*SUBMISSION TO THE AUSTRALIAN SENATE*

***The environmental, social and economic impacts of large-capacity fishing vessels commonly known as 'Supertrawlers' operating in Australia's Marine Jurisdiction***

# The role of underwater acoustics in mitigation of dolphin bycatch/depredation associated with trawls in the small pelagic fishery.

**September 2016 Supplement**

**Geoff McPherson**

Marine Acoustic Biodiversity Solutions.

Adjunct Principal Research Fellow,
Engineering, College of Science and Engineering,
James Cook University

Cairns. Queensland Australia. mobile

27th September 2016

Ms C. McDonald
Committee Secretary
Senate Standing Committees on Environment and Communications
PO Box 6100
Parliament House
Canberra ACT 2600

Dear Ms MacDonald,

Thank you for providing an opportunity to submit an updated supplement based on additional information to the role of acoustic techniques in dolphin mitigation in the Small Pelagic Fishery and specifically the operating vessel FV *Geelong Star*.

This Submission extends new findings from Submissions #8 and #22 already presented.

## Personal qualification for providing this submission

To qualify for providing science based data for this submission I wish to indicate,

1. I was a Fisheries Biologist with Fisheries Queensland Government 38 years primarily working on life history and stock assessment of coastal, reef and oceanic fish species.
    - I did work in some stock assessment areas primarily age structured modeling of demersal and pelagic fish stocks.
    - I will not comment on South East Trawl issues as I believe stock assessment has been well addressed by appropriate specialists.
    - For twenty six years of the above period I increasingly worked on the role of underwater acoustical physics and psychoacoustics in marine mammal interactions with fishing gear.
2. I am currently a Principal Adjunct Research Fellow, Engineering, College of Science and Engineering, James Cook University specialising on the impacts of underwater noise in marine and freshwater ecosystems.
3. I have recently completed,
    - 8 years with fisheries research agencies of Japan (Fisheries Research Agency, Far Seas Tuna Lab and Japan Fisheries Acoustics) on dolphin mitigation.
    - 8 years with the US Western Pacific Fishery Management Council, Marine Mammal Committee, specialising in dolphin mitigation
    - A 2 day consultancy developing acoustic aspects of the dolphin mitigation package for Seafish Tasmania.
    - Australian fisheries agencies on mitigation of marine mammal interactions with fishing gear.
    - On the JASCO Applied Sciences project for the GBRMPA Contract “Underwater Noise Guidelines for the Great Barrier Reef”.
4. I was a Member of the Bioacoustics Technical Committee of the American Acoustical Society for two years.

# THE ROLE OF UNDERWATER ACOUSTICS IN MITIGATION OF DOLPHIN BYCATCH/DEPREDATION ASSOCIATED WITH TRAWLS IN THE SMALL PELAGIC FISHERY.
# September 2016 Supplement.

## KEY POINTS

- Australian Fisheries Management Authority Fisheries Observer data of dolphin bycatch by the FV *Geelong Star* operating in the Small Pelagic Fishery showed dolphin bycatch as,
    - Prior to June 2015 at **9 dolphins in 60 trawls.**
    - Subsequent to an integrated barrier net and acoustic package being installed on the FV *Geelong Star* in mid-2015 and as of November 2015 the dolphin bycatch was **zero dolphins for 100 trawls.**
    - For this supplement in September 2016 the dolphin bycatch was **zero dolphins for 462 trawls.**

- The FV *Geelong Star* has arguably achieved one of the most successful dolphin bycatch mitigation strategies in Australian fishing industry. That success has probably been achieved as it was developed in the absence of involvement with Government fishery agencies.
    - The dolphin bycatch mitigation was entirely due to the actions of Seafish Tasmania.
    - AFMA has insisted on bycatch excluder devices that eliminate bycatch when it occurs however, the mitigation strategy of the FV *Geelong Star* would appear to be not to have the bycatch in the first place.

- A component of the dolphin bycatch mitigation package is based on known acoustic behaviour of dolphins approaching trawl fishery gear and interaction with passive and active acoustic components associated with the fishing gear.

- The US fisheries agency NOAA in 2016 is proposing to have fisheries research biologists undertake specific dolphin mitigation activities while working on Pacific fisheries (including trawls).
    - The main components are early detection of dolphins, use of acoustic devices and a move-on rule.
    - The proposals for US scientists match what is being conducted in the Small Pelagic Fishery but are barely reflected in what Australian fisheries agencies require.

- Increasingly it appears that Australian Commonwealth fisheries agencies, with a district focus on southern Australian if not Great Australian Bight waters, are actively reducing reference to the role of underwater acoustics and bycatch in marine mammals, dolphins in particular which are the focus of this Submission.
    - Dolphins are obligate echolocators and social whistles so it is difficult to understand why this is occurring.
    - This apparent approach is entirely at odds with what is happening internationally and Australian fisheries authorities would not be unaware of what is happening.

# COMMENTS

## Initial dolphin bycatch of the FV *Geelong Star.*

Australian Fisheries Management Authority (AFMA) reported that during the first 6 months of the FV *Geelong Star* operations in Australian waters **9 dolphins were taken in 60 trawls.** This initial bycatch should be placed into context.

### The scale of the dolphin bycatch relative to other fisheries

The scale of the initial **9 dolphins in 60 trawls** bycatch could well be considered into the perspective of other Australian fisheries where dolphin mortality previously and still occurs (whether monitored or not),

- Over a three year period in the mid 1980's approximately 14,000 dolphins were taken in offshore nets set by a Taiwanese fishery.
    - Commonwealth and northern Australian State fisheries agencies were involved.
    - Bycatch mitigation of dolphins in nets using acoustic methods (both active and passive) began with this fishery and a comparable fishery in the Northern Pacific.

- In 2001 Seafish Tasmania placed a recommended trawl excluder device to mitigate marine mammal bycatch (including dolphins) well before AFMA required any such installation (from Seafish Tasmania Senate Submission #22).
    - The original design of the excluder was ineffective at allowing dolphins to escape and in a five month period in 2005 a total of 25 dolphins were recorded as mortalities in five separate incidents.
    - Following the first dolphin mortality incident a voluntary code of conduct was implemented that involved
        - maintaining a watch for the presence of dolphins prior to setting the trawl,
        - in the event of a mortality, moving on 10 nm before resetting the trawl.

