Ministry for Primary Industries
Manatū Ahu Matua

Report of the Technical Advisory Group 2019 on a Return to Flat Oyster Farming

23–27 September 2019

Produced for Biosecurity New Zealand to inform advice to the
Bonamia Programme Governance Group

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Executive summary

This document reports on discussions from meetings convened in September 2019 of the Technical Advisory Group on the Risk of Farming Flat Oysters (TAG 2019).

New Zealand differs substantially from many other countries where oyster culture occurs. New Zealand has several wild fisheries that persist without the enhancement of stock, spat or settlement substrata. These fisheries are important to commercial, recreational and indigenous (customary) fishers, and to the ecology of the systems of which they are a part. These oyster fisheries are of high socio-economic and cultural importance. The recent *Bonamia ostreae* (*B. ostreae*) incursion poses as substantial threat to these fisheries. The *B. ostreae* Programme's main objective is to protect uninfected wild oyster populations from *B. ostreae*. This is to be achieved through six specific objectives:

- restrict the spread of *B. ostreae* from existing infected areas;
- prepare for potential future infections and outbreaks;
- protect customary, recreational and commercial fisheries from *B. ostreae*;
- protect cultural rights in regard to flat oysters;
- enable future oyster farming opportunities, where appropriate; and
- promote biosecurity best practice and improve biosecurity practices in major risk groups, to reduce the risk of transmitting *B. ostreae*.

The purpose of TAG 2019 is to provide scientific and technical advice to the *Bonamia* Programme Governance Group on the question of farming flat oysters (*Ostrea chilensis*) in New Zealand. TAG 2019's specific role is to assist the Governance Group to consider if, where and when it may be appropriate for flat oyster farming to occur.

The Terms of Reference for TAG 2019 required the provision of advice on:

- the level of risk that flat oyster farming poses to uninfected wild oyster populations and the Bluff oyster fishery;
- whether the risk posed differs between areas or under different farming approaches;
- the tools and mitigations available to reduce any risk, including the efficacy of these options.

Specific questions that MPI asked TAG 2019 to address resulted in TAG 2019 providing recommendations on:

- the safest places to start flat oyster farming in New Zealand;
- the level of risk that the re-establishment of flat oyster farming poses to uninfected oyster populations in areas where *B. ostreae* has been detected;
- the differences in risk between Marlborough Sounds and Big Glory Bay, Stewart Island.

Conclusions of the Technical Advisory Group

1. The risk posed by the development of flat oyster farming in New Zealand is location specific and, if unmitigated, is high and unacceptable. Addressing this risk is going to involve all marine users.
2. If oyster farming is to occur, the risk to wild oyster fisheries posed by oyster farming, and by aquaculture generally to marine systems, would need to be mitigated. A national biosecurity framework and assigned responsibilities for proactive biosecurity are absolutely critical to ensure no further introductions of exotic diseases occur and the risk of already introduced pathogens, such as *B. ostreae*, is eliminated and/or mitigated. The development of the proposed National Environmental Standard for Marine Aquaculture (NES: Marine Aquaculture) represents an opportunity to embed an integrated approach to biosecurity incorporating both Biosecurity Act 1993 and resource management requirements. Integration of the responsibilities of regional councils and the Ministry for Primary Industries (MPI), and regular communication between these entities and the aquaculture industry, is considered critical.

3. When a national biosecurity framework and assigned responsibilities have been established, the nature of biosecurity management plans for development of oyster farming will depend on the *B. ostreae* status and risk status of growing areas. To better determine where oyster farming should occur, *B. ostreae* surveillance activities should be reviewed and a national surveillance plan for ongoing activities developed, underpinned by agreed protocols on sampling and testing. A new national surveillance programme is required to identify epidemiologically separate areas where:

   i. *B. ostreae* is present in wild oyster populations, especially those subject to important fisheries;

   ii. oyster farm sites are free from *B. ostreae* and distant to wild oyster stock and therefore pose the lowest risk;

   iii. *B. ostreae* has been previously detected in areas remote from major wild fisheries but where standards for "freedom" from *B. ostreae* are met that may allow the assessment of risk of a structured and controlled return to farming; and

   iv. *B. ostreae* has become established near major wild fisheries and thus where aquaculture may present a high-to-unacceptable risk in relation to the specific objectives of the Governance Group.

4. Risk assessment, and the extent of controls required for inclusion in biosecurity plans, will be dependent on *B. ostreae* status and its proximity to wild oyster fisheries. This surveillance can also be used to access the efficacy of eradication strategies, that is, the effects of removing primary and alternative hosts.

5. Development of New Zealand flat oyster culture needs to be undertaken strategically, with strong, cohesive collaboration. All farms should be required to have an approved, third party audited biosecurity plan that is subject to periodic mandatory reporting. Farming will be contingent on such a plan.

6. New farm development should occur in low-risk areas, that is, those free from *B. ostreae* and most isolated from significant wild flat oyster populations.

7. In controlled areas where surveillance shows that *B. ostreae* is established outside of Stewart Island, a small-scale (one or two farm sites only), structured and supported return to flat oyster farming can be trialled so farming systems can be developed and evaluated, and the risk of *B. ostreae* to the wider environment assessed. In such cases, appropriate monitoring needs to be in place to ensure farmed stock is removed if infection is detected and before excessive mortality from *B. ostreae* occurs.

8. The anthropogenic risk pathways need to be addressed. An effective and ongoing public communication strategy and management framework for incidental vectors, including biofouling, are needed to increase awareness of marine biosecurity and transmission pathways.

Specifically

9. A return to flat oyster farming in Marlborough Sounds can be considered, cognisant of the recommendations in this report:

   i. The *B. ostreae* status needs to be determined to assess risk.

   ii. If recommencement is deemed acceptable, it should initially be limited to identify appropriate and approved systems with appropriate risk management and monitoring.

   iii. The Controlled Area Notice (CAN) will need to remain in place.

   iv. TAG 2019 could not agree on whether a level of infection would be tolerated in farmed stocks.

10. The positive detection of *B. ostreae* in Big Glory Bay, Stewart Island, in September 2019 suggests that, at this point in time, a return to flat oyster farming there poses an unacceptable risk. Any attempts to eradicate *B. ostreae* primary and alternative hosts (if identified) will require extensive surveillance and high biosecurity requirements to prevent its establishment.

11. All the aquaculture farms operating in Big Glory Bay should be required to adopt a standard of biosecurity practice and to adhere to compliance measures commensurate with the increased risk that has now been confirmed in the bay.[1]

9(2)(b)(ii) [redacted]

[redacted]

[1] The Ministry for Primary Industries (MPI) and Environment Southland will need to determine the measures required.
[2] The Technical Advisory Group (TAG) 2019 was made aware that resource consents for the farms may require applications for renewal; TAG 2019 was of the view this would provide an ideal opportunity to put in place, and ensure the implementation of, appropriate biosecurity and compliance measures.

Introduction

PURPOSE OF THIS DOCUMENT

1. The Ministry for Primary Industries (MPI) convened the Technical Advisory Group on the Risk of Farming Flat Oysters (TAG 2019) comprising national and international experts on oyster fisheries, aquaculture and shellfish diseases between 23 and 27 September 2019. The TAG provided scientific and technical advice and guidance to Biosecurity New Zealand (a branch of MPI) and the *Bonamia* Programme Governance Group on the farming of flat oysters (*Ostreae chilensis*) in New Zealand. TAG 2019 was asked to consider specifically if, where and when it may be appropriate for flat oyster farming to occur in New Zealand, and the risk that farming flat oysters poses to uninfected wild oyster populations.

BACKGROUND

2. The September TAG 2017 report provides the following useful commentary, which outlines the current situation (Ministry for Primary Industries, 2017, p 6):

> It is not known how *B. ostreae*[3] entered New Zealand. Evidence indicates that it is a recent introduction. Infection was probably spread between two key farm areas in the Marlborough Sounds (Tory Channel and Port Underwood) and the 9(2)(b)(ii) [redacted] by human vectors transferring infected material; the sequence of infection among sites is not known. The spread of B. ostreae to low density scattered wild populations in Queen Charlotte Sound and the outer Pelorus Sounds most likely occurred by waterborne infection. There has been no spread of infection from the initial delimiting survey in April 2016, except to the distant Big Glory Bay farm sites on Stewart Island in May 2017 (Anderson et al. 2016, Michael et al. 2017, Anderson et al. 2017). Because infection was not detected in Big Glory Bay in September 2016 and was detected with high prevalence on one farm site in May 2017, a human vector (intentional or unintentional) is suspected.
>
> There is a high likelihood that the response to the 2017 Big Glory Bay detection (aided by the apparent limited natural dispersal capacity of *B. ostreae*) has contained the infection within Big Glory Bay. No (*B. ostreae*) infection has been detected in oysters sampled from the Foveaux Strait fishery in February 2017 and June 2017, from Bluff Harbour in June 2017, and from a hatchery and two farms located off Horseshoe Bay (Stewart Island) in June and August 2017. Additionally, no (confirmed *B. ostreae*) infection has been detected in wild *O. chilensis* populations in Tasman Bay, Golden Bay, Cloudy Bay, Chatham Islands and Otago. The 2017 TAG were of the opinion that *B. ostreae* could be contained within Big Glory Bay and the Marlborough Sounds given the absence of spread observed in the Marlborough Sounds to date and the low densities of flat oysters that occur naturally in these areas. Eradication of *B. ostreae* from these areas is unlikely. The European experience is that eradication programmes, even sustained over several years, may not be successful as indicated by the re-emergence of *B. ostreae* following the reintroduction of oysters to previously infected sites.

RECOMMENDATIONS MADE BY TAGS IN 2015 AND 2017

3. Since the first detection of *B. ostreae* in 2014, MPI has tasked two separate TAGs with providing recommendations. With the detection of *B. ostreae* at three sites, two in the Marlborough Sounds and one at the 9(2)(b)(ii) [redacted] in Nelson, MPI identified the need for a TAG to provide scientific and technical advice to the *Bonamia* Response Controller on the issue of the potential threat posed by the spread of *B. ostreae* to New Zealand's flat oyster aquaculture and fishery industries, and the environment. The first TAG (TAG 2015) met from 25 to 28 June 2015 and again on 26 August 2015. TAG 2015 made several recommendations (Jones et al, 2015), including containment, removal of stock and

[3] *Bonamia ostreae* is a protozoan parasite in the Order Haplosporida that infects haemoctyes of oysters and induces physiological disorders and eventual death of a large proportion of infected animals.

infrastructure from infected farms and the establishment of a national surveillance programme. The removal of oyster stock from farms in the infected area was considered critical, to try to prevent the establishment and spread of *B. ostreae*. This removal did not occur until September 2017, after the *B. ostreae* incursion in Big Glory Bay, Stewart Island.

4. In 2017 the aquaculture industry requested that MPI consider retaining stock from the Marlborough Sounds farms for the purpose of breeding *B. ostreae*-resilient oysters (Hilton et al, 2017). In response to this proposal, a TAG was assembled by MPI to provide independent, expert scientific and technical advice on *Bonamia* spp.-resilience breeding in flat oysters. That TAG (TAG 2017) presented its recommendations in September 2017 (Ministry for Primary Industries, 2017). Findings made by TAG 2017 included:

- a recommendation for removal of all remaining farm stock, to prevent the spread of *B. ostreae*; and
- conclusions that:
  - there was no evidence that surviving farmed oysters were resilient;
  - maintenance of stock on the affected sites would enhance the risk of spread;
  - enhancement of naïve wild oyster populations was highly unlikely to be successful and also could spread infection; and
  - research efforts should focus on containment measures and *B. exitiosa* host parasite interactions (Ministry for Primary Industries, 2017).

Purpose of the Technical Advisory Group 2019

5. MPI convened this third TAG in September 2019. The purpose of TAG 2019 is to provide open and frank, independent, expert scientific and technical advice on flat oyster farming in New Zealand in the context of the *Bonamia* Programme Governance Group's overall goal "to protect uninfected wild oyster populations from *B. ostreae*" and specific objectives to:
   - restrict the spread of *B. ostreae* from existing infected areas;
   - prepare for potential future infections and outbreaks;
   - protect customary, recreational, and commercial fisheries from *B. ostreae*;
   - protect cultural rights in regard to flat oysters;
   - enable future oyster farming opportunities where appropriate; and
   - promote biosecurity best practice and improve biosecurity practices in key risk groups to reduce the risk of transmitting.

QUESTIONS TO BE ADDRESSED BY TAG 2019

6. MPI provided TAG 2019 with a set of questions to address. The TAG was permitted to expand on or change the emphasis of the questions, based on the *Bonamia* Programme Governance Group's objective and aims (see para 5), and TAG discussions.

7. The specific questions provided to TAG 2019 were:
   1. What level of risk would the re-establishment of flat oyster farming in areas where *B. ostreae* has been detected pose to uninfected oyster populations and the wild oyster fishers.[4]
      a. Does the level of risk differ between the Marlborough Sounds and Big Glory Bay (Stewart Island)?
      b. Under what circumstances could farming occur in areas where *B. ostreae* has been detected without compromising the Bonamia programme objectives or aims? Could biosecurity management conditions or farming strategies (e.g. adaptive management) mitigate identified risk?
      c. What is the role of surveillance in determining the risk that the reintroduction of oyster farming poses to uninfected wild oyster populations or the fishery? What other considerations are relevant?
      d. What level of risk does the farming of flat oysters pose to uninfected wild populations, relative to any risk posed by wild oyster populations in Marlborough (where *B. ostreae* has been detected)?
   2. 9(2)(b)(ii) [redacted]
      [redacted]
   3. What potentially suitable environments (where oyster farming has not occurred to date), including land-based recirculating systems, offer opportunities for flat oyster farming in New Zealand?
   4. What biosecurity management approaches and mitigation measures, including testing protocols and compliance measures, are available to reduce the risk posed by the farming of flat oysters in new areas or under different conditions?
      a. What work should occur prior to the establishment of farms to assess the potential biosecurity risk of transmitting *B. ostreae*?
      b. Does the level of risk vary between different areas or approaches to farming?
   5. Is any research particularly critical to a consideration of the future of flat oyster farming?

