Surveillance Report
South Georgia Patagonian Toothfish Longline Fishery

Certificate No.: **MML-FC-003**

Moody Marine Ltd.
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Author(s): J Rice, J Cooper, P Medley, A Hough

Moody Marine Ltd.
Moody International Certification
Salisbury House
Stephenson's Way
Wyvern Business Park
Derby. DE 21 6LY
UK
Tel: +44 (0) 870 7529002
Fax: +44 (0) 1332 675152

1.0 GENERAL INFORMATION

Scope against which the surveillance is undertaken:

MSC Principles and Criteria for Sustainable Fishing as applied to South Georgia Patagonian Toothfish Longline Fishery

Species: Patagonian Toothfish *Dissostichus eleginoides*

Area: Around the island of South Georgia and the associated plateau to the west around Shag Rocks, within the Government of South Georgia and the South Sandwich Islands (GSGSSI) 200 nm Maritime Zone. The fishery falls within CCAMLR sub-area 48.3

Method of capture: Bottom-set longlines.

Date of Surveillance Visit:	**GSGSSI: 21-25 August 2004** **MRAG: 30 September 2004**			
Initial Certification	**Date: 22 March 04**		**Certificate Ref: MML-FC-003**	
Surveillance stage	**1st**	**2nd**	**3rd**	**4th**
Surveillance team:	**Lead Assessor:** **A Hough** **Assessor(s):** **J Rice, J Cooper, P Medley**			
Company Name: **Address:**	Government of South Georgia and the South Sandwich Islands Government House Port Stanley Falkland Islands FIQQ 1ZZ			
Contact 1 **Contact 2**	Director of Fisheries			
Tel No: **Fax No:** **E-mail address:**	+500 27433 + 500 27434 Harriet.Hall@fco.gov.uk			

2.0 RESULTS, CONCLUSIONS AND RECOMMENDATIONS

This report contains the findings of the first surveillance cycle in relation to this fishery. Accordingly, most findings relate to compliance with the Conditions of Certification set out in the certification report and the issue of Chain of Custody. As conditions are closed out (i.e. actions are completed), the assessment focus will concentrate on the overall ongoing operation of the fishery in relation to the MSC Principles and Criteria.

Information has been collected principally from the Government of South Georgia and the South Sandwich Islands (GSGSSI), their consultants, MRAG and industry representatives.

Item	**Comments**
1	**Entry of South Georgia Patagonian Toothfish Products into subsequent Chain of Custody schemes**
Activity assessed	The final report on the South Georgia Patagonian Toothfish Longline Fishery of March 2004 stated that: "Weaknesses in labelling and tracking of fish from the certified fishery have been identified in (the report). Also, the Objections Panel expressed concern that "*rigorous Chain of Custody Certification is an essential matter for this fishery*". The MSC Accreditation Manual specifies the types of certificate that may be issued to a fishery. Normally, this would comprise a **joint fishery/chain of custody certificate** which is issued when "the certification body responsible for issuing the associated fishery management certificate is satisfied that the system of tracking and tracing implemented by the fishery is sufficient to provide a guarantee that all fish and fish products invoiced by the fishery originate from the evaluated fishery". As appropriate systems were not in place at the time that the fishery was certified, the final report further stated: "Accordingly, the certificate issued will initially be a **Fishery Management Certificate** only. When additional, suitably precautionary, procedures have been implemented and verified to ensure continuing tracking and traceability of fish, an addendum will be produced to this report (which will be placed on the MSC website) and the certificate re-issued as a **joint fishery/chain of custody certificate.** Until this joint fishery/chain of custody certificate is issued, fish and fish products from the fishery MAY NOT enter into further chains of custody, and ARE NOT eligible to carry the MSC Logo."
Observations	Procedures have now been put in place to enable tracking and traceability of product from this fishery. This is via a Chain of Custody scheme operating within the fishery. Key features of the scheme are: 1. The Chain of Custody is operated through a Group scheme as defined by the MSC Chain of Custody Methodology Version 5 of February 2004. 2. The scheme is operated by the Government of South Georgia and the South Sandwich Islands and contracted organisations. 3. Membership of the scheme is open to Group Members. These Group Members will be companies/vessels with licences to fish in the South Georgia Maritime Zone in the season for which group membership is sought. In addition, among other requirements, applicants for group membership must: • Demonstrate that it has no links to any companies or entities, either through direct or beneficial ownership, that have or are engaged in IUU fishing for toothfish • Demonstrate that it has committed no serious infractions of CCAMLR or

	GSGSSI conservation measures or laws in the last season in which it fished • Have the necessary additional equipment to participate in the group scheme, and demonstrate through sea trials that the equipment is capable of operation under standard fishing conditions 4. In addition to standard CCAMLR and GSGSSI requirements to carry VMS equipment, to have on-board observers and to be subject to inspection at sea by patrol vessels, Group Members must comply with other requirements of the group scheme. These include: • Inspection of vessels, at designated ports, prior to commencing fishing operations • Automated labelling of all boxes of toothfish product to a pre-set specification, detailing all relevant aspects of capture and box contents • Daily uploading of product data onto a central database • Inspection on cessation of fishing operations, including weighing of total catch and sampling of box labels and contents 5. This scheme meets the requirements of the MSC Chain of Custody standard, i.e. • There is a clearly documented control system specifying procedures and responsibilities • Inspections, VMS and recording of catches prevents any mixing of certified and non-certified product • Catches are clearly and securely labelled • Appropriate records are maintained 6. The group scheme is responsible for the accurate labelling and tracing of toothfish product to the point at which the product has been inspected on cessation of fishing activities, at either KEP, South Georgia or Port Stanley, Falkland Islands. After inspection, Chain of Custody will be the responsibility of the individual Group Members and will be subject to a further Chain of Custody certification. 7. The central database of product label information will provide the basis for further verification of chain of custody integrity at later points in the Chain of Custody. This will be subject to future separate certification assessments along the Chain of Custody.
Conclusion	Moody Marine is now satisfied that appropriate procedures are in place to ensure product so labelled originates from the certified fishery and is in a form appropriate for future traceability. Various techniques are also now available to ensure ongoing verification of product provenance. Accordingly, the above Group Scheme is appropriate for certification and contains precautionary measures appropriate to the value and sensitivity of Patagonian toothfish product. The Fishery certificate has now been re-issued as a joint fishery/chain of custody certificate and the previous certificate withdrawn.

2	**Condition of Certification 1: Ongoing Surveillance**
Activity assessed	The fishery shall be subject to annual surveillance visits by Moody Marine. This surveillance will specifically include the following issues: • determining that catch limits for sub-area 48.3 continue to be set to achieve long-term management objectives that are at least as precautionary as those that are currently used when determining catch limits and that catches do not exceed catch limits by an extent that would have a long-term negative impact on the probability of sustaining the population • the planning and execution of research focussed on achieving a better understanding of the impacts of the toothfish fishery. The initial focus of this research should be as set out in the following conditions. As research into the impacts of toothfish fishing are discussed in specific detail below, this section deals with catch limits, catches and effects upon the sustainability of the affected population.
GSGSSI Progress Report	At the October 2003 meeting of the Fish Stock Assessment Working Group the UK identified some problems with the time series of recruitment estimates for South Georgia. We re-calculated the recruit densities from the raw survey data using our new best estimate growth curve and discovered that there were indeed some errors, probably in data extraction or processing at CCAMLR, in the past. When these new (corrected) recruit data were run in the standard projection model (GY), the simulated population went extinct before 2004 in a significant proportion of the runs (up to 50%). This clearly has not happened, as indicated by the relatively flat CPUE in recent years. We therefore reluctantly came to the conclusion that the old assessment method – estimating recruits at age 4 from survey data and running a stochastic forward projection to the fishery at ages 7+ - could not adequately capture the dynamics of the population. In a series of papers to the Subgroup on Assessment Methods and the Fish Stock Assessment Working Group we explained this in some detail, and investigated a number of alternative assessment methods which attempt to estimate current stock size directly rather than trying to construct the adult population from recruits estimated from surveys. The most promising methods were an ASPM (AD-model builder version), mark-recapture (which is also being proposed for assessing toothfish in the Ross Sea), and integrated stock modelling approaches such as NIWA program CASAL. The assessment method that was eventually used by CCAMLR this year was to base the projections of the GY model on mark-recapture estimates of current biomass made using our tagging data. The mark-recapture method used was a closed population model (Petersen), which assumed a 10% tag mortality rate, a 100% detection rate (because we have observers) and a variable recapture probability based on age using our age-based selectivity function. We were able to estimate a tag loss rate from our data. Confidence intervals were derived both empirically and using bootstrapped recapture events. Sufficient data were available to derive estimates of exploitable biomass in 2003 and 2004. It is clear that the various alternative methods for assessing adult stock size directly, including the mark-recapture estimate, and their integration with GY and the CCAMLR decision rules, would benefit from further testing. We and CCAMLR therefore considered that the setting of catch levels this year required the application of more than usual precaution. To reflect this, in addition to using the already conservative GY approach, at the 2004 meeting of WG-FSA we advocated using the bootstrapped lower 95% confidence of the lower of the two estimates of current biomass (that from 2003) from the mark-recapture model. This lower limit was 42000 tonnes of exploitable biomass. Mindful of Condition 1, to arrive at an estimate of sustainable yield we used exactly the same projection method as in past years, calculating long-term catch through application of the well-known operational decision rules over a 35-year run of the GY model. The only difference between this and previous years was that in previous years the recruitment series was treated as absolute recruitment. In 2004 we treated the recruitment series as an index of relative

recruitment (therefore preserving the estimate of recruitment variability) and adjusted the survey catchability coefficient q (=1.6) so that exploitable biomass was equal to the estimate (42000 t) from the mark-recapture analysis. This provided a yield estimate of 3050 tonnes for 2004/05. The TAC in 2005 will be a 27% reduction on that in 2004.