- From late 2010 for approximately 12 months 52 dolphins were recorded as bycatch in the southern shark gillnet fishery in the Coorong area off the mouth of the Murray River. The events were seen as a one-off associated with the flooding of the river and an enhanced level of dolphin prey in the area.
    - The fishery was temporarily closed.
    - A sector of the southern shark fishery believed that the bycatch was, and still is, associated with a specific gear setting technique used in that local fishery compared to other techniques in the fishery where bycatch has always been substantially lower.

- In August 2016 the South Australian Sardine Fishery a fishery of 28-34,000 tonnes included in its Fishery Assessment Report that "~8 dolphin were taken per 100 shots" with other fishery documents suggesting that more than 1000 net shots were made each season.
    - Ward *et al* (2015) estimated the total numbers of dolphins encircled and mortalities had declined to 275 (95% CI 169-382) and 10 (0-31) respectively.

## The capability of the acoustic components of the initial dolphin bycatch mitigation strategy

When the FV *Geelong Star* began operations in Australian waters in early 2015 it had been fitted with acoustic bycatch mitigation devices recommended by a European manufacturer.

- The device had a marketing reference as a *deterrent* but it did not specifically say from what, namely from the immediate area or from being entangled in gear which are two entirely different things and should have been stated.
    - Acoustic bycatch mitigation alarms/pingers are often unilaterally referenced as *deterrents* without any explanation if the *deterrence* is from the sound or being entangled in gear (Reeves *et al* 1996). This makes it easier to conduct an 'rigged experiment' to test for *deterrence* in a fisheries sense so when there is no *spatial deterrence* there would be a claim for failure of the device in a fisheries sense when in fact the animals were simply now more aware of the fishing gear than ever, there would be no need to move away from the gear at all and the result was in fact *deterrence from entrapment*.
    - This semantic twisting is commonly used to limit logistically appropriate acoustic bycatch mitigation strategies in fisheries, primarily to eliminate the fishery.
    - Fishing results should be applied over semantic arguments and the current FV *Geelong Star* bycatch mitigation record since mid-June 2015 is an outstanding example of this.

- Coral Sea tuna fishermen had used the inappropriately labelled devices in the early 2000's to try to deter 200 to1000 kg dolphin species from a volume of water with not prey or baitfish involved with no spatial deterrence effect.
    - Using the same device initially used by FV *Geelong Star* and
    - Using this, and another unit, both described in FRDC 2003/016 Toothed Whale project in the order of 30 times more sound pressure (an approximation of terminology).

- The devices initially available to FV *Geelong Star* has been used in several fisheries in the southern hemisphere as a bycatch mitigation alarms that functions by *deterring* dolphins from being entangled in a gillnet only, with no suggestion of moving a dolphin from the area.

- The Sound Pressure Level of the device initially utilised was a wide frequency range output of 145 to 150dB, depending on variant, in the time domain with no indication as to where the acoustic power was concentrated relative to the peak hearing sensitivity of dolphins.

Therefore the initial acoustic units would have been most likely useless from the very beginning to achieve spatial deterrence from exposure to the Sound Pressure Level of the devices alone, and the region of the trawl net.

When the Western Australian Pilbara trawl fishery trialled an acoustic device (Stephenson & Wells 2004) to mitigate dolphin interactions around bottom fish trawls the specific acoustic device was demonstrated to be not effective as it did not deter bottlenose dolphins from the volume of water around each trawl net.

- When that same device was assessed by myself for the Queensland (as a Fisheries Scientist and Acoustic Engineer – noting my current Adjunct position) and NSW Governments in around 2004 I had considered it to be acoustically useless.

- Effectively for a 180 degree quadrant around the alarms the devices would not have been detectable by dolphins at a range of possibly 10 m , even more useless when put in the context of the dimensions of the FV *Geelong Star* of 70 m by30 m.

- I advised against the use of the acoustic device to FRDC, but it was used.

The South Australian Sardine Fishery Industry Code of Practice (2015) (*Code of Practice for mitigating of interactions of the SA Sardine Fishery with wildlife* SASIA 2015) specifically mentions the requirement for detection of dolphins prior to setting, and detection during setting, using visual techniques that have been consistently shown internationally to be a generally poor method of detection relative to acoustic detection, and especially at night.

- The South Australian Sardine Association was shown in 2008 how common dolphin acoustic detection worked on an operating vessel prior to and during setting operations using an internal hull mounted contact microphone.

- The potential for early detection of common dolphin by South Australian sardine fishery vessels, based on 2007 and 2008 acoustic experience on sardine purse seiners was included in an Expression Of Interest to Fisheries Research & Development Corporation (FRDC) in December 2015.
    - In December 2015 FRDC considered early detection of dolphins around fishing gear, at least by longer range and more effective techniques, was not a priority!

## FRDC funded "Small Pelagic Research Coordination Program: Technical workshop to explore options for mitigating marine mammal interactions in the Small Pelagic Fishery (Melbourne June 2015).

In June 2015 FRDC hosted an expert workshop on bycatch mitigation options for the Small Pelagic Fishery *Small Pelagic Research Coordination Program: Technical workshop to explore options for mitigating marine mammal interactions in the Small Pelagic Fishery (Melbourne June 2015.* The report may be found at,
http://frdc.com.au/research/final-reports/Pages/2014-046-DLD.aspx

The workshop highlighted the fact, for some, that acoustic methodologies have been part of mitigation of dolphin bycatch in fish trawls internationally since 1998 and over broader areas to reduce fishery interactions with large dolphin species in oceanic fishing operations.
http://frdc.com.au/research/Final_Reports/McPherson%202015%20FRDC%20Workshop%20Minimising%20fish%20trawl%20interactions%20%284%29.pdf

