m. Table 6 provides a summary of inspections conducted by district including key information sourced as part of those inspections.

Description	Nelson	Christchurch	Dunedin	Total
Total number of landings by port*	29	25	28 **	82
No. of inspections undertaken	13	12	11	36
Inspections of observed trips	1	0	1	2
Obtained unload manifests	12	12	11	35
Obtained copies of net plans	3	4	6	13
Codend reports completed adequately	2	11	0	13

Table 6 – Provides a summary of inspection data. *includes mixed trips (multiplie FMA's and multiple target species. ** includes 19 landings in Timaru and 3 in Bluff.

A total of 2,515 tows were associated with the 36 trips inspected. Of the total tows 1,661 of these were exclusive to targeting hoki on the WCSI which accounts for 66% of all tows conducted. The total estimated greenweight of hoki associated with exclusive targeting of hoki was approximately 15,401 tonne accounting for approximately 90% of estimated hoki catch related to these trips.

The unload shedules obtained suggest that 'S' grade hoki (for those vessels that processed to such a grade) averaged 7% by weight of total hoki processed. Green block and meal averaged 1.5% by weight. For a summary of TCEPR effort data and unload manifest information refer to Annex C.

Processing specifications collected during both the observer phase and in port inspection phase are attached your information in Annex D.

Figure 13 depicted on the following page illustrates some of the activities undertaken by Fishery Officers during the in port inspection phase of the operation. The photos illustrate examples of carton checks carried out where numbers of hoki per block were counted and blocks were weighed, size differentials were examined within a grade and the measuring of codend meshes.

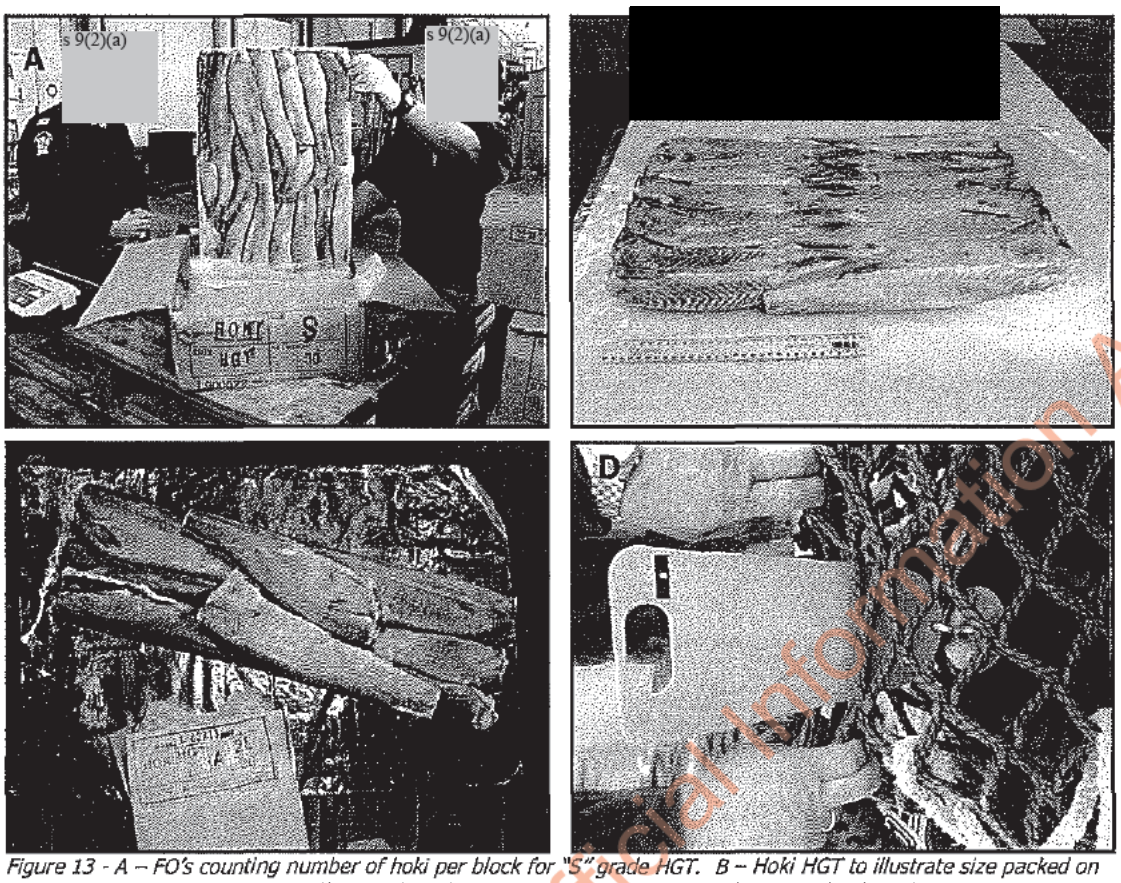

Figure 13 - A – FO's counting number of hoki per block for "S" grade HGT. B – Hoki HGT to illustrate size packed on Korean vessel. C – Hoki HGT to illustrate "2L" block packed on Ukraine vessel. D - Codend mesh measurements using certified gauge.

It is worth noting that a number of Official Information Act requests were received by Mfish compliance as a direct result of the inspections completed. This appears to have occurred as a result of the attention the fleet operating in the WCSI hoki fishery were getting and hence the heightened awareness of industry.