[4] Which TAG 2019 interpreted as being: Foveaux Strait, Tasman Bay and Cloudy Bay wild oyster stocks.

APPROACH TO "RISK"

8. TAG 2019's approach to "risk" includes providing advice on:

   - the level of risk that flat oyster farming poses to uninfected wild oyster populations and the Bluff oyster fishery;
   - whether the risk posed differs between areas or under different farming approaches; and
   - the tools and mitigations available to reduce any risk, including the efficacy of these options.

9. The term "risk", in the context of TAG 2019's advice, refers to the risk of transmitting *B. ostreae* to wild oyster populations through the farming of flat oysters. Throughout this document, risks are referred to as uncontrolled (that is, the base level of risk without any risk management) and controlled (that is, the risk posed by activities once risk mitigation and other biosecurity controls have been applied). Risk is referred to as acceptable (that is, consistent with the appropriate level of protection pursuant to international agreements, such as the Sanitary and Phytosanitary Agreement (SPS Agreement)) or unacceptable (that is, greater than or inconsistent with the appropriate level of protection). Risk management is consistent with the approach described in the Australian Animal Quarantine Policy Memorandum 1999/26 (appended to this document), which outlines the risk assessment and risk management framework used in Australia to provide a framework consistent with the SPS Agreement and World Organisation for Animal Health (OIE) controls outlined in the OIE Aquatic Animal Health Code (OIE, 2019a).

UNDERPINNING CONTEXT FOR RISK ASSESSMENT

10. The 1992 Rio Declaration on Environment and Development (United Nations Conference on Environment and Development, 1992) defines the responsibilities of human beings to safeguard the common environment:

    > **Principle 4:**
    > In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it.
    >
    > **Principle 15:**
    > In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

    Therefore, where an action may lead to environmental harm, the burden of proof falls to those taking the action to prove it is not harmful.

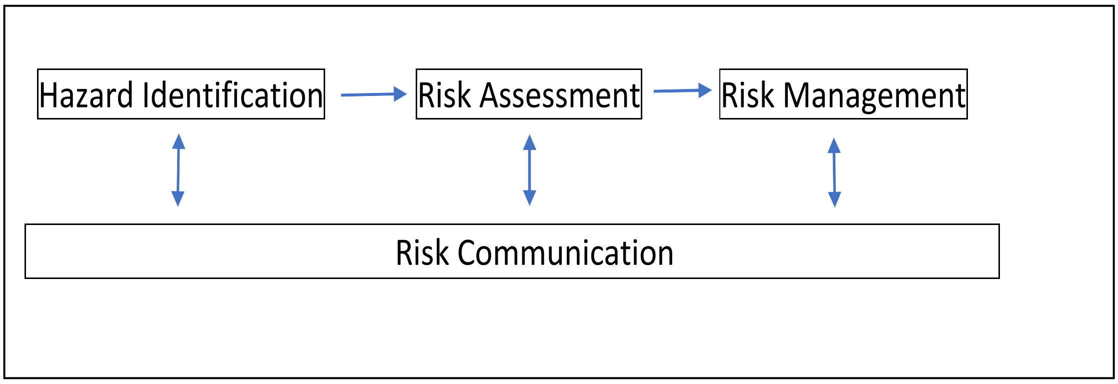
11. Reflecting the above, TAG 2019's risk assessments have assumed a "precautionary" position when faced with issues of uncertainty.

RISK ANALYSIS

12. TAG members collectively have a good understanding of risk assessment in terms of the evaluation of the likelihood, and the biological and economic consequences of the entry, establishment and spread of a hazard (OIE, 2010). They are familiar with the approach to risk assessment outlined in the OIE Aquatic Animal Health Code, Chapter 2.1, which outlines internationally accepted principles for conducting transparent, objective and defensible risk analyses.

13. The Aquatic Animal Health Code outlines the components of risk assessment as hazard identification, risk assessment, risk management and risk communication (Figure 1).

Figure 1: Essential steps towards risk management outlined in the Aquatic Animal Health Code



Source: OIE, Aquatic Animal Health Code, 2019a

Technical Advisory Group 2019 meeting processes and objectives

14. TAG 2019[5] comprised five experts with individual or collective expertise on aquatic animal health and epidemiology; risk analysis; aquaculture and fisheries biosecurity; ecological parasitology; fisheries and marine ecology; and flat oyster fisheries in New Zealand (Appendix 1). Most have worked closely with farmers and farming operations. The meeting was led by an independent chair. TAG members were sent the Terms of Reference document and a range of relevant pre-meeting reading material. The TAG met between 23 and 27 September 2019. The meeting involved:

- Day 1: An introductory three-quarter day workshop in Wellington involving: Stuart Anderson, Director of Fisheries Management and *Bonamia* Governance Chair (MPI); 9(2)(a) [redacted]
- Day 2: A morning meeting with an affected Marlborough Sounds oyster farmer 9(2)(a) [redacted], in Blenheim, followed by a TAG discussion.
- Day 3: A full day working session[6] at MPI Invercargill, which included a meeting with 9(2)(a) [redacted], Consents Manager (Environment Southland), and a Skype conference with Cawthron Institute staff including: 9(2)(a) [redacted]
- Day 4: Day trip to Stewart Island for a site visit to a Horseshoe Bay hatchery and oyster farm, and a meeting with Stewart Island oyster farmers 9(2)(a) [redacted]
- Day 5: A three-quarter day working session at MPI Invercargill, which included a meeting with 9(2)(a) [redacted]

MEETING NOTES

15. The co-ordination of meetings with the flat oyster farmers initially proved to be problematic, with the farmers taking the opportunity to express their concerns on a number of issues:

- Given the composition of TAG 2019, the farmers had no confidence that it could address the posed questions in an adequate, unbiased and professional manner.
- TAG 2019 did not include anyone with a practical flat oyster farming background.
- The farmers expressed a feeling of exclusion and frustration, with a lack of timely communications.

16. To facilitate face-to-face meetings, the farmers and TAG agreed that only selected members of TAG 2019 would meet with the oyster farmers. The TAG recognised that this was not ideal, but it did allow TAG members to gain useful input from and engagement with the farmers.

BLENHEIM MEETING

9(2)(b)(ii) [redacted]

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[5] Logistical support was provided by Rose Bird, Independent Contractor/MPI.
[6] Sarah Fish, Senior Adviser, Long Term Planning and Transition, MPI, joined the group.

9(2) [redacted]

18. 9(2)(b)(ii) [redacted]

19. We outlined the TAG 2019 agenda and described for 9(2)(a) [redacted] a process, based on international standards and biosecurity best practices, that necessitated the previous removal of oysters following the introduction of *B. ostreae*. We also outlined the processes that would need to be implemented in the context of risk management if a return to farming in Marlborough could be facilitated.

STEWART ISLAND MEETING

20. Selected members of TAG 2019 also met with four Stewart Island flat oyster farmers (9(2)(a) [redacted]), a meeting that included a site visit to the Horseshoe Bay hatchery. The Stewart Island farmers also took the opportunity to share their concerns with the TAG including:

- 9(2)(a) [redacted]
- the lack of MPI consultation on the closure of the Big Glory Bay farm(s) with the destruction of infrastructure and the removal of stock;
- that the wild oyster fishery was setting the TAG agenda;
- that the flat oyster farming industry lacked input into the TAG processes.

21. Like 9(2)(a) [redacted], the Stewart Island farmers also explained their various farming methods and described the type of product they could potentially produce.

22. While the Stewart Island farmers typically produced a larger oyster that required several years to reach market size, they expressed openness to adapt their production to biosecurity considerations as necessary, including shortening production cycles to mitigate the effects of *B. ostreae*.

23. As with 9(2)(a) [redacted], we outlined the TAG 2019 agenda and worked the farmers through a potential restart process, based on international standards and biosecurity best practices, which may allow a return to farming in Stewart Island. The TAG stressed that any return would take time and the adoption of best practices in terms of biosecurity.

INVERCARGILL MEETINGS

24. 9(2)(a) [redacted] (Environment Southland) has recently taken up the post of Consents Manager. She highlighted the limited biosecurity conditions for marine resource consents and noted that Environment Southland did not currently have the legislative tools or resources to require biosecurity procedures or to ensure their compliance.

25. The full TAG met with 9(2)(a) [redacted], representing the Bluff Oyster Management Company Ltd; and 9(2)(a) [redacted] of Aquaculture New Zealand. We outlined the TAG agenda and our initial thoughts in addressing the questions that MPI had set for us.

26. 9(2)(a) [redacted] emphasised the need for us to take a highly risk-averse approach in making recommendations, given the nationally iconic status of the Bluff oyster wild fishery. 9(2)(a) [redacted] supported the need for us to take a precautionary approach, but he also reminded us of the economic opportunity that a return to flat oyster farming presented.

AUCKLAND MEETING

27. The TAG Chair met with representatives of Sanford's in Auckland: 9(2)(a) [redacted] TAG 2019's approach and some of the findings were briefly outlined. In the following question and answer session, matters covered included:

- the role of Sanford as a major national player in the sector (wild fishery and aquaculture). In terms of flat oysters, Sanford has wild oyster quota in Foveaux Strait and allocated aquaculture space including in Big Glory Bay, Stewart Island. It has allocated space that could be used for flat oyster farming;
- Sanford questioning who had framed the TAG questions and the relationship between them and the TAG's terms of reference;
- Sanford questioning how *B. ostreae* got to New Zealand. The TAG Chair noted the uncertainty around the introduction. It may have been here for some time but, with a change in environmental factors, its presence has now been detected;
- Sanford being aware of information suggesting *B. ostreae* has already been detected in the Foveaux Strait wild oyster fishery at the time of the meeting;[7]
- acknowledgement of the critical need to improve the national approach to biosecurity. It should be a level playing field (holistic approach to biosecurity): recreational boat operators and customary fishers should all be part of biosecurity compliance measures and have to take responsibility for their actions;
- all biosecurity risk pathways needing to be addressed: industry, recreation, customary and conservation. It should not just be the sole responsibility of industry;
- Sanford expressing concern over the general lack of awareness of the Controlled Area Notice (CAN), highlighting the need for better education on biosecurity (recreation and customary takes);
- Sanford querying who should be responsible for and bear the cost of biosecurity (national surveillance and research);
- setting criteria that would facilitate flat oyster farming, with the underpinning criteria needing to be clearly spelled out, especially the consequences that could result if infection is detected;
- 9(2)(b)(ii) [redacted]

[7] The TAG checked with MPI and no such detection has been confirmed.

Discussion and recommendations

28. The TAG 2019 discussions on the potential to re-establish flat oyster farming have been conducted in the context of *B. ostreae* being an unwanted organism in New Zealand, with a localised distribution, and *Ostrea chilensis* (*O. chilensis*) having a New Zealand-wide distribution and supporting several wild fisheries of high socio-economic and cultural importance. The TAG's understanding is that the highest priorities are the ongoing containment of *B. ostreae* and the protection of wild populations of *O. chilensis* from *B. ostreae* infection.

29. A commentary on the topics discussed in the TAG meetings is set out below together with the TAG's recommendations.

PRIMARY CONSIDERATIONS

National approach to biosecurity

30. TAG 2019 considered the risk posed by the development of oyster farming in New Zealand, if unmitigated, to be high and unacceptable. If oyster farming is to occur, the TAG considered that addressing the risk posed by *B. ostreae* to flat oyster aquaculture requires an integrated, proactive approach to biosecurity, based on internationally accepted best practices. The TAG noted that current biosecurity standards are absent or lacking and recommends that a national approach to biosecurity is needed. The TAG does not believe that this approach will be adequately achieved by the proposed National Environmental Standard (NES) for Marine Aquaculture (NES Marine Aquaculture).

31. The need for an integrated approach has been recognised internationally. Pernet et al (2016) argue that addressing infectious diseases in oyster aquaculture requires a new, integrated approach in the form of ecosystem-based management of diseases that considers the entire ecosystem and socio-economic considerations. Climate change (Rowley et al, 2014), anthropogenic translocation of pathogens (Bass et al, 2019), and habitat change have accelerated the incidence of disease in aquaculture. Catastrophic biosecurity failures that have resulted in substantial economic losses and lost opportunities for aquaculture in Chile (Asche et al, 2010) and elsewhere (Lafferty et al, 2015) have led to the implementation of integrated national biosecurity management programmes that have realised considerable benefits (Sitjá-Bobadilla and Oidtmann, 2017; Jackson et al, 2018). For salmon, where implementation of these standards is most advanced, this integration comprises the whole value chain of production, including pre- and post-border risk analysis, biosecurity standards, epidemiological surveillance, early detection systems for diseases, more stringent disease control, increased diagnostic capability (reference and private laboratories) and good practices for the use of pharmaceutical products (Lara and Gallardo, 2019).

32. In New Zealand, benefits that could be obtained by the aquaculture industry adopting an integrated biosecurity management approach have been recognised for some time (Sinner et al, 2013; Castinel et al, 2014). Castinel et al (2014) highlight a lack of awareness and experience with diseases and their management that makes the New Zealand aquaculture industry vulnerable to incursions and the spread of new pathogens, and to disease outbreaks caused by those pathogens already present. Industry would benefit from having a generic disease risk management framework in place, developed with support from government and research providers. Fundamental principles, such as pathway management, monitoring and reporting, should form the basis of good practices, and generic approaches for responding to any future crises would ideally be developed in advance. Castinel et al (2014) made specific recommendations to the mussel and oyster aquaculture industry: to develop and implement on-farm biosecurity practices that include recording and reporting stock and gear movements to assist with traceability in the event of a disease outbreak, and to record and report animal production data (including baseline and abnormal mortalities). Development of biosecurity response plans for managing key pathogens, like *Marteilia refringens*, *B. ostreae* and oyster velar virus disease (OVVD), should be prioritised (Castinel et al, 2014).

