Ministry of Fisheries
Te Tautiaki i nga tini a Tangaroa

Introduction of Bladder Kelp Seaweed, *Macrocystis pyrifera* (KBB), in Fisheries Management Areas 3 and 4 into the Quota Management System on 1 October 2010

Initial Position Paper

21 August 2009

New Zealand Government

Executive Summary

1 The purpose of this document is to commence a consultation process on behalf of the Minister of Fisheries (the Minister) on a proposal to introduce bladder kelp (*Macrocystis pyrifera*) in Fisheries Management Areas (FMAs) 3 and 4 into the Quota Management System (QMS) on 1 October 2010.

2 This step is in accordance with s 19(7) of the Fisheries Act 1996 (the Act).

3 The proposal is restricted to the attached (growing) seaweed stage only. The Ministry of Fisheries (MFish) proposes to continue to manage the free-floating and beach-cast seaweed states under the non-QMS framework.

4 This document outlines the rationale for managing attached bladder kelp within the QMS, and proposes Quota Management Areas (QMAs), a 1 October to 30 September fishing year, and using greenweight as the unit of measure to express the Total Allowable Catch (TAC) and Annual Catch Entitlement (ACE).

5 If the Minister agrees to introduce attached bladder kelp in FMAs 3 and 4 into the QMS, then these two stocks will be notified by *Gazette*. MFish will then consult in 2010 on supporting management measures for this fishery including the setting of a TAC and allowances.

6 If the Minister decides not to introduce these bladder kelp stocks into the QMS, he is required to remove these stocks from Schedule 4C of the Act and provide for an open-access fishery.

7 MFish notes that the harvest of bladder kelp has economic growth potential for New Zealand. However, this seaweed is an important habitat-forming species and its total harvest will need to be carefully managed to ensure its sustainability, as well as the fisheries resources it supports.

8 MFish welcomes your comments on this proposal to assist the Minister to make a determination under s 17B of the Act on whether to introduce attached bladder kelp in FMAs 3 and 4 into the QMS framework.

9 Stakeholders are requested to forward their comments on this proposal by **21 September 2009** to:

Tracey Steel
Ministry of Fisheries
PO Box 1020
Wellington

or by e-mail to tracey.steel@fish.govt.nz.

10 A copy of this document can be found at www.fish.govt.nz by clicking on the 'consultations' link.

Introduction

11 Over the past 10 years, MFish has undertaken a programme to introduce species into the QMS as part of its strategic direction to manage fisheries under the QMS framework and to meet its obligations to Maori under the Deed of Settlement.

12 MFish considers the QMS framework generally provides the best means of meeting the purpose of the Act – to provide for utilisation while ensuring sustainability. However, MFish acknowledges the QMS may not always be the most appropriate framework to manage some species and stocks, and that other methods of active management, or indeed no active management, may be most appropriate.

13 MFish is required to consider introducing bladder kelp in FMAs 3 and 4 into the QMS for two reasons:

a) A settlement (26 November 2008) between MFish and Mr R Beattie regarding historic seaweed permitting decisions requires the Minister to consider introducing bladder kelp in FMAs 3 and 4 into the QMS. This decision must be made pursuant to s 17B(1) of the Act during the 2008-09 fishing year; and

b) MFish considers there is growing demand for attached bladder kelp in FMAs 3 and 4 and this will require active management to ensure sustainable use.

14 MFish will also use this proposal to help inform of your views about how government should manage other bladder kelp stocks and seaweed species with high value in the future. Depending on feedback received on this proposal, MFish will consider further QMS introductions for seaweeds in the future.

Background Information

Species and state

15 Bladder kelp is a large seaweed occurring throughout New Zealand. This seaweed occurs predominately in coastal waters around southern North Island, the South Island, Chatham Islands, Stewart Island, and New Zealand's sub-Antarctic islands.