4.2.2 *Highgrading detected*

During this phase a number of vessels came to the attention of the investigation team. s 9(2)(a) was provided with unload manifest information including carton check information collected by Fishery Officers in order to make an assessment of whether or not it was probable that a vessel was highgrading. This was only considered in instances where very small quantities of hoki green block and 'S' grade product were landed. A couple of examples of where highgrading was identified are highlighted below.

s 9(2)(b)(i) **inspection**

The vessel conducted 45 tows all of which targeted hoki on WCSI. The unload manifest recorded the following for hoki HGT (where cartons were 28 kgs):

grade	# fish per pan	weight	No. cartons	Greenweight (kgs)
2L	1-13	1000gm	4579	211,549.8
L	14-19	720-1000	329	15,199.8
L (B grade)	14-19	720-1000	20	924
M	20-26	500-720	639	29,521.8
S	27+	550 or less*	123	5,682.6
Green block		15 kgs	126	1,890
Total				**264,768**

*according to master this is down to 380gm proc weight.

The fish in the 'S' grade are not actually small given that the master advised Fishery Officers that they process down to 380 g for this grade. A 380 g processed piece translates to a fish with total length of 580-590mm. On inspection Fishery Officers found that on average the vessels were packing approximately 33 fish per block, giving an average of 424 g processed weight which translates to a length of approximately 610-620 mm.

s 9(2)(a) advised that based on last years data the 95% confidence interval for genuinely small fish (< 500mm) in a trip of 45 tows was 1.33% by weight. The % of greenblock by greenweight for this vessel is well below this at 0.71%. In light of this the s 9(2)(b) certainly appeared on the face of it to be highgrading small hoki. However given the quantities involved and the fact that this had been compared to last years observer data the investigation team were reluctant to take any further action in respect of this vessel.

s 9(2)(b)(ii) **inspection**

The vessel conducted 63 tows all of which targeted hoki on WCSI. The unload manifest recorded the following for hoki HGT (where cartons were 28 kgs):

grade	# fish per pan	weight	No. cartons	Greenweight (kgs)
2L	1-15		17,870	
L	16-21		1,734	
M	22-29		1,754	
S	30-75		604	
Green block			300	8,400
Total				**1,023,044.4**

Fishery Officers counted between 30-45 pieces per 'S' grade block. The green block contained a mixture of large damaged (ranging between 7-25 hoki per block) and small hoki (ranging between 21-32 hoki per block).

With 45 fish per block it was clear that the s 9(2)(b) was not packing anywhere near the maximum number of fish per block for the 'S" grade. The average processed piece weight for 45 fish per block would equate to 311 g which would translate to about 550 mm in length. It was also likely that the vessel was packing considerably less than 45 fish per block thereby equating to larger fish.

s 9(2)(a) advised that with 1023 tonnes greenweight we would expect (on the basis of the observer data so far) to have about 8.8% of the catch by weight being fish < 55cm in length, and would be very suspicious if we had less than about 6% by weight of these fish in the landing. Even if the processing cutoff is only 50 cm (which seemed unlikely) we would still expect to have 4.9% of the landing as small fish.

s 9(2)(a) went on to add that even if all the green blocks were comprised entirely of fish shorter than the processing cutoff, they make up only 0.82% of the landing by weight. FO observations suggested that the green blocks contained a mixture of small fish and larger fish (indicating that the 0.82% by weight for greenblock did not solely represent small hoki and was likely to be considerably less). The landing from this vessel was considered well outside the pattern shown by the observer data collected at sea, falling well short of expectations. If the processing cutoff was 55 cm then the best estimate of weight missing was about 70 tonnes and that even if the processing cutoff was 50 cm there would still be 39 tonnes unaccounted for.

s 6(c)

s 6(c) [redacted]

s 9(2)(b) inspection

The vessel conducted 40 tows all of which targeted hoki on WCSI. The unload manifest recorded the following for hoki HGT (where cartons were 28 kgs):

grade	# fish per pan	weight	No. cartons	Greenweight (kgs)
2L	1-14		3070	137,536
L	15-20		603	27,858.6
M	21-28		664	
S	29-50		1377	
Green block		14 kgs	338	4,732
Total				**268,719**

According to the vessels processing specifications anything above 53 cm in length is packed and that the S grade contains all the fish between 54 and 65 cm in length. Based on observer data this should result in blocks with about 36 fish in them on average. However FO carton checks found that between 30 and 35 pieces were packed per block which suggests they may not be packing all the fish at the lower end of the S grade.

The 53 cm figure is based on 14 kg/50 fish * 1.65 CF = 462 g as the minimum greenweight of a fish that would be packed.

Observer data suggests that vessels packing anything above 53 cm should have an average of 5.09% green block by weight in their landing. The s 9(2)(b) however only landed 1.76% of green block by weight.

The best estimate of the quantity of small fish that should have been landed is the mean of the observer data - i.e. 5.09%. Therefore the y best estimate of missing small fish by weight is 5.09 - 1.76 = 3.33 % equating to approximately 9 tonnes.

However, there were a large number of S grade cartons in the landing - rather more than one might expect from applying the s 9(2)(b) grading specifications to the observer data. Three possibilities were thought to account for this:

(a) the S grade fish may not have been processed to the same state as the larger ones (e.g. the tail cut may have been made further toward the tail, resulting in fewer fish than expected fitting into each carton);
(b) Some fish that should really have been M grade have been packed as S grade; or
(c) The S grade cartons contain most of the missing small fish < 54 cm in length.

