Jennifer Marohasy
Science Statement
Mon Nov 12 23:53:43 2001

Text from Science Statement

Following is the text of the science statement as tabled at the Reef Protection Taskforce meeting yesterday, Monday 12th November 2001.

"The current level of scientific understanding on impacts of terrestrial run-off on the Great Barrier Reef World Heritage Area

Statement prepared for the Reef Protection Taskforce by
Christian H. Roth (CSIRO Land and Water), David McB. Williams (Reef CRC / AIMS), Peter Ridd (James Cook University) and George E. Rayment (Sugar CRC / NR&M)

Provision of a credible and a comprehensive science base that reflects the general state of knowledge accepted by the scientific community and that is accepted by all members of the Reef Protection Taskforce is a critical prerequisite for the successful achievement of the Taskforce's objectives. This statement intends to provide a consolidated view of our current understanding of the impacts of terrestrial run-off on the Great Barrier Reef World Heritage Area (GBRWHA). In doing so, the statement seeks to allay concerns that there are conflicting views in the scientific community not being adequately reflected in the mainstream scientific debate on issues related to the link between land use impacts and the health of the GBRWHA.

The current level of generally accepted scientific understanding with respect to the above issues has been documented in detail in the recent review undertaken by David Williams on behalf of the Reef CRC. It represents the outcome of a review of existing published scientific literature, complemented by a robust and broad consultation of experts in the fields of marine and terrestrial sciences and whose expertise is relevant to the GBRWHA. The review document, which has been endorsed by GBRMPA and which is publicly accessible at www.reef.crc.org.au/aboutreef/coastal/waterqualityreview.shtml, has been made available to the members of the Reef Protection Taskforce. Its executive summary is also attached to this document for reference.

The executive summary clearly outlines what we currently know and what we don't know. A key message is that a significant proportion of the GBRWHA (including the outer reef) is not likely to be threatened by terrestrial runoff. Areas at risk are near-shore reefs and seagrass beds south of Port Douglas and within 20km of the coast. The areas of most concern are those between Port Douglas and Hinchinbrook as well as Bowen to Mackay. The other key conclusion is that we are still confronted with a high level of uncertainty concerning our understanding of processes and how these might relate to

health of the GBRWHA. This is not surprising given the complexity of the often non-linear relationships of the ecological processes involved. Since compilation of the review, more scientific publications have become available or are in the process of being published, indicating that our state of knowledge is in constant flux and as new and sometimes contrasting views are introduced, healthy scientific debate is stimulated. This is normal and rigorous scientific debate is an essential part of the process of transforming scientific information into knowledge or understanding.

For instance, very recent work published or being in the process of being published by P. Larcombe, P. Ridd and others (JCU) and not yet included in the review provides additional support to the view that increased sediment loads from runoff probably play a negligible role in turbidity or 'smothering' related impacts on near-shore ecosystems of the GBRWHA. Conversely, there is also new scientific evidence (K. Fabricius et al., AIMS) that the complex interactions between terrestrial sediment and the nutrients and organic matter associated with that sediment are leading to changes in the quality of the sediment, in turn possibly affecting deposition dynamics, so that in localised conditions, additional sediments originating from runoff may impact some near-shore ecosystems after all. This example illustrates the difficulty the scientific community faces in delivering consistent messages to concerned stakeholders and agencies. The consolidation of new information into knowledge takes time, and there is significant risk in drawing premature conclusions.
In summary, the assessment of the potentially adverse impacts of terrestrial runoff and delivery of pollutants (sediments and associated nutrients, pesticides, heavy metals) to the GBRWHA from land-based activities is not straightforward and will continue to be so for a while. The main reasons for this are:

· We have little or no baseline data to indicate what the GBRWHA looked like before European settlement. Much of our understanding has only emerged over the past decade or two, so that in many instances we have to infer from other reef systems with longer records and from the interpretation of "records" embodied within coral cores.

· Against the backdrop of strong disturbance from natural processes (cyclones, inherent climatic variability, wave re-suspension of sediments etc.) it is very difficult to distinguish or even quantify the relative contribution of anthropogenic disturbances. It is likely that adverse impacts will express themselves in reduced capability to recover from natural disturbances rather than becoming visible in the form of direct impacts.

· We are dealing with complex ecological processes, where inherent ecosystem buffering capacity makes it difficult to identify clear trends in change from relatively short-term studies. However, in many ecosystems, apparent resistance to change due to high buffering capacities can be followed by an abrupt ecosystem collapse once critical disturbance thresholds have been overstepped. Predicting these thresholds is extremely difficult, yet absolutely critical, as an overstepping can often lead to irreversible changes or to very slow rates of recovery when the "pressure" abates.