33. The need for a better biosecurity approach has been recognised by MPI, the aquaculture industry and the wild oyster fishery. The Foveaux Strait Dredge Oyster Fisheries Plan documents biosecurity as a high priority (Ministry of Fisheries, 2009) and the *Aquaculture Biosecurity Handbook* (Ministry for Primary Industries, 2016), developed by MPI in conjunction with Aquaculture New Zealand, provides the industry with an overview and guidance for on-farm

biosecurity. At the same time as the *Aquaculture Biosecurity Handbook* was released, MPI published, in conjunction with Aquaculture New Zealand, the technical paper *Options to strengthen on-farm biosecurity management for commercial and non-commercial aquaculture* (Georgiades et al, 2016). The *Aquaculture Biosecurity Handbook* details national and international "best practice" from both the regulatory and aquaculture industry perspectives and provides information to enable effective on-farm biosecurity management. It was intended that the aquaculture industry would take up responsibility for biosecurity, however, there was no requirement for the aquaculture industry to adopt the recommended approaches.

34. In June 2017 MPI published a discussion document entitled *Proposed National Environmental Standard for Marine Aquaculture* (Ministry for Primary Industries, 2017). The objective of the Proposed NES for Marine Aquaculture is to develop a more consistent and efficient regional planning framework for the management of existing marine aquaculture activities and on-farm biosecurity management. The proposed NES seeks to make (future, that is, 2025) consenting for existing marine farms more consistent and efficient, as well as providing for best practice biosecurity management and more flexibility to adapt to new opportunities. Lojkine (2018) reviewed public submissions to the NES. She noted that marine farm biosecurity nationally should be compulsory, enforceable and comprehensive (that is, that it covers all matters in the MPI technical paper (Georgiades et al, 2016) and that it covers all aquaculture species), and that the aquaculture industry should implement and monitor on-farm biosecurity, with such monitoring verified through an independent auditing process. Regional councils will enforce the NES, with support from MPI, see Lojkine (2018) and Appendix 2 for details on regulatory tools.

35. While Lojkine (2018) proposed that the use of different tools will be necessary to effectively manage marine farm biosecurity in New Zealand, TAG 2019 recognises the lack of integration, the lack of specific responsibilities assigned to entities, the lack of funding to ensure biosecurity is implemented and monitored, and the lack of verification of compliance (that is, the lack of auditing) by entities independent to the aquaculture industry.

Return to flat oyster farming

36. While TAG 2019 was given a series of questions to answer that relate to specific areas, in providing its advice to assist the Bonamia Governance Group in considering if, where and when it may be appropriate for flat oyster farming to occur, the TAG needs to look beyond those specific areas.

37. From an economic, practical and safety viewpoint, new farm development should occur in low-risk areas, that is, those most isolated from significant wild flat oyster populations and free from *B. ostreae*. To this end, existing consented space that has those two characteristics may, after an initial surveillance, be the most appropriate for a return to flat oyster farming.

TAG 2019'S RESPONSES TO MPI QUESTIONS

38. TAG 2019 has addressed in the section below the questions put to it and, in doing so, has perceived the need to highlight the difference between the TAG 2017 process and recommendations, with its focus on resistant individuals and the development of a resilience programme, and TAG 2019, with its focus on how farming can occur in the presence[8] of the parasite *B. ostreae* in both Marlborough Sounds and Big Glory Bay, Stewart Island, without increasing the risk to wild populations. In doing so, TAG 2019 agrees with conclusion 2 of the TAG 2017 report that the presence of high densities of oysters infected with *B. ostreae* poses at least some risk to the spread of infection (Ministry for Primary Industries, 2017). Farmers in Marlborough Sounds and Stewart Island (Big Glory Bay and Horseshoe Bay) currently hold valid Resource Management Act 1993 resource consents for aquaculture space, and flat oysters are one of the species specified in the consents that potentially can be farmed. Both regions have tested positive for *B. ostreae*. The current status of *B. ostreae* infection in wild oyster populations in Marlborough is not known. Big Glory Bay wild oysters tested positive for *B. ostreae* in September 2019.

[8] To be validated.

Questions

Question 1: What level of risk would the re-establishment of flat oyster farming in areas where *B. ostreae* has been detected pose to uninfected oyster populations and the wild oyster fishery?

39. Uncontrolled risk is unacceptable. If an effective, integrated framework for biosecurity were to be established, as outlined in this report, with high and enforceable standards for proactive biosecurity on-farm and off-farm, and if key fishery and other uninfected populations were remote from the *B. ostreae*-endemic area in which farming is to occur, the risk could be acceptable. It is accepted that this approach could be applied at a regional and/or local level but there is considerable merit in having a consistent national approach.

Question 1a: Does the level of risk differ between Marlborough Sounds and Big Glory Bay (Stewart Island)?

40. In assessing whether the level of risk differs between Marlborough Sounds and Big Glory Bay, the TAG considered that the risk differed between the two areas but could not agree on what measures were appropriate to mitigate risk in Marlborough Sounds and Big Glory Bay.

41. It was suggested that Marlborough Sounds and Big Glory Bay do not have the same risk profiles, due to differences in their proximity to nationally iconic wild oyster fisheries and the likelihood of whether *B. ostreae* has become established in populations of wild molluscs. The level of risk differs because the social, economic and cultural loss is much higher near Big Glory Bay, due to its proximity to Foveaux Strait. Also, the two areas are at two different stages of a biosecurity response.

42. It was suggested that, although the risk of spread is the same, the fisheries differ in their economic values only, not their social, customary or ecological values.

43. The TAG did agree that proximity to the Foveaux Strait wild flat oyster fishery was a significant differentiating factor when planning a way forward.

44. It is unclear if *B. ostreae* has become established in Marlborough Sounds wild oyster fisheries, but the TAG assumed that this scenario is at least possible and may be likely. The current status should be determined by an extensive screening programme before any decisions related to recommencement are made. The aquaculture areas in Port Underwood (Marlborough Sounds) are less than 40 kilometres from Cloudy Bay wild capture oyster populations (OYS7C). Anderson et al (2016) considered the risk posed by the Marlborough Sounds farms is naturally mitigated by distance from the major fishery and a relative lack of nearby susceptible hosts.

45. In October 2019, in Big Glory Bay, the presence of *B. ostreae* was confirmed in one wild oyster, and eradication may yet be attempted. Big Glory Bay is approximately 12 kilometres away from the major, iconic Bluff oyster fishery in Foveaux Strait (Biosecurity New Zealand, 2019). Bluff oysters have a high profile in New Zealand and are considered to be a national treasure and premium seafood product. Farms in Big Glory Bay have close proximity to the Bluff oyster fishery and exist in an area where wild *O. chilensis* are common, their distribution, together with other bivalves such as mussels (mytilids), is continuous, and, with oceanographic connectivity, could potentially facilitate transmission of disease from farms to wild populations.

46. Gaining an understanding of the risk posed by *B. ostreae* urgently requires an extension to the current surveillance programme and an improvement in testing and confirmation procedures. A review of *B. ostreae* surveillance to date, with an understanding of sampling and lab practices, is needed. Further surveillance, using sentinel animals or from a thorough search for wild stock, is required to establish the status of *B. ostreae* in these areas.[9] If *B. ostreae* is established more broadly than is currently thought in either region, this knowledge will influence the risk profile and management strategy accordingly.

47. A fundamental question for TAG 2019 is if the risks associated with re-establishing flat oyster farming in waters where *B. ostreae* may be present are compatible with the priorities of containing *B. ostreae* and preventing its spread to uninfected wild populations.

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[9] For example, the aberrant surveillance results obtained for samples in Otago need to be clarified.

48. In addressing this question, we took the opportunity to review the TAG 2015 and TAG 2017 reports and recommendations. We concur with TAG 2017 that the principal risk of *B. ostreae* spreading will be by anthropogenic means; with human mediated transport, either intentional or accidental, remaining the most likely mechanism by which *B. ostreae* could spread over long distances or to new locations.

49. TAG 2017 determined that leaving farmed oysters known to be infected with *B. ostreae* in the water posed an increased, and therefore unacceptable, biosecurity risk and recommended the farms be depopulated. We concur, in terms of biosecurity best practice, that this was an appropriate recommendation in the context of detection of a new pathogen in New Zealand that may have not yet become established in wild oyster populations as far as could be determined at that time. We also accept TAG 2017's observation that the risk of oysters cultured at high aquaculture densities has the potential to increase the risk of establishment and spread of *B. ostreae* compared with the risk associated with relatively lower-density wild populations, because host density favours higher levels of infection and disease caused by directly transmitted *B. ostreae*. For this reason, flat oyster aquaculture would not be advisable in areas where *B. ostreae* has been detected but where a return to disease freedom may be pursued.

50. In the case of exotic disease incursions, the most cost-effective biosecurity response in the long term is often to attempt eradication followed by a period of surveillance, with the aim of returning to freedom from that disease (see Chapter 1.4 on surveillance in OIE, 2019a). This is the international model that has been followed in Australia following the recent white spot virus outbreaks in prawns. After the removal of stock on affected farms, two years of surveillance,[10] in which the exotic or unwanted organism is not detected, is required to support a self-declaration of freedom from that organism within a particular area. A return to freedom can facilitate the recommencement of farming under biosecure conditions (OIE, 2019a). However, if a return to freedom cannot be achieved, the next step is to transition to zoning and compartmentalisation while maintaining basic biosecurity conditions (see Chapter 4.1 and Chapter 4.2 in OIE, 2019a). How applicable examples of eradication of other diseases are to *O. chilensis* and *B. ostreae* is yet to be determined. The recurrence of *B. ostreae* in Dutch oyster stocks after an eight-year absence (Van Banning, 1991) raises questions about persistence of infection in the environment and the need to investigate alternative hosts and carriers.

51. While the model was used by MPI in response to the *B. ostreae* incursions in New Zealand, the initial aim of the New Zealand response was not eradication but a focus on removing propagule pressure to reduce the risk of it spreading to the wild fishery. There was a recognition that eradication needs a wider consideration – an understanding of alternative hosts and the complete lifecycle of *B. ostreae*. Reducing host density (farmed stock) to reduce numbers of deaths, and thereby propagule pressure, was the right focus and primary tool for New Zealand.

52. In reviewing the TAG 2017 recommendation to depopulate the farms, it became evident to TAG 2019 that farmers were very unsure where they fit in the whole disease response process, a matter we address further below.

53. In considering the current situation, TAG 2019 is of the opinion that the level of unmitigated risk posed by the re-establishment of flat oyster farms in areas where *B. ostreae* has been detected to uninfected oyster populations and the wild oyster fishery in the broader New Zealand context is highly location dependent. Thus, a blanket prohibition on flat oyster farming in New Zealand is not the recommended approach for the future, as explained further below.

54. If the presence of *B. ostreae* in Marlborough Sounds in wild flat oyster populations is confirmed in the absence of farmed oysters, the risk of spreading this disease agent by anthropogenic means will remain into the foreseeable future. This is regardless of whether oyster aquaculture occurs or not, so long as *B. ostreae* remains present in wild flat oysters or other host species in that area. Georgiades (2015) identified that the pathways for translocating *B. ostreae* from infected to uninfected areas include:

- movements of *O. chilensis*;
- movements of shellfish other than *O. chilensis* (including cross-contamination as opposed to infection);
- equipment movement;
- vessel movement;

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[10] Or an agreed epidemiologically relevant period.

- human consumption and waste production;[11]
- shellfish used as bait and burley.

55. These risks need to be addressed in a consistent manner with the objective of putting in place mechanisms whereby biosecurity requirements can be placed on aquaculture operators[12] and all other marine operators, in an organised, auditable and reportable manner. To this end, we have identified that the legislative framework poses a "legislative risk", due to the lack of integration and alignment in addressing biosecurity requirements, especially surveillance, compliance requirements (monitoring) and timely reporting between the various Acts[13] and their Regulations. In particular, we note that both the Biosecurity Act 1993 and Resource Management Act 1991 regulate compliance and reporting. Appropriate tools to implement a biosecurity system may exist but some are not compulsory and others can be changed by outside agencies.

56. Examples of flaws:

- Resource consent conditions do not address biosecurity requirements holistically. Environmental incident reporting can be weekly or less frequently, rather than "as soon as possible". Coastal permit consent conditions can be changed by the Environment Court.
- The CAN under section 131(3) Biosecurity Act 1993 controls movement of shellfish, equipment and vessels into or out of the CAN areas but not movement within. No restrictions are in place on moving flat oysters within the Stewart Island or Contained Zones because currently there is no mechanism in the Biosecurity Act, outside section 53[14] restrictions, to prevent re-establishment of a farm if it has an existing consent and registration. There is also no requirement to notify of these movements, therefore, a farm could be repopulated without the knowledge of regulators. A CAN cannot be used to manage activities, other than movement, that create risk.
- Biofouling on marine farm structures and boats on moorings may provide "stepping stones" for the spread of pathogens and invasive species (Adams et al, 2014), but biofouling is not regulated consistently across New Zealand. Domestic biofouling regulations vary between regional and unitary councils.

57. We are of the view that legislative risk factors may be largely mitigated by adopting an integrated approach that incorporates best biosecurity practices,[15] setting the biosecurity bar at a high level and ensuring that biosecurity practices are proactive. TAG 2019 identified the proposed NES: Marine Aquaculture as one potential mechanism for the mitigation of risk by including criteria that would require that all coastal permits for aquaculture space have conditions that include mandatory biosecurity sections that address and align both the Biosecurity Act 1993 and Resource Management Act 1991 compliance and reporting requirements. All farms must be required to have an approved (and independently audited) biosecurity plan.

