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Manatū Ahu Matua

Aquaculture Mid-Term Research Strategy: 2013

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The Aquaculture Unit
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Executive Summary

"To increase value through research and innovation" is one objective of the Government's Aquaculture Strategy and Five-Year Action Plan, which was launched in June 2012.

In December 2012, an Aquaculture Research Forum was established to progress the collaborative development of an industry-wide research strategy, whilst encouraging better collaboration and co-ordination between industry, government, and science providers, and better alignment of research priorities with industry needs. Forum membership includes Aquaculture New Zealand (representing marine aquaculture) and AquA ™ Aotearoa Incorporated (representing land-based aquaculture), universities, CRIs and private science providers, and representatives from the Ministry for Primary Industries and the Ministry for Business, Innovation and Enterprise.

This Aquaculture Research Strategy aims to communicate a vision for research in the aquaculture sector. It focuses on seven key Research Areas: biosecurity; animal productivity; climate change; water; new species; social licence for aquaculture; consumers, products, and markets.

This Research Strategy will be updated bi-annually.

1 Introduction

The Government's *Aquaculture Strategy* and *Five-Year Action Plan to Support Aquaculture* was launched in June 2012. It contains seven objectives, one of which is "Increase Value through Research and Innovation." The *Aquaculture Mid-Term Research Strategy* sits within this area of work.

The mid-term timeframe for this strategy is circa five years. This does not mean we expect to deliver all priorities within this document within five years: it means that over the next five years, these are the research areas we want to focus on, and the outcomes we want to work towards. This is the first collaborative research strategy for the aquaculture sector, developed through a consultative process with a newly established Aquaculture Research Forum. It will be reviewed bi-annually.

The Objectives of the Research Forum and Research Strategy are:

- to facilitate discussion so researchers, industry and government are aware of each other's research priorities;
- to inform government's aquaculture investment;
- to provide opportunity for better coordination, collaboration and alignment with industry's research priorities;
- to inform and support the MPI Aquaculture Unit in their production of a Mid-Term Research Plan.

Desired Key Outcomes from the Forum are:

- to communicate a vision for research in the aquaculture sector;
- to communicate a coordinated research commitment for the sector;
- to identify prioritised research needs;
- to identify critical technology gaps;
- to identify capacity gaps;
- to identify synergies/areas of common interest and investment;
- to identify common critical constraints;
- to provide support to the Aquaculture Unit in its delivery of the Government's Five-Year Aquaculture Strategy;
- to inform Government's aquaculture research investment;
- to provide an informal forum to encourage knowledge sharing and nurture collaborative partnerships.

2 Industry Collaboration

Aquaculture New Zealand (AQNZ) is the representative industry body for the salmon, mussel and oyster industries in New Zealand. It began a process of reviewing its existing industry research strategy in the latter part of 2012, and the Aquaculture Unit worked closely with AQNZ to maximise synergies between the development of this strategy document and the AQNZ strategy document. The AQNZ document *Seeking Solutions 2013. A Research Needs Guidance Document* was released in March 2013. The document focuses on the salmon, mussel and oyster industries.

AquA™ Aotearoa Incorporated (AquA) is the representative industry body for land-based freshwater aquaculture in New Zealand. In March 2013, they released a research document *Freshwater Land-Based Aquaculture – Research Priorities*. The document focuses on a wider range of existing and potential land-based species such as grass carp, eels, koura, and whitebait.

Relevant objectives and priorities from both of these industry documents are provided in the Research Area Tables in section 4.

3 Engagement Process

The members of the Aquaculture Research Forum are listed in section 7. They represent the aquaculture industry (both marine and land based), CRIs, universities, and Government. The first meeting of the Aquaculture Research Forum took place in December 2012 and a second in February 2013.

The first meeting of the Research Forum discussed constraints, opportunities, general issues, research themes, and expectations of what the Forum and Research Strategy could deliver. Summaries are shown below:

Expectations of what the Research Forum can deliver:

- greater focus on research capability building;
- greater visibility of all research initiatives;
- clearer linkages between private sector intentions and government initiatives;
- networking, but also strategic planning leading to new collaborative work (e.g. PGP programmes);
- provide a strategic focus for R&D to enable an overall investment approach to the industry and a more integrated approach between researchers, industry and Govt;
- identify, understand and address key barriers to aquaculture development in New Zealand;
- prioritisation of research investment.

Key Constraints:

- Lack of development of research capability (operational and applied) in aquaculture by industry, CRI's and funding agencies.
- The industry is traditionally a low investor in R&D and typically only funds company-specific projects.
- Unlike other primary industries, aquaculture has no R&D levy.
- Uncertain private investment climate due to regulatory constraints, limits ability of sector to invest in high risk R&D.
- High cost of entry for new aquaculture ventures.
- High level of uncertainty regarding security of tenure for aquaculture lessees (makes investment in sector less attractive).
- Collaborate between research providers and industry needs to deliver appropriable research outcomes for industry.
- The overall level of research funding available is highly competitive.
- Some funding streams encourage/insist on collaboration between different research providers and industry. Research providers already collaborate frequently, and effective collaboration generates genuine synergies. But sometimes collaboration 'for collaboration's sake' is not beneficial, and it can impose inefficiencies (e.g. spending time on relationship management).
- Industry training is a different issue from research, and different aspects may be carried out at universities and technical institutes; is there an adequate coverage of aquaculture training available at advanced level: for example, a Masters in Aquaculture Business Management?
- Cost of infrastructure to enable commercialisation of R&D.
- Public perceptions of aquaculture industries are hindering growth.

Key Opportunities:

- Post-graduate and post-doctoral researchers provide outstanding opportunity to add to the innovation capacity of the aquaculture industry and the opportunity should be facilitated – possibly through jointly-funded government and industry post-doc positions.
- Direct more focus on engaging young Māori in capability building given the ownership profile of the industry.
- Build investor confidence for existing and new aquaculture ventures.
- Establishing appropriate balance in use of natural resources (water space, land and coastal structures) between economic growth and environmental concerns; and establish a NZ wide paradigm.
- New Zealand has access to some world leading research capability within the CRIs, universities and Cawthron.
- Potential of R&D to improve profitability of industry through increased volume and value.
- Potential of R&D to help differentiate distinctive and high value NZ products.
- Government backing industry development via significant and integrated investment in research, infrastructure and capability development (both within industry and research sectors).
- Growing biotechnology expertise and new tools can be applied to a wider range of species and types of production.