Based on the observer data and the s 9(2)(b) grading specifications we would expect an average of 36 fish packed in each S grade block. If the missing small fish are in the S grade cartons we would expect this number to increase; if larger fish are being packed out of grade or the degree of processing is different we would expect fewer.

Fo inspection data didn't find any S grade cartons with as many as 36 fish per block, so there was no reason to believe that the missing small fish were interspersed through the S grade cartons. However it was considered possible that some cartons may have been packed out of specification.

If this held true then an average of at least 5 fish per S grade block packed out of specification would be required to account for the missing number. The investigation team were not confident that this could be assessed accurately as the hoki were packed in three layers per block, and the middle layer was largely invisible. As a result of the triple layer and the difficulty anticipated with obtaining a good estimated of the numbers above and below a certain size a decision was made to cease any further action.

As a result of the triple layer block an alternative strategy to deal with this was developed in the event that this would be required for future use.

4.3 At sea boardings (Operation Weka)

Operation Weka was the at-sea phase conducted during Operation Maxi. 5 Fishery Officers and 1 Fisheries Investigator were deployed for the purposes of undertaking at sea boarding inspections of vessels operating in the WCSI hoki fishery. This phase was to compliment the information being collected during both the observer and in port phases of Operation Maxi.

This phase commenced with the deployment of the te Mana on the 18th August 2005 to the WCSI hoki ground coinciding with peak activity in the fishery. The te Mana was not on task in the WCSI hoki grounds until the 21st August 2006 due to mechanical problems.

HMNZS Te Mana - West Coast South Island - 17 – 27 August 2005

A total of 16 vessels were identified for priority one boardings, with a further 7 vessels identified for priority two boardings. Those vessels carrying Mfish observers were excluded from boarding list.

The main purpose of this phase was to create a deterrent effect by having an enforcement presence during the peak fishing activity in the WCSI hoki fishery. The boardings also provided the opportunity to observe real time fishing and factory operations both of which

are not able to be observed by Fishery Officers once the vessel returns to port to unload product.

Fishery Officers deployed for this phase were briefed and tasked to collect the following information where possible:

- Fishing gear used (including mesh size),
- Factory setup and processing capability as it related to hoki,
- Processing specifications for hoki states and grades,
- Inspection of discard chutes immediately on boarding,
- Examination of hoki product including green block (on those vessels without meal plants).
- Measurement of codend meshes where able to (i.e. when codend on deck)

This is not a comprehensive list of taskings but rather a summary of the key areas of interest to the investigation team. For a complete list of taskings refer to briefing documentation for this phase.

It was recognised early that some of information obtained during this phase would only represent a small snapshot in time, however it was still considered that a better understanding of vessel and factory operations would be gained whilst the vessel was operating at sea and that this information would compliment information gathered during the other 2 phases, and would greatly assist with identifying target vessels worthy of further attention once they returned to port for landing. Unfortunately due to inadequate communication between the vessel and shore based staff little benefit was derived in respect of predetermining problem vessels that may be worthy of greater attention.

All was not lost however as the deterrent effect that the presence of the te Mana had whilst deployed on the WCSI, although not easily measured, had a major impact judging from the high level of awareness amongst industry players.

This phase of the operation was concluded on the 27th August 2005.

4.3.1 Summary of information

A total of thirteen boarding's, of deepwater vessels, were conducted during the at sea phase. Of these, nine vessels were boarded whilst operating in the WCSI hoki fishery. Of the nine vessels boarded on the WCSI, seven were Korean flagged, 1 was Belize flagged and 1 was Ukrainian flagged. The vessels boarded on the WCSI are listed in table 7.

Nationality	Vessel Name	Call sign
Korean	s 9(2)(b)(ii)	
Belize		
Ukraine		

Table 7 - List of vessels inspected whilst operating on the WCSI hoki ground.

Potential offending identified

A number of vessels were suspected of discarding due to observations made during this phase. Details of this are listed below.

- s 9(2)(b)(ii) suspected of dumping, later determined that dumping was probably offal. Industry observer onboard advised boarding crew that 48% of each tow was made up of small non-commercial hoki.
- s 9(2)(b)(ii) suspected of dumping small hoki from the discard chute. This was observed by FO present in Helo. FO estimated that approximately 3*bins of small hoki were discarded from chutes. When Helo moved in with lights on vessel, the vessel responded by promptly ceasing any further discarding.
- s 9(2)(b)(ii) had 120*15 kg blocks of damaged hoki with only one green block containing small hoki. This indicated to the boarding Officer's that highgrading was occurring on this vessel.
- s 9(2)(b)(ii) – factory manager advised that 15-20% of each tow was very small hoki however boarding crew found no evidence of small hoki and very little to no by-catch recorded. Onshore team were advised that this was a problem vessel.
- s 9(2)(b)(ii) had total of 26 tonne of hoki onboard with only 240 kgs of small and damaged hoki which equated to 0.9% of catch. Chief Officer informed boarding crew that they had been catching very small hoki which made up between 5-10% of each tows catch. Despite this however they had only reported approximately 0.9% green block which comprised both small and damaged hoki.

