MITIGATION MEASURES FOR PELAGIC LONGLINE GEAR: A REPORT ON THE WORK OF THE SEABIRD BYCATCH WORKING GROUP, AGREEMENT ON THE CONSERVATION OF ALBATROSSES AND PETRELS

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Introduction

The Agreement on the Conservation of Albatrosses and Petrels (ACAP) is an international Agreement that aims to achieve and maintain a favourable conservation status for albatrosses and petrels, perhaps the most threatened group of birds in the world. While these seabirds face threats both on land and at sea, the greatest threat to their survival is widely acknowledged to be incidental mortality in commercial fisheries, particularly those using longline and trawl gear types.

In recognition of the serious problem posed to seabirds by fisheries interactions, ACAP's Advisory Committee has established a Seabird Bycatch Working Group (SBWG). This working group had been formed to advise the Agreement on actions that will assist in assessment, mitigation and reduction of negative interactions between fishing operations and albatrosses and petrels. The working group comprises representatives from ACAP's 13 Parties, together with invited expert with relevant technical or other expertise. The SBWG has met twice since 2007, and copies of the reports of its meetings can be found at http://www.acap.aq .

Noting the key recommendations of the Independent Expert's report on the Self Assessment of CCSBT's performance relating to Ecologically Related Species, this paper:

— provides a summary of issues relating to bycatch mitigation that may be of use to the CCSBT in developing research and management approaches to mitigate seabird bycatch in its fisheries;
— encourages CCSBT members to use the FAO Best Practice Technical Guidelines for IPOA/NPOA-Seabirds as a template when updating or preparing NPOA-Seabirds; and
— informs the commission of ACAP resources that may assist in the development of observer programmes and risk assessments for non-target species.

Summary of Mitigation Measures — Agenda Item 2.4:
ACAP Review of Mitigation for Pelagic Longline Gear

Although several seabird avoidance measures have been trialled to varying degrees in pelagic fisheries, proven and accepted seabird avoidance measures require substantial improvement. ACAP recently reviewed seabird bycatch mitigation measures for pelagic longline fishing and identified knowledge gaps. The review was based on published literature and expert opinion, and has been endorsed by ACAP as representing the current best scientific advice. The CCSBT and its Members are encouraged to use this material to guide the development of policy and practice within fisheries under their jurisdiction.The results of the review are shown in Table 1.

It should be noted that many of the mitigation measures currently adopted by fishers and fisheries managers have little empirical support as to their efficacy. This applies to measures

such as side setting, light tori lines, bait casting machines, blue-dyed bait and line-shooter effect on mainline tension. With respect to light bird scaring lines, the SBWG concluded that thorough comparative experimental assessment of light and conventional bird scaring lines needs to be undertaken against Southern Ocean assemblages of diving seabirds (e.g., *Procellaria* spp. petrels and *Puffinus* spp. shearwaters) and albatrosses, with research based on larger sample sizes and more transparent methodologies before the measure could be applied with any confidence.

Review of Relevant International Instruments — Agenda Item 3:

Best Practice Guidelines for IPOA/NPOA-Seabirds

ACAP is committed to assisting its Parties, Range States and other organisations in the implementation of the FAO IPOA-Seabirds. This instrument is an important mechanism for implementing national and international initiatives for reducing or eliminating seabird bycatch in relevant fisheries.

Recently ACAP worked with FAO and contributed both financially and through expert participation to prepare Best Practice Technical Guidelines for IPOA/NPOA-Seabirds to assist countries in preparing and implementing more effective NPOA–Seabirds, and to provide RFMOs with guidance on implementing IPOA–Seabirds within a regional framework. The new guidelines were approved at FAO COFI in March 2009 and recently published as *FAO Fisheries and Aquaculture Report No. 880* (CCSBT-ERS/0909/Info06). It is expected that these will also be published in the FAO Series of Technical Guidelines for Responsible Fisheries. ACAP considers the implementation of the new guidelines is important for the conservation of seabirds, particularly albatrosses and petrels, and strongly encourages CCSBT members to make every effort to use the guidelines as a template when updating or preparing NPOA-Seabirds.