Research areas discussed:

- Biosecurity.
- Animal Health/Productivity.
- Animal Welfare.
- Water Quality.
- Food Safety.
- Genetics.
- Pioneering Species.
- Domestication of Species.
- "Social Licence" – social, cultural and economic benefits.
- Economic Modelling.
- Climate Change.
- Consumer Trends/Wants.
- New Products.
- New Markets.

4 Research Areas

4.1 Biosecurity

The protection of species and ecosystems from diseases caused by infections organisms, including emerging and exotic pathogens is paramount.

Effective risk management systems and tools, supported by science, are crucial to the future security of aquaculture value chains.

Key objectives:

- Maintaining trade.
- Minimising production loss.
- Managing risk cost-effectively.

Specific research topics:

- Cost-effective bio-fouling control.
- The impacts of marine pests on farming and profitability.
- How can farmers better engage with the biology of their farm and increase their understanding of the links between biosecurity, animal health and productivity/profitability?
- Improve our knowledge of marine transmission pathways.
- How can science inputs improve the economically viable surveillance of our border?
- Undertake risk assessment of major known threats, to better understand their likely impacts and the drivers that will alter their risk profiles.
- Breeding for resistant diseases (link to genetics under 5.2).
- Develop a "Whole of Pathway" Biosecurity Toolbox covering:
  - establishment of critical baseline data through regular health and environmental monitoring;
  - identification of risk;
  - identification of incursion;
  - location-specific and pathogen-specific considerations;
  - who to inform?
  - mortality loss triggers;
  - what triggers for rapid detection response?
  - options for action (what kind of threat? = what kind of response?);
  - where on the pathway are science inputs needed?
  - where are links to other centres of knowledge needed?
  - what generic emergency management and readiness tools can be developed, ready for application to a specific threat?

GOVERNMENT LINKS:

- **Aquaculture Strategy & Five-Year Plan, Project 1.5** ***Establish Biosecurity Plans for Key Growing regions*****.** This project has started and is on-going. Contact **richard.fraser@mpi.govt.nz**. The work to establish Biosecurity Plans is closely linked to:
- **GIA – Government Industry Agreement on biosecurity**.
  If a GIA proceeds, an Operational Agreement will agree significant levels of detail on processes, resources, priorities and cost-sharing.
- **MPI Modelling Coastal Currents Project**.
  The development of a spatially explicit ocean current modelling application that will allow users to select a release point and simulate spread of organisms/particles in offshore, coastal and nearshore waters. Final Model to be presented to Biosecurity Research Forum in October 2013.
  Contact **daniel.kluza@mpi.govt.nz**
- **MPI Biofouling Management Project**. A multi-national collaborative approach to bio-fouling evaluation. Report due October 2015.
  Contact **eugene.georgiades@mpi.govt.nz**
  Links to CRMS (Craft Risk Management Standard).
- **MPI Identification of on-farm Biosecurity Management Options Project**. Project will include industry consultation and will identify and provide recommendations of best practice preventative and management options, which will be fit-for-purpose for the NZ aquaculture industry. Will describe potential organism pathways into and within NZ. Final report August 2014.
  Contact **richard.fraser@mpi.govt.nz**
- **MPI Marine Pathways Project**. Contract with NIWA and Cawthron to undertake a review of practical options for reducing the spread of unwanted marine species within domestic pathways in NZ. The review will focus on six pathways for the spread of marine pests, one of which is marine aquaculture. Report due June 2013.
  Contact **melanie.russel@mpi.govt.nz**

INDUSTRY LINKS:

"Seeking Solutions" AQNZ Research Needs Guidance Document, 2013.

Dealing with pests and pathogens:

- Develop understanding of current performance (includes costs of negative impacts), needs, perceptions and behaviours around pest and pathogen risk.
- Elucidate best practice at multiple levels (farm, sector, region etc.) to protect the industry and meet business needs (e.g. what strategies can be put in place that do not prevent a sector from farming, but do provide protection from risks?).
- Understand what's next; develop risk profiles of current and leading potential new species so that proactive risk management solutions may be developed.
- Develop fit for purpose generic investigation and initial response processes to guide industry and government as appropriate – best response for minimal impingement on industry.

- **MBIE Sector Investment Plan – Biological Industries**. Sets out priorities for investment of up to $38.4 million per annum in the Biological Industries Research Fund ('the Fund') by the Ministry of Business, Innovation and Employment (MBIE) through the 2013 science investment round. **http://www.msi.govt.nz/get-funded/research-organisations/2013-science-investment-round/request-for-proposals/biological-industries-research-fund/**

RELATED RESEARCH:

- **Cawthron (CAWX0802) Adding Value to New Zealand's Cultured Shellfish Industry**: **Maximising Profit, Minimising Risk**: This research programme has been developed in response to the Aquaculture NZ (AQNZ) Research Strategy and the priorities of NZ's major aquaculture companies. Cawthron has partnered with Plant & Food Research to deliver a research programme that will add value to existing shellfish products across the whole value chain, develop new shellfish species and create effective biosecurity risk management for pests and diseases. See **www.cawthron.org.nz** or contact **nick.king@cawthron.org.nz** for further information.
- **Cawthron (CAWX1201) On farm biosecurity in aquaculture: methodology for industry risk management planning** (project currently "on-hold"). Contact Grant Hopkins or Robert Matheson.

4.2 Animal Productivity

Key objectives:

- The on-going improvement of factors affecting the pre-harvest value chain: animal survival, growth and vigour.
- Animal Health Tools: on-going development of effective vaccines and probiotics.
- Genetic advancements.

Specific research topics:

Mussels:

- Security and quality of wild and hatchery spat supply.
- Improving spat retention on line.
- Genetics.
- Feed efficiencies/nutritional requirements.
- Growth efficiencies.
- Disease resistance.
- Epibionts and biofouling.
- Predators.

