GBR Science Summary, No. 1

Overview of the GBR situation and background of the author.

By Walter A. Starck, PhD.

Coral Reef Biology

It is currently fashionable to use the adjectives "delicate" and "fragile" in describing coral reefs and their ecology. This is misleading and is based more on assumption than actual assessment. Much of our present understanding of ecology comes from the study of relatively simple terrestrial communities. In such communities a few key species tend to play a critical role. Like links of a chain, if any one is disrupted the whole collapses. Such an idea applied to the myriad species and interrelationships on coral reefs results in an imaginary house of cards, a fragile structure threatened with catastrophe from the slightest interference.

Fortunately, reefs are not like that. Complex natural communities are fundamentally different from simple ones. The difference is redundancy. Immensely complex systems with large numbers of individually critical components are doomed to failure. Redundancy, that is multiple backups for critical functions, avoids this problem.

On reefs interrelationships between organisms are not so much a chain as a network of broadly overlapping functions and requirements. A single link breaks a chain. A few webs here and there make little difference to a net. Every function in reef communities is attended by a variety of organisms. No one is indispensable. Absence of or failure for one species is an opportunity for others.

From one reef to another, from year to year, or even season to season on the same reef populations of individual species vary noticeably yet the community maintains. The important thing is not who does a job but that it gets done. A host of attendants with diverse capabilities to perform each function enables reefs to cope with challenges which would devastate simpler, less flexible communities.

Healthy reef communities may range from a half dozen species of corals and about 100 species of fishes (e.g. Clipperton Atoll in the eastern Pacific) to around 600 species of corals and over 2000 species of fishes (e.g. central Indonesia).

In addition to their temporal and geographic variation reefs also encompass a broad range of ecological conditions. Although they thrive in clear, low nutrient oceanic waters there is a broad range of reef species that are adapted to turbid, nutrient enhanced coastal lagoon conditions.

In many places nearshore reefs occur in areas where they are particularly vulnerable to storms, floods and high temperatures. It is common for such reefs to suffer periodic devastation interspersed with intervals of recovery whenever a succession of favourable years permits.

Almost ever year one or more tropical cyclones cross the GBR somewhere and wreck massive destruction on tens of thousands of hectares of reefs which however recover again in only a few years.

In short, coral reefs are highly variable, flexible and resilient communities. There is in fact, no known instance of human induced extinction of any reef fish or invertebrate anywhere. The world-wide total for extinctions of all reef organisms of any type since the advent of mankind stands at one, the Caribbean monk seal. Today's reef fauna still exists in all its primordial diversity.

Reef science

Scientific understanding of reefs is still very patchy and highly specialized. Only a literal handful of researchers have both the scientific background, plus widespread and long term experience necessary to make reasonable judgments of reef conditions. Even then assessment is difficult due to the highly variable nature of reef communities. What is often seen as evidence of human detriment is either a natural condition of reefs in a particular situation or the result of natural events such as storms, floods, and population fluctuations of various organisms that appear unnatural to those of limited experience.

"Expert" opinion is repeatedly cited as supporting the need for additional restrictions on reef activities. There are two kinds of expertise. One is based on formal training and theory, and the other on a breadth and depth of actual experience. Very few academics or administrators have extensive direct experience of the GBR. Fewer still have extensive experience of reefs elsewhere in the world as a basis for comparison, including both heavily fished reefs and remote un-fished ones. Australian training and theory in fisheries and resource management is almost entirely based on overseas examples where overfishing and reef degradation from multiple sources are very real problems. When one's training and understanding emphasizes the real existence of such problems, then one naturally looks for them close to home. The infinite realm of hypothetical possibilities provides an unlimited supply, and our society is not short of persons who amplify such possibilities into scares. In the absence of broad experience and realistic, discipline-balanced scientific appraisal any and all of such problems can be perceived as real even by "expert" scientists, let alone by politicians and public.

Researchers also need to stay on the good side of the establishment to get grants and permits. Then too grants to study threatening problems are much more likely to receive funding than are investigations of a more esoteric nature. What starts as speculation ends up having to be defended . From there it's easy to begin firmly believing what started as only possibility. Beyond this, science also has its fads and fashions with ideas becoming widely accepted at one point only to be later revised or discarded. Reef studies are no exception.

In addition to exaggerating environmental risks in their research grant applications, some reef scientists, encouraged by both media attention and special interest environmental groups, have indulged in strident public advocacy for particular environmental causes. When such recommendations are published in the media, the massive conflict of interest

of the proponents goes unreported, and, by virtue of their scientific authority, their remarks generally stand unchallenged. In the face of such fraudulence, the general public has virtually no chance of discerning the truth.

Why the public isn't told the truth by experts who do know

There are a handful of academics and administrators who have both the credentials and experience to know that the overfishing claims about the Great Barrier Reef are untrue. Why, then, do they not speak out?

The answer, regrettably, is that it is rarely possible for them to do so because of the strong personal ostracism to which they will be subjected as a result. Speaking out against the politically correct version of an environmental problem, be it reef-related or otherwise, is a no-win situation. No matter how senior or well qualified they may be, persons who choose to combat the conventional wisdom won't be believed, and, one way or the other, end up being denigrated. More junior persons, rightly, fear for their employment or career and, should they work for government agencies or specialist research centres, are even subject to compulsory managerial direction regarding their public statements. The peer review process used both in grant applications and when papers are submitted for publication also imposes a strong and undesirable pressure for scientists to conform to prevailing views. Again, therefore, it is not surprising that the public remains uniformed.

The GBR situation

The Great Barrier Reef is the largest contiguous area of coral reefs in the world. Distance, weather and a relatively small population in the region mean that most of the GBR is rarely even visited. Of the estimated 2900 reefs in the complex, only a few dozen are regularly used for tourism. The total annual fish harvest per square kilometer is less than 1% of what reefs elsewhere commonly sustain.