Reports of meetings of other organisations relevant to the ERSWG — Agenda Item 4:

ACAP Advisory Committee and Seabird Bycatch Working Group Meeting Reports

Meeting reports for the ACAP Advisory Committee and its Seabird Bycatch Working Group can be found at the ACAP Website www.acap.aq . This paper reports on all issues relevant to the Commission and ERSWG arising from recent meetings of the Advisory Committee and the SBWG.

Species which may be affected by SBT fisheries operations — Agenda Item 5.1:

Synthesis of available data to provide initial estimates of total ERS mortality by year and species (or species group) — Agenda Item 5.1.1:

Information on ACAP species that occur within the CCSBT Convention Area

Over the last 18 months a series of assessments have been produced for all of the species on Annex 1 of the Agreement. These provide comprehensive data on the population status, trends and distribution of albatrosses and petrels, including species that occur within the CCSBT convention area such as the black-browed, grey-headed, shy and white-capped albatrosses. These species assessments are available on the ACAP website and can be freely downloaded (http://www.acap.aq).

ACAP is currently updating information provided previously to the Commission by BirdLife International as CCSBT-ERS/0602/Info06 to present an analysis of the spatial overlap

between albatross and petrel distribution and CCSBT fishing effort, using data from BirdLife's Global Procellariiform Tracking Database and CCSBT's public domain catch and effort data. CCSBT-ERS/0602/Info06 highlighted the importance of the CCSBT area, which overlapped with 56% of Southern Hemisphere breeding albatross distribution, and 23% of available petrel distribution data, emphasising the potential for interaction with fisheries in this area, and the importance of the area for the survival of these vulnerable species. ACAP anticipates providing the updated information to the Commission at the next ERSWG meeting. Information on spatial overlap, together with that contained in the ACAP Species Assessments, should prove to be very useful in developing estimates of total annual mortality for albatrosses and petrels.

Discussion and recommendation of analyses to be conducted in future to obtain improved estimates of ERS mortality and estimates of uncertainty. (Agenda Item 5.1.2)

ACAP is committed to reviewing and utilising available information on foraging distribution and seabird bycatch to assess the risk of fishing operations on ACAP species in fishing regions, including both RFMO areas of competence and national EEZs. However, the difficulty of this task is exacerbated by a general lack of available data from many fisheries on bycatch levels and species composition, particularly at a fine scale. Routine collection, analysis and reporting of such data is essential to improve estimates of ERS mortality and to reduce levels of uncertainty

The type of information necessary to effectively analyse bycatch of non-target species can differ somewhat from that used for fish stock assessments, and this needs to be recognised when data collection programs for fisheries are designed. ACAP's work program specifically includes developing products that will assist RFMOs and other fishery managers in collecting such data, but the results of this work are not available at present. They will be provided at future meetings of the ERSWG. Lack of such information, however, should not be used as a reason to avoid undertaking risk assessments for bycatch species as use of fishing effort and distribution data can provide valuable information on areas where bycatch is likely to be occurring.

ACAP supports the conduct of risk assessment processes and notes that CCAMLR and some other tuna RFMOs (WCPFC and ICCAT) have risk assessment processes for ERS in place or under development. ACAP has considerable expertise available to assist in risk assessments for albatrosses and petrels and would be pleased to assist the Commission in undertaking assessments for seabirds within SBT fisheries.

Update on mitigation research and priorities — Agenda Item 5.1.3:

ACAP Mitigation Research Plan for Pelagic Longline Fishing Gear

In order to progress the development of relevant mitigation research, ACAP's SBWG has developed a plan of research for pelagic longline fisheries. The plan includes identifying specific research experiments needed, principal investigators, best host locations, and possible funding sources.

