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An assessment of the potential for near-seabed midwater trawling to contact the seabed and to impact benthic habitat and Vulnerable Marine Ecosystems (VMEs)

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Geoff Tingley, Ministry for Primary Industries

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1 Introduction

In general pelagic (midwater) trawling is perceived as having a much lower potential for causing adverse environmental impacts than demersal (bottom) trawling, especially with respect to benthic environments (SPRFMO, 2012; Ministry of Fisheries, 2008). This view is largely driven by the way pelagic trawls are mostly used, being fished in the upper layers of the sea to catch pelagic schooling fish. In some circumstances, it is not uncommon for pelagic trawl gear to be used to catch fish near the seabed and is seen in New Zealand in the fisheries for southern blue whiting (*Micromesistius australis*) (MPI, 2013; MPI, 2014). Typically, this latter type of use occurs in areas of relatively flat and/or soft seabed where the lighter, more easily damaged midwater gear, is at lower risk of damage but this approach can be extended into rougher terrain if the fishers are prepared to accept the risk of damaging the gear.

Within a SPFRMO context, the level of potential benthic impact of midwater trawl gear has been considered both in the SPRFMO Benthic Impact Assessment Standard (SPRFMO, 2012) and in individual member fishing impact assessments (Ministry of Fisheries, 2008). However, the New Zealand Bottom Fishing Impact Assessment (*op. cit.*), which drew on accepted understandings that different gear types carry different benthic risk profiles (see Chuenpagdee et al, 2003), was principally focussed on assessing demersal fishing activity and gears and the consideration of the use of pelagic trawl gear was not considered in depth.

Defining the potential benthic impact of trawl gear is inherently difficult, as it is not just the type of gear but the manner in which it is employed that determines the risk and potential impacts. The SPRFMO Benthic Impact Assessment Standard (SPRFMO, 2012) recognises this, and defines bottom trawl gear as

> "*any trawl net fished in such a way that it has a likelihood of coming into contact with the seabed at some time during the trawling operation*".

What constitutes 'a likelihood' in this context is not defined. The 2nd SPRFMO Commission Meeting in January 2014 adopted a Conservation and Management Measure for the Management of Bottom Fishing in the SPRFMO Convention Area (CMM 2.03) that defines the term 'bottom fishing' as

> "*fishing using any gear type likely to come in contact with the seafloor or benthic organisms during the normal course of operations*".

As its name suggests, in normal use, midwater trawl gear would not necessarily be expected to contact the seabed. However, as noted above, midwater trawl gear can be, and is, effectively operated as demersal trawl gear, designed to fish on the seabed in some fisheries. The demersal trawl fisheries in the western SPRFMO Convention Area have a single target species, orange roughy (*Hoplostethus atlanticus*), which tend to aggregate in areas of steep slopes and rough terrain, often on seamounts, hills and knolls. Due to a historic lack of success in using midwater trawls to target orange roughy, believed to be due to orange roughy having a strong tendency to dive with the approach of fishing gear (Koslow et al., 1995; Kloser et al., 1997, 2002; O'Driscoll et al., 2012), and because of the nature of the ground where orange roughy tend to aggregate, midwater nets have not been used to target orange roughy in the SPRFMO Convention Area.

New Zealand vessels started targeting alfonsino (*Beryx spp.*) in the SPFRMO Convention Area using midwater trawls in about 2011. This activity came under scrutiny following the adoption of SPRFMO CMM 2.03 as it was unclear whether this activity should be covered by a 'bottom fishing' CMM or not. All use of midwater trawls to target alfonsino has been undertaken under a New Zealand High Seas Fishing Permit for bottom fishing and each vessel carried a Ministry observer who recorded benthic interactions. The analyses of data collected on benthic bycatch and other indicators of benthic contact from the observer programme form the basis of this paper.
The analyses presented in this paper are to inform the discussion of whether midwater trawling for bentho-pelagic species such as alfonsino should continue to be included in the approach to manage bottom fishing or not and the likely impact on benthic habitats and vulnerable marine ecosystems (VMEs).