During an extended flight over the reef at any time over any regiona only occasional boats are to be seen, and over an extensive cruise through the reef one typically sees very few other vessels. The reality is that on most of the reef most of the time no human activity or influence can be seen or detected. For all practical purposes 90% of the GBR is already a green zone.

The large scale rezoning of the GBR and ever increasing restrictions on any activity involving the reef is an imaginary solution for problems that do not exist. No actual threat has been demonstrated and there is no crisis involved. GBRMPA badly needs restructuring towards identifying real problems and to conducting the research and monitoring necessary for sound knowledge-based decision making. Currently only about 10% of their budget goes to monitoring and research and the remaining 90% to maintaining and promoting themselves. Management by hypothesis and PR isn't good enough.

No reef fish has ever been exterminated by line fishing. There is no risk in permitting fishing on the GBR to continue with minimal restriction, and imposing local restrictions only when evidence of some need develops.

The Precautionary Principle and Preservation of Biodiversity

In advocating the need for expanded green zones "precaution" and "biodiversity" are often cited as justifications. In particular, these claims are often invoked when no good answers are available to support questionable evidence and rationales for various other claims. Like "safety" and "family values", "precaution" and "biodiversity" are unquestionably good sounding things no one can argue against. If analysed however they pretty quickly become meaningless.

Everything we do entails risk and even doing nothing can not avoid it. Without some reasonable assessment of probability trying to take measures to avoid risk is meaningless. They could just as well do even more damage than they were intended to prevent. Biodiversity simply means the diversity of life. No evidence has ever been presented for any human induced decrease in biodiversity on the GBR. In fact, the heavily abused and overfished reefs of Indonesia and the Philippines have maintained an even higher biodiversity than the GBR. The claim of preserving biodiversity is meaningless. It is under no threat to begin with and if such an event were to occur it would require specific action to address the nature of the particular problem.

Background of the author

The author has a PhD in marine science including post graduate training and professional experience in fisheries biology. His reef experience includes some 50 years of fishing and diving on coral reefs including those in the eastern, central and western Pacific areas as well as the Indian Ocean and tropical western Atlantic region. He has had the opportunity to study two reefs every year for 10 years each. One was in Florida the other on the GBR. He has also been able to extensively dive reefs in both overfished areas and sustainably fished ones as well as a number of remote un-fished oceanic reefs. His Barrier Reef experience includes over 1000 dives ranging from far northern Cape York to the Capricorn group at the southern end of the GBR.

From this perspective the impression of the GBR is essentially that of an un-fished reef but with a greater abundance of large fishes than is typical of isolated oceanic reefs probably because of greater nutrient supply.

Note regarding criticism

Although proponents of environmental problems claim concern for the environment any suggestion a situation may not be as bad as feared is met with anger and denial rather than hope or interest. Invariably if they can not refute the reason and facts presented they ignore them and resort to personal denigration plus the backing of "expert" opinion. This may be effective politics but it is poor science. Science is based on reason and evidence not consensus or expert opinion. Ignoring inconvenient facts and argument is simply poor science regardless of how many "experts" agree.

If we force the debate to address the reason and evidence we present we will win, hands down. If we engage in a pissing match of credentials and hypothetical possibilities there is no way to prevail.

Key Points/Soundbites

- Coral reefs are anything but "fragile". They are among the toughest and most resilient of natural communities.
- Humans have never exterminated any reef fish or invertebrate anywhere.
- Most reef "experts" aren't. Their expert status derives from having advanced training in something about which little is known.
- Scientists and bureaucrats have a vested interest in problems. They bring recognition, importance and funding. Without them they are relegated to obscurity and meager budgets.
- On most of the GBR most of the time no human activity or influence can be seen or detected.
- For all practical purposes 90% of the GBR is already a green zone.
- No reef fish has ever been exterminated by line fishing.
- Science is all about reason and evidence not about consensus or expert opinion.
- Environmentalists don't love the reef , they only love threats to it.
- GBRMPA's management has about as much effect on the reef as it would on the moon. All it really achieves is being a bigger pain in the ass than bad weather for reef users and maintaining a play school for the difficult to employ at only $30 million a year.
- The precautionary principle is meaningless without some reasonable assessment of threat. If applied to every possibility we couldn't get out of bead in the morning or stay there either.
- Preservation of biodiversity is a platitude masquerading as science. No actual threat to biodiversity has been demonstrated or is even suspected on the GBR.

GBR Science Summary, No. 2

DPI Line fishery statistics and comparisons.

By Walter A. Starck, PhD.

Fishery statistics

Two key indicators in fisheries management everywhere are the annual yield and the catch per unit of effort. Curiously, these seem to be never mentioned by those claiming overfishing on the GBR. DPI statistics show the current annual commercial catch of reef fishes from the GBR is just over 4000 tonnes and the recreational catch is estimated to be about 2000 tonnes (Williams, 2002: p.66 *et seq.*). From 1989 to 1995 the annual harvest grew from about 2400t to 3200t. From 1995-98 the total then increased by about 430t each year, peaking at 4475t in 1998 and declining to 4095t in 2000 (Fig. 1).

Four thousand tonnes can be an impressive amount of fish or a negligible one depending upon the size of the region from which it is produced. Salmon farming, for example, currently produces about 12,000t annually from a few small bays in Tasmania. (see: http://www.dpiwe.tas.gov.au/inter.nsf/WebPages/EGIL-5KD7D6?open)

In reef fisheries assessment, the yield per unit of area is a widely used and important measure. Normally this is quantified in terms of annual yield in tonnes per square kilometer of reef and lagoon area. This most important measure also seems never to be provided or even mentioned in GBR management discussion or decisions. To ignore key measurements of harvest in the context of a discussion of overfishing cannot but seem either incompetent or deliberately deceptive.

