



Western Australian Shark Hazard Mitigation Drum Line Program:

Peer Review Close Out Report

August 2014

Client: Government of Western Australia - Environmental Protection Authority

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Western Australian Shark Hazard Mitigation Drum Line Program: Peer Review Close Out Report

Review of 'DPC Response to Submissions on Public Environmental Review'

August 7, 2014

1.1 General comments

We note the responses provided by the DPC to the public submissions and to our PER Review. We note that the DPC have addressed many of the concerns and issues as well as adopting some of the recommendations suggested. The DPC has addressed a number of issues that our PER Review specifically sought clarity on.

There are several responses on the underlying modelling and risk assessment specifically for white sharks that we do not agree with, and others that we do agree with. However, this only emphasizes the uncertainty that would face any assessment of the data available on white sharks. Captures of white sharks are poorly and unreliably recorded in commercial fishery logbooks; efforts to validate catch history are fraught with difficulty and white shark bycatch/fishing effort relationships are not necessarily comparable between regions or over time due to regional differences in abundance, in the catchability of sharks, variations in the configuration of gear, management changes impacting fishing behaviour and variability in the motivation to report captures over time. A previous study by Malcolm *et al.* (2001) identified that, unlike WA-based fisheries where there are lower levels of capture, the catch of white sharks was not well correlated with fishing effort in the SESSF (the fishery responsible for the highest capture of white sharks in the southwest population and outside of Western Australian State waters). Their conclusion was that estimating overall catch from effort was unlikely to estimate the true fishing mortality.

Although the DPC has made reasonable attempts to improve and utilise recorded catch data, these underlying uncertainties make assessments of current stock status highly speculative to the point where they are of limited use to inform management. Continuing to look at existing data will not improve the advice and is of less importance than how to manage risk and impact going forward (to both the public and the white shark population).

The DPC is faced with a trade-off between what level of removal of sharks will significantly reduce the risk of shark attack (their duty of care/social objective) and what level of removal will not place populations of sharks at risk or negatively impact the ecosystem of which they are part (the environmental objective). We recognize that the scientific process to support an environmental objective of providing a long-term sustainable catch from the white shark population, may be quite different to that required to support an objective of acceptable risk to the white shark population over a 3-year (drum-line) program. This is one of the reasons why we consider it important to be as explicit as possible on the program objectives.

The PER and the Referral of the proposed program focuses on the environmental objective. However, the two (social and environmental) are integrally linked and we reiterate that the management of the proposed program would be greatly strengthened by identifying performance measures for both. This will also provide the best level of decision-support for any future consideration to extend, re-commence or redesign components of the proposed program and a framework to evaluate the efficacy of any alternative mitigation measures if they are required. We reiterate that doing so requires effective monitoring, clear trigger points, decision rules and agreed actions in response to these trigger points – all linked to defined program management objectives. The DPC have now addressed some of these issues in their management

plan. We advise that some should be strengthened to assist the DPC in their decision process and these issues are dealt with under the specific comments below.

1.2 Establish clear and measureable objectives and performance measures, including trigger points and corresponding management actions.

DPC write that...“..’The removal of any shark that has the potential by nature of its size and identity (species) to bite a person no doubt reduces the risk of such an incident occurring’ (page 8 of the peer review) accurately addresses the overall objective of the drum line program.”

The DPC clearly define the ‘duty of care/social’ objective of the program is to reduce the risk of shark attack. This is not disputed. By their response, the DPC effectively define that the capture of a single shark of a size and species capable of biting a person would fulfil that objective. While the successful capture and destruction of any target sharks can be considered as a measure of performance relative to this objective, we reiterate that the DPC should consider ways to estimate the extent to which the removals of the proposed program significantly reduce risk as an additional performance measure. The WA Government’s duty of care is not disputed – the reason for this additional performance measure (as discussed in more detail below) is to provide the DPC with a robust level of evidence to underpin decisions regarding such shark mitigation measures into the future.

We note that the program also has an environmental objective to ensure that the overall viability of populations of target sharks (white sharks in particular) is not compromised.

DPC write that...”The statement in the peer review that the drum line program has the potential ‘.. to continue for an unspecified timeframe ...’ is misleading and inaccurate.”

That the current program is proposed for a period of three years is not in question. However, the PER document states “it is hoped that effective alternative or complementary mitigation measures to drumlines may become available in the future.” The challenge for the DPC will be in the event that such measures are not forthcoming. If a firm decision has already been made not to seek a continuation of the drum program beyond the 3-yr period, then this needs to be clearly stated. Such a decision would influence the estimation of environmental risk and hence the environmental objective.