2 Data and methods

Ministry observers on New Zealand vessels operating in the SPRFMO Convention Area record standardised information. Specifically, observers record two types of information that can inform on whether there is any benthic contact by fishing gear. These two types of information are, (i) the presence or absence of benthic material brought up in the gear for each set or tow and (ii) the recording of a gear event code.

The frequency with which benthic material is brought up when using midwater trawl gear is relatively low, with six of 238 (3%) midwater tows during the period 2011–2013 with a recorded presence of benthic material. Over the same time period, the rate for demersal trawl tows with benthic material was 37%.

To consider the evidence of contact with the seabed in the gear event codes recorded by observers for each tow, the description gear event codes must first be explored. There are thirteen gear event codes in use (Table 1), of which a number are absolute indicators of benthic contact and others can be interpreted as indicators of benthic contact of varying strength. More than one gear event code can be recorded for each tow, thus a tow that gets caught fast and tears the net would be coded as 'AB' or 'BA'. If more than three codes are required for a single tow, code 'Y' is used and the details recorded in a comments field.

Table 1: Gear event codes used by NZ observers and the interpretation of whether they indicate bottom contact when reported for tows using midwater trawl gear.

Code	Description	Indicator of bottom contact
A	Net torn	Yes, in some instances
B	Net caught/net fast	Yes
C	Winch failure during setting	No
D	Winch failure during hauling	No
E	Net deliberately towed for a long period at non-fishing depth	No
F	Haul gear to doors up, turn and then shoot away again	No
G	Twisted warps, crossed doors	Possibly
H	Gear lost	Yes
I	Broken or snapped warp	Possibly
O	Other (detail in comments)	Possibly
U	Unknown, unobserved	No
Y	More than three gear event codes, see comments section	Yes, if at least one code is indicative of bottom contact.
Z	No gear events	No

The observer recorded gear event codes ‘B’ and ‘H’, which indicate respectively the net caught on the seabed and gear lost, are categorical indicators of gear contact with the seabed. Codes that may indicate seabed contact are ‘A’, ‘G’, ‘I’, ‘O’ and ‘Y’. The argument for these latter codes in indicating bottom contact varies from strong to weak. Logically, those codes indicating significant gear damage (e.g. ‘A’ and ‘I’) are more likely to indicate bottom contact than codes that do not reflect actual damage to the gear. An examination of each gear event code and other evidence in the observer record are presented in Table 2, which shows an interpretation of the definitive and imputed evidence for bottom contact for each gear event code type from the 238 midwater tows by New Zealand vessels in the SPFRMO Convention Area observed during the period 2011–2013.

Gear codes ‘D’, ‘H’, ‘U’ and ‘Y’ were not recorded for midwater tows over the period 2011–2013 (Table 2). Codes ‘C’, ‘E’ were rarely recorded and are assumed to not be indicators of bottom contact. These code groups will not be considered further in these analyses, other than to note that they have a non-zero probability of bottom contact. Any gear event code that contained code ‘B’ is considered to have contacted the seabed.

Midwater trawl nets can be easily torn when they come into contact with rough ground, thus gear event code ‘A’ is likely to indicate bottom contact. Some net tears could, however, be caused by technical failures in other components of the gear or due to errors in deployment. When the evidence for bottom contact associated with code ‘A’ is considered, however, the link can be strongly established. For example, for code ‘A’ (but not code ‘B’) flagged tows, of 16 tows, 5 had unequivocal or strong evidence of bottom contact (Table 2). For one of these the observer reported benthic material, another had an observer comment indicating the net got caught, one had multiple areas of gear damage, and two had ‘large’ tears, i.e. 31% of code ’A’ flagged tows had at least strong evidence of bottom contact. The coincidence of codes ‘A’ and ‘B’ should also not be overlooked, with one third of ‘A’ coded tows also coded as net caught ‘B”: a much higher proportion than seen for other gear codes (e.g. for code ‘Z’, 3% were also coded ‘B’). Overall, strong or unequivocal evidence for seabed contact was seen in about half of tows coded ‘A’.