All three reasons are important enough to adhere to the precautionary principle in managing the land-based sources of impacts on the GBRWHA until we achieve more certainty in our understanding of impacts. However, the last of the three points raised above is the most compelling one to do this; whilst there is currently little evidence for widespread deterioration of near-shore systems, we might be closer to some of the thresholds than our current records allow us to determine. The very real risk is that by not undertaking any significant action now to reduce delivery of elevated levels of nutrients and pollutants to the GBRWHA, we may overstep some thresholds leading to irreversible loss of near-shore reef systems and sea grass beds. Moreover, whilst it is not within the scope of the Reef Protection Taskforce, it is worth noting that post-European

land use has very significantly altered and in many cases caused significant damage to rivers or loss of wetlands in the majority of the catchment area of the GBRWHA. The direct and indirect impacts of the changes to or loss of freshwater biodiversity and food chain links to the GBRWHA have yet to be fully assessed.

In conclusion, we state that:

i. on the basis of the evidence available that post-European land use has significantly increased runoff and sediment associated nutrient and contaminant delivery to near-shore regions of the GBRHWA,
ii. in view of the detrimental impact this has had on freshwater aquatic systems,
iii. and given the significant risk that this impact may in future adversely affect areas of high exposure along the wet tropical and central Queensland coasts of the GBRWHA,

there is a continued urgency for the Reef Protection Taskforce to proceed as planned and work towards a plan that will lead to a reduction of these impacts and risks".

END:

Statement from Roth et al.

The current level of scientific understanding on impacts of terrestrial run-off on the Great Barrier Reef World Heritage Area

8th. Nov. 13th. 2001.

Statement prepared for the Reef Protection Taskforce by

Christian H. Roth (CSIRO Land and Water), David McB. Williams (Reef CRC / AIMS), Peter Ridd (James Cook University) and George E. Rayment (Sugar CRC / NR&M)

Provision of a credible and a comprehensive science base that reflects the general state of knowledge accepted by the scientific community and that is accepted by all members of the Reef Protection Taskforce is a critical prerequisite for the successful achievement of the Taskforce's objectives. This statement intends to provide a consolidated view of our current understanding of the impacts of terrestrial run-off on the Great Barrier Reef World Heritage Area (GBRWHA). In doing so, the statement seeks to allay concerns that there are conflicting views in the scientific community not being adequately reflected in the mainstream scientific debate on issues related to the link between land use impacts and the health of the GBRWHA.

The current level of generally accepted scientific understanding with respect to the above issues has been documented in detail in the recent review undertaken by David Williams on behalf of the Reef CRC. It represents the outcome of a review of existing published scientific literature, complemented by a robust and broad consultation of experts in the fields of marine and terrestrial sciences and whose expertise is relevant to the GBRWHA. The review document, which has been endorsed by GBRMPA and which is publicly accessible at www.reef.crc.org.au/aboutreef/coastal/waterqualityreview.shtml, has been made available to the members of the Reef Protection Taskforce. Its executive summary is also attached to this document for reference.

The executive summary clearly outlines what we currently know and what we don't know. A key message is that a significant proportion of the GBRWHA (including the outer reef) is not likely to be threatened by terrestrial runoff. Areas at risk are near-shore reefs and seagrass beds south of Port Douglas and within 20km of the coast. The areas of most concern are those between Port Douglas and Hinchinbrook as well as Bowen to Mackay. The other key conclusion is that we are still confronted with a high level of uncertainty concerning our understanding of processes and how these might relate to health of the GBRWHA. This is not surprising given the complexity of the often non-linear relationships of the ecological processes involved. Since compilation of the review, more scientific publications have become available or are in the process of being published, indicating that our state of knowledge is in constant flux and as new and sometimes contrasting views are introduced, healthy scientific debate is stimulated. This is normal and rigorous scientific debate is an essential part of the process of transforming scientific ***information*** into knowledge or ***understanding***.