Oysters:

- Consistency of wild catch spat.
- Survival to harvest.
- Disease.
- Alternative farming structures.
- Genetics.

Salmon/Kingfish/Hapuka:

- Feed efficiencies.
- Growth efficiencies.
- Decreasing mortality.
- The effect of stress on animal productivity.
- Genetics.
- Product quality.
- Net fouling.
- Reducing impact of predators.
- Cutting edge reproductive technologies.
- Ovarian fluid effects on sperm performance.
- Improved shelf life.
- Hybrid production models to improve productivity and product quality (e.g. Ocean Ranching, pre-harvest holding systems).

RELATED RESEARCH:

Seafood Innovations Limited (SINNO1201): Transformation of the New Zealand Seafood Industry through Ecosystem Stock Management, Domestication of Species, and Market Driven Quality Enhancement.
A new government/industry partnership to develop and deploy 30 new products, processes or services in the seafood value chain to improve NZ's competitive advantage and to grow premium value seafood exports with incremental annual export revenue of $300M for the NZ seafood industry by 2030.
See **http://www.seafoodinnovations.co.nz** for more information.

Cawthron (CAWX0802) Adding Value to New Zealand's Cultured Shellfish Industry: Maximising Profit, Minimising Risk:
This research programme has been developed in response to the Aquaculture NZ (AQNZ) Research Strategy and the priorities of NZ's major aquaculture companies. Cawthron has partnered with Plant & Food Research to deliver a research programme that will add value to existing shellfish products across the whole value chain, develop new shellfish species and create effective biosecurity risk management for pests and diseases.
See **www.cawthron.org.nz** or contact **nick.king@cawthron.org.nz** for further information.

University of Auckland – Fluid Mechanics Project, exploring the flow through aquaculture pens, funded through a Faculty Research Development Fund grant.
Contact Prof. Jim Denier.
J.denier@auckland.ac.nz

Grass Carp:

- Feed efficiencies.
- Growth efficiencies in RAS.

Koura:

- Create a selective breeding program for koura.
- Explore polyculture potential in static water ponds, i.e. koura, mullet, ducks etc.

GOVERNMENT LINKS:

- **MBIE Sector Investment Plan – Biological Industries**. Sets out priorities for investment of up to $38.4 million per annum in the Biological Industries Research Fund ("the Fund") by the Ministry of Business, Innovation and Employment (MBIE) through the 2013 science investment round. **http://www.msi.govt.nz/get-funded/research-organisations/2013-science-investment-round/request-for-proposals/biological-industries-research-fund/**

INDUSTRY LINKS:

"Seeking Solutions" AQNZ Research Needs Guidance Document, 2013:

Mussel Nutrition:

- Better determine mussel nutritional requirements and food properties of phytoplankton (and other suspended nutrients), including preferred nutrition sources.
- Understand trends in, and predict impacts of, weather patterns (e.g. Southern oscillations) on food availability (quantum, type, location in water column, effects on growing areas), productivity and mussel condition.

Other:

- Using information generated previously to assess farming practice changes necessary to maintain productivity in face of weather changes.
- Identify and assess techniques to reduce the impact of predation on mussels.

Mussels:

- Improving spat availability/security:
  - Research that can direct location of spat catching, and technology used, to maximise spat numbers caught (e.g. more spat catching areas, improved spat catching rope etc.).
  - Enhance spat supply (volume and variety) from Kaitaia, hatchery and locally caught sources to enable sector growth.
- Maximising spat performance and retention.
- Understand reasons for, and quantum of, poor spat retention before and after seeding (includes retrospective and prospective research).
- Understand carrying capacity of growing areas, especially in relation to the development of additional growing areas.

Oysters:

- Maximising oyster performance:
- Ensure the security of spat supply especially the consistency of wild catch spat.
- Techniques to maximise survivorship to market (both OsHV-1 and other causes of stock loss need to be considered).

Salmon:

- Maximising fish performance:
- Utilisation of real-time and remote technology for monitoring multiple facets of fish performance on farm (e.g. real-time remote biomass assessment).
- Reducing negative impacts from predators, including an understanding of effects of stress on fish productivity and improved methods to mitigate predator presence.
- Use of selective breeding, genomics, other technologies etc. To drive fish performance (e.g. in areas of deformities, runting, maturation issues).

4.3 Climate Change

A changing climate will present new challenges and opportunities for aquaculture.

An understanding of likely impacts, where they are currently known, will improve industry preparedness and resilience.

Key objectives:

- Improving the aquaculture sector's ability to adapt to climate change.
- Ocean acidification.
- Water temperature changes.
- Ocean current changes.
- Ensure appropriate genetic types are selected for changing conditions.
- Raise awareness and communicate potential impacts of climate change to industry stakeholders.
- Ensure that climate change is not presented as an "aquaculture-only" problem.

Specific research topics:

- Impact of weather patterns on water quality.
- Impact of weather patterns on food availability for mussels.
- Impacts of ocean acidification on the aquaculture sector, including the early life of shellfish.
- Impact of climate change on ocean upwelling: consequences for New Zealand marine habitats.
- Impact of water temperature and ocean current changes on salmon industry.
- How climate change may impact availability and cost of land-based feeds for aquaculture industry.
- How ocean temperature changes may alter risk profiles for bio-security threats.
- Impact of climate change on phytoplankton blooms.
- Impact of dominant El Nino cycles.

GOVERNMENT LINKS:

- **Govt Aquaculture Strategy & Five-Year Plan, Project 6.5** ***"Investigate the impacts of climate change and measures to adapt and respond."*** This project will scope and produce an inventory of current climate change and aquaculture work by govt, industry and CRIs, develop an engagement plan for stakeholders, and produce a discussion document on potential climate change implications and response measures. Project will commence in June 2013, discussion document by March 2014.
  Contact **anna.crosbie@mpi.govt.nz**

- **The Natural Resources Sector cross-government project** has four priorities: marine, climate change, freshwater, and biodiversity each associated with a work programme aimed at supporting initiatives to unlock economic potential of natural resources while understanding and managing to environmental constraints. For more information see **http://www.mfe.govt.nz/about/natural-resources-purpose-functions.html**

- **National Science Strategy Committee for Climate Change, Climate Change Research Strategy 2002, and, Climate Change Mitigation Measures:** Water quality benefits and costs, MfE. Both documents available on **http://www.mfe.govt.nz/publications/climate**

INDUSTRY LINKS:

"Seeking Solutions" AQNZ Research Needs Guidance Document, 2013.

