

The background of the page is a solid blue color with a white wavy shape in the center. The white shape is a horizontal band with a wavy top and bottom edge, containing the text. Below this white band, there are two more wavy bands, one light blue and one medium blue, also with wavy edges. The bottom of the page is a solid blue color.

**Gladstone Fish Health  
Scientific Advisory Panel**

**Final Report  
5 January 2011**

### Acknowledgments

The Gladstone Fish Health Scientific Advisory Panel would like to extend its thanks to those commercial and recreational fishers who assisted in providing information and samples, the Gladstone Area Water Board for its assistance and to Ben Westlake and Christina Schmid of Fisheries Queensland for secretariat support to the Panel.

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# Summary of investigation

## ***Reporting process***

This report has been prepared by the Gladstone Fish Health Scientific Advisory Panel (the Panel) for the Honourable Craig Wallace MP, Minister for Main Roads, Fisheries and Marine Infrastructure, Queensland. The report is based on information provided to the Panel by the Queensland Government and other stakeholders relating to the fish health issues observed in Gladstone Harbour and surrounding areas in the latter half of 2011 (Appendix 1) and the Panel's scientific expertise and relevant scientific literature. The conclusions and recommendations presented in this report represent those formulated by members of the Panel. The views of government and non-government "invitees" in relation to conclusions reached and recommendations made by the Panel have been taken into consideration.

## ***Executive summary***

### **Background**

In 2011, the Queensland Government received reports (primarily by commercial fishers) of barramundi fish and subsequently other species being caught with obvious signs of disease, including bulging/red eyes, blindness, severe skin lesions and skin discolouration. The Government then undertook an investigation of Gladstone Harbour and surrounding areas following reports that commercial fishers were sick with what appeared to be bacterial infections on their arms, feet and legs following contact with, or abrasions and fish spikes from net-caught barramundi that were exhibiting evidence of disease. At that time, the Queensland Government was concerned about the potential food safety issues of consuming the diseased fish, given the type of disease remained unknown. Furthermore, there were concerns about the possibility of the transfer of the disease from affected fish to other fish and consequently its entry into the food chain.

### **Queensland Government Response**

On 16 September 2011, Fisheries Queensland closed Gladstone Harbour and the surrounding area to fishing under section 46 of the *Fisheries Act 1994* in response to concerns about human health and the transfer of disease between fish and entry into the food chain. The emergency fisheries declaration closed Gladstone Harbour and the surrounding area to all forms of commercial and recreational fishing for a period of 21 days between 16 September 2011 and 7 October 2011.

From the initial testing of nine diseased barramundi, two conditions were identified that were affecting barramundi in the Gladstone area;

1. Red-spot disease (epizootic ulcerative syndrome (EUS)), which is a fungus endemic to fin fish species of mainland Australia. This condition was only confirmed in one fish from Port Alma.
2. An external parasitism due to the fluke *Neobenedenia sp*, which was affecting the eye and skin particularly in the barramundi in Gladstone Harbour. This parasite has previously been found in Queensland waters in Hinchinbrook Channel between Hinchinbrook Island and mainland Queensland where barramundi are in high densities.

In September 2011, Gladstone Area Water Board staff reported that an estimated 30,000 barramundi between 90 and 130cm in length (equivalent to approximately 300 tonnes) were washed over the Awoonga Dam wall into the Boyne River estuary between December and March 2011. This was an unusual event, as it was the first time the dam had spilled over since 2002. Subsequently the commercial catches of barramundi demonstrated these high numbers of barramundi in the Boyne River and Gladstone

Harbour as the 2011 catch was 18 times that of the average annual catch from 2005 to 2010.

Based on the available scientific literature, the Queensland Government concluded the high levels of external *Neobenedenia sp* parasitism and bacterial infections in barramundi were likely to disappear as water temperatures increased. The Queensland Government reported neither condition is detrimental to human health.

Fisheries Queensland, in cooperation with commercial fishers, conducted a survey of fish health status across a number of sites in the Gladstone area in early October 2011. It was found that while it seemed the relative number of barramundi with deep lesions had decreased, the numbers affected by the parasitic fluke and skin discolouration (redness) was still a significant problem in the Harbour fish. The Boyne River remained the site of the highest number of barramundi affected by the parasite compared to the other sites sampled. Of the 24 non-barramundi fish and sharks caught, two fish from the Boyne River and two lemon sharks from Wild Cattle Island to the south of the Boyne River mouth had some skin discolouration.

Queensland Health received reports from 37 people who were concerned they might have been unwell or had infections or other skin conditions as a result of contact with diseased fish or seawater. The majority of interviewees reported infected injuries and skin infections. However, a range of symptoms were described by interviewees, including flu-like illnesses, infected injuries, boils, eye discharge and redness/rashes on the hands and feet. No link was identified between the conditions found in fish and the human health issues. While bacterial infections are occasionally associated with the handling of fish, there are no major zoonoses (illnesses transmitted to humans from animals) in the literature related to the handling of fish.

In early October 2011, the Queensland Government released a report outlining the water quality conditions in Port Curtis. This report indicated that water quality in the Harbour and the two estuaries (Boyne River Estuary and Calliope River Estuary) was consistent with historical trends, apart from the impacts of flooding in January 2011, which saw much lower salinities over an extended period beyond what had been observed in the last three decades.

In October 2011, the Queensland Government lifted all fishing bans noting that:

1. the disease in fish did not appear to be of human health significance;
2. the identification of likely causes of the lesions in the fish; and
3. the test results of the fishers and Gladstone Harbour water revealed no significant issues that warranted continuation of the fishing ban.

All forms of fishing were permitted in Gladstone Harbour and surrounding areas from Friday 7 October 2011.

During this period, subsequently and currently commercial fishers remained concerned about the health of seafood species caught in Gladstone Harbour and surrounding areas. Fishers have raised concerns over the health of other fish species, besides barramundi, sharks and invertebrates such as crabs, prawns and scallops. In response, the Queensland Government continues to monitor Gladstone Harbour and surrounding areas and conduct additional laboratory testing of fish, scallops and crustacean samples.

The Queensland Government's explanations for what is being observed in Gladstone Harbour are as following:

1. An estimated 30,000 large barramundi suffered physical stress including wounds to the body when washed over Awoonga Dam. The stress of their forced relocation, the increased crowding and competition for food due to the dramatic increase in barramundi numbers in the area and colder water temperature during winter would have stressed the fish and made them susceptible to disease.

2. Monitoring of other species of fish indicated that 5% of fish have lesions ranging from mild skin conditions, fin damage to skin discolouration. This is a low level of prevalence, which may be caused by a number of stressors, but quite significantly were the extreme natural events that occurred earlier in the year resulting in severe flooding.
3. The parasites and hyperaemia (redness) observed in sharks is a widespread general condition given that Fisheries Queensland Observers have recorded it in sharks caught in other areas to the north and south of Gladstone.
4. The shell erosion disease of mud crabs previously observed and documented in Gladstone Harbour may be a natural phenomenon.
5. There is no evidence to suggest that the erosive shell disease or the gill parasite observed in prawns is any greater than that observed in other prawn species from areas outside of Gladstone.

Following the suggestion of the Panel to develop a conceptual model of the cause-effect relationship to help guide studies and eliminate potential causal factors, the Queensland Government summarised the potential stressors on fish species being reported for Gladstone Harbour, including key questions arising from the reports and the available evidence. This and other information was used to develop a set of indicative diagrams in relation to the fish health issue in Gladstone Harbour and surrounding areas during 2011. The concept maps and diagrams are provided in this report.

### **Scientific Advisory Panel**

On 27 September 2011, the Queensland Minister for Main Roads, Fisheries and Marine Infrastructure announced that the Gladstone Fish Health Scientific Advisory Panel (the Panel) would be established to provide independent scientific advice to the Government. The primary role of the Panel is to review the Queensland Government's existing monitoring programs and examine the available information with a view to identifying a possible cause(s) of the fish health issues being observed in Gladstone Harbour and its surrounds, with a secondary role being to consider the water quality monitoring programs currently in place and human health issues where appropriate. A list of the documents, reports and datasets considered by the Panel is provided in Appendix 1.

The Panel comprised eminent scientists, from the government and academic sectors, with recognised expertise and research publications concerning: aquatic environmental science including water quality; fish health and toxicology; and human health especially in relation to potential for transmission of diseases from marine species to humans. Several government scientists and a representative of the commercial fishing sector were invited to participate in Panel meetings and inter-sessional activities. The Panel was appointed for a three month term and asked to report to the Minister by the end of December 2011. The Panel's Terms of Reference are provided in Appendix 2. The Panel convened four times between 6 October 2011 and 9 December 2011 and undertook inter-sessional activities.

### **Findings and recommendations**

The Panel noted that identifying the cause(s) of the disease(s) and prevalence of parasites on fish in Gladstone Harbour is a complex and difficult task. This task is further complicated by the extreme flood events of the 2010-2011 summer and the historical and ongoing industrial development of the Harbour, which have changed the local environment.

Determining conclusively whether any environmental changes have anything to do with the reported fish health problems is a formidable and perhaps impossible undertaking given the available data for fish and human diseases has been collected using descriptive study designs (e.g. case series, cross sectional surveys) without the benefit

of normal baseline values for fish and human diseases making determination of causation difficult. Nevertheless, it is the Panel's view there is an issue of concern around the health of some species of fish in Gladstone Harbour and this is possibly caused by environmental factors.

In reviewing the Queensland Government's response, the Panel acknowledges and supports the Government's ongoing investigation of the issue and notes that good progress has been made to date. Having reviewed the available data and reports and provided advice on the future investigations of Gladstone Harbour, the Panel notes that the Queensland Government has acted or is acting based upon earlier advice provided by the Panel.

The Panel has made specific comments and recommendations in relation to the issues of fish health, water quality and human health with a view to identifying a possible cause(s) of the fish health issues being observed in Gladstone Harbour. The Panel has also provided suggestions to the Queensland Government for its consideration on ways ongoing studies could be expanded in the future to increase the possibility of determining whether any environmental changes have anything to do with the reported fish health problems.

### **Fish Health**

Fish are normally good integrative indicators of eco-system and environmental health. The Panel concluded there is an issue of concern around the health of some species of fish in Gladstone Harbour and this is possibly caused by environmental factors, but the extent of the issue is currently not known. The data for barramundi indicates this species may be stressed, but it is less clear for other fish species.

The Panel reviewed the Queensland Government's explanations for what is being observed in Gladstone Harbour, but the lack of historical baselines and/or good comparative baseline information in areas to the north and south of Gladstone on the level of skin abnormalities in fish species makes it difficult to determine if the Gladstone data is an anomaly until further surveys are completed. The Panel proposed to the Queensland Government an assessment of the hypothesis that there is a yet unknown factor (or factors) causing stress in some fish species. Barramundi appear to be more strongly affected because of the additional population stress associated with the introduction of an estimated 30,000 barramundi into already stressed (flooded) Gladstone Harbour between 12 December 2010 and March 2011 with the overflow of the Awoonga Dam. The Panel recommends that the identification of potential causal agent(s) should be the focus of future investigations.

The pathology data and other information available to date indicate that some species of fish in Gladstone Harbour may be stressed and potentially immuno-compromised. However, this is only a hypothesis and it is necessary to continue Fisheries Queensland and other studies to determine the extent to which populations of barramundi and other fish species in Gladstone Harbour have been stressed and potentially compromised. Furthermore, it will also be necessary to determine whether a causal relationship can be definitively established between what is being observed in the fish in Gladstone Harbour and water quality and sediment. This has not been established to date.

While the Panel agreed the observed parasitic infections, lesions and skin discolouration in fish taken from Gladstone Harbour indicates that these fish may be stressed, the Panel also noted there are a range of possible causes for this including human induced mechanical damage, chemical damage, nutritional issues and physical issues that need to be investigated.

The Panel emphasised the need for comparative information from similar unaffected systems to determine the scale of the problem being observed in barramundi and other

fish species in the Gladstone area. This includes establishing baselines and trends during “normal” periods, and appropriate areas outside the Harbour to act as a form of control for comparative analysis i.e. the use of more sophisticated study designs. The Panel suggested that ongoing pathology studies are a priority to support epidemiological studies and as a component of more in-depth investigations, including the development of a case definition for the observed skin discoloration or “reddening”.

The Panel reviewed the data for the parasite (*Neobenedenia* sp.) which was affecting the eye and skin particularly in the barramundi. The parasite has been reported previously in Australia and has a wide host specificity and is known to cause mass mortalities in aquaculture cages in many countries. Reports of high prevalences in wild fish are unusual, but may simply be a reporting issue. While the presence of *Neobenedenia* on barramundi explains many of the lesions reported, the reasons for the current high prevalence and abundance of the parasite are unclear but outbreaks are known to occur including in Hinchinbrook Channel, Queensland but not to the extent seen in this instance.

### Recommendations

- The fish health issue should be the ongoing focus of Queensland Government studies.
- As a priority, a conceptual model should be completed of possible cause-effect relationship(s) to help guide studies and eliminate potential causal factors. The development of the concept maps (Appendix 3) and the set of indicative diagrams (Figures 7-10) is the first step in developing the conceptual model.
- There is an immediate need to develop a case definition for the observed skin discoloration (“reddening”) in fish.
- The ongoing monitoring of the prevalence of the parasite, lesions and skin discoloration and the associated pathology investigations should continue as a priority and be guided by the conceptual model.
- Consideration should be given to experimental work with diseased fish and fish with *Neobenedenia* to better understand the parasite’s taxonomy, biology and pathogenesis; and studies on wild fish with lesions held in captivity and exposed to water of different quality.