Other indicators from the fishery are relatively robust: mean size at depth continues to increase, and overall CPUE remains constant. However, there are indications from fine-scale analysis of the CPUE data that the areas of Shag Rocks and the area to the west of Shag Rocks have experienced some declines in CPUE recently. Therefore, as another precautionary measure, we proposed (and CCAMLR adopted) a closure of areas west of Shag Rocks (management area A below) and a split of the TAC between Shag Rocks and South Georgia, with a reduced proportion to be taken in Shag Rocks compared to 2004 (Figure 1).

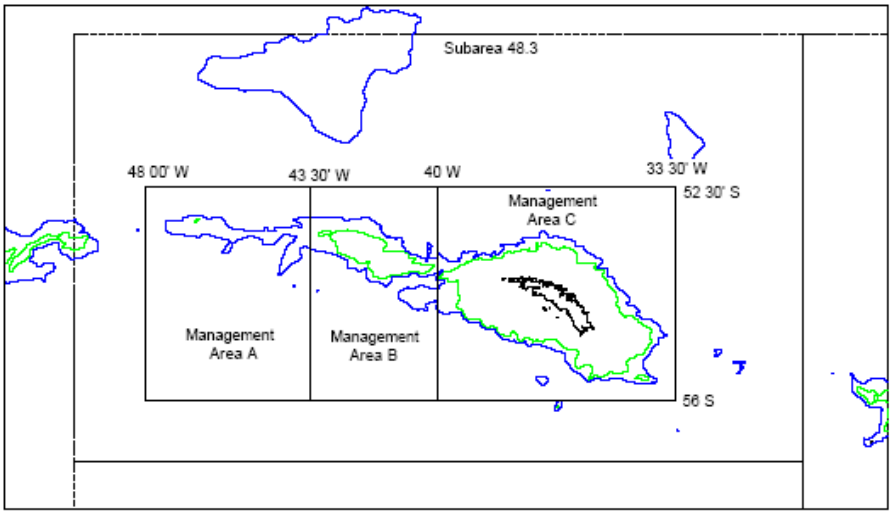


Figure 1. Area of licensed longline fishery and the three new management areas for catch allocation in the 2004/05 season (1 000 m and 2 000 m contours given).

GSGSSI has taken additional management action to ensure that the catch will be evenly distributed around Shag Rocks and South Georgia and will not, as a result of the reduction in TAC, be concentrated in hot spots. Management Area B (Figure 1) will be divided into three areas, each with a quota limit, and management area C into 9 areas.

As will be reported below, CCAMLR has acknowledged the separate genetic status of populations on the north Scotia Ridge and Maurice Ewing bank, and has closed these areas to fishing. With these closures and that of the area to the west of Shag Rocks, GSGSSI has total control over the only legitimate fishery in CCAMLR Subarea 48.3. This will considerably reduce the potential for IUU fishing and fishing outside the GSGSSI zone to undermine conservation efforts for this stock.

A considerable programme of work is planned for the future assessment of this and other toothfish stocks in the CCAMLR Area (the assessments of which suffer from the same problems as the South Georgia assessment; Fish Stock Assessment report paragraph 4.15 and Scientific Committee report paragraph 4.63).

Finally, it should be noted that the various review teams (both the assessment and objection teams) expressed some unhappiness with the assessment method for toothfish as it was implemented in 2002. This unhappiness was reflected in recommendations 1-3 (1: robustness to uncertainty; 2: between sex differences; 3: robustness of catch limits to alternative hypotheses). Whilst the above work has not fully addressed all of these recommendations, it was with some of these criticisms in mind that the review of assessment methods was undertaken. Thus the spirit of the recommendations is being taken into account in our current work.

Observations	The general yield model used for previous stock assessments has appeared to be inadequate. Based on new data, catches have been greater than the model implies could have been sustained. That is, based on test observations, the model does not seem to be consistent with reality. This has called the recruitment estimates into question. There are data suitable for alternative models which have been tested. Of these, tagging gives the most consistent results to estimate current biomass. The estimates agree with one of the alternative methods, the local depletion models, about which the scientists have reservations. The new TAC has now been obtained by tuning the generalised yield model biomass to the tagging based estimates of biomass. This does appear to be the best option, but clearly on-going development is desirable and is being promoted by CCAMLR. CCAMLR, based on the documented discussion, appears to be considering the possibility of worst-case scenarios, which is appropriate for precautionary approach. Some further research on ageing toothfish has taken place, but it is clear that ageing with the required degree of confidence will take some time. The best estimate for IUU catch in the 2004 season was 0.0 metric tonnes. The indications are that IUU catch has declined although there is a lot of caution in CCAMLR in concluding this. The fishery has introduced area controls to reduce depletion in particular areas and spread fishing mortality. This appears to be at least partly in response to concerns that CPUE may not be proportional to stock size (hyperstability), but remains stable while the stock contracts over its range as it is depleted. Setting up such areas is a potentially useful adaptive management measure if monitored effectively. The issue of hyperstability has been raised with the client who state “It is clear from the plots of CPUE presented at the 2004 Fish Stock Assessment Working Group meeting in Hobart that the fishery is not contracting to ever smaller areas, and continues to fish over the whole of the distributional area for toothfish at South Georgia and Shag Rocks. Nevertheless, this is an issue which should be monitored closely, and if hyperstability is a problem moving fishing activities from low CPUE areas may not solve it.” There are independent indices that suggest fishing mortality has been decreasing. The average size is increasing and catch rates have remained relatively constant. By maintaining the current TAC (or decreasing it) and assuming biomass is increasing, F will decrease thereby reducing risks to the fishery. The 2005 TAC has been set 27% lower than the previous year in response to uncertainty over recruitment indices and the state of the stock.
Conclusion	TACs have been set taking into account the precautionary principle and these have declined as further uncertainties have been identified. Population indices independent of the model suggest that the biomass is stable and the spawning stock biomass is probably increasing. Therefore the TAC has been maintained at an appropriate level and meets the requirements of Principle 1 and should meet the objectives for sustainable fishing of this stock. Taking into account difficulties encountered with the model and interpretation of the available data, it is considered important that the assessment is monitored. The fishery will continue to be subject to annual surveillance audits which will continue to revue the assessment methodologies, catch limits, catches and implications for the sustainability of the affected population.

3	**Condition of Certification 2: Confirmation of Stock Identity**
Activity assessed	Existing studies shall be reviewed and, where necessary, extended in order to demonstrate that the toothfish stock at South Georgia is sufficiently discrete that locally implemented management measures alone should be sufficient to ensure the sustainability of this stock. This is to include the following: • To review existing studies and where necessary commission supplementary new studies, on genetic characteristics of toothfish populations • To review existing studies and where necessary commission supplementary new studies, involving the tagging of toothfish to determine movement out of South Georgia into adjacent areas. Similar studies involving toothfish populations in neighbouring areas of the South Atlantic should be initiated so as to provide information on any migration into South Georgian waters On the basis of genetic and tagging studies, to examine various scenarios of mixing of adult and/or juvenile toothfish and the implications of this for the sustainability of the stock **Timescale**: Existing studies should be fully reviewed, supplementary studies identified and scheduled, and an estimation of the implications for stock sustainability carried out within 12 months of certification. Additional studies to address any areas of uncertainty should be carried out over appropriate timescales as agreed with the assessment team. The assessment of the implications of such studies for the sustainability of the stock should be reviewed as information becomes available. This will be a subject addressed during annual surveillance audits. **Note**: The words "to demonstrate" in the first sentence of Condition 2 shall be interpreted to mean that stock identification studies will be reviewed and, where necessary, extended in order to determine the degree of stock discreteness and level(s) of mixing with other populations. Ongoing certification will be considered in light of the results of these studies.
GSGSSI Progress Report	**Genetics** We have two new genetic items to submit for this condition. The first is a study by Arkhipkin and Shaw. The second is an independent study by Belchier *et al*. Both studies compare toothfish from South Georgia and Shag Rocks with fish from elsewhere in the Antarctic and on the Patagonian shelf. They both confirm the very distinct genetic identity of fish from South Georgia and Shag Rocks. However, we are not content to stop the study at this point. We will continue to seek samples from the entire regional distributional range of toothfish, including from the South Sandwich Islands, Chilean and Uruguayan waters. The results from the BAS study are not yet fully available or published. We expect a preliminary report in March 2005. However, in summary, mitochondrial DNA analysis has been performed on large samples of toothfish obtained from the commercial fisheries operating at South Georgia/Shag Rocks and the Falkland Islands. Analysis of 12S mitochondrial sequences has confirmed that there is sharp genetic division between the populations found at the eastern edge of the Patagonian shelf and those found at South Georgia and other sites south of the Polar Front. These results agree strongly with the recently published study of Shaw *et al*. (2004) and provide further evidence that the passage of the Antarctic Polar Front (APF) and the presence of deep-water troughs between these regions are major barriers to genetic exchange. The extremely clear-cut separation between the South Georgia and Shag Rocks populations is such that simple and cheap electrophoresis techniques could easily be used forensically to distinguish between samples originating from the two areas. Analysis of the 16S mitochondrial sequences provided no additional information. The seven nuclear microsatellite loci examined in previous studies on *Dissostichus eleginoides* (Reilly and Ward 1999, Appleyard *et al* 2002, 2004) have been used to investigate genetic exchange between putative toothfish populations from a number of different regions within the Atlantic sub-Antarctic region. Further samples from the Falklands/Patagonian Shelf region and from South Georgia/Shag Rocks have been analysed along with new material obtained from several sample locations further east. These include Bouvet Island, the Meteor Rise, and the Ob and Speiss seamounts, which represent the one remaining area (SE Atlantic) in the