58. We recognise that anthropogenic risk is problematic and more difficult to address because it relies on individuals accepting responsibility for their actions. The main risk pathways have been identified and these need to be addressed in a nationally consistent manner. The current approach to domestic biofouling serves as a good example of the need for a consistent national approach. A simple fix would be to nationally align the domestic approach to biofouling with the approach taken for international vessels.[16]

59. Change will need to be supported by appropriate communication, farmer–community– tangata whenua education strategies and the adoption of a national strategy to address anthropogenic risk in a nationally consistent manner. The time has come for all marine users to be brought on board. We stress and emphasise the importance of timely communications. We also acknowledge the challenge of involving the recreational sector and tangata whenua who have customary use rights.

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[11] This includes "customary takes".
[12] A recognition that the movement of infected animals and tissues is a prime risk.
[13] Biosecurity Act 1993, Resource Management Act 1991 and Fisheries Act 1993.
[14] Duties of owners of organisms.
[15] OIE (2019a) Aquatic Animal Health Code, Chapter 11.3, Infection with *Bonamia ostreae*.
[16] See Biosecurity New Zealand (13 January 2020) Biofouling management. https://www.mpi.govt.nz/importing/border-clearance/vessels/arrival-process-steps/biofouling/biofouling-management. Accessed 22 January 2020.

60. MPI has recognised the need to strengthen biosecurity, and, in conjunction with Aquaculture New Zealand, produced a technical paper in 2016 entitled *Options to strengthen on-farm biosecurity management for commercial and non-commercial aquaculture* (Georgiades et al, 2016). The aim of the publication was to assist the commercial and non-commercial aquaculture[17] interests to strengthen their on-farm biosecurity practices. The document provides technical information, biosecurity objectives and best practice options to enable farmers to make informed decisions regarding their on-farm biosecurity management. It is clearly noted that the options document does not set prescriptive measures, practices, rules or requirements on farmers. TAG 2019 has the firm opinion that the time has come for “set prescriptive biosecurity measures, practices, rules or requirements”. Moreover, compliance with these requirements needs to be ensured and independently audited.

61. The need for an education strategy was highlighted in a report prepared for MPI by Coast and Catchment Limited (Sim-Smith et al, 2016), which noted (page 100) that “biosecurity practices for the majority of New Zealand farms do not meet current international standards for best practice”. Sim-Smith et al (2016) further identified the following major barriers to the implementation of biosecurity best practices in the New Zealand aquaculture industry:

- the belief that “nothing can be done” to stop pest and disease transmission;
- that the widespread movement of stock[18] around the country is elevating biosecurity risk;
- the use of wild brood-stock presents a disease risk;
- the challenge of farm-level identification and removal of biofouling species;
- a lack of treatment of intake and effluent water in land-based facilities;
- a paucity of aquatic health specialists in the shellfish sectors.

62. The report noted that engagement of the aquaculture industry is critical for ensuring widespread, effective uptake of any proposed biosecurity measures, regardless of whether they are mandatory or voluntary. It also provided a number of recommendations on how to address the identified barriers to the implementation of biosecurity best practices. Our meetings with various flat oyster industry players reinforced the need for, and the value of, meaningful and timely engagement.

Question 1b. Under what circumstances could farming occur in areas where *B. ostreae* has been detected without compromising the *Bonamia* Programme objectives or aims? Could biosecurity management conditions or farming strategies (for example, adaptive management) mitigate identified risk?

Marlborough Sounds

63. TAG 2017 determined that the risk of spread associated with farmed oysters is greater than that associated with wild populations, because of the higher densities at which farmed oysters typically occur; the likely higher rates of infection and mortality among farmed oysters, compared with wild animals, as a product of enhanced transmission dynamics at high host densities, and because of the increased likelihood of human-mediated spread from farms. TAG 2017 concluded that leaving oysters on farms in Marlborough Sounds as the basis for a resilience breeding programme would enhance the risk of *B. ostreae* being spread to uninfected wild oyster populations, including those in Foveaux Strait. Consequently, an in-water breeding programme was considered counter to the objectives of containment of *B. ostreae* and protection of wild population, and was not recommended.

64. While there is no recent surveillance data for flat oysters from Marlborough Sounds, TAG 2019 is of the view it is unlikely that *B. ostreae* could be eradicated from Marlborough Sounds if its presence is confirmed in wild oysters. The period of time that *B. ostreae* was present in the Marlborough Sounds before it was detected is unknown, and experience in Europe indicates that *B. ostreae* has never been eradicated from an infected area where populations of infected wild hosts occur. Bucke (1988) reported *B. ostreae* infection remains present on cleared beds, and oysters have also become infected when relayed to areas that have been cleared and remained fallow for a number of years (Van Banning, 1991).

[17] For example, marae-centered aquaculture.
[18] Especially uncontrolled movement of stock.

65. We also support the TAG 2017 observation that the spread of *B. ostreae* through non-human-assisted mechanisms (for example, natural dispersal) over long distances is considered unlikely, based on the historical patterns of *B. ostreae* spread in the northern hemisphere.

66. The depopulation of all flat oyster farms in Marlborough Sounds has not eliminated the potential for either natural or human-assisted spread beyond the containment area, because of the potential for *B. ostreae* to be present in wild oyster populations. The zone of infection needs to be defined using properly designed surveillance and carefully delimited as a Controlled Area. The current CAN will have to remain in place while *B. ostreae* occurs in the area, unless *B. ostreae* spreads further and New Zealand considers that the control programme is no longer feasible, that the pathogen cannot be controlled, and the country as a whole is regarded as infected (that is, *B. ostreae* is declared endemic to New Zealand and no longer under official control).

67. Ben-Horin et al (2018) developed a model demonstrating that oyster aquaculture operations may limit the spread of disease in wild populations of oysters. TAG 2019 members debated the merits of including reference to this model in this report. It was noted:

- the model is a simulation using theoretical data, and its predictions remain unvalidated;
- the model considers a different type of farming environment and a different pathogen (*Perkinsus*) and is not present in the Marlborough Sounds context; and
- the model should be referenced because the theory should work regardless of the pathogen.

68. The findings of Ben-Horin et al (2018) are contrary to long-held beliefs that diseases of aquaculture organisms are often spread from farmed populations to wild populations, and their results may indeed be unique to the culture of filter-feeding bivalve. Modelling showed that, if aquaculture operators harvest their bivalves before disease-related mortality and large-scale shedding of pathogens occurs, the cultured bivalves act as pathogen sinks and have a positive effect in reducing disease pressure on wild populations. If diseased bivalves are left in the water too long, however, the positive effect can become negative. The opportunity therefore exists in Marlborough Sounds, if the Sounds were to be confirmed *B. ostreae*-endemic, to assess whether flat oyster aquaculture could be designed to serve as a “sink”, rather than a “source”, for pathogens, because aquaculture operators can remove oysters from the system before transmission accelerates. If aquaculture is to recommence in a *B. ostreae*-endemic area, such as Marlborough Sounds, care should be taken to design farms with pathogen transmission reduction as a goal. Surveillance and epidemiological modelling should be used to provide assurance that farms are not materially exacerbating transmission and disease relative to background transmission in wild populations uninfluenced by aquaculture.

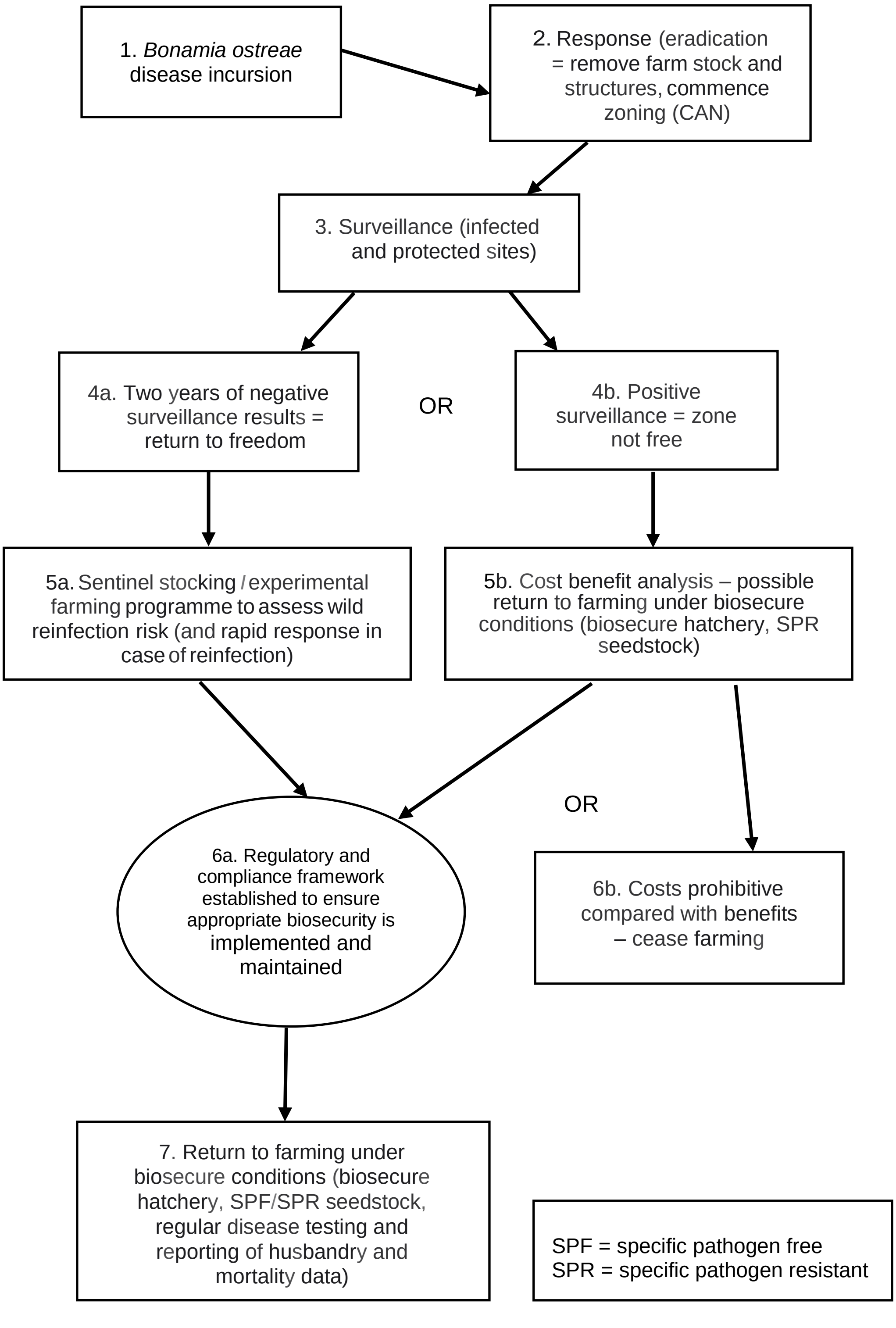
69. While it is conceivable that aquaculture of a directly transmissible pathogen like *B. ostreae* could be managed to minimise transmission of the parasite to wild oyster populations, the challenging application of this paradigm is the reality that *B. ostreae* is an unwanted organism[19] under the Biosecurity Act 1993 and an OIE notifiable organism. As an unwanted organism, if it is found in a commercial flat oyster farming operation, MPI can direct that the oysters have to be removed. The implication of this is self-evident, if flat oyster farming is to be restarted and an infection is detected at a farming site, the oysters would have to be removed within the epidemiological unit, which may affect several farms.

70. In considering the Marlborough Sounds situation,[20] we are of the opinion that best practice indicates a return to farming is possible, provided it is done under appropriate biosecurity conditions. To help understand the level of risk associated with the re-establishment of flat oyster farming in Marlborough Sounds, the TAG looked at the generally accepted overseas process that would allow a return to farming after a pathogen has been detected (Figure 2). This process is based on international biosecurity best practice and has a number of clearly defined steps. Steps 1 and 2 have been put in place by MPI.

[19] Biosecurity (Notified Organism) Order 2016.
[20] Recognising that the least risk will be in *B. ostreae*-free areas furthest from significant wild populations.

71. In our discussions with the flat oyster farmers, it became apparent they had been subjected to steps 1 and 2 and were unaware of the other possible steps. Had they been made aware of the whole incursion-response process through timely communications, at the time, before or during the depopulation of their farms, some of their dissatisfaction with MPI and the New Zealand Government bureaucracy and its approach to the *B. ostreae* detection could have been mitigated.

Figure 2: Proposed pathway to flat oyster farming in New Zealand



Note: Sites previously infected with *B. ostreae* start at step 3, and previously uninfected sites start at step 6a. Risk assessment is applied in steps 5a and 5b. Any incursion or mortality from *B. ostreae* in areas outside the Marlborough Sounds CAN revert to step 2. Eradiation and removal of farm hosts reduce the likelihood of high infection pressure, establishment and spread. For areas infected with *B. ostreae* where farm stock has been removed, basic biosecurity protocols and surveillance are in place, OIE standards allow a self-declaration of freedom to be declared for that epidemiological unit if surveillance does not detect *B. ostreae* infection for two years (OIE, 2019b, Article 11.3.5; see: https://www.oie.int/index.php?id=171&L=0&htmfile=chapitre_bonamia_ostreae.htm and Article 11.3.6 for the maintenance of free status conditions).