### **Water Quality**

The Panel reviewed the available water quality data and reports and agreed that the data provided by the Queensland Government was appropriately collected and analysed. The Panel concluded that the water quality results received to date indicate the observed values of the measured water quality parameters are not unusual (compared to historical values and trends), except for extremely low salinity during the 2010-2011 wet season. A number of areas of the Harbour, including the Boyne River, had zero or close to zero salinity for extended periods of time. The measured water quality parameters provide no insights into the cause of the high parasitic levels, lesions and skin discoloration observed in the fish.

The Panel recommended the water quality monitoring be expanded to include analysis for dissolved metals (operationally defined as the fraction of metals in the water column that pass through a 0.45 µm filter). The Queensland Department of Environment and Resource Management (DERM) completed additional monitoring including dissolved metals during the week of 26 September 2011. The values observed were within the expected ranges for Australian tropical/sub-tropical coastal environments and not expected to cause adverse biological effects. The total (acid extractable) metals data from the sediment samples indicate the metal concentrations are at levels that would not



be expected to cause adverse biological effects. One sediment site, QE3, had higher concentrations of aluminium, arsenic, barium and iron, which appears to be due to a different type of mineralization at this site. The Panel noted the lack of monitoring data for metals in sediments and the apparent lack of monitoring data for organic chemicals in sediments and water, and suggested these should be considered for inclusion in the monitoring program.

Given the focus of the monitoring programs, the Panel discussed whether the available water quality data is fit for purpose. The Panel noted the current parameters measured may not provide an appropriate trigger for ecosystem health problems that may be responsible for the observed fish health issues in Gladstone Harbour. Water quality parameters need to be selected on the basis that they will provide a trigger for biological investigations at the chronic (or if possible sub-chronic) level.

The Panel recommended that the Queensland Government commission or conduct a comprehensive literature review on the potential of chemicals to cause the observed signs in fish and then design a test program for metals and organic chemicals, as well as natural toxins that targets the chemicals that may be associated with the observed signs in fish.

The Panel noted that this case highlights the need for monitoring programs to align with some form of hypothesis testing (or conceptual model). It is noted that many of the chemicals that could contribute to health problems in fish (e.g. chemical induced immune-suppression) are hydrophobic and thus highly bio-accumulative and the chemical concentration in sediments would possibly provide a better surrogate than the water phase. Thus testing of sediments should accompany future water quality sampling campaigns. However, the Panel emphasised there is no evidence from the histopathology reports of heavy metal impacts on fish tissues.

The Panel noted that the current sampling does not include organic chemicals or broad scale bacterial (prokaryotes) and microalgal (eukaryotes) assessment and recommends the Queensland Government assess the usefulness of including surveys of prokaryotic and eukaryotic community structure and composition using DNA bulk sequencing techniques and organic chemicals in the ongoing monitoring program.

#### Recommendations

- The Panel recommended the water quality monitoring be expanded to include analysis for dissolved metals (operationally defined as the fraction of metals in the water column that pass through a 0.45 µm filter). The dissolved metal fraction will potentially contain the readily bio-available fraction of metals (the fraction of metals that are readily taken up by aquatic organisms). DERM completed additional monitoring including dissolved metals during the week of 26 September 2011.
- The Panel recommended continued water quality monitoring by the Queensland Government as an indicator of the general health of the Gladstone Harbour and surrounding areas and the program is continuing.
- The Queensland Government commission or conduct a comprehensive literature review on the potential of chemicals to cause the observed signs in fish and then design a test program for metals and organic chemicals, as well as natural toxins that targets the chemicals that may be associated with the observed signs in fish.
- The Panel recommended a one-off quantification of legacy persistent organic pollutants (such as polychlorinated dibenzodioxins, chlorinated pesticides and polychlorinated biphenyls) in sediments and (if possible) fish lipid tissue.

- DERM should re-assess and amend the monitoring program as necessary, as more information becomes available (framed as an adaptive management approach).
- The Queensland Government should engage with Port Curtis Integrated Monitoring Program Inc. (PCIMP) and industries around Gladstone Harbour to ensure monitoring programs do have the ability to detect potential impacts of the multiple potential stressors on Gladstone Harbour. The concept maps (Appendix 3) and indicative diagrams (Figures 7-10) could provide the basis for this engagement.

### **Human Health**

To assess the human health impacts, the Panel was provided with a Queensland Health report on a group of instances of illness in fishers from the Gladstone area that could potentially indicate an outbreak, and one Panel member undertook a detailed assessment of the report. This included access to the de-identified line listing of the cases that formed the basis of the Queensland Health report and enabled the accuracy of the summarised data in the Queensland Health report to be confirmed from the original data.

The Panel concluded that Queensland Health had conducted an appropriate and adequate investigation of the fishers. The Panel agreed with Queensland Health that the cases described did not form a single outbreak of one disease. The Panel agreed that there was no indication of an outbreak of disease in fishers that could be linked with disease in fish in Gladstone Harbour and agreed that additional investigations by Queensland Health of this group of fishers was not warranted. The Panel noted the occurrence of non-multiresistant *Staphylococcus aureus* (nmMRSA) in commercial fishers is an issue that warrants further investigation in collaboration with the commercial fishing industry.

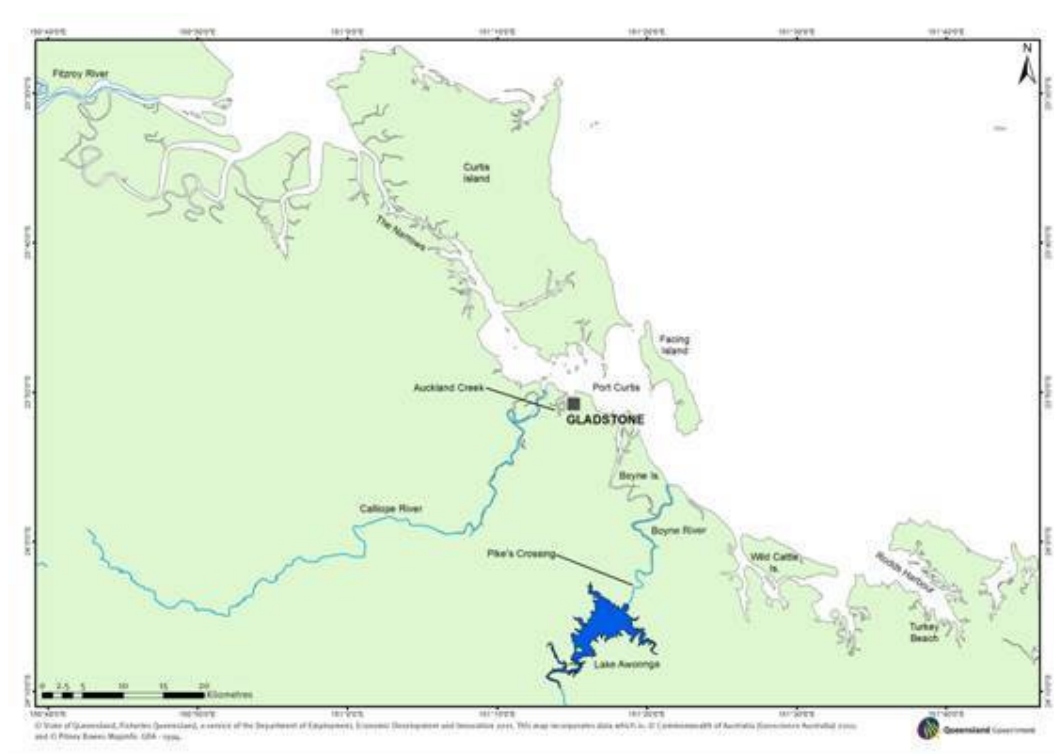
### **Recommendations**

- That a study be conducted to establish a baseline incidence for illness in commercial fishers in the Gladstone area and possibly other areas of Queensland. This is essential if any outbreak of disease is to be identified in the future.
- That appropriate OH&S statistics be routinely collected for the Queensland commercial fishing industry.
- That appropriate best practice OH&S guidelines for fishing and fish handling be developed in collaboration with the commercial fishing industry.

## Introduction

Following reports (primarily by commercial fishers) of barramundi fish (*Lates calcarifer*) in the Gladstone region (Figure 1) being caught with obvious signs of disease including bulging/red eyes, blindness, severe skin lesions and skin discolouration (Figures 2, 3 and 4), Fisheries Queensland organised for diseased barramundi to be provided to Biosecurity Queensland for testing. Fisheries Queensland is the lead agency in developing the policy framework to protect and conserve fisheries resources while maintaining profitable commercial and enjoyable recreational fishing sectors (see [www.fisheries.qld.gov.au](http://www.fisheries.qld.gov.au)). One of Biosecurity Queensland's roles is to coordinate the Queensland Government's efforts to prevent, respond to, and recover from pests and diseases that threaten the economy and environment (see [www.biosecurity.qld.gov.au](http://www.biosecurity.qld.gov.au)).

The fish were provided by commercial fishers through the Gladstone Fish Markets. Nine fish were received for testing by Biosecurity Queensland on 28 August 2011.



**Figure 1:** Map depicting Gladstone, Gladstone Harbour and surrounding areas.

On 13 September 2011, the Queensland Seafood Industry Association (QSIA) advised Fisheries Queensland that at least six commercial fishers were sick with what appeared to be bacterial infections on their arms, feet and legs following contact with, or abrasions and fish spikes from net-caught barramundi that were exhibiting evidence of disease. The QSIA is the peak industry body representing the Queensland Seafood Industry. Its members include professional fishers, seafood processors, marketers, retailers and other businesses associated with the seafood industry (see <http://www.qsia.com.au/>).

With this information, Queensland Health and Safe Food Production Queensland were concerned about the potential food safety issues of consuming the diseased fish, given that at that time the type of disease remained unknown. Furthermore, there were concerns about the possibility of the transfer of the disease from affected fish to other fish and consequently its entry into the food chain. Safe Food Production Queensland

(SFPQ) works in partnership with Queensland Health (QH) across the entire food chain to ensure Queensland's food supply is safe (see [www.safefood.qld.gov.au/](http://www.safefood.qld.gov.au/)).

### **Queensland Government assessment, response and conclusions to date**

On 16 September 2011, Fisheries Queensland closed Gladstone Harbour and the surrounding area to fishing under section 46 of the *Fisheries Act 1994* over concerns of potential impacts on human health and food safety issues of consuming the diseased fish. This followed a meeting of officers from Fisheries Queensland, Biosecurity Queensland, Safe Food Production Queensland, Queensland Health and the Department of Environment and Resource Management. The closure was put in place to avoid any possibility of unsafe product entering the seafood supply chain, and to further prevent infections from handling diseased fish. The emergency fisheries declaration closed Gladstone Harbour and the surrounding area to all forms of commercial and recreational fishing for a period of 21 days between 16 September 2011 and 7 October 2011.

From the initial testing of the nine diseased barramundi, two conditions were identified that were affecting barramundi in the Gladstone area. The first was red-spot disease (epizootic ulcerative syndrome (EUS)) which is a fungus endemic to fin fish species of mainland Australia. This condition was only confirmed in one fish from Port Alma.

The second condition was external parasitism due to the fluke *Neobenedenia sp.*, which was affecting the eye and skin particularly in the barramundi in Gladstone Harbour. This parasite has previously been found in Queensland waters in Hinchinbrook Channel between Hinchinbrook Island and mainland Queensland where barramundi are in high densities<sup>1</sup>.

In September 2011 the Gladstone Water Area Board staff<sup>2</sup> reported that an estimated 30,000 barramundi between 90 and 130cm in length (equivalent to approximately 300 tonnes) entered the Boyne River estuary when the Awoonga Dam (Figure 1) spilled over between December 2010 and June 2011. This was the first time the Dam had spilled over since 2002. Barramundi were reported being washed over the Dam wall from 12 December 2010 to March 2011.

Catches of barramundi demonstrated that the numbers of barramundi in the Boyne River and Gladstone Harbour (Figure 1) well exceeded the catch recorded in previous years, with each monthly catch in 2011 exceeding the annual catch for each of the previous six years. The commercial catch records received to date indicate that the 2011 catch was 18 times that of the average annual catch from 2005 to 2010 (Figure 5).

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<sup>1</sup> Deveney MR, Chisholm LA, Whittington ID. (2001) First published record of the pathogenic monogenean parasite *Neobenedenia melleni* (Capsalidae) from Australia. *Dis Aquat Organ.*, 461:79-82.

<sup>2</sup> Gladstone Water Board official, personal communication, September 2011.



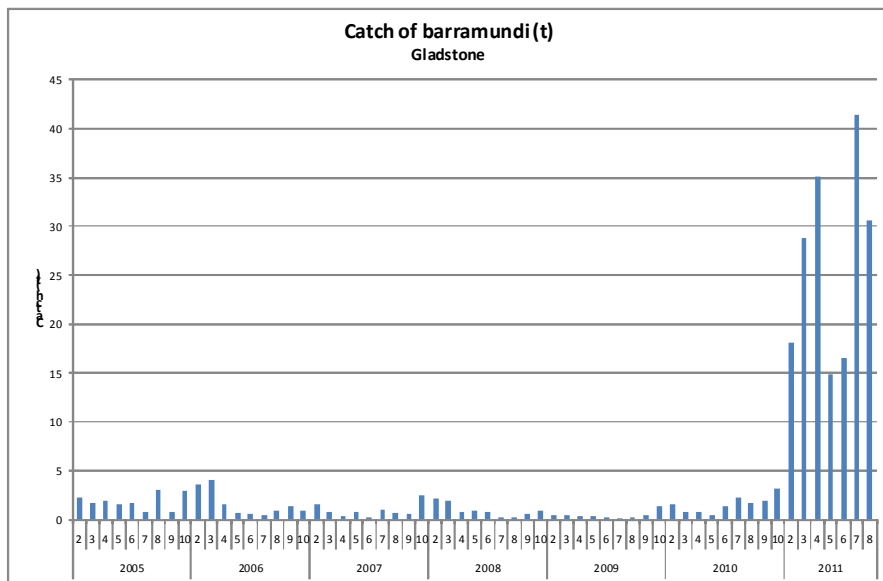
**Figure 2:** Photograph of a barramundi depicting the bulging red eyes typical of that observed in some fish taken from the Gladstone area.