It is of interest to note the wide variation in the % of small hoki as assessed by the vessels i.e. ranging between 5-48% of catch/tow (albeit that the 48% was assessed by a Industry observer). Of course this is not surprising given the source of the information and the fact that it was being provided to enforcement Officers.

4.3.3 Subsequent Action by the SOU in relation to the FV s 9(2)(b)(ii)

As a result of the information received regarding the s 9(2)(b)(ii), the SOU decided that this vessel would be met by Fishery Officer's in Nelson on landing. The information supplied suggested that this vessel was a serious problem and that the team were highly suspicious regarding this vessels activity in respect of high grading of small hoki and dumping of by-catch species. It was well known that this vessel, operated by s 9(2)(b)(ii), would land immediately into containers destined for export. This was of great concern as any subsequent examination of product would be impossible.

An action plan was prepared in order to set out steps required if a product examination was deemed necessary. This was done in order to avoid any risk associated with detaining the product for any longer than was absolutely necessary. A number of staff, from Nelson Office and the Forensic Science team, were briefed and were on standby in the event that a product examination was deemed necessary.

The vessel's ETA for Nelson was 23:00 hrs on the 23rd August 2005. FI's s 9(2)(a) travelled to Nelson in order to meet the vessel on arrival and uplift documentation for examination. Documentation required included the following: TCEPRs; unload manifest recording all hoki by state, grade, number of units and weight; and vessel processing specifications as they related to hoki.

s 6(c)

s 6(c)

Following the vessel inspection and carton check it became obvious that the vessel was only packing between 28-38 pieces of hoki HGT per 15 kg block within the 'S' grade. The average piece weight associated with this is 394 grams which has an associated length of between 590-600mm. This information certainly suggested that the vessel was highgrading and given the apparent lack of green block may well have been worth following through with. However by this stage it was too late to progress further as product had already been unloaded from the vessel, with the majority unloaded straight into containers for export.

4.3.4 Health and Safety

A number of health and safety issues were raised as a consequent of the at sea boarding's. FO s 9(2)(a) contracted a fairly serious strep infection which was believed to have come from one of the Korean vessels that he had boarded. He was placed under care of the infectious diseases unit on arrival back home. It is of great concern that the sanitary conditions on board the Korean fleet pose a real health risk for both compliance staff and Mfish observers. FI s 9(2)(a) has prepared a separate document in respect of this matter.

4.3.5 Cream TV

Two cameramen contracted to CTV accompanied FO's during vessel boardings. It was the responsibility of the cameramen to talk to the vessel master immediately upon boarding in order to obtain consent for filming. Complaints were received from shore-based fishing companies about CTV filming on board vessels and the lack of consent. This has been dealt with as a separate matter.

5. Length based Analysis of highgrading

A length based analysis was completed by s 9(2)(a) and s 9(2)(a) in order to determine the extent of highgrading of small hoki associated catches in the WCSI hoki fishery.

5.1.1 Methodology

In order to estimate the extent of highgrading a number of key sources of information were used, they were:

- Length frequency data collected by Mfish observers
- Conversion of lengths to weight
- In port of inspections of vessel landings
- TCEPR data
- Green block composition

Length frequency data

As mentioned earlier observers were placed on 13 factory vessels and observed 14 trips. Placement of observers was limited by company cooperation and for health and safety reasons and as such placement was not random. Despite this however length frequency data collected by observers was collected using a random sampling protocol to avoid any bias. After each haul observers would collect a random sample of 100 hoki to measure, sex and stage.

A total of 512 tows were sampled by observers for the purposes of collecting length frequency data, of these tows 481 were used for the purposes of this analysis. 31 tows were excluded from the analysis for the following reasons: where a random sample of 100 was not drawn, and/or the tow targeted species other than hoki, and/or tow data was incomplete, and/or the tow occurred outside of the WCSI, and/or the tows occurred within the 25-mile restricted fishing zone. The 481 tows sampled and included in this analysis represent 11.5% of all tows targeting hoki in the WCSI hoki fishery (outside 25-mile restricted zone). The length measurements were used to illustrate the length frequency distribution associated with hoki for the area of study.

The proportion of small hoki < 55 cm in length (arbitrary cutoff) were calculated for each tow. These proportions were expressed as proportions by weight for the purposes of this analysis.

Mathematical modelling was used to evaluate the effects of explanatory variables such as tow duration, speed, headline height, total catch, gear type, starting latitude, starting groundrope depth, starting seabed depth and day/night start on the proportion of small hoki caught.

Conversion of lengths to weights

In order to compare vessel processing (TCEPR) and landing (CLR) data to the observer samples meant that the observer data needed to be converted to weights. This was done using the formula described in section 1.1.1.2.

In port inspections of vessel landings

A total of 36 vessel inspections were undertaken during Op Maxi. Information sourced by FO's during those inspections is described in section 4.2.

Where hoki size cutoffs were not established during the inspection then these sizes were determined by dividing the block weight by the maximum number of processed fish/block as per the vessels processing specifications. This would derive an average processed piece weight. This weight was then multiplied by the appropriate conversion factor to determine average greenweight which was then used to identify the predicted total length (refer to section 1.1.1.2 for details).

TCEPR data

TCEPR data was extracted for all factory vessels operating within the WCSI hoki fishery. Hoki recorded as green block, meal and all processed primary states were calculated for each trip using the processing data. Where the vessel was either fishing outside the area of interest or targeting another species, for one or more tows, then the processing data was excluded.