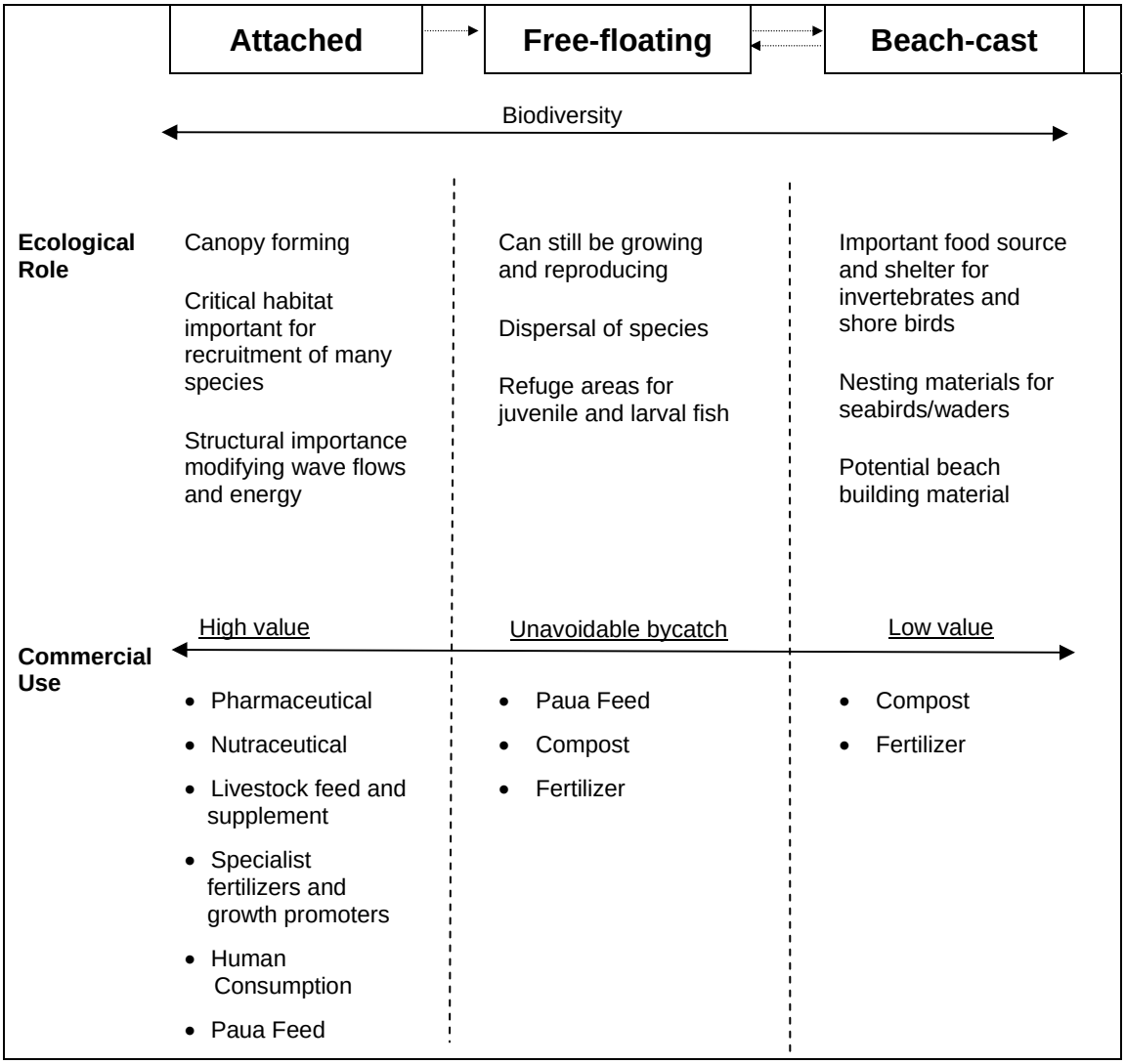
16 Individual plants can grow up to 20 metres in length and is one of the fastest growing seaweed species in New Zealand (growing in length of up to 1 metre each day). Bladder kelp typical occurs in dense stands and is the predominate habitat-forming species in many areas.

17 Bladder kelp, like all other large seaweeds, occurs in one of three states – attached (growing) to the substrate, free-floating, and beach-cast.

18 Each seaweed state provides an important ecological role within the marine ecosystem. Bladder kelp forests form extremely productive communities, turning over their biomass many times each year. A significant proportion of the annual kelp production becomes free-floating and beach-cast in response to storm events, seasonal mortality, or senescence.

19 The key characteristics of each seaweed state are described in Figure 1.

Figure 1 Key characteristics of each seaweed state



20 The attached (or standing/growing) state plays a critical role in coastal, inshore and estuarine ecosystems providing food, shelter and habitats for a very wide range of micro- and macro-fauna including various fish and shellfish species of high social, cultural and economic value. Kelp beds play a very important role in modifying the coastal environment by influencing water temperature, clarity, wave action, and tidal movements.