**Figure 3:** Photograph of a barramundi depicting a skin lesion typical of that observed in some fish taken from the Gladstone area.



**Figure 4:** Photograph of a barramundi depicting the skin discoloration typical of that observed in some fish taken from the Gladstone area.



**Figure 5:** Monthly catch in tonnes of barramundi in Gladstone from 2005 to 2011. Note the marked increase in barramundi catch in each month of 2011.



Based on the available scientific literature, the Queensland Government concluded the high levels of external *Neobenedenia sp* parasitism<sup>3</sup> and bacterial infections<sup>4</sup> in barramundi were likely to disappear as water temperatures increased. The Queensland Government reported neither condition is detrimental to human health.

Fisheries Queensland conducted a survey of fish health status across a number of sites in the Gladstone area in early October 2011 to determine the distribution of sick fish, particularly barramundi as it was the primary species of concern at that time. In addition, any ill fish from any species caught were collected for testing (Figure 6). The survey was conducted with commercial barramundi fishermen using 6 to 8 inch mesh nets. Fish health condition was recorded for each fish caught including presence of lesions, eye condition and skin discolouration. Photographs were taken of each fish and samples were taken where fish were displaying signs of illness. The survey found that while it seemed the relative number of barramundi with deep lesions had decreased, the numbers affected by the parasitic fluke and skin discolouration (redness) were still a significant problem in the Harbour fish. The Boyne River remained the site of the highest number of barramundi affected by the parasite compared to the other sites sampled.

Of the 24 non-barramundi fish and sharks caught, two fish from the Boyne River and two lemon sharks from Wild Cattle Island to the south of the Boyne River mouth (Figure 1) had some skin discolouration. Fisheries Queensland continues to work with commercial net, trawl and crab fishers to observe catches and take samples of fish, crustaceans and molluscs over several sites within and outside Gladstone Harbour (Figures 6 and 11 to 14).

Queensland Health received reports from 37 people who were concerned they might have been unwell or had infections or other skin conditions as a result of contact with diseased fish or seawater. Most of these people were interviewed by Queensland Health to establish whether there was any clear pattern of illness among interviewees and to identify possible links between diseased fish and risks to human health. The majority of interviewees reported infected injuries and skin infections. However, a range of symptoms were described by interviewees, including flu-like illnesses, infected injuries, boils, eye discharge and redness/rashes on the hands and feet. No link was identified between the conditions found in fish and the human health issues. While bacterial infections are occasionally associated with the handling of fish<sup>5</sup>, there are no major zoonoses (illnesses transmitted to humans from animals) in the literature related to the handling of fish.

In addition to the testing of diseased fish and reviewing the medical conditions of the fishers, the Department of Environment and Resource Management released a report on 4 October 2011 outlining the water quality conditions in Port Curtis. This report indicated that water quality in the Harbour and the two estuaries (Boyne River Estuary and

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<sup>3</sup> Hirazawa, Noritaka ; Takano, Ryoko ; Hagiwara, Hiroko ; Noguchi, Mitsuyo ; Narita, Minoru; 2010. The influence of different water temperatures on *Neobenedenia girellae* (Monogenea) infection, parasite growth, egg production and emerging second generation on amberjack *Seriola dumerili* (Carangidae) and the histopathological effect of this parasite on fish skin. *Aquaculture* 299:2-7.

<sup>4</sup> Bromage, Erin; 2004. The humoral immune response of *Lates calcarifer* to *Streptococcus iniae* 2004. PhD Thesis, James Cook University.

<sup>5</sup> Lowry, T. and Smith S.A. (2007). Aquatic zoonoses associated with food, bait, ornamental, and tropical fish *JAVMA*, V 231, No. 6.

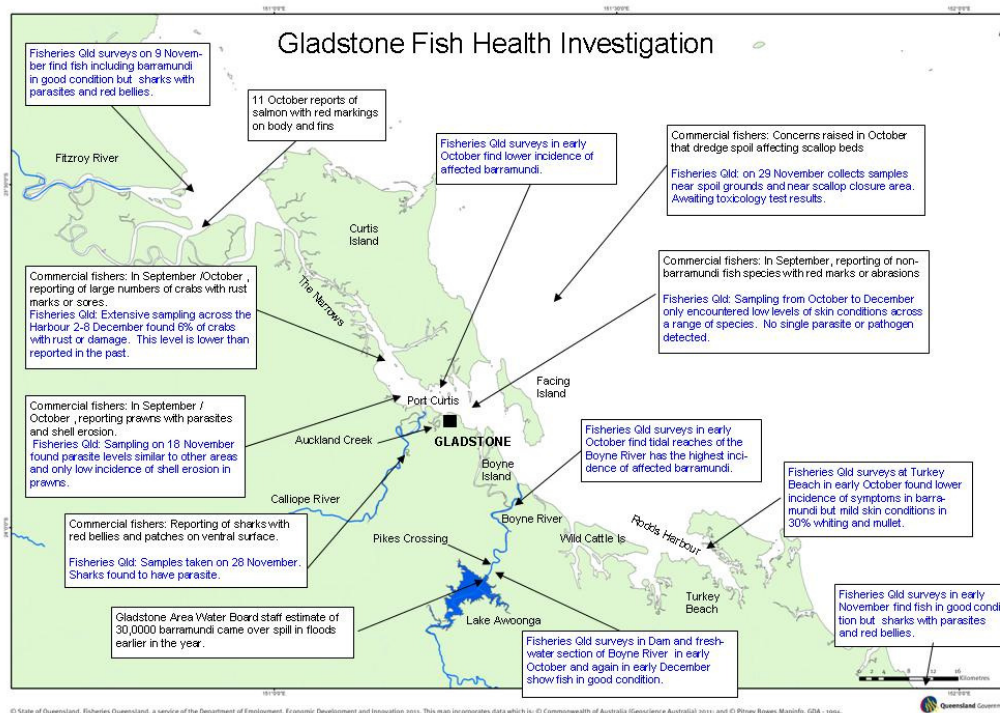
Calliope River Estuary) was consistent with historical trends apart from the impacts of flooding in January 2011, which saw much lower salinities over an extended period beyond what had been observed in the last three decades.

In October 2011, the Queensland Government lifted all fishing bans noting that:

- the disease in fish did not appear to be of human health significance;
- the identification of likely causes of the lesions in the fish; and
- the test results of the fishers and Gladstone Harbour water revealed no significant issues that warranted continuation of the fishing ban.

All forms of fishing were permitted in Gladstone Harbour and surrounding areas from Friday 7 October 2011.

During this period, subsequently and currently commercial fishers remained concerned about the health of seafood species caught in Gladstone Harbour and surrounding areas. In early August 2011, fishers raised concerns over the health of other fish species, besides barramundi, sharks and invertebrates such as crabs, prawns and scallops (Figure 6). In response to these ongoing concerns, Fisheries Queensland is continuing to monitor Gladstone Harbour and surrounding areas and arranged for the additional laboratory testing of fish, scallops and crustacean samples to assess the extent of affected seafood in the Gladstone area. Sampling is also occurring to the north and south of Gladstone to provide a baseline to compare fish health in the Harbour (Figure 6).



**Figure 6:** Map depicting Gladstone and surrounding areas highlighting the location of reports of fish health issues received by Fisheries Queensland and the location of surveys undertaken by Fisheries Queensland in response to the reports.

Safe Food Production Queensland continues to engage with accreditation holders to ensure that they are aware of their food safety obligations under the legislation. Safe Food Production Queensland accreditation categories included wild animal harvester, producer or processor. A seafood supplier must be accredited with Safe Food Production Queensland before they can legally supply seafood in Queensland (see <http://www.safefood.qld.gov.au/index>). Safe Food Production Queensland also continues



to respond on a regular basis to particular questions raised by persons accredited with it under its Seafood Food Safety Scheme.

The Fisheries Queensland's hypothesis is that an estimated 30,000 large barramundi (between 90 and 130cm in length and equivalent to approximately 300 tonnes) suffered physical stress including wounds to the body when washed over Awoonga Dam. The stress of their forced relocation, the increased crowding and competition for food due to the dramatic increase in barramundi numbers in the area, and colder water temperature during winter would have stressed the fish and made them susceptible to disease.

In response to concerns about the health of other species, Fisheries Queensland monitoring indicated that approximately 95% of a total of nearly 2,000 non-barramundi fish caught in the Gladstone area were in good health. Of the remaining 5%, which was comprised of a variety of species, lesions observed ranged from mild skin conditions, fin damage to skin discolouration. No one bacterial, parasitic or fungal pathogen has been identified from the over 20 fish samples tested by Biosecurity Queensland. The presence of viral agents was assessed histologically to determine if further specific testing was indicated. However, no viral testing was done.

The Department's hypothesis is that the low level of prevalence may be caused by a number of stressors, but quite significantly included the extreme natural events that occurred earlier in the year resulting in severe flooding.

Fisheries Queensland's hypothesis for sharks is that the parasites and hyperaemia (redness) observed may be a more widespread general condition given that Fisheries Queensland observers have recorded it in sharks caught in other areas to the north and south of Gladstone. Fisheries Queensland also concluded the shell erosion disease comprising up to 6% of mud crabs (*Scylla serrata*) caught across Gladstone Harbour in Fisheries observations has been previously observed and documented in a 2001 study of the area. The study found affected mud crabs comprised up to 21% of the catch and concluded that it may be a natural phenomenon<sup>6</sup>. Fisheries Queensland concluded there was no evidence to suggest that the erosive shell disease or the gill parasite observed in prawns is any greater than that observed in other prawn species from areas outside of Gladstone. The 2011 banana prawn (*Fenneropenaeus merguensis*) catches in the Gladstone area have exceeded previous years. Until the results from testing including toxicology of the scallops are available, no conclusions can be made in regard to scallops.

### ***Timeline of events and potential stressors***

Following the request of the Panel to develop a conceptual model of the cause-effect relationship to help guide studies and eliminate potential causal factors, the Queensland Government summarised the potential stressors on fish species being reported for Gladstone Harbour including key questions arising from the reports and the available evidence. The approach taken was guided by the Panel's advice about the range of potential causes of stress on fish species. Initially the Queensland Government developed concept maps that summarised current information in the fish health investigation according to five potential stressors: (i) mechanical; (ii) nutritional/fitness; (iii) biological; (iv) physical and (v) chemical. The approach taken was guided by the Panel's advice about the range of potential causes of stress on fish species. This was done for barramundi, fin fish and sharks, and prawns and crabs and these are provided

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<sup>6</sup> Andersen, L., Norton, J., 2001. Port Curtis mud crab shell disease: nature, distribution and management. FRDC Project No. 98/210. Central Queensland University, Gladstone.

in Appendix 3. This and other relevant information was used to develop the following set of indicative diagrams in relation to the fish health issue in Gladstone Harbour and surrounding areas during 2011:

- Port Curtis baseline condition (Figure 7);
- Port Curtis Dec 2010 – Mar 2011 (Figure 8);
- Port Curtis Apr 2011 – Jun 2011 (Figure 9); and,
- Port Curtis Jul 2011 – Sep 2011 (Figure 10).

The diagrams summarise the known events or activities that could potentially have been a contributing factor to the fish health issue observed in the region.

### Port Curtis baseline condition



Stocked barramundi populate the Awoonga dam in large numbers. These barramundi have large fat stores and have the freshwater coloration of dark body and tails.



The wild barramundi in Port Curtis are, on the whole, smaller and thinner than the stocked population in the Awoonga Dam. The wild barra have yellowish tails. Pikes Crossing on the Boyne River marks the transition from freshwater to saltwater.



Automatic water quality monitoring buoys



Commercial barramundi fishing



Recreational barramundi fishing



Barramundi, top and side views



Dredging



Commercial fisheries



Shipping



Gladstone



Various industries



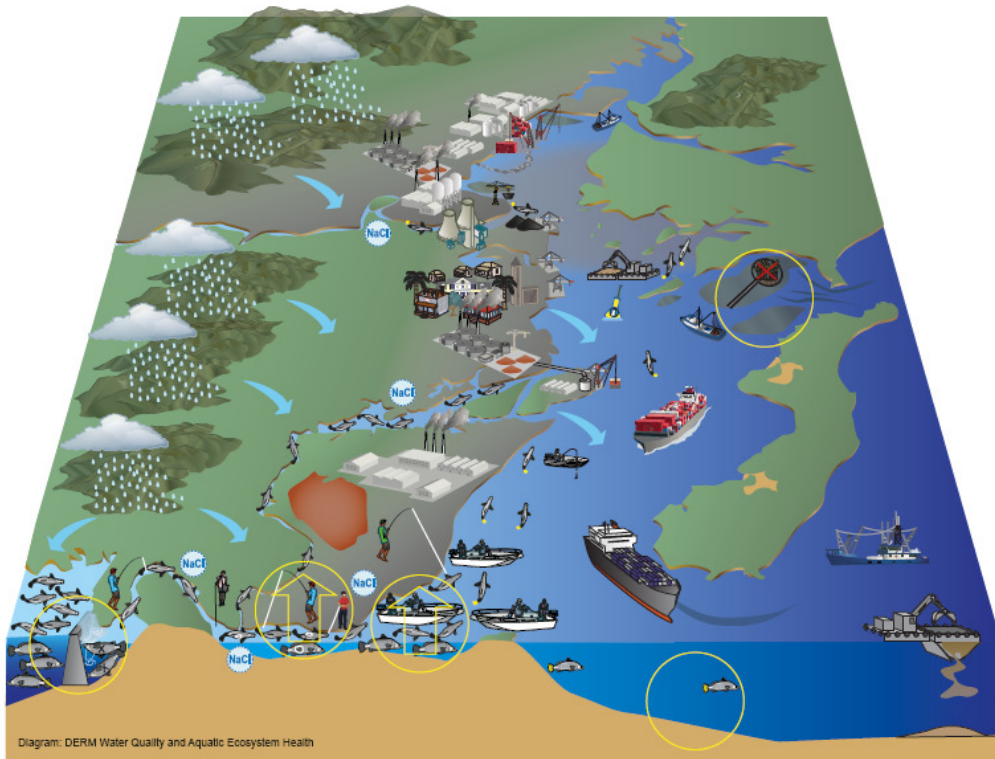
Port activities



Seagrass beds

**Figure 7:** Graphic depicting events, activities and observations from the Gladstone area prior to the occurrence of the fish health issue.