For instance, very recent work published or being in the process of being published by P. Larcombe, P. Ridd and others (JCU) and not yet included in the review provides additional support to the view that increased sediment loads from runoff probably play a negligible role in turbidity or 'smothering' related impacts on near-shore ecosystems of the GBRWHA. Conversely, there is also new scientific evidence (K. Fabricius et al., AIMS) that the complex interactions between terrestrial sediment and the nutrients and organic matter associated with that sediment are leading to changes in the quality of the sediment, in turn possibly affecting deposition dynamics, so that in localised conditions, additional sediments originating from runoff may impact some near-shore ecosystems after all. This example illustrates the difficulty the scientific community faces in delivering consistent messages to concerned stakeholders and agencies. The consolidation of new information into knowledge takes time, and there is significant risk in drawing premature conclusions.

In summary, the assessment of the potentially adverse impacts of terrestrial runoff and delivery of pollutants (sediments and associated nutrients, pesticides, heavy metals) to the GBRWHA from land-based activities is not straightforward and will continue to be so for a while. The main reasons for this are:

- We have little or no baseline data to indicate what the GBRWHA looked like before European settlement. Much of our understanding has only emerged over the past decade or two, so that in many instances we have to infer from other reef systems with longer records and from the interpretation of "records" embodied within coral cores.

- Against the backdrop of strong disturbance from natural processes (cyclones, inherent climatic variability, wave re-suspension of sediments etc.) it is very difficult to distinguish or even quantify the relative contribution of anthropogenic disturbances. It is likely that adverse impacts will express themselves in reduced capability to recover from natural disturbances rather than becoming visible in the form of direct impacts.

- We are dealing with complex ecological processes, where inherent ecosystem buffering capacity makes it difficult to identify clear trends in change from relatively short-term studies. However, in many ecosystems, apparent resistance to change due to high buffering capacities can be followed by an abrupt ecosystem collapse once critical disturbance thresholds have been overstepped. Predicting these thresholds is extremely difficult, yet absolutely critical, as an overstepping can often lead to irreversible changes or to very slow rates of recovery when the "pressure" abates.

All three reasons are important enough to adhere to the precautionary principle in managing the land-based sources of impacts on the GBRWHA until we achieve more certainty in our understanding of impacts. However, the last of the three points raised above is the most compelling one to do this; whilst there is currently little evidence for widespread deterioration of near-shore systems (localised impacts have been documented), we might be closer to some of the thresholds than our current records allow us to determine. The very real risk is that by not undertaking any significant action now to reduce delivery of elevated levels of nutrients and pollutants to the GBRWHA, we may overstep some thresholds leading to irreversible loss of near-shore reef systems and sea grass beds. Moreover, whilst it is not within the scope of the Reef Protection Taskforce, it is worth noting that post-European land use has very significantly altered and in many cases caused significant damage to rivers or loss of wetlands in the majority of the catchment area of the GBRWHA. The direct and indirect impacts of the changes to or loss of freshwater biodiversity and food chain links to the GBRWHA have yet to be fully assessed.

In conclusion, we state that:

i. on the basis of the evidence available that post-European land use has significantly increased runoff and sediment associated nutrient and contaminant delivery to near-shore regions of the GBRHWA,
ii. in view of the detrimental impact this has had on freshwater aquatic systems,
iii. and given the significant risk that this impact may in future adversely affect areas of high exposure along the wet tropical and central Queensland coasts of the GBRWHA beyond those incidences of deterioration already documented,

there is a continued urgency for the Reef Protection Taskforce to proceed as planned and work towards a plan that will lead to a reduction of these impacts and risks.

Jennifer_Marohasy

From: Jennifer_Marohasy
Sent: Friday, November 16, 2001 5:55 PM
To: 'Dave Williams'; Christian. Roth (E-mail) (E-
Subject: RE: revised GBRWHA science statement - reply

Dear Dave and Christian,

Thank you for this information.

The only work I have read in detail is that of Duke et al 2001. I would appreciate Dave forwarding to me copies of the other references quoted.

I hope the conference goes well. I am stuck in Brisbane with our Board meeting and associated committee meetings.

Regards, Jennifer.

-----Original Message-----
From: Dave Williams [mailto:d.williams@aims.gov.au]
Sent: Friday, November 16, 2001 5:23 PM
To: Jennifer Marohasy (E-mail)
Cc: Christian Roth (E-mail)
Subject: FW: revised GBRWHA science statement
Importance: High

Dear Jennifer

I agree with Christian plus a couple of additions. Numbers in brackets refer to the para in my review (www.reef.org.au/pdf/WQdocAugust01.pdf if you haven't got the latest):

- Reef Flat photos, Wachenfeld 1995 (C2.4)
- Whitsunday reef growth, Van Woesik et al 1999 (C2.11)
- Green Island seagrass, Udy et al. 1999 (B2.27)
- Mackay mangrove die-back, Duke et al 2001. preliminary investigation into dieback of mangroves in the Mackay region. report to Queensland Fisheries Service, Northern Region (DPI) and the community of Mackay Region. 15 May 2001. 81pages.

if you haven't got a copy of any of these and would like one, or I can be of further assistance, please don't hesitate to call.