21 The free-floating stage provides a food source for a variety of organisms including kina and paua. The floating stage can also play a significant role in the dispersal of invertebrates and juvenile fish.

22 The beach-cast stage is either washed back into the sea over subsequent tidal cycles or remains in the beach environment, where it is incorporated into physical beach processes, or into the terrestrial or marine food webs through consumption and decomposition. Beach-cast material can support a diverse ecology of organisms through nutrient cycling

and decomposition including various micro- and macro-fauna, and if washed up high enough on the beach, it can provide habitat for sand dune formation.

23 Because bladder kelp is essential to the functioning of coastal and inshore marine ecosystems, the harvest of this species must be carefully managed to ensure sustainability of the seaweed species harvested and the diverse range of aquatic communities it supports.

Current Access Arrangements to Bladder Kelp

Commercial access

24 Bladder kelp (as well as all other seaweeds) is currently managed outside the QMS.

25 The statutory regime controlling the commercial harvest of bladder kelp relies on a permitting regime. The Act prescribes that no person shall take any bladder kelp for the purpose of sale unless that person does so under the authority of, and in accordance with, a current fishing permit issued under s 91[1] of the Act.

26 However, a moratorium[2] currently applies to the issue of new fishing permits to 'target' bladder kelp (*refer* Schedule 4C of the Act). Bladder kelp is a moratorium species as it has been identified as being vulnerable to sustainability risk in an open-access permit environment and to ensure these risks are adequately managed while being considered for introduction into the QMS.

27 Commercial fishers authorised to target bladder kelp pre-1992 can continue to take this seaweed in accordance with fishing permits issued under s 91. There are only two commercial fishers authorised to target bladder kelp in FMA 3 and one commercial fisher authorised to target bladder kelp in FMA 4.

28 Notwithstanding the above, commercial fishers are, however, entitled to take bladder kelp providing:

i) It is harvested as an inevitable consequence of the taking of other fish, aquatic life or seaweed under the authority of, and in accordance with, a current fishing permit, or

ii) It is harvested in a 'beach-cast state' only and that it is taken from within an approved commercial seaweed harvest area as defined in the *Fisheries Beach-cast Seaweed Area Prohibition Notice 2005*.

29 The following are approved commercial seaweed harvest areas in FMA 3:

a) The 'coastal area' between Haumuri Bluffs (approximately 42º33.9'S and 173º30.3'E) and the Waipara River (approximately 43º09.2'S and 172º48.1'E).

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[1] Section 89(1) of the Act provides an exemption for any seaweed species belonging to the Class Rhodophyceae (ie, red seaweeds) and is unattached and cast ashore;

[2] Commercial access to bladder kelp (as well as the other main seaweed species) has historically been constrained by moratoria on new fishing permits. The most recent of these was implemented in 1992. While this moratorium was lifted for non-QMS stocks from 1 October 2004, it remains in place for a few non-QMS stocks (Schedule 4C), including bladder kelp, where there is deemed to be a level of risk with an open-access permit regime

b) The ‘coastal area’ between Akaroa Head and the Waitaki River (approximately 44º56.3'S and 171º08.9'E), excluding within 1 kilometre of the banks of Ashburton River, Rangitata River, Washdyke Lagoon and Wainono Lagoon.

c) The ‘coastal area’ between Cape Wanbrow (approximately 45º07.7'S and 170º58.8'E) and Shag Point (approximately 45º27.9'S and 170º49.2'E).

30 There is presently no approved commercial seaweed harvest area in FMA 4.

31 Commercial fishers must land all bladder kelp catches to a licensed fish receiver and must comply with all recordkeeping provisions.

32 The Ngai Tahu Deed of Settlement requires MFish to ‘decommercialise’ several individual seaweed species. Bladder kelp is not one of these species and can be taken for commercial purposes within FMAs 3 and 4.

Non-commercial access

33 The harvest of bladder kelp by customary Maori and recreational fishers is unrestricted. Any non-commercial fisher can harvest bladder kelp in any state, from harvest area, and in any quantity.

Current and Future Demand for Bladder Kelp

34 Commercial catches of bladder kelp in FMAs 3 and 4 are relatively small. Specific catch, effort and landing information is unable to be disclosed for privacy and commercial sensitivity reasons as it is attributed to less than three fishers.