Table 2: Number of occurrences of specific gear event codes and evidence or indications of benthic contact for 238 midwater tows during the period 2011–2013. The number column does not sum to 238 due to multiple codes being used for some tows.

Gear Code	Use (number)	Evidence of seabed contact.	Interpretation of seabed contact	Seabed contact			
				Confirmed		Imputed	
				No	%	No	%
A	21	5 with code 'B' One with benthos. One with net caught comment.	One with codes 'A', 'O' & other gear damage. Two with 'large' net tears comment.	7	33%	3	14%
B	18	All, one with benthos	N/A	18	100%	–	–
C	1	None	None	0	0%	0	0%
D	0	n/a	n/a	0	–	0	–
E	1	None	None	0	0%	0	0%
F	80	6 with code 'B' Two with benthos.	One with codes 'A', 'O' & other gear damage. One with code 'A'.	8	10%	2	3%
G	4	One with code 'B'.	None	1	25%	0	0%
H	0	n/a	n/a	0	–	0	–
I	1	None	Snapped warp	0	0%	1	100%
O	9	One with code 'B'.	One with codes 'A', 'F' & other gear damage.	1	11%	1	11%
U	0	n/a	n/a	0	–	0	–
Y	0	n/a	n/a	0	–	0	–
Z	120	2 with benthos.	One with caught longline.	2	2%	1	1%

Gear event code 'F' is unconnected with bottom contact, representing a 'doors-up' turn and re-shoot event sequence. Seventy-four 'F' (but not 'B') code tows were observed, of which two had benthic material reported and thus had confirmed seabed contact, with two other tows having net tears but which were also coded 'A' and so were included under the 'A' code above. Importantly, therefore, for a gear event code with no expectation of bottom contact, about 3% of 'F' coded tows showed strong evidence of bottom contact (Table 2).

Gear event codes 'G' and 'O' had few occurrences (4 and 9 respectively), each with one associated 'B' coding. None of the non-'B' coded tows showed any evidence of seabed contact and so these tow are believed to have a low probability of seabed contact, much like codes 'C' and 'E'.

Gear event code 'I', indicating a broken warp, is a likely indicator of bottom contact but the single occurrence was not supported by any other evidence of seabed contact and thus for these analyses, this code was not assumed to be indicative of bottom contact.

The final gear event code, 'Z', is the code most frequently assigned, with 120 records and indicates no observed gear events. As such code 'Z' would not be expected to be an indicator of bottom contact. However, as with code 'F', there were two tows that recorded benthic material and one caught a longline, representing about a 3% seabed contact rate.
It is clear that midwater trawls fished for alfonsino do contact the seabed, as there is unequivocal evidence to prove this. Moreover, even when there is no outward sign of gear having touched the seabed from the gear event code, some tows still bring up benthic material. Given that demersal trawl nets are widely considered poor sampling tools for benthic materials (Ministry of Fisheries, 2008) and midwater trawl nets, by their more open design, being poorer still, these two factors taken together are fairly strong evidence that

whatever measure of seabed contact can be estimated from observer records will underestimate the actual rate of contact.

Given the above considerations, it is clear that different assumptions of what represents seabed contact will result in different estimates of contact. For this reason, two different approaches have been evaluated. First, minimum seabed contact rates have been determined using unequivocal evidence of seabed contact i.e. code ‘B’ or benthic material reported by observers (Table 3). Second, seabed contact rates have been evaluated based on the assumption that, in addition to code ‘B’ and the presence of benthic material, gear event code ‘A’ is also a indicator of seabed contact (Table 4).

Using gear event code ‘A’ as an indicator of seabed contact can be justified as, (i) some event must be causing the net to tear, (ii) approximately one third of code ‘A’ tows showed strong evidence of bottom contact, (iii) there is evidence from the ‘F’ and ‘Z’ codes that bottom contact can occur even without incurring net tears such that the estimate at (ii) above is likely to be an underestimate and other tows will hit the seabed with no recorded evidence. It remains uncertain whether this second approach underestimates, overestimates or is a good approximation of the actual rate of seabed contact in this fishery.