Southern Ocean for which detailed genetic analysis does not as yet exist. Preliminary results suggest that differences exist between the Falkland, South Georgia and SE Atlantic populations. However, the difference between the South Georgia and Falkland populations is less well defined than is apparent from the mitochondrial DNA analyses. These results again are in strong agreement with the results recently published by Shaw et al (2004) although as yet, sample sizes are too small to asses whether the observations are a result of male-biased dispersal as suggested by Shaw *et al* (2004) or result from historical barriers to gene flow. Full analysis of the data should be available early in 2005.

A new technique known as Fast Isolation by AFLP of sequences containing repeats (FIASCO) is currently being utilised at BAS to rapidly screen toothfish for new microsatellites. De-novo microsatellite isolation usually takes weeks (or months) however FIASCO offers the ability to vastly reduce screening time. Accordingly, 133 new microsatellites have been identified to date, 19 times more than have been used in existing studies. The analysis of greatly increased numbers of microsatellite loci, which include some trinucleotide repeats, should make it possible to resolve the population structure of toothfish in the Southern Ocean at a much finer level than in previous studies.

The ongoing work will focus on the development of appropriate primers for the new microsatellites and the analysis of material collected from all of the South Atlantic locations using the newly developed tools. Applications are currently being considered for a PhD student to work on the project for the next three years.

Tagging

A total of 4151 fish have now been tagged and released around South Georgia. Altogether, 195 tagged fish have been recovered over the 5 years of the programme, although a number of these were recovered the same year that they were released. Ignoring these, 161 fish have been recaptured.

One tag has been reported from Chilean waters. This was a young male, reported from fairly north on the Chilean coast. The Chilean observer programme is reasonably good, and picked up this fish. Accounting for it would imply that fewer than 1% of South Georgia animals travel to Chilean waters. Interestingly, we still have no reported recaptures from Argentine or Falkland Islands waters, despite there being very good observer programmes in place in both areas and a tagging program in place in Argentine waters.

We intend to expand the tagging programme again this year, with a target of 4500 fish. We are now planning to use tagging data for estimates of biomass and natural mortality, in addition to movement, dispersion and growth. One commercial vessel plans to fish in the South Sandwich islands (there is a 28 t TAC in the area) sometime over the next year or so. If this goes ahead, fish will be tagged and genetic samples obtained. Although the west Shag Rocks area is closed, we will be undertaking tagging there from a research vessel, attempting to tag 100 fish.

We are currently working on re-publicising our tagging programme, especially within the fishing industry in Argentina and the Falkland Islands, but also in the Chilean fishery.

One interesting new result from the tagging programme is to confirm that toothfish *do* move between the various areas around South Georgia/Shag Rocks, and not necessarily at the same rate

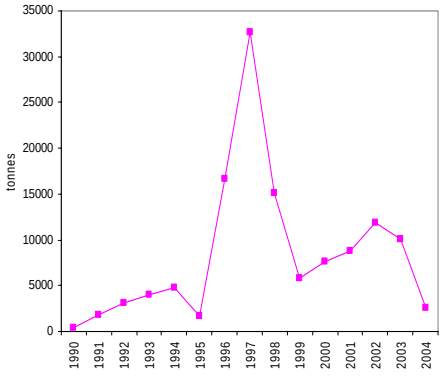
We also now have several recaptures of juvenile fish which were tagged in shallow water at Shag Rocks. They have moved to North SG, South SG and into deeper water around Shag Rocks. This confirms our previous hypothesis about post-juvenile dispersal of toothfish.

Models of mixing

We can make some initial assessment of the possible effects of mixing between the SG/SR and other toothfish populations from current reported recaptures and our genetic results. The likely rate of exchange between the South Georgia/Shag Rocks population and the populations of the

	Patagonian shelf (including around into Chilean waters) may be at the level of the 1% estimated from our single Chilean recapture (above). So far we have no information on immigration, just emigration, and therefore must at the moment make the precautionary assumption that the movement is one-way. Given that the current GY assessment uses a very wide (uncertain) estimate of natural mortality, 0.13-0.2, the increase in natural mortality suggested by a 1% loss each year would not be significant within the model. Our mark-recapture estimate of toothfish exploitable biomass, reported above to be 42,000 t, used a median natural mortality rate of 0.165. Applying an additional one-way emigration rate of 1% per year to this would increase it to approximately 0.167, which reduces the current lower 95% confidence interval estimate of current biomass by 0.3%, although this is only discernable when calculating the empirical confidence intervals – this very small change is lost in the general variability of the bootstrap estimate. Our current estimate of the effect of the very small amounts of emigration discovered so far is therefore that it is likely to have a negligible effect on the population. In our view, looking at the genetic evidence, it is equally unlikely that we would find significant immigration into the SG/SR population from the Patagonian Shelf. However, we will be unable to assess this aspect of immigration until the Argentine tagging programme (which started this year) and Falkland Islands programme (due to start soon) have been in operation for several years.
Observations	The stock identification work is considered to be progressing well. There is one new primary publication (Shaw *et al* in Molecular Ecology), additional tagging results which were reviewed at the CCAMLR meeting, and a PhD student is being sought to work on these issues intensively. The new results with mitochondrial DNA support the argument that the SGSSI management unit is a distinct population unit, and that the SGSSI unit can be managed separately from the stock or stocks supporting fisheries in the areas around the Falklands and Argentina. The microsatellite DNA results showed somewhat less differentiation than the mtDNA, but information from those two molecular genetics sources commonly show a similar relationship (mtDNA showing more differentiation than microsatellite DNA). The proponents note that they plan to examine further specimens from yet more areas, and as methodology allows, also continue to see additional genetic markers. The tagging program has increased in the most recent years, and the methods used follow good practices for the field (double tagging, use of high rewards, surveillance to support voluntary reporting, etc). The recapture information available to the point are also consistent with managing the stock supporting the SGSSI fishery as distinct from the stock(s) supporting fisheries elsewhere, with very little mixing of the fishable biomass between the areas around SGSSI and other areas supporting toothfish fisheries. Presently only a few thousand fish have been tagged in the SGSSI area, and there have been only 161 recaptures (excluding recaptures in the year of tagging), and is a fairly small body of information on which to base conclusions about stock separation and affinities. It is noted that plans are being implemented to expand the tagging program, with a target of over 4,000 fish tagged in the current year, and more information should come available on any further recaptures of fish tagged in past years as well.
Conclusion	The data collection methods applied in both the genetics and the tagging are sound scientifically and use good current practices. The initial requirements of this condition are considered to have been met. In relation to the requirement for additional studies to address any areas of uncertainty, the appointment of a PhD student to work on the stock identity and distinctiveness issues is appropriate, and indicates that progress will continue in this area. The PhD student should ensure that analysis and interpretation of results does not fall behind the availability of new information. The information reported on application of the mixing model was brief, and few conclusions could be drawn from the results. However it was only 2004 when numbers of fish tagged reached the few thousands per year, and the database of 161 recaptures will be augmented substantially over the next few years. The true value of applying statistical mixing models to the tagging data will only start to be realised as the data from the more intensive tagging

	experiments has come available. Accordingly, the assessment of the implications of such studies for the sustainability of the stock will be a subject reviewed during future annual surveillance audits.