Annual yield

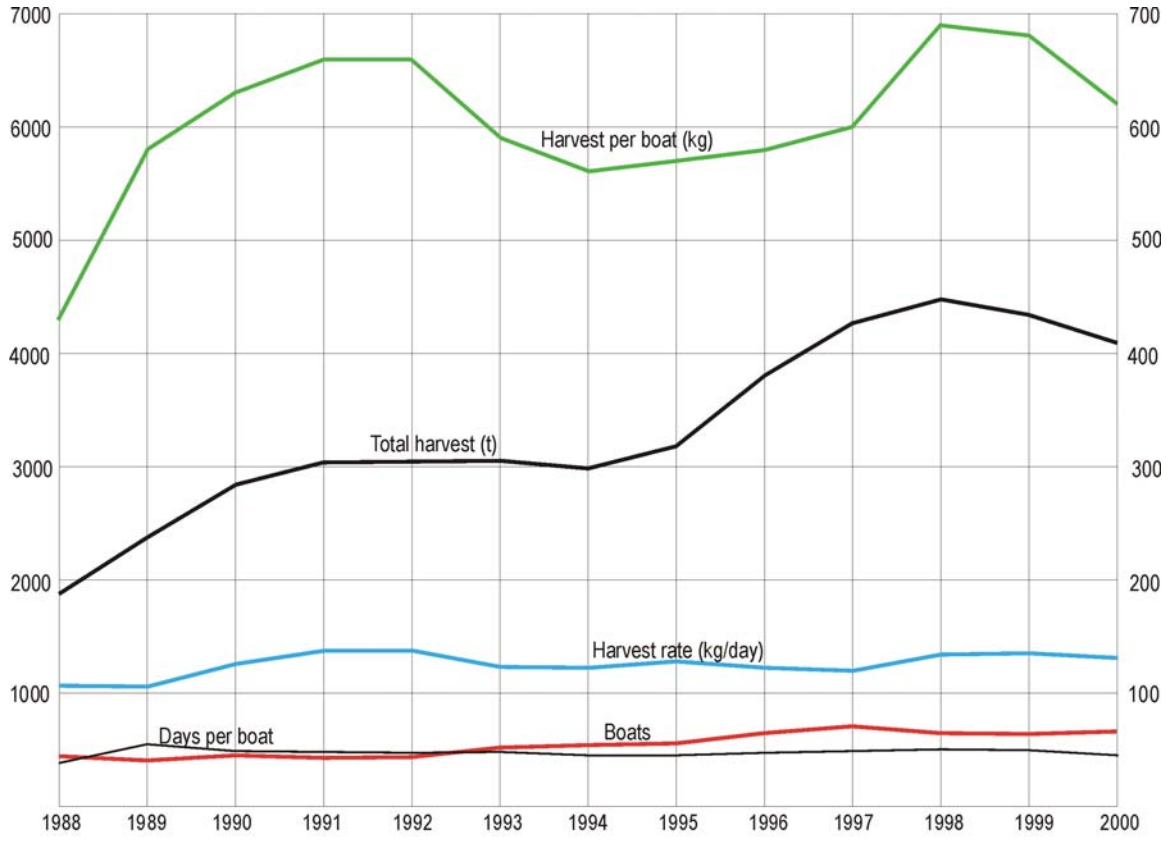
Catch per unit of area is easy to derive. It is simply the total annual yield divided by the area of reef and lagoon from which it is harvested. With some 346,000 km² of reef and lagoon area on the GBR the total annual catch in 2000 was about 17 kg/km².

This is a miniscule figure on which to base a claim of overfishing. Elsewhere, over a wide range of Pacific reefs, the annual harvest averages some 7700 kg/km^{2,} a figure which is generally considered by fisheries biologists to be sustainable (Adams *et al.*, 1996). In actual practice this level of catch is ongoing. Thus expert opinion in this instance is consistent with observable fact.

Maintaining that the GBR is overfished at an annual harvest of 17 kg/km^2 when over a broad range of other Pacific reef areas an average of 7700 kg/km^2 (Fig. 2) is sustainable is not a credible argument. It amounts to claiming that the GBR is the most unproductive reef area in the world with less than 1% of the productivity of other reefs.

Jennings and Polunin (1995) have suggested, based on observations at different sites in Fiji subject to different levels of fishing activity, that a fin-fish yield of at least 10,000 kg/km^2 of reef is sustainable, at least where reefs are subject to low influence from human land-based activities. Although the above figures have been introduced by the

author into recent public debate over further restrictions on fishing activity on the GBR, the proponents of overfishing claims have been unwilling to address them. The sole response (other than uninformed personal attack) has been to argue that actual reef area only comprises about 30% of the total seabed within the World Heritage reef area. However, even if one were to consider the entire harvest to come from only 30% of the area, the catch per unit of area would still only amount to some 56.6 kg/km^2. In actual fact though, a large portion, probably over half, of the total GBR catch does not come from reefs themselves but from the lagoon area between reefs. The only counter argument offered, if presumed to be valid, is thus not only quantitatively insignificant but worse still reveals a fundamental lack of knowledge of the actual fishery of which the same opinions are being cited as expert.



