Mr. Michael Lodge
Independent Adjudicator
c/o Marine Stewardship Council
3rd Floor Mountbarrow House
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London SW1W 9RB

12 January 2010

Sent by electronic mail to: toothfishobjection@msc.org

Dear Mr. Lodge:

We are a group of marine scientists who have conducted foodweb related ecological research both in the Ross Sea and elsewhere. Some of us have been working among sites in the Southern Ocean for over 40 years, and our research subjects include Antarctic toothfish (*Dissostichus mawsoni*). Unofficially, we call ourselves FORSE, Friends of the Ross Sea Ecosystem, and often have conflicting opinions among ourselves on certain ecological questions, i.e. the norm of healthy science. However, we have no conflict endorsing the Objection that ASOC lodged against the proposed certification of the Ross Sea Toothfish Longline Fishery.

During the information acquisition phase of this certification process, FORSE did collectively submit written comments to Moody Marine (MM; letters 7 March 2008, 25 August 2009), and also participated first person, as “Penguin Science”, during a meeting with MM in Wellington in April 2008. Several of us submitted independent comments to this certification as well by the August 2009 deadline.

We feel that ASOC’s objection is well founded on good scientific principles. It is our considered opinion that the Ross Sea toothfish fishery is not sustainable as currently managed but more importantly can not be certified by MSC as such, particularly considering the ideals upon which MSC was founded and the paucity of life history data and lack of verifiable stock assessment or monitoring of the target species in this fishery. What is known identifies Antarctic toothfish as perhaps the most vulnerable of all: large, long-lived, late maturing and slow growing beyond the juvenile stage. Certification of this fishery is a clear departure from the methods of previous MSC certifications, as highlighted herein.

We are dismayed that MM in preparing its final assessment largely dismissed important comments from its peer reviewers to specific guidepost scores (see ASOC Objection), as well as ignoring our own expert review and comments. MSC/MM seemingly is hiding behind the concepts of “uncertainty” and “precautionary” as normally applied to modeling and management, respectively, as if these can be applied with equal weight to whether a fishery is sustainable or whether it harms a stock or its ecosystem and regardless of the fishery or region involved. This Ross Sea toothfish fishery has begun to operate in an ecosystem that has never known large-scale, commercial fishing of any kind before (with the

exception of whaling during the 1920s and again in the 1970-80s), unlike those of Europe and the North Atlantic, which have been fished for hundreds of years and are the forte of MSC. For example, by-catch and harm to the benthos from the Ross Sea toothfish fishery are affecting ecological communities 1000s of years old, unlike fisheries of Europe where benthic communities have been scraped clean by bottom trawlers for many decades prior to this more recent age of "precaution". Thus, the concepts of "precaution" and "uncertainty" are not equivalent for the Ross Sea and, say, the North, Norwegian or Baltic seas: existing certification schemes seem inadequate to assess a fishery in the Ross Sea, at least as they have been applied here.

Like the peer reviewers, we question the sources of information MM used in reaching conclusions to determine scores for many of the Indicators and Guideposts sections of the assessment. We endorse ASOC's comments[1], as well as those of the peer reviewers, mostly ignored, but who in our opinion are well versed in the workings of CCAMLR in general, and its deliberations over this Ross Sea toothfish fishery specifically.

This fishery, if treated as others summarized in the MSC Net Benefits report, should have failed to achieve passing scores in many Guideposts. In our opinion, MM has spent insufficient effort in assessing this fishery's sustainability independent of the industry and its promoting governments. We direct your attention to the appending tables, which we have assembled by reading through the Net Benefits report and then going to the certification documents for the individual fisheries. While you might quibble with a few insertions in the table, the overall pattern of the information available for the Ross Sea toothfish, the fishery take, and the ecosystem effects of the fishery, as well as the means by which critical information might be gathered on the fish stock itself, is starkly absent compared to most other MSC certified fisheries.