An assessment of the suitability of pelagic mitigation technologies for future research and application was carried out using the expertise of the SBWG and further expert opinion**.** Mitigation measures were grouped as primary, secondary, or other, and a priority ranking for future research assigned on a 5 point scale. Primary measures were those considered likely to be effective without other mitigation measures, and secondary measures were those considered useful for deployment with other measures, but unlikely to significantly reduce

bycatch if used in isolation. The results of this assessment are shown in Table 2, together with details of the criteria used for assessment.

It was assessed that from a global research perspective bird scaring or tori lines, the bait setting capsule and side setting were the highest priority for research. Weighted branchlines, the bait pod, smart hooks and circle hooks were high priorities; and blue dyed squid was of moderate priority. Research on technologies such as the underwater setting chute, night setting, line shooters, thawed bait, strategic offal discharge, blue-dyed fish, fish oil and bait casting machines were considered a lower priority and were not discussed further. With respect to night setting, the Working Group acknowledged the effectiveness of this mitigation measure, but believed further research on this was not needed.

The Working Group agreed that seabird bycatch mitigation research should best be carried out in locations where seabird interactions with pelagic gear are most intense, as it is these locations that would yield the most useful research outcomes. Locations where aggressive species are most abundant and overlap with fisheries include the pelagic fisheries of Chile in winter, Uruguay and Brazil from May through September, and in South Africa in winter. Personnel from BirdLife International's Albatross Task Force are currently in place in Chile, Brazil, Uruguay, South Africa and Namibia where they are currently collaborating with fishers in seabird bycatch mitigation research programs.

Specific research projects were identified that may be of relevance for CCSBT pelagic longline fisheries. Australia has led the development of the bait setting capsule, a device designed to deliver baited hooks to a depth beyond the access of foraging seabirds at the stern of a pelagic longline vessel. Graham Robertson of the Australian Antarctic Division has funding to develop a prototype and carry out pilot research to demonstrate the efficient performance of a prototype underwater setting capsule. Pending a positive outcome of pilot research, Dr. Robertson is seeking funding to carry out comprehensive research to determine the relative performance of the bait setting capsule, side setting and conventional stern setting. A location to stage this research effort has not been established at this stage.

The United States is developing a streamer line system for pelagic longline fisheries and has plans to trial the streamer line system in two "worst case" southern hemisphere, pelagic fisheries. Funding is in place to carry out this research. Trials will compare the relative efficiency of the streamer line designed with a control of no deterrent and to a second mitigation technology to be determined. The host locations will include South Africa and either Brazil, Chile or Uruguay. Work is scheduled to be completed in 2009.

New Zealand and Australia have procured "safe leads", a product which promises to eliminate safety issues related to weighted branchlines. Pilot-level testing of these weights within Australian and New Zealand fisheries has already been undertaken.

Effective mitigation research requires a dedicated approach by both fishers and fisheries managers. Such research is critical if levels of seabird bycatch are to be reduced to minimal levels, and CCSBT members are encouraged to support the research outlined in Table 2 and report the findings to the CCSBT and other interested organizations.

Recommendations

It is recommended that the CCSBT ERSWG:

1. reviews the information provided in Table 1 when considering the application of currently available mitigation methods;

2. encourages CCSBT members to use the FAO Best Practice Technical Guidelines for IPOA/NPOA-Seabirds as a template when updating or preparing NPOA-Seabirds;
3. utilizes the comprehensive biological and ecological information contained within ACAPs species assessments to develop appropriate strategies to minimize the interactions between CCSBT fisheries and threatened albatrosses and petrels.
4. supports the collection of data to enable accurate estimation of incidental bycatch of non-target species through strengthening of observer programmes and submission of relevant data;
5. supports the conduct of ecological risk assessments on an ongoing basis after evaluation of a suitable approach for SBT fisheries; and
6. strongly encourages Members to collaborate on implementing the mitigation research initiatives outlined in Table 2.

Table 1: Review of Seabird Bycatch Mitigation Measures for Pelagic Longline Fisheries.