Experience with shark control programs elsewhere suggests that once implemented, they can be hard to cease without good data and robust scientific advice, or the social acceptance, to underpin such a decision. If no application is made to extend the drum line program after 3 years, it will be important that the DPC has the information to evaluate the efficacy of the program and demonstrate to the public that it has either met its overall objective(s) or that there is other evidence to suggest that continuation is not warranted (e.g. if the program did not result in a significant reduction in risk; other options come online) and that no continuation of the drum-line program is warranted. A failure of the program to significantly reduce the risk of shark attack, should that be the outcome, is not failure of the resolve to achieve duty-of-care, it provides a measured and valid reason to seek an alternative strategy. If the program does not satisfactorily perform against its overall performance measures, or any decrease in risk is not permanent, then it will also be important to review the program to determine the implications of ceasing it. No scientific information has been presented to indicate that the program will satisfactorily perform against performance measures within the 3 year period, nor that any reduction in risk would be permanent. We reiterate the need to adjudicate the program against performance measures to provide the DPC with the information required to underpin future decisions on shark attack risk mitigation.

1.3 Management Advisory Committee

We note the DPC's comments that other shark control programs do not include a Management Advisory Committee, performance indicators, trigger limits or catch limits. However, we note that the most recent review of the Queensland shark control program recommends formal trigger events be determined (PER Appendix 14, page 4). Although not a feature of other shark control programs, establishing such measures would be consistent with best practice in environmental/fisheries decision-support processes and would establish WA as a leading jurisdiction in this space.

1.4 Descriptive terminology

We note the following in the 'Response to Submissions' in reference to comparisons drawn between a drumline-based shark control program in Hawaii and that proposed by the DPC for WA:

"The deployment of a series of static long lines offshore from high use areas in Hawaii were not designed to provide a barrier effect at select areas as is the design of the Western Australian program."

We agree that different shark control programs and specifically the Hawaiian program and the proposed WA program are not easily compared. However, we note that the proposed program and the DPC might be better served by not referring to the drumline program as a 'barrier'. This is one of the common public misconceptions about other shark control programs - particularly the net-based program in NSW. Shark control programs including that proposed by the DPC do not provide a barrier. They are fishing programs designed to catch a proportion of sharks within their area of operation. Referring to the DPC program as 'a barrier' or "providing a barrier effect" implies that sharks will be excluded from the area. This will not be the case and a proportion of sharks entering the Marine Monitored Areas will continue to pass through the drum line area and visit inshore waters during the program as part of their normal behaviour. This point is recognized by the DPC in their comment that: "An analysis of the data from the recent drum line trial program shows that tagged sharks were in close proximity to baited drum lines, yet not one tagged shark was caught on a drum line." Keeping this message clear will avoid the perception that all risk of attack has been mitigated.

1.5 Catch levels and trigger points

The statement of an Acceptable Catch Limit (ACL) for target species is an improvement to the management plan. DPC state that the ACLs for target species are:

White shark: 25 over the three year period
Tiger shark: 900 over the three year period
Bull sharks: 10 over the three year period

We also note that the clear articulation of 'Trigger Points' (TP) for both target and non-target species is a significant improvement to the management plan. The stated TPs for target and non-target species are as follows:

Trigger Points	
Target species	
White	20
Tiger	350
Bull	10
Listed elasmobranchs	
Dusky	30
Grey nurse	5
Shortfin mako	50
Non-listed elasmobranchs	
Cumulative of species	50
Other listed marine species*	
Marine life including seals, sea lions, whale sharks, manta rays, dolphins, turtles and seabirds	3

The setting of trigger points at catch levels below ‘acceptable catch limits’ is also a very good response. We do note that the Trigger Points relate to the numbers of sharks destroyed or considered to have died rather than catch numbers. The assessment of catch against Trigger Points is thus dependent on the DPC having robust estimates of post-release mortality. This suggests that research in this area is a key requirement and should be addressed as a priority. We note the risk assessment provided by the DPC in the original PER document assumes a 100% mortality rate of captured animals. Without additional information on post-release mortality, catch numbers alone should be used to identify Trigger Points.

1.6 Contingency Measures

The DPC identify the following Contingency Measures (actions) that may be taken in the event that Trigger Points are reached.

“Should any of the trigger points described above be met, contingency measures will be implemented which may include the following:

- **effort reductions achieved through non-baiting of drum line hooks overnight;**
- **variation of bait types;**
- **inclusion of acoustic pingers on drum lines (if interactions with whales and/or dolphins);**
- **increased effort of patrols if catch exceeding predictions in a particular location;**
- **additional observer trips; and**
- **a within-season review of the program.**

The trigger points and contingency measures detailed above will be incorporated into the Management Plan.”