Central to management and to MSC's certification is the degree to which a stock can be quantified and the effect of the harvest monitored. On the basis of MM comments in the certification document, we strongly believe that the persons involved have little understanding of how pre-fished biomass of a fish stock could be ascertained and then monitored by a well-known-to-be-problematic mark-recapture program, which is the case of the Ross Sea, especially with virtually no other supporting information. As Table 2 notes, management of other fisheries certified by MSC involve detailed assessment protocols based on acoustics and/or direct biotic sampling, i.e., a program, usually rigorous, of experimental catches or samples by an agency independent of the fishery. Essentially, what would be involved to derive pre-fished biomass with respect to the Ross Sea

[1] The one exception is the statement by ASOC on pg 27 of their objection in regard to PI 1.1.2.3. The substance of the statement is entirely true, but the average and median age of the fish caught in the fishery to date has been 15-16 years, with 6 years being the standard deviation around the mean age for most of the years.

fishery would be nothing more than adding up the total annual reported takes over the life of the fishery, including some guess as to illegal catch. Annual monitoring in this case is a complete guess, as acknowledged by CCAMLR scientists (and well known by MM peer reviewers) but somehow pardoned by MM as "precautionary" because 3500 tonnes per year doesn't sound like much compared to some other fisheries. On the other hand, few if any other fisheries are dealing with a major predator in a 'virgin' polar ecosystem, which is therefore simplified and slow-responding. It's simplified structure means that perturbations to any component ripple widely through the foodweb.

To put this another way, all that tagging promises to do, at best, apart from giving a little non-quantitative information about movement (of small, subadult fish — not the preferred target of the fishery, by the way; see comments in ASOC objection), is provide an estimate of the fished stock size, in numbers, once fishing has gone on for a long time. If that works, one can insert the sizes of fishes in catches to get a "biomass" estimate. Then, if managers are prepared to make some assumptions based on experience with other fishes, and maybe indications of mortality and growth rate from catch age compositions, a modeled guess can be made of what proportion of that might give a sort of sustainable yield. This is totally invalid in the case of the Ross Sea toothfish, i.e. making learned assumptions, as indicated by the recent, radical revision of age at maturity from 8-10 to 16 years, a further indication of the evolving science of this fish; see ASOC comments.

If you have data for sizes of all past catches (which is not possible in this case) you might get an approximate idea of whether the stock could now be much less than its original size before fishing began in earnest. Of course, a "model" can give you an answer, but it is unverifiable. A true estimate of stock change is not possible given that the current Ross Sea stock was very quickly "juvenalized", i.e. no longer many old fish as of just a few years of fishing; see ASOC comments and CCAMLR reports.

So, everything goes back to the questionable tagging estimates if there have been no valid direct surveys, which have their own problems and which do not exist in the Ross Sea fishery, and if there is no long history of CPUE or something to indicate depletion rates. We all know in which way the latter are generally biased – one can often get a "good" answer even as the stock collapses toward economic extinction!

Every fisheries scientist knows or should know the pitfalls in tag estimates - sample size, bias, tag loss by fish and fishermen, etc. From MM's account, which ultimately comes from CCAMLR, it is obvious that the tag results so far are totally useless for the intended purpose. CCAMLR scientists know this and have written caveats into their FSA reports, although CCAMLR's Commission, as a political body, can be selective on the scientific advice assimilated into decisions. MM has taken the easy route - on the assumption that the CCAMLR consensus

is okay because participating scientists are well-intentioned and some of them are highly competent. That is obviously a very dangerous route for an independent certifying agency, which MSC is supposed to be.

With a minimal amount of checking, the MSC will easily ascertain that the CCAMLR FSA working group and Scientific Committee are not unanimous, in the slightest, when it comes to the adequacy of the tag-recapture effort to assess or monitor this fishery. Given the weakness and inadequacy of even the tag-recapture program, as pointed out in the ASOC comments (and above), which come directly from the statements of CCAMLR scientists in FSA reports and SC meeting minutes, MSC should not be arguing for certification but rather a moratorium on further Ross Sea fishing until the critical information is available to properly manage this fishery. Then the clients could come forward and apply for certification, just as MSC's European clients have done in the case of their respective fisheries.

Last, the Conditions suggested by MM to be applied to the portion of the Ross Sea toothfish fishery being considered, thus to approve initial certification, have mainly to do with obtaining critical life history and ecosystem information. As experienced marine scientists, we know first hand what is involved in high-seas marine research, especially in the Southern Ocean. In this context, we know that the Conditions MM has proposed for its client companies are mere dreaming, with little likelihood that they will be achieved in a meaningful way. Appended to this letter are our comments about each Condition, with points based on our Southern Ocean research experience. We can state unequivocally that without a research budget of several million dollars per annum, the conditions imposed here cannot usefully be met and certainly not within the certification period of this fishery.