The proportion, by weight, of fish landed under the processing cutoff was calculated for each trip.

For the purposes of this analysis all hoki packed green or converted to meal was assumed to be unsuitable for processing due to size (i.e. was smaller than processing cutoff).

Green block composition

A check on the assumption 'that all hoki in the greenblock is small' was tested during Operation Mini in which all the hoki (12,328 fish) packed as naked green block were thawed, measured and weighed. This data was used in this analysis to calculate the proportion of hoki above the processing cutoff of each vessel that packed green block.

The green block composition, from Operation Mini, showed that approximately 80% by weight of hoki measured were under the vessels processing specifications, 11% were undamaged hoki larger than the vessels processing specifications and the remaining 9% were damaged hoki larger than the processing specifications. This indicates that 20% by weight is made up of fish larger than the vessels processing specifications. This would differ from vessel to vessel, however by assuming that all hoki meal and hoki greenblock is made up of only small hoki (less than vessel processing specifications) the vessels are given every allowance in that any potential highgrading may be masked or at least minimised. This also ensures that any subsequent action taken by the investigation team is the result of a conservative approach.

5.1.2 Results of analysis

To estimate the extent of highgrading across the WCSI hoki fishery, for 2005, it was assumed that the catch taken by each vessel operating in the fishery would have the same size frequency distribution to that illustrated by the 481 tows from which length frequency data was collected. The size frequency distribution is illustrated in figure 14. This makes the assumption that all vessels operating in the WCSI hoki fishery are taking catches from the same population of fish, and that the tow by tow catches taken by both observed and unobserved vessels are unbiased samples from that population with respect to size composition.

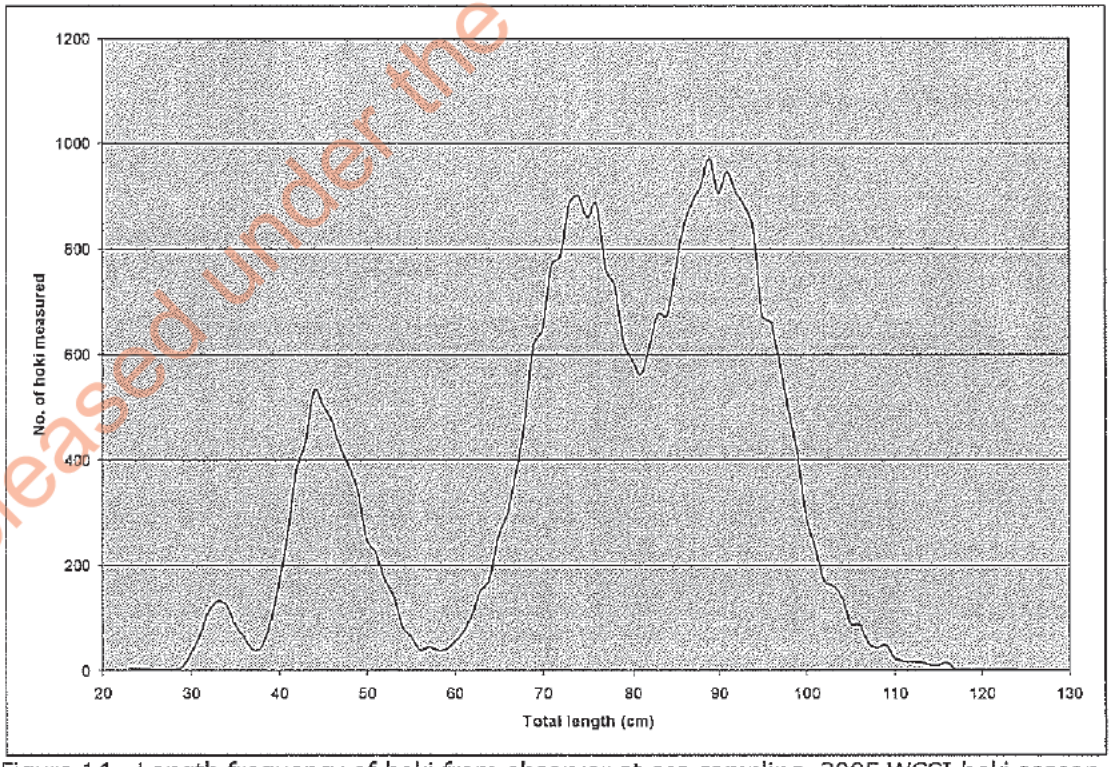

Figure 14 - Length frequency of hoki from observer at-sea sampling, 2005 WCSI hoki season. Factory vessels > 45 m in length only

Length frequency data as illustrated in Figure 14 was used to give aggregate weights of hoki measured for each length as illustrated in Figure 15. In comparing the two graphs one can see that hoki < 55 cm in total length make up a reasonable proportion of the catch by number (as shown in figure 14) but the proportion by weight (as shown in figure 15) is much smaller. This is to be expected given the length weight relationship of hoki.

