Appendix 10: Annex to Fish Health section- Disease profile of MH

Historical disease profile

Outlined in Table 1 is a summary of common disease agents (pathogens) affecting salmonid production within Macquarie Harbour prior to 2006.

To some extent, diseases observed were influenced by the main salmonid species farmed in Macquarie Harbour at the time. During the early years of salmonid farming, Macquarie Harbour was primarily used for the production of ocean trout, with Atlantic salmon being the minority species. At this time Lactococcosis (previously called Streptococcosis), Vibriosis and infection with the Tasmanian Aquabirnavirus\(^1\) were the principle diseases of concern.

With the establishment of a series of new lease areas located in the central part of Macquarie Harbour, salmonid production increased and diseases such as MAS began to emerge (first detected in 1999). The combination of Vibriosis in rainbow trout and MAS in Atlantic salmon resulted in significant levels of antibiotics being used to control disease between 2000 and 2005. Following the introduction of the injectable vaccines, AnguiMonas and Anguillvac-C, in 2006 the incidence of both MAS and Vibriosis declined dramatically, with no reports of either clinical disease occurring since 2007.

Table 1. Disease profile within Macquarie Harbour prior to 2006.

<table>
<thead>
<tr>
<th>Disease</th>
<th>Causative agent</th>
<th>Agent type</th>
<th>Impact</th>
<th>Principal species affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lactococcosis</td>
<td>Lactococcus garvieae</td>
<td>Bacterium</td>
<td>Major</td>
<td>Rainbow trout</td>
</tr>
<tr>
<td>Vibriosis</td>
<td>Vibrio anguillarum</td>
<td>Bacterium</td>
<td>Major</td>
<td>Rainbow trout</td>
</tr>
<tr>
<td>MAS</td>
<td>Aeromonas salmonicida (atypical)</td>
<td>Bacterium</td>
<td>Major</td>
<td>Atlantic salmon</td>
</tr>
<tr>
<td>Aquabirnavirus</td>
<td>Tasmanian Aquabirnavirus</td>
<td>Virus</td>
<td>Minimal</td>
<td>Rainbow trout</td>
</tr>
<tr>
<td>Ichthyophoniasis</td>
<td>Ichthyophonus hoferi. (DRIP complex)</td>
<td>Mesomycetozoea</td>
<td>Minimal</td>
<td>Rainbow trout</td>
</tr>
<tr>
<td>Yersiniosis</td>
<td>Yersinia ruckeri (non-Hagerman strain)</td>
<td>Bacterium</td>
<td>Moderate</td>
<td>Atlantic salmon</td>
</tr>
</tbody>
</table>

Lactococcosis (Streptococcosis) in rainbow trout, caused by the bacterium Lactococcus garvieae, was the major cause of disease of rainbow trout in Macquarie Harbour until the early 1990s, at which time incidence of disease declined and has not re-emerged. The disease is considered to be carried in fish transferred to marine sites, where it expresses as clinical disease. Hygiene measures at hatcheries are considered to have played a major part in its control.

\(^1\) Tasmanian Aquabirnavirus has recently been re-described as Enzootic Aquabirnavirus Pancreatitis
Prior to 2006, Vibriosis was the major disease affecting salmonids farmed in Macquarie Harbour. Although fish were vaccinated at hatcheries prior to transfer, outbreaks of disease repeatedly occurred in rainbow trout throughout their first 12 months at sea. The repeat occurrence of disease within a single population was of concern because it suggested that natural exposure did not result in immunity, as would normally have been expected. There may have been a number of reasons for this, but high environmental levels of the pathogen and immunosuppression were considered the most likely possibilities.

Following the introduction of injection vaccination procedures in 2004/05 there was a rapid decline in reported cases involving *Vibrio anguillarum* serotype O1. Since 2007 there have been only very rare isolations of the organism, limited to individual fish. One study in 2008 looking at normal flora of rainbow trout in Macquarie Harbour established that vaccinated fish were still carrying *V. anguillarum* serotype O1 as normal gut flora, however few of the fish examined had clinical signs of disease. Of note however is that with the continued success of the AnguiMonas and injectable Anguillvac-C vaccines, serotype variants as O3 and O12 of *Vibrio anguillarum* have been detected on rare occasions. While the isolation of these two serotypes was associated with vaccine failure in individual fish rather than a disease outbreak, it highlights the fact that other serotypes of *Vibrio anguillarum* occur in Macquarie Harbour and have potential to emerge as alternate causes of disease in the future.