72. A return to farming that does not pose an unacceptable risk will require:

- clear delimitation of the infected zone and further ongoing surveillance of wild and farmed oysters in the area, to determine spread;
- farming practices predicated on an approved biosecurity plan that is enforceable;
- risk analysis and sale of oysters only to markets overseas or where indicated as acceptable by the risk assessment;
- farmer compliance and auditing of the reporting of:
    a. hatchery production, stock and husbandry records and records of movement;
    b. any unusual expression of altered health status or elevated or unusual mortality;
    c. deviations from operating norms or expectations;
- an acceptance that flat oyster farming practices will not be allowed to exacerbate the current environmental risk posed by the level of infection in the wild oyster (and other shellfish) populations. A basis for returning to operations, and go or no-go points, will need to be established. For example, can the presence of some *B. ostreae* on oyster farms be tolerated, and, if so, at what level? If *B. ostreae* is considered established in the wild in Marlborough Sounds, in the absence of a large wild fishery nearby, some TAG members agreed that diseased oysters being present on farms within the zone would be tolerated, with the requirement to harvest them before mortality becomes excessive, thereby managing them as potential sinks, not sources, of *B. ostreae*. Other TAG members were of the view that, if *B. ostreae* was detected on the farm, all oysters would have to be removed and disposed of in a biosecure manner;
- a method of reintroduction that limits disease by farming segregated age classes and ensuring that a farm is destocked at the end of the second year (as suggested by 9(2)(a) [redacted] personal communication);
- surveillance, to ensure the farms do not unacceptably increase the risk of transmission[22] of *B. ostreae*,[23] with clearly defined and agreed criteria prior to farming;
- a communications strategy on the CAN rules (and penalties) that explains the reasons for them;
- a structured surveillance programme that monitors the potential spread of *B. ostreae* by:
    a. testing of blue mussels (*Mytilus edulis* and *M. galloprovincialis*); ribbed mussels (*Aulacomya maoriana*) and farmed and wild green-lipped mussels (*Perna canaliculus*) will need to be an integral part of the programme, to determine whether or not they are carriers of viable *B. ostreae*. Other benthic bivalves (horse mussels (*Atrina zelandica*), scallops (*Pecten novaezelandiae*), cockles (*Austrovenus stutchburyi*), nutshells (*Nucula hartvigiana*, *Macomona liliana*, *Dosina zealandica*, *Panopea spp.*) found in areas identified as infected should also be investigated, to determine whether they are potential *B. ostreae* carriers that can act as vectors of infection;
    b. validating the potential for *B. ostreae* to persist in sediment and organic matter;
    c. gaining a better understanding of *B. ostreae* in the New Zealand situation.
- a wider communication strategy that has the aim of promoting farmer–community–tangata whenua acceptance of international biosecurity best practice, and improving the lines of communication between the regulatory authorities (MPI, regional and unitary councils) and stakeholders;
- flat oyster farming education so farmers understand:
    a. that a return to commercial farming is going to take time, good science and a shared approach to biosecurity;
    b. that biosecurity controls must include: compliance, surveillance and reporting;
    c. that connectivity must exist between management practices and biosecurity risk;

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[21] 9(2)(a) [redacted]
[22] The risk parameter would be clearly defined in the MPI policy that would allow the return to farming.
[23] If *B. ostreae* is there, but not causing mortality, its presence can be tolerated.

d. the response that will be taken to defined *B. ostreae* events; and

e. that product of any sort can only be sold internationally or in areas where sale is shown to pose an acceptable risk.

Summary comments

73. TAG 2019 is of the opinion that farming in Marlborough Sounds under appropriate biosecurity and compliance measures could be permitted in areas where *B. ostreae* has been detected with a low likelihood of compromising the *B. ostreae* Programme's objectives or aims. We strongly advise structured and managed farming development, with disease testing at regular intervals as indicated by the surveillance plan, and firm documentation of development, progress and production. Monitoring is a fundamental part of this.

74. With any farming, anthropogenic-mediated actions (intentional or unintentional) still represent a major risk for the spread of *B. ostreae*.

75. How oyster farming will influence risk and the spread of *B. ostreae* is unknown. It is accepted that any large mortality events will potentially increase the parasite load in the environment and thus raise the risk of spread. TAG 2019 could not agree on whether a level of infection would be tolerated in farmed stock and whether farmed stock should only be removed if it is shown to exacerbate infections in wild oysters. The development of a policy on farming could address this difference.

76. TAG 2019 stresses the need for:

- integrated, effective engagement between farmers, MPI, regional or unitary councils on biosecurity;[24]
- farmer acceptance of, and compliance with, high biosecurity standards and an agreed response to infections (high mortalities would not be allowed);
- independent surveillance, testing of stock, biosecurity compliance checks and auditing of farm biosecurity plans; and
- a strategy to maintain effective communication between farmers, the aquaculture industry, regional authorities and MPI.

Recommendations – Marlborough Sounds

77. Once a biosecurity framework and responsibilities for proactive biosecurity are in place, TAG 2019 recommends a small-scale (one or two farms only), structured and supported return to flat oyster farming in Marlborough Sounds, so farming systems can be developed and evaluated, and the risk of *B. ostreae* to the wider environment properly assessed.

78. Farmers must be prepared to accept that their farming regime will be underpinned by an independently approved biosecurity plan, which will be subject to audit. Farming must be contingent on development and implementation of such a plan, while results from surveillance of wild oysters and other molluscs near the experimental farms may be used to inform the response to any detections of *B. ostreae* in farmed oysters.

79. TAG 2019 recognises that there are cost implications; biosecurity (plans, compliance, audits, surveillance, responses and so on) is a cost of doing business just like the costs associated with wild fisheries and MPI-levied research and compliance.

Big Glory Bay, Stewart Island

80. Because Big Glory Bay farms and wild stock were infected with *B. ostreae* , and this semi-open bay and Paterson Inlet have patchy distributions of wild oysters that extend to Foveaux Strait and into the wild fishery, and given its proximity to the fishery and the continuity of oyster population, we have classified Big Glory Bay as a high-risk area.

81. The wild fishery in Foveaux Strait holds an iconic status nationally. To be consistent with the objective of the *B. ostreae* Programme, we must take a precautionary approach (highly risk averse, with risks mitigated until assessed as at least "very low" or meeting the appropriate level of protection) when making any recommendations on a return to flat oyster farming in this area.

[24] This includes who is responsible for ensuring biosecurity compliance.

82. To provide context to our risk consideration, we have provided in Appendix 1 an overview of the wild oyster fishery in Foveaux Strait. This summary highlights that the trend in oyster densities is mostly driven by periodic disease mortality caused by *B. exitiosa* and variability in recruitment to the oyster population (which may also be affected by pathogens). Based on previous data from Marlborough Sounds, we predict that co-infections of *B. exitiosa* and an incursion of *B. ostreae* into Foveaux Strait would have a catastrophic effect on the oyster population and potential negative commercial impact on the wild oyster fishery.

83. We have indicated above for Marlborough Sounds a process following internationally accepted disease and biosecurity management practices that could allow a return to farming. We asked ourselves, is the situation in Big Glory Bay analogous to the Marlborough Sounds, or should flat oyster farming be prohibited in the bay? If so, what would be the justification?

84. We looked at the potential scenarios that would facilitate a return to farming in the bay and two are possible.

85. Figure 2 outlines a generalised approach to farming in Big Glory Bay contingent on regulatory and compliance frameworks for increased biosecurity. The substantially increased risk posed by unmanaged oyster farming to local socio-economics, cultural values, the Foveaux Strait ecosystem and the fishery require a high level of biosecurity and rapid response in the event of reinfection. The two scenarios we envision are discussed below.

Scenario 1: Big Glory Bay meets OIE criteria for freedom from B. ostreae

86. In this instance, a return to flat oyster farming could be considered. In recognition of the risk, an approach with a high biosecurity bar would be required and would entail:

1. a review of all consent conditions for all marine farms operating in the bay and the introduction of a biosecurity management plan, to ensure they are all operating to the same biosecurity standards;
2. further careful assessment of an apparent “free” status (one-to-two years of surveillance). Large numbers of oysters and other bivalves (including but not limited to blue mussels and ribbed mussels – see above) should be tested to ensure they are not infected or carrying *B. ostreae*;
3. the CAN[25] remaining in place, to ensure compliance with permitting conditions for all green-lipped mussel movements off or on to Stewart Island, and no non-permitted movements. Testing may be necessary to ensure harvested green-lipped mussels do not include *O. chilensis*;
4. independent or collaborative sentinel testing (test for freedom) over a two-year period;
5. seed stock being sourced locally from *B. ostreae*-free locations or sourced from a bio-secure hatchery;
6. surveillance results remaining negative for *B. ostreae*, so the development of farm activities could commence based on a management approach predicated on an approved biosecurity plan that is incorporated into the consent conditions. The plan would specify: the standards to be put in place; monitoring and testing to be undertaken; reporting requirements and other relevant controls. Biosecurity compliance would be subject to random audit. Approved testing and confirmation protocols would need to be agreed with farmers as would an agreed response (extent and speed of removals) based on predefined prevalence and mortality. Given the proximity to the Foveaux Strait oyster fishery, the prevalence of *B. ostreae* in farmed oysters would be set at 0 percent;
7. recognition that aquaculture structures in Big Glory Bay may exacerbate the *B. ostreae* risk because they may provide a stepping-stone mechanism for *B. ostreae* dispersal. A prescribed biofouling management regime for structures and vessels using Big Glory Bay needs to be implemented;
8. recognition of the risk posed by recreational and customary fishers moving oysters, and the need to mitigate this risk through education and compliance.

[25] The southern CAN area needs to be revised to exclude Otago Harbour. The Otago Harbour should have its own CAN.

Scenario 2: Surveillance has returned a B. ostreae *positive test*

87. In this instance, with a positive result for *B. ostreae* being confirmed:

    1. all consent conditions should be reviewed for all marine farms operating in the area (including Horseshoe Bay) and require the introduction of a biosecurity management plan, to ensure the farms are all operating to the same biosecurity standards;
    2. a structured surveillance programme should be introduced to determine the geographical spread and host taxonomic range of the pathogen in Big Glory Bay, Stewart Island. Oysters and other bivalves (including but not limited to blue mussels and ribbed mussels – see above) should be tested for *B. ostreae* infection in the detection zone and wider environment, to assess the risk of spreading *B. ostreae*. If the infection is restricted to wild molluscs in a small well-defined area, and it is considered feasible,[26] attempt the eradication of infected molluscs to try to return to freedom;
    3. a survey should be undertaken to determine if *B. ostreae* has spread beyond Big Glory Bay;
    4. the CAN must remain in place to ensure compliance with permitting conditions for all green-lipped mussel movements off or on to Stewart Island, and that there are no non-permitted movements. Testing, to ensure harvested green-lipped mussels do not include *O. chilensis*, is critical;
    5. any return to commercial flat oyster farming should not be permitted until farming strategies can be devised that maintain a demonstrably lower *B. ostreae* infection profile than the background levels in wild populations. Any return to flat oyster farming could be established in Marlborough Sounds. Such a return would require an appropriate cost-benefit analysis of farming operations under intense biosecurity and testing procedures and trigger points for stock and structure removal procedures;
    6. active surveillance should resume, as outlined in the surveillance plan;
    7. if a management approach is agreed, an approved, comprehensive biosecurity plan must be incorporated into the consent conditions. The plan will specify the standards to be instigated, monitoring to be undertaken and reporting requirements. Plan compliance will be subject to random audit;
    8. it should be recognised that aquaculture structures in Big Glory Bay may exacerbate the *B. ostreae* risk because they are likely to provide a stepping-stone mechanism. A prescribed biofouling mitigation regime would be required for structures and vessels using Big Glory Bay;
    9. Big Glory Bay should remain closed to all outside stock and spat as per the CAN.

Recommendations – Big Glory Bay

88. Flat oyster farming in Big Glory Bay without risk mitigation creates an unacceptable risk, due to its close proximity to Foveaux Strait and uncontrolled anthropogenic influences. Recent surveillance has detected the presence of *B. ostreae*, and a return to flat oyster farming is not recommended at this time.

89. Confirmation of the presence of *B. ostreae*-active oyster farms in the bay represents a potential mechanism for increasing parasite infection pressure. Under such circumstances, a recommencement of flat oyster aquaculture in Big Glory Bay is not recommended.

90. At some point in the future, if farming strategies can be devised that maintain a demonstrably lower *B. ostreae* infection profile than the background levels in wild populations, farming could potentially restart. This would require the highest biosecurity standards, to ensure that farming would pose no increased infection risk to the Foveaux Strait oyster fishery.

91. For scenarios 1 and 2, TAG 2019 stresses the need for aquaculture operators to accept high biosecurity standards, the need for an effective communications strategy, and removal of stock when required (Step 2; Figure 2).

[26] The feasibility of attempting a return to freedom was questioned by some TAG members.

Question 1c: What is the role of surveillance in determining the risk that the reintroduction of oyster farming poses to uninfected wild oyster populations or the fishery? What other considerations are relevant?

92. The importance of surveillance cannot be overstated. It has an indispensable role in developing a baseline disease profile and understanding what is happening before, if, and when farming happens again. Surveillance will provide data on pathogen prevalence and putative host species that potentially provide sources of infection, and frequent testing will provide estimates of infection prevalence and intensity in farmed stock over time. This time-series will be invaluable for informing models of infection, reinfection and spread. TAG 2019 is of the opinion that *B. ostreae* requires the development of a national surveillance plan, with the primary aim of:

    1. validating test and confirmatory diagnostic methodologies for *B. ostreae* and *B. exitiosa* in *O. chilensis* and ensuring diagnostic sensitivity and specificity are understood;
    2. reviewing surveillance activities to date;
    3. developing a nationally consistent approach to surveillance, based on OIE criteria (Chapter 1.4; OIE, 2019a);
    4. monitoring sites where *B. ostreae* has been detected;
    5. producing an agreed upon approach to determine the rate and distance of *B. ostreae* spread;
    6. providing a basis for assessing risks and to predict socio-economic and ecological effects of *B. ostreae* incursions and mortality;
    7. assessing the effects of flat oyster farming on *B. ostreae* infections in wild bivalves in Marlborough Sounds, to determine whether it can present a sink for *B. ostreae* and to better define the risk profile for *O. chilensis* farming.[27]

93. A standard approach to surveillance will ensure that results can be interpreted in a consistent way. Surveillance will need to be underpinned by the validation of a nationally agreed surveillance strategy that meets OIE standards (OIE, 2019b, Chapter 1.1.4 and Chapter 3.1.1) and nationally consistent diagnostic operating procedures. For example:

    1. validated[28] diagnostic tools with defined diagnostic sensitivity and specificity, as applied to *O. chilensis*;
    2. sample sizes adequate to detect *B. ostreae* at relevant prevalence in hosts that are patchy in distribution in the wild (see Chapter 1.4 on surveillance; OIE, 2019a);
    3. survey species that include putative reservoir hosts or carriers (for example, green-lipped mussels);
    4. standard operating procedures for sample collection and processing of tissues;
    5. an agreed approach to sampling for molecular testing and histology or other approaches, and a national archive of tissues (wax blocks with database and metadata for samples);
    6. standard procedures for confirmation of *B. ostreae* positives;
    7. reporting to a central agency on hatchery, stock production and movement data on an agreed basis, as are fisheries catch and effort data.