Mussels:

- Understand trends in, and predict impacts of, weather patterns (e.g. southern oscillations) on food availability (quantum, type, location in water column, effects on growing areas), productivity and mussel condition.
- Using information generated previously to assess farming practice changes necessary to maintain productivity in face of weather changes.

RELATED RESEARCH:

- **NIWA (C01X1225) Climatic conditions to 2100 and assessed impacts & implications for New Zealand's environment, economy and society**: This project will update and improve projections of climate trends, variability and extremes across New Zealand out to 2100, based on the latest global projections. It will generate new knowledge about the potential impacts of climate change and variability on New Zealand's environment, including our natural ecosystems and native species, and the impacts on the many productive activities which depend on the environment and enable continued growth and prosperity. The work comprises five inter-related research projects: (1) improved climate projections; (2) case studies of key pressures, critical time steps, and potential responses for five important environments (Alpine and high elevation native forest ecosystems; high- and hill-country environments; lowland environments; coastal and estuarine systems; marine food webs; (3) identifying feedbacks, understanding cumulative impacts and recognising limits; (4) increasing capacity to generate, translate, share and apply climate change science via collaborative learning processes; (5) synthesising the research to support co-ordinated, evidence-based decision-making and policy development by New Zealand organizations.
- New Zealand Climate and Oceanic Setting Chapter of the **Aquatic Environment and Biodiversity Review** (AEBAR) available at **http://www.mpi.govt.nz/news-resources/publications**
- Development of new **Department of Statistics** Tier 1 Statistic-Atmospheric and Ocean Climate Change (MPI lead for ocean component)
- **University of Otago/NIWA Ocean acidification time series.** The only time series of dissolved pCO2 and pH in NZ waters is the bimonthly sampling of a transect across neritic, subtropical and subantarctic waters off the Otago shelf since 1998
- **MPI project Marine Environment Monitoring Project (MEMP) ZBD2010-42.** This ongoing project collates of all potential data series into a metadata database, and completes a scientific evaluation of the existing time series as to their 'fit to purpose' for marine environmental monitoring. Contact: Judi Hewitt (NIWA)
- **MPI project Ocean acidification impact on key NZ molluscs ZBD2009-13.** This project is using laboratory experiments to quantify responses of key New Zealand mollusc species (paua, *Haliotus iris*, cockles, *Austrovenus stutchburyi,* and oysters *Tiostrea chiliensis*) to levels of ocean CO_2 saturation predicted to occur in NZ waters over the

following decades. Results will be combined with information on the role of these key species in influencing ecosystem structure and function, to assess local and ecosystem-scale implications of acidification of NZ coastal waters expected in the following decades. Contact: Vonda Cummings (NIWA)

- **MPI project ZBD2008-11 Predicting plankton biodiversity & productivity with ocean acidification.** This project attempts to document the spatial and inter-annual variability of a number of plankton groups in terms phytoplankton abundance, biomass and community composition in sub-tropical and sub-Antarctic water. On-going Contact: Barb Hayden at NIWA.

4.4 Water

Access to quality water, and managing the effects of aquaculture on water quality, are two of the industry's biggest challenges.

Key objectives:

- The effects of aquaculture on water quality.
- Protecting the ability of the aquaculture industry to grow safe, reputable food products.
- Ability of industry to access water space.
- Downstream costs to aquaculture of intensification of farming and other activities on the land.

Specific research topics:

- Science input into management tools to assist in improving water quality.
- Science input into tools to manage water better in relation harvest days.
- Microbial source tracking tools (faecal pollution).
- Improve science links with other sectors across all environments in relation to water management.
- What science inputs from aquaculture sector are needed to inform and influence Integrated Coastal Management/Catchment Planning.

GOVERNMENT LINKS:

- **Govt Aquaculture Strategy & Five-Year Plan, Project 1.1** ***"Ecological Effects of Aquaculture."*** This project will provide risk-based guidance to support ecological impact assessments. To be completed by mid 2013.
- **Integrated Kaipara Harbour Integrated Management Group (IKHMG).** Was established in 2005 to promote integrated management and inter-agency coordination of Kaipara harbour and its catchment. **http://www.kaiparaharbour.net.nz**
- **Land and Water Forum and Freshwater Reforms 2013.** The Land and Water Forum was established in 2009, and in 2012 provided advice to Govt on setting limits for water quality and quantity, and on improvements to decision-making. The *Freshwater reform 2013 and beyond* paper sets out proposed reforms to freshwater management in NZ. **http://www.mfe.govt.nz/issues/water/freshwater/land-and-water-forum**
- **MPI Nitrogen Levels and Adverse Marine Ecological Effects Project.** A literature review of nitrogen levels and adverse ecological impacts from temperate embayments in order to assist consenting authorities in determining at what concentration of nitrogen adverse effects may be experienced. The literature review will address the questions:

- What temperate coastal marine systems can realistically be used to inform questions of nitrogen levels and adverse ecological effects in NZ?
- What levels of nitrogen inputs having adverse ecological effects have been detected at large scales, in comparison to that of individual aquaculture farms, and where?
- Have regional nitrogen management levels for marine coastal waters been implemented anywhere comparable to NZ?
- What guidelines and lessons from overseas be applied to NZ?
- What needs to be determined on a case-by-case basis by regional modelling studies, in order to plausibly determine likely nitrogen effects? Final report September 2013

- **MBIE Sector Investment plan – Environment Fund:** Sets out priorities for investment of approximately $2.0 million per annum in the Environmental Research Fund by the Ministry of Business, Innovation and Employment (MBIE) through the 2013 science investment round.

INDUSTRY LINKS:

"Seeking Solutions" AQNZ Research Needs Guidance Document, 2013.

Continued access to existing water space.

Access to new water space.