Great Barrier Reef commercial line fishery catch statistics, 1988-2000.
Days per boat and Harvest rate use right side scale. All others use left scale.
Data from Williams (2002)

Fig.1

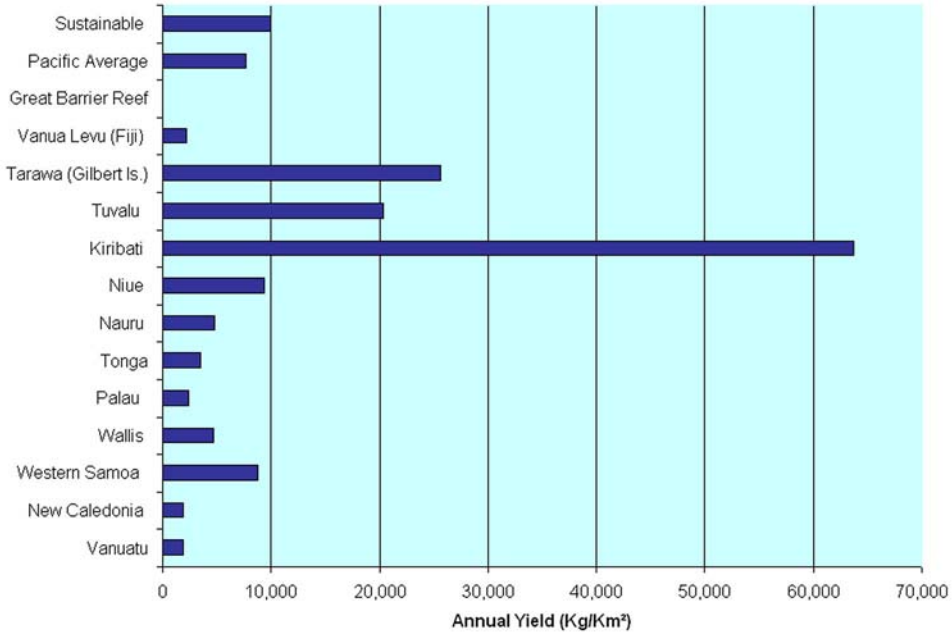


Fig.2

Catch per unit effort

In conjunction with annual yield, catch per unit of effort is perhaps the most important measure of fishing pressure and in particular, overfishing. The theoretical ideal of fisheries management is maximum sustained yield. When the harvest exceeds the sustainable yield, the population left to spawn is inadequate to provide the number of new recruits necessary to replenish the population. A progressive population decline results. When this occurs, the total harvest and the catch per unit of fishing effort decline in tandem.

Figures for catch per unit of effort in Great Barrier Reef waters are maintained by the Queensland Department of Primary Industries (Fig.1). This long established and globally used measure of fishing sustainability is therefore readily available, but strangely it too remains unmentioned by those making the claims of overfishing on the GBR.

From 1988 – 2000 the number of boats participating in the GBR commercial line fishery ranged from 410 in 1989 to 714 in 1997 (Fig. 1). In 2000 the figure is 666 boats. The harvest rate in kg/day/boat ranged from 108 in 1989 to 140 in 1992 with the 2000 rate being 134 kg/day/boat. The number of days per boat per year varied from 39 to 54 while the total harvest per boat ranged from 4.3 tonnes in 1988 to 6.9 tonnes in 1998. The catch per unit of effort simply does not show any evidence of decline, as would be expected if overfishing was indeed taking place.

Summary

DPI statistics clearly show that the GBR line fishery harvest is extremely low. On an area basis it is less than 1% of what reefs elsewhere commonly yield on a sustainable basis. The catch per day per boat over recent years has in fact increased. Unlike the theoretical arguments, imaginary models, anecdotal observations and unsubstantiated opinions used

to support claims of overfishing these statistics are actual measures of real catch and effort. Even granting allowance for any quibbles about their accuracy these statistics leave the claims of overfishing without a shred of credidility.

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Key Points/Soundbites

- The relatively small Australian salmon farming industry produces over twice the annual harvest of the total commercial and recreational catch of all species from the entire GBR.
- The annual line fishery yield from the GBR averages out to some 17 kg/km². The average from a broad range of other central and western Pacific reefs is 7700 kg/km². The GBR has either the most underfished reefs in the world or the poorest.
- Proponents of overfishing on the GBR have consistently ignored the most basic and important fishery statistics. These readily available DPI statistics overwhelmingly refute any claims of overfishing.
- Overfished fisheries characteristically show both a declining total harvest and decline in the catch per unit of fishing effort. The GBR statistics show clear *increases* in both the total catch and the catch per unit of effort.

GBR Science Summary, No. 3

Coral trout census surveys.

By Walter A. Starck, PhD.

Fish census data

If overfishing was occurring on the GBR it would surely be reflected in declining populations of the most heavily targeted species. Coral trout (*Plectropoma* spp.) are the most heavily fished species on the GBR and constitute 40-45% of the catch. Over the past two decades the Great Barrier Reef Marine Park Authority (GBRMPA) has contracted with Dr. Anthony Ayling for him to conduct extensive underwater visual surveys of coral trout numbers on the GBR. This body of information now totals hundreds of surveys encompassing the entire GBR region. These surveys are based on a well designed and conducted methodology and the results have been treated with appropriate and powerful statistical analysis. In fact, they make up the most extensive and long term body of population information available for any reef fish anywhere in the world.

It is also important to bear in mind that this work is not based on estimates or models but on actual counts of individual fish. The only reasonable probability for error is that coral trout are somewhat cryptic and there will be some fish present that will be hidden in the coral and not seen. Actual numbers on the reef therefore may be somewhat higher but will never be less than are counted.

Remarkably, this exceptionally valuable body of information exists only as unpublished reports in the library of the Marine Park Authority. Certainly, GBRMPA must have deemed this work important and competently conducted to have continued to support it at substantial expense for so long. It is difficult to avoid wondering if the reason for non-publication of the Ayling studies is that it was not desired that this information be readily available to the public. Had the findings revealed evidence for overfishing, it seems unlikely that they would have been left to languish in a small regional library.