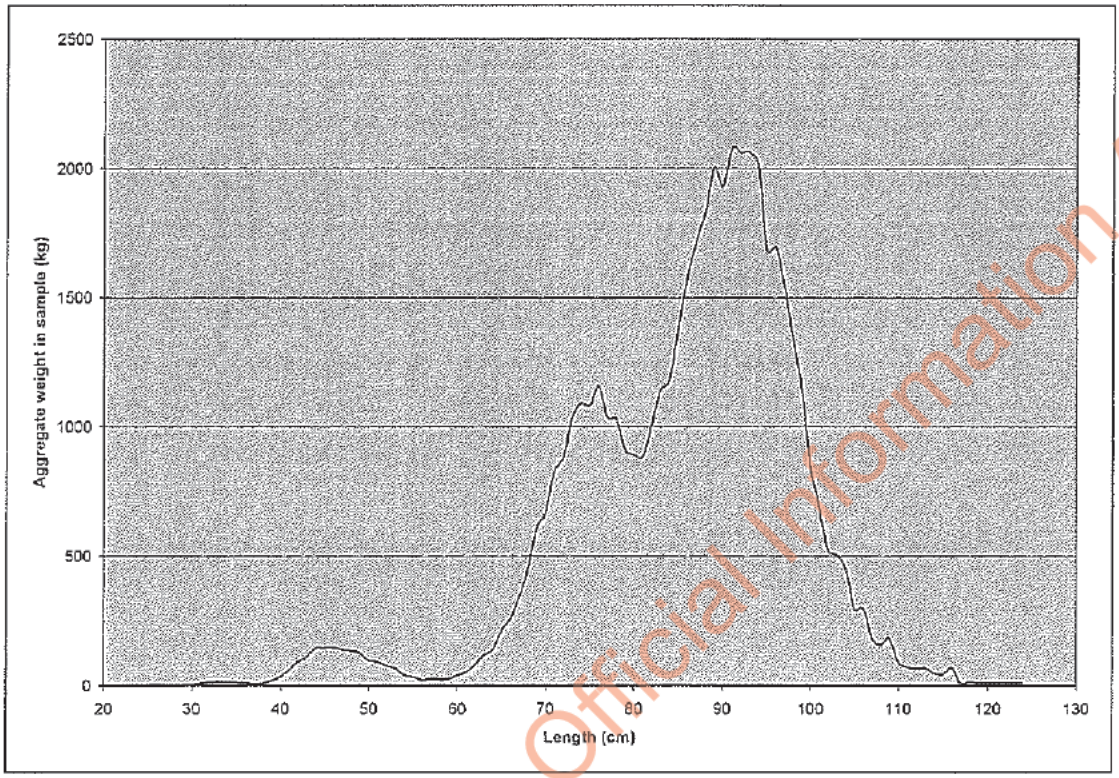

Figure 15 - Aggregate weights of hoki caught by total length in observer length/frequency samples

Explanatory variables as described under the heading 'Length Frequency data' in section 5.1.1 were compared between observed and non-observed tows in order to determine whether 1 or more variables, or a combination of variables, had a significant influence on size composition of the hoki catch. The analysis showed that effort associated with observed tows closely matched effort by non-observed vessels in the fishery and that any variables detected as having a significant effect accounted for less than 5% of the variance in the data.

No difference was found between average measured mesh sizes between observed and unobserved vessels. Nominal codend mesh sizes varied from 100-110 mm.

Analysis of the data showed that the combination of the size frequency as measured by observers and the estimates of processing cutoff size made by fishery officers produced a reasonable estimate of the weight of unwanted hoki that would be landed/and or legally authorised for discard on an observed vessel. In contrast, unobserved vessels reported on average less small hoki than the analysis predicted. The presence or absence of industry observers was shown to have no effect on this result and thus trips with an industry observer onboard were included in the unobserved category.

Vessel nationality was also considered and the results of which showed a clear difference between the landings of NZ and foreign crewed vessels. In general NZ domestic vessels do not appear to be highgrading their hoki catch.

Table 8 contains a list of those vessels that fell outside the lower bound of the 99% confidence interval which strongly indicates that they have been involved in the illegal act of highgrading small hoki, during at least one trip. This list of vessels was identified based on TCEPR data in conjunction with the vessels processing specifications as these datasets were considered to be most easily defended.

Vessel name	Vessel flag state	Estimated weight dumped (kgs)	Estimated % of small hoki dumped (below vessel specifications)	Estimated % of small hoki dumped (below FO inspection)
s 9(2)(b)(ii)	NZ	35,000	61%	61%
	NZ	45,000	92%	92%
	NZ	-28,000	-50%	-50%
	NZ	-2,000	-10%	32%
	Malta	27,000	89%	89%
	Malta	9,000	83%	83%
	Korean	23,000	74%	90%
	Korean	19,000	81%	76%
	Korean	15,000	88%	95%
	Korean	18,000	47%	73%
	Korean	11,000	18%	67%
	Korean	82,000		86%
	Korean	44,000	87%	87%
	Korean	32,000	94%	92%
	Korean	42,000	87%	90%
	Korean	6,000	50%	84%
	Korean	2,000	28%	80%
	Panama	5,000	18%	83%
	Belize	27,000	86%	97%
	Japanese	17,000	67%	67%
	Ukraine	12,000	61%	61%
	Ukraine	2,000	47%	88%
	Ukraine	13,000	71%	88%
	Ukraine	10,000	81%	90%
	No unobserved trips			
	Vanuatu	9,000	67%	67%
	Vanuatu	9,000	71%	93%
Total				

*Table 8 – list of vessels suspected of highgrading small hoki during at least 1 trip. **indicates worst offenders.*

As you can see from table 8 vessels which were determined as beyond reproach are the s 9(2)(b)(ii). It is worth noting that the s 9(2)(b)(ii) had Mfish observers onboard during the only trip that it made to the WCSI hoki fishery and as such did not have much chance to offend.