The workshop also highlighted the New Zealand (NZ) fishery experience with specific depredation mitigation type devices/pingers in the NZ jack mackerel fishery, a fishery equivalent to the Small Pelagic Fishery where common dolphin had been a major bycatch species. The NZ fishery has utilised a specific acoustic depredation mitigation devices/pinger a STM Products Dolphin Dissuasive Device (DDD), specifically named not to have an area *deterrence* or *repellent* function but to have a function to degrade close-in sonar examination of prey (such as a fish on a line or in a net) and navigational targets (such as inside a net). They have been used in fish trawls in Europe and are used extensively through Asian fishing organisations.

http://www.frdc.com.au/research/Final_Reports/Richard%20Wells%20FINAL%20-%20Marine%20Mammal%20Captures%20in%20the%20JMA%20Fishery.pdf

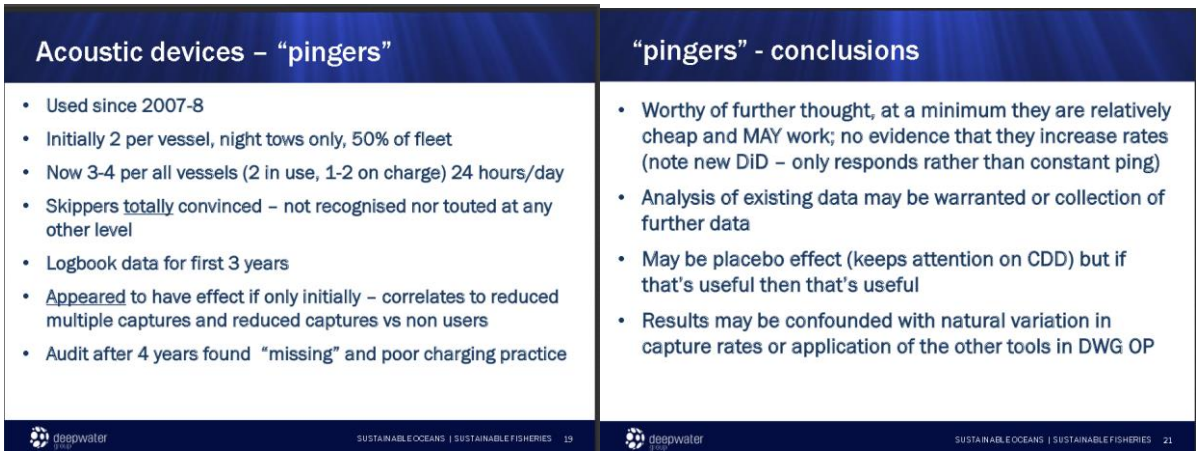
The DDD type units,

- Generate fast sweep Frequency Modulated tones, and broad frequency impulse signals more like strong dolphin echo clicks, through the frequency range of returning dolphin echo clicks to reduce their acoustic capability within and around the nets.
- Dolphins are obligate echolocators seemingly choosing sonar information over visual information when negotiating some obstacles and prey items.
- My own work conducted in South Australian waters with common dolphin around sardine purse seines clearly indicated that different dolphins respond to different signal types.

There are still clear enhancements that need to be made to the DDD type units. They should be seen more as a developing technology with improvements required to,

- determine water flow impact on signal types and model the effective sound field to determine optimum deployment numbers on nets,
- include additional sound characteristics based on known psychoacoustic parameters of dolphin sonar systems,
- address battery longevity and charge issues.

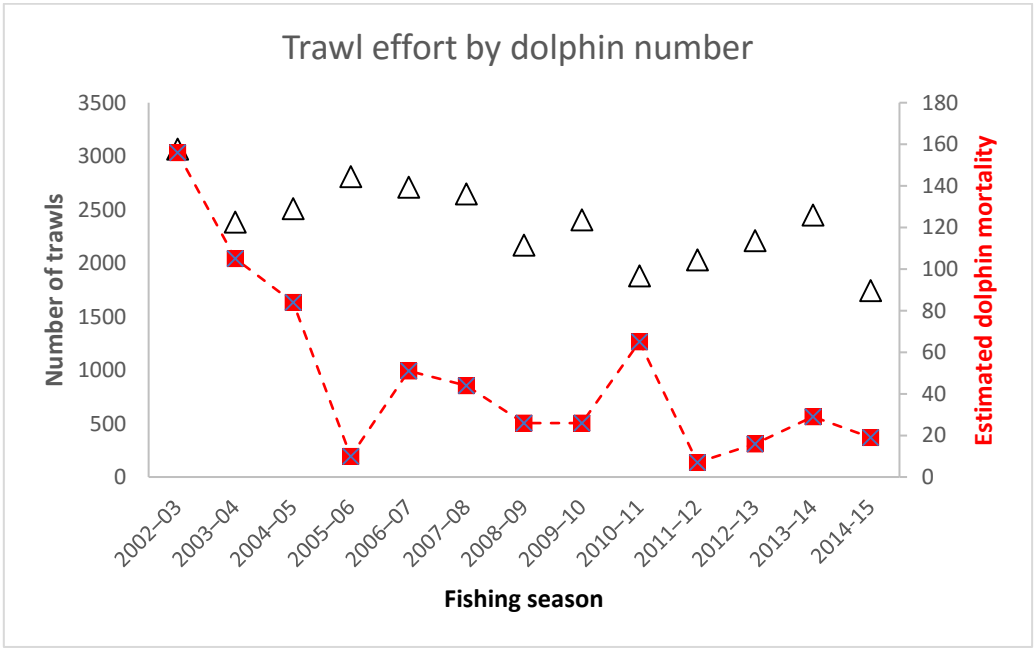
The NZ representative of the jack mackerel trawl fishery provided relatively neutral comments about the efficacy of acoustic bycatch mitigation devices to mitigate dolphin catch in small pelagic fishery trawl nets over twice the size of the FV *Geelong Star* nets. The NZ presentation provided dates when specific acoustic devices were placed on gear, how many devices were placed on gear, electric failures with the gear and noting a lack of statistically significant in dolphin bycatch mitigation. The representative noted that there was confidence with the acoustic devices as fishermen would not go to sea with a full working suite of devices. Two slides presented are shown below and were previously provided in the previous Submission #8 although they may now be reinterpreted with additional data.