For a while, those interested in considering the details of Dr. Ayling's studies were able to read his informative summary posted on the web at: http://fastinternet.net.au/~rock/trout.htm . This summary was entitled: WHERE ARE ALL THE CORAL TROUT? In September 2003 I drew attention to the availability of this document on the internet during a public debate about overfishing on the GBR. Shortly thereafter the article was removed, and apparently it is no longer publicly available. I therefore provide the following précis of Ayling's findings as reported in this document.

The Ayling census of coral trout on the Great Barrier Reef

Ayling reported in 2003 on the results of surveys made over the previous 14 years. The research included repeat surveys on some reefs over a period of 10 years.

Surveys were made of both protected reefs, where fishing is prohibited, and of reefs open to fishing.

Major survey results included the following:

- A *1986 survey* of the Capricorn-Bunker area at the southern end of the GBR sampled 12 reefs, including six that had been closed to fishing for five years. The average coral trout density was 57 per hectare on the protected reefs and 49/ha on the fished reefs. Variability between individual counts was such that this small average difference was not statistically significant.

- *In 1991* a large number of reefs were surveyed in the Cairns Section of the Marine Park, between Dunk Island and Lizard Island. 29 of these reefs were open to fishing while 18 had been closed to fishing for 7 years. The average coral trout density on the protected reefs was 33.9 fish/ha compared to 34.6/ha on the fished reefs.

- *In 1992* another set of counts in the Cairns Section surveyed five closed reefs and five fished reefs. Again there was no significant difference between the closed and the open reefs. The average was 28.4 fish/ha on the protected reefs and 27.8/ha on the fished reefs.

- B*etween 1983 and 1994*, counts from three regularly fished reefs off Townsville found that the average density of coral trout was 34/ha in 1983, 34.3/ha in 1989 and 66/ha in 1994.

- In the Cairns Section repeated counts from the same reefs were conducted in 1983 and 1991. In 1983 the average density was 22.5 fish/ha and this had increased to 31.7/ha in 1991.

- Off the Whitsunday Islands, counts on three reefs (Hook, Line and Hardy) found 57/ha in 1984, 84/ha in 1988 and 124/ha in 1994.

These results demonstrate the occurrence of a marked ***increase*** in the numbers of coral trout on all of the sampled reefs during the 1980s and 1990s. Furthermore, all the reefs sampled were close to population centres. They thus had been subjected to much more regular fishing pressure than most of the GBR which, being remote and difficult of access, is rarely fished at all.

The concept of "catchability"

The absence of figures that demonstrate decreases in fish abundance has not prevented the emergence of a popular view that a decline has occurred in Great Barrier Reef fish catches over recent decades. This decline is inferred from anecdotal evidence by individual fishermen and can be attributed to fish learning to become wary, *i.e.* to a reduction in fish "catchability".

For example, catch rates by commercial fisherman on protected reefs (for intentionally experimental purposes) were cited by Ayling as being three to four times greater than those from regularly fished reefs despite comparable population densities prior to fishing. He also cited similar results from Heron Island near the southern end of the GBR. Reduced catchability of fish in areas subjected to frequent fishing, and not depleted fish populations, was concluded by Ayling to be the basis for the popular perception of overfishing.

Finally, Ayling *et al*. (2000) in a report to the Queensland Fish Management Authority again reported finding no effect of reef zoning on coral trout density.

Regional population of coral trout

An estimate was made by Ayling of about 1,200 major reefs for the GBR. Each reef was said to have an average of about 500 hectares of reef slope where coral trout are common, and about 2,500 hectares of reef flat and lagoon where they are less common. His surveys indicated an average density of about 50 fish/ha on the reef slope and about 10 fish/ha in the lagoon and reef flat. Size estimates showed that on average half of these fish were over 38 cm long and thus able to be taken by fishermen.

Based on these data, about 30 million adult coral trout were estimated for the whole GBR population. However, because large areas of broken ground, which also support coral trout, occur between individual reefs, the total figure was acknowledged to possibly be twice or more the 30 million calculated.

The total annual catch of coral trout from the GBR was estimated at 2 million kilograms. Given the average size of coral trout, this represents about 3 million fish, or about 10% of the available stock. Annual recruitment being about 40% of the available stock, fish replenishment is in fact far higher than the annual catch, which is therefore sustainable.

Coral trout grow rapidly, the fastest growing individuals reaching 30 cm long in about 12 months, and most individuals reach the 38 cm minimum by the end of two years.

It should again be noted that the extensive Ayling estimates are based on counts of actual fish seen. It should also be noted that the 30 million total population estimate covers only the reef slope areas of the 1200 major reefs and not the same total for the five times larger but 1/5 as densely populated reef flat and lagoon areas, nor the inter-reef area which was estimated to support as much again as the major reefs, nor the similar number of smaller reefs. Much of the actual catch in fact comes from these other areas. Thus the total coral trout population is almost certainly 2 to 4 times larger than the estimated 30 million. Accordingly, fishing pressure must in reality be only about ½ to ¼ of the already low level of the Ayling estimate.

Given these data, and the estimates of fishing pressure derived from them, it is clear that present Great Barrier Reef catch levels are not any threat to coral trout numbers. It is worth recalling the conclusion by Ayling in the undated Web document: "Just remember: the number of fish that are caught does not relate to the number of fish that are there, but to how easy they are to catch."

Unpublished surveys from the Whitsunday and Palm Islands

While the exceptional body of information assembled by Ayling has been ignored in debate on overfishing, a virtually anecdotal study has been widely cited as proof of overfishing and the need for greatly increasing closed areas (e.g. James Cook University media release "Green zones could double spawning stocks of fish" http://media.jcu.edu.au/story.cfm?id=96). Unfortunately, because this work too is unpublished (see: Willamson, 2000) it cannot be examined in detail. Nonetheless, to the degree possible, I will comment on it here.

The study involved surveys of two small protected reefs, one in the Whitsunday Islands and the other near the Palm Islands, and reportedly found the presence of significantly larger numbers of coral trout than occurred on other (unprotected) reefs in the same general area.

