Ministry for Primary Industries
Manatū Ahu Matua

Initial Position Paper on Management Controls for Hagfish Pots

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MANAGEMENT CONTROLS FOR HAGFISH

INTRODUCTION

1 The Ministry for Primary Industries (MPI) is seeking tangata whenua and stakeholder information and views on proposed management controls requiring escape holes in hagfish pots.

2 MPI proposes two options for management controls on hagfish pots (Table 1). Option 1 is the *status quo* and proposes to retain the current management regime (*i.e.* an open access fishery with no management measures). Option 2 proposes to set a minimum number of escape holes each with a minimum diameter. The minimum number of escape holes could be anywhere between 100 and 500, while escape hole diameter could be anywhere between 12 mm and 30 mm. MPI has a preference for setting an escape hole diameter of 30 mm, but that does not preclude the Minister for Primary Industries (the Minister) choosing any number within the range specified. These measures are proposed under section 11 of the Fisheries Act 1996 (the Act).

Table 1: Proposed options for management controls for hagfish

	Hagfish management measures
Option 1 (*Status quo*)	Fishery is open access with no management measures set. Density and diameter of escape holes are optional.
Option 2 (MPI preferred option)	Set a minimum of 100 - 500 escape holes for each hagfish pot, and a minimum escape hole diameter of 30 mm. This does not preclude the Minister from choosing a minimum diameter of between 12 mm and 30 mm, or any minimum number of holes between 100 and 500.

3 Evidence from hagfish fisheries overseas indicates that these species are highly susceptible to localised depletion and overfishing. Information available to MPI at this time indicates that targeted fishing pressure on hagfish is going to increase. Based on data collected, there is a high level of discarding in the fishery, and according to fisher interviews, these discards are predominately juveniles. Evidence from overseas suggests that hagfish may not survive when discarded at the surface as they are sensitive to fluctuations in temperature between the surface water and water at their natural depth. Furthermore, anecdotal evidence suggests that localised depletion may have already occurred during the 2009/10 fishing year. Together, this information highlights a sustainability concern for the common hagfish fishery.

4 Over the long term, the best framework available to MPI for managing the sustainable utilisation of hagfish is the Quota Management System (QMS). Hagfish, however, cannot be introduced into the QMS earlier than 1 October 2014, due to time constraints associated with this process.

5 In the short term, MPI considers that management measures are necessary to ensure survival of juvenile hagfish, and to mitigate risks to the sustainability of the fishery.

CONTEXT

Need to Act

6 MPI understands that industry is currently gearing up at least 5 vessels to target hagfish, with a goal of increasing target hagfish fishing in the immediate future.

7 Hagfish species are low productivity species. Their slow growth and low fecundity make them susceptible to overfishing and localised depletion. Most international hagfish fisheries have collapsed or declined. Anecdotal evidence suggests that areas targeted in the past remain depleted today. In addition to overall catch, the current catch of juveniles poses a risk to long term sustainability, given evidence that suggests this fishery is characterised by high discarding rates of juveniles.

8 Fishing gear used to target hagfish typically consists of pots 230 litres in size with up to four entrance funnels and up to 500 12 mm diameter holes used for sinking, drainage, and escape of very small individuals. The high incidence of juvenile hagfish caught in pots suggests that the escape hole size typically used in the NZ fishery is sub optimal for targeting market sized individuals.

9 The most appropriate management framework available to MPI for managing hagfish is the QMS; however, hagfish cannot be introduced into the QMS before 1 October 2014. MPI considers it is necessary to set measures to control the size and the number of escape holes in hagfish pots over the short term to facilitate the development of a sustainable hagfish fishery and maximise utilisation over the long term.

Management Approach

10 The hagfish fishery is currently an open access fishery. Hagfish species will be proposed for introduction to the QMS in 2014.

Biological Characteristics of Hagfish

11 Information available to MPI at this time on the biological characteristics of hagfish is limited. There are five described species of hagfish in New Zealand, and at least a further three undescribed species. MPI has limited information about the geographic ranges of New Zealand hagfish species.

12 The common hagfish (*Eptatretus cirrhatus*) is endemic to New Zealand. It appears to be the most abundant hagfish species in New Zealand waters, and the species most sought after in the hagfish fishery. MPI has no information on the population size of this hagfish species.