4	**Condition of Certification 3: Continuing Monitoring, Control and Surveillance**
Activity assessed	The surveillance, monitoring and associated measures required to achieve certification should be maintained or improved (e.g. through improved/increased surveillance or proven effects of Catch Documentation Scheme). Improvement should include for the development of verifiable indicators of IUU activity in order to provide data for modelling of the extent and effect of IUU fishing.
GSGSSI Progress Report	Surveillance has continued at the same or higher rates than were present in 2002 and 2003, the basal levels required for certification. Other surveillance activities are on-going, but are at a level of sensitivity that goes beyond this paper. In terms of the "verifiable indicators of IUU activity and its effects", the Agnew & Kirkwood model will continue to be applied to estimate IUU activity from South Georgia. We are currently working on extending our analysis backwards in time to cover the period 1993 – 1998. This is not trivial, because we have to re-construct the surveillance activities at that time and unfortunately the data are not in suitable format for this (as they were for the later analysis). There has been a further development in this field with some other CCAMLR scientists developing alternative models for estimating IUU fishing. We will proceed by firstly refining our own estimate from the early years at South Georgia, and may extend the analysis to include these new methods. CCAMLR estimates that the total IUU catch in the Convention Area has declined over the last two years. Estimates of total world catch (made from trade statistics and CDS data) have also been dropping. Confidence that these data represent actual supply is given by the price of toothfish, which has been increasing steadily for the last several years; the supply-demand equation for toothfish appears to be quite elastic. The decline in IUU catch can probably be attributed to a number of factors: much higher levels of surveillance and probability of arrest in all EEZs within the Convention Area, declining catch levels leading to smaller economic gains, the increasing number of countries participating in the CDS, the development of the electronic (fraud resistant) CDS and stricter import controls by the US and other primary importers including the insistence on presentation of VMS records. There is no room yet for complacency, but it does seem that our estimates of zero IUU activity around South Georgia appear correct. *CCAMLR estimate of IUU catch*  **Figure 2 Estimated CCAMLR IUU catch of toothfish.**
Observations	The level of surveillance by fishery patrol vessels (measured by the number of days on patrol within the South Georgia Maritime Zone) has increased year-on-year. It is noted that "other surveillance activities are ongoing". Such activities have been discussed with Moody Marine and are considered very positive in their contribution to thwarting IUU fishing. For reasons of confidentiality, however, these methods are not disclosed here. The model used to estimate IUU activity, based on recorded encounters, was reviewed as part of the initial certification. It is noted that GSGSSI continue to review and develop the model and are open to alternative models for estimating IUU fishing under development elsewhere.

Conclusion	The level of surveillance is adequate to meet the conditions for continued certification. Efforts underway by GSGSSI to control, and evaluate the effects of, IUU fishing are acknowledged. Monitoring, control and surveillance has exceeded the baseline set in 2002/03 and looks set to increase further. The requirements of this condition have therefore been met and exceeded, but will be subject to ongoing review to ensure that this is maintained at the required levels.

5	**Condition of Certification 4: Impacts of fishing on rajid populations**
Activity assessed	A strategy (or research plan) should be developed to obtain reliable information on fishery-related impacts on rajid populations. The outcomes of this strategy should be sufficient to determine whether, and to what degree, populations are being maintained, depleted, or placed at risk of extinction and to provide points of reference to interpret the effects of by-catches on populations of these species. The strategy should include, but not be limited to, population estimates of rajids from by-catch and ongoing surveys and may require further research on the biology of the species concerned. Interpretation should include information from IUU effort estimates. Mitigation measures should be developed as part of, or in advance of, the strategy, as appropriate, and the biological basis of mitigation measures should be established. **Timescale**: A suitable strategy/research plan should be developed within 12 months of certification and the strategy fully implemented within three years of certification
GSGSSI Progress Report	Our research plan is as follows 1. *Determine and minimise the impact of fishing on rajids* a. *Determine the mortality of ray discards, and estimate the total deaths arising from longline fishing each year* b. *characterise the factors affecting ray capture* c. *examine the likely effect of different mitigation measures* 2. *Undertake assessments of rajid populations* a. *establish and monitor rajid population trends* b. *establish demographic parameters (growth, maturity, fecundity etc) for rajids* c. *make an estimate of population status and sustainable yield* 1. **Determine and minimise the impact of fishing on rajids** 1.a **Determine the mortality of ray discards, and estimate the total deaths arising from longline fishing each year** Research leading to determination of the impact on populations is well under way. We have an almost-completed PhD project on ray distribution and discard mortality and demography. Industry-partnered experiments have also taken place on the potential to reduce discard mortality. There are three species caught in the fishery, one of which is a shallow-water species – *Raja georgiana*. We expect discard mortality to be very low for this species because our results (below) indicate that skates caught in shallow water experience good discard survivorship. Furthermore, we are in the process of introducing a ban on longline fishing in waters shallower than 500m, and since the depth distribution of this species is 100-600m it would seem that the impacts on this species from toothfish longlining are likely to be minor. Of the two deeper water species, only one is caught in any numbers – the new species described by Endicott *et al* as *Raja sp*. Our research plan will focus on this species, although it will not ignore the other. We have now conducted two experiments on the survivorship of rays discarded from longliners; one in 2003 and one in 2004. The results of the first were reported in Endicott *et al* 2003 and they are more or less confirmed by the results of the second experiment. Survivorship decreases as the depth of fishing increases beyond about 800m depth. From 0 to 800 m, survivorship approaches 1, although we have had difficulty obtaining samples from these depths. The reason for this difficulty is that the most abundant species, *R. sp. anon.* occurs primarily in waters deeper than 1000m (Endicott *et al* 2002), few rays of any species are caught between 600 and 1000m, and as noted above the limitation of fishing in waters shallower than 500m has almost eliminated any catches of *R. georgiana*.

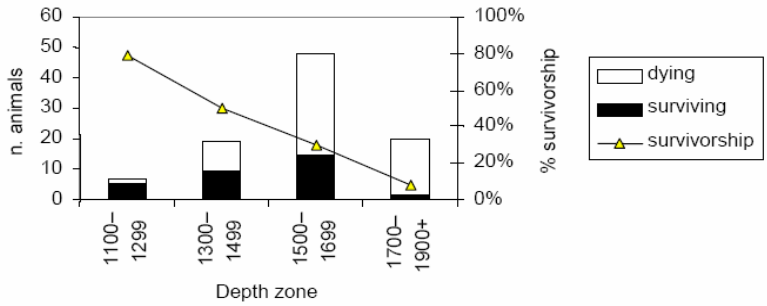


Figure 5.20: The number (and percent survivorship) of rajids by depth zone from the survivorship data recalculated from WG-FSA-03/57.

Figure 3 Survivorship of *R. sp. anon*. from the first (2003) survivorship experiment.

In 2003 we used this figure to calculate that out of a total of 179 tonnes of rays either cut off lines or landed in 2003, probably 85 tonnes were killed, 94 tonnes surviving. We will be able to repeat this calculation to estimate total deaths of rays over the last 4 years. We should also be able to use the information coming out of task 1(b), together with whatever catch data do exist, to obtain a minimum estimate of rays killed (by species) back to the start of the fishery.

1.b. **characterise the factors affecting ray capture**

We have established through analysis of data from the last 4 years that there are significant differences in the numbers of rays caught between vessels, between different areas, in different months, at different depths, with different nationalities and using different bait. Full results are not yet available or written up, but it is likely we will be able to characterise the problem effectively within the next year (i.e. by 2006).

Another point to consider is that rays have only been the focus of major research since 2001. Even data from that year are not as reliable as from subsequent years, but the reliability of these data is set to continue increasing. However, preliminary results seem to show a general decline in CPUE of rays over the years of current analysis. This adds impetus to our efforts to develop some useful mitigation measures.

1.c **Examine the likely effect of different mitigation measures**

Following on from 1.b it is clear that there will be some fairly obvious mitigation methods available to us in addition to cutting rays off the line to maximise their survivorship. These other mitigation measures could be a combination of restricting fishing depth, area and bait used. These various alternatives will be examined over the period of the next year, with results expected to lead to recommendations for management at the 2006 meeting of CCAMLR, with likely implementation in the 2007 fishing season.

2. **Undertake assessments of rajid populations**

2.a. **establish and monitor rajid population trends**

This will result from the analysis in section 1. However, if, as we expect, some restrictive

management measures will be implemented, it will be important to establish experimental fishing for rajids which maintains standard sampling positions and effort each year over the whole of the rajid distribution, and does not simply rely on data deriving from the commercial fishery. We are currently talking to industry about the possibility of setting up such standard longline surveys, which are done elsewhere (for instance for sablefish in the Gulf of Alaska).

2.b **Establish demographic parameters (growth, maturity, fecundity etc) for rajids**

This task will be undertaken as part of the PhD work. We already have some information on growth rates of these species and have established a methodology for age determination (Endicott et al 2000). Fecundity estimates are not possible from our current dataset, but there is a reasonable set of data worldwide on rajid fecundity which we will use to make some assumptions about our species. We have already characterised age at maturity etc (Endicott et al 2000).

2c **Make an estimate of population status and sustainable yield**

We intend (2.a) to continually monitor trends in rajid abundance.

We have several options for undertaking a quantitative assessment of population size, none of them very easy.

Surveys
This option is only available for the shallow water species, *R. georgiana*. This is not a major bycatch in the fishery, especially since the minimum depth of fishing has been increased to 500m Therefore, whilst technically feasible this is not a practical option.

Density estimate
This is the method that will produce the most immediate results, although they will be accompanied by considerable uncertainty. Using our estimate of toothfish population size, and also using information from depletion experiments (Agnew et al 2004) we can estimate the relationship between toothfish density and catch per hook. If we assume similar ranges of attraction for rays as for toothfish, we can estimate ray densities associated with ray catch rates. Combined with the distributional data (1.b) we should be able to estimate total rajid population size for the deep water species.

This is a rather tortuous method of estimating population size, and makes a series of assumptions which are very difficult to test. We propose to use it as an interim estimator in 2005-2006, but would also need to conduct a substantive tagging experiment later in the project.