Table 3: The overall percentage of midwater tows in the SPRFMO Convention Area that showed unequivocal evidence of having touched the seabed during fishing in 2011–2013. Bottom contact is evidenced by an observer gear event code ‘B’ and/or benthic material record for each tow.

	2011	2012	2013	Totals
Total number of observed tows	62	53	123	238
Number of tows with bottom contact	5	3	15	23
Percentage of tows with bottom contact	8%	6%	12%	10%

Table 4: The overall percentage of midwater tows in the SPRFMO Convention Area that showed strong evidence of having touched the seabed during fishing in 2011–2013. Bottom contact is evidenced by an observer gear event code of ‘A’ and/or ‘B’ and/or benthic material record for each tow.

	2011	2012	2013	Totals
Total number of observed tows	62	53	123	238
Number of tows with bottom contact	8	7	23	38
Percentage of tows with bottom contact	13%	13%	19%	16%

It is notable that the overall percentage bottom contact from midwater tows shows some increase from 2011 and 2012 to 2013.

It is possible that fishing in different areas may influence the fishing pattern and risk profile of the fishers with respect to bottom contact and thus the probability of bottom contact. To address this issue, the data were analysed into their component parts, apportioning the indicated bottom contact into the different main fishing areas (Figure 1) and the New Zealand implemented spatial management sub-areas of fully open, open with a move on rule, and closed (Figure 2).

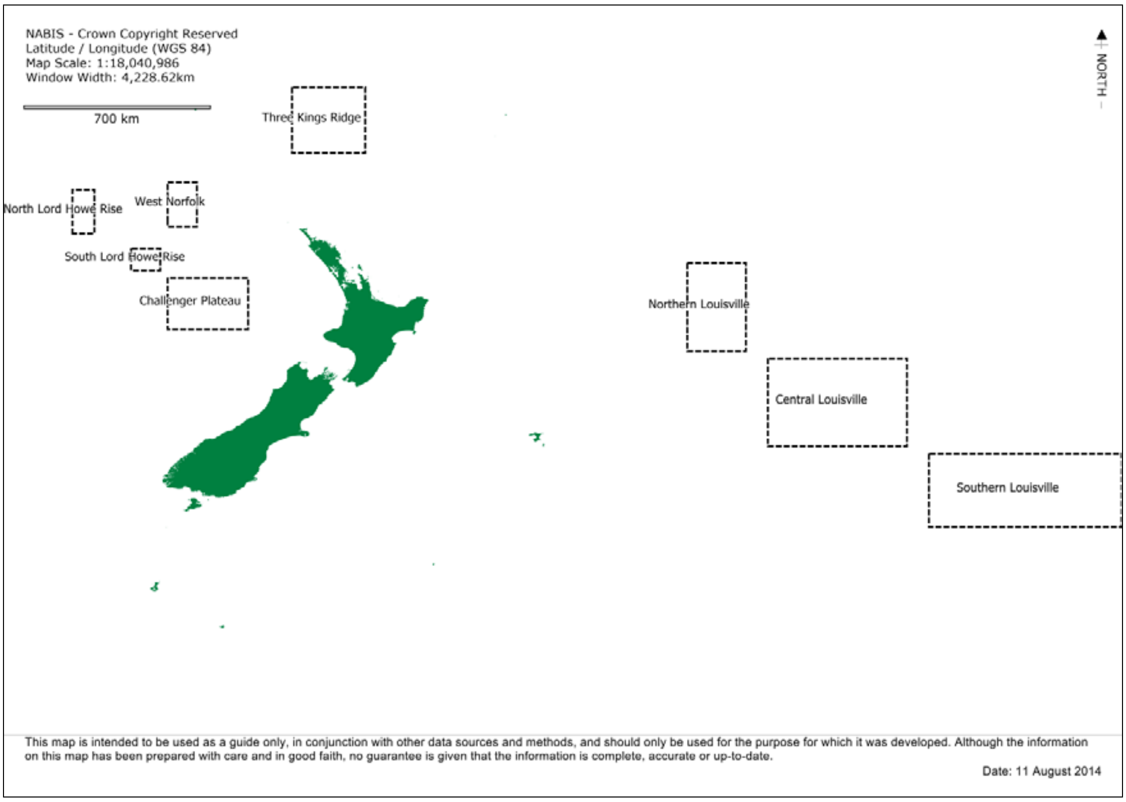

Figure 1: Some of the main fishing areas described by Clark *et al*., 2010.