35 There is an increasing domestic and international market demand for seaweeds, including bladder kelp. This demand for seaweed is due to the ever-increasing use of compounds derived from seaweed for a wide range of value-added products for human consumption, aquaculture, pharmaceuticals and cosmetics.

36 The value derived from seaweed is likely to fall on a continuum; with attached seaweed having the highest value and beach-cast seaweed for composting purposes having the lowest value. While much of the domestic demand for seaweed is presently supplied by beach-cast material, the demand is greatest for attached seaweeds for the following two reasons:

- The quality of beach-cast and free-floating seaweed broken from attached plants is generally not as high in comparison with attached seaweed. This is particularly the case when seaweed is required for human consumption and pharmaceutical purposes; and

- Both quantity and consistency of supply of beach-cast and free-floating seaweed is frequently sporadic and generally coincides with storm events. Seaweed-based industries generally require consistent supply of seaweed material.

37 MFish is aware of a proposal to develop substantial bladder kelp fisheries in FMAs 3 and 4 based on the attached state only. Presently, these fisheries are unable to develop under the current non-QMS regime where access is generally limited to the beach-cast state only.

38 Both customary and recreational fishers may consider bladder kelp to be of high importance in some areas. Maori historically used seaweeds for food and other uses. Recreational

fishers typically gather seaweeds after storm events to provide fresh compost material for gardens and vegetable plots.

Introducing bladder kelp in FMAs 3 and 4 into the QMS

39 Section 17B of the Act sets out the criteria for assessing whether a species or stock should be managed under the QMS.

40 In the case of bladder kelp in FMAs 3 and 4 (which is on schedule 4C), s 17B provides that the Minister must determine to make these stocks subject to the QMS, unless he determines that the purpose of the Act would be better met by setting one or more sustainability measures[3] under s 11 (other than a TAC set under s 13 or s 14).

41 If the Minister decides not to introduce these bladder kelp stocks into the QMS, he is required to remove these stocks from the permit moratorium and provide for open-access.

42 MFish's preference is that stocks are managed under the QMS because this framework and its associated rights[4] generally provide the best long-term use and sustainability outcomes. However, MFish recognises the QMS may not always be suitable and that s 11 management measures alone may better meet the purpose of the Act for some species or stocks. This is particularly the case for low value species where both demand and sustainability risk are low, and where the additional administrative costs imposed on fishers by the QMS (ie, ACE balancing and additional reporting) do not warrant the benefits of QMS entry and may in fact impede utilisation.

43 MFish assesses each of the bladder kelp states (attached, free-floating and beach-cast) against the legislative criteria for introduction into the QMS. This approach is necessary because the different states have different sustainability risks and use opportunities, and may benefit from different management approaches.

Assessment of attached bladder kelp

MFish's initial view

44 Attached bladder kelp is the most vulnerable of the three seaweed states and is also likely to be subject to most demand in future. Therefore, the attached state will require the most active management to ensure sustainable use.

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[3] Section 11 (3) Without limiting the generality of subsection (1) of this section, sustainability measures may relate to—

(a) The catch limit (including a commercial catch limit) for any stock or, in the case of a quota management stock that is subject to section 13 or section 14 of this Act, any total allowable catch for that stock:

(b) The size, sex, or biological state of any fish, aquatic life, or seaweed of any stock that may be taken:

(c) The areas from which any fish, aquatic life, or seaweed of any stock may be taken:

(d) The fishing methods by which any fish, aquatic life, or seaweed of any stock may be taken or that may be used in any area:

(e) The fishing season for any stock, area, fishing method, or fishing vessels.

[4] Under the QMS fishers are allocated rights in perpetuity to harvest a quantity of a species within a given management area referred to as a QMA. Rights create positive incentives for quota owners to manage their fishing activities to ensure the long-term sustainability of the fisheries resource. Because quota owners have confidence of supply, the QMS provides better incentives to invest in research to maximise sustainable use and improve the value obtained from a fishery. Because quota is transferable the use of the resource tends to move to the most efficient user over time. Rights also provide better incentive for fishers to take collective action to improve management outcomes.

45 MFish's initial position is to recommend that the Minister agrees to introduce attached bladder kelp in FMAs 3 and 4 into the QMS. MFish considers for attached bladder kelp that the purpose of the Act would be better met by introduction to the QMS than only s 11 measures alone.