Tagging
The difficulty with this approach is that we really need an estimate of the deep water species, and yet we know survivorship is very low for animals taken below about 1500m. Therefore, we will have to tag only shallow water animals in good condition (which is possible) and estimate mixing with the wider population. We have done this successfully for toothfish, but we do not know if rays are similarly mobile.

A second difficulty is that if all rays are cut off at water level our recovery rate will be very low. We persuaded CCAMLR this year to recognise and agree in principle to allow all rays to be recovered in a mark recapture experiment:

> FSA-2004, paragraph 6.65 At WG-FSA-03, the Working Group recommended that, wherever possible, vessels should cut all rajids from their lines whilst still in the water, except on the request of the observer during the observer's biological sampling period (SC-CAMLR-XXII, Annex 5, paragraph 5.97).
>
> 6.66 WG-FSA-SAM noted that there may be some degree of conflict between the above advice and the need for accurate estimates of recaptures of marked animals in areas where tag and recapture

programs are being developed as progress towards rajid assessments (WG-FSA-

04/4, paragraph 2.45. The Working Group recognised that it might be difficult to detect tagged rays if they are cut off at the sea surface rather than being brought on board.

6.67 The Working Group suggested that in some fisheries, and in some sea states, it might be possible to identify tags reliably when rays break the surface. Tagged animals could then be retained and untagged fish released. However, the Working Group noted that the detection probability was still likely to be lower than 100%, and it would be important to undertake some experiments to determine detection probability.

6.68 If the detection probability of tagged rajids at the sea-surface is low, the Working Group suggested that it may be necessary for a relaxation of the requirement to cut all rajids from the line on specified vessels and/or for specified time periods.

We are currently planning that a major rajid tagging programme should commence in 2006 (We feel that a major tagging programme on rays in 2005 would interfere with our planned major tagging programme for toothfish in this year - target: 5500 animals. We would then be in a position to make a mark-recapture estimate of population size before implementing the large suite of mitigation measures that are anticipated.

Production/age structured models
These would use the trends in abundance generated in 2a together with estimates of extraction. This is possible, but will require several more years of monitoring before sufficient contrast is available in the CPUE trend data to create a meaningful assessment.

Sustainable yield
In the absence of a fully-defined population model, an estimate of total replacement sustainable Z will be made using a Leslie matrix or similar model, as has previously been applied for rajids (Brander, 1981; Walker & Hislop, 1998; Quinn & Deriso 1999). This should allow an estimate of sustainable yield to be made. However, we have not yet fully defined appropriate models for this.

Timetable
The timetable for this work needs careful consideration. There is a need to undertake the tagging experiment in the 2006 and 2007 fishing seasons. After this time, we would recommend that a full suite of mitigation measures, fully defined and tested in the intervening years, be implemented. A standard longline monitoring programme needs to be designed and introduced in the 2006 fishing season, so it can be established for 2 years prior to the change in management.

Table 1 Proposed research timetable for rajid populations

1a	*Determine the mortality of ray discards, and estimate the total deaths arising from longline fishing each year*	2005
1 b	*characterise the factors affecting ray capture*	2005, 2006
1c	*examine the likely effect of different mitigation measures*	2006, 2007
	Recommend mitigation measures	October 2007
	Establish standard longline monitoring	2006
	Implement full suite of mitigation measures	2008
2a	*establish and monitor rajid population trends*	2005 onwards
2b	*establish demographic parameters (growth, maturity, fecundity etc) for rajids*	2006

	<table><tr><td>*2c*</td><td>*make an estimate of population status and sustainable yield*</td><td></td></tr><tr><td></td><td>*Surveys*</td><td>2005 (estimate of R. Georgiana population)</td></tr><tr><td></td><td>*Density*</td><td>2006</td></tr><tr><td></td><td>*Tagging*</td><td>Tag 2006; recover 2007 (estimate of Bathyraja and R. anon stocks)</td></tr><tr><td></td><td>*Production/age structured models*</td><td>2007</td></tr><tr><td></td><td>*Sustainable yield*</td><td>2006 – 2007 (all species)</td></tr></table>
Observations	The research plan appears to be appropriate. It covers the two main areas required: 1) research methods to minimise catchability for the relevant species; 2) develop models to allow the population to be assessed. The most vulnerable Rajidae species has been identified and focus on the two deep water species appears appropriate. The assessment needs to be careful it does not just focus on the more common species – the key issue is the relative catchabilities for by catch species. Species that are naturally rare will only occur rarely in the catches, but if their fishing mortality is high they can still become relatively endangered. The tagging approach to assessment proposed appears probably the best way to monitor the population and obtain information on dynamics of these species. Notwithstanding the problems indicated, the observer coverage makes tagging a potentially reliable method. However, there is a conflict of interest between the tagging programme to understand the population dynamics and the need to minimise impact on the population, which will need to be addressed. Also, the mitigation measures are likely to make commercial CPUE measures unreliable to monitor the stock. A research time table has been set out. The aim is to have enough information to set mitigation measures in place for the 2008 season. This would seem to be reasonably realistic, as the assessment will be able to use models and information from published sources. It is assumed that the 27% reduction in 2005 toothfish TAC should also reduce fishing mortality on the by catch species.
Conclusion	Research, development of a monitoring programme, and research on mitigation measures appears to be appropriate. Development of both the mitigation measures and the monitoring programme need to be continued and conducted according to the time table given. Achievement of the programme will be monitored during future MSC certification surveillance audits in relation to this time table. This would realise implementation of mitigation measures in the 2008 season. This is within the timescale of the condition, although it is acknowledged that some flexibility may be required depending on the findings of the research.

6	**Condition of Certification 5: Production of Fishery Management Plan**
Activity assessed	The management measures used in the fishery are considered good, but need to be codified. A fishery management plan for toothfish is considered necessary for effective management of the fishery, as described in the FAO code of conduct. This should include: • Contingency plan for future funding should revenues from operating fishery prove insufficient to fund monitoring and enforcement • Transparent information on licensing requirements, including a vessel code of conduct • A recovery plan should the stock fall below precautionary reference points **Timescale**: This plan should be completed within 12 months of certification. The content of the plan will be verified on completion and implementation of this plan will be the subject of ongoing surveillance.
GSGSSI Progress Report	A fishery management plan is attached in tabular format. This addresses all the issues raised in the condition, and was brought into force this year. This year the licensing application round was more transparent than in previous years. A full set of information is given to all applicants, and includes details of research that they will be expected to carry out as well as compliance requirements. Regarding monitoring compliance (relevant to the code of conduct), the UK has presented numerous papers to CCAMLR via the EU. Although the paper listed below was not actually presented to CCAMLR in 2003 (due to administrative faults at the Commission) we did make progress this year with the adoption of new rules for analysing compliance by CCAMLR this year (paragraphs of the SCIC report follow) 3.27 **The Committee recommended** to the Commission that it undertake an annual assessment of compliance in accordance with the principles outlined below. Such an assessment could be considered by the Commission in the light of the Scientific Committee's current consideration of the performance of vessels with regard to conservation measures, specially those involving mitigation. 3.28 The objectives of undertaking the assessment are: (i) to ensure that conservation measures are being effectively implemented and objectively monitored; (ii) to evaluate the effectiveness of conservation measures in meeting their conservation objective; (iii) to identify vessels, areas, sectors or fisheries where compliance with conservation measures is inadequate; (iv) to identify specific action points for the Commission and Contracting Parties. 3.29 The preparation of the compliance assessment for consideration by the Commission should involve at least the following steps: I. All provisions of a conservation measure must be amenable to monitoring. II. SCIC suggested that an appropriate procedure for undertaking the assessment would be: (i) for the Commission to task the Secretariat with collating and analysing the data required for the assessment; (ii) for the Scientific Committee (including WG-FSA) to review these calculations and provide advice to SCIC; (iii) for SCIC, taking into account such comments and advice, as well as other relevant data, to agree a final assessment. III. The final assessment report will include a description of any technical difficulties encountered in monitoring compliance, with suggested solutions to these problems, including, where appropriate, recommendations on improvements of conservation measures. 3.30 In the first instance, SCIC recommended that the Secretariat identify the

	types of monitoring data and the methods of collection that are currently used in the assessment of compliance with conservation measures. SCIC recommended that it and the Scientific Committee comment on these methods and provide recommendations on their modification or adoption by the Commission meeting in 2005.
Observations	The management plan table does address all conditions and codifies the management measures. The management plan is, however, terse. This should not be a problem given the amount of documentation already available for this fishery, but in its current form it would not be useful as a stand-alone document for general use. Licensing requirements are supplied. These strictly implement CCAMLR conservation measures. The contingency plan for funding is outlined and sets the basis for ensuring future funding. There is no reason to suppose that this contingency would not be met and it appears that this is being addressed satisfactorily. A recovery plan is set out. This consists of a moratorium on commercial fishing while continuing patrols and IUU interdiction as is currently undertaken. This is considered appropriate.
Conclusion	The management plan is acceptable as an internal document and so the condition is met for continued certification. The use and effectiveness of the management plan will, however, be monitored during future MSC certification surveillance audits. Monitoring would include the availability/provision of documents held by GSGSSI and the updating of the document with, for example, mitigation measures as they are proposed for Rajidae by-catch. Keeping the document current will make it a useful fisheries management tool. As a recommendation, it is felt that the plan could be improved for external use, as a minimum, simply by using hypertext for connecting to other relevant documents which could be bundled with the table document.