Measure	Scientific evidence for effectiveness in pelagic fisheries	Caveats /Notes	Need for combination	Research needs	Minimum standards
Night setting	Duckworth 1995; Brothers et al. 1999; Gales et al 1998; Klaer & Polacheck 1998; Brothers et al. 1999; McNamara et al. 1999; Gilman et al. 2005; Baker & Wise 2005.	Less effective during full moon, under intensive deck lighting or in high latitude fisheries in summer. Less effective on nocturnal foragers e.g. White-chinned Petrels (Brothers et al. 1999; Cherel et al. 1996).	Recommend combination with bird scaring lines and/or weighted branch lines	Data on current time of sets by WCPFC fisheries. Effect of night sets on target catch for different fisheries.	Night defined as nautical dark to nautical dawn
Side setting	Brothers & Gilman 2006; Yokota & Kiyota 2006.	Only effective if hooks are sufficiently below the surface by the time they reach the stern of the vessel. In Hawaii, side-setting trials were conducted with bird curtain and 45-60g weighted swivels placed within 0.5m of hooks. Japanese research concludes must be used with other measures (Yokota & Kiyota 2006).	Must be combined with other measures. Successful Hawaii trials use bird curtain plus weighted branch lines. In Southern Hemisphere, strongly recommend use wth bird scaring lines until side-setting is tested in the region.	Currently untested in the Southern Ocean against seabird assemblages of diving seabirds and albatrosses - urgent need for research. In Japan, NRIFSF will continue testing in 2007.	In Hawaii, side setting is used in conjunction with a bird curtain and 45 weighted swivel within 1m of the baited hook. Clear definition of side setting is required. Hawaiian definition is a minimum of 1 m forward of the stern.

Measure	Scientific evidence for effectiveness in pelagic fisheries	Caveats /Notes	Need for combination	Research needs	Minimum standards
Single bird scaring lines - conventional configuration	Imber 1994; Uozomi & Takeuchi 1998; Brothers et al. 1999; Klaer & Polacheck 1998; McNamara et al. 1999; Boggs 2001; CCAMLR 2002; Minami & Kiyota 2004. Melvin 2003.	Effective only when streamers are positioned over sinking baits. In pelagic fisheries, baited hooks are unlikely to sink beyond the diving depths of diving seabirds within the 150 m zone of the bird scaring line, unless combined with other measures such as line weighting or underwater setting. Entanglement with fishing gear can lead to poor compliance by fishers and design issues need to be addressed. In crosswinds, bird scaring line must be deployed from the windward side to be effective.	Effectiveness increased when combined with other measures e.g. weighted branch lines and/or night setting	Optimal design for pelagic fisheries under development: refine to minimise tangling, optimise aerial extent and positioning, and ease hauling/retrieval. Two studies in progress developing optimal bird scaring line for pelagic fisheries including Washington Sea Grant and Global Guardian Trust in Japan. Controlled studies demonstrating their effectiveness in pelagic fisheries remain very limited.	Current minimum standards for pelagic fisheries are based on CCAMLR Conservation Measure 25-02
Single bird scaring line - Light configuration	Yokota et al. 2008 compared conventional and light bird scaring lines against Laysan albatrosses and considered light lines to be more effective in reducing bait take. A similar study conducted by Brouwer et al. 2008 in New Zealand contained confounding effects	Evidence for effectiveness in Yokota et al (2008) is unconvincing because of small number of sets (18), no seabirds were caught in one experiment, and although a significant difference was detected in a 2nd experiment, the confidence limits around the mean values of both treatments overlapped extensively.		Thorough comparative experimental assessment of light and conventional bird scaring lines against Southern Ocean seabird assemblages of diving seabirds and albatrosses urgently needed. Research needs to be based on larger sample sizes and more transparent methodologies.	Use of this measure is not recommended at this time.