13 Hagfish are low productivity species. They are slow growing and slow to reproduce, developing roughly 20 – 30 large eggs at a time. Egg production can take up to 2 or 3 years, and evidence suggests that embryonic development is also slow, with early embryonic stages of the hagfish *E. burgeri*, for example, developing at only 7 months. Hagfish are not known to have a larval phase. For the common hagfish, females likely undergo their first spawning cycle at a length between 412 mm and 534 mm[1]. Males, however, do not develop gonadal tissue until considerably larger sizes than females (up to 600 mm), indicating that reproduction may not occur for a specific cohort until individuals are as large as 600 mm.[1]

14 Due to the slow growth rate of hagfish, negative impacts from fishing on the long term sustainability of hagfish fisheries may not be fully apparent for up to 10 - 15 years. It is important, therefore, to mitigate this risk before negative consequences are realised, and recruitment of new individuals into the population is too low.

15 Hagfish are not known to migrate. It is not known when or where hagfish reproduce in New Zealand, but evidence suggests that the common hagfish does not have a specific spawning season.[1]

16 As predators and scavengers, hagfish are an important link in benthic ecosystems. The impact of removing hagfish from these systems is unknown.

[1] Martini, F. and Beulig, W. (2013) Morphometrics and Gonadal Development of the Hagfish *Eptatretus cirrhatus* in New Zealand. PLoS ONE 8(11):e78740. doi:10.1371/journal.pone.0078740

Stock Status

17 There are no estimates of absolute or relative abundance of hagfish, and the level of natural mortality is unknown. There is insufficient scientific information available to calculate estimates of current biomass, maximum sustainable yield, or the biomass that can support maximum sustainable yield.

18 Catch trends provide some indication of current stock status. Catch reached a peak of 1275 tonnes in the 2009/10 fishing year (Figure 2). This suggests that hagfish could support a modest small scale fishery in New Zealand; however, it is important to note that international fisheries have developed similar levels of catch initially but could not be sustained. Anecdotal evidence suggests that areas targeted in the 2009/10 fishing year, when fishing pressure was high, remain depleted today. Furthermore, there is evidence[1] to suggest that at the peak in fishing effort, take was characterised by juvenile size classes and individuals that had not yet spawned.

Hagfish Fishery

19 Reported landings increased rapidly in the 2005/06 fishing year (Figure 1), but there is no evidence to suggest that hagfish were targeted before this point in time. Hagfish are also taken in small quantities as bycatch, primarily by bottom long line in the ling fishery, in pots in the rock lobster fishery, and by bottom trawl in the scampi fishery.

20 Hagfish fisheries are driven by an export market to Korea, where hagfish meat is considered to be a delicacy. Elsewhere hagfish skin is used as leather, but New Zealand hagfish is not used for this purpose as the skin is porous. Overseas demand has led to a fishery for hagfish developing in New Zealand waters that is responsible for varying levels of catch since 2005. Fishing has occurred primarily on the 500 metre depth contour on the north east coast of the North Island and the north west coast of the South Island (Figure 2). Levels of commercial catch have ranged from hundreds of tonnes to a maximum reported catch of 1,275 tonnes in recent years (Figure 1). Reported landings have decreased in recent years, though MPI understands that this is primarily due to a company going out of business. Five vessels (each fishing up to 950 pots) have reported fishing for hagfish during this period with additional vessels about to enter the fishery. MPI understands that two of the vessels responsible for the majority of catch in 2009/10 have permanently left the fishery.

Figure 1: Reported Catch Landings (tonnes) for hagfish from the 1999/00 fishing year to the 2011/12 fishing year