7	**Condition of Certification 6: Request for external review**
Activity assessed	Independent, external, review of CCAMLR toothfish management measures does not currently take place. Accordingly, there should be a request from the UK (which may need to be channelled through the EC) for such an external review **Timescale**: This request should be progressed within 12 months of certification.
GSGSSI Progress Report	This year we encouraged CCAMLR to seek an external review of its assessment method for toothfish. This review was to have taken place this year, but unfortunately there were no volunteers. We have again, this year, requested a wide-ranging review as set out in an accompanying letter to CCAMLR. The response of the Subgroup on Assessment Methods has also been provided. Since the issue has been progressed twice with CCAMLR over the last year (at Fish Stock Assessment Working Group in October 2003 and at the Subgroup on Assessment Methods in July 2004) we believe that we have satisfied this condition (progression within 12 months). However, we will keep raising this issue whenever we can and will report back as there is further progress.
Observations	The UK has made this request to CCAMLR, according to the condition, and a call for a review of the assessment methodology was made in Commission Circular 04/06. This request fulfils a narrow interpretation of the Condition, in that the request was made. However, the response from CCAMLR did not achieve the objectives behind the Condition of Certification. No qualified reviewers bid for the contract to conduct the review, apparently because inadequate funding being provided for the review. The UK has already initiated dialogue with CCAMLR to address the situation (letter Agnew at al. to Ramm et al. 5 July 2004), which they clearly consider important. Both the UK and CCAMLR should be encouraged to ensure that the second call for bids is made with a more realistic provision for funding. The correspondence also makes the positive gesture of clarifying that the initial call for bids from CCAMLR was worded in such a way that the review being requested might be interpreted as a very narrow review of software performance and clarity of manuals. The UK correspondence clarifies that they want an independent review of the actual approaches to conducting the assessments, including the soundness of the model formulations and data sources being used in the assessment. Our assessment notes that even a comprehensive review of the assessment formulation and data sources may fall short of the objectives of this Conditions of Certification. The Condition of Certification calls for the independent external review of the "toothfish management measures", and not exclusively the assessment model. The soundest assessment does not ensure conservation of the resource and sustainability of the fisheries, if the actual management measures are ineffective – or implemented ineffectively. The existing CCAMLR review process and the annual reviews of compliance with the Conditions of Certification by the Moody Marine MSC assessment team constitute a partial independent review of the management measures, in that if the management measures are functioning badly, consequences will be detected. However, that is not a substitute for an independent review of the management measures individually as well as in combination.
Conclusion	It is acknowledged that GSGSSI have met the requirements of this condition. Recognising the importance of transparency of the CCAMLR process to effective, inclusive, management, we welcome the intent of GSGSSI to continue to pursue this matter and so effect an independent external review of the toothfish management measures. This issue will be recorded in future surveillance audit reports as appropriate.

8	**Condition of Certification 7: Evaluation of impacts on stock of IUU fishing**
Activity assessed	At present, in allocating future harvests (TAC), IUU fishing is assumed to be zero. Although IUU fishing is taken into account in determining stock status retrospectively, this is seen as a weakness of the current system. A more specific method is required to take account of likely IUU fishing in determining future TAC's. This should take account of new, and more comprehensive means of estimating IUU fishing (MRAG 2002). **Timescale**: It is assumed that this condition would require consent within CCAMLR. It should, however be progressed within 12 months of certification.
GSGSSI Progress Report	We will not progress this issue through CCAMLR. We believe that we have the information and ability to progress it ourselves. Furthermore, any approach through CCAMLR would have significant impacts on other CCAMLR fisheries, which could be resisted by other CCAMLR Parties. To deal with this condition, in April each year MRAG/GSGSSI will make an assessment of the level of IUU fishing that has taken place within Subarea 48.3 for that fishing season so far. GSGSSI will withhold part of the TAC for Subarea 48.3 if there is evidence of IUU fishing at South Georgia prior to the fishing season. This policy is currently in place, and is codified in the Fishery Management Plan.
Observations	This issue has been adequately addressed by GSGSSI, without CCAMLR involvement, to further sustainable exploitation of the toothfish resource. IUU is currently estimated to be zero within the 48.3 area. However, a procedure has been developed to adjust the TAC within season should IUU fishing be estimated to be greater than zero.
Conclusion	The requirements of this condition have been met. Implementation of such measures will be monitored through future surveillance audits.

9	**Condition of Certification 8: Discard of hooks in fish heads**
Activity assessed	An estimate should be provided, for each vessel, of hooks discarded as part of fishery waste available to birds, primarily in fish heads. **Timescale**: This should be carried out within 12 months of certification. If identified as a significant issue, a regulation should be put into place to address this, with appropriate monitoring, as soon thereafter as practically possible.
GSGSSI Progress Report	We carried out monitoring of this problem in 2002. Through CCAMLR, we put in place a non-mandatory requirement to retain all hooks in offal during the 2003 fishing season. This was successful and the requirement became mandatory in the 2004 fishing season. Paragraph 5 of Conservation Measure 25-02 now reads *The dumping of offal is prohibited while longlines are being set. The dumping of offal during the haul shall be avoided. Any such discharge shall take place only on the opposite side of the vessel to that where longlines are hauled. For vessels or fisheries where there is not a requirement to retain offal on board the vessel, a system shall be implemented to remove fish hooks from offal and fish heads prior to discharge.* One might reasonably ask if satisfying this condition has lead to improvements in performance and real environmental gains. We can categorically say that hook discharge performance has improved when compared with the situation that prevailed during the period when the fishery was being evaluated for certification. Compare the current situation where discarding is rare compared with 2002, during certification, where hook discharging was a regular occurrence with estimates of up to 14.7 % of fish heads discharged containing hooks. We can also point to evidence that the number of hooks being picked up by albatrosses has also declined. Regular surveys are made of the number of hooks found in nests on Bird Island and the results of these show a general decline over the last 4 years. However, we have to understand a little more about albatross distribution and feeding ecology before we can interpret this. Below we summarise briefly information for three species of albatross (Birdlife International, 2004): black browed, wandering and grey-headed. Of these three species, the wandering albatross may be the only birds that are capable of ingesting a whole discarded toothfish head. They may be the most susceptible to picking up hooks and fishing gear, and indeed the largest number of items is found in nests from these birds. Black browed (usually the most numerous albatross species associated with fishing vessels around south Georgia) and grey-headed albatross are often seen to scavenge offal but not usually whole toothfish heads. Black browed albatross forage around South Georgia during the breeding season but undertake an annual inter-breeding migration to the Benguela current where they are often found in association with fishing vessels and where there is also a longline fishery. They return to South Georgia via the central south Atlantic (35° S) and they have to cross the area of the surface longline tuna fishery both ways. Wandering albatross forage around South Georgia and along the Scotia ridge to the Burdwood Bank and north along the Patagonian shelf during their breeding period. Between breeding periods they forage generally in the south Atlantic, once again in an area coincident with surface longline operations. Grey-headed albatross are biennial breeders and appear to be the most widely distributed of the three species between breeding seasons, South Georgia animals having been tracked around the globe generally in the polar frontal zone (40-50° S), which is generally further south than surface longline tuna operations. Breeders forage around and to the north of South Georgia, again in the polar frontal zone. Thus it would seem that there is ample opportunity for some birds to pick up hooks in areas other than around South Georgia: wandering albatross from discards in the high seas (unregulated) and domestic longline fisheries in the SW Atlantic; black brows from the South