The original protection of particular reefs by restrictive zonation was based on public submissions that the reefs in question were particularly rich and should be protected. To later attribute differences as being due to protection when such perceived differences were the basis for granting protection in the first place is not a convincing argument. To make such argument while ignoring the far more extensive and powerful findings from Ayling, and to present this opinion to the public and to government as scientific proof, goes beyond simple error or bias. Such claims are either truly ignorant, or alternatively a deliberate attempt to mislead.

It should be noted that although Dr. Ayling was also involved in some of the Whitsunday and Palm Islands survey work, the widely cited interpretations are by others and are at variance with Ayling's own conclusions based on his much more extensive data from many other reefs.

Summary

The extensive long term and still ongoing underwater surveys of coral trout populations on the GBR by Dr. Ayling are perhaps the most comprehensive population data for any reef fishes anywhere in the world. This remarkable body of work has been funded by GBRMPA for almost two decades at very substantial cost. That the results have never been published or even mentioned by GBRMPA is even more remarkable.

These results irrefutably show that coral trout are abundant everywhere and there is no significant difference between the most frequently fished reefs near population centres and remote rarely visited ones nor between reefs open to fishing and those closed to it. These surveys clearly indicate that our most heavily fished

species is in fact being only lightly harvested. They also strongly infer that no environmental benefits should be expected from the recently increased restrictions on fishing.

Most disturbing of all, the existence of this exceptional body of knowledge and its total disregard by GBRMPA raises serious questions about the factual basis, scientific quality, and indeed even the integrity with which GBRMPA's management of the reef is being conducted.

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Key Points/Soundbites

- Extensive long term underwater surveys of our most heavily fish species (coral trout) show they are abundant everywhere and clearly indicate very little fishing pressure on their populations.
- The failure of GBRMPA to publish or even acknowledge this exceptional body of information raises serious questions with regard to both the integrity and the competence of GBRMPA's stewardship of the reef.
- The Ayling surveys are based on actual counts of fish seen. The only reasonable possibility of error is that some fish hidden in the coral could be missed so that actual numbers present could be higher, but never lower, than what was seen and counted.

GBR Science Summary, No. 4

Effect of Line Fishing

By Walter A. Starck, PhD.

Overview

From 1993 through to the present GBRMPA has funded a large scale long term study of the Effects of Line fishing (ELF) conducted by the Reef Cooperative Research Centre. In all of the debate leading up to the recent large expansion of green zones on the GBR GBRMPA has repeatedly claimed ELF findings as supporting the need for further restrictions on fishing. Unfortunately, as is so often the case with GBRMPA claims, no evidence was presented but simply their claims for such evidence. This year, after the new zoning was a *fait accompli* the ELF study was finally published. It is a massive technical document of some 216 pages most of which would be incomprehensible to non-scientists. Examination reveals its findings are not nearly so clear and unequivocal as was claimed in the earlier debate. The following is a summary and commentary on its key findings and methodology.

The ELF Study

ELF is an extensive experimental study and model based analysis of the effect of line fishing (ELF) on the GBR. It claims to show "…that the two main target species of the RLF (reef line fishery), the common coral trout and the red throat emperor, were significantly more abundant, larger and older in areas zoned Marine National Park 'B' (and so closed to fishing) than in adjacent General Use areas that have always been open to fishing."

Although the ELF study was extensive, well designed and well conducted some key aspects should be recognized.

- The differences between closed and open reefs were generally much less than differences between regions and over time on the same reefs.
- No evidence is available as to what portion of the observed differences between the open and closed reefs may be the result of fishing or of natural environmental differences or variability.
- Of the 4 study areas 3 were in locales subject to frequent fishing whereas most of the GBR is subject to much less fishing effort. In the less heavily fished study area no significant difference was found between the open and closed reefs and this would be more indicative for the GBR as a whole than the frequently fished ones.
- The more heavily fished areas showed a greater difference between open and closed reefs but the highest populations were in the most heavily fished areas and even the open reefs in such areas had several times the population density of closed reefs elsewhere.
- Though Dr. Ayling was a co-author of the study and his unpublished surveys were cited no attempt was made to address or even acknowledge

that this extensive work indicates a quite different picture for the reef as a whole.

- Reason dictates that any fish removed from a reef means fewer are immediately left. The crucial question for management however, is whether the numbers left are adequate for replenishment. The ELF study makes no attempt to assess this vital parameter. A detectable difference is not in itself evidence of unsustainability or ecological degradation.
- The study findings clearly show (but did not discuss) that even on the most heavily fished reefs coral trout remained common and catches good with no evidence of a long term continuing decline in either the harvest or the catch per unit of effort.
- The immediate effect of high catches and a significant drop in numbers of fish when a protected reef is opened to fishing is not unexpected. Although these experiments clearly demonstrated a short term increase in catchability they were not continued long enough to indicate the nature of ongoing effects as catchability decreased.
- Under all scenarios tested the model showed ongoing future yields to be less than the 1996 catch. Models however tend to produce the results they were designed to produce and typically require considerable adjustment to do so. As tools for gaining insight into the dynamics of complex phenomena they can be most useful but they tend to be highly unreliable for predicting actual future events. It does not require computers and sophisticated mathematics to understand that with most of the GBR either unfished or only very lightly fished in 1996 more extensive fishing would result in an increase in the total catch.

Although this study has been interpreted by GBRMPA to clearly indicate the benefit of substantially increased areas being closed to fishing the key findings presented in fact provide little support for this and are even contraindicative of it. It should also be noted that GBRMPA was a sponsor of this study and it was conducted with their support, approval and cooperation.