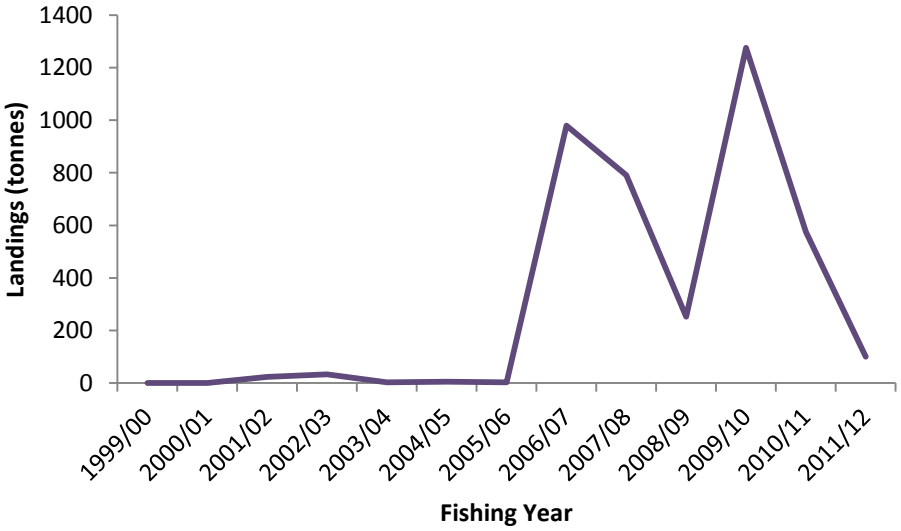
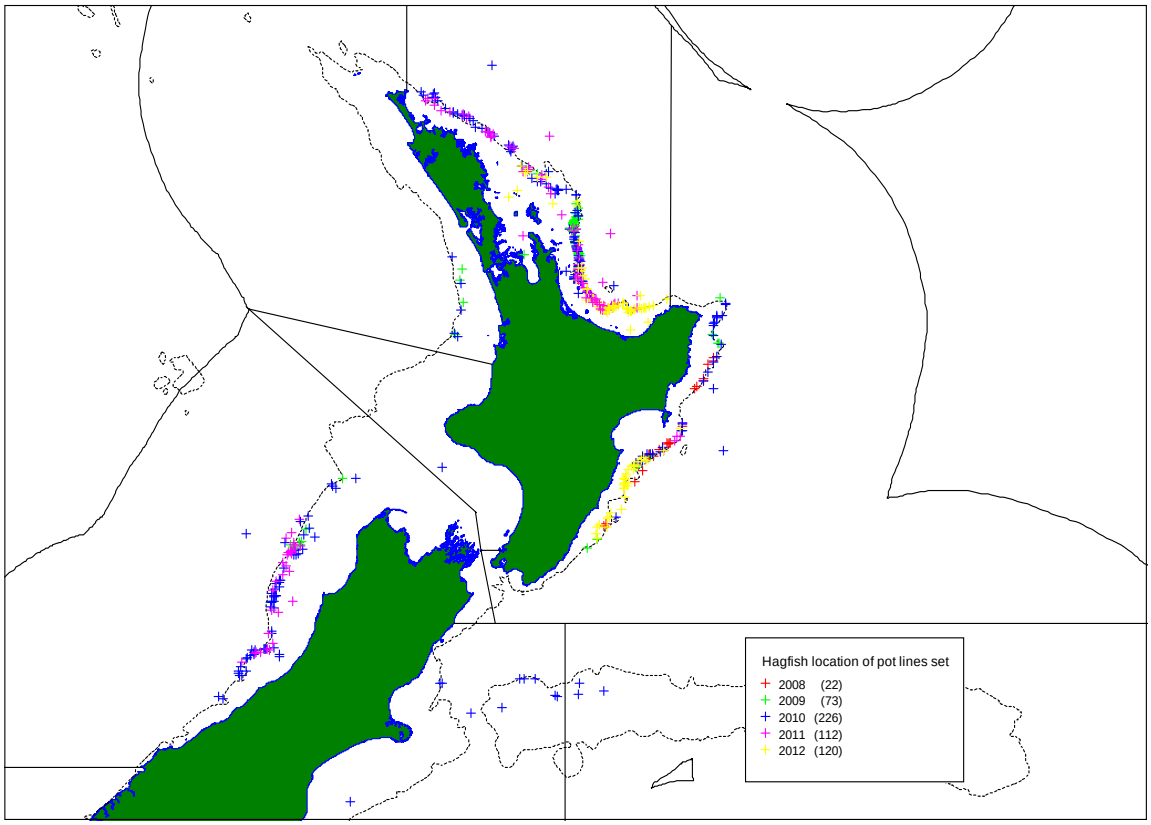