- Understand effects so that ecological issues of negligible risk and benefits are elucidated, and how remaining risk may be cost effectively mitigated to acceptable levels.
- Develop an understanding of key information necessary for, and methodology to, improve processes to recognise and allocate productive water space for aquaculture.
- Costs of water space tenure.
- Develop appropriate risk assessment methodology and data, and understand needs of far field environmental monitoring and methods of attribution of inputs to minimise costs of water space occupancy (e.g. bonds, coastal occupation charges, broad scale environmental monitoring).
- Ensure that compliance monitoring (e.g. environmental monitoring) is smart, efficient, cost effective and minimum necessary.

RELATED RESEARCH:

NIWA – Marine Futures (C01X1227) A research programme considering the future of our marine ecosystems, which will develop, with key stakeholders, an agreed decision-making framework that facilitates economic growth, improves marine stewardship, and ensures cumulative stresses placed on the environment do not go beyond an ecosystem's ecological adaptive capacity. 3 Year programme: 2012 – 2015. MBIE funded. Contact **Simon.Thrush@niwa.co.nz**

NIWA – Predicting the occurrence of vulnerable marine ecosystems for planning spatial management in the South Pacific region (C01X1229) This project aims to produce predictive models for Vulnerable marine ecosystems (VMEs) in the South Pacific. The effectiveness of potential management and conservation scenarios to protect VMEs will be evaluated using these models. The project will collate all available biological and environmental data for building habitat suitability models.

Cawthron – Innovative systems for safe New Zealand seafood in premium markets (CAWX0703): The Seafood Safety programme supports research that ensures continued access to, and premium status in, international seafood markets by assessing pre- and post-harvest risks from micro-organisms to New Zealand's multi-million dollar seafood industry. Contact Lesley Rhodes or Robert Matheson.

Cawthron – Unveiling the mystery of Karenia brevisulcata toxicity (CAWX1108): This project will help define the toxic components of Karenia brevisculata, a marine microalgae that has bloomed in New Zealand waters and has the potential to devastate the aquaculture sector. This knowledge is critical for future management and monitoring of harmful algal blooms by MPI and industry. A collaborative project with Japan.

- Ensure that any nationally consistent consent/environmental conditions are beneficial to industry, based on best available science and do not default to most conservative standards.

Water quality:

- Maintain (and enhance in the case of degraded areas) the water quality from food safety and animal health perspectives, including:
  - use of technology, e.g. microbial source tracking, to identify and model sources of input (freshwater effects and coastal effects) where this can be used to inform effective mitigation efforts;
  - elucidation of methodology to mitigate freshwater and coastal water negative inputs;
  - identifying drivers to change negative inputs and/or exacerbator behaviour;
  - ensuring testing regimes are fit for purpose, cost effective and, where possible, can be used to drive changes to water quality.
- Understand water quality from a nutrient perspective, including:
  - sources of nutrients and their mitigation;
  - carrying capacity and how to positively influence nutrient budgeting;
  - in the case of fed aquaculture, mitigating nutrient releases from farms to improve social licence and opportunity for productivity.

Salmon:

- Investigate techniques to reduce, mitigate or remediate benthic impacts to reduce monitoring requirements, enable access to greater water space or increase productivity from existing space.

AquA "Freshwater Land-Based Aquaculture Research Priorities" Document:

- To research and determine the annual waste water quality from a fish farm and to develop methods of treating this water that will lead to useful and hopefully profitable recycling of the nutrients present in the water. Note possible uses are in algal production, cress farming, and fresh-water crayfish production – others may arise as the project develops.

4.5 New Species

Significant challenges exist, but science and technology can provide exciting opportunities to progress the commercialisation of new and emerging species.

Key Objectives:

- Science and research that supports the commercial viability of new and emerging species:
  - What to grow?
  - How to grow?
  - Where to grow?

Specific research topics:

- Develop broodstock and hatchery technologies to support the commercial production of new and emerging species.
- Develop on-growing technologies to support the commercial production of new and emerging species.
- Develop marker assisted approaches to aid in selection of broodstock to ensure genetic diversity, rapid quantitative gain in traits of interest and reduced risk of loss of biodiversity.
- Comprehensive cost-models to ascertain the "cost of death" of new species.
- Policy lens and investment lens research: what do industry and investors need to know to support investment in new species?
- Improved models for partnering industry and research capability to support new species work.
- Engineering and technology solutions for new species – especially for land-based facilities.
- Science input into technical barriers to development of new species (e.g. disease)

INDUSTRY LINKS:

AQNZ "Seeking Solutions" Research Guidance Document 2013:

- The farming of trout for food production remains, from a marketing and technical standpoint, a major opportunity for the aquaculture industry. This is currently prevented by legislation. There is a need, however, to carry out the necessary research to address questions around biosecurity, environmental and financial impacts of farming trout for food, against the context of current levels of trout culture for recreational purposes.
- The aquaculture potential of eels (and possibly rock lobster) is limited by access to juvenile stock (i.e. quota barriers to development). To address those issues requires research into the effects of accessing juvenile stocks, and any potential subsequent culture and proportionate release of ongrown stock. This information is required to assess the potential for using juveniles for aquaculture purposes, without an adverse impact on the population of the quota managed stocks.

- There is a clearly expressed need for the ability to trial new species and/or techniques on established farms as a cost effective method of commercial development. Meeting this need may require the ability to establish smaller experimental aquaculture operations or add to existing aquaculture operations under a less onerous resource management regime. Government backed experimental farming space in a variety of locations would also meet this need, but is considered a more complex solution and one that carries greater levels of difficulty and less flexibility.

INDUSTRY LINKS:

AquA "Freshwater Land-based Aquaculture Research Priorities" Document:

Key Objective:

- To research and quantify the proposed commercialised species: flesh colour, odour, taste, texture, composition, skeletal anatomy and density. Suitable product forms and cooking methods will be selected (considering food safety.)

Research Priorities:

Silver carp:

- Is poly-culture farming of Silver Carp in a RAS possible?
- What sort of yield or maximum stocking rate can be achieved?

Whitebait:

- The lifecycle of the Giant Kokopu needs to be documented and rigorously tested in nursery facilities.