In our opinion, it would be a disgrace for the MSC to participate in misleading the public by certifying this fishery, even temporarily, based on such Conditions.

Sincerely,

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Table 1. Comparison of fisheries listed in the MSC Net Benefits report. Y = yes, N = no; scores outside the performance of most other fisheries included in the table highlighted in red type.

	Biomass Assessment	Biomass Monitoring	Age/Sex Selectivity	Life-history Known	Limited Entry	Significant Bycatch, Including fish*	Habitat Destruction*
Western Australia Rock Lobster	Y	Y	Y	Y	Y	N	N
Thames Blackwater Herring	Y	Y	Y	Y	Y	N	N
Alaska Salmon	Y	Y	Y	Y	Y	N	N
New Zealand Hoki	Y	Y	**N**	**N**	Y	**Y**	**Y**
Bury Inlet Cockles	Y	Y	Y	Y	Y	N	N
SW Handline Mackerel	Y	Y	Y	Y	Y	N	N
LC Nephrops Creel	Y	Y	Y	Y	Y	N	N
SG Patagonian Toothfish[1]	Y	Y	Y	Y	Y	"N"	**Y**
SA Hake Trawl	Y	Y	Y	Y	Y	**Y**	**Y**
Baja Red Rock Lobster	Y	Y	Y	Y	Y	N	N
Bering Pollock	Y	Y	Y	Y	**N**	N	N
Hastings DoverSole	Y	Y	Y	Y	Y	N	N
BSAI Alaska Cod	Y	Y	**N**	Y	N	**Y**	**Y**
Australia Mackerel Icefish	Y	Y	Y	Y	Y	**Y**	**Y**
US N Pacific Halibut	Y	Y	Y	Y	Y	N	N
AFSN Herring	Y	Y	Y	Y	Y	N	N
US N Pacific Sablefish	Y	Y	Y	Y	Y	**Y**	N
Hjalmaren Pikeperch	Y	Y	Y	Y	Y	N	N

Patagonian Scallop	Y	Y	Y	Y	Y	N	N
AAFA Albacore[2]	"Y"	"Y"	Y	Y	Y	N	N
NEFSC Sea Bass	Y	Y	Y	Y	Y	N	N
Oregon Pink Shrimp	Y	**N**	Y	Y	Y	N	**Y**
AF North Sea Herring	Y	Y	Y	Y	Y	N	N
Lakes & Coorong S Aust[4]	"Y"	"Y"	Y	Y	Y	N	N
Norway Saithe	Y	Y	Y	Y	**N**	**Y**	**Y**
SPSG North Sea Herring	Y	Y	Y	Y	Y	N	N
Canada No. Prawn	Y	Y	Y	Y	**N**	N	**Y**
KDSFF Flounder & Snow Crab[3]	"Y"	Y	**N**	Y	Y	**Y**	N
St Lawrence Shrimp	Y	Y	Y	Y	**N**	N	**Y**
Germany NS Saithe	Y	Y	Y	Y	**N**	**Y**	**Y**
SPSG Western Mackerel	Y	Y	Y	Y		N	N
Domstein Arctic Cod & Haddock	Y	Y	Y	Y	**N**	**Y**	**Y**
Ross Sea Toothfish	**N**	**N**	**N**	**N**	**N**	**Y**	**Y**

* As deduced from Conditions placed on certification

1. Significant bycatch of skates and macrourids; CCAMLR's 'move on' rule applied, but efficacy of this rule has not been studied.
2. While this hook-and-line fishery is low impact, the stock is heavily impacted by other interests to the point of being deemed "fully exploited" and perhaps "over exploited'.
3. Recovering from historic over-fishing.
4. Several species in the fishery; not much money or resources for assessment, but fishery very small with 'primitive' methods.

Table 2. Additional comparison of fisheries listed in the MSC Net Benefits report.