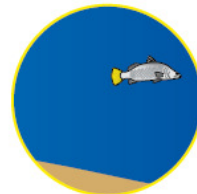
Port Curtis Dec 2010 – Mar 2011



Following flooding summer rains, the Awoonga Dam overtops and thousands of captive barramundi are washed downstream. Many die at the foot of the dam, others are bruised as they are carried along roughly by the flood waters.



The recreational and commercial barramundi catches in the Boyne River increase dramatically during February to March 2011. From 1 November to 1 February the barramundi fishery on the Queensland east coast is closed.



During the summer of 2011 the number of barramundi migrating out of the Boyne River is unknown.



Bruised barramundi



By February, significant seagrass dieback was evident in the Port Curtis area.



Extreme freshwater input resulted in very low salinity in rivers and estuaries, with estuaries being fresh for extended periods at lower depths.

**Figure 8:** Graphic depicting events, activities and observations from the Gladstone area between December 2010 and March 2011.

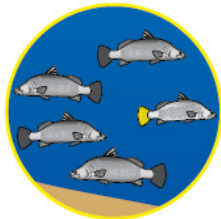
# Port Curtis Apr 2011 – Jun 2011



Diagram: DERM Water Quality and Aquatic Ecosystem Health



Commercial fishers continue to catch record numbers of barramundi. Although the barramundi catch was reduced during the two month closure of the Boyne River, the *monthly* catch of barramundi in the Gladstone Harbour was more than 1½ times the average *annual* harbour catch of barramundi.



Awoonga barramundi are dispersing throughout the Port Curtis region and are being caught outside the Boyne River.



Recreational fishers report excellent catches of barramundi in the salt and freshwater section of the Boyne River down stream of Awoonga Dam. The barramundi are in good health although losing condition by June (ie. Awoonga escapees took on a thinner appearance).

**Figure 9:** Graphic depicting events, activities and observations from the Gladstone area between April 2011 and June 2011.



## Port Curtis Jul 2011 – Sep 2011



Recreational fishers report catching barramundi with cloudy eyes and ragged/damaged fins. Some fish showed redness on the belly.

With the opening of the Boyne River fishery in July, catches of Barramundi return to record levels, although sick barramundi were reported. Catch of barramundi was reduced in August with more sick fish being encountered.



By August, sick barramundi were being reported in areas such as the Calliope River and Hamilton Point. In these areas, the ratio of Awoonga barra to wild barra was about 4:1. About half the Awoonga barra had red lesions.



In the winter of 2011, when water temperatures were lowest, the majority of the fish caught were Awoonga escapees. By August, 200 tonnes of barramundi had been marketed compared to an average of 10 tonnes for previous years. More than half of the barramundi caught had red lesions; in some catches this was nearly 100%.



A temporary closure to all fishing in the Gladstone Harbour was in place between 16 September and 7 October 2011.



Sick barramundi had symptoms including red rashes, red eyes and skin lesions.



Sickness in barramundi coincided with the time when water temperatures were low.

Mild skin conditions were detected across a range of other species at low population levels. The question of whether this is higher than normal background conditions still remains.

**Figure 10:** Graphic depicting events, activities and observations from the Gladstone area between July 2011 and September 2011.

# Scientific Advisory Panel

## Terms of Reference

On 27 September 2011, the Queensland Minister of Main Roads, Fisheries and Marine Infrastructure announced that the Gladstone Fish Health Scientific Advisory Panel (the Panel) would be established to provide independent scientific advice to the Government.

The primary role of the Panel is to review the Queensland Government's existing monitoring programs and examine the available information with a view to identifying a possible cause(s) of the fish<sup>7</sup> health issues<sup>8</sup> being observed in Gladstone Harbour and its surrounds with a secondary role being to consider the water quality monitoring programs currently in place and human health issues where appropriate.

Specifically, the Panel was requested to:

- Review the available test results, and assess previous water quality data and the current water quality and sediment monitoring regime.
- Review the pathology and toxicology testing of seafood.
- Investigate the potential impacts, if any, on human health.
- Advise Government as to whether there is a need for additional testing or investigations.
- Advise Government whether there are any identifiable reasons, based on the information supplied to the Panel and the expertise of its members, for the health issues affecting seafood species (fin fish and crustaceans) in the Gladstone area and the evidence for links to human health issues.

The Panel was appointed for a three month term and asked to report to the Minister by the end of December 2011. The Panel's Terms of Reference is provided in Appendix 2.

## Membership

The Panel was chaired by Dr Ian Poiner from the Australian Institute of Marine Science, and comprised eminent scientists, from the government and academic sectors, with recognised expertise and research publications concerning: aquatic environmental science including water quality; fish health and toxicology; and human health especially in relation to potential for transmission of diseases from marine species to humans. Several government scientists and a representative of the Commercial Fishers sector were invited to participate in Panel meetings and inter-sessional activities. A list of Panel members and invited participants and their areas of expertise is provided in Appendix 2.

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<sup>7</sup> The use of the word, "fish" in this report is taken to have the same meaning as defined in the Queensland *Fisheries Act 1994* and therefore includes species other than fin fish such as sharks, crustaceans and invertebrates.

<sup>8</sup> Green turtle and dugong were not included in the Panel's TORs as they were being assessed elsewhere as part of the Queensland Government's response to the observed increase in stress on turtle and dugong populations in Queensland waters following the widespread loss of seagrass, their primary food source, due to the 2011 flooding events.

## **Meetings of the Scientific Advisory Panel**

The Panel convened four times between 6 October 2011 and 9 December 2011 to assess the available scientific information relating to the investigations being undertaken and develop recommendations. The Panel established a *GovDex* site to facilitate inter-sessional activity and communications within the Panel. A list of the documents, reports and datasets considered by the Panel is provided in Appendix 1. An account of the Panel's conclusions and recommendations is provided below for consideration by the Minister.

## **Findings and recommendations**

### **General**

The Panel noted that identifying the cause(s) of the disease(s) and prevalence of parasites on fish in Gladstone Harbour is a complex and difficult task. This task is further complicated by the extreme flood events of the 2010-2011 summer (Figure 8) and the historical and ongoing industrial development of the Harbour (Figure 7), which have changed the local environment. For example, the extreme flood events of the 2010-2011 summer negatively and significantly affected Gladstone Harbour's seagrass beds.

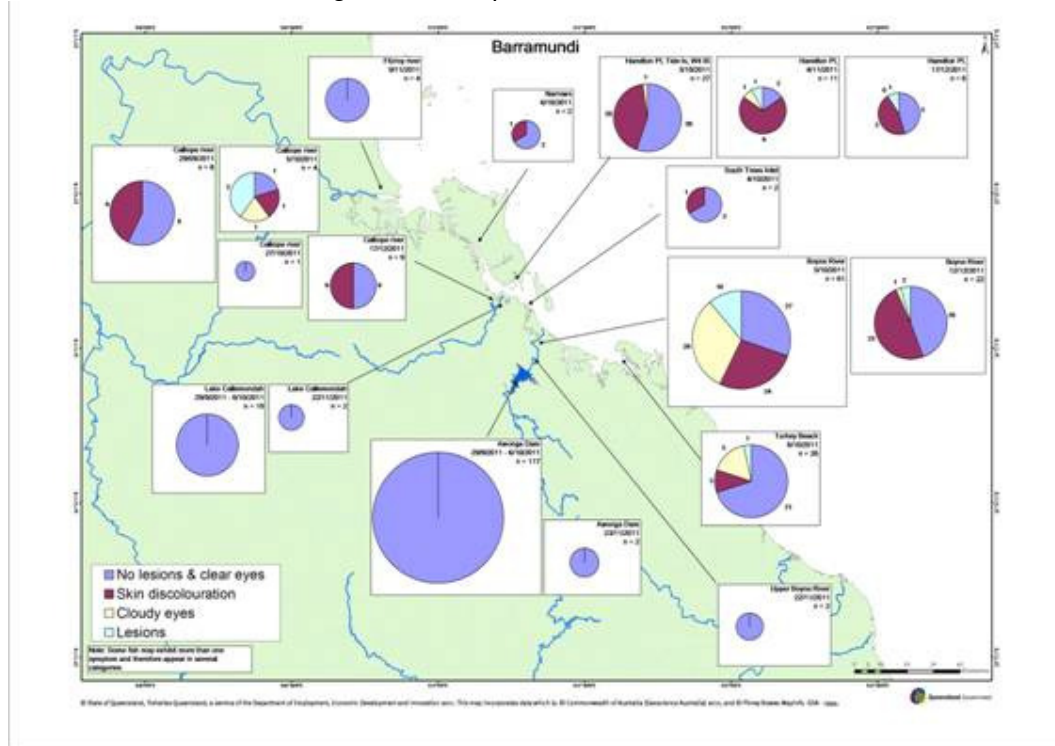
Determining conclusively whether any environmental changes have anything to do with the reported fish health problems is a formidable and perhaps impossible undertaking. The Panel noted all data for fish and human diseases has been collected using descriptive study designs (e.g. case series, cross sectional surveys) without normal baseline values for fish and human diseases, and that, although these provide valuable evidence, the quality of evidence is low in the hierarchy of evidence. This makes determination of causation difficult. Nevertheless, it is the Panel's view there is an issue of concern around the health of some species of fish in Gladstone Harbour and this is possibly caused by environmental factors.

### **Queensland Government's Response**

As noted above determining conclusively whether any environmental changes have anything to do with the reported fish health problems is a formidable and perhaps impossible undertaking. However, the Panel acknowledges and supports the Queensland Government's ongoing investigation of the issue and notes that good progress has been made to date. The locations sampled by Fisheries Queensland in Gladstone Harbour and the surrounding areas and a summary of the incidence of fish health issues observed (i.e. fish displaying cloudy eyes, skin discolouration or lesions) is provided in Figures 11, 12, 13 and 14. Having reviewed the available data and reports and provided advice on the future investigations of Gladstone Harbour, the Panel notes that the Queensland Government has acted or is acting based upon the advice provided by the Panel.

In response to concerns about the health of other species, Fisheries Queensland monitoring indicated that approximately 95% of a total of nearly 2,000 non-barramundi fish caught in the Gladstone area were in good health. Of the remaining 5%, which was comprised of a variety of species, lesions observed ranged from mild skin conditions and fin damage to skin discolouration. No one bacterial, parasitic or fungal pathogen has been identified from the over 20 fish samples tested by Biosecurity Queensland. The presence of viral agents was assessed histologically,

however further viral testing was not required.

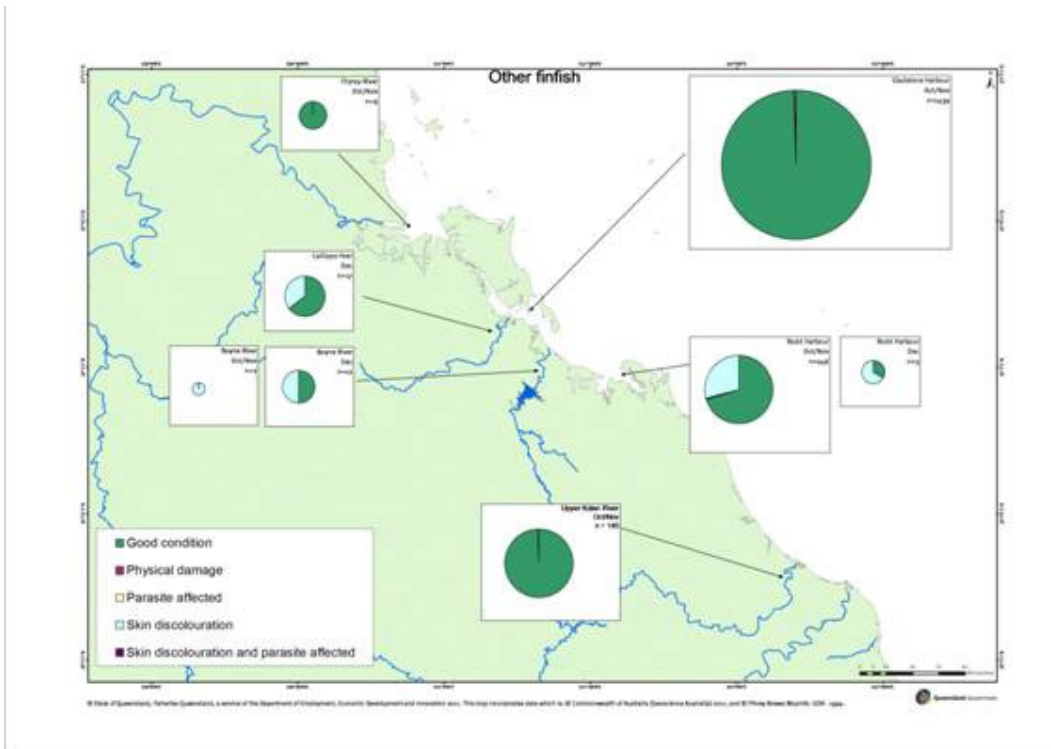


**Figure 11:** Barramundi: Map of Gladstone Harbour and the surrounding area showing the locations sampled by Fisheries Queensland and the prevalence of health issues (i.e. cloudy eyes, skin discolouration and other lesions) observed in sampled barramundi.