Recent historical analyses of correspondence between NZ trawl fishery interests in New Zealand, Italy and Australia up to 2014 warrant further comment for this Supplement Submission. Sales of acoustic devices to the NZ fishery were all communicated to myself by the manufacturer of the device with respect to acoustic and deployment issues. I retain a 3 year record of email statements about when the devices were placed on nets, how many devices were on nets and on how many vessels in the fleet, device failures, how many other mitigation systems were being trailed for the Code Of Conduct at exactly the same time as the acoustic devices.

- It is clear that deployments were never consistent complicating any fishery wide effectiveness analyses.

NZ Environment Department records (https://data.dragonfly.co.nz/psc/v20150002/whales-and-dolphins/jack-mackerel-trawl/all-vessels/eez/2011-12/ ) show in the figure below that bycatch dropped from an estimated mean of 156 dolphins over the summer of 2002/03 to the lowest number of estimated dolphins of 9 by 2011/12. Several bycatch mitigation measures contributed to the fishery Code Of Practice developments such as trawl time, restriction of U turns with the net close to the surface.



Despite a note to the contrary (in the PowerPoint slides included above), the fishery operators indicated that acoustic devices were first partially deployed on NZ trawls from the 2009/10 season partially in a logistical/experimental process with other Code of Practice components. Devices certainly could have been sourced prior to 2009/10 from other fisheries in the northern hemisphere instead of from the manufacturer of course, but they would have been of an earlier inferior model (acoustically and electrically).

DDD device failures were observed on deployments and concerns about battery levels for optimum sound output were commonly expressed with good reason. This has been acknowledged by the device manufacturer. NZ fishery operators slowly accepted the manufacturer's suggestions and fisheries acousticians' advice on deployment of additional units on the nets that are approximately twice the size of the FV *Geelong Stars* in order to approach some degree of sound field uniformity.

Referencing the figure above there was a sudden rise in dolphin mortalities to 65 in 2010/11 under the influence of operational issues as part of finalising an operational Code Of Practice, yet deployments were still limited to a single device per net on vessels using them where the sound field of the device would be ineffective over much of the net.

- By analogy single depredation mitigation devices on the FV *Geelong Star* net would be as effective as a half a dose of an antibiotic or an analgesic, namely minor and potentially ineffective.

Multiple deployments of devices per net did not occur consistently until the 2011/12 season. This season had the lowest dolphin bycatch.

In the most recent fishing seasons 2012/13 and 2013/14 the estimated dolphin bycatch from the figure above (10% observer coverage corrected for non-observation) was 16 and 29 respectively. Over 50% of the dolphin bycatch in 2013/14 was attributed to a single new vessel fishing inappropriately, in terms of the Code of Practice. Perhaps more importantly the vessel had been inexplicably supplied with a STM Products acoustic device more suited to a passive driftnet featuring low Sound Pressure Level but continual operational output.

- That single vessel recorded 16 dolphins in 9 days of the 29 taken in 2013/14.
- That vessel replaced the acoustic devices to be consistent with other vessels in the fleet and dolphin bycatch declined again.

Despite the variations and where acoustic device deployment was considered to be constant, NZ fishery vessel skippers were convinced of their effectiveness (see PowerPoint slides above) that they associated with reduced bycatch and more effective trawling. Those opposed to fishery success would argue that a 95% statistical confidence would be more convincing though highly unlikely in a fisheries sense with rare event occurrences. A more consistent deployment programme may well have provided a clearer picture but that did not happen. Martınez-Abraın (2008) however, noted that a biologically relevant bycatch mitigation result was often more important in ecology than an artificially statistically significant result.

US National Marine Fisheries Service in 1996 (Reeves *et al* 1996) in a major workshop on *Acoustic Deterrence of Harmful Marine Mammal-Fishery Interactions* concluded with the use of acoustics to mitigate bycatch including,

> *6.4 It is unrealistic to expect statistically meaningful experiments to be conducted for all potential target species and for all fishery or aquaculture contexts in which the use of acoustic deterrent devices may be contemplated or tried. The results of experiments done with particular species in particular contexts should be used to make inferences about applicability to other species and contexts. Such inferences should be made cautiously, and monitoring programs should be conducted to determine efficacy and side-effects*

*6.15 In all investigations of acoustic deterrents, propagation characteristics need to be considered. Actual measurements of sound fields are necessary to evaluate the distances at which the sounds are likely to be perceived by target and non-target animals. Optimal deployment of acoustic devices depends on site-specific propagation conditions, which are themselves influenced by factors such as weather, vessel traffic, and biological background noise.*

*6.16 It is important to recognize that single solutions are unlikely to be universally applicable. Also, it should not be assumed that any given approach will remain effective indefinitely. Thus, it is incumbent on both the private and public sectors to maintain an ongoing commitment to support innovative research and development in the pursuit of ways to achieve. bycatch reduction and the safe control of depredation.*

The NOAA Report effectively concluded that clear cut determinations of any single mitigation measure as part of a group would be unlikely to be statically significant but if trends were positive then adaptive investigation should continue. This is clearly what is happening with the acoustic approach of the NZ jack mackerel trawl fishery to mitigate common dolphin bycatch.

## The initial Senate Submissions from late 2015

Acoustic approaches to bycatch and depredation mitigation of dolphins moving into trawl nets were addressed in McPherson Submission #8 (*The role of underwater acoustics in mitigation of dolphin bycatch/depredation associated with trawls in the small pelagic fishery)***.**

In the Seafish Tasmania Submission #22 an integrated dolphin bycatch mitigation scheme utilising physical/acoustic bycatch strategy represented a major unilateral vessel/company/fishery achievement not in any way supported by Australian Fisheries Management Authority 9AFMA) nor FRDC,

- The dolphin bycatch from mid-2015 to the time of the November 2015 Submission #22 was **zero dolphins for 100 trawls.**
- The fact that a fishery achieved a biodiversity requirement in the absence of Government involvement, should not be unexpected.
    - The NZ jack mackerel trawl fishery introduced a package of dolphin mitigation schemes including acoustic techniques with trawl nets larger than those used by the Small Pelagic Fishery, totally without Government interference.