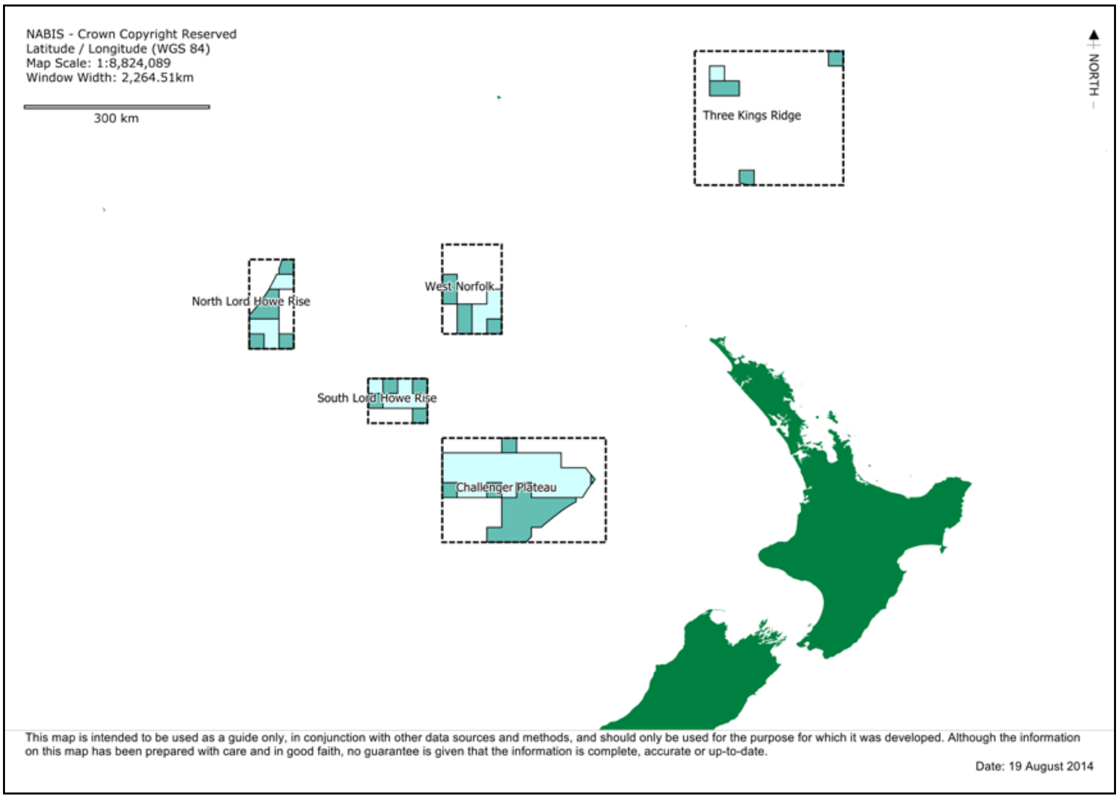

Figure 2: The New Zealand implemented spatial management sub-areas of fully open (pale blue) and open with a move on rule (dark blue) areas for the fishing areas to the north and west of New Zealand.

Table 5: The numbers of midwater tows in the SPRFMO Convention Area that did (+ve) or did not (+ve) show unequivocal evidence of having touched the seabed during fishing in 2011–2013, by fishing area and SPRFMO spatial area type. Bottom contact was evidenced by an observer gear event code 'B' and/or benthic material record for each tow. The highlighted rows are those areas with a sample size greater than or equal to 30.