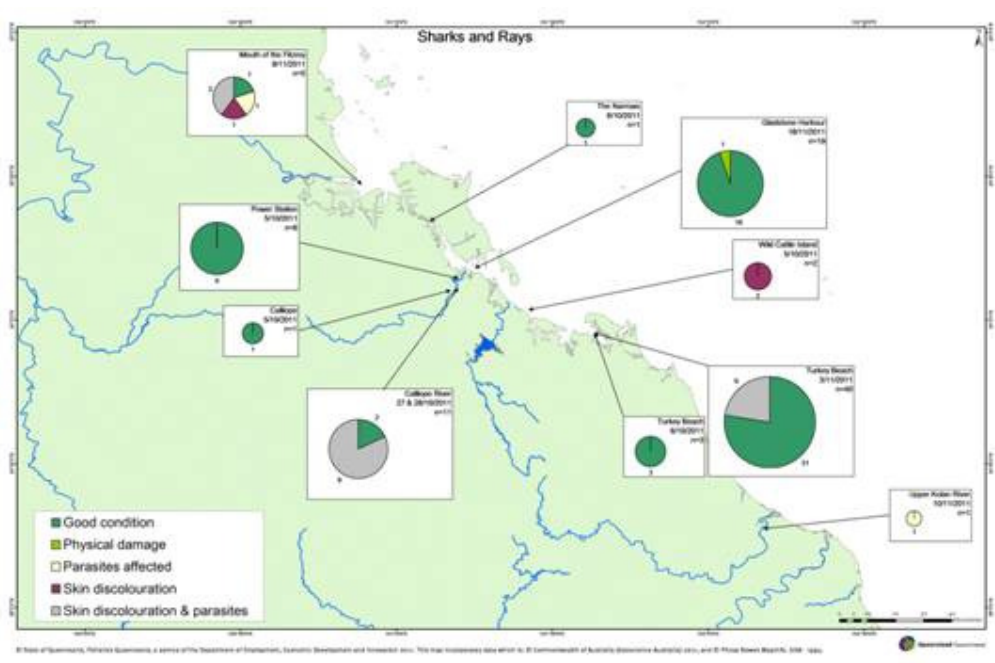
The Department's hypothesis is that the low level of prevalence may be caused by a number of stressors, but quite significantly included the extreme natural events that occurred earlier in the year resulting in severe flooding. With a lack of historical baselines and/or good comparative baseline information in areas to the north and south of Gladstone on the level of skin abnormalities in fish species, it is difficult to determine if the Gladstone data is an anomaly until further surveys are completed.

The Panel has also provided suggestions to the Queensland Government for its consideration on ways ongoing studies could be expanded in the future to increase the possibility of determining whether any environmental changes have anything to do with the reported fish health problems.

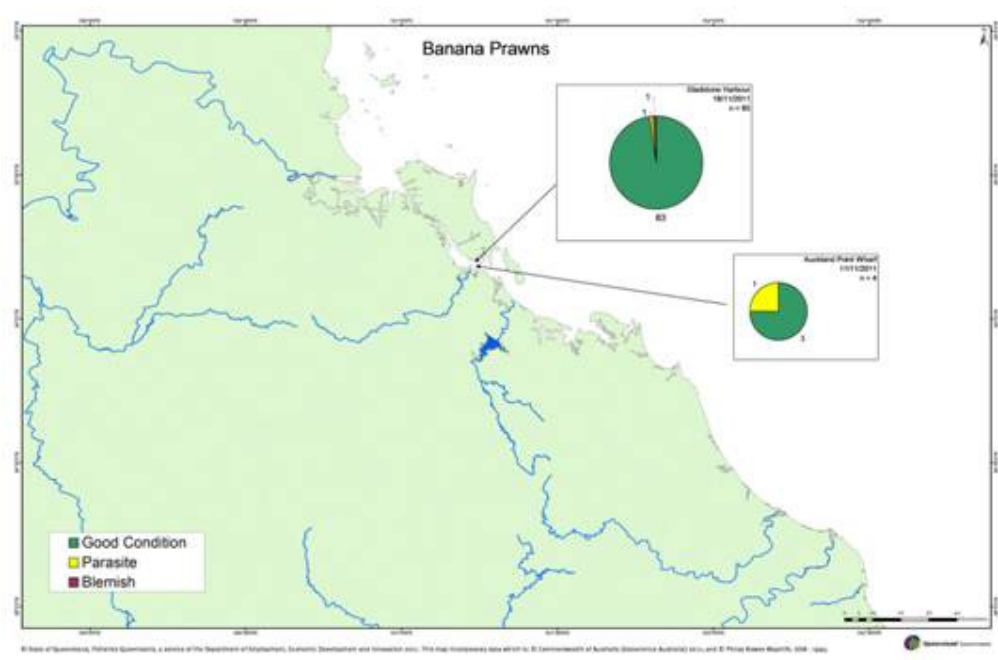




**Figure 12:** Other finfish: Map of Gladstone Harbour and the surrounding area showing the locations sampled by Fisheries Queensland and the prevalence of health issues (i.e. skin discolouration and other lesions) observed in sampled fin fish other than barramundi.



**Figure 13:** Sharks and rays: Map of Gladstone Harbour and the surrounding area showing the locations sampled by Fisheries Queensland and the prevalence of health issues (i.e. skin discolouration and other lesions) observed in sampled sharks and rays.



**Figure 14:** Banana prawns: Map of Gladstone Harbour and the surrounding area showing the locations sampled by Fisheries Queensland and the prevalence of health issues (i.e. gill parasite and blemishes) observed in sampled banana prawns.

The following outlines the Panel's specific comments and recommendations in relation to the issues of Fish Health, Water Quality and Human Health with a view to identifying a possible cause(s) of the fish health issues being observed in Gladstone Harbour; consideration of the water quality monitoring programs currently in place; and the reported human health issues.

### Fish Health

The Panel reviewed the available fish health data and reports and noted the data provided by the Queensland Government was appropriately collected and analysed. The Panel noted that fish are normally good integrative indicators of eco-system and environmental health, and having noted there may be an issue of concern in Gladstone Harbour the Panel undertook a more in-depth analysis of the fish health issue.

The Panel concluded there is an issue of concern around the health of some species of fish in Gladstone Harbour and this is possibly caused by environmental factors. The extent of the issue is currently not known. The data for barramundi indicates this species may be stressed, but it is less clear for other fish species. This highlights the need for systematic data collection in Gladstone Harbour and other places to establish baselines, which requires ongoing investigation by the Queensland Government.

While according to the reviewed reports, barramundi presented the clearest evidence of ill health, the problems are apparently not confined to this fish species. Therefore, the Panel proposed to the Queensland Government an assessment of the hypothesis that there is a yet unknown factor (or factors) causing stress in some fish species, but that barramundi appear to be more strongly affected because of the additional population stress associated with the introduction of an estimated 30,000 barramundi into Gladstone Harbour between 12 December 2010 and March 2011 with the overflow of the Awoonga Dam.

The addition of an estimated 30,000 large barramundi into an already stressed environment (floods) is likely to have caused a general environmental impact affecting barramundi and possible other species as a result of increased competition for food, and increased harassment by predators.

The Panel noted the reports of disease from mud crabs and prawns concluded the incidence of bacterial infections and parasites observed were not unusual compared to previous studies in Gladstone Harbour and elsewhere. There were also concerns raised by commercial fishers about scallops caught near the spoil grounds outside Gladstone Harbour, and this is currently being assessed by Fisheries Queensland. Samples were collected for toxicological testing.

#### Collection of comparative information

The collection of comparative information is necessary in order to determine the scale of the problem being observed in barramundi and other fish species in the Gladstone area compared to what could be expected in a similar unaffected system. The data also allows an assessment of temporal changes and the identification of trends.

#### Fish pathology

The pathology data and other information available to date indicate that some species of fish<sup>9</sup> in Gladstone Harbour may be stressed and potentially immunocompromised. However, this is only a hypothesis and it is necessary to continue Fisheries Queensland and other studies to determine the extent to which populations of barramundi and other fish species in Gladstone Harbour have been stressed and potentially compromised. Furthermore, it will also be necessary to determine whether a causal relationship can be definitively established between what is being observed in the fish in Gladstone Harbour and water quality and sediment. This has not been established to date.

While the Panel agreed the observed parasitic infections, lesions and skin discolouration in fish taken from Gladstone Harbour indicates that these fish may be stressed, the Panel also noted there are a range of possible causes for this including:

- Human induced mechanical damage (e.g. nets and cuts);
- Chemical damage (e.g. exposure to toxins (metals, organic chemicals and natural toxins); low pH; turbidity);
- Nutritional issues (e.g. poor nutrition); and
- Physical issues (e.g. mechanical damage to the skin and or gills from algal blooms; insult by parasites or bacteria; salinity through its impact on a fish's ability to osmoregulate; low dissolved oxygen; high carbon dioxide).

This being the case, the Panel recommends that the identification of potential causal agent(s) should be the focus of future investigations. In reviewing the fish health data and reports, the Panel noted that at this time there is no evidence to indicate the fish with parasites, lesions and/or skin redness are a risk to human health via handling (see "Human Health" below for further information). However, the Panel noted that under the standard food guidelines, no fish with signs of disease should be consumed at any time in Gladstone Harbour or elsewhere.

The Panel emphasises the importance of establishing baselines and trends during "normal" periods, and suggests ongoing studies should include appropriate areas outside the Harbour to act as a form of 'control' for comparative analysis i.e. use

more sophisticated study designs. The Panel suggests that ongoing pathology studies are a priority to support epidemiological studies and as a component of more in-depth investigations. In instances of disease outbreaks in wild populations where the pattern of lesions do not match known diseases, more sophisticated studies (possibly beyond that expected of a diagnostic laboratory) could be considered including eliminating viruses as causal agents<sup>10</sup>.

The parasite (*Neobenedenia* sp.) has been reported previously in Australia and has a wide host specificity. It is known to cause mass mortalities in aquaculture cages in many countries. Reports of high prevalences in wild fish are unusual, but may simply be a reporting issue<sup>11</sup>. While the presence of *Neobenedenia* on barramundi explains many of the lesions reported, the reasons for the current high prevalence and abundance of the parasite are unclear, but outbreaks are known to occur including in Hinchinbrook Channel, Queensland<sup>12</sup> but not to the extent seen in this instance. *Neobenedenia melleni* is a widespread pathogen of many teleost species in aquaria and aquaculture<sup>13</sup>. Most Monogenea have strict host-specificity but *N. melleni* has the broadest host-specificity of any monogenean species, having been recorded from over 100 species in more than 30 families from five orders of captive and wild fish<sup>14</sup>.

The Panel also highlights the need to develop a case definition for the observed skin discolouration or “reddening”. For example, was the shark or fish live or was it post-mortem lividity; and, what is the location and extent of the “reddening”. “Reddening” on live animals is of interest, post-mortem lividity is likely to be of less interest.

#### *Recommendations:*

- The fish health issue should be the ongoing focus of Queensland Government studies.
- As a priority, a conceptual model should be completed of possible cause-effect relationship(s) to help guide studies and eliminate potential causal factors. The development of the concept maps (Appendix 3) and the set of indicative diagrams (Figures 7-10) is the first step in developing the conceptual model.
- There is an immediate need to develop a case definition for the observed skin discolouration (“reddening”) in fish.

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<sup>10</sup> Skerratt, L, Speare R, Berger L. Mitigating the impact of diseases affecting biodiversity - Retrospective on the outbreak investigation for chytridiomycosis. *EcoHealth* 2011;7(Supplement: 1):S26-S26.

<sup>11</sup> Jones, J.B. 2005. Chapter 10: Mass mortalities in the ocean. Pp 371-374. **In:** Rohde, K (ed) *Marine parasites*. CSIRO Publishing, Canberra.

<sup>12</sup> Deveney MR, Chisholm LA, Whittington ID. (2001) First published record of the pathogenic monogenean parasite *Neobenedenia melleni* (Capsalidae) from Australia. *Dis Aquat Organ.*, 461:79-82.

<sup>13</sup> Deveney MR, Chisholm LA, Whittington ID. (2001) First published record of the pathogenic monogenean parasite *Neobenedenia melleni* (Capsalidae) from Australia. *Dis Aquat Organ.*, 461:79-82.

<sup>14</sup> Whittington, I. D. 2004. The Capsalidae (Monogenea : Monopisthocotylea): a review of diversity, classification and phylogeny with a note about species complexes. *Folia Parasitologica* 51:109-122.

- The ongoing monitoring of the prevalence of the parasite, lesions and skin discolouration and the associated pathology investigations should continue as a priority and be guided by the conceptual model.
- Consideration should be given to experimental work with diseased fish and fish with *Neobenedenia* to better understand the parasites taxonomy, biology and pathogenesis; and studies on wild fish with lesions held in captivity and exposed to water of different quality.

### **Water Quality**

The Panel reviewed the available water quality data and reports and agreed that the data provided by the Queensland Government was appropriately collected and analysed.