As a result of its unilateral developments the FV *Geelong Star* recommenced fishing operations in mid-2015 with an integrated barrier net (also effectively a low Target Strength passive acoustic reflective mesh), dolphin depredation mitigation devices (that appear to function by reducing the clarity of returning dolphin sonar echoes) and a trial dolphin acoustic detection system. A brief description of the barrier net and some of the passive acoustic detection and active acoustic interference (to limit sonar capability inside the net is provided in Submission #22.

Current psychoacoustic work with dolphin sonar systems involving prey presence suggests that even in conditions of full optical acuity if sonar acuity is reduced, dolphins will not continue navigational activity without full sonar acuity.

The Department of the Environment Submission #10 noted the science involved with fish catch estimation, noted enhancements in bycatch mitigation and encouraged further development in bycatch mitigation.

- That is precisely what FV *Geelong Star* was doing with its unilateral bycatch mitigation package.

However, AFMA made no mention of acoustic bycatch mitigation enhancements nor dolphin acoustic dependency in its Submission #18. Yet acoustic capability featured in its South East Management Advisory Committee SEMAC-21 Minutes in August 2015 namely,

> *An ongoing commitment to continuously review and progress the development and implementation of a range of mitigation measures (e.g. further development of the* ***barrier net*** (added: now with an acoustic basis)*,* ***use of acoustic devices/ hydrophones*** *and scoping the use of an escape hatch in front of the barrier net).*

FRDC did not even mention the role of acoustics in bycatch mitigation in its own workshop that brought international acoustic methods to the fore to allow FV *Geelong Star* to use them and achieve the dramatic dolphin mitigation it has.

Dolphins are acoustic animals, obligate echolocators and social whistle communicators, and any attempt within Australia to paint dolphins with no acoustic capability, nor ability to respond to acoustic stimulae, should be seen as almost diversionary.

## Australian fishing industry initiatives to further mitigate dolphin bycatch in nets and trawls by late 2015.

In late 2015 an Expression Of Interest was presented to FRDC for the shark fishing industry to identify the close-in but erratic association of dolphins with gear setting and retrieval to give greater acoustic warning to vessels prior to gillnet setting operations of the close presence of dolphins.

- The project proposal involved the close-in to moderate range (up to 2-3 k) detection of dolphins from trawl and purse seine net gear using 'flick of a switch' vessel deployable existing acoustic equipment developed for mobile detection of dolphins and mid frequency sounds although not up to now for the specific use of the fishing industry.
- In December 2015 FRDC indicated that early detection of dolphins prior to setting gear was not a priority.

At the time it appeared that FRDC was pursuing the development of a Potential Biological Removal (PBR) strategy to determine how many dolphins could be killed before fishing was terminated. FRDC Report 2015/035 released in September 2015 clearly did address how many dolphins could perish before fishing should be terminated as a priority with no reference to avoiding dolphin mortality in the first place.

While having a PBR mortality limit, a Trigger Level, would have clear advantages for fishery operation, the concept of an authorised dolphin mortality without any provision to avoid the mortality in the first place would not sit well with any fishery operator who would rather not have dolphin bycatch. Any press visage of a dead dolphin would always be attributed to the fishery operation and not to any Government permit that sanctioned the mortality.

In September 2016 FRDC released FRDC 2015/035 that specifically addressed the available take levels of dolphins by the fishing industry referenced as Potential Biological Removal. Specific PBR levels and indeed Trigger Limits were obtained for seals, sea lions with effectively no limit on mortality of seals and limitations for sea lions. While specific low trigger limits were determined for a group of inshore bottlenose dolphins there were few reasons to consider a conservative Trigger Limit for common dolphins given a Trigger Limit would be 261 dead dolphins in the Kangaroo Island area alone.

With such a high potential Trigger Limit for common dolphins offshore, any isolated take by Small Pelagic Fishery would be biologically negligible. However, with the current publicity associated with FV *Geelong Star* so outlandishly skewed beyond reason due to erroneous press reporting only taking pre mid-2015 bycatch data never referenced to other trawl fisheries, it is clear that zero deaths of dolphin would always be preferred by the Small Pelagic Fishery.

The FV *Geelong Star* has made significant strides with mitigating dolphin bycatch utilising standard techniques (outside Australia at least). Why Australian fisheries agencies are so negative to acoustic-based dolphin mitigation strategies for use with an animal group so responsive to acoustic stimulae is not known.

Essentially the active acoustic devices provided to the FV *Geelong Star* at the commencement of fishing operations in 2015 may have appeared to be appropriate from a marketing perspective but woefully inadequate acoustically for a trawl fishery perspective especially given the dimensions of the FV *Geelong Star* nets.

# AFMA Draft Vessel Management Plan for the FV *Geelong Star*.

On 6th June 2016 AFMA released a draft Vessel Management Plan for the FV *Geelong Star*.
http://www.afma.gov.au/revised-draft-geelong-star-vmp-6-june-2016/

Bycatch of marine mammals are addressed in general with,

## Part 3. Marine Mammals

- The concession holder must ensure the vessel uses an AFMA approved marine mammal excluder device operated in accordance with the performance criteria in **Appendix B**.
- The vessel master must advise AFMA of any changes to marine mammal mitigation devices prior to being used by the vessel. The installation of additional devices must not compromise the performance of other devices required under this vessel management plan.
- The vessel master must ensure that prior to the setting of fishing gear a crew member is available to monitor the presence/absence of all marine mammals.
- The vessel master must ensure that no marine mammals are in sight before deploying the net.
- The concession holder must ensure the vessel uses net bindings at all times while fishing gear is being deployed.
- If a marine mammal is observed coming aboard the vessel, the vessel master must ensure:
    - hauling is stopped as soon as the marine mammal is hauled on deck past the stern roller
    - the animal is released as quickly and as humanely as possible and in a manner to maximise the animal's chance of survival
    - the crew's safety remains a priority during this process.

With respect to dolphins no specific acoustic provisions are made for the group that utilises acoustic more. Specific regulations relate to fishing areas.

- ***Dolphins***¶
    - The vessel master must comply with *Small Pelagic Fishery (Closures) Direction No.1 2015*.¶
    - The vessel master must comply with the mandatory closures applying to dolphins as defined in **Appendix E**.¶

Highest priority appears to be providing for a high chance of survival with trawl excluder devices when captured which is reasonable for seal and sea lions as few methods have to date prevented them from entering a trawl net.