The final conclusions Mapstone *et al. (p. 108)* contain several points of considerable import (my plain English interpretation is in parenthesis):

- "…the simulations indicated that under all strategy sets, populations of common coral trout were likely to remain biologically robust to harvest." (In other words no matter what we do to manage the reef line fishery it is likely to remain "biologically robust", *i.e.* not overfished.)
- "The likely increase in area closures under the Representative Areas Program is likely to exacerbate the decline in fishery performance." (The RAP plan can be expected to result in poorer fishing.)
- "There was little convincing evidence of consistent secondary effects of fishing on, for example, the prey of the primary harvest species, common coral trout." (There was no evidence that fishing had any detrimental effect on biodiversity or the ecological integrity of the broader reef community.)

- "The utility of the area closures was most compromised when fishing effort was greatest, and the effects of increased fishing effort were most severe when area closures were greatest." (Closing more areas to fishing can be expected to increase its impact.)

Commentary

Most national parks are only small to modest in size and the management aim is to maintain as pristine conditions as possible consistent with a requirement for a sustainable level of public access and recreation. The GBR is an exception in that it is not only vast but it incorporates important regional resources and must accommodate a range of recreational and commercial uses. How this may be achieved and the aims, balances, tradeoffs, effectiveness and costs involved has received far too little analysis. This difficult issue is compounded by the complex dynamic nature of reef communities and a poor understanding of their functioning, current condition, variability, and trends.

Coral reefs are robust and flexible communities that recover well from perturbations. No endangered species are involved. There is little risk in monitoring the situation and addressing problems if and when they become apparent rather than trying to take elaborate pre-emptive action to avoid an endless array of imaginary possibilities. In view of our ignorance and the complexity of the matters involved it would also be prudent to test measures before applying them on a broad scale and to carefully assess their results when implemented.

The present management approach is largely an *ad hoc* reactive one based on opinion and anecdotal information It amounts to an attempt at remote control management employing hypothetical solutions to imaginary problems with no attempt to assess either the reality of the purported problems or the results of any measures taken. Its main virtues are than it can be done entirely from an office and success can be proclaimed with little chance of contradiction.

A much clearer analysis of management objectives with particular reference to the balances and broader consequences of the various uses is badly needed as is a much more empirically based approach. Most importantly GBRMPA, to do an effective job, needs to be restructured and refocused toward developing the sound body of knowledge essential to meaningful management of the reef. Management by theory and hearsay without broad and ongoing knowledge of either actual conditions or the results of management measures amounts to an expensive charade. It creates the appearance of doing something but is of little benefit to the reef and only impedes its sensible use and enjoyment.

While no suggestion is implied that the time of publication of this study was contrived to be too late to affect public debate regarding the expanded green zones it does seem most inappropriate that with the date of publication so close to such time the cutoff date was not extended until reasonable public consideration could have been given to this important evidence.

Key Points/Soundbites

The key conclusion of the large scale long term Effect of Line Fishing study which GBRMPA claimed supported the need for increased green zones and other restrictions on fishing were:

- No matter what we do to manage the reef line fishery it is likely to remain "biologically robust".
- The RAP plan can be expected to result in poorer fishing.
- There was no evidence that fishing had any detrimental effect on biodiversity or the ecological integrity of the broader reef community.
- Closing more areas to fishing can be expected to increase its impact.

To which one can add:

- Interpretation of these findings as supporting the need for increased green zones and other restrictions on fishing can only be either incompetence or dishonesty.

Reference

Mapstone B.D., Davies C.R., Little L.R., Punt A.E., Smith A.D.M, Pantus F., Lou D.C., Williams A.J., Jones A., Ayling A.M., Russ G.R., McDonald A.D.

2004. The Effects of Line Fishing on the Great Barrier Reef and Evaluations of Alternative Potential Management Strategies. CRC Reef Research Centre. Technical Report No 52. pp i-xi + 1-205 CRC Reef Research Centre, Townsville, Australia.

GBR Science Summary, No. 5

GBRMPA Budget Analysis

By Walter A. Starck, PhD.