MAS is a disease primarily of salmon caused by the bacterium *Aeromonas salmonicida* (biovar Acheron), an atypical form of *A. salmonicida* unique to Macquarie Harbour. This disease was first observed in late 1999 in a group of smolt transferred to a newly allocated lease within central Macquarie Harbour. Prior to this time none of the new leases had been stocked. The disease affects Atlantic salmon and caused significant mortality across multiple year-classes on central leases. Although the number of MAS cases increased significantly in Atlantic salmon on these leases during subsequent summer periods, the development and introduction of the AnguiMonas vaccine has eliminated outbreaks in recent years. Since mid-2007 there have been no positive findings of *A. salmonicida* (biovar Acheron) from Macquarie Harbour or elsewhere in Tasmania. However, the bacterial pathogen is still considered to be present in Macquarie Harbour and has potential to re-emerge if conditions become conducive to clinical outbreaks.

The Tasmanian Aquabirnavirus (TABV) was first isolated in rainbow trout within Macquarie Harbour, detected as part of TSHSP activities in 1998. Despite extensive testing of stock in other regions of Tasmania this virus has never been detected outside of Macquarie Harbour. Although infection with TABV is not normally associated with overt clinical disease, there is concern that establishment of the virus in hatcheries may cause disease in younger stock, and this, together with control of MAS, is the reason for maintenance of strict movement restrictions applied to stock in Macquarie Harbour. There is a close genetic similarity of TABV to Infectious Pancreas Necrosis Virus which is a major cause of disease in salmonids overseas. The genetic difference between these two viral agents is limited to a few nucleotides in a variable region of the genome. Cycling of the pathogen in stock increases the risk of developing a more pathogenic form of the virus.

*Ichthyophonus hoferi* was previously considered to be a mobile pathogenic fungi, but has subsequently been allocated to the DRIP group of organisms (*Dermocystidium*, rosette agent, *Ichthyophonus* and *Psorospermium*) of the Mesomycetozoea that taxonomically are at the fungal-animal boundary of organisms. During March 2006 a significant number of rainbow trout were noted with unusual lesions at two sites within Macquarie Harbour at the time of harvest. Testing to determine prevalence of infection within Macquarie Harbour detected it in 25% of mortalities from cages across farms in the region. Infection with *Ichthyophonus hoferi* was detected at all sites tested and was present in both rainbow trout and Atlantic salmon, although prevalence was much higher in rainbow trout. The disease has continued to cause periodic problems due to downgrading of carcass quality at harvest in rainbow trout.

Several species of *Vibrionaceae* have been consistently isolated from fish in Macquarie Harbour. In nearly all cases, isolation has been from single fish, a pattern suggesting individual fish failure rather than disease outbreak. The more frequently isolated species are *Vibrio scophtalmi* and *Vibrio ichthyoeenteri*, both of which
have been described as causes of disease in fish, principally turbot (*Scophthalmus maximus*) and Japanese flounder (*Paralichthys olivaceus*).

### 1.1.1 Diseases 2011 to 2013

Over recent years salmonid farms in Macquarie Harbour have experienced comparatively low levels of disease in both rainbow trout and Atlantic salmon, primarily due to the introduction of vaccines developed by the DPIPWE Fish Health Unit.

As part of preparation of this report, the DPIPWE Animal Health Laboratory database was examined to determine diagnoses based on laboratory submissions from 2011 to 2013. Results for Atlantic salmon and rainbow trout are summarized in Figure 1 and Figure 2 below.

Submission of diagnostic samples to the DPIPWE Animal Health Laboratories has been used here as an indicator of disease incidence. Thus it is assumed that an individual submission equates to an individual case. In reality this may not occur on all occasions. Cages may be sampled multiple times during a single disease event, a single case may have a diagnosis of a number of potential pathogens present, or samples submitted may not be appropriate to confirm a diagnosis. In regard to the last case, these are included within the category 'no isolation'. Thus the figures supplied must only be considered as a rough indicator.

In order to better monitor disease within Macquarie Harbour, diagnosis of each clinical case must be made by the consulting veterinarian and cumulative figures compared with all stock within the year-class for the appropriate time period. This data is not supplied to DPIPWE and analysis of such data is considered the responsibility of the relevant company veterinarian.