This is not the case for dolphins as evidenced by the combined strategy developed by FV *Geelong Star*. There is no suggestion of acoustic bycatch prevention is given for either detection prior to

setting or to reduction of the likelihood of entering the net. There is some potential for acoustic device enhancement (industry have certainly asked for improvement with batteries and acousticians have specific design enhancement in mind).

Any further unilateral changes to acoustic gear by FV *Geelong Star* would be enhancements of the systems that have been on the vessel since June 2015 and would not interfere with any AFMA stated systems given that acoustics doesn't exist in the AFMA provisions.

## US fisheries recommends a proposal for US fishery research consider marine mammal mitigation measures in US Pacific waters in July 2016.

In July 2016 NMFS' Office of Protected Resources has received a request from NMFS' Northwest Fisheries Science Center for authorization to take marine mammals incidental to fisheries research conducted in US northwest Pacific waters. As required by the Marine Mammal Protection Act NMFS is proposing regulations to govern the interactions of the fisheries researchers with the marine mammal species.
https://www.regulations.gov/document?D=NOAA-NMFS-2016-0060-0001

This NOAA proposal summarises rules for fisheries research activities (trawl, longline, trap, gillnet etc) would achieve the least practicable adverse impact on the affected marine mammals. The NOAA summary highlighted three main strategies for consideration for scientists to mitigate interactions namely,

1. *"Required monitoring of the sampling areas to detect the presence of marine mammals before deployment of certain research gear.*
2. *Required use of acoustic deterrent devices on surface trawl nets.*
3. *Required implementation of the mitigation strategy known as the "move-on rule mitigation protocol" which incorporates best professional judgment, when necessary during certain research fishing operations"*

The NOAA proposal should be compared to what Australian Fisheries agencies expect their scientists to achieve where dolphin mitigations may occur during fisheries research activities and what the commercial fishing industry, specifically the FV *Geelong Star*, is doing to mitigate dolphin interactions and specifically not experiencing the entanglement in the first place which is different to managing the entanglement hopefully without a mortality..

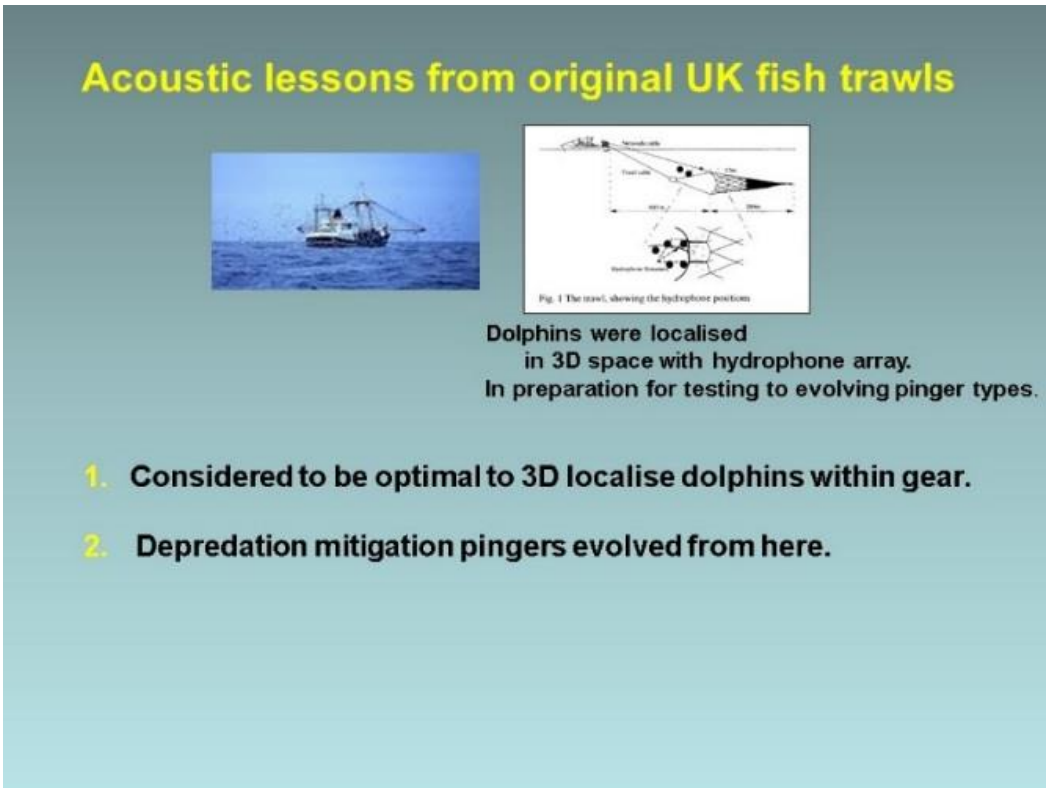
### Comparing the proposed NOAA points to Australian regulatory provisions,

- *Detect the presence of marine mammals*, specifically dolphins for this Submission, before deployment of gear.
    - Detection if it exists is restricted currently to visual techniques that are relatively to extremely poor at night.

Left. Standard US Fisheries and Japanese commercial visual BIG EYES detection system for marine mammals