Commercialisation of Redfin Perch:

- Promote the redfin perch as a viable aquaculture species within New Zealand.
- Build on Mahurangi Technical Institutes initial successes with the species, i.e. commercialise the hatchery by promoting farms within New Zealand.
- Investigate market opportunities, primarily in Europe and Asia. (Note: markets are currently well established in Europe, i.e. in supermarkets).
- Investigate domestic market opportunities.

GOVERNMENT LINKS:

Govt Aquaculture Strategy and Five-Year Plan, Project 3.1 ***Develop options to improve the management of land-based aquaculture.*** A review of existing regulations is underway with DOC, with an aim of streamlining processes. The outcome of the review will hopefully assist the land-based aquaculture industry develop new commercial species. The review process is in its infant stages and is anticipated to take a further 18 months. Contact **richard.fraser@mpi.govt.nz**

MBIE Sector Investment Plan – Biological Industries. Sets out priorities for investment of up to $38.4 million per annum in the Biological Industries Research Fund by the Ministry of Business, Innovation and Employment (MBIE) through the 2013 science investment round. http://www.msi.govt.nz/get-funded/research-organisations/2013-science-investment-round/request-for-proposals/biological-industries-research-fund/ see page "emerging industries", page 12.

Customs Import Prohibition (Trout) Order. In 2012, the Government extended the prohibition on trout until November 2015. Current legislation prohibits the buying and selling of New Zealand trout, processing of New Zealand trout for the purpose of sale, and the domestic farming of trout.

MPI – Project to develop an operational policy regarding options for the sustainable harvest of glass eels and elvers. Outcome expected by end of 2013. Contact **Santiago.bermeo-alvear@mpi.govt.nz**

- Refine redfin perch farming practices in a New Zealand RAS system. (Already farmed in RAS systems in Ireland).
- Cannibalism of this species has already been mitigated in New Zealand with a 100 percent success rate.

Short-finned eel:

- Consistency of egg quality.
- Consistency of hatch rates.
- Novel food types for rearing larval eels.
- Disease resistance of hatchery produced individuals.
- Possible use of probiotics to maintain health.
- Investigate the use of other technologies to maintain larval health i.e. ozone.
- Sustainable harvest of wild-caught glass eels.

Wild eel fattening:

- Controlled temperature and feeding in RAS systems (this is currently a Kiwinet funded research project that is to start shortly).

Trout:

- Science input that will assist future political decision-making on the farming of trout.
- Consideration given to trout being farmed for export markets exclusively so as to not compete or threaten the tourism/recreational trout industry.

RELATED RESEARCH:

None at present.

4.6 Social Licence for Aquaculture

The term "a social licence for aquaculture" refers to the acceptance by a local community of local aquaculture activities, and reflects a community's perceptions of the costs and benefits of aquaculture.

Key objectives:

- Research that provides a better assessment, understanding and communication of the benefits of aquaculture:
  - social interactions;
  - cultural interactions;
  - economic interactions;
  - environmental interactions;
  - public awareness.

Specific research topics:

- Develop standardised methodologies for social impact assessments within the sector.
- Establish an improved evidence base on the links between the economic and social benefits of aquaculture.
- Identify and better promote any 'ecosystem service benefits' from aquaculture.
- Develop capability and processes for aquaculture to provide spat etc. For re-seeding of commercial, customary and recreational fisheries.
- Adaptive management approaches: how can Govt better deal with uncertainty in consenting processes?
- Site specific monitoring to establish a network of baseline data.
- Regulatory opportunities to change the public perception of aquaculture "exploiting" the "public commons" – e.g. coastal occupation charges and bonds.

GOVERNMENT LINKS:

- **Govt Aquaculture Strategy & Five-Year Plan: Project 2.7** ***"Improving Information"***. 'This will collate and improve information on the ecological, cultural, and social costs and benefits of aquaculture to support decisions and community comfort.' Internal MPI funding bid is in place to address the information gaps we expect to identify. Completion of inventory, identification of info gaps, and plan to address them, to be complete by July 2013. Contact **anna.crosbie@mpi.govt.nz**
- **MPI Social Impact Assessment of Aquaculture Activities Project.** Will provide a literature review, establish an improved evidence-base on the socio-economic impacts of aquaculture, and develop a standardised methodology for social impact assessments within the aquaculture sector in NZ. Final report July 2013. Contact **anna.crosbie@mpi.govt.nz**

INDUSTRY LINKS:

AQNZ "Seeking Solutions" Research Guidance Document 2013.

Continued access to water space/new access to water space.

- Understand the social, economic and environmental benefits of aquaculture. At both the regional and national levels.
- Understand drivers (including how information can be used) to improve the social licence of aquaculture.

RELATED RESEARCH:

- **NIWA– Marine Futures (C01X1227) –** A research programme considering the future of our marine ecosystems, which will develop, with key stakeholders, an agreed decision-making framework that facilitates economic growth, improves marine stewardship, and ensures cumulative stresses placed on the environment do not go beyond an ecosystem's ecological adaptive capacity. 3 Year programme: 2012–2015. MBIE funded. Contact **Simon.Thrush@niwa.co.nz**

- **NIWA – Coastal conservation management (CO1X0907)** – A research programme to develop a national scale coastal fish-habitat classification and habitat predictor scheme (to 100 m water depth), along with a companion stressors/impact framework; that can be used to better manage impacts on coastal fish-habitats and their fish production values. Alongside this, the research will identify, evaluate and incorporate the impacts of human-driven stressors (both land and marine based). The resulting tools will quantify both the values of different habitats to fish at local, regional, and national scales, and human-driven impacts on those values, which will allow marine resource managers to implement appropriate cost-effective management strategies. Contact Mark Morrison at NIWA.

4.7 Consumers, Products, Markets

Developing and maintaining products and markets and satisfying consumer expectations are central requirements to industry growth.

Key objectives:

- Creating new value and efficiencies along the post-harvest value chain.
- Research new technologies to improve product processing, shelf-life, packaging.
- Research opportunities for new value-added seafood products.
- Research to support new trade and market access.
- Research to assist securing of international investors.