		2011		2012		2013		All years Totals	
Fishing area	SPRFMO area type	-ve	+ve	-ve	+ve	-ve	+ve	-ve	+ve
Challenger	Open	0	0	0	0	1	0	1	0
Challenger	Move on rule	0	0	0	0	2	1	2	1
Lord Howe	Open	15	3	7	1	58	8	80	12
Lord Howe	Move on rule	16	0	6	1	2	0	24	1
Lord Howe	Closed	26	2	37	1	43	6	106	9
Louisville Ridge	Closed	0	0	0	0	2	0	2	0
	Totals	57	5	50	3	108	15	215	23

It can be seen that the sample size of observed tows from some area/year combinations are very small. In order to reduce the risk of bias in the outcome, sample sizes for each area of less than 30 tows across years were excluded from further analysis. The numbers presented in Table 5 have been converted into the percentage of tows that were known to have touched the seabed in each area and year (Table 6). These data represent the minimum percentage seabed contact.

Table 6: The percentage of midwater tows in the SPRFMO Convention Area that showed unequivocal evidence of having touched the seabed during fishing in 2011–2013, by fishing area and by SPRFMO spatial area type where the all years sample size was greater than 30. Bottom contact was evidenced by an observer gear event code 'B' and/or benthic material record for each tow.

		Alfonsino target			2011–2013 average
Fishing area	SPRFMO area type	2011	2012	2013	
Lord Howe	Open	17%	13%	12%	13%
	Closed	7%	3%	12%	8%
	Average for each year	11%	4%	12%	10%

Table 7: The numbers of midwater tows in the SPRFMO Convention Area that did (+ve) or did not (+ve) show strong evidence of having touched the seabed during fishing in 2011–2013, by fishing area and SPRFMO spatial area type. Bottom contact was evidenced by an observer gear event code 'A' and/or 'B' and/or benthic material record for each tow. The highlighted rows are those areas with a sample size greater than or equal to 30.

		2011		2012		2013		All years Totals	
Fishing area	SPRFMO area type	-ve	+ve	-ve	+ve	-ve	+ve	-ve	+ve
Challenger	Open	0	0	0	0	1	0	2	1
Challenger	Move on rule	0	0	0	0	2	1	1	0
Lord Howe	Open	14	4	6	2	51	15	71	21
Lord Howe	Move on rule	14	2	6	1	2	0	22	3
Lord Howe	Closed	26	2	34	4	42	7	102	13
Louisville Ridge	Closed	0	0	0	0	2	0	2	0
	Totals	54	8	46	7	100	23	200	38

The numbers presented in Table 7 have been converted into the percentage of tows in each area and year that were estimated to have touched the seabed with a high likelihood (Table 8).

These data represent what is probably the best estimate of percentage seabed contact from these data.

Table 8: The percentage of midwater tows in the SPRFMO Convention Area that showed strong evidence of having touched the seabed during fishing in 2011–2013, by fishing area and by SPRFMO spatial area type where the all years sample size was greater than 30. Bottom contact is evidenced by an observer gear event code of ‘A’ and/or ‘B’ and/or benthic material record for each tow.

		Alfonsino target			2011–2013 average
Fishing area	SPRFMO area type	2011	2012	2013	
Lord Howe	Open	22%	25%	23%	23%
	Closed	7%	11%	14%	11%
	Average for each year	13%	13%	19%	16%

3 Discussion

Two measures to indicate bottom contact have been used to try and provide (i) a minimum estimate of the percentage of tows that contact the seabed and (ii) a ‘best’ estimate of the percentage of tows that contact the seabed.

In producing the minimum estimate of seabed contact, only unequivocal evidence was used, i.e. a net caught observation or benthic material brought up in the trawl gear. Other evidence, however, clearly indicates that this measure will underestimate the true rate of bottom contact. This can be seen from tows where there was no indication of seabed contact other than the presence of benthic material (e.g. as for gear event codes ‘F’ and ‘Z’). The poor sampling ability of midwater trawl gear also means that the occurrence of benthic material will underreport actual seabed contact.