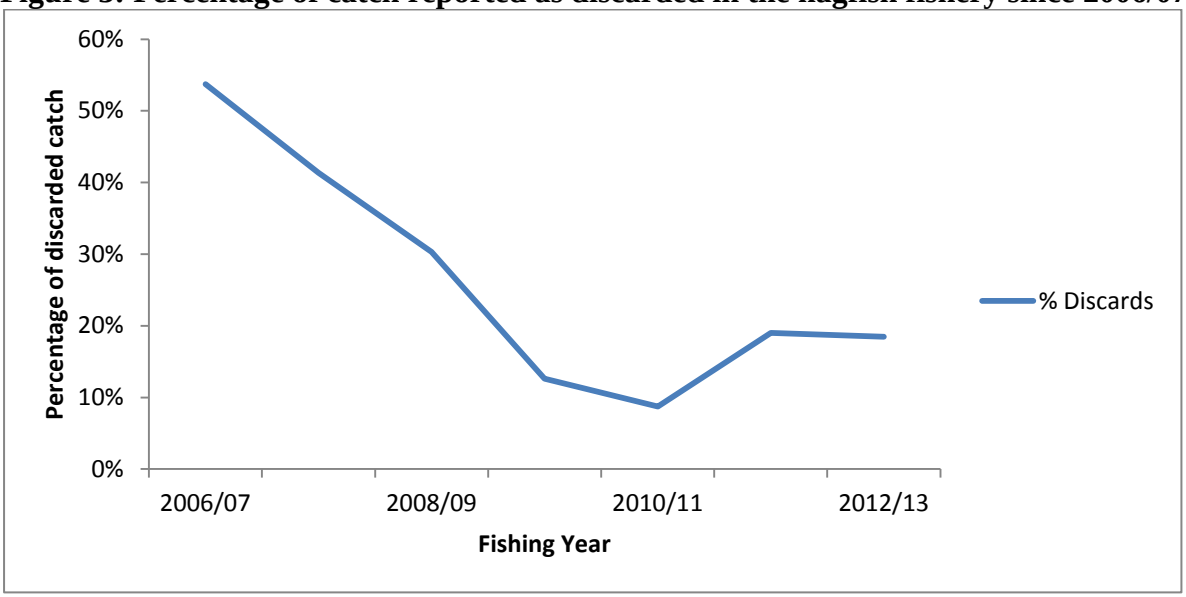
Figure 2: Distribution pot lifts set for target fishing for hagfish (with 500m depth contour) from the 2007/08 fishing year to the 2011/12 fishing year



21 Because fish of 400 grams or greater are preferred by the market, smaller hagfish are often discarded. The proportion of hagfish discarded has decreased from more than 50%

of the catch in 2006/07 to vary between 10% and 20% of the catch in recent years (Figure 3).

Figure 3: Percentage of catch reported as discarded in the hagfish fishery since 2006/07



22 There is potential for fishing related mortality from this level of discarding to be high. Evidence from overseas suggests that mortality of individuals discarded at the surface can be as high as 100% due to hagfish having a low tolerance to temperature fluctuations between surface water and their natural depth. MPI also understands that hagfish pots were lost in recent years, which can drive up levels of mortality as these pots continue to ghost fish (when lost fishing gear continues to trap and kill individuals).

Section 11 Sustainability Measures

23 Section 11 of the Act outlines a non-exhaustive list of sustainability measures that the Minister may set for a stock. It includes: the catch limit for a stock; the size, sex, or biological state of any fish that may be taken; the areas from which any fish may be taken; the fishing methods by which any fish may be taken or that may be used; and the fishing season.

24 MPI recognises that any of these measures may be used to address sustainability concerns for hagfish. However, MPI believes that many of these are unlikely to achieve the goal of minimising juvenile discarding and mortality.

25 MPI is aware that the primary risk of mortality facing juveniles discarded at the surface is a fluctuation in temperature between the surface water and their natural water temperature at depth. There is potential for seasonal measures to mitigate this risk by coordinating fishing effort to coincide with naturally low surface water temperatures.

However, MPI has insufficient information to propose such an option at this time. In addition, MPI is aware that there is a preference for target hagfish fishing to take place during the summer season due to market demand.

26 MPI has no information on juvenile distribution, and therefore cannot recommend area closures to promote juvenile survival at this time. A catch limit is not recommended as this would not prevent individuals from being discarded at the surface, and therefore not address the risk of mortality to juveniles. Sustainability measures relating to the size, sex, or biological state of fish that may be taken are not recommended for the same reason.