The Panel concluded that the water quality results received to date indicate the observed values of the measured water quality parameters are not unusual (compared to historical values and trends), except for extremely low salinity during the 2010-2011 wet season. A number of areas of the Harbour, including the Boyne River, had zero or close to zero salinity for extended periods of time. The measured water quality parameters provide no insights into the cause of the high parasitic levels, lesions and skin discoloration observed in the fish.

Changes to salinity can affect marine species that are unable to avoid the changes. Freshwater species need to constantly lose water gained through osmosis while marine species need to constantly drink (to make up for osmotic loss). The changes in osmolarity and particularly the changes in sodium and potassium caused by changes in salinity can be lethal. However, barramundi are adapted to moving from fresh to salt water and also to sub-optimal water quality (such as found in summer in billabongs and in floods and freshes). It is because they are such “tough” fish that they are so successful as aquaculture species.

The Panel discussed the focus on total (particulate plus dissolved) metals data in water and a lack of monitoring data for metals in sediments and the apparent lack of monitoring data for organic chemicals in sediments and water. Given the focus of the monitoring programs, the Panel discussed whether the available water quality data is fit for purpose. The Panel noted the current parameters measured may not provide an appropriate trigger for ecosystem health problems that may be responsible for the observed fish health issues in Gladstone Harbour. For example, mercury (Hg), which can be highly toxic due to formation of methyl mercury, was not included in the list of tested metals. Even if Hg is not likely to be introduced via the current industrial activities, there might be other sources that cannot be ruled out upfront. Likewise, legacy persistent organic pollutants could have been remobilised during dredging. While these possibilities are highly speculative, they warrant further exploration.

Water quality parameters need to be selected on the basis that they will provide a trigger for biological investigations at the chronic (or if possible sub-chronic level). Thus it is recommended that the Queensland Government commission or conduct a comprehensive literature review on the potential of chemicals to cause the observed signs in fish and then design a test program for metals and organic chemicals as well as natural toxins that targets the chemicals that may be associated with the observed signs in fish.

The Panel noted that this case highlights the need for monitoring programs to align with some form of hypothesis testing (or conceptual model). It is noted that many of the chemicals that could contribute to health problems in fish (e.g. chemical induced immune-suppression) are hydrophobic and thus highly bio-accumulative and the chemical concentration in sediments would possibly provide a better surrogate than

the water phase. Thus testing of sediments should accompany future water quality sampling campaigns. However, the Panel emphasised there is no evidence from the histopathology reports of heavy metal impacts on fish tissues. Most of the common heavy metals have a documented tissue pathology, which the Queensland Government pathologists would have recognised.

The Panel noted that the current sampling does not include organic chemicals or broad scale bacterial (prokaryotes) and microalgal (eukaryotes) assessment and recommends the Queensland Government assess the usefulness of including surveys of prokaryotic and eukaryotic community structure and composition using DNA bulk sequencing techniques and organic chemicals in the ongoing monitoring program.

*Recommendations:*

- The Panel recommended the water quality monitoring be expanded to include analysis for dissolved metals (operationally defined as the fraction of metals in the water column that pass through a 0.45 µm filter). The dissolved metal fraction will potentially contain the readily bio-available fraction of metals (the fraction of metals that are readily taken up by aquatic organisms). DERM completed additional monitoring including dissolved metals during the week of 26 September 2011. The values observed were within the expected ranges for Australian tropical/sub-tropical coastal environments and not expected to cause adverse biological effects. The total (acid extractable) metals data from the sediment samples indicate the metal concentrations are at levels that would not be expected to cause adverse biological effects. One sediment site, QE3, had higher concentrations of aluminium, arsenic, barium and iron, which appears to be due to a different type of mineralization at this site.
- The Panel recommended continued water quality monitoring by the Queensland Government as an indicator of the general health of the Gladstone Harbour and surrounding areas, and the program is continuing.
- The Queensland Government commission or conduct a comprehensive literature review on the potential of chemicals to cause the observed signs in fish and then design a test program for metals and organic chemicals as well as natural toxins that targets the chemicals that may be associated with the observed signs in fish.
- The Panel recommended a one-off quantification of legacy persistent organic pollutants (such as polychlorinated dibenzodioxins, chlorinated pesticides and polychlorinated biphenyls) in sediments and (if possible) fish lipid tissue.
- DERM should re-assess and amend the monitoring program as necessary, as more information becomes available (framed as an adaptive management approach).
- The Queensland Government should engage with Port Curtis Integrated Monitoring Program Inc. (PCIMP)<sup>15</sup> and industries around Gladstone Harbour

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<sup>15</sup> The Port Curtis Integrated Monitoring Program (PCIMP) is the first collaborative holistic monitoring program to be undertaken for the whole of Port Curtis. PCIMP was established in 2001 as a consortium of members from 16 bodies representing industry, government (both local and state), research institutions and other stakeholders to develop a cooperative, monitoring program for assessing the ecosystem health of Port Curtis, and to

to ensure monitoring programs do have the power to detect potential impacts of the multiple potential stressors on Gladstone Harbour. The concept maps (Appendix 3) and indicative diagrams (Figures 7-10) could provide the basis for this engagement.

## **Human Health**

To assess the human health impacts the Panel was provided with a report on a group of instances of illness in fishers from the Gladstone area that could potentially indicate an outbreak (see *Queensland Health\_HHRA Final 7 Oct.doc*). In addition, Panel member, Prof Rick Speare undertook an assessment of the Queensland Health report (see *Illness in Fishers-Rick\_Speare-15Oct11.pdf*). Queensland Health provided Prof Speare access to the de-identified line listing of the cases, which formed the basis of the Queensland Health report. This enabled the accuracy of the summarised data in the Queensland Health report to be confirmed from the original data.

The Panel concluded that Queensland Health had conducted an appropriate and adequate investigation of the fishers. The Panel agreed with Queensland Health that the cases described did not form a single outbreak of one disease. The Panel agreed that there was no indication of an outbreak of disease in fishers that could be linked with disease in fish in Gladstone Harbour. The Panel agreed that additional investigations by Queensland Health of this group of fishers was not warranted.

The Panel noted the occurrence of non-multiresistant *Staphylococcus aureus* (nmMRSA) in commercial fishers is an issue that warrants further investigation in collaboration with the commercial fishing industry. Workplace Health and Safety Queensland is engaging with the industry to try to address some of the multiple risk factors for transmission among this group of mainly men who are cramped together for long periods with limited access to fresh water.

### *Recommendations:*

- That a study be conducted to establish a baseline incidence for illness in commercial fishers in the Gladstone area and possibly other areas of Queensland. This is essential if any outbreak of disease is to be identified in the future.
- That appropriate OH&S statistics should be routinely collected for the Queensland commercial fishing industry.
- That appropriate best practice OH&S guidelines for fishing and fish handling be developed in collaboration with the commercial fishing industry.

## **Appendices**

Appendix 1 - List of documents, reports and datasets considered by the Panel.

Appendix 2 - Terms of Reference and a list of Panel members and invited participants and their areas of expertise.

Appendix 3 – Concept maps developed by the Queensland Government summarising the available information on the Gladstone fish health issue.

**Appendix 1 - List of documents, reports and datasets considered by the Gladstone Fish Health Scientific Advisory Panel**

**Details of information/documents provided to the Panel (and made available through GovDex)**

	<b>Name of document</b>	<b>Description</b>	<b>Author/Provided by</b>	<b>Date of upload</b>
Fish Health				
FH – Concept Mapping	Concept Map (Shellfish).jpg	Concept Map – shellfish	Fisheries Queensland	Nov 29
FH – Concept Mapping	Concept Map (Finfish sharks).jpg	Concept Map – finfish and sharks	Fisheries Queensland	Nov 29
FH – Concept Mapping	Concept Map (Barra).jpg	Concept Map – barramundi	Fisheries Queensland	Nov 29
FH – Fisheries sampling	FQ_GladstoneCrabSamplingMap Ver3.jpg	Graphic depiction of fish sampling results – mud crab - updated	Fisheries Queensland	Dec 14
FH – Fisheries Sampling	FQ_GladstoneMudCrabs7-12-2011.jpg	Graphic depiction of fish sampling results – mud crabs.	Fisheries Queensland	Dec 08
FH – Fisheries Sampling	Fisheries sampling - Sharks and Rays.jpg	Graphical depiction of fish sampling results – sharks and rays	Fisheries Queensland	Nov 30
FH – Fisheries Sampling	Fisheries sampling - Other Finfish.jpg	Graphical depiction of fish sampling results – other finfish	Fisheries Queensland	Nov 30
FH – Fisheries Sampling	Fisheries sampling - Barramundi.jpg	Graphical depiction of fish sampling results – barramundi	Fisheries Queensland	Nov 30
FH – Fisheries Sampling	Fisheries sampling - Banana Prawns.jpg	Graphical depiction of fish sampling results – banana prawns	Fisheries Queensland	Nov 30



FH – Fisheries Sampling	FQ_Fish-sampling-data-update-Nov11.pdf	Fish sampling update – 11 November 2011	Fisheries Queensland	Nov 24
FH – Fisheries Sampling	FQ_Map-of-Gladstone-fish-sampling-8Nov11.pdf	Fish sampling map – 8 November 2011	Fisheries Queensland	Nov 09
FH – Fisheries Sampling	FQ_Fish-sampling-data-updated8Nov11.pdf	Fish sampling update – 8 November 2011	Fisheries Queensland	Nov 09
FH – Fisheries Sampling	FQ_Map-of-Gladstone-fish-sampling-20Oct11.pdf	Fish sampling map – 17 October 2011	Fisheries Queensland	Oct 24
FH – Fisheries Sampling	FQ_Fish-sampling-data-update-17Oct11.pdf	Fish sampling update – 17 October 2011	Fisheries Queensland	Oct 24
FH – Fisheries Sampling	FQ_Gladstone fish sampling protocol.doc	Details of fish sampling protocol.	Fisheries Queensland	Oct 24
FH – Fish Pathology Testing	BQ Gladstone Fish Health Report-8Dec2011.pdf	Biosecurity Queensland report including toxicology results	Biosecurity Queensland	Dec 08
FH – Fish Pathology Testing	BQ lab report_P11-75654.pdf	Biosecurity Queensland lab report for fish testing	Biosecurity Queensland	Nov 17
FH – Fish Pathology Testing	BQ lab report_P11-75573.pdf	Biosecurity Queensland lab report for fish testing	Biosecurity Queensland	Nov 17
FH – Fish Pathology Testing	BQ lab report_P11-75569.pdf	Biosecurity Queensland lab report for fish testing	Biosecurity Queensland	Nov 17
FH – Fish Pathology Testing	BQ lab report_P11-75566.pdf	Biosecurity Queensland lab report for fish testing	Biosecurity Queensland	Nov 17
FH – Fish Pathology Testing	BQ lab report_P11-75531.pdf	Biosecurity Queensland lab report for fish testing	Biosecurity Queensland	Nov 17
FH – Fish Pathology Testing	BQ lab report_P11-75529.pdf	Biosecurity Queensland lab report for fish testing	Biosecurity Queensland	Nov 16

FH – Fish Pathology Testing	BQ lab report_P11-75528.pdf	Biosecurity Queensland lab report for fish testing	Biosecurity Queensland	Nov 16
FH – Fish Pathology Testing	BQ lab report_P11-75468.pdf	Biosecurity Queensland lab report for fish testing	Biosecurity Queensland	Nov 16
FH – Fish Pathology Testing	BQ lab report_P11-75467.pdf	Biosecurity Queensland lab report for fish testing	Biosecurity Queensland	Nov 16
FH – Fish Pathology Testing	BQ lab report_P11-75466.pdf	Biosecurity Queensland lab report for fish testing	Biosecurity Queensland	Nov 16
FH – Fish Pathology Testing	BQ lab report_P11-75412.pdf	Biosecurity Queensland lab report for fish testing	Biosecurity Queensland	Nov 16
FH – Fish Pathology Testing	BQ-Gladstone-Fish-Report-November-2011.pdf	Fish Health Sampling Reports Gladstone Harbour As at 3 November 2011	Biosecurity Queensland	Nov 08
FH – Fish Pathology Testing	BQ Lab Report P11-75286.pdf	Biosecurity Queensland lab report for fish testing	Biosecurity Queensland	Nov 07
FH – Fish Pathology Testing	BQ Lab Report P11-75194.pdf	Biosecurity Queensland lab report for fish testing	Biosecurity Queensland	Nov 07
FH – Fish Pathology Testing	BQ Lab Report P11-75124.pdf	Biosecurity Queensland lab report for fish testing	Biosecurity Queensland	Nov 07
FH – Fish Pathology Testing	BQ Lab Report P11-75123.pdf	Biosecurity Queensland lab report for fish testing	Biosecurity Queensland	Nov 07
FH – Fish Pathology Testing	BQ Lab Report P11-75085.pdf	Biosecurity Queensland lab report for fish testing	Biosecurity Queensland	Nov 07
FH – Fish Pathology Testing	BQ Lab Report P11-75082.pdf	Biosecurity Queensland lab report for fish testing	Biosecurity Queensland	Nov 07