Specific research topics:

- Developing marketing around food that has been locally and sustainably harvested and produced according to the values and customs of Māori and or small communities.
- Consumer and sensory science to inform breeding programmes.
- New packaging technologies to extend shelf life.
- Post-harvest treatments to extend shelf life of chilled products .
- Seafood safety.
- High value marine nutraceuticals and other products from seafood.
- How can industry prepare for the fact that market access requirements and risk profiles for food safety are going to change in the future?
- How to get upper quartile prices for a much larger proportion of our products? We need to better understand consumer and chef drivers (not just price and packaging), provenance and sustainability, quality and culinary versatility etc. We need more decisions based on research rather than guesswork, to ensure we stay away from commodity prices.
- The link between environmental quality and the publics' perception of food safety – do we need to better disseminate the science to underpin the story we tell?

INDUSTRY LINKS

AQNZ "Seeking Solutions" Research Guidance Document:

Oysters:

- Maximising margins.
- Forecasting global product availability and demand and understanding of, and tools for managing market drivers to ensure continued price strength during recovery from lowered production.
- Development of benchmarking indicators for domestic oyster producers, compared between different oyster species and different oyster producing countries.

AquA "Freshwater Land-Based Aquaculture Research Priorities" Document:

Key Objectives:

- To research and quantify the proposed commercialised species: flesh colour, odour, taste, texture, composition, skeletal anatomy and density. Suitable product forms and cooking methods will be selected (considering food safety).
- To research processing efficiency, product differentiation and product enhancement – value add.
- To research the species storage lives determined for live, chilled, frozen and other potential processed products.
- To research sustainable extruded fish foods with nutrient delivery targeted to fish species, low nitrogen leaching, controlled buoyancy and controlled disintegration in the water.
- To research novel feed ingredients and biochemical products from under-utilised terrestrial or marine animal raw materials and co-products, ideally with a protectable IP or market position.
- To research the pet food and waste products industries to survey the availability, nutritional content and processibility of protein, fat and carbohydrate streams in the NZ fish and agricultural industries. Note: this information will have considerable value in assessing and providing knowledge pathways to the utilisation of waste streams, reducing the carbon and environmental food waste from New Zealand industry.
- To research and determine the annual waste water quality from a fish farm and to develop methods of treating this water that will lead to useful and hopefully profitable recycling of the nutrients present in the water. Note possible uses are in algal production, cress farming, and fresh-water crayfish production others may arise as the project develops.
- To research by-product opportunities e.g. nutracueticals, cosmecueticals, petfood, energy etc.
- To research the development of a New Zealand brand freshwater aquaculture brand; marketing campaign; including food H&S standards and endorsements i.e. biocert, sustainability, heart foundation tick, nutritional and health benefits understood.

GOVERNMENT LINKS:

Govt Aquaculture Strategy & Five-Year Plan, **Objective 5** ***"Increase Market Revenues"*** **contains a range of projects:**

- Develop an aquaculture investment plan to support growth.
- Fund market co-ordination role within Aquaculture New Zealand.
- Where and document trade barriers in key markets for seafood products.
- Maintain and review animal health, biosecurity and food safety management to gain and/or maintain trade access.
- Support efforts to demonstrate the sustainability of products including through third-party certification.

MBIE Sector Investment Plan – Biological Industries.
Sets out priorities for investment of up to $38.4 million per annum in the Biological Industries Research Fund by the Ministry of Business, Innovation and Employment (MBIE) through the 2013 science investment round. **http://www.msi.govt.nz/get-funded/research-organisations/2013-science-investment-round/request-for-proposals/biological-industries-research-fund/** see page "foods for health", page 12, "market development", page 13 and "international linkages with Singapore", page 14.

RELATED RESEARCH:

- **Callaghan Innovation – Bio-resource Processing Alliance (CO8X1203)**: This programme creates a platform of critical enabling technologies targeted at developing high value co-products from primary industry biological raw materials. The added value to NZ's economy will approach $100 million by 2020 through successful application to secondary streams arising from NZ's forestry, marine, agricultural, horticultural, animal and microbiological industries. 2012-2018
- **Seafood Innovations Limited (SINNO1201)**: Transformation of the New Zealand Seafood Industry through Ecosystem Stock Management, Domestication of Species, and Market Driven Quality Enhancement. A partnership investment to develop and deploy 30 new products, processes or services in the seafood value chain to improve NZ's competitive advantage and to grow premium value seafood exports with incremental annual export revenue of $300M for the NZ seafood industry by 2030. See http://www.seafoodinnovations.co.nz for more information.
- **Cawthron – Innovative systems for safe New Zealand seafood in premium markets (CAWX0703)**: The Seafood Safety programme supports research that ensures continued access to, and premium status in, international seafood markets by assessing pre- and post-harvest risks from micro-organisms to New Zealand's multi-million dollar seafood industry. Contact Lesley Rhodes or Robert Matheson
- **Plant and Food research (C02X0806): Biomodification Technologies for the Manufacture of Engineered Marine Molecules**. The central theme of this programme is the use of both commercial, and novel marine-sourced immobilised enzymes in the manufacture of high-value protein and lipid derivatives from NZ's seafood by-products.
- **kanDO Innovation**: Automated Shellfish processing (KAND1102); Technology project grant.
- **Lincoln University (LINX1001): A new preservation method for producing superior "ready to eat" dried foods.** Researching a new, patentable preservation method for "ready to eat", dried foods. The research focuses on protein-based snacks due to the excellent reputation New Zealand has for the quality of its meat and seafood and because protein-based snacks are one of the fastest growing snack segments globally.

5 Implementation of the Research Strategy

5.1 Constraints to Implementation and Implementation Ideas raised at the Forum Meeting

- The need for more funding for response to biosecurity incursion (NB. Link to GIA on Biosecurity).
- The need for more funding targeted at emerging industries and species.
- The removal of "Post-Doc" funding has made it harder for CRIs to retain staff in NZ.
- Improve the availability of temporary research marine space.
- Encourage communication of research results to non-specialist groups, using audience-specific material.
- Encourage better dissemination of research results across industry.
- Promote New Zealand's reputation in aquaculture research.
- Investigate the viability of a Cooperative Research Centre/what lessons we can take from Australian model?
- Aim for more co-operative R&D agreements, incubators, education and extension partnerships.
- Aim for more public-private partnerships.
- Aim for more patent/licensing agreements.
- Better co-ordination of funding applications/via a central register?
- Central register of research both in-stream and completed.
- Improving investor confidence in the aquaculture sector.