94. National surveillance of oyster farms could monitor infection in farmed stock on a regular (semi-annual or annual) basis. Threshold levels of prevalence and intensity of infection that would trigger the depopulation of farms would need to be established. For operations such as in Horseshoe Bay and Big Glory Bay, Stewart Island, thresholds may be zero whereas in Marlborough Sounds the parasite load that can be tolerated should be assessed based on surveillance data of wild bivalve populations and a risk analysis.

[27] This last point represents a majority view of TAG 2019.
[28] Standard molecular testing methods (qPCR and ddPCR) that maximise specificity and sensitivity.

Question 1d: What level of risk does the farming of flat oysters pose to uninfected wild populations, relative to any risk posed by wild oyster populations in Marlborough Sounds (where *B. ostreae* has been detected)?

95. This question has been addressed in paragraph 67, where we noted that, if *B. ostreae* is confirmed to be established in Marlborough Sounds in wild flat oyster populations, the risk of spreading by anthropogenic means remains and will continue to remain into the foreseeable future regardless of whether oyster farming recommences or not. However, oyster farming has the potential to exacerbate risk, and unmanaged farming is greater than the risk posed by low density wild populations in Marlborough Sounds. Farming under an approved biosecurity plan can reduce the risk posed by farming to an acceptable level.

96. The novel idea that bivalve farms provide a pathogen sink (Ben-Horin et al, 2018) remains, and we emphasise an untested modelling paper. In theory, the ability to reduce infection pressure in wild populations is advantageous, with an adaptive surveillance strategy to ensure that no significant *B. ostreae* mortality occurs. Should a mortality event or peak in *B. ostreae* intensity occur, the risk of spreading *B. ostreae* to Tasman Bay and Cloudy Bay populations increases. A single, infected, dying flat oyster can transmit disease horizontally by cohabitation (Buss et al, 2019) and theoretically produce an infective dose high enough to kill up to 25,000 nearby oysters (Diggles and Hine, 2002).

97. We highlight that there are several uncontrolled and poorly regulated risk pathways that are not associated with oyster farming that, coupled with the lack of an integrated approach to biosecurity compliance and reporting (Biosecurity Act 1993, Resource Management Act 1991 and Fisheries Act 1996), create an unacceptable risk for the spread of *B. ostreae* and other marine pathogens. Such pathways include biofouling of domestic vessels.

9(2)(b)(ii)

[redacted]

Question 3: What potentially suitable environments (where oyster farming has not occurred to date), including land-based recirculating systems, offer opportunities for flat oyster farming in New Zealand?

107. Based on the collective experience of TAG members, we are of the firm opinion that, at this present point in time, land-based flat oyster grow-out systems are not practicable, whereas land-based systems for hatcheries and nurseries can operate effectively and efficiently.

108. Land-based systems are preferred for biosecurity, but the technology is not available for cost effective grow out of filter feeding bivalves at this time.

109. New Zealand has many sites with water space consent where oyster farming could be developed. Disease status, location in relation to significant wild flat oyster populations and connectivity via currents should be considered prior to development.[29] *Ostrea chilensis* occurs in Hauraki Gulf. A hatchery programme using local stock could provide flat oyster farming opportunities in Coromandel. Chatham Islands is another potential site that is isolated from significant wild populations, and preliminary surveillance suggests it may be free of *B. exitiosa* and *B. ostreae*. Banks Peninsular provides cold-water farming opportunities but is oceanographically linked to the Cloudy Bay oyster population. Historically, flat oysters were abundant in Tasman Bay. Tasman Bay, Golden Bay and Croisilles Harbour present opportunities; however, these areas should be subjected to higher levels of biosecurity due to their proximity to Marlborough Sounds.

[29] See the Primary Industries and Regions South Australia 2017 report *Zoning In: South Australian Aquaculture Report 2015 /16* for an example of the action undertaken prior to establishing a farming zone.

Question 4: What biosecurity management approaches and mitigation measures, including testing protocols and compliance measures, are available to reduce the risk posed by the farming of flat oysters in new areas or under different conditions?

Question 4a: What work should occur prior to the establishment of farms to assess the potential biosecurity risk of transmitting *B. ostreae*?

110. Any development of new flat oyster farming areas needs to occur within a biosecurity framework with an underpinning criterion that no development can occur until surveillance has been undertaken to understand the *B. ostreae* status of the proposed area.

111. The consideration of a new area for farming flat oysters should follow a prescribed model, and we have outlined the type of approach that should be followed:

   1. surveillance of farm site and environs constituting an epidemiological unit, to establish *B. ostreae* status and a baseline for other pathogens of significance (for example, *B. exitiosa*);
   2. risk assessment for nearby wild oyster populations;
   3. develop and have independently reviewed a biosecurity plan that includes full details of operational considerations, reporting of hatchery, stock production and stock movements, health status and mortalities, and a regular testing programme, appropriate to provide early detection of *B. ostreae* infection, and prevalence and intensity of *B. exitiosa* infection (if appropriate). Agreed sampling and testing protocol. Thresholds for infection of wild stocks and/or infection or mortality of farmed stocks that trigger farm removals;
   4. structured collaborative development plan with the regional authority, MPI, and a research provider.

112. Table 1 outlines the start-up model for new and/or existing farms waiting to reopen.

Table 1: Start-up model for new and/or existing oyster farms waiting to reopen

Phase One:[30] **Identification requirements**	Carry out hydrodynamics analysis
	Baseline health assessment of wild flat oysters and other bivalves
Phase Two: **Testing phase – answering specific questions**	Will oysters grow?
	Are pathogens present?
	Research to determine which species to target
	Test other bivalves for pathogens
	Carry out cost benefit analysis
Phase Three: **Establishment phase**	Spat collection: a. catch locally available wild spat (lowest risk); and b. if you have access to local hatchery in the zone, potentially select for resistance
	Test different densities on different lines.
	Monitor farm stock and wild stock (flat oysters and at least one other bivalve): • six monthly (12 monthly absolute minimum) – four times over two years before harvest (PCR and histology) For early trials, the intensity of sample may want to increase with increasing age and susceptibility

[30] Given the time and cost of the Resource Management Act consenting regime for aquaculture space, Phases 1 & 2 provision should be made so that these phases can be untaken on a 'temporary consent' basis.

Question 4b: Does the level of risk vary between different areas or approaches to farming?

113. The level of risk is location dependent. It will vary with the characteristics of the area, oceanographic and vessel connectivity, proximity to major flat oyster fisheries and the method of farming undertaken.

114. TAG 2019 is not in a position to comment on the risk profiles of different New Zealand farming approaches because they have not been quantified.

115. Farm planning in endemic areas for pathogens should include provision to decrease the risk of the farm increasing the pathogen load in the environment.

Question 5: is any research particularly critical to a consideration of the future of flat oyster farming?

116. TAG 2019 is of the opinion that research needs to be strategic, prioritised and widely peer reviewed to ensure the science is robust. The following priorities should be addressed:

   i. designing a nationally accepted robust surveillance programme that will include:

      – collecting samples for both molecular testing and histological examination – standardise methods;

      – establishing a national archive of tissues (extracted nucleic acid and wax blocks with database and meta data for samples) for future research;

      – validating diagnostic tests, accreditation of laboratories and inter-laboratory comparisons for tests; and

      – reviewing, revising and continuing the national surveillance programme including, where appropriate, establishing baselines and the spread of *B. ostreae* infection (reinstate sampling in Marlborough Sounds and Otago);

   ii. identifying non-*O. chilensis* hosts and carriers;

   iii. developing an understanding of persistence of *B. ostreae* cells in pallial cavity water;

   iv. gaining an understanding of the ecology and epidemiology of *B. ostreae* and *B. exitiosa*, host pathogen relationships and occurrence and persistence in aquaculture systems;

   v. developing an *O. chilensis* breeding programme that could include developing *B. exitiosa*-resilient oyster lines as a model towards potentially developing *B. ostreae*-resistant lines sometime in the future.

Communication strategy

117. The structured development of oyster farming requires a scientific design, with appropriate data recorded to allow analysis of disease effects, production metrics and economic feasibilities. Previously, much of these data were hidden behind commercial confidentiality. Development of New Zealand flat oyster aquaculture will require collaboration, sharing of knowledge and open data. To this end, a communication strategy for the future is vital.

Concluding comments

118. TAG 2019 was tasked with providing expert scientific and technical advice and guidance to Biosecurity New Zealand and the *Bonamia* Programme Governance Group on the farming of flat oysters in New Zealand. This included assessing the risk that farming flat oysters poses to uninfected wild oyster populations. Listed below are key points from our review:

    1. The principal risk of *B. ostreae* (or any other new marine pathogen) spreading is by anthropogenic means, with human-mediated transport, either intentional or accidental, remaining the most likely mechanism by which *B. ostreae* could, and has, spread[31] over long distances or to new locations, particularly in the absence of infection between infected areas. The risk pathways have been identified and the risks will remain unacceptable until the pathways are managed.
    2. An integrated approach, with compulsory criteria, is required for biosecurity because the regulatory environment (Biosecurity Act 1993, Resource Management Act 1991, Fisheries Act 1996), while having a number of tools to use,[32] is insufficient. In particular, Resource Management Act consent conditions (including monitoring) associated with coastal permits are totally inadequate in terms of addressing biosecurity.
    3. The risk that a return to flat oyster farming poses to the objectives of the *B. ostreae* Programme is location dependent, but until the identified pathways have been addressed the risk is unacceptable.
        i. Oyster farm sites around New Zealand free from *B. ostreae* and distant to wild oyster stock pose the lowest risk.
        ii. 9(2)(b)(ii) [redacted]
        iii. A return to farming in Marlborough Sounds would represent an unacceptable risk to wild stock, without risk mitigation. There has been insufficient surveillance to determine whether *B. ostreae* has established in wild oysters in Marlborough Sounds. Given the wider recommendations in this document, a return to farming is possible but will require surveillance and the implementation of measures to address the identified pathways to decrease the risk to an acceptable level.
        iv. A return to farming in Big Glory Bay, Stewart Island, poses an unacceptable risk without risk mitigation, because of its proximity to Foveaux Strait and the lesser ability to control anthropogenic movements of oysters and infection. In the event of “freedom”, risk mitigation can decrease the risk to an acceptable level by decreasing the likelihood of *B. ostreae* introduction.
    4. Hatcheries need to adopt best biosecurity practice, which could be modelled on the Australian approach (Commonwealth Government of Australia, 2018).
    5. Integrated processes that include oyster farmers, regional councils, MPI, the aquaculture industry and research providers are essential for effective communication, education and “bottom-up” strategies, to ensure world best practice in terms of biosecurity and aquaculture development.
    6. An effective and ongoing public communication strategy is needed to increase awareness of marine biosecurity and transmission pathways.
    7. Consideration should be given to investigating, through scientific trials in Marlborough Sounds, if farmed oysters can create sinks for *B. ostreae* infection with flow-on benefits for wild populations.

[31] From the top of South Island to Marlborough Sounds.
[32] Many tools are not compulsory.

Summary recommendations

a. The national surveillance programme needs to be reviewed and expanded.

b. The development of the NES for Marine Aquaculture represents an opportunity to embed an integrated approach to biosecurity, incorporating both Biosecurity Act 1993 and Resource Management Act 1991 requirements. Integration between regional authorities and MPI, and regular communication, is considered critical.

c. Development of the New Zealand flat oyster culture needs to be strategic and with high levels of collaboration. All farms should have an approved biosecurity plan that is subject to reporting and auditing.

d. The anthropogenic risk pathways associated with oyster farming, as well as those not associated with oyster farming, all need to be addressed.

e. A return to flat oyster farming in Marlborough Sounds should be considered, following the recommendations in this report. Farming can be recommenced on a sentinel basis and then expanded in a step-wise fashion to assess systems and with appropriate levels of monitoring and surveillance of wild bivalve populations. The CAN will need to remain in place.

f. The positive detection of *B. ostreae* in Big Glory Bay, Stewart Island, in September 2019 suggests that, at this point in time, a return to flat oyster farming there poses an unacceptable risk. Any attempts to eradicate *B. ostreae* primary and alternative hosts (if identified) will require extensive surveillance and high biosecurity requirements to prevent its establishment.

g. 9(2)(b)(ii) [redacted]

h. The consent conditions of all the aquaculture farms in Big Glory Bay, Stewart Island, should be reviewed so that their operations are underpinned by approved biosecurity plans.

i. 9(2)(b)(ii) [redacted]

j. Communication and education strategies must be developed and implemented.