	African and central south Atlantic fisheries, however, there may be less opportunity for grey-headed albatross to do this. Levels of incidence are generally low with black-browed albatross, perhaps because even when offal is dumped with hooks, their feeding is more selective, and they are not capable of ingesting large items such as heads with embedded hooks. Furthermore, they show no real trend, possibly because the animals are foraging further afield, but also perhaps because the incidence is too low to detect significant trends. The most significant reduction in the occurrence of fishing gear has been seen with grey-headed albatross in the period 2002-2004. There was a large rise in occurrence of gear in grey-head nests in 2001 and 2002. This may have been due to the IUU fishing that appears to have been taking place around South Georgia in 1999 and 2000. According to the tracking data, these animals are unlikely to be picking up hooks anywhere else. It would seem strange that the peak in abundance would have been two years after this date, but this may be because they are biannual breeders. The very sharp return to low levels in 2004 is probably a response to the joint measures of eliminating IUU (in 2001) and eliminating hook/line discarding in offal (since 2002). The greatest single response is with wandering albatross. A more detailed breakdown of the data reveals a decline of both hooks and hooks with lines found around nests since 2000/2001. Once again, these reductions are probably attributable to two actions, elimination of IUU in the early 2000s and elimination of hook/line discarding in offal since 2002. Despite this there are still relatively large numbers of nests with fishing gear in them. This may be because of occasional discards of hooks in the legal fishery (we have mentioned that compliance is good but not perfect) but it would also be natural to expect that wandering albatross are picking up gear and hooks from the demersal longline fisheries on the Patagonian shelf during their breeding period, and bringing them back to the nest. They may also be picking them up from mid-ocean tuna vessels, but this is probably not as important a source of hooks as the Patagonian shelf fisheries. We feel that significant progress has been made in reducing the number of hooks discharged into the sea in the South Georgia longline fishery and that this is leading to demonstrated positive environmental results. We intend to continue to monitor this in the future and keep up the pressure for better performance in the fishery.
Observations	It would appear that the level of hook discards in the South Georgia fishery has been greatly reduced, now that that a CCAMLR regulation is in force. This must have gone a long way to reducing the problem of seabirds swallowing hooks. However, it was noted that the methods employed by different vessels varied and that the Condition of Certification requested that "an estimate should be provided, for each vessel, of hooks discarded…". This is not given, nor is a reason for its absence mentioned. The most that can be deduced is that in 2002, as a worst case, 14.7% of discarded fish heads contained hooks, but now the discard of hooks is "rare". It would be helpful to have at least a "ball park" estimate of the current level, presumed to be much less than 14.7%. It would also be useful to know the level of variation between vessels. Useful information is given on the changes over time in the incidence of hooks found annually on Bird Island, South Georgia, in association with breeding albatrosses. Discussion is given on the providence of Bird Island hooks, pointing out (correctly) that they may not necessarily come from the South Georgia fishery. However, no information is given to prove this assertion. Longline hooks used for toothfish and for tuna are readily distinguishable (e.g. Cooper, J.M. 1995. Fishing hooks associated with albatrosses at Bird Island, South Georgia, 1992/93. *Marine Ornithology* 23(1): 17-21). Further, it may be possible to distinguish hooks from different toothfish fisheries and/or vessels, since there are recognizable differences in hook design and attachment methods (see also Cooper 1995, and subsequent CCAMLR papers on the subject).
Conclusion	The fact that monitoring and appropriate conservation measures have been put in place before

	the timescale required by this condition is seen as a very positive measure and is to be commended. Estimates of hook discarding have previously been provided from GSGSSI and led to the original implementation of the Conservation Measure 25-02. Ongoing compliance with the conservation measure is monitored by observers, but the precise level of ongoing hook discard is not quantified. Going forward, further information should therefore be collected on: a) estimates of hooks discarded by each vessel (preferably as a % of discarded heads containing hooks) by season (within time allocations for the work which take account of other observer requirements) b) the mechanism employed on the vessel to prevent discarding of hooks in fish heads This information could then be used to evaluate the degree of ongoing compliance and the effectiveness of different hook retrieval mechanisms. This would then be evaluated during future surveillance audits. To further demonstrate the effectiveness of the conservation measures, the GSGSSI may also wish to consider an analysis of hooks recorded at Bird Island over time in terms of type and assumed fishery (at least a pelagic (tuna) against a demersal (toothfish) split).

10	Condition of Certification 9: Research into the ecosystem relations of toothfish
Activity assessed	To direct specific research into the ecosystem relations of toothfish. This condition may be regarded as a sub-section of Recommendation 4. As stated in Recommendation 4, the assessment team recognise that resource requirements to implement a full ecosystem model would be high and the other conditions outlined here are of much greater significance for the fishery. This research should therefore specifically include, but not be limited to, identification of predators of toothfish at various life stages and prey of toothfish prior to recruitment into the fishery. This research should be carried out with development of a quantitative ecosystem model in mind, although production of such a model is not part of this condition at this time. **Timescale**: A research programme should be developed and implementation begun within 12 months of certification
GSGSSI Progress Report	As part of developing a broader understanding of toothfish within the ecosystem around South Georgia, the identification of the predators at various life-history stages and prey of toothfish prior to recruitment has been ongoing. From studies undertaken at South Georgia and Shag Rocks in 2004 the diet of pre-recruit toothfish (200-800 mm TL) is dominated by fish (97% by weight), with the yellow fin notothen (*Patagonotothen guntheri*) the principal prey at Shag Rocks, where the largest aggregations of pre-recruits are usually caught (Collins et al. 2004). Potential predators of adult toothfish include elephant seals, Southern bottle-nosed whales, sleeper sharks, sperm whales and killer whales, but diet data are difficult to obtain from these species. Sperm whales and killer whales have been reported taking toothfish from long-lines (Ashford et al. 1996), but it is thought that only sperm whales have the potential to dive deep enough to predate on the adult toothfish directly. MRAG has been conducting research into the consequences of this depredation, both in terms of the effects it has on the fishing industry and the effects it has on the predators themselves. By examining catch and observer data it has been possible to get some idea of the quantity of fish taken and the main areas where it is happening (Purves *et al*. 2004), this can influence the fishing strategy of the vessels and may have important repercussions in future stock assessments. A proposal has also been put forward by MRAG to obtain funding for a more detailed study into the behavior of the whales around South Georgia. Little is currently known about their movements, either during the season around the vessels or where they go to out of season. It is hoped that by attaching satellite locator tags to whales it will be possible to determine how the fishing industry has influenced their behaviour and gain a greater understanding of their role in the ecosystem as a whole. Elephant seals have also been reported to take toothfish (Reid and Nevitt 1998), but this has not been quantified. Pre-recruit toothfish, which occur at shallower depths than the adults, are potentially within the foraging range of penguins and fur seals, but toothfish remains have not been found in the diets of fur seals, gentoo or macaroni penguins that have been studied at Bird Island, South Georgia in the last 15 years (Keith Reid pers comm.).
Observations	The work on prey of toothfish prior to recruitment is progressing satisfactorily. Sample sizes are not all that large, but the consistency of diet suggests that we aren't dealing with one of those North Sea –like situations where we need tens of thousands of stomachs to get a fair representation of the diversity of diet of some of the predators. The proponents should be encouraged to sample stomachs widely in the area, because given the observation that the large majority of stomachs had only a single prey type, there is a possibility that pre-recruit toothfish are actually generalist and opportunistic foragers, and the apparent consistency arises because prey aggregate and one type of prey dominates a given area and time. Whether that turns out to be the case or not, the approach taken is addressing effectively the part of the Condition of Certification regarding increasing knowledge of prey of toothfish prior to recruitment. The work on identification of *predators* of toothfish at various life stages does not seem to be moving very quickly. The publications cited are nearly all from prior to certification, and

	present work from even earlier. Work with groundfish (particularly cod) in the Northwest Atlantic, has demonstrated the challenges of determining and even coarsely quantifying the predation on various life stages of a marine fish. All the more reason why a more complete plan for increasing information on predators is needed. The work on whales may help increase information on predators of large toothfish, and the arguments why whales may be the only important predator on toothfish is plausible. Predation on smaller toothfish may be more important biologically, and there are a larger number of potential sources of predation. More attention to cost-effective options to increase information on predators on smaller toothfish is warranted. For example, it would seem worthwhile to do something more systematic than rely on a "pers. comm." for information on whether penguins and other seabirds feed on small toothfish.
Conclusion	Although a research 'plan' has not been presented, substantive research is underway, particularly in the prey of toothfish but also into other areas of toothfish ecosystem relationships. Much of this is quantitative and so could lend itself to future ecosystem modelling. The intent of the condition is therefore considered to have been met. Areas requiring further attention are clear, however, and an ongoing plan to continue to fill data gaps should be developed prior to the next MSC certification surveillance report. Of course, this could refer to research undertaken elsewhere as appropriate.

11	**Condition of Certification 10: Determination of significant interactions with benthic habitat.**
Activity assessed	The potential for longline fishing activity to significantly impact upon benthic habitats is generally regarded as being low. However, research should be directed at locating areas of complex benthic habitat, particularly biogenic features, within the areas exploited by fishers. This may be addressed through observer recording of evidence of biogenic features through retrieval in long-lines. If such areas are found, efforts to protect these from gear impacts, including those associated with long-lines should be considered and results documented. **Timescale**: Collection of suitable information takes place at present and should be continued. Initial mapping of fishing activities and areas of complex benthic habitat should be carried out within three years following certification (or earlier if sufficient information is collected) and further developed thereafter as more information is collected.
GSGSSI Progress Report	During 2004, research has been initiated to investigate the impact of longline fishing activity on benthic habitats. One of the first steps has been to generate a much higher resolution bathymetric dataset for South Georgia than has hitherto been available. Existing UK Hydrographic Office and IHO/NOAA GEBCO data were supplemented by finer scale echosounder data obtained from numerous commercial fishing and research vessels operating within the South Georgia region. Swath bathymetry data, collected from the British Antarctic Survey's research vessel RRS James Clark Ross were also available from several cruises at South Georgia. Although to date the coverage of the multibeam swath surveys at South Georgia has been limited, the resolution of the bathymetric data from this source is extremely high. With coverage increasing every year we expect to be able to add to the dataset in future years. From 2001 our observers on the fishing vessels have been recording data on benthos. Among other things they record any macrofauna that are brought up by counting the number of hooks with any benthos on. This gives some idea of species abundance and is a more useful indicator than weight as much of the benthos is damaged during the haul with only a small part of it reaching the surface. The benthos was grouped into 6 different phyla which typically characterise deep water habitats, namely Crustacea, Echinodermata, Cnidaria, Mollusca, Porifera and Tunicata. A preliminary exploration of the diversity of the South Georgia benthic fauna was expressed using the Shannon diversity index (H) and measure of equitability (E_H) (Zar, 1999). These measures attempt to account for both the abundance and evenness of the species groups present and assume that they are all equally vulnerable to the gear. Both general additive models (GAM) and generalised linear models (GLM) were developed using Splus to describe the relationship between biological characteristics and bathymetric features (e.g. underwater canyons). Due to the importance of monitoring hard and soft deepwater corals (Cnideria) and sponges (Porifera), the relative abundance of these species groups have been investigated in more detail. The results indicate that the presence of the deepwater canyons has no significant effect on the benthic fauna, both in terms of overall diversity and the actual abundance of Cnideria and Porifera. Preliminary results do suggest, however, that both abundance and diversity of these two groups may vary with depth, and be different between larger regions within the South Georgia maritime zone. The results have identified a number of important requirements for future work: • The above analysis was only able to use data up to and including the 2003 fishing season. Up to this point the location of the benthos could only be determined as the mid-point of the line, which, considering the length of the line, may not be a true representation of its location. In 2004 and 2005 the resolution of these data was