Discussion

46 There is a market demand for attached seaweeds like bladder kelp for use in value-added production. However, to achieve the value potential of this fishery, a robust management framework is necessary ito create incentives and confidence for business to invest in the following:

- Research necessary to prove up the fishery to maximise sustainable yield;
- Infrastructure to efficiently harvest and process the product; and
- Market development and R&D to improve the value of production.

47 The rights associated with the QMS framework create better incentives and confidence for business to invest than an open-access fishery managed using s 11 measures. Under open-access, business cannot ensure consistency of supply because fishers are competing to take the total catch limit. Without certainty of supply, the incentives to invest in developing the value of a fishery are greatly lessened.

48 Attached seaweeds are an important component of the marine ecosystem. MFish considers uncontrolled harvest under an open-access regime has the potential to cause significant risks to both the standing stock and aquatic environment. Management of these risks is best achieved through the QMS framework by setting of appropriate TACs. The QMS also provides incentives for rights holders to invest in the development of best fishing practices to maintain sustainability while ensuring maximum yield. An open-access competitive fishery is unlikely to result in as good sustainable use outcomes.

49 MFish considers for bladder kelp in FMAs 3 and 4 that the purpose of the Act is better provided for by managing the attached state within the QMS because:

- The demand for this resource is likely to grow;
- There is potential to develop additional value in this fishery; and
- There are sustainability risks associated with the harvest of attached seaweeds,.

50 Introducing attached bladder kelp into the QMS will impose higher administrative costs on fishers than s 11 measures. However, the additional costs in this case are outweighed by the benefits derived in having a rights-based QMS system.

51 MFish is not aware of any other issues that would prevent bladder kelp in FMAs 3 and 4 from entering the QMS.

Assessment of free-floating bladder kelp

MFish's initial position

52 MFish's initial position is to not recommend introducing free-floating bladder kelp into the QMS because the purpose of the Act would be better met by setting sustainability measures under s 11.

53 MFish expects demand for free-floating bladder kelp to be low. The sustainability risks are also less than for attached seaweed. MFish is also concerned the additional costs imposed by managing free-floating bladder kelp in the QMS may impact on the economic viability of using this low value resource.

Discussion

54 Free-floating bladder kelp is an important source of detritus in marine ecosystems and ultimately the source of beach-cast seaweed (which is important part of beach ecology). The risks to sustainability of harvesting free-floating bladder kelp, however, are less than for the harvest of attached bladder kelp. MFish also expects the demand to harvest free-floating bladder kelp in FMAs 3 and 4 will be low because:

- The value of free-floating bladder kelp is low and generally would only be used to make compost and fertiliser;
- It is difficult to develop a business around a resource with unpredictable supply and quality; and
- It will be more cost effective to harvest detached bladder kelp from the beach (where it becomes concentrated) rather than targeting free-floating weed using a boat or net.

55 Because demand is likely to be low, competition between fishers for the use of this resource is not expected to be significant in the near-term. Sustainability and use risks would therefore likely be adequately managed through the use of s 11 measures such as closed areas and catch limits. Section 11 measures are currently working well for the management of beach-cast seaweeds (see discussion below).

56 MFish is also concerned that the additional administrative costs imposed by QMS introduction (ie ACE balancing and additional reporting) may impact on the future economic viability and use of this low value resource.

57 Introducing free-floating bladder kelp into the QMS would also likely increase costs for near shore trawl and set net fisheries because of bycatch issues. Fishers who incidentally catch free-floating bladder kelp in their nets would be required under the QMS to balance free-floating bladder kelp against ACE.

58 Differentiating between free-floating and attached bladder kelp will be extremely difficult for fisheries officers asked to monitor compliance with commercial reporting requirements. MFish recognises these difficulties and will look to mitigate the potential negative impacts of this delineation of origins when further work on implementation begins.

59 MFish still considers that s 11 measures would better meet the purpose of the Act for free-floating bladder kelp rather than introduce into the QMS because:

- Demand is expected to be low and s 11 measures will adequately manage sustainability risks;
- The additional administration costs associated with the QMS would likely impact on the economic viability and use of this low value fishery; and
- Introduction into the QMS would also likely increase costs for inshore trawl and net fishers due to the need to balance free-floating bladder kelp taken as an incidental bycatch against ACE.