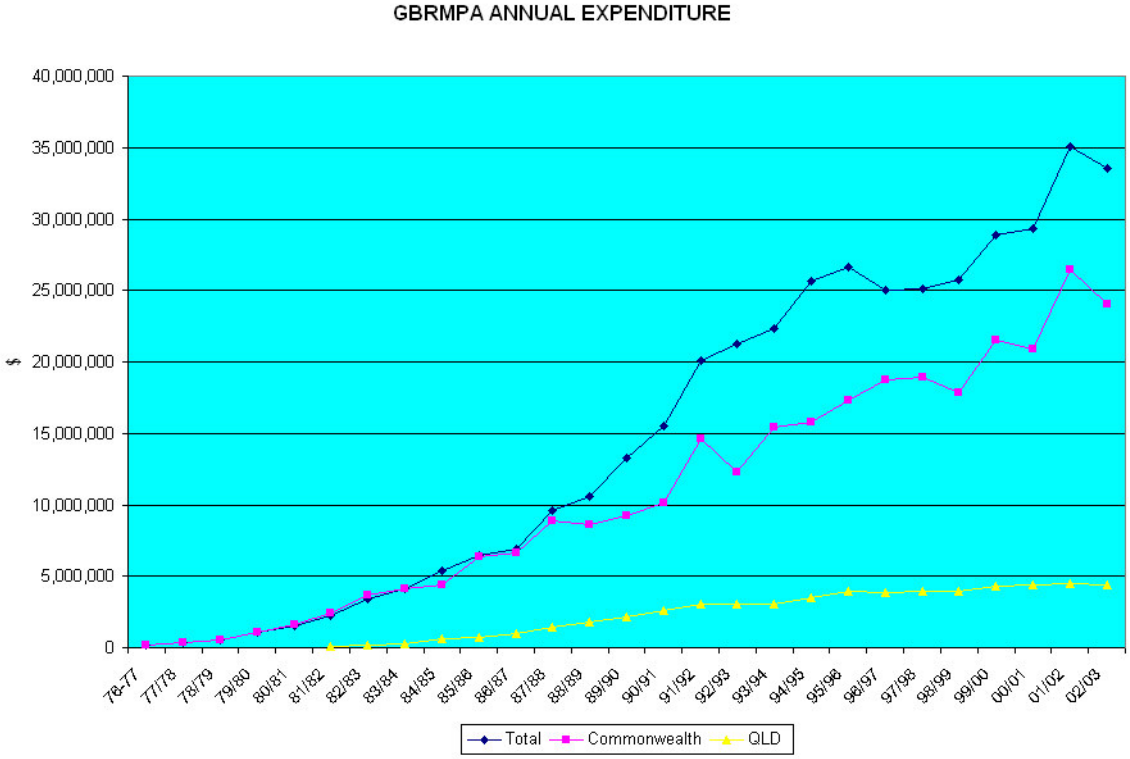
Overview

Examination of the Great Barrier Reef Marine Park Authority budgets from the 26 Annual Reports is instructive not only in what they reveal but also for what they conceal. One might think that in the absence of major new issues requiring address the major effort for GBRMPA would have been required in the early stages of establishment after which ongoing administration would become largely routine and require somewhat less effort. However government bodies rarely work this way and GBRMPA is no exception and it now spends nearly 10 times as much to do the same job it did a half-dozen years after it began and nearly 100 times what it did two years after it began.

Over the years the annual financial statement has grown from a clear and simple one page accounting into over 50 pages of arcane accountancy procedures, acronyms and aims defined activities that sound important but reveal little of where actual expenditure is going or what it is achieving.

Some Budget Trends and Figures

Annual Expenditure

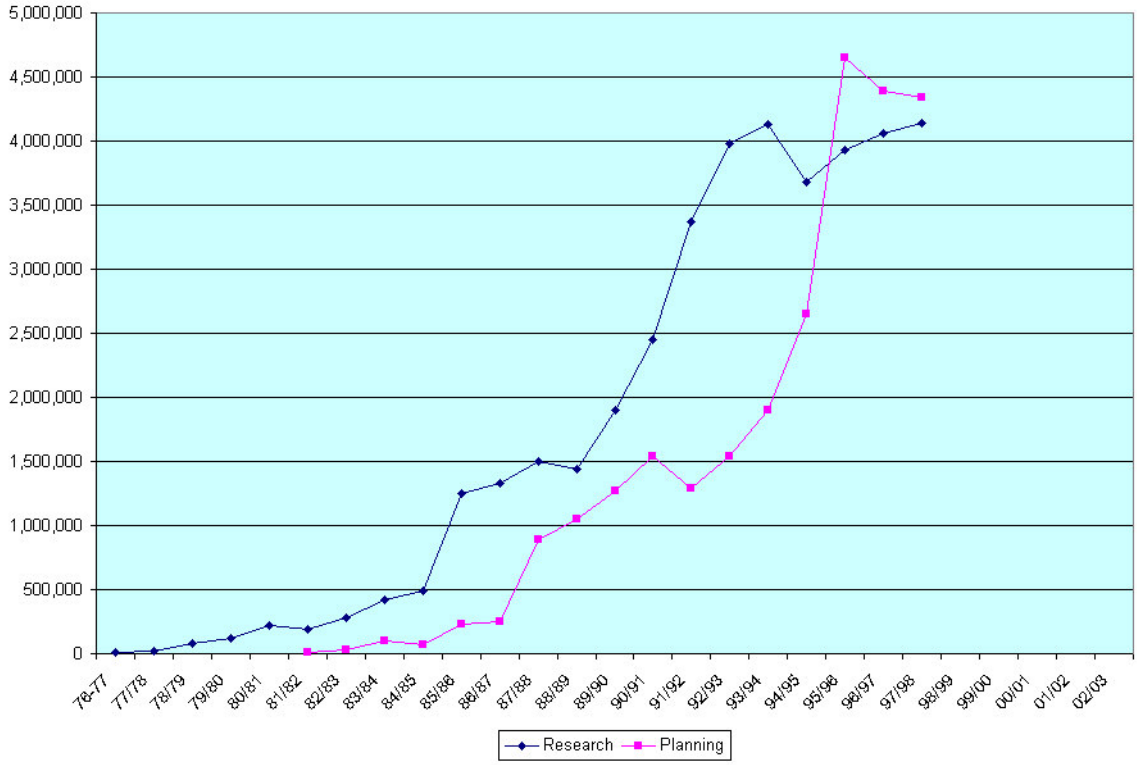


GBRMPA expenditure has accelerated over time and if permitted to follow the exponential trend of the past 25 years would in another 25 consume the entire federal

budget. This of course will not be permitted to happen and the only real question is at what level do we curtail it. A strong case can be made that it is already far in excess of requirements for the job it does and that it should either be cut back or restructured in accord with accountable performance aimed toward clearly defined objectives.

It is interesting to note that although both the Queensland state contribution to GBRMPA revenue and the Environmental Management Charge they receive each now amount to as much as their total budget of only 15 to 20 years ago the Commonwealth contribution has continued its upward trend undiminished. With some 700% increase over that time they still manage to perform the same job.

Research and Planning Expenditure



Scientific knowledge of both coral reefs in general and of the GBR itself is still very fragmented and incomplete. Without better understanding of reef biology and of the actual conditions on the reef attempting to manage it becomes a meaningless charade. Unfortunately much of even what little we do understand is not relevant to management issues. Research and ongoing monitoring is essential to provide the information necessary to effective management. The need for further study to reach any sound understanding is a recurrent theme in publications on reef research. Rarely has it