FH – Fish Pathology Testing	BQ Lab Report P11-75082 SAS.pdf	Biosecurity Queensland lab report for fish testing	Biosecurity Queensland	Nov 07
FH – Fish Pathology Testing	BQ Lab Report P11-74922.pdf	Biosecurity Queensland lab report for fish testing	Biosecurity Queensland	Nov 07
FH – Fish Pathology Testing	BQ Lab Report P11-74903.pdf	Biosecurity Queensland lab report for fish testing	Biosecurity Queensland	Nov 07
FH – Fish Pathology Testing	BQ Lab Report P11-74868.pdf	Biosecurity Queensland lab report for fish testing	Biosecurity Queensland	Nov 07
FH – Fish Pathology Testing	BQ Lab Report P11-74796.pdf	Biosecurity Queensland lab report for fish testing	Biosecurity Queensland	Nov 07
FH – Fish Pathology Testing	BQ Lab Report P11-74663.pdf	Biosecurity Queensland lab report for fish testing	Biosecurity Queensland	Nov 07
FH – Fish Pathology Testing	BQ Lab Report P11-74622.pdf	Biosecurity Queensland lab report for fish testing.	Biosecurity Queensland	Nov 07
FH – Fish Pathology Testing	BQ_Clarification-of-Interim-Biosecurity-Report-6Oct-2011.pdf	Clarification of details within fish testing report provided by Biosecurity Queensland.	Biosecurity Queensland	Oct 24
FH – Fish Pathology Testing	BQ_gladstone-fish_health-BQ-report-2.pdf	Fish testing report provided by Biosecurity Queensland.	Biosecurity Queensland	Oct 24
FH – Fish Pathology Testing	Biosecurity Qld_Interim Vet Diagnostic_30 Sept 11.doc	Briefing to Chief Veterinary Officer Biosecurity Queensland - Gladstone Fish Health  Interim Veterinary Diagnostic Assessment (IVDA)	Biosecurity Queensland	Oct 05
FH – Fish Catch Records	FQ_catch graphs_Barramunid_Gladstone and Fitzroy.doc	Graphs representing cumulative catch of barramundi, number of fishing days where barramundi was caught and catch of barramundi (kg) caught per fishing day for the Gladstone harbour (S30) and the Fitzroy	Fisheries Queensland	Dec 2

		Area (R30; R29 & S29)		
FH – Fish Catch Records	FQ_cumulative catch graphs_fitzroy and Gladstone.doc	Graphs of cumulative catch of key fish caught in Gladstone harbour (S30) and the Fitzroy Area (R30; R29 & S29)	Fisheries Queensland	Dec 1
FH – Fish Catch Records	FQ_Awoonga Barra spillover.pdf	Details of Awoonga dam overflow	Fisheries Queensland	Oct 14
FH – Fish Catch Records	Gladstone barra catch graphs.doc	Details of catch of Barramundi in Gladstone Harbour provided by Fisheries Queensland	Fisheries Queensland	Oct 12
FH – Incident Background	FQ_Gladstone Incident response to mid-nov2011.doc	Timeline and details of response from Queensland Government in relation to the Gladstone Fish Health issue	Fisheries Queensland	Nov 11
FH – Incident Background	Gladstone SITREP #16 6oct11.doc	Daily SITREP prepared by Fisheries Queensland	Fisheries Queensland	Oct 07
FH – Incident Background	Gladstone SITREP #15 5oct11.doc	Daily SITREP prepared by Fisheries Queensland	Fisheries Queensland	Oct 06
FH – Incident Background	Gladstone SITREP #14 4oct11.doc	Daily SITREP prepared by Fisheries Queensland	Fisheries Queensland	Oct 06
FH – Incident Background	GFHSP Chronology of Events.doc	Chronology of events surrounding the discovery and investigation of sick fish in Gladstone Harbour.	Fisheries Queensland	Oct 04
FH – Incident Background	Gladstone SITREP #13 3oct11.doc	Daily SITREP	Fisheries Queensland	Oct 04
FH – Incident Background	Gladstone SITREP #12 30sep11.doc	Daily SITREP	Fisheries Queensland	Oct 04
FH – Incident Background	Gladstone SITREP #11 29sep11.doc	Daily SITREP	Fisheries Queensland	Oct 04
FH – Incident	Gladstone SITREP #10 28sep11.doc	Daily SITREP	Fisheries Queensland	Oct 04

Background				
FH – Incident Background	Gladstone SITREP #9 27sep11.doc	Daily SITREP	Fisheries Queensland	Oct 04
FH – Incident Background	Gladstone SITREP #8 26sep11.doc	Daily SITREP	Fisheries Queensland	Oct 04
FH – Incident Background	Gladstone SITREP #7 23sep11.doc	Daily SITREP	Fisheries Queensland	Oct 04
FH – Incident Background	Gladstone SITREP #6 22sep11.doc	Daily SITREP	Fisheries Queensland	Oct 04
FH – Incident Background	Gladstone SITREP #5 21sep11.doc	Daily SITREP	Fisheries Queensland	Oct 04
FH – Incident Background	Gladstone SITREP #4 20sep11.doc	Daily SITREP	Fisheries Queensland	Oct 04
FH – Incident Background	Gladstone SITREP #3 19sep11.doc	Daily SITREP	Fisheries Queensland	Oct 04
FH – Incident Background	Gladstone SITREP #2 16sep11.doc	Daily SITREP	Fisheries Queensland	Oct 04
FH – Incident Background	Gladstone SITREP #1 15sep11.doc	Daily SITREP	Fisheries Queensland	Oct 04
FH – Scientific References	Collation of research projects.doc	List of research projects	Fisheries Queensland	Dec 07
FH – Scientific References	Net damage injuries.pdf	Journal article – additional literature provided by Panel member  Net damage injuries to New Zealand hoki, <i>Macrurus novaezelandia</i> (Brian Jones)	Brian Jones	Nov 28

		(New Zealand Journal of Marine and Freshwater Research, 1993: Vol. 27: 23-30)		
FH – Scientific References	SAP journal article_dogger bank itch.pdf	Journal article – additional literature provided by Panel member	Brian Jones	Oct 13
FH – Scientific References	SAP journal article_EUS menhaden.pdf	Journal article – additional literature provided by Panel member	Brian Jones	Oct 13
FH – Scientific References	EUS review.pdf	Journal article – additional literature provided by Panel member	Brian Jones	Oct 07
Human Health				
HH	Queensland Health_HHRA Final 7 Oct.doc	Human health risks associated with diseased fish in the Gladstone region Assessment Report and Recommendations 7 October 2011	Queensland Health	Oct 13
Water Quality				
WQ – Water Quality Sampling	DERM_Comparison of Auckland Ck hatchery data.doc	Analysis of water quality tests from Gladstone Area Water Board	DERM	Dec 08
WQ – Water Quality Sampling	FQ_explanatory notes_hatchery sampling results.doc	Water quality test results at the Gladstone Area Water Hatchery intake	Gladstone Area Waterboard	Dec 1
WQ – Water Quality Sampling	FQ_Hatchery_Additional_Monitoring_Sep_Oct_Nov_2011 (1).xls	Water quality test results at the Gladstone Area Water Hatchery intake	Gladstone Area Waterboard	Dec 1
WQ – Water Quality Sampling	FQ_WQ_Hatchery_results_(2).xls	Water quality test results at the Gladstone Area Water Hatchery intake	Gladstone Area Waterboard	Dec 1
WQ – Water Quality Sampling	DERM_phys-chem-port-curtis-october 2011.pdf	DERM water testing results October 2011 – phys/chem	DERM	Nov 24
WQ – Water Quality	DERM_nutrients-port-curtis-october	DERM water testing results October 2011 –	DERM	Nov 24

Sampling	2011.pdf	nutrients		
WQ – Water Quality Sampling	DERM_metals-port-curtis-october 2011.pdf	DERM water testing results October 2011 - metals	DERM	Nov 24
WQ – Water Quality Sampling	PCIMP Report 2008-2010.pdf	Port Curtis Integrated Monitoring Program Port Curtis cosystem health report 2008-2010	Port Curtis Integrated Monitoring Program (provided by Leigh Gray)	Nov 22
WQ – Water Quality Sampling	Port Curtis Ecosystem Health Report Card 2011_Summary.pdf	Port Curtis Integrated Monitoring Program Port Curtis cosystem health report 2008-2010 Summary	Port Curtis Integrated Monitoring Program (provided by Leigh Gray)	Nov 22
WQ – Water Quality Sampling	Home	Website link to: Western Basin Dredging Sediment Quality report and EIS (report too large to upload to Govdex)	Gladstone Ports Corporation (provided by Leigh Gray)	Nov 18
WQ – Water Quality Sampling	DERM_supplementary water data_port-curtis.pdf	Water Quality of Port Curtis and Tributaries Supplementary Report Based on Data Collected in the week of 26th September 2011 November 2011	DERM	Nov 08
WQ – Water Quality Sampling	7-cm_port_curtis_modelling.pdf	Hydrodynamic Modelling of the Port Curtis Region CSIRO	CSIRO (provided by DERM)	Oct 24
WQ – Water Quality Sampling	Port Curtis monitoring summary.xls	Details of monitoring program summary for Port Curtis.	DERM	Oct 13
WQ – Water Quality Sampling	GPC_WBPD_Stage1_Water_Quality_Management_Plan.pdf	Water quality reports from Gladstone Ports Corporation website.	Gladstone Ports Corporation	Oct 05
WQ – Water Quality Sampling	GPC_Report_Towards_a_light-based_monitoring_program_Environmetrics	Water quality reports from Gladstone Ports Corporation website.	Gladstone Ports Corporation	Oct 05

	.pdf			
WQ – Water Quality Sampling	GPC_Briefing_Western_Basin_Dredging_and_Disposal_Project_Environmental_Impacts.pdf	Water quality reports from Gladstone Ports Corporation website.	Gladstone Ports Corporation	Oct 05
WQ – Water Quality Sampling	DERM-port-curtis-water-quality.pdf	Port Curtis and Tributaries Comparison of Current and Historical Water Quality October 2011	DERM	Oct 05
WQ – Scientific References	Chesapeake Bay Front Page.mht	Journal article – additional literature provided by Panel member	Brian Jones	Oct 13
WQ – Scientific References	SAP journal article_aerosolized toxins.pdf	Journal article – additional literature provided by Panel member	Brian Jones	Oct 13
WQ – Scientific References	SAP journal article_brevetoxins.pdf	Journal article – additional literature provided by Panel member	Brian Jones	Oct 13
<b>Ecosystem Health</b>				
EH – Seagrass Monitoring	FQ_Seagrass report_October 2011.pdf	Gladstone Permanent Transect Seagrass Monitoring - October 2011 Interim Update Report	Fisheries Queensland	Nov 10
EH – Seagrass Monitoring	FQ_Seagrass report_September 2011.pdf	Gladstone Permanent Transect Seagrass Monitoring - Additional September 2011 assessment Update Report	Fisheries Queensland	Nov 10
EH – Seagrass Monitoring	FQ_Seagrass report_July 2011.pdf	Gladstone Permanent Transect Seagrass Monitoring - July 2011 Update	Fisheries Queensland	Nov 10
EH – Seagrass Monitoring	FQ_Seagrass report_March 2011.pdf	Gladstone Permanent Transects Seagrass Monitoring Sites - February and March 2011 Update	Fisheries Queensland	Nov 10
<b>Industry Representation</b>				
Industry Representation	QSIA_1_letter from Law Essentials.doc QSIA_2_Gladstone Harbour Chronology of	Documents received from Law Essentials with information specific to the fish and	QSIA	Dec 23



	<p>events.doc</p> <p>QSIA_3_details.doc</p> <p>QSIA_4_McMullen.pdf</p> <p>QSIA_5_Appo.pdf</p> <p>QSIA_6_Pershhouse.pdf</p> <p>QSIA_7_auction statement.pdf</p> <p>QSIA_8_Dale.pdf</p> <p>QSIA_9_Zink.tif</p> <p>QSIA_10_Samuels.tif</p>	<p>crustacean health issues in Gladstone.</p> <p>The first attachment is the letter from Michael Garrahy summarising these documents.</p> <p>The other documents are a chronology of dredging and development in the Harbour and Statuary Declarations from fishers particularly relative to the crab disease.</p>		
Industry Representation	QSIA REPORT TO THE SCIENTIFIC PANEL.pdf	QSIA comments and report to the GFHSAP	QSIA	Dec 19
Industry Representation	QSIA_fisher statement.pdf	Comments provided by commercial fisher in relation to the Gladstone fish health issue	QSIA	Dec 19
Industry Representation	QSIA_Gladstone Fishboard Baseline Steven Nearhos Ref 86508 Dec 8 2011 draft.pdf	Independent Testing undertaken by Baseline - Inspection of fish and possible attribution of RSD initiation at Gladstone.	QSIA	Dec 14
Industry Representation	<p>QSIA_sunni ,fish 029.JPG</p> <p>QSIA_sunni ,fish 028.JPG</p> <p>QSIA_sunni ,fish 027.JPG</p> <p>QSIA_sunni ,fish 026.JPG</p> <p>QSIA_sunni ,fish 025.JPG</p> <p>QSIA_sunni ,fish 024.JPG</p> <p>QSIA_sunni ,fish 021.JPG</p> <p>QSIA_sunni ,fish 020.JPG</p> <p>QSIA_sunni ,fish 018.JPG</p>	Photos from catch from Turkey beach week beginning 5 December 2011 showing the sorts of lesions and rashes seen on other species. Fish caught by Chris Putman.	QSIA	Dec 14

	<p>QSIA_sunni ,fish 017.JPG</p> <p>QSIA_sunni ,fish 015.JPG</p> <p>QSIA_sunni ,fish 014.JPG</p>			
Industry Representation	QSIA_Law Essentials letter including video links.doc	Letter from Law Essential to QSIA	QSIA	Dec 5
Industry Representation	QSIA_email comments 20 november 2011.doc	QSIA comments	QSIA	Nov 24
Industry Representation	Timeline barra with pics 2.pdf	Timeline barra – statement provided by Johnny Mitchell in relation to Awoonga dam overflow and Barramundi catch	Johnny Mitchell (provided by Fisheries Queensland)	Nov 22
Industry Representation	BHart_response to DERM water quality report.pdf	Response provided by Barry Hart in relation to DERM water quality report.	Barry Hart (provided by Fisheries Queensland)	Nov 08
Industry Representation	QSIA Response to the Explanatory note to the Interim Biosecurity Report of the 6th October 2011.doc	QSIA comment on Biosecurity Queensland report.	QSIA	Oct 31
Industry Representation	QSIA_meeting with Gladstone fishing community_19102001.doc	Details of meeting held by QSIA with the Gladstone fishing community.	QSIA	Oct 28
Panel Documents				
Panel documents	GFHSAP details of document provided - sorted.doc	List of documents provided to the panel up to 7 December 2011	Fisheries Queensland	Dec 08
Panel documents	Gladstone Harbour SAP ToR 29Sep11.doc	Terms of Reference for the GFHSAP	Fisheries Queensland	Oct 03
Panel documents	Gladstone Fish Health Scientific Advisory Panel	Govdex site established	created by Govdex Robot	Sep 30

## **Appendix 2 - Terms of Reference and a list of Panel members and invited participants and their areas of expertise**

### **GLADSTONE HARBOUR AND SURROUNDING WATERS**

#### **Scientific Advisory Panel – Terms of Reference**

##### **Context/Background**

Following reports of diseased finfish, notably barramundi, from commercial catches in the Gladstone region, the Queensland Seafood Industry Association (QSIA) advised the Government that a number of commercial fishers or people associated with commercial fishers had reported health issues.