	Year	No. pages in which natural history, history of the fishery, stock assessment discussed, 2008-2009	Tonnage	Biomass Assessment	Number Conditions*	Conditions Met
Western Australia Rock Lobster	2000 2006		10.5	Biotic sampling	17	Not yet
Thames Blackwater Herring	2000, 2005		2	Acoustic	1	Yes
Alaska Salmon	2000 2007		287,000	Acoustic, aerial	0	
New Zealand Hoki	2001 2007		90,000	Biotic sampling	24	Partially
Bury Inlet Cockles	2001 2007		960	Biotic sampling	1	Yes
SW Handline Mackerel	2001 2007		1,700	Biotic, acoustic	1	Not yet?
LC Nephrops Creel	2003 2008		120	Biotic sampling	1	Yes
SG Patagonian Toothfish[1]	2004 2009		3,500	Biotic sampling	10, 0	Stock decreasing?
SA Hake Trawl	2004		120,000	Acoustic	7	Partially
Baja Red Rock Lobster	2004 2009		1,200	Biotic sampling	1	Yes
Bering Pollock	2005 2009		50,000	Acoustic	23+	Not yet
Hastings Dover Sole, Herring, Mackerel	2005		137 10 10	Acoustic Biotic sampling	5	Partially
BSAI Alaska Cod	2006		103,000	Acoustic	4	Not yet
Australia Mackerel Icefish	2006		1,000	Biotic sampling	21	Not yet
US N Pacific Halibut	2006		24,000	Biotic sampling	1	Yes
AFNS Herring	2006		65,000	Acoustic	1	Yes
US N Pacific Sablefish	2006		18,100	Biotic sampling	2	Partially
Hjalmaren Pikeperch	2006		166	Biotic sampling	0	

Patagonian Scallop	2006		45,000	Biotic sampling	4	Not yet
AAFA Albacore	2007		10,000	Artisinal in a sea of industry	0	
NEFSC Sea Bass	2007		7	Biotic sampling	2	Yes
Oregon Pink Shrimp	2007		11,600	Biotic sampling	4	Yes
AF North Sea Herring	2008	2, 2, 4	5	Acoustic	7	Yes
Lakes & Coorong S Aust[4]	2008		100-600	Biotic sampling	2	
Norway Saithe	2008	1.5, 2, 7	296,000	Biotic sampling Acoustic	6	Partially
SPSG North Sea Herring	2008	2.5, 3, 6	15,000	Acoustic	5	Partially
Canada No. Prawn	2008	2, 2, 2	68,000	Acoustic	5	Partially
KDSFF Flounder & Snow Crab	2008	2.5, 2, 3.5	98 220	Biotic sampling	4	Yes
St Lawrence Shrimp	2009	2, 2, 2	28,800	Acoustic	1	Not yet
Germany NS Saithe	2008	1, 2, 4	9,700	Acoustic, biotic sampling	3	Not yet
SPSG Western Mackerel	2009	2, 3, 5	140,000	Acoustic, biotic sampling	5	Not yet
Domstein Arctic Cod & Haddock	2009	1, 2, 4	5,000	Acoustic	6	Not yet
DPD A-S Herring	2009	2, 4, 5	31,000	Acoustic	0	
DPD NE Atlantic mackerel	2009	2, 2, 4	24,000	Acoustic, biotic sampling	0	
DPD North Sea Herring	2009	2.5, 2.5, 3	47,200	Acoustic	2	Not yet
Ross Sea Toothfish	**2009**	**0.5, 0.5, 2.5**	**3,500**	**None (tag-recapture)**	**6**	**Not yet**

* Affected to some degree by the format used by the consulting firm completing the certification.

1 Shust, K.V. and Kozlov A.N. (2006). Changes in size composition of the catches of toothfish *Dissostichus eleginoides* as a result of longterm long-line fishing in the region of South Georgia and Shag Rocks. *Journal of Ichthyology* 46(9): 752–758.

COMMENTS ON MSC CONDITIONS PLACED ON THIS FISHERY CERTIFICATION

As ASOC did not direct their comments specifically toward the research specified to meet the Conditions of Certification, we would like to do so here. First, however, we ask who will determine whether the specified research plans or results are satisfactory, and monitor compliance with recommended measures. Would this be MSC, MM, CCAMLR, or an outside scientific peer reviewer? That this question is not answered in the Certification Report suggests that the imposition of conditions on this particular fishery has not been well thought out. We note that CCAMLR recently rejected the New Zealand proposal for a commercial toothfish fishing vessel to look for toothfish eggs and larvae by towing a continuous plankton recorder through presumably ice-covered winter seas, and to fund the cruise from the sale of the toothfish caught on the "expedition". We therefore suggest that a "plan" such as that one, when it is merely just a proposed idea, should not be given credence by MSC for certification purposes.