In order to get a more realistic estimate of bottom contact, other evidence was examined. Gear event code ‘A’ indicates a torn net. The most logical cause of net tears is by the net getting snagged on the seabed, so including this code as an indicator of bottom contact is sensible. However, there may be an element of overestimation of bottom contact from using this code as torn nets can occasionally be caused by errors in gear deployment (e.g. twisted doors). Despite this, the evidence for net tears being evidence for seabed contact is, however, convincing, with about half of ‘A’ coded tows also showing unequivocal evidence of seabed contact and known underestimation of benthic sampling by trawl gear, especially midwater trawl gear.

All of the estimates presented here are subject to a substantive known underestimation due to the poor sampling efficiency of trawl gear and midwater gear particularly. This will result in tows that touch the seabed but do not get caught or sustain no net damage, and will be unlikely to bring up benthic material either, so the true probability of seabed contact will be underestimated.

In summary, the overall average of level of indicated bottom contact for all observed midwater tows across the three years is a minimum of 10% and more realistically 16% (Tables 3 and 4). Restricting the analysis to area and across-year sample sizes greater than 30, gives the same result of a minimum of 10% and more realistic estimate of 16% (Tables 6 and 8).

A complication exists as the seabed contact rate for tows appears to be different for different management area types. For unequivocal evidence of seabed contact, closed areas (where bottom fishing was prohibited during 2011–2013) have a lower rate of seabed contact (8%) than areas open to bottom fishing (13%), (Table 6). A similar but more pronounced pattern is seen when the ‘strong’ evidence base is used, with closed areas showing a lower contact rate (11%) than open areas (23%). A possible cause for this difference is that vessels may make less efforts to avoid bottom contact in the open areas, which would suggest that only the data from closed areas should be considered. However, this argument is not consistent with industry statements about the fragility of the midwater gear, where any bottom contact is likely to result is substantive gear damage and is thus avoided (Andrew Smith, *Pers. Comm.*). It is also inconsistent with the occurrence of evidence of bottom contact where the gear continues in use without being brought on deck. Evidence of this latter inconsistency comes from gear event codes that include code ‘F’ (haul gear to doors up, turn and then shoot away again) coupled with unequivocal evidence of benthic contact (either benthic material or gear event code “B”). This combination of evidence occurred for 10% of tows coded ‘F’ (Table 2). The rate of seabed contact by midwater tows can be seen to have increased over time, irrespective of which subset of data are considered, most notably in 2013 (Tables 3, 4, 6 and 8).

The first question to address is, does the observed rate of seabed contact warrant this type of fishing being defined as ‘bottom fishing’?

Bottom fishing has been defined as ‘*fishing with any gear type likely to come in contact with the seafloor or benthic organisms*’ (FAO 2008), while the definition of bottom trawl in the SPRFMO Bottom Fishery Impact Assessment Standard is,

> ‘*any trawl net fished in such a way that it has a likelihood of coming into contact with the seabed at some time during the trawling operation.’* (SPRFMO, 2012).

A more recent definition of bottom fishing can be found in the Conservation and Management Measure for the Management of Bottom Fishing in the SPRFMO Convention Area (CMM 2.03) agreed at the 2nd SPRFMO Commission Meeting,

> ‘*fishing using any gear type likely to come in contact with the seafloor or benthic organisms during the normal course of operations*’.

The average estimated bottom contact rates for closed areas or overall is between 8% and 16% and the estimated maximum bottom contact rates for specific areas and years is up to 25% (Lord Howe, open areas, 2012). Recognising that these are most probably underestimates of the actual contact rate, it is not difficult to conclude that this method of fishing does fall within the SPRFMO definition of ‘bottom fishing’.