Pending the outcome of laboratory testing of samples of diseased fish and in view of community concerns regarding food safety and human health, the Fisheries Gladstone (Gladstone Harbour and Surrounding Waters) Emergency Disease and Quarantine Declaration 2011 was put in place on Friday 16 September 2011. This prohibits all fishing, the use of all forms of fishing apparatus and the landing of any live fish (excluding crab) within the prescribed area that were caught outside the prescribed area. The interim closure is intended to be for no more than 21 days.

Biosecurity Queensland has to date provided interim test results for samples of barramundi, and advised that eye lesions are due to a parasite (*Neobenedenia* sp, a fluke) and skin lesions in one fish are due to red spot disease. Work on pathology and toxicology is continuing in relation to identification of causes of lesions in a variety of seafood species taken from the area. Queensland Health is continuing to follow up on any individuals reporting health issues. The Department of Environment and Resource Management is collating and reporting on available water quality monitoring and sediment metals information for the area.

##### **Objectives and Roles**

The Queensland Government is convening an expert Scientific Advisory Panel to provide independent advice to the Minister for Main Roads, Fisheries and Marine Infrastructure via the Department of Employment, Economic Development and Innovation.

The role of the Scientific Advisory Panel is to review the Queensland Government's monitoring regimes, results and analysis primarily focusing on fish health in Gladstone Harbour and surrounds but also including consideration of water quality monitoring and human health issues where relevant and appropriate. This may include:

- The water quality monitoring regime currently in place in Gladstone Harbour;
- The investigation of recent fish and other diseased marine species in Gladstone Harbour;
- Whether there is evidence of a link between the water quality and health of seafood species in Gladstone Harbour and surrounding areas; and
- Whether there is any risk to human health in relation to water quality or seafood taken in these waters and recommendations for improvements in safe work practices in the fishing industry.

Specifically, the Scientific Advisory Panel is requested to:

1. Review
  - the available test results, and assess previous water quality data and the current water quality and sediment monitoring regime;
  - the pathology and toxicology testing of seafood; and

- the investigation of potential impacts, if any, on human health.
- 2. Advise Government as to whether there is a need for additional testing or investigations.
- 3. Advise Government whether there are any identifiable reasons, based on the information supplied to the Panel and the expertise of its members, for the health issues affecting seafood species (finfish and crustaceans) in the Gladstone area and the evidence for links to human health issues.

It is expected that the Panel will provide a preliminary assessment of existing information and reports within two weeks (by 13 October 2011), and will advise within six weeks as to what additional monitoring and analysis may be required. A final report from the Panel will be completed by mid December.

### Membership

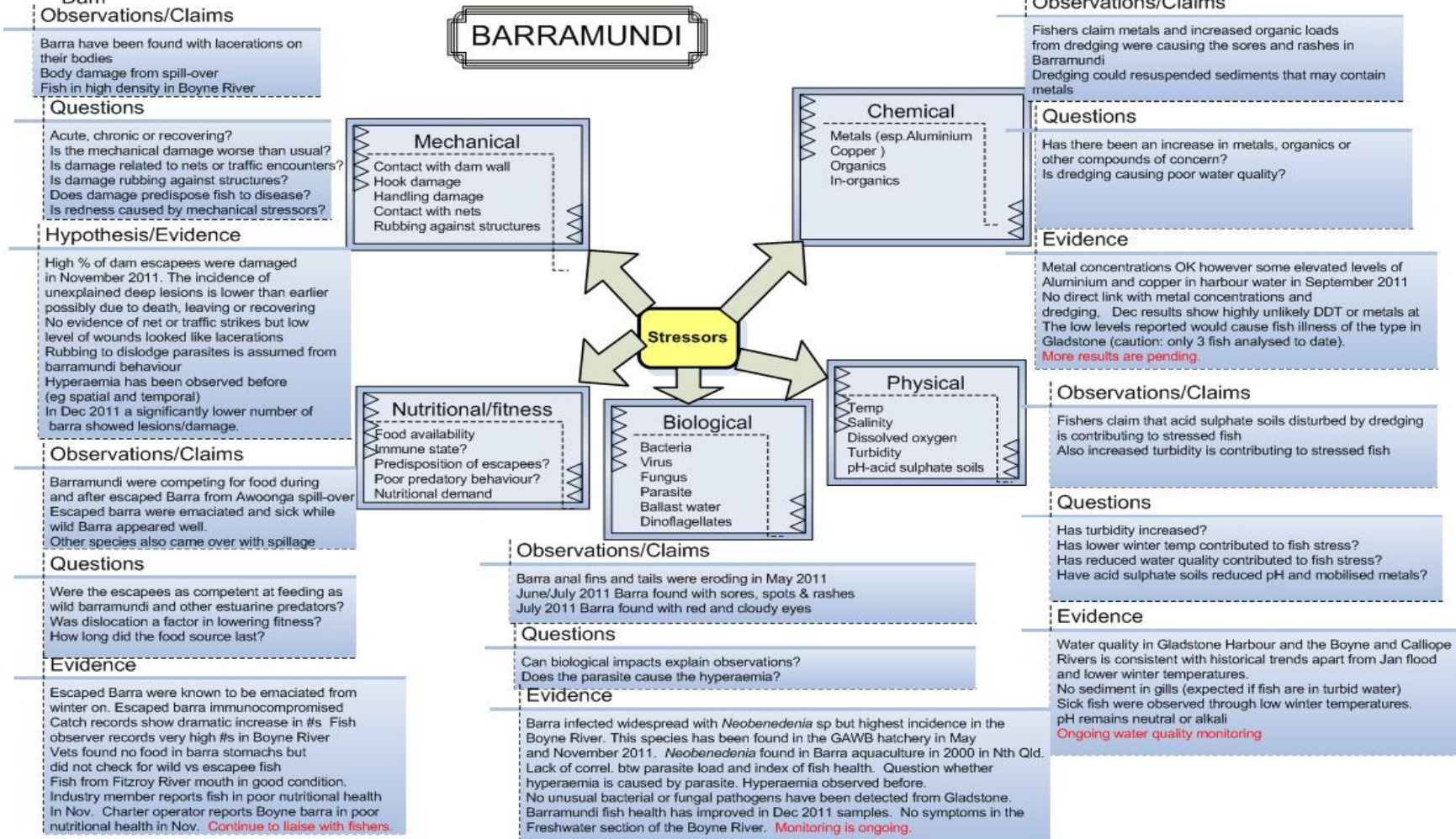
The membership of the Panel comprises eminent scientists, from the government and academic sectors, with recognised expertise and research publications concerning: aquatic environmental science including water quality; fish health and toxicology; and human health especially in relation to potential for transmission of diseases from marine species to humans.

<b>Panel Members</b>	
Dr Ian Poiner (Chair)	Chief Executive Officer, Australian Institute of Marine Science (Tropical marine ecology and fisheries)
Professor Beate Escher	University of Queensland, and Deputy Director, Entox (Environmental toxicology)
Prof Rick Speare	Anton Breinl Centre, James Cook University (Human health; tropical and zoonotic diseases)
Professor David Parry	Science Leader, Australian Institute of Marine Science, Northern Territory (Estuarine habitat and health, ecotoxicology)
Dr Brian Jones	Adjunct Professor, Murdoch University and Principal Fish Pathologist, Department of Fisheries Western Australia
Prof Rod Connolly	Griffith University, Australian Rivers Institute (Water quality and ecosystem health)
Dr John Robertson	General Manager, Fisheries Habitat and Assessment, Fisheries Queensland
Julia Playford - (Invitee)	Director, Water Quality and Aquatic Ecosystem Health, DERM
Paul Florian - (Invitee)	Director, Environmental Health, Queensland Health, Rockhampton
Michael Gardner - (Invitee)	President, Queensland Seafood Industry Association
Leigh Gray – (Invitee)	Manager, Water Quality Operations, Great Barrier Reef Marine Park Authority

Secretariat will be provided by Fisheries Queensland, a service of the Department of Employment, Economic Development and Innovation.

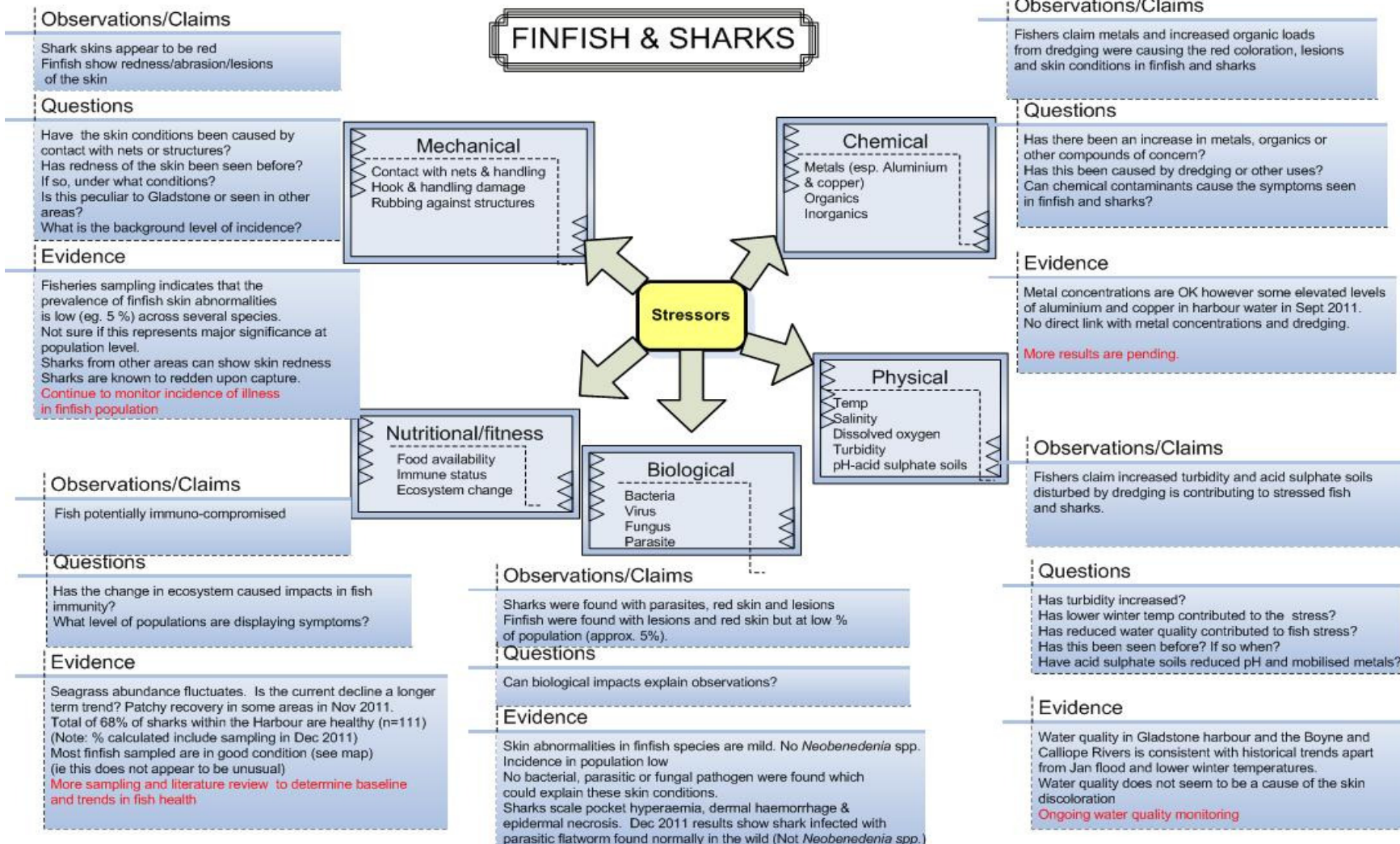
**Appendix 3 – Concept maps developed by the Queensland Government summarising the available information on the Gladstone fish health issue.**

**Situation:** In July 2011 commercial fishers operating in the Gladstone area were catching Barramundi with sores, redness (hyperaemia), rashes and red and cloudy eyes. A very large number of barramundi (est. 30,000) entered Boyne River & Gladstone waterways from Awoonga Dam





**Situation:** Commercial fishers operating in the Gladstone area reported finding finfish & sharks with lesions and red coloration of the skin. Mild skin abnormalities were examined in finfish and sharks.



**Situation:** Commercial fishers operating in the Gladstone area have reported finding mudcrabs with shell erosion and prawns with shell erosion.