27 Overall, MPI considers that setting management measures for escape holes is the best option available in the short term to mitigate juvenile mortality and ensure the long term sustainability of the hagfish fishery.

Optimal Escape Hole Size

28 Studies on the optimal escape hole size for the New Zealand common hagfish have not been done. The only information MPI has to inform setting of escape hole size comes from studies done overseas on different species.

29 A study undertaken in the Atlantic hagfish (*Myxine glutinosa*) fishery on the east coast of Canada trialled escape hole sizes of 13.5 mm, 14.3 mm, and 15.1 mm.[2] In this study, the use of the 13.5 mm escape holes was not continued after the first commercial trip due to the high percentage of juveniles retained. There was a target minimum market size of 80g for this fishery. The traps with 14.3 mm diameter escape holes retained 33.9% of below market size individuals, while the 15.1 mm traps retained only 19.8% of below market size individuals. This indicates that escape holes with diameters up to 15.1 mm are preferable so as to raise the size of individuals landed and lower the number discarded on the surface.

30 Importantly, this study focussed on a Myxine species, known to be much skinnier and more elongated than Eptatretus species such as the New Zealand common hagfish. This is reinforced by the target minimum market size of 80g for this trial, which is small compared to the preferred market size of 400g in the New Zealand common hagfish fishery. This suggests that optimal escape hole size will be much larger for the New Zealand fishery than the study indicates. MPI is aware that in the *Eptatretus stoutii* fishery on the west coast of Canada, escape hole size diameter was increased from 15

[2] Grant, S., Hiscock, W., Bishop, G., and Rennie, S. 2009. Assessment of the Emerging Atlantic Hagfish (*Myxine glutinosa*) Fishery in NAFO Subdivision 3O: Year V. *Centre for Sustainable Aquatic Resources, Marine Institute of Memorial University of Newfoundland.* P-275.

mm to 30 mm in 1990. MPI proposes that a similar approach is appropriate for potting the New Zealand hagfish.

Proposed Response

31 MPI is consulting on the management options for the common hagfish set out in Table 1. MPI's preferred option is Option 2: to set a minimum number of between 100 and 500 escape holes, each with a minimum diameter of up to 30 mm. This does not prevent the Minister from selecting any dimension between 12 mm and 30 mm. Furthermore, if the Minister does decide to set a minimum diameter, this does not prevent fishers from using additional holes of a smaller diameter to facilitate sinking and drainage, so long as the minimum number of escape holes with a specified minimum diameter are used.

32 MPI has little information to inform the setting of a minimum escape hole size, but considers that there is a sustainability risk from continuing with the *status quo*. Therefore, MPI proposes setting a minimum escape hole size as soon as practicable and readdressing this measure as appropriate when information improves.

Option 1 (*Status quo*)

33 Option 1 is the *status quo*. Under this option, no management controls will be set for the hagfish fishery. MPI understands that fishers are currently using anywhere between 50 and 500 escapes holes with a diameter of ~12 mm to allow for very small hagfish to escape, and to aid sinking and drainage of the hagfish pots (Figure 4).

Figure 4: Plastic 230 litre pots typically used for hagfish potting (note inlet funnel and escape holes).

34 Option 1 poses a sustainability risk. There is compelling information that the current configuration of pots retains unacceptable levels of juvenile hagfish. This leads to a large proportion of the catch being subsequently discarded, with a low chance of survival.

35 Under Option 1, MPI expects fishers will continue to use current methods, and there will be no effort made to limit juvenile catch or minimise discarding. This option does not address the sustainability concern for this fishery.

Option 2 (MPI preferred option)

36 Option 2 proposes to set 100 – 500 as a minimum number of escape holes per pot, and to set a minimum diameter for each escape hole. MPI has a preference for a minimum escape hole diameter of 30 mm, but this does not prevent the Minister from choosing any dimension between 12 mm and 30 mm. Nor does it prevent fishers from using additional holes of a smaller diameter, so long as pots have at least the minimum number of escape holes with the minimum diameter that the Minister may choose to set.

37 MPI understands that a larger size of escape holes than currently used might be resisted by fishers, because a greater amount of bait will be lost outside the pots through more or larger escape holes and result in lower catch rates of hagfish. Submissions are invited on this issue.