60 MFish will continue to monitor the use of free-floating bladder kelp in FMAs 3 and 4 and will reconsider introducing the free-floating state into the QMS if sustainability and utilisation risks are identified in future.

Assessment of beach-cast bladder kelp

MFish's initial position

61 MFish's initial position is to not introduce beach-cast bladder kelp into the QMS because the purpose of the Act would be better met by setting sustainability measures under s 11.

62 The current management of beach-cast seaweeds using s 11 measures appears to be adequate. MFish is also concerned the additional costs imposed by QMS introduction on beach-cast seaweed fishers may impact on the economic viability and continued use of this low value resource.

Discussion

63 MFish currently manages all beach-cast seaweed, regardless of species, as a single management unit using s 11 measures (ie, commercial fishers report beach-cast seaweed catches under a single reporting code '*SEO*' regardless of species composition).

64 It would be administratively difficult to separate the management of beach-cast bladder kelp from the management of beach-cast seaweed generally. Separating bladder kelp would raise issues of seaweed identification and would increase harvest costs for fishers taking beach-cast seaweed due to the need to sort seaweeds. Costs would also increase if beach-cast bladder kelp was introduced in the QMS due to additional administrative costs (ie ACE balancing and additional reporting).

65 MFish considers the current management of beach-cast seaweeds nationally using s 11 measures has worked since its inception in 2002 and the risks of not providing for use or sustainability are low at this time.

66 Beach-cast seaweed is a low value fishery primarily used to make compost and fertiliser. This seaweed is cheaply harvested and simply scooped off the beach following storm events with little in the way of sorting or identification. Demand is currently low to medium and there is little known competition between fishers for catch. Demand is not expected to increase significantly because of the difficulties of developing a business around a resource with unpredictable supply and quality.

67 Introducing beach-cast bladder kelp into the QMS would add additional costs to fishers that may impede utilisation opportunities for this low value resource (ie, increasing costs could impact on the economic viability of the current businesses using beach-cast seaweed).

68 If the future demand for beach-cast seaweed increases MFish can consider again introduction into the QMS.

Conclusion

69 On the basis of the above analysis, MFish's initial position is to recommend that:

- The Minister introduces attached bladder kelp in FMAs 3 and 4 into the QMS. The QMS will provide the best means to achieve the purpose of the Act and will enabling fishers to maximise value while ensuring sustainability;

- The Minister agrees to manage free-floating and beach-cast bladder kelp outside of the QMS using s 11 measures. Section 11 measures better meet the purpose of the Act for these states; and

- MFish will continue to monitor the use of free-floating and beach-cast seaweeds in FMAs 3 and 4 and will reconsider introducing these states into the QMS if sustainability and utilisation risks are identified in the future.

70 MFish will investigate whether free-floating seaweeds should be to managed as a single unit and probably in conjunction with beach-cast seaweeds

Proposed Quota Management Areas

71 The biological characteristics of bladder kelp suggest it should be managed on a small spatial scale as it is vulnerable to local over-harvesting. MFish considers that QMAs for this species should provide the boundaries within which quota owners and stakeholders can practice small-scale management and adaptively move to smaller stock management over time, using fisheries plans, alteration of QMAs and other measures within the Act.

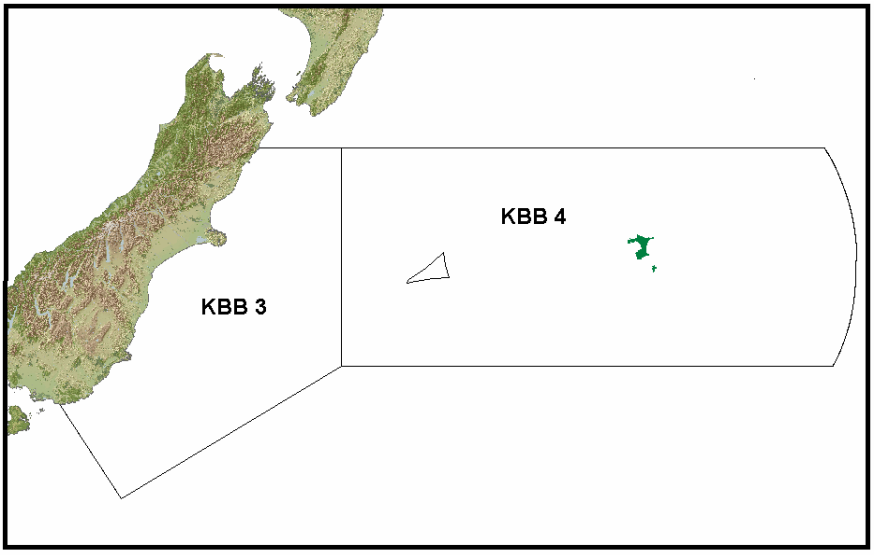
72 The Act sets out two statutory obligations that must be considered when defining QMAs:

- As far as practicable, the same QMAs should be maintained for different species (s19(2)); and

- A separate QMA may be set for the waters around the Chatham Islands if the stock can be managed effectively as a unit (s 19(3)).

73 In considering these statutory obligations, MFish proposes QMAs for attached bladder kelp stocks under review based on standard FMAs 3 and 4 boundaries. The proposed QMAs are shown in Figure 2.

Figure 2 Proposed QMAs for attached bladder kelp in FMAs 3 and 4



74 The proposed QMAs align to existing FMAs 3 and 4 boundaries for the other seaweed species on Schedule 4C.

Fishing Year

75 The proposed fishing year for bladder kelp is from 1 October to 30 September.

Unit of Measure

76 The proposed unit of measure is greenweight.

Next Steps

77 The next steps in the process of determining whether attached bladder kelp in FMAs 3 and 4 should be introduced into the QMS on 1 October 2010 are as follows:

a) Following the consultation period, ending 21 September 2009, MFish will submit final advice and recommendations to the Minister on the proposed QMAs, fishing year, unit of measure, and an assessment in accordance with s 17B of the Act.

b) If the Minister agrees that attached bladder kelp in FMAs 3 and 4 should be introduced into the QMS, then a Declaration Notice will be published in the *Gazette* that will contain the stocks' introduction date, QMAs, fishing year, and unit of measure.

c) In the event that attached bladder kelp in FMAs 3 and 4 is gazetted to become QMS stocks, MFish will consult on the proposed management measures that will apply, including the TAC and allowances, and aggregation limits. Alternatively, if these stocks are not gazetted, MFish will begin steps to remove bladder kelp in FMAs 3 and 4 from Schedule 4C (this will enable the issue of new fishing permits to take these stocks).

BLADDER KELP – *MACROCYSTIS PYRIFERA* – (KBB)

Species

78 *Macrocystis pyrifera* is a member of the kelp order Laminariales, and belongs to the family Lessoniaceae. This species is also found in south-eastern Tasmania, southern South America (to Peru on the west coast and to 50°S on the east coast), and in the northern hemisphere from California to Baja.

Biological Summary

Distribution

79 *Macrocystis pyrifera* occurs in the southern North Island around Cook Strait (from Kapiti Island on the west coast to Castlepoint on the east coast), South, Stewart, Chatham, Bounty, Antipodes, Auckland and Campbell Islands (Adams 1994). The distribution is patchy and there is both seasonal and interannual variation in abundance (Hay 1990, Pirker *et al*. 2000).

80 *Macrocystis* frequently forms colonies or large populations in calm bays, harbours or in sheltered offshore waters. It can tolerate a wide range of water motion including areas where tidal currents reach 5-7 knots (Hay 1990). Smaller thalli can be found in shallow pools and channels and there are free-living populations known from Port Pegasus and Paterson Inlet on Stewart Island.

81 Devinny & Volse (1978) studied the impact of sediments on the development of *M. pyrifera* gametophytes and found that sediments interfered with the settlement of spores and the process of attaching to substrate, as well as negatively effecting sporelings that had already settled. In the presence of water motion, sediments had a scouring effect on sporelings and survivorship was reduced.

Reproduction

82 This species has a diplobiontic, hetermorphic life history in which the conspicuous sporophyte phase alternates with a microscopic, dioecious gametophyte phase. Sori are produced on basal sporophylls.