Clear statements of actions (‘Contingency Measures’) to be taken in the event of reaching or exceeding a trigger point also represent clear improvements in-line with the PER review advice. However, particularly in the case of white sharks, the stated contingency measures may not avoid the program exceeding the acceptable catch limit for this species.

A further improvement would be to strengthen these actions given that the stated acceptable catch limits relate to the “environmental objective” of minimising the risk to shark populations.

The management plan does not articulate ‘contingency measures’ should acceptable catch limits be reached or exceeded. Given that the duty of care/social objective to reduce the risk of shark attack by removing target sharks would have been achieved on reaching the acceptable catch limit of any of the nominated target species, then an environmentally responsible measure would be to cease the program

should an acceptable catch limit for any species be achieved. We strongly suggest that decision rules for contingency measures be adopted prior to the commencement of the program should it be approved.

1.7 Biological sampling of captured sharks

We support the comprehensive set of operational data and biological sampling identified by DoF.

“(1) Biological samples will be collected from all white sharks where practical and appropriate. For white sharks that are euthanised as part of the Program this may include; fin clips or other tissue samples for genetics and/or vertebral samples for age and growth studies. For white sharks which are caught and released as part of the Program this may include; fin clips or other tissue samples for genetics; internal acoustic tagging for movement patterns and alert systems as part of the Shark Monitoring Network; fin mounted SPOT or PAT/PSAT tagging for vertical and horizontal movement patterns and injections with tetracycline and conventional fin tags for mark-capture and age and growth studies. Biological samples will be collected for other shark species where practical and appropriate.”

The research component of the management plan shows significant improvements including the statement of collecting core research data on white sharks in particular. We reiterate that the collection of samples would be greatly improved if dead and euthanased white sharks were returned to shore for a full examination by DoF staff. This is standard procedure in the NSW shark control program and provides for the most complete research benefit from killed animals. Given the relatively small number of white sharks under the DPC’s ‘acceptable catch limit’, doing so is unlikely to present significant resource expenditure under the program. While agreeing with DPC, that *“the logistics of sampling at sea and/or retaining all deceased animals is not a trivial issue”*, we note that in the event that dead sharks cannot be returned to shore – at least a biological sample for genetic analysis should be made in addition to standard data on length and sex would provide some of the most important information contributing to monitoring this population and any effects of the drum line program on it.

It is noted that the management plan includes the statement that *“Biological samples will be collected for other shark species where practical and appropriate”*. This is a positive statement; however, we argue that including tiger sharks as a core part of the sampling program is warranted given that the DPC is now aware that the catches of this species will dominate and be high.

We reiterate that it is important, if the program is approved, that sufficient data are collected to scientifically review, adjudicate and provide evidenced-based advice which the DPC (and EPA) can consider when deciding to cancel, modify or continue the program.

“(4) A gear selectivity trial may be undertaken during the Program to determine the effectiveness of different size hooks on minimising catch of non-target species and undersize sharks. Hooks no smaller than an approximate 25/0 circle design will be used at all times.”

The gear selectivity trial is noted and its inclusion similarly strengthens the research component of the management plan. However, the DPC indicates that hooks no smaller than 25-O would form the basis of the gear trial – which may examine at best the impact of ‘J’ vs ‘circle’ hooks of 25-O. The trial of more standard-sized hooks is recommended from both the perspective of reducing the injuries likely to be sustained to non-target animals as well as on a cost effective basis. Purpose-made ‘25-O’ hooks are no doubt an expensive option compared to off-the-shelf sizes used in other shark control programs. The program would benefit from trialling more conventional sized hooks and testing the premise that bycatch is reduced by using large hooks. This would also assist in identifying gear that best balances possible increased levels of bycatch with the ability to release non-target animals in condition more conducive to their survival. The use of more conventional sized hooks (combined with the use of appropriate wire trace rather than chain) may also permit the release of non-target animals by cutting the trace and leaving the

hook in place which is the standard and recommended best practice release method for bycatch in commercial and recreational fisheries. Determining and, if necessary, improving the post-release mortality of sharks is a critical component for the program so that it can adequately assess when Trigger Points have been reached and contingency measures are required.