![Infectious disease findings in submissions from Atlantic salmon to DPIPWE AHL](image-url)

**Figure 1.** Infectious disease findings in submissions from Atlantic salmon to DPIPWE AHL
Based on available data, yersiniosis is the most frequently diagnosed condition for Atlantic salmon. Subclinical carriage of *Yersinia ruckeri* in smolt infected in hatcheries commonly results in outbreaks of disease following transfer to sea. Under normal circumstances marine yersiniosis would resolve in a few weeks after introduction without the need for antibiotic intervention. Yersiniosis is considered to be primarily a hatchery issue, in particular within those hatcheries using traditional flow-through production systems. Vaccine efficacy with Yersinivac-B has been variable, arising from the difficulty of delivering sufficient vaccine in fry to provide long lasting protection. Most hatcheries now use multiple dip-vaccination of fry, which is reported to improve stock survival. Both Huon Aquaculture and Petuna are now trialling injection vaccination prior to transfer of stock to marine sites, with one company reporting no cases of yersiniosis in 2013. Research is in progress to evaluate multivalent injectable vaccines that will incorporate the vaccine Yersinivac-B with *Aeromonas salmonicida* and *Vibrio anguillarum* vaccines. The progressive introduction of injectable Yersinivac-B formulations and the move to injection vaccination prior to transfer to sea should result in greatly reducing the incidence of post-transfer yersiniosis at marine sites.

Ichthyophonus continues to occur in rainbow trout but the there is no significant difference noted in the number of cases submitted to DPIPWE AHL over the three year period. Examination of disease incidence over a wider time period would be required to draw any conclusions.

Tasmanian Aquabirnavirus continues to be isolated from rainbow trout within Macquarie Harbour, however laboratory diagnosis has declined since 2012. Given that active surveillance was removed from the TSHSP after 2012, this decline may well be artifact caused by the lack of structured testing and the need for individual companies to pay for viral culture. Such testing is expensive and no longer forms part of the cost structure for the surveillance program.

Of concern is the number of incidental findings of bacteria in fish examined known to cause disease overseas and represented by the category 'Vibrio other'. These agents represent spill over from wild populations and potential new diseases should they become established within the farm population as a whole.
1.1.2 Summary of cases seen at Animal Health Laboratory 2012 - 2014.

These are the key findings from a review of 99 cases (70 Atlantic salmon and 29 rainbow trout) submitted to the Animal Health Laboratory from January 2012 to November 2014, as part of the Tasmanian Salmonid Health Surveillance Program. Please note, as above, the findings are based on case submissions and are not analyzed based on epidemiological units such as cages or lease sites. Thus the data is biased to causes of morbidity or mortalities. Factors contributing to disease events cannot be discussed in detail because there is often insufficient history and epidemiological information provided to support a thorough assessment of contributing factors.

Yersiniosis was the most common diagnosis (35/70) from Atlantic salmon sampled at Macquarie Harbour over this period. The majority of Atlantic salmon with yersiniosis (24/35 cases of yersiniosis) were 400g or less. Laboratory findings of intercurrent disease were uncommon and only a few of the cases (4/35 cases of yersiniosis) had gross or microscopic evidence of nephrocalcinosis. Transfer to sea is likely to be one factor which contributed to yersiniosis in smolt; however, additional environmental stressors (in light of the low level of intercurrent disease) is considered most likely to contribute to yersiniosis in larger, acclimatized fish. There was only one case where yersiniosis was diagnosed in rainbow trout. This low incidence of yersiniosis in rainbow trout, compared to Atlantic salmon, is considered normal.

Other bacterial pathogens were less common causes of disease. There were individual cases of Photobacterium damselae ssp. damselae, Pseudomonas fluorescens and Vibrio anguillarum in Atlantic salmon and two cases of Photobacterium damselae ssp. damselae in rainbow trout. Intralesional bacteria consistent with Nocardia was found in only one case of interstitial nephritis in Atlantic salmon.

Less common infectious disease in farmed salmonids at Macquarie Harbour were Ichthyophonus hoferi (10/29) and Tasmanian Aquabirnavirus (TABV), and were generally restricted to rainbow trout. Again, this is considered normal. Only four of the cases of Ichthyophonus were reported to be associated with fish mortalities and in one of those cases there was intercurrent Yersinia ruckeri, Vibrio anguillarum and Photobacterium damselae ssp. damselae infection – each pathogen was isolated from a different fish. Disease due to Enzootic Aquabirnaviral Pancreatitis infection was confirmed in one case by virology at CSIRO Australian Animal Health Laboratory (Geelong) and six other cases had histopathological findings (pancreatitis) consistent with TABV infection (microscopic pancreatitis consistent with TABV infection was noted in Atlantic salmon in one case).

Nephrocalcinosis was the most common non-infectious disease process (14/70 Atlantic and 2/29 Rainbow trout cases) based on laboratory findings.

In summary, yersiniosis was the primary cause for disease in Atlantic salmon in Macquarie Harbour. Other factors, aside from acclimatization, which could have contributed to carriers of Yersinia ruckeri developing clinical yersiniosis with mortalities, were not identified based on this brief review of laboratory submissions to the Animal Health Laboratory.