Age and growth

83 *Macrocystis* thalli are perennial and grow to 20 m in length. A number of studies of *Macrocystis* in New Zealand have examined growth characteristics (e.g. Rapson *et al*. 1942, Moore 1942, Kain 1982, Nyman *et al.* 1990, 1993; DeNys *et al.* 1990, 1991, Brown *et al.* 1997). For *M. pyrifera* the seasonal pattern of blade relative growth rate (RGR) in Otago Harbour varies between years. Blade RGR's during 1986-87 were similar year-round except for summer when lower rates were recorded, leading Brown *et al.* (1997) to conclude that this pattern represented N-limited growth similar to that of *M. pyrifera* in California. However, ongoing work on a nearby *M. pyrifera* population indicates that between 1998-2000, blade RGR was light-limited during winter and N-limited from mid-summer, a pattern consistent with *M. pyrifera* from British Columbia, Canada (Wheeler and Srivastava

1984) and the Falkland Islands (van Tussenbrook 1989) (Hurd pers. comm.). The high inter and intra-annual variation seen in growth rates of *M. pyrifera* illustrate the importance of long-term (> 1-year) monitoring to gain a thorough understanding of seasonal patterns. Seasonal patterns of nitrogen-limited growth can be implied from the ratio of tissue carbon (C) and nitrogen (N) (C:N) with higher ratios indicating greater N-limitation. For the Order Laminariales, 10-15 indicates N-sufficiency, 16-20 indicates mild N-limitation while values of >25 indicate severe N-limitation. For *Macrocystis pyrifera* from Otago Harbor, the maximum C:N ratio is rarely >20 indicating only mild N-limitation of growth in summer.

84 McCleneghan & Houk (1985) examined the impact of canopy removal on holdfast growth in *M. pyrifera* in California and concluded that kelp canopy removal reduces hapteral divisions thus slowing holdfast growth, an impact that was still apparent six weeks following harvest. However Barilotti *et al*. (1985) found no effects of harvesting on hapertal elongation and branching as well as on plant survivorship.

Relationship with other species

85 *Macrocystis* forests are characterised as being amongst the most productive marine communities in temperate waters. Schiel & Foster (1992) state "the high productivity and habitat complexity of these plants contribute to the formation of diverse communities with considerable ecological, aesthetic and economic value. Moreover, food and habitat are exported from kelp forests to associated communities such as sandy beaches and the deep sea."

86 Along the east coast of the South Island the major understorey species associated with *Macrocystis* forests are the brown algae *Ecklonia radiata* and *Carpophyllum flexuosum*, along with a rich fauna of sessile invertebrates (Pirker *et al.* 2000).

87 Small scale harvesting experiments carried out in Akaroa Harbour showed that "harvesting canopy biomass had no measurable effect on *Macrocystis* plants, and the dominant understorey species" (Pirker *et al*. 2000).

Biomass Estimates

88 Maximum biomass of *Macrocystis* occurs in the winter months (Cummack 1980, Pirker *et al.* 2000). Pirker *et al.* noted that marked differences can exist in the demography of *Macrocystis* at a spatial scale of only a few kilometres – and that beds decline and regenerate at different times. In the Akaroa Harbour sites they studied they concluded that no one forest is capable of supporting the removal of consistent amounts of canopy, although two harvests could be sustained per year – one in late spring/early summer just prior to frond senescence and then another cut in late autumn/early winter.

Assessment and catch summary

Previous assessments

89 No previous assessments of commercial catch. Experimental harvest data present in Cummack (1980) and Pirker *et al*. (2000).

Commercial catches

90 Table below shows reported *Macrocystis* landings (reported as KBB on QMRs) - reported by greenweight (tonnes) by fishing year. Blank cells indicate nil catches.

	01-02	02-03	03-04	04-05	05-06	06-07	07-08
KBB1							
KBB2	0.07	0.2					
KBB3	104.5	37.0	7.5	17.9	2.8	8.4	6.4
KBB4	0.3						2.1
KBB5	1.3	2.3	2.6	3.2			
KBB6							
KBB7							

General Issues

91 Pirker *et al.* (2000) concluded that sustainable harvest of *Macrocystis* is possible in New Zealand using similar strategies to those employed by the State of California for the *Macrocystis* beds there. They considered that a combination of aerial photography and *in situ* measurements provide an easy method for assessing canopy biomass. They caution, however, that high levels of annual variation in canopy biomass, within and between forests, necessitates the need for annual stock assessments at a population scale until a better understanding of variability is reached.

92 Pirker *et al.* provide detailed options for harvesting strategies for the Banks Peninsula sites studies. They also consider that harvesting of other *Macrocystis* forests should not be allowed before stock assessment surveys have been carried out.

References

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