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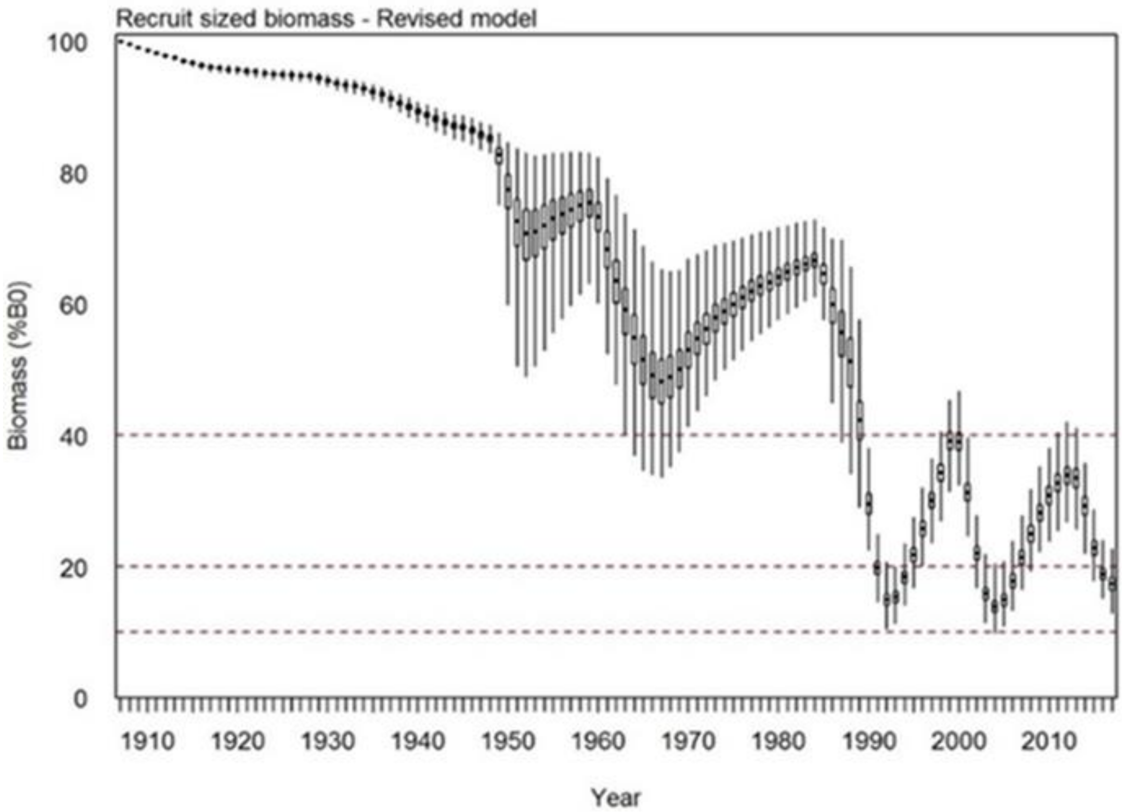
Appendix 1: Foveaux Strait oyster fishery – brief overview

Figure 3 shows the effects of disease mortality on recruit-sized oysters in the Foveaux Strait fishery. Estimates of B_0 and population size before 1940 are uncertain. A decline between 1958 and 1964 is attributed to disease (co-infections of *Bucephalus longicornutus* and possibly *Bonamia exitiosa*). Biomass showed a constantly increasing trend in abundance between 1965 and 1985, despite high levels of catch and high fishing effort. A rapid, short-lived decline in landings in 1969 (not shown) was the result of a long industrial dispute that lasted most of the oyster season. The 1985 disease event (*B. exitiosa* epizootic) caused a rapid decline in biomass, followed by recurring mortality causing cycles in abundance. The 1985 epizootic may have been either due to a re-emergence or reintroduction of *B. exitiosa* (Ben Diggles pers. comm.) or another pathogen (for example, *Apicomplexa* (APX)) comprising a co-infection in the oyster population. A density-dependent threshold is evident post-1985, where disease prevents the population from rebuilding to higher levels. The oyster population rebuilds quickly in the fishery areas that have been fished for many years. There is also a marked reduction in recruitment post-1985, the percentage of brooding-sized oysters brooding was 6–18 percent pre-1985 and less than 2 percent from 1993 to 1999.

Figure 3: Recruit-sized (legal-sized oyster) biomass as a percentage of B_0 (the biomass before fishing began) from the last (2017) Foveaux Strait oyster fishery (OYU 5) stock assessment, 1910–2010

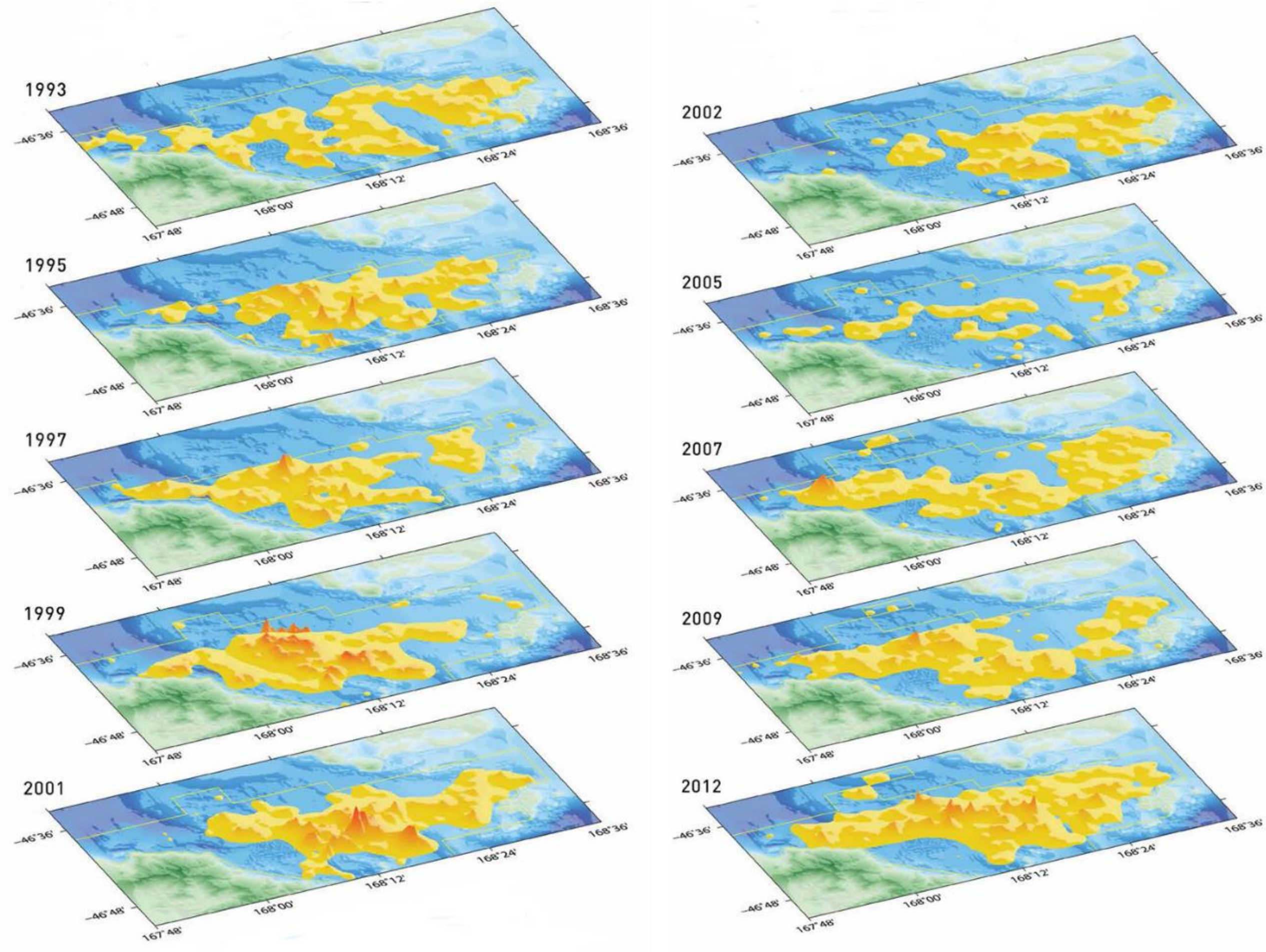


Note: Horizontal dashed lines show 40 percent, 20 percent and 10 percent B_0.

Image: Kath Large, National Institute of Water and Atmospheric Research.

Figure 4 shows the waxing and waning of “oyster beds” that remain spatially stable. Note the low oyster densities in the northern, more exposed part, of Foveaux Strait. The area of high oyster density in the western fishery in 2007 had not been fished for five years prior to 2008, after which it was reduced by *B. exitiosa* mortality in 2009.

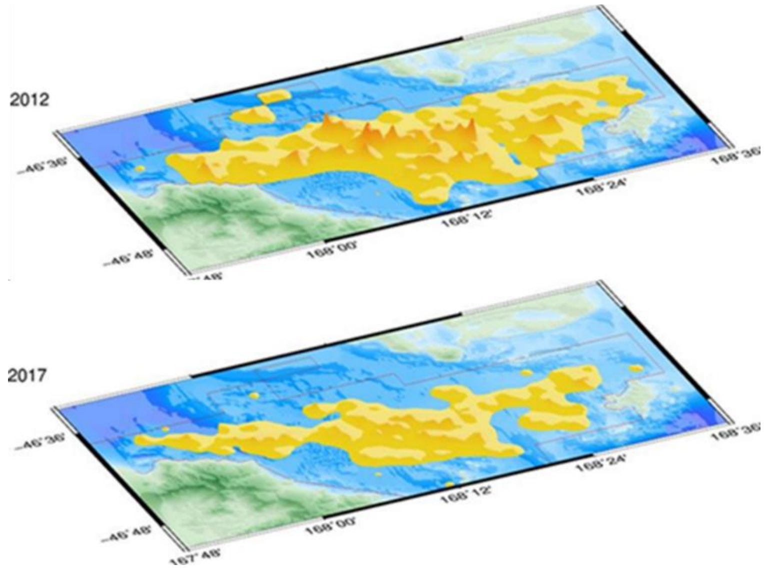
Figure 4: Distribution of oysters in Foveaux Strait from dredge surveys, 1993–2012



Note: The demographics and biology of oysters suggest the fishery comprises localised populations that have persisted in the same locations after high disease mortality from *B. exitiosa* and periodic high levels of fishing.

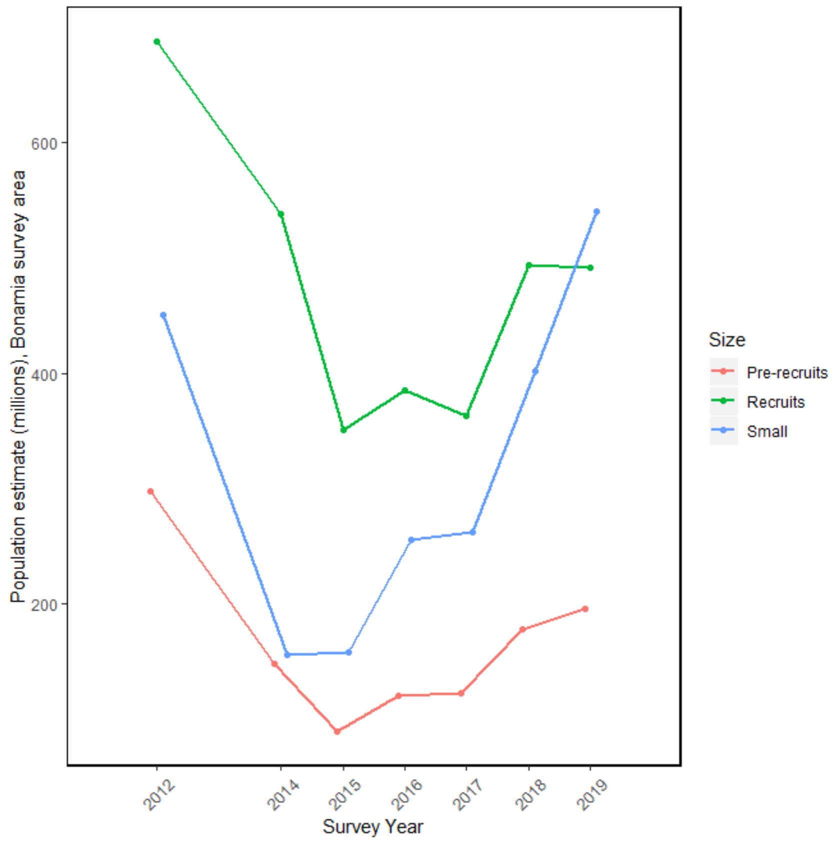
Image: Erika Mackay.

Figure 5: High oyster densities reduced by *B. exitiosa* mortality between the last two stock assessments in 2012 and 2017



In Figure 6, National Institute of Water and Atmospheric Research survey data between 2012 and 2019 show declines in the population sizes of all three size groups (recruit, pre-recruit and small) between 2012 and 2015. Thereafter, the data show an increase in recruitment flowing through to the small size group (blue line) and then to the larger size group.

Figure 6: Mean population sizes for pre-recruit (oysters that grow in to the harvestable population within two years), recruit- (legal sized) and small-sized oysters in the core commercial fishery area (representing 46 percent of the stock assessment survey area) between 2012 and 2019



SUMMARY

The Foveaux Strait oyster fishery is a high-value, iconic fishery that has been fished for over 150 years. Oysters are an important customary (taonga), recreational and commercial species, and are important to the socio-economic wellbeing of Bluff and Invercargill. Variation in oyster densities is mostly driven by periodic disease mortality caused by *B. exitiosa*, and variability in recruitment to the oyster population. The harvest levels are currently low, less than 2 percent of legal-sized oysters, and the effects of fishing are not detectable on the future stock size.

Oyster habitat and the fishery area

Foveaux Strait represents an extreme in oyster habitat, with a deep 20–50 metre gravel substrate, sometimes overlaid with sand, with strong tidal currents. This habitat is unique amongst oyster fisheries, and Foveaux Strait differs markedly from the mainly low-energy, shallow (less than 10 metre) and muddy estuarine, embayment and intertidal habitats of other historic oyster fisheries. Storm surges mobilise sediments that bury oysters in coarse calcareous sand and gravel, and thereby reduce their ability to feed, causing physiological stress and reducing reproductive output.