38 Given the minimal information available for optimal escape hole size in the New Zealand common hagfish fishery, a relatively cautious approach should be taken to setting management measures, particularly for species with biological characteristics that make them vulnerable to fishing pressure, like hagfish. Option 2 is cautious and reflects that the best available information indicates hagfish are highly susceptible to localised depletion and overfishing. The proposal for a diameter of 30 mm is based off the best available information, which includes knowledge of fishing practices involving a minimum escape hole diameter of 30 mm for a similar hagfish species in Canada, and studies conducted on other hagfish species.

39 MPI understands that interest in the hagfish fishery is growing and expects fishing pressure to increase in the immediate future. Evidence suggests that the hagfish fishery in New Zealand is indiscriminate in targeting juveniles as well as adult hagfish. Given that MPI currently has no information on population size and the level of catch that can sustain the fishery, it is important to enact management measures that aim to reduce juvenile take and discarding over the short term, while better information is collected.

40 Option 2 is a more cautious option than Option 1, but MPI considers that such an approach is necessary to provide for long term utilisation of this fishery while ensuring sustainability, thus serving the purpose of the Act. This is particularly important to work towards while the fishery is still in the early development stages in most areas.

41 If the Minister decides to set a minimum number of escape holes with a minimum diameter, these will implemented as soon as possible following his decision by a notice in the *Gazette*.

ASSESSMENT AGAINST STATUTORY OBLIGATIONS

42 Section 11(1) of the Act allows the Minister for Primary Industries (the Minister) to set or vary any sustainability measure for one or more stocks or areas, after taking into account any effects of fishing on any stock and the aquatic environment, any existing controls that apply to the stock or area concerned, and the natural variability of the stock concerned.

43 Section 11(3) outlines a non-exhaustive list of sustainability measures that the Minister may set for a stock. It includes, but is not limited, to measures that may relate to fishing methods. Any such measures may be implemented by notice in the *Gazette* as proposed in this paper or by the making of regulations under section 298 of the Act.

44 In order to mitigate the impacts of fishing related mortality of juvenile hagfish, MPI considers it is necessary to set management controls on escape holes for hagfish pots. MPI is of the view that it is necessary to take the steps proposed in this paper to ensure the sustainability of the fishery. The biological characteristics and the overseas experience suggest that hagfish populations, as outlined in this paper, are vulnerable to localised depletion and collapse. MPI considers that the current measures in place are not sufficient to ensure the sustainability of the stocks given the predicted level of fishing effort expansion.

45 Section 11(2) states that before setting or varying any sustainability measure, the Minister shall have regard to any provisions of: any regional policy statements, regional plans, or proposed regional plans under the Resource Management Act 1991; any management strategy or plan under the Conservation Act 1987; sections 7 and 8 of the Hauraki Gulf Marine Park Act 2000; any regulations under the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012; and any planning documents lodged with the Minister of Fisheries (Minister for Primary Industries) by a customary marine title group under section 91 of the Marine and Coastal Area (Takutai Moana) Act 2011. MPI is not aware of any provisions that would impact on the proposals in this paper. MPI considers that there are no relevant conservation services, fisheries services or fisheries plans to be taken into account in considering the proposed sustainability measures.

46 Before implementing any s 11 sustainability measure, the Minister must consult with persons or organisations that have an interest in the stock or the effects of fishing on the aquatic environment in the area concerned, including Maori, environmental, commercial, and recreational interests, as well as provide for the input and participation of tangata whenua as required by s 12 of the Act.

FUTURE CONSIDERATIONS

47 The best framework available to MPI for managing hagfish is the QMS. MPI is also consulting on a proposal to introduce hagfish into the QMS, with a goal of introduction occurring on 1 October 2014.

CONCLUSION

48 Hagfish are becoming an increasingly popular target fishery. Scientific and anecdotal evidence indicates that hagfish are highly susceptible to overfishing and localised depletion. As the hagfish fishery is currently open access, this raises an immediate sustainability concern.

49 MPI proposes to set management controls for escape holes on hagfish pots. By setting a minimum number of escape holes coupled with a minimum diameter for each escape hole, MPI aims to maximise juvenile survival and minimise discarding. MPI believes this will promote the long term sustainable utilisation of this fishery.