Measure	Scientific evidence for effectiveness in pelagic fisheries	Caveats /Notes	Need for combination	Research needs	Minimum standards
	and inadequate description of methodologies; these concerns preclude confident conclusions to be drawn from this study. Neves et al. 2008 showed light BSLs significantly reduced seabird mortality in the absence of any other mitigation measures.				
Paired bird scaring line – conventional configuration	Two streamer lines best in crosswinds to maximise protection of baited hooks (Melvin et al. 2004).	Potentially increased likelihood of entanglement - see above. Development of a towed device that keeps gear from crossing surface gear essential to improve adoption and compliance.	Effectiveness will be increased when combined with other measures. Recommend use with weighted branch lines and/or night setting	Development and trialling of paired streamer line systems for pelagic fisheries.	Current minimum standards for pelagic fisheries are based on CCAMLR Conservation Measure 25-02
Weighted branch lines	Brothers 1991; Boggs 2001; Sakai et al. 2001; Brothers et al. 2001; Anderson & McArdle 2002; Gilman et al. 2003a; Robertson 2003; Lokkeborg & Robertson 2002, Hu et al. 2005.	Supplementary measure. Weights will shorten but not eliminate the zone behind the vessel in which birds can be caught. Even in demersal fisheries where weights are much heavier, weights must be combined with other mitigation measures (e.g. CCAMLR Conservation Measure 25-02).	Must be combined with other measures e.g. bird scaring lines and/or night setting	Mass and position of weight both affect sink rate. Further research on weighting regimes needed. Testing of safe-leads in progress. Where possible, effect on target catch as well as seabird bycatch should be evaluated. Factors such as swivel weights, mainline tension, bait hooking	Global minimum standards not yet established. Requirements now vary by fishery and vessel. Hawaii minimum requirements are 45g less than 1 m from hook. Australia requires 60 or 90g located 3.5 or 4 m from the hook, respectively, which is a compromise

Measure	Scientific evidence for effectiveness in pelagic fisheries	Caveats /Notes	Need for combination	Research needs	Minimum standards
				position, bait size and life status, deployment position (effect of propeller turbulence) all affect sink rate and need to be quantified.	specification recognising that live bait is used extensively in fishery.
Blue dyed bait	Boggs 2001; Brothers 1991; Gilman et al. 2003a; Minami & Kiyota 2001; Minami & Kiyota 2004; Lydon & Starr 2005. Cocking et al. 2008.	New data suggests only effective with squid bait (Cocking et al. 2008). Onboard dyeing requires labour and is difficult under stormy conditions. Results inconsistent across studies.	Must be combined with bird scaring lines or night setting	Need for tests in Southern Ocean.	Mix to standardized colour placard or specify (e.g. use 'Brilliant Blue' food dye (Colour Index 42090, also known as Food Additive number E133) mixed at 0.5% for minimum of 20 minutes)
Line shooter effect on mainline tension	Reduced bycatch of Northern Fulmar in trials of mitigation measures in North Sea, Lokkeborg & Robertson 2002; Lokkeborg 2003. Increased seabird bycatch in Alaska (Melvin et al. 2001). Robertson et al (2008) found no effect on sink rates in demersal IWL gear.	Supplementary measure. No published data for pelagic fisheries. May enhance hook sink rates in some situations but unlikely to eliminate the zone behind the vessel in which birds can be caught. More data needed. Found ineffective in trials in North Pacific demersal longline fishery (Melvin et al. 2001).	Must be combined with other measures such as night setting and/or bird scaring lines or weighted branch lines	Data needed on effects on hook sink rates in pelagic fisheries.	Not established

Measure	Scientific evidence for effectiveness in pelagic fisheries	Caveats /Notes	Need for combination	Research needs	Minimum standards
	Robertson et al (In Prep) indicates that use of a line shooter in pelagic longline fisheries to reduce mainline tension (e.g., for deep setting) slows significantly the sink rates of hooks.				
Bait caster	Duckworth 1995; Klaer & Polacheck 1998.	Not a mitigation measure unless casting machines are available with the capability to control the distance at which baits are cast. This is necessary to allow accurate delivery of baits under a bird scaring line. Needs more development. Few commercially-available machines have this capability.	Not recommended as a mitigation measure.		
Underwater setting chute	Brothers 1991; Boggs 2001; Gilman et al. 2003a; Gilman et al. 2003b; Sakai et al. 2004; Lawrence et al. 2006.	For pelagic fisheries, existing equipment not yet sturdy enough for large vessels in rough seas. Problems with malfunctions and performance inconsistent (e.g. Gilman et al. 2003a and Australian trials cited in Baker & Wise 2005)	Not recommended for general application	Design problems to overcome	Not yet established