Below is our assessment of the research effort required to meet MSC Conditions for Certification of the Ross Sea toothfish longline fishery. The text in boxes comes from the certification document. We also provide a rough cost estimate for carrying out such research, emphasizing the lack of reality in specifying a given Condition.

Condition 1. Knowledge of biology and ecology of the target stock.
Action required: There is a lack of adequate knowledge on the life history and population characteristics of the target stock. Whilst there is information adequate to achieve a conditional pass against the MSC standard, the lack of knowledge increases uncertainty in the status of the population and so the effects of the fishery. An appropriate research plan to test the life-history hypothesis (including older fish) should be developed and implemented so as to provide key information.
Timescale: An outline research plan should be available by the first annual audit. Implementation of the research programme should be begun by the third annual audit and results to reduce key uncertainties available within the lifetime of the current certificate.

Presumably, what is meant here is to test the Hanchet et al. (2008) hypothetical life history of the juvenalised population (large fish no longer found, especially over the shelf) as affected by circulation of the Ross Gyre etc. First of all, neither eggs nor larvae of this species have been obtained but on the basis of finding spent fish it has been deemed that the species spawns during winter over the sea mounts to the north (of course, the Ross Shelf slope, which is the bread-basket of the fishery, is covered by sea ice at that time of fishing); among many of the life history aspects that are not known is how often a particular fish spawns, knowledge especially critical to managing this species.

Therefore, the first order of business would be to determine where the species spawns, including whether it's at the surface or the bottom, ostensibly by a series of trawls or longlines deployed during winter in the vicinity of the northern sea mounts and the shelf break (both life history strategies left possible by Hanchet

et al. 2008). Required would be an icebreaker with capabilities of conducting this sampling at a series of depths. Secondly, the frequency of spawning of individual fish, by age/size class, might be ascertained by a mark-recapture program spanning at least 10 years, targeting post-spawned fish also injected with tetracycline and including repeated, annual sampling in the vicinity of spawning sites (determined as above),. Some sort of x-ray tomography could assess the egg mass of females prior to being released to determine fecundity relative to fish size. Cost for research vessel, and series of cruises: about $2M+ per annum (probably more)? Note: the US research icebreaker, *R/V Nathaniel B. Palmer*, which has demonstrated capability of conducting these trawls, costs about US$24M to operate for a year, not including the science on board.

Condition 2. Improved stock assessment through wider tagging programme
Action required: Tagging appears the only appropriate strategy to obtain an abundance index on the stock. Currently, the tagging programme is considered appropriate to the management of the fishery, but relies on NZ vessels to provide data in which managers and scientists have sufficient confidence. It is understood that UK vessels tagging data is to be used in the near future. To improve the quality of the tagging programme, any vessels joining the Unit of Certification should be verifiably undertaking tagging at a level sufficient to be used in the stock assessment, or other appropriate amendments to the stock assessment should be undertaken. To reduce uncertainty in the stock assessment, companies within the MSC certified group should liaise with stock assessment scientists to maximise the efficiency of the tagging programme.
Companies should also promote, within CCAMLR, the compliance with requirements of the tagging programme among the whole fleet.
Timescale: Full cooperation with the tagging programme by vessels within the unit of certification should be demonstrated by the time of the first annual audit post joining the MSC certified group. Liaison with stock assessment scientists should be carried out by first surveillance audit and implemented within the next season, or other appropriate revisions to stock assessment undertaken over the same timescales.
Promotion, through CCAMLR, of active participation in the tagging programme throughout the fleet should be undertaken by first surveillance audit.

We question the source of the opinion about tagging being the only way to get an abundance index (please see the main body of our letter where we discuss the weaknesses of this strategy). Our main question here: Why is it that the South Georgia Patagonian toothfish fishery and the fishery for toothfish at Heard Island use research fishing in the assessment process and not tag-recapture? And, why can research fishing not be done in the case of the Ross Sea fishery? Yes, this would require a dedicated research vessel. Final question, why hasn't CCAMLR instituted a tag-recapture program alongside the research fishing at Heard Island or South Georgia to verify its Ross Sea tag-recapture method?