Further, CMM 2.03 requests the Scientific Committee to “undertake an assessment of the likely impact of specific gear types, particularly trawl, on VMEs, to further inform the definition of bottom fishing”. Without detailed long-term studies, the likely impact of midwater trawling with the bottom contact rates seen in these analyses can only be assessed by logical argument. In this context, two assumptions are important:

- much of the area fished (underwater features, seamounts, hills, etc.) contains terrain that is steep and rough; and
- midwater trawls are not designed to be fished on areas of rough seabed.

It could be argued, therefore, that the type of contact implied by the net coming fast on the bottom or sufficient to tear the net, coupled with the two assumptions above, is suggestive of a degree of seabed contact of limited extent. The suggestion is that midwater trawl contact in this fishery is more like point contact rather than the extended seabed contact of a bottom trawl.
The scale of the fishery is also a factor that should be considered in addressing the risk of potential adverse benthic effects. The midwater trawl fishery for alfonsino is a very small fishery of about 100 tonnes per year, with an average of about 80 tows over each of the last three years. The risk of adverse impacts of a fishery of this size using midwater trawls is likely to be low. However, the fishery has increased from 50–60 tows in 2011–2012 to about 120 tows in 2013.

The area open to bottom fishing, which also encompasses about half of the midwater effort, is a minority of the habitat type that is likely to contain VMEs. The New Zealand demersal fleet fished widely in the area from about 1980. The area that is fully open to demersal fishing represents about 17% of the historic footprint, with a further 17% being open to fishing but subject to a low-weight threshold move-on-rule specifically to protect benthic habitat and VMEs. There is also area outside of either of these footprints within the habitat range of VMEs that has never been fished. Given these considerations, the overall scale of the fishery can only be described as small and therefore unlikely lead to significant adverse effects on potential VMEs.

The overall level of benthic impact from this type of midwater trawling will not be zero but will be substantially lower than that caused by demersal trawling. Individual tows could have single or multiple ‘point’ contacts with the seabed by relatively large, heavy, mobile gear with the frequencies reported in this study. These findings indicate that an impact or risk rating higher that that previously given to midwater trawling in the Bottom Fishery Impact Assessment Standard (SPRFMO, 2012) would be appropriate. Using the scale of Chuenpagdee et al., 2003), as used in the SPRFMO Bottom Fishery Impact Assessment Standard (*op. cit.*), this study would suggest increasing the rating for this type of fishing from a value of 1 (very low) for both physical habitat and biological habitat, to a value of 2 (low) for both physical habitat and biological habitat.

There remains the question of whether the type and amount of benthic impact from midwater trawling of the type analysed in this paper is likely to cause significant adverse effects. Most of the evidence points to a level of impact that is some way below the threshold of significant adverse effect. This can be summarised as,

(i) the seabed contact is likely to be point contact, not the extended contact seen in most demersal mobile gear interactions with the seabed;

(ii) the frequency of contact (e.g. contact per 100 tows), as shown in Tables 3, 4, 7 and 8, is low when compared to other trawl fishing (e.g. the contact rate is 100% for demersal trawling);

(iii) the scale of the fishery is small (3 vessels or less, 80 tows and about 100 t catch per year);

(iv) the proposed impact rating of ‘2’ (see above) is low, a similar rating to that given to demersal longlines;

(v) there are spatial closures specifically to protect potential VMEs;

(vi) the area open to demersal fishing is a minority of the habitat suitable for VMEs in this bio-region, only about one third of the historic footprint is open to fishing and there are other areas that are not fished;

(vii) The area actually impacted by fishing (the area covered by the trawl track) is a small proportion of the area that is open for fishing.

(viii) interactions between point seabed contacts, which will be patchily distributed spatially, and potential VMEs, which will themselves be patchily distributed, are likely to be uncommon.

In conclusion, given the observed frequency of seabed contact when using midwater trawls to target alfonsino, it is considered that this type of midwater trawling does fall under the description of 'bottom trawling' as defined in CMM 2.03. The benthic impact this type of fishing exerts is higher than midwater trawling for pelagic species but substantially less than for demersal trawling, and a rating of '2' is thus proposed. It is, however, considered unlikely that this type of activity will cause significant adverse effects on VMEs.

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