Measure	Scientific evidence for effectiveness in pelagic fisheries	Caveats /Notes	Need for combination	Research needs	Minimum standards
Management of offal discharge	McNamara et al. 1999; Cherel et al. 1996.	Supplementary measure. Definition essential. Offal attracts birds to vessels and where practical should be eliminated or restricted to discharge when not setting or hauling. Strategic discharge during line setting can increase interactions and should be discouraged. Offal retention and/or incineration may be impractical on small vessels.	Must be combined with other measures.	Further information needed on opportunities and constraints in pelagic fisheries (long and short term).	Not yet established for pelagic fisheries. In CCAMLR demersal fisheries, discharge of offal is prohibited during line setting. During line hauling, storage of waste is encouraged, and if discharged must be discharged on the opposite side of the vessel to the hauling bay.
Thawing bait	Brothers 1991; Duckworth 1995; Klaer & Polacheck; Brothers et al 1999.	Supplementary measure. If lines are set early morning, full thawing of all bait may create practical difficulties.	Must be combined with other measures.	Evaluate sink rate of partially thawed bait.	

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Table 2. Assessment of the suitability of pelagic mitigation technologies for future research and application. Rankings have been assigned on a 5 point scale, where 5 is the highest ranking. See below for details of the criteria used for assessment.

Mitigation	Effective surface feeding birds	Effective diving birds	Practical	Safe	Cost Capital	Cost Ops	DWF/ Dom	Compliance	Future Research Priority
Primary									
Streamer lines	4	3	4	4	5	5	5/5	1	5
Weighted branchlines	4	3	5	1	4	4	5/5	5	4
Underwater Setting									
Chute	2	1	2	3	2	5	1/5	1	1
Bait setting capsule	5	4*	4	4	2	5	5/5	3	5
Bait Pod / Smart hooks	5	4*	3	4*	4	4	5/5	1	4
Night Setting	4	3	5	4	5	3*	5/5	3	1
Secondary									
Circle Hooks	?	?	5	5	5	5	5/5	5	4
Bait placement/casting	2*	2*	5	3	4	4	5/5	1	1
Line shooter?	2	2	5	4	4	4	5/5	1	1
Thawed bait	2	2	3	5	5	5	5/5	1	1
Strategic offal discharge	2	2	3	5	5	5	5/5	1	1
Other									
Side Setting	2*	2*	3	4	4	5	5/5	5	5
Blue Dyed Squid	3	3	3	5	5	4	5/5	1	3
Blue Dyed Fish	1	1	3	5	5	4	5/5	1	1
Fish Oil	1	4	2	4	4	3	5/5	1	2

Each mitigation method was grouped as primary, secondary, or other. Primary measures were those considered likely to be effective without other mitigation measures, and secondary measures were those considered useful for deployment with other measures, but may not

significantly reducing bycatch if used in isolation. Side setting, blue-dyed fish and squid bait, and fish oil were regarded as possible candidates for primary mitigation but were considered separately due to their early stage of development and/or limited research results to date. Acoustic alarms, water jets, time-area closures, and artificial lures/bait were not considered. Each was assigned a priority ranking for future research based on the scientific literature and individual experience using the following criteria:

- Effectiveness on surface foraging seabirds
- Effectiveness on diving seabirds
- Practical use on the vessel
- Safe use on the vessel
- Capital Cost – costs for purchase of a specific technology
- Operational Cost – costs related to vessel operations (lost fishing time)
- Applicability to distant water fleets and domestic fleets
- Compliance – the ability to monitor use and performance

Each method was ranked for each criterion on a relative scale of 1 to 5, with 1 being the lowest ranking and 5 being the highest. Considering the ranking for each criterion, each mitigation method was ranked in a similar way resulting in a prioritized list of mitigation methods to focus future research.