FA s 9(2)(a) prepared a summary of landings by grade, as taken from unload manifests for both observed and inspected vessels. Charts and spreadsheets of this are provided in Annex E. This information was then broken down further by senior crew nationality and specification type in order to make direct comparisons easier (i.e. compare 'apples' with 'apples'). The charts relating to this are provided in Annex F. By comparing the information contained in Table 8 to these summaries it becomes clear which vessels appeared to be highgrading.

5.1.3 Summary

The extent of highgrading in the WCSI hoki fishery is estimated to be between **596** and **1806** tonnes of small hoki. The range reflects the difference between the processing specifications (using maximum number of pieces per block) and the fishery officer landing observations. These tonnages equate to between **1.8%** and **5.6%** of the hoki catch taken by factory vessels > 46m operating in this fishery.

6 Impact of highgrading

Typically one, two and three year old hoki are at risk of highgrading due their size. The implications associated with removing these hoki from the population, before they have matured and added to the recruitment of the fishery, must be significant in respect of the health and sustainability of the WCSI hoki fishery.

It seems quite possible that the current state of the WCSI hoki fishery, in combination with other factors such as environmental, is the result of many years of illegal activity going unchecked.

By misreporting substantial quantities of hoki which have been either illegally discarded or misreported as offal the Ministry of Fisheries can not accurately assess the state of the hoki stock and thus make well informed decisions about the management of the fishery and any applicable reductions to the TACC. In not knowing the total extraction of hoki from the WCSI fishery one wonders how the Ministry of Fisheries can ensure that hoki is a healthy and sustainable fishery.

7 Possible Solutions

There are provisions in section 21 of the Fisheries Act 1996 when setting or varying the TACC.

S21 (1) states that in setting or varying any total allowable commercial catch for any quota management stock, the Minister shall have regard to the total allowable catch for that stock and shall allow for - (b) all other mortality to that stock caused by fishing.

The current TACC for hoki has a current allowance to account for "other sources of 'fishing-related' mortality". However as advised by s 9(2)(a) (Senior Fisheries Management Advisor) this does not include an explicit allowance for illegal catch beyond the vague acknowledgement that high grading may be occurring in the fishery. The additional 40 tonnes allowance was 20 t each for customary and recreational catch.

s 9 2)(a) also advised that the Ministry had suggested a 5% allowance to account for illegal catch. However industry challenged the Ministry to "prove" that illegal catch (dumping) was occurring, as a condition for acknowledging a higher level of mortality. The matter was dropped in the absence of defensible estimates of discards.

In light of the results from Operation Maxi relating to the extent of highgrading in the WCSI hoki fishery the Ministry may well now be in a position to progress an illegal catch allowance in respect of hoki.

There has been some suggestion that the western and eastern hoki stocks be managed separately. This would certainly make it easier to manage the WCSI hoki fishery by reducing the TACC in that area without impacting on operators fishing in the eastern area. Of course

this is not to say that a similar level of highgrading is not occurring in relation to the eastern stock. Certainly separate quota management areas for western and eastern stocks would facilitate better management of extractions.

Reducing the TACC is of course not the only way to reduce or limit illegal activity. The Ministry could consider some the following input controls as possibilities to curve the level of highgrading:

- Real time closures to protect juvenile hoki caught as a consequence of fishing spawning aggregations in the WCSI hoki fishery. This could coincide with peak spawning activity. Picher et al (2002) believe this reduces the incentive to discard and falsely report.

- Increase codend mesh size to enable smaller hoki to escape. Picher et al (2002) have shown this to reduce the incentive to discard and falsely report.

- Reduce tow time so that the lining effect in the rear of the codend is minimised and juvenile hoki have some chance of escapement.

- Require that square mesh is used only as this has been shown to be more selective than diamond mesh (diamond mesh appears to be predominantly used by vessels operating in the WCSI hoki fishery).

- Reduce twine thickness that makes up codend mesh. Increased twine thickness has been shown to reduce gear selectivity due to a decrease in the mesh opening and an increase in stiffness of the twine both of which inhibit escape. It is also believed that twine may introduce a visual barrier discouraging fish from escaping.

- Use of fish mitigation devices in order that small fish are redirected out of the net before entering the codend.

- 100% observer coverage i.e. all vessels fishing in WCSI hoki fishery

Given that the analysis showed that vessel nationality showed a clear difference between the landings of NZ and foreign crewed vessels and that in general NZ domestic vessels did not appear to be highgrading their hoki catch compared to that of foreign vessels it may well be feasible to impose greater input controls on foreign charter vessels by way of permitting and/or vessel registration requirements.

Another alternative is that hoki could be added to schedule 5A of the Fisheries Act 1996 in order to circumvent any incentive to highgrade and carry forward underfishing entitlement to the next year. The reason for this is that under the current regime if ACE in the preceding year is not fully caught either the amount of uncaught ACE or 10% of the ACE (which ever is the lessor) will also be allocated to the person who held the ACE at the end of the previous year. This does not apply to stocks in schedule 5A, of the FA1996, or stocks where the TACC is decreased in the following year. Hoki is not a species listed in schedule 5A and is therefore subject to the provisions of underfishing entitlement where no TACC reductions have occurred.