Other questions and points: Please see the ASOC Objection where it describes CCAMLR's assessment of the biases inherent even in the NZ tagging effort. One of the main problems even with the current tagging is that it is biased spatially, and by age classes tagged (see ASOC Objection); a research vessel would be able to overcome this problem. Cost, about $2M+ per annum (probably more) to operate research vessel for Ross Sea studies.

Condition 3. Knowledge of benthic habitat
Action required: 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. If such areas are found, and are considered vulnerable to impacts from fishing gear, then measures to protect these from gear impacts should be implemented.
Timescale: Initial mapping of areas of complex benthic habitat in areas where fishing may occur should be carried out within three years following certification (or earlier if sufficient information is collected). This should also be considered in relation to potential impact from current and possible future fishing activity. Measures to protect vulnerable habitat should be implemented (at least within the MSC client group) within the lifetime of the certificate.

Please provide citations showing that longline impacts on the benthos are generally thought to be low. This did not seem to be the opinion of participants in CCAMLR's VME workshop in August 2009. Why is it that CCAMLR has been in the process of prohibiting longlining in waters shallower than 550 m? At least half of the 1500 sets deployed in the 2008 Ross Sea fishery brought VME taxa to the surface (stony corals, black corals, gorgonians, sponges and bryozoans), with an unknown amount dropping off in the 1500-2000 m ascent. If the impact is so low, why is it that for every longline fishery certified by MSC there is a condition to investigate impacts to benthic communities? Also, how many other longline fisheries are dealing with a benthos that has never seen fishing before, and one composed of sessile organisms 1000s of years old? We suggest that impacts to a unique, undisturbed and ancient ecosystem should be considered differently than in cumulative damage to ecosystems already heavily impacted and thus impoverished, e.g., in the North Sea. What is meant in the Condition by 'initial mapping'? Is this the same as first attempts at mapping?

Two years ago the NZ *R/V Tangaroa* made one pass, using in part bottom photography to look at the benthos, cruising down the approximate 175 E longitude line at a cost of at least $1.5M for a several-weeks long cruise. The main fishing grounds of the Ross Sea fishery, that overlying waters of the shelf break, was transected in one line. Does this then suffice as 'initial mapping'? We would contend that a grid overlapping the current main fishing ground and several years of effort is required, and more, if the mapping of possible future fishing locations is to be involved, as stated in the Condition. Improving confidence in whether or not longlines affect the Ross Sea benthic communities would come from the use of an ROV or autosub in the vicinity of longlines being retrieved, thus to learn how much of the fauna drops off before the line reaches the surface, or is destroyed by thrashing fish? Not an outrageous request, given that the HIMI icefish (certified) fishery used cameras to assess ecosystem impacts of trawling. Cost, about $3M?

Condition 4. Trophic effects
Action required: Overall, there do not appear to be unacceptable impacts (given exploitation rates) of the fishery on ecosystem interactions. However, there are uncertainties remaining, notably in relation to pre-recruits. Research is therefore required on major predators and prey of toothfish at sizes below that which recruit to the fishery and to reduce uncertainty of the dependence of top predators on larger toothfish
Timescale: An outline research plan should be available by the first annual audit. Implementation of the research programme should be begun by the third annual audit and results to reduce key uncertainties available within the lifetime of the current certificate.

Please provide citations, so that we can assess the source of the statement that there does not appear to be unacceptable impacts of the fishery on ecosystem interactions? We note that CCAMLR has an Ecosystem Monitoring Programme (CEMP), but also note that no aspect of CEMP is involved in this fishery. What is the source of the opinion that the only "uncertainties" revolve around pre-recruits? Please cite more than the Pinkerton et al. (2007) modeling study, in which a huge number of assumptions took the place of data, as acknowledged by the authors.