Best wishes

Dave

David Williams
Deputy CEO, CRC Reef
Principal Research Scientist, AIMS

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-----Original Message-----

From: Christian.Roth@csiro.au [mailto:Christian.Roth@csiro.au]
Sent: Tuesday, 13 November 2001 6:24 PM
To: Dave Williams
Subject: FW: revised GBRWHA science statement
Importance: High

Dave,

do you care to respond? As far as I can see the work of Wachenfeld, 1995, Van Woesik & Done 1997 and Van Woesik et al 1999 qualifies, as well as Haynes et al 2000a. Can you complement and confirm?

Christian

-----Original Message-----
From: Jennifer_Marohasy [mailto:Jennifer_Marohasy@canegrowers.com.au]
Sent: Tuesday, 13 November 2001 3:27 PM
To: 'Christian.Roth@csiro.au'
Cc: George Rayment (E-mail)
Subject: RE: revised GBRWHA science statement

Dear Christian

Which published papers provide evidence of localised deterioration?

Regards, Jennifer.

-----Original Message-----
From: Christian.Roth@csiro.au [mailto:Christian.Roth@csiro.au]
Sent: Tuesday, November 13, 2001 3:26 PM
To: Terry.Wall@premiers.qld.gov.au; rosh.ireland@env.qld.gov.au
Cc: ampto@uq.net.au; brian.head@env.qld.gov.au; baldwinc@dnr.qld.gov.au; edward.smallwood@atsic.gov.au; g.manson@GBRMPA.gov.au; izethoven@wwfqld.org; jade.daylight-baker@atsic.gov.au; Jennifer_Marohasy@canegrowers.com.au; john@logicworld.com.au; liz.young@premiers.qld.gov.au; mpanitz@qfvg.org.au; nqcc@beyond.net.au; paul.bidwell@agforceqld.org.au; peta_jamieson@lgaq.asn.au; nevillep@dpi.qld.gov.au; qsia@qsia.com.au; scott.spencer@dnr.qld.gov.au; s.morris@GBRMPA.gov.au; smcfarlane@commerceqld.com.au; Terry.Wall@premiers.qld.gov.au; toni.malamoo@atsic.gov.au; d.williams@aims.gov.au; peter.ridd@jcu.edu.au; george.rayment@dnr.qld.gov.au
Subject: revised GBRWHA science statement
Importance: High

Dear Terry,

Following our discussion of the paper yesterday and on the basis of comments received during that discussion, the authors and myself have had a discussion today about possible revisions to the text. We have agreed that we need to revise the text with a view to avoid any possible ambiguities. We wish to clearly point out that whilst there is no evidence of *widespread* deterioration, there is documented evidence of localised deterioration on individual near shore reefs. Consequently, we have made a few minor changes to the document to clearly reflect this. Please find the amended document attached.

Christian Roth

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Dec 2001

The current level of scientific understanding on impacts of terrestrial run-off on the Great Barrier Reef World Heritage Area

David McB. Williams (CRC Reef / AIMS), Christian H. Roth (CSIRO Land and Water), Russell Reichelt (CRC Reef), Peter Ridd (James Cook University), George E. Rayment (Sugar CRC / Qld NR&M), Piers Larcombe (JCU), Jon Brodie (JCU), Richard Pearson (Australian Centre for Tropical Freshwater Research / JCU), Clive Wilkinson (Global Coral Reef Monitoring Network), Frank Talbot, Miles Furnas (AIMS/ CRC Reef), Katharina Fabricius (CRC Reef/ AIMS), Laurence McCook (CRC Reef/ AIMS)

Run-off of sediment and nutrients to the Great Barrier Reef has increased several-fold as a result of past and current land-use practices. There is significant concern that coastal ecosystems in the Great Barrier Reef World Heritage Area (GBRWHA) are being adversely affected as a consequence of this increase.

While improvements have been made in sustainable land use, other adverse practices continue, including: expansion of farming into marginal areas; increases in fertiliser application; overgrazing; and loss of riparian vegetation and wetlands. If more effective action is not taken to reduce run-off of sediment, nutrients and other pollutants, the present threat to the World Heritage Area and adjacent freshwater systems will worsen.