	increased, firstly by recording the specific GPS position during periods of observing the line and secondly by the production of detailed identification sheets. In future therefore it should be possible to map the distribution of benthos, especially cnidarians and sponges, with much greater accuracy. We are planning such an analysis for later in 2005. • High resolution swath bathymetric data is currently available for only a limited number of areas of the South Georgia slope and shelf as the majority of swath surveys have been carried out in water depths > 2000 m. Areas of overlap with the commercial longline toothfish fishery are currently restricted to a few regions to the South and South East of South Georgia and a small region to the north west of Shag Rocks. However it is intended to continue the collection of swath bathymetry data from the zones in which the fishery operates. This will greatly improve our knowledge of habitat preference of the benthic invertebrate by-catch in the toothfish longline fishery. • An obvious sequel to this work will be to identify areas where highly sensitive sessile benthos is likely to be most abundant, and where it might be receiving the highest impact from longlines. Quantification of potential impact should be more feasible when higher resolution data are available. These analyses are likely to be possible in 2006 or 2007, and advice provided to management as appropriate.
Observations	It is noted that there has been reasonable progress on this condition already and areas requiring further attention have been identified. Knowledge of the locations of fishing activities is high, and being consolidated well with appropriate spatial analysis tools. It is important that the current level of knowledge of positions of fishing activities be maintained. However, there is good reason to expect the surveillance of fishing activities will remain high for direct fisheries management purposes, with an ancillary benefit of knowing the areas where benthic habitat features and benthic communities may be being impacted by the fishing gears. Progress appears much slower on determining where sensitive habitat features are located. The swatch technology recently being used in the area will provide near state-of-the-art knowledge of bottom topography, but there are two problems still. One is that the swath technology will take a lot of time and/or money to map the entire EEZ, and only a restricted part of the sea floor is being mapped annually. The documentation provided states that greater priority will be given in the coming years to ensuring that when the areas to be mapped are selected, priority will be given to areas where the fleet operates. This is an appropriate response to the Condition of Certification, but should be accompanied by a multi-year plan for where swath – and possibly other technologies – will operate. This would be particularly important if the fleet appears to be gradually moving the preferred fishing grounds. In that case it would be important for the mapping to be ahead of the movement of the fleet – to the extent that the changes in fleet fishing practices can be predicted from past fleet operations. The second problem with the current status is that bottom mapping, whether with swath or other technologies, gives the bathymetry accurately, but actually may not detect many biotic benthic features of relevance to this Condition. The proponents are being creative and opportunistic in trying to learn as much as possible from bycatches in the fishing operations, trawl surveys, etc. The wording of the Condition even acknowledges that it would be expensive and probably not justified to mount some major project for quantifying the benthos in the EEZ. Nonetheless, a clearer plan for how detection of sensitive biogenetic habitat features (corals, sponges, etc) will be linked to the much more precise bathymetry data as the latter come available would be welcome. For example, it is clear that the utmost care needs to be taken in interpreting quantitatively the relative abundance of taxonomic groups of benthic fauna based on materials brought up on hooks, without any information given on "hookability". It may be that there is information on "hookability" from other fisheries that might be used. Also, it is not clear on the degree of taxonomic identification applied or whether voucher specimens are returned to port for further study or are being sent to experts for more specific identification. The Condition of Certification notes that it might take as much as three years for even an initial mapping of habitat features, and "initial mapping" of the benthos defined in the Condition. Nonetheless, something more than opportunism would appear to be needed for evaluators to

	conclude that we have anything like an “initial map” of the benthos, to contrast with our data-rich maps on distribution of fishing activities.
Conclusion	GSGSSI are progressing well with achieving the requirements of this condition over the required timescale. The comments above may prove useful in furthering achievement. This condition will be subject to further surveillance and will be reported particularly in the next two audit reports.

15	**Any complaints against the certified operation; recorded, reviewed and actioned**
	No records of complaints in relation to the fishery management system are provided.
16	**Any relevant changes to legislation or management regime.**
	It is noted that GSGSSI have greatly increased transparency in licensing operations, including consultative meetings with industry on licensing procedures. As part of this, GSGSSI are also now monitoring the CCAMLR website for information on possible IUU activity by applicants. At the time of writing, licensing for the 2005/06 season had been completed and eight vessels had been licensed. As noted in Section 1 above, GSGSSI have already implemented a system of verifying total landings by licensed vessels – involving the unloading and independent weighing of all toothfish.
17	**Overall Conclusions**
	The overall management of the fishery through CCAMLR and the GSGSSI continues to at least the level as during the main assessment. Issues with stock assessment have been recognised and are being addressed in a precautionary manner. Mechanisms have been established to provide information to allow tracking of fish, necessary for toothfish product to enter into future Chain of Custody assessment and so to carry the MSC logo. These also further control the catches of toothfish to strengthen compliance by licensed vessels. GSGSSI have taken appropriate measures to address the conditions of certification raised during the MSC certification assessment. Some comments have been made by the assessment team to assist in further development of measures, as relevant. MSC Certification should therefore continue and surveillance audits continue to the same schedule.

Information Sources:

Meetings

1. GSGSSI
2. Industry Representatives
3. Falklands Conservation
4. MRAG
5. MRAG

Reports etc

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5. BirdLife International (2004). Tracking ocean wanderers: the global distribution of albatrosses and petrels. Results from the Global Procellariiform Tracking Workshop, 1–5 September, 2003, Gordon's Bay, South Africa. Cambridge, UK: BirdLife International.
6. CCAMLR e-cc-xxii. Assessing the compliance of fishing vessels with conservation measures. Delegation of the European Community, 2003
7. CCAMLR e-ccxxiii CCAMLR report
8. CCAMLR sc-xxii Fish stock assessment agenda item 5
9. CCAMLR sc-xxii Fish stock assessment figures/tables
10. CCAMLR sc-xxii. Tables 3.2, 3.3.
11. CCAMLR sc-xxiii Scientific Committee report
12. CCAMLR sc-xxiii. 2004 Fish stock assessment text
13. CCAMLR XXIII - Assessing compliance 2004. EC draft that was eventually not tabled at the 2004 meeting of CCAMLR. UK letter and the CCAMLR response
14. D.J. Agnew and G.P. Kirkwood (United Kingdom). Assessment of the status of the toothfish stock in Subarea 48.3
15. D.J. Agnew, J. Pearce and M. Endicott 2003. Bycatch of rays in the 2002/03 toothfish fishery around South Georgia. WG-FSA-03/58.
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17. GSGSSI Benthos ID sheets used by observers
18. GSGSSI Definition of new management areas
19. GSGSSI Fisheries licensing policy statement
20. GSGSSI General licence conditions for SG fisheries
21. GSGSSI Licence application form
22. GSGSSI Licence application information
23. GSGSSI Management plan
24. GSGSSI Toothfish licensing document 2005
25. GSGSSI Vessel registration form
26. M. Endicott and D.J. Agnew 2003. The survivorship of rays discarded from the South Georgia longline fishery. WG-FSA-03/57.
27. M. Endicott, L.J.V. Compagno and D.J. Agnew, 2002. Identification of Amblyraja species in the longline fishery in Subarea 48.3. WG-FSA-02/54
28. P.W. Shaw, A.I. Arkhipkin and H. Al-Khairulla (United Kingdom). Genetic structuring of Patagonian toothfish populations in the Southwest Atlantic Ocean: the effect of the Antarctic Polar Front and deep-water troughs as barriers to genetic exchange (*Molecular Ecology* (2004) (in press))
29. Observer Report, J Roe (UK), vessel Ibsa Quinto. 23/8/04

30. Wakeford R.C., Belchier, M. and Morris, P. (2004). A preliminary analysis of longline fishing activity related to the bathymetry around South Georgia. ICES CM 2004/T:07. 15pp.
31. Wakeford R.C., Clark J.M., Belchier M., Morris, P. and D.J. Agnew (2004). Mapping deep-water benthic habitats around South Georgia. ICES CM 2004/T:016 (poster).

Guidelines used:

1. MSC Principles and Criteria for Sustainable Fishing
2. MSC Fishery Certification Methodology Version 5