In our opinion, to satisfy the first part of this Condition, research on pre-recruits, i.e. fish < 7 years old (the pre-recruit age 'known' at the time that the MM certification was written, but since radically revised upward to 16 years). We note that a few 2-5 year old fish are caught in the fishery (2007 FSA report), and presumably their stomach can be checked to determine prey. The sample size and spatial distribution based on the fishery, however, is not large. What about the 0-2 year olds? No one even knows where these fish occur. Therefore, see Condition 1 and what might be required, i.e. a series of winter cruises in which young toothfish are sampled from multiple depths. As for the second part of this Condition, namely to reduce uncertainty of dependence of top predators, this would require sampling of known predators: Weddell seals during winter, killer whales, Arnoux's beaked whales (known to feed heavily on by-catch macrourids) and sperm whales at various times; around the northern sea mounts, southern elephant seals would have to be sampled. Required, at the least, would be winter cruises to the Ross Sea shelf in which stomach lavaging and tissue sampling of Weddell seals would be conducted. Tissue sampling, again by way of research vessel, would be required for the other predators. Estimated cost: One winter cruise $2-3M as a start. It is known that penguins prey on small Patagonian toothfish in the Antarctic Peninsula region (see various documents submitted to MM). Thus, assuming Hanchet et al. (2008) are correct about juvenile toothfish movements, appropriate would be placement of a crew on the Balleny Islands to sample penguin diet. Also needed would be the sampling of penguin and seal diet in the pack ice north of the Ross Sea shelf during winter. The cost of that would be in the $ millions as well.

Condition 5. By-catch
Action required: An assessment of the risk posed by the fishery to populations of significant bycatch species (initially skates/rays and macrourids) should be undertaken to address elements of uncertainty in the operation of the fishery. The risk assessment should be updated in light of future research on the species concerned (e.g. 'Year of the Skate' and information in Pinkerton et al 2007). Should unacceptable levels of risk be identified, then appropriate mitigation measures should be implemented as soon as possible.
Timescale: An initial risk assessment should be undertaken by the first annual audit and updated thereafter as appropriate.

Addressing the by-catch issue, like the assessment of benthic impacts, is a condition for almost all other longline fisheries certified by MSC. Apparently the problem is more than an "uncertainty". Based on minutes from the 2009 CCAMLR meetings, "Year of the Skate" was deemed by CCAMLR to be unsatisfactory for one of the same reasons that that the toothfish tagging programme is insufficient, i.e. lack of participation by fishing vessels. Given that macrourids and skates possess a life-style even more "conservative" than do even toothfish (long lived, low fecundity etc), our comments addressed to Conditions 1-4 in the case of toothfish would apply. It would seem that a dedicated research vessel is required to satisfy this Condition. We note that in various FSA papers, which annually "characterise" the Ross Sea fishery, the rates by which non-target fish are caught is proportional to the toothfish catch. What this says to us is that the rule of thumb, move fishing location if the by-catch is too large, is an insufficient mitigation strategy. If the "move on" rule was effective, then some sort of inverse relationship should be evident between catch and by-catch.

Condition 6. Closed areas
Action required: The client should promote and/or cooperate with relevant processes to determine necessary closed areas against objective biological criteria. Where a need for closed areas is identified, operations of vessels within the MSC client group should be consistent with the aims and objectives of such closed areas.
Timescale:
By the first annual audit the client group should identify the process or processes most relevant to the identification of closed areas related to the fishery and provide information on associated timetables. By the second annual audit, the client should demonstrate ongoing support for appropriate initiatives reviewing closed area requirements against objective biological criteria. Within the lifetime of the certificate, the client group should demonstrate that ongoing operations are consistent with the aims and objectives of any such closed areas.

It is really not clear why this Condition exists, and what it means to "promote and/or cooperate"? The document should be more specific. How will the clients demonstrate adherence? The ASOC comments note that vessels from countries other than NZ fish in areas where the NZ government prohibits NZ vessels to fish, and says nothing about UK vessels. What, therefore, is the significance to effects on Antarctic toothfish or the ecosystem of such a closure? We note that "objective biological criteria" are not defined, and reiterate our statement above that it is currently unclear as to who will monitor compliance with recommended measures. As this condition does not require research on the part of the client

companies, but just reports from CCAMLR observers about where vessels did or did not fish, we have no further comment.

In conclusion, we note that the financial cost to conduct the research required to manage for a truly sustainable fishery in such a remote and inhospitable region will be considerable. It may be that some of the above estimated costs could be combined; nonetheless, we estimate the total annual cost of a realistic research program designed to fill key knowledge gaps at several million dollars per year. We submit that this information is needed before the fishery is certified as sustainable.