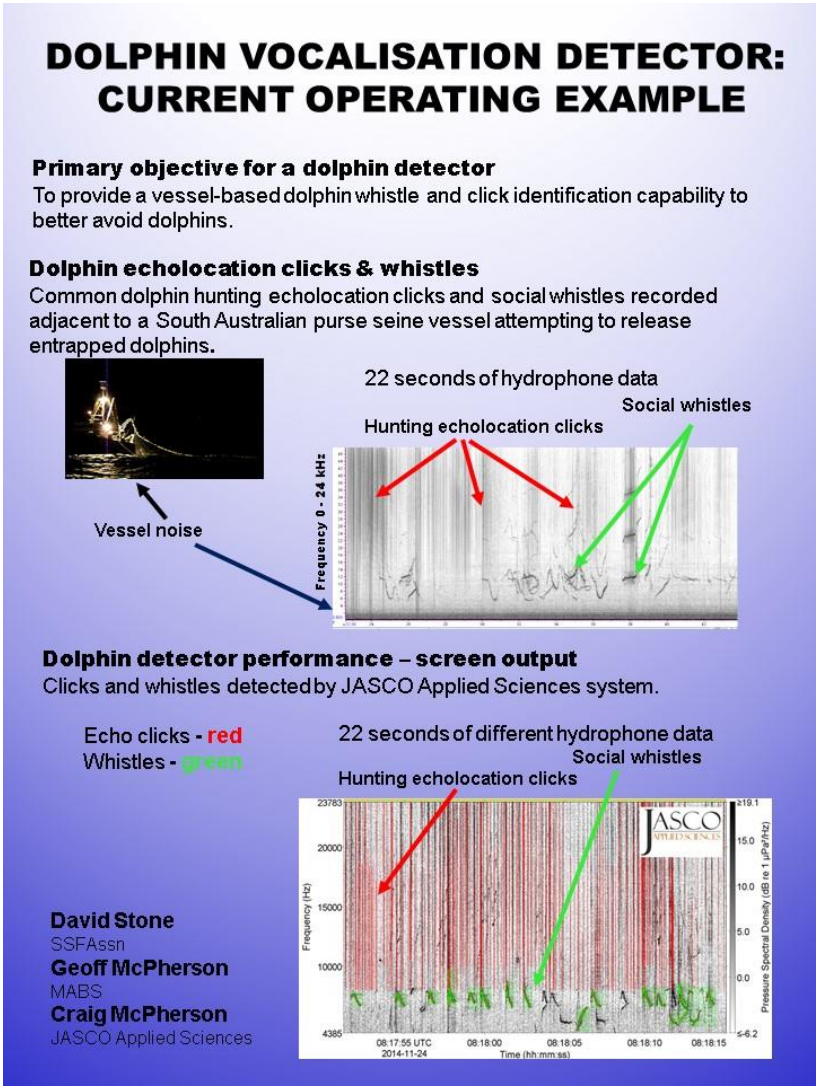
Right. South Australian Sardine purse seine night visual detection system.

- Most NOAA research vessels from which fisheries research activities are conducted have significant passive acoustic monitoring capability for marine mammals.
  - A passive acoustic dolphin detection and localisation system was tested within a radius of a NOAA midwater trawl in the Gulf of Mexico that provided a research vessel the ability to avoid dolphin interactions and entrapments in the trawl. http://biowaves.net/services/mitigation/pisces-dolphin-mitigation
    - The system from 2011 is based on a towed hydrophone array.
    - The array shown would be totally unrealistic for commercial fishery application.
- The mathematical processes for the NOAA Gulf of Mexico 3D localisation and range bearing to animals significantly outside the configuration of the near- trawl array are no different to that of Connolly et al 1998) for dolphins in UK fish trawls in 1998.
    - An slide describing the technique of Connolly et al (1998) is presented from the FRDC June Expert Committee on bycatch, also presented as Senate Submission #8 is presented below




- The mathematical processes are no different to the 3 dimensional localisation software developed for tracking dolphins in 3D in or around fishing gear (McPherson C *et al* 2007, funded by Australian Fisheries Management Authority Project R01/933).
- In late 2015 an Expression Of Interest to FRDC for the southern shark fishery to achieve early detection of common dolphin before nets were set and especially in the dark, as well as for the Small Pelagic Fishery and the South Australian sardine fishery. A Supplement provided with the EOI included a summary of common dolphin vocalisations taken around a South Australian sardine purse seiner in 2008 during the process of eliminating dolphin from inside the net at night,

- The skipper had not visually observed any dolphins during gear setting, only during the hauling stage when another vessel was called to assist.
- The vocalisations were visually and audibly readily identified from acoustic software
- The vocalisations were also affirmed with an automated whistle and click detectors that would be more appropriate in a commercial fishery context.
- The vocalisations ceased when fishing crews finally observed the dolphins exit the net.




- While at times dolphin visual detection (with all inherent visual observation errors) may be as effective as acoustic detection (with concessions that dolphins do not always vocalise) that is almost certainly not the case when depredation/predation feeding behaviour of all dolphins is about to occur or is in progress. The active hunting for prey or the social communication associated with the depredation around the fishing gear would be infinitely more effective, especially at night.
- FRDC considered early acoustic detection of dolphins of low priority.

The role of acoustic detection of marine mammals in order to avoid interactions with marine mammals continues outside Australia. Examples include,

- Alaska Longline Fisherman's Association advising fishery operators to reduce specific vessel self-noise and to buy a hydrophone for distance detection of toothed whales to at least 5 k ( http://www.alfafish.org/whale-avoidance/)
  - This information was provided to FRDC for an Expression of Interest in December 2015.
- Alaska Longline Fisherman's Association in 2016 received a grant to trial industry based towed acoustic arrays with automated software to permit an industry level capability to detect and avoid sperm whales that depredate on vertical longline catches. (http://seaswap.info/research/current-projects/).
- US researchers and the Alaska Longline Fisherman's Association are working on an acoustic decoy to replicate the sound of gear hauling fishing vessels to divert the attention of nearby toothed whales.
  - The decoy process to date is described by Thode et al (2015).
- Midwater trawling as part of the US NOAA Gulf of Mexico cleanup monitoring generated dolphin bycatch.
  - NOAA utilised an acoustic company to devise a trial for 2D localisation and direction identification of common dolphin out to 3k from a trawl net. http://biowaves.net/services/mitigation/pisces-dolphin-mitigation
- Indian Ocean and Central Pacific tuna fisheries are addressing depredation minimisation using long range acoustic detection of marine mammals.
  - For the Indian Ocean Tuna Commission on which AFMA is a full member, Le Foulgoc (2015) demonstrated that toothed whales (dolphins) predating on longline gear were following vessels so if the whales can detect the vessels, the vessels should also be suited to detect the whales to mitigate interactions

- *Acoustic devices*.
  - It is significant that NOAA identified the use of acoustic devices to mitigate bycatch.
  - NOAA mentioned specific acoustic devices and referred to them as *deterrents* which are those devices were shown to be ineffective in the Small Pelagic Fishery with the FV *Geelong Star* where bycatch was **9 dolphins in 60 trawls**.
  - The NOAA proposal does not mention the acoustic bycatch depredation mitigation devices used by Japanese fisheries throughout the Indo Pacific, in the NZ or its own requests to develop deterrents in its own Pacific North West fisheries including request to reprogramme DDD acoustic depredation migration devices used in NZ and by the FV Geelong Star.
  - Terminology of acoustic devices for bycatch mitigation or depredation mitigation is often used in misleading ways, usually to seem negative in an anti-fishery sense.
  - FRDC and AFMA did not make any mention of acoustic devices in their Senate Submissions.