Provision of a credible and a comprehensive science base that reflects the general state of knowledge accepted by the scientific community is critical to the public debate. This statement intends to provide a consolidated view of our current understanding of the impacts of terrestrial run-off on the Great Barrier Reef World Heritage Area (GBRWHA).

Current scientific understanding about terrestrial run-off in the GBRWHA has been documented in detail in a recent review undertaken by David Williams on behalf of the CRC Reef. It represents the outcome of a review of existing published scientific literature, complemented by a robust and broad consultation of experts in the fields of marine and terrestrial sciences and whose expertise is relevant to the GBRWHA. The review document is publicly accessible at www.reef.crc.org.au/aboutreef/coastal/waterqualityreview.shtml. Major conclusions of the review are summarised in the CRC Reef brochure "Land use and the Great Barrier Reef World Heritage Area" (enclosed).

These documents clearly outline our present state of knowledge. A key conclusion concerns the area under threat. Areas at risk are near-shore reefs and seagrass beds south of Port Douglas and within 20km of the coast. The areas of most concern are those between Port Douglas and Hinchinbrook as well as Bowen to Mackay. A major proportion of the GBRWHA (including the outer reef) is not likely to be threatened by terrestrial runoff.

The other key conclusion is that while enhanced runoff has severely damaged coral reefs elsewhere, there is a lot of uncertainty about the processes by which runoff may damage the GBRWHA. This is not surprising given the complexity and interactions between the physical and ecological processes involved. Since compilation of the review, more scientific publications have become available or are in the process of being published, indicating that our state of knowledge is in constant flux and as new and sometimes contrasting views are introduced, healthy scientific debate is stimulated. This is normal and rigorous scientific debate is an essential part of the process of transforming scientific ***information*** into knowledge or ***understanding***.

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In summary, the assessment of the potentially adverse impacts of terrestrial runoff and delivery of pollutants (sediments and associated nutrients, pesticides, heavy metals) to the GBRWHA from land-based activities is not straightforward and will continue to be so for a while. The main reasons for this are:

- We have little or no baseline data to indicate what the GBRWHA looked like before European settlement. Much of our understanding has only emerged over the past decade or two, so that in many instances we have to infer from other reef systems with longer records and from the interpretation of "records" embodied within coral cores.

- Against the backdrop of strong disturbance from natural processes (e.g. cyclones, inherent climatic variability, natural biological cycles), many of which have "recovery" periods of decades, it is very difficult to distinguish or even quantify the relative contribution of anthropogenic disturbances. It is likely that adverse human impacts from enhanced runoff will be first observed in the reduced capability, or failure, of coral reefs or seagrass beds to recover from natural disturbance rather than as direct impacts.

- We are dealing with complex ecological processes, where inherent ecosystem buffering capacity makes it difficult to identify clear human-induced trends in change from relatively short-term studies. However, in many ecosystems, apparent resistance to change due to high buffering capacities can be followed by an abrupt ecosystem collapse once critical disturbance thresholds have been overstepped. Predicting these thresholds is extremely difficult, yet they are absolutely critical, as an overstepping can often lead to irreversible changes or to very slow rates of recovery when the "pressure" abates.

All three reasons are important enough to adhere to the precautionary principle in managing the land-based sources of impacts on the GBRWHA until we achieve more certainty in our understanding of impacts. The very real risk is that by not undertaking any significant action now to reduce delivery of elevated levels of nutrients and pollutants to the GBRWHA, we may overstep some thresholds leading to irreversible loss of near-shore reef systems and sea grass beds. Moreover, post-European land use has very significantly altered and in many cases caused significant damage to rivers or loss of wetlands in the majority of the catchment area of the GBRWHA. The direct and indirect impacts of the changes to or loss of freshwater biodiversity and food chain links to the GBRWHA have yet to be fully assessed.

In conclusion, on the basis that:

i. available evidence indicates that post-European land use has significantly increased runoff and sediment associated nutrient and contaminant delivery to near-shore regions of the GBRHWA,
ii. runoff has had clear detrimental impacts on freshwater aquatic systems,
iii. there is significant risk that this impact is currently or may in future damage areas of high exposure along the wet tropical and central Queensland coasts of the GBRWHA,

there is a *continued urgency* to work towards a reduction in the runoff of sediments, nutrients, herbicides and other pollutants into the Great Barrier Reef World Heritage Area. .