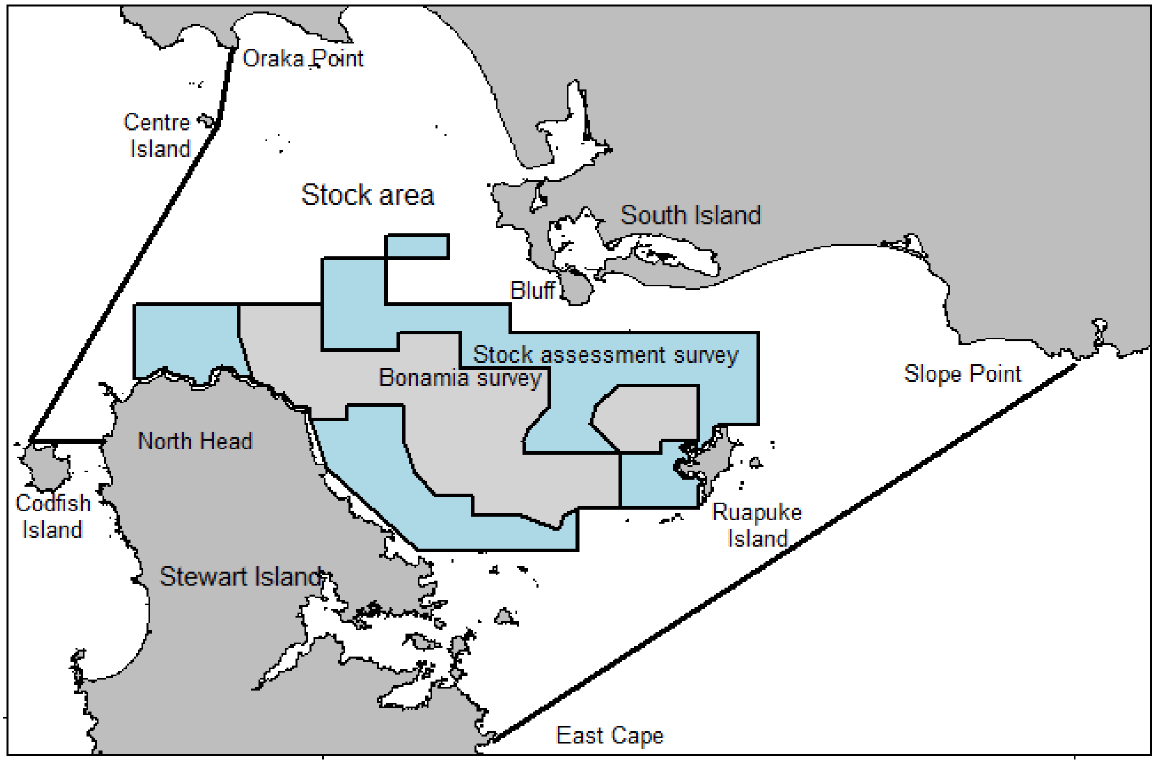
Oyster pathogen *Bonamia exitiosa*

The haplosporidian parasite of flat oysters, *B. exitiosa*, was originally thought to be an endemic disease of Foveaux Strait oysters. However, recent studies have found *B. exitiosa* has a broad, worldwide geographical distribution and that it infects a number of oyster species (Hill-Spanik et al, 2015). Three *B. exitiosa* epizootics since 1985 have shown that mortality from *B. exitiosa* is oyster-density dependent and a recurrent feature of the oyster population. This mortality is the principal driver of oyster population abundance during epizootics, and recurrent mortality events suggest that *B. exitiosa* epizootics can be expected in the future. Management of the fishery recognises that recruit-sized stock abundance and future benefits from the fishery (harvest levels) are mainly determined by the levels of *B. exitiosa* mortality (assuming near long-term average recruitment), and that the current harvest levels and any effects of fishing on either oyster production or on exacerbating *B. exitiosa* mortality are not detectable. Co-infections are common in oysters, and several pathogens infect oysters in Foveaux Strait. Two of these co-infections, an APX and *Bucephalus longicornutus*, are known to disrupt reproduction and therefore affect recruitment. The highest recruitment occurs at times of low oyster density leading to reduced disease transmission and low oyster mortality from *B. exitiosa*, indicative of low disease infection during reproduction that is likely to result in higher brooding percentages (that is, higher recruitment). Disease mortality therefore drives the oyster population down and, at times, disease may also reduce recruitment to the fishery.

Surveys of the Foveaux Strait oyster population

The Foveaux Strait oyster population is surveyed annually to provide up-to-date information on the status of the fishery and disease, provide forecasts for the following oyster season, and to inform management. Management of the fishery assumes a single stock (OYU 5). The western boundary of the Foveaux Strait oyster stock area is defined by a line from Oraka Point (Southland) to Centre Island and on to Codfish Island and North Head (Stewart Island). The eastern boundary is a line between Slope Point (Southland) and East Cape (Stewart Island). The stock area is 3,300 square kilometres. Oysters are patchily distributed within the stock area, and most are concentrated in a smaller region of the managed area. The 2007 stock assessment survey area comprised 1,072 square kilometres (Figure 7). All commercial fishing occurs within this area. Since 2012, five-yearly stock assessments, in 2012 and 2017, have placed greater onus on the annual surveys to monitor changes in the oyster population in commercial fishery areas as well as the status of *Bonamia*. Annual surveys sample the whole stock assessment survey area; however, sampling is focused on the commercial fishery area and *Bonamia* survey area (Figure 7). The *B. exitiosa* survey area is 46 percent of the stock assessment survey area and represented 75 percent and 69 percent of the legal-sized oyster population in 2012 and 2017 respectively.

Figure 7: Western and eastern boundaries of the stock area (heavy black lines), the stock assessment survey area (light blue polygon) and *Bonamia* survey area (light grey polygon)



Oyster surveys estimate the densities and population sizes of three size groups of oysters. Surveys also estimate the prevalence and intensity of *B. exitiosa* infection and short-term (summer) mortality. Surveys incorporate a sampling design aimed at better estimating oyster densities and population sizes of oysters. Some limited sampling in the remaining stock assessment area is undertaken to allow data from these surveys to be comparable from year to year, and to be incorporated into stock assessments. The precision of these surveys is relatively high with coefficient of variation well below the 20 percent target set by Fisheries New Zealand for stock assessment surveys.

At relatively low levels of catch (less than 30 million oysters per year), the trend in the abundance of legal-sized oysters in the Foveaux Strait fishery is driven by disease mortality from *B. exitiosa* and the levels of recruitment to the population (spat settlement). Oyster spat settlement was low between the summers of 2009–10 and 2015–16, despite the population size of spawning-sized oyster densities increasing until 2012. Consequently, the numbers of small and pre-recruit oysters (medium sized that would be legal sized within two years) declined markedly and were unable to replace the large numbers of oysters killed by *B. exitiosa*. Until 2012, *B. exitiosa* killed 8–12 percent of recruit-sized (legal-sized) oysters, and fishing removed 1–2 percent of the recruited population. The recruit-sized oyster population was increasing, albeit slowly, despite the *B. exitiosa* mortality and low recruitment. The increased *B. exitiosa* mortality between 2013 and 2016 (200 million oysters between 2012 and 2014), and the continued low replenishment of spat to the oyster population and medium-sized oysters to the fishery, resulted in a significant decline in the recruit-sized oyster population. All three sized groups of oysters declined between 2012 and 2017. Recruit-sized oysters declined by 47 percent in the *Bonamia* survey area (688 million oysters in 2012 to 364 million oysters in 2017). Pre-recruit-sized oyster density declined by 59 percent (297 million oysters in 2012 to 123 million oysters in 2017) and small oysters declined by 42 percent (451 million oysters in 2012 to 262 million oysters in 2017) in the same area and over the same time. All three sized groups of oysters increased between 2017 and 2018 in the *Bonamia* survey area, 36 percent, 45 percent and 53 percent for recruit-sized, pre-recruit and small oysters respectively. The recruit-sized population further increased 10 percent between 2018 and 2019, as did pre-recruit sized oysters (21 percent) and small oysters (48 percent).

Appendix 2: Tools available to manage marine farm biosecurity

Lojkine (2018), in Section 6 of her report addressing marine farm biosecurity, provides details on regulatory tools that are available to manage marine biosecurity. These are summarised below.

Biosecurity Act 1993

The Biosecurity Act 1993 provides a series of tools for the internal management of biosecurity in New Zealand, contained in Part 5 and Part 5A.

Part 5:

National policy direction

A national policy direction must be made by the Minister responsible for the Biosecurity Act (currently the Minister for Primary Industries), and its purpose is to ensure that activities under Part 5 of the Biosecurity Act provide the best use of available resources for New Zealand's best interests, and align with one another (where necessary) to contribute to the achievement of the purpose of the Biosecurity Act.

National and regional pest management plans

Sections 59–78 of the Biosecurity Act 1993 set out the provisions relating to national and regional pest management plans. Where pest management plans exist that specifically identify marine pests they can be used to control the spread or introduction of marine pests from one part of the country to another. It is not mandatory under the Biosecurity Act 1993 to prepare national or regional pest management plans.

National and regional pathway management plans

Sections 79–98 of the Biosecurity Act 1993 set out the provisions relating to national and regional pathway management plans. A pathway management plan must specify identical matters to a pest management plan (see Section 6.1.2 of this report), except that the plan is focused on pathways instead of specific pests. Not compulsory to prepare.

Small-scale management plans

Section 100V of the Biosecurity Act 1993 allows regional councils to declare small-scale management programmes, which consist of small-scale measures to eradicate or control an unwanted organism. Programmes are targeted to specific unwanted organisms. Not compulsory to prepare.

Part 5A:

Government/industry agreements

Sections 100X to 100ZH of the Biosecurity Act 1993 provide for government/industry agreements, and set out a framework that enables government and industry to work together to achieve the best possible outcomes from readiness or response activities by making joint decisions on activities, and jointly funding the costs of activities. Not compulsory to prepare.

Other tools

Controlled Area Notices

Section 131 of the Biosecurity Act 1993 provides for the imposition of Controlled Area Notices (CANs). While CANs are most commonly used to impose movement controls to reduce the effect of a disease or pest outbreak, section 131(1)(c) does enable movement controls to be instituted to protect any area from the incursion of pests or unwanted organisms.

Resource Management Act 1991

The Resource Management Act identifies a series of tools for giving effect to the sustainable management purpose of the Act.

National policy statements

A national policy statement can state matters that local authorities are required to achieve or provide for in policy statements or plans. The purpose of a New Zealand coastal policy statement (section 56 Resource Management Act 1991) is to state objectives and policies in order to achieve the purpose of the Act in relation to the coastal environment of New Zealand. Section 57 of the Resource Management Act 1991 states that there shall, at all times, be at least one New Zealand coastal policy statement.

National environmental standards

Section 43 of the Resource Management Act 1991 provides that the Governor-General may, by Order in Council, make regulations (known as national environmental standards) that prescribe *inter alia* standards for the matters listed in sections 12 (use of the coastal marine area) and 15 (discharges of contaminants) of the Act. Not compulsory to prepare.

Regional policy statements

Section 59 of the Resource Management Act 1991 sets out the purpose of a regional policy statement.

Regional policy statements are mandatory under section 60 of the Resource Management Act 1991, but must be prepared in accordance with the functions of a regional council under section 30, and the provisions of Part 2 of the Resource Management Act 1991. A regional policy statement must also be prepared in accordance with a New Zealand coastal policy statement.

Regional coastal plans

Section 63 of the Resource Management Act 1991 states that the purpose of: the preparation, implementation and administration of regional plans is to assist a regional council to carry out any of its functions in order to achieve the purpose of the Act. Section 64 requires that there shall at all times be, for all the coastal marine area of a region, one or more regional coastal plans.

Aquaculture New Zealand A+ programme

Aquaculture New Zealand has recently developed the A+ New Zealand Sustainable Aquaculture programme (the A+ programme), to provide New Zealand marine farmers with practical tools to demonstrate transparency around their environmental performance. Not compulsory to prepare.

Appendix 3: Technical Advisory Group 2019 members and support

9(2)(a)

From left to right: Mark Farnsworth; 9(2)(a) ; Sarah Culloty; Marty Deveney; Keith Michael; Ben Diggles; 9(2)(a) and Ryan Carnegie.

TAG

Name	Organisation	Expertise
Dr Ryan Carnegie	Virginia Institute of Marine, Chesapeake Bay, United States of America	Parasitology *B. ostreae* PhD Biosecurity management of shellfish transfers / aquaculture disease and health management Phylogeography – processes that influence distribution of species looking at genetics
Prof Sarah Culloty	University College Cork, Ireland	Ecological parasitology World leading expert in *B. ostreae* Mollusc diseases – life cycles, epidemiology, diagnostics Climate change impact on diseases Preventing and mitigating impact of diseases on farmed shellfish
Dr Marty Deveney	South Australian Research and Development Institute, Adelaide	Aquaculture and fisheries biosecurity, including disease management Risk analysis Parasitology *B. exitiosa*

Name	Organisation	Expertise
Dr Ben Diggles	DigFish Services, Brisbane	Risk analysis Fish and shellfish health Environmental risk assessment Disease risk assessment and prevention Aquatic animal welfare
Dr Keith Michael	National Institute of Water and Atmospheric Research, Wellington	Fisheries science, fisheries enhancement and ecology Expert on Bluff oyster fishery *B. exitiosa* and its behaviour in Foveaux Strait Climate, disease and shellfish population dynamics
Mark Farnsworth MNZM	Independent Chair	Resource Management Act 1991 practitioner Resource Management Act 1991 / Exclusive Economic Zone Hearing Commissioner Meeting facilitator

Logistical support

9(2)(a) [redacted]