5.2 Information Dissemination and Infrastructure Projects

Aquaculture Research Register The Aquaculture Research Register will record: ➢ Successful Research Funding Applications. ➢ Current and Completed research projects.	**Project Details** The Register will be held by MPI and will form part of the Toolbox/Information Hub being established on its aquaculture website pages. The Register will be updated once a year. Research Forum members will be given a template into which information can be uploaded. The template will request the following information: ➢ Project name; ➢ Brief project summary/expected outcomes; ➢ Public funding source (if any); ➢ Contact person/email; ➢ Hyperlink to further information or PDF documents.
Temporary Marine Research Space Investigate options to make more temporary research marine space available to industry, and to make consenting of temporary research marine space more cost effective.	**Project Details** The Forum agreed that this is an important issue worthy of further consideration. However, after discussion it was agreed that this project needs to be progressed by the NZ Aquaculture Forum, at which Chief Executives of Regional Councils and MPI staff address strategic governance issues, including Resource Management issues.

6 Next Steps

This first Research Strategy is seen as the starting point for an on-going process of collaboration. The newly established Research Forum will be invited to continue to meet six monthly, so that collaboration and co-ordination between stakeholders can continue in an informal networking environment. At these meetings the Forum membership will also work towards the following on-going tasks:

- Review and update the Research Strategy (bi-annual).
- Update the newly established Research Register (annual).
- Respond to on-going issues, reviews, and projects that are relevant to the objectives and outcomes of the Forum.

7 Aquaculture Forum Membership

Organisation	Name and position	Contact	Notes
Government			
Ministry for Primary Industries: Aquaculture Unit	Anna Crosbie Senior Aquaculture Analyst	anna.crosbie@mpi.govt.nz	
Ministry for Primary Industries: Sustainable Farming Fund	Louise Askin Senior Project Adviser (Sustainable Farming Fund)	louise.askin@mpi.govt.nz	
Ministry for Primary Industries: Primary Growth Partnership	Joseph Montgomery Manager Primary Growth Partnership	joseph.montgomery@mpi.govt.nz	
Ministry for Primary Industries	Rich Ford Principal Scientist	richard.ford@mpi.govt.nz	
Ministry for Business, Innovation and Enterprise	Deborah Mills Sector Manager Biological Industries	Deborah.Mills@msi.govt.nz	
Te Puni Kōkiri	Tony Seymour Senior Policy Analyst	seymt@tpk.govt.nz	Tony will be joining the Forum in June 2013.
Research Providers			
NIWA	Andrew Forsythe Chief Scientist Aquaculture and Biotechnology	Andrew.Forsythe@niwa.co.nz	
NIWA	Michael Bruce Manager Bream Bay Aquaculture Park	Michael.Bruce@niwa.co.nz	
NIWA	Dr. Philip Heath Manager Mahanga Bay Aquaculture Facility		Philip is no longer working for NIWA. New contact **p.heath@tisbe.co.nz**
Cawthron	Jacquie Reed Aquaculture Group Manager	Jacquie.Reed@cawthron.org.nz	Mike Mandeno also represented Cawthron. In June 2013 he took up a position at Seafood innovations Ltd.
Cawthron	Nick King Shellfish Genetics and Selective Breeding	Nick.King@cawthron.org.nz	
Plant & Food Research	Danette Olsen General Manager Seafood Technologies	Danette.Olsen@plantandfood.co.nz	
Plant & Food Research	Nick Thorpe Portfolio Manager, Seafood Technologies	Nick.Thorpe@plantandfood.co.nz	
Industry			
Aquaculture NZ	Colin Johnston Technical Director	Colin.Johnston@aquaculture.or.nz	
Seafood Innovations Ltd	John Gibson	John.Gibson@seafoodinnovations.co.nz	Seafood Innovations Ltd was established as a joint venture research consortium company by the former **The New Zealand Seafood Industry Council Limited** and **The New Zealand Institute for Plant and Food Research Limited** to promote the carrying out of research relating to the seafood industry in New Zealand.

Auckland Tourism, Events and Economic Development Ltd	Leanna Covacich Growth Programme Specialist	leanna.covacich@aucklandnz.com	A cluster of land-based aquaculture projects was formalised by the Rodney Economic Development Trust. The cluster formed a legal entity – AquA™ Aoteoroa Incorporated – which has become a national united voice for land-based aquaculture lobbying and knowledge sharing.
Mahurangi Technical Institute	Paul Decker General Manager	paul@mti.net.nz	Paul is also the Chairman of AquA Incorporated
AquA Incorporated	Blair Jamieson Board Member AquA.	weedkill@nzwm.co.nz	Through the company NZ Waterways Restoration, Blair uses grass carp to restore water quality in water systems.
AquA Incorporated	Robert Hutton Board Member AquA.	robert@fluidpower.co.nz	Robert has a reticulated grass carp farm in the Nelson region.
Andy Elliot	Kono	Andy.Elliot@Kono.co.nz	

Academic Sector:			
Victoria University	Dr. Peter Ritchie Senior Lecturer School of Biological Sciences	Peter.Ritchie@vuw.ac.nz	
Waikato University	Prof. Chris Battershill Chair in Coastal Science	cbatters@waikato.ac.nz	
University of Auckland	Dr. Andrew Jeffs Associate Professor Leigh Marine Laboratory	a.jeffs@auckland.ac.nz	
University of Auckland	Prof Jim Denier Department of Engineering Science	j.denier@auckland.ac.nz	
Massey University	Matt Golding Associate Professor Food Formulation and Characterisation	M.Golding@massey.ac.nz	
AUT	Dr Andrea Alfaro Associate Professor Marine Ecology and Aquaculture	andrea.alfaro@aut.ac.nz	
AUT	Luke Krieg Research Office	luke.krieg@aut.ac.nz	
Otago University	Dr. Chris Hepburn Dept. of Marine Science	chris.hepburn@ac.nz	