Another option, albeit extreme, is to allow for the legal discarding of small hoki less than a prescribed length with the condition that all such hoki is reported accurately. That is total quantities discarded must still be reported in returns, both TCEPRs and CLRs, in order that total weights extracted can be accounted for and utilised for stock assessment purposes. There should be no requirement for discarded small hoki to be reported on MHRs in order to fully negate any incentives to highgrade. In doing this management of the stock will be based on better quality data regarding total extractions than under the current regime. Of

course this assumes that we can change the behaviour of a lifetime i.e. getting crew to accurately report species discarded.

8 Recommendations

As described in section 5.1.3 the extent of highgrading in the WCSI hoki fishery has been estimated to be between **596** and **1806** tonnes of small hoki.

It is important to note that the extent of highgrading estimated here solely relates to small hoki taken from the WCSI hoki fishery. No consideration, at this stage, has been given to highgrading in the remainder of the hoki fishery. This will form phase III of the analysis. There is certainly plenty of anecdotal evidence to suggest that highgrading is widespread in the hoki fishery but no attempt has been made here to determine the extent. Nor has there been any attempt to determine the level of highgrading associated with large hoki as a result of excessive damage.

The TACC in HOK1 was overcaught by 4% during the 2004-05 fishing thereby resulting in a total annual deemed value, distributed amongst 37 clients, of $2,759,802.41. Annual deemed values were charged at a rate of between $0.52 -$1.18 per kilogram of ACE overfished (the majority of annual deemed values payable was charged at a rate of $0.59/kg). Of the total annual deemed value calculated credits were given for a total of $78,441.26 (which may have been the result of amended MHRs) thereby reducing the annual deemed value payable to $2,681,361.15.

The annual deemed value would have been greater still had all of the small hoki caught been declared and counted against ACE. Assuming an annual deemed value rate of $0.59/kg a further $351,640 (associated with 596 tonne) to $1,065,540 (associated with 1806 tonne) would have been distributed amongst commercial fishers. Of course the amount of deemed value payable may well have differed amongst commercial fishers based on the differential annual deemed values applied as a consequence of the amount they overfished by comparative to ACE held.

As a result of between 596 tonne and 1,806 tonne of small hoki been estimated as highgraded in respect of the WCSI hoki fishery I therefore recommend that the following is undertaken:

- Presentation of length based analysis of highgrading in the NZ WCSI hoki fishery to Science Group.
- Present findings to Compliance staff including the use of the length based analysis to determine the extent of highgrading in the NZ WCSI hoki fishery. This could commence initially in the South Island as a number of staff from district offices in the South Island were involved in Operation Maxi. This should also be made available to North Island staff in order to illustrate an example of investigative innovation.
- Presentation to Industry via the Compliance Advice Team.
- Article published in the Seafood magazine in order to achieve wider coverage and public awareness of some of the issues relating to the commercial sector.
- Solutions for resolving, or minimising the amount of, highgrading in the WCSI fishery should be seriously considered particularly as part of any fishery plan developed for hoki.
- Consideration needs to be given to the current regime under which many foreign nationals are employed. We know very little about the terms and conditions of their

contracts and the way in which these may provide incentives for illegal activity. The submission of employment contracts for each senior crew member could be required as part of the vessel registration conditions.

s 9(2)(a)

Fishery Investigator
Ministry of Fisheries
WELLINGTON

Approve/Decline

s 9(2)(a)

Investigations Manager (Acting)
Ministry of Fisheries
WELLINGTON

Comments:

References

Anderson, L. G. (1994) An Economic Analysis of Highgrading in ITQ Fisheries Regulation Programs. *Marine Resource Economics* 9: 209-226.

Anderson, O.F; D.J. Gilbert & M.R. Clark (2001) Fish discards and non-target catch in the trawl fisheries for orange roughy and hoki in New Zealand waters for the fishing years 1990-91 to 1998-99. New Zealand Fisheries Assessment Report 2001/16 57p.

Anderson, O.F. & M.H. Smith (2005) Fish discards and non-target catch in the New Zealand hoki trawl fishery, 1999-2000 to 2002-03. New Zealand Fisheries Assessment Report 2005/3 37p.

field evidence. Can. J. Fish. Aquat. Sci. 62: 224-235.

Crane, S. A., Fenaughty, J. M. and Gauldie, R.W. (1987) The relationship between eye diameter and fork length in the spiny oreo dory, Allocyttus sp. (Note). New Zealand Journal of Marine and Freshwater Research. 21: 641-642.

Francis, R.I.C.C. (2003) Analyses supporting the 2002 stock assessment of hoki. NZ Fisheries Assessment Report 2003/5. 34 p.

Pitcher, T.J, Watson, R., Forrest, R., Por Valtysson & Guenette. S (2002) Estimating illegal and unreported catches from marine ecosystems: a basis for change. Fish and Fisheries 3: 31-339.

Rochet M-J and Trenkel V.M. (2005) Factors for the variability of discards: assumptions and

Sullivan, K.J.; Mace, P.M.; Smith, N.W.McL.; Griffiths, M.H.; Todd, P,R.; Livingston, M.E.; Harley, S.J.; Key, J.M. & Connell, A.M. (2005). Report from the Fishery Assessment Plenary, May 2005: stock assessments and yield estimates. Unpublished report held in NIWA Library, Wellington.