- *Move-on rule*.
  - Currently is a Management provision of Small Pelagic Fishery, and effectively comparable activities for sardine purse seines.

**Comparing the proposed NOAA points to the Small Pelagic Fishery mitigation strategies,**

- *Detect the presence of marine mammals* before deployment of gear.
    - FV *Geelong Star* utilises a visual detection system **as well as** has an early acoustic detection system available for external hull based deployment.

- *Acoustic devices*.
    - FV *Geelong Star* initially deployed small low intensity acoustic bycatch mitigation alarms referred to by some as deterrent devices but immediately replaced them when it became clear that their marketing terminology was not matched by their performance in a trawl sense.
    - FV *Geelong Star* unilaterally deployed multiple DDD acoustic depredation mitigation devices and has achieved arguably the best bycatch mitigation in Australian fisheries history.
    - Acoustic gear development is still required as indicated by most industries but that will not occur while there is so much antipathy to acoustic techniques within Australia.

- *Move-on rule*.
    - The vessels owns established their own move-on rule in 2006 according to Senate Submission #22.

Effectively the US NMFS is proposing a series of mitigation steps for researchers in Pacific waters to mitigate interactions with dolphins in trawls, longlines etc.

- The detection before gear deployment will most likely include acoustic detection (as most US Fisheries vessels are fitted with some type of acoustic detection equipment) while in Australia primitive visual-only systems are advocated by fisheries agencies.
    - The Small Pelagic Fishery has an acoustic dolphin detection system as part of its dolphin bycatch mitigation strategy.
- While the US is advocating acoustic ‘deterrent’ devices to mitigate bycatch, Australian fisheries agencies are determining how many dolphins can be killed before fishing must stop as the priority with no mention of acoustic detection.
    - The Small Pelagic Fishery is  well ahead of the US proposal for utilising acoustic devices by already having rejected those prosed by US Fisheries and is utilising acoustic devices that function as intended.
- The move-rule is consistent between the US and Australian fisheries agencies.
    - The operators of the FV *Geelong Star* developed a unilateral voluntary move-on strategy for dolphins as early as 2006.

# CONCLUSIONS

1. Current dolphin bycatch publicity for the FV *Geelong Star* has been dominated by ill-informed news outlets (often intentionally) that refer to bycatch from the pre mid 2015 mitigation package installation.
    - The current bycatch mitigation strategy is multi component including acoustic components.
    - The current dolphin bycatch rate should now be **zero dolphins in 462 trawls**.

2. FRDC has released a project FRDC 2015/035 *Critical knowledge gaps: estimating potential maximum cumulative anthropogenic mortality limits of key marine mammal species to inform management* that was intended to determine how many dolphins could be taken from within a given population before genetic population damage would be considered serious so effectively what US Fisheries calls Potential Biological Removal.
    - This in turn would permit the estimation of Trigger Limits for each fishery.
    - A Trigger Limit or PBR figure could not be determined for common dolphin.

3. As there is no conclusive understanding of how many dolphins could be killed before a fishery closes, such as the Small Pelagic Fishery, logic would suggest that mitigating dolphin mortality in the first place should be of highest priority.
    - The FV *Geelong Star* is working adaptively to achieve that.
    - The Small Pelagic Fishery, the South Australian Sardine Fishery, the southern shark fishery all would benefit from being able to detect dolphin presence before the setting of the gear which is in all the Codes of Practice of the various fisheries.
        - Unfortunately FRDC determined that acoustic early detection of dolphin before gear setting, infinitely more reliable that visual detection, was not a priority.

4. Commonwealth fishery agencies AFMA and FRDC appear not to acknowledge the unilateral success of the FV *Geelong Star* to develop its own integrated bycatch mitigation scheme including passive and active acoustic components to bycatch mitigation in the first instance, before any form of Trigger Limit for mortality would be evoked.
    - Australia's stance against Japanese Whaling activity has been that if there is no need to kill a whale if you don't have then it has a corollary here where it would be preferable to not have a dolphin mortality in the first place rather, than allowing mortalities to add up towards a Trigger Limit.
        - There should be consistency in regulatory approaches.
    - With respect to AFMAs request for crew being made solely responsible for visual observation that should be considered in the light of the generally far better close and long range detection of acoustic behaviour particularly in situations of dolphins joining vessels or engaging in depredation both extremely acoustic experiences and especially at night.
        - Acoustic detection systems in automated mode would not not take away from visual observation, it frees up crew to do it with the default having a greater change of detection than the visual techniques.
        - An automated acoustic detection system was included in the Expression of Interest to FRDC in December 2015.
    - The overwhelming success of the fishery unilateral dolphin migration package as at September 2016 being **zero dolphins for 462 trawls**, the successful package including the acoustic components, should be noted by the Senate.

5. Enhancements to the successful acoustic mitigation package are possible
    - Changes to the acoustic output of the depredation mitigation devices have already been considered with the design engineers.
    - Acoustic, electrical and logistical changes to devices capable of mitigating bycatch are however not worth pursuing while Commonwealth fishery agencies still consider dolphins to be deaf mutes instead of animals with an obligate acoustic behaviour pattern with appropriate responses to acoustic stimulate in fishery situations.
    - Finally, Australia's fisheries regulations with provision for marine mammal detection prior to setting and hauling could do far better by including passive acoustic systems as needs dictate.

**Geoff McPherson**
Marine Acoustic Biodiversity Solutions.

Adjunct Principal Research Fellow,
Intelligent Systems, Information & Modelling, College of Science, Technology & Engineering, James Cook University

Cairns. Queensland Australia. mobile

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