A key part of the program and its monitoring will be information on catch and effort. The management plan would be further strengthened if such analyses were included as 'Core research undertaken by Government' instead of being listed under 'potential research by other agencies'. Similar to commercial fisheries data – there is a need to ensure that such data are monitored, analysed and stored in a consistent manner – rather than being at the convenience of, for example, a university-based project. We recognise that this may be the intent, as catch and effort analyses are mentioned in the 'program review and monitoring' section. However, it is not clear in the way these sections are described. This will become particularly important should the program be continued beyond its current three-year proposed timeframe (although duly noting that an extension is not the current intention).

The proponent clearly identifies a plan to investigate post-release survival of non-target animals. However, this is not mentioned in the research component of the management plan. As mentioned above, this information will be critical to adjudicating when a Trigger Point is reached. It should be included under 'Core research undertaken by Government' – we assume this was intended and is an oversight.

1.8 Improve the accuracy of data collection from commercial fisheries within WA regarding white shark bycatch.

DPC note that: "DoF is finalising a project which reconstructs the history of white shark mortalities induced by all sources (including all commercial and recreational fisheries operating on the south-western stock) throughout the full range of the south western white shark population."

We support this reconstruction of white shark mortalities but we recognize the inherent uncertainties in such an exercise. We reiterate that existing catch and effort data, no matter what effort or techniques are applied to improve it, comes with such a high degree of uncertainty that its usefulness to inform management actions is compromised. Continuing to look to the past will not improve current assessments. We emphasize the importance of effectively recording current white shark mortalities across the geographic footprint of the population (which includes not only Western Australia but other jurisdictions). While trigger points have been established for the mortalities of white sharks under this program (20 animals over 3 years), it is the total cumulative mortality across the population that is the key value of interest in assessing status. Therefore ongoing efforts to record current mortalities of the white shark from commercial fishing and any other known sources should be undertaken. This needs to be across the footprint of the population including in jurisdictions outside Western Australia.

1.9 CSIRO research cited in response to PER review of 'weight of evidence' approach

We reiterate that there are several responses on the underlying modelling and risk assessment specifically for white sharks that we do not agree with, and others that we do agree with. However, this only emphasizes the uncertainty that would face any assessment of the data available on white sharks. We do note that the DPC response to our review of Appendix 9 refers to two published scientific papers one of CSIRO origin, the other that included CSIRO staff. It is important that the points raised are clarified.

The DPC response states in reference to Goldsworthy et al. (2013):

“This modelling used one of the most intensive sampling regimes undertaken in Australia to determine trophic relationships across a wide number of species. Ecosystem simulations indicate that the functional group “pelagic sharks”, which includes white sharks, have most likely experienced population growth and this “appears to be primarily to be driven by reductions in fishing mortality”.

The Goldsworthy *et al.* (2013) model of the GAB ecosystem incorporates ‘pelagic sharks’ as a functional group which means that data for all species that were incorporated were added together and treated as a single ‘population’. This is a standard and convenient ecosystem modelling technique. However, it also means that one cannot infer species-specific information from a modelled trend that integrates data across all species. In reality, some species included within a functional group may see a projected increase while others decrease. What is important to note is that the Goldsworthy model did not contain any data specifically relating to white sharks – therefore using their model output to infer the population status of white sharks is uninformative and may well be erroneous.

The DPC response in reference to inferring population size for white sharks (which have a low level of information) from catch data on dusky sharks (which have a much high level of information), states:

“The generation of abundance estimates for a population that has low levels of information by using data (such as catch rates) that are compared with species for which there are high levels of information is an approach that has been promoted by CSIRO researchers (e.g. Punt *et al.* 2011).”

The calculations of white shark numbers based on with dusky shark population estimates and catch rates do not represent the use of the data-poor techniques as presented by Punt *et al.* (2011). The Punt *et al.* paper focuses on trends in fishing mortality between species – the DPC’s analyses requires that fishing mortality, not the trend in fishing mortality, is the same between neonate dusky sharks and white sharks in order to make the comparison. This is highly unlikely and the authors of the Punt *et al.* paper warn against such comparisons. It is unlikely that these analyses can offer useful information that would support or refute estimates of population size in this context.

1.10 References

Goldsworthy *et al.* (2013). Trophodynamics of the eastern Great Australian Bight ecosystem: Ecological change associated with the growth of Australia’s largest fishery. *Ecological Modelling* 255: 38–57

Malcolm, H., Bruce, B.D. and Stevens, J.D.S. (2001). A review of the biology and status of white sharks in Australian waters. Final report to Environment Australia, Marine Species Protection Program. CSIRO Hobart. 114 pp

Punt, A. E., Smith, D.C. and Smith A.D.M. (2011). Among-stock comparisons for improving stock assessments of data-poor stocks: the “Robin Hood” approach. *Journal of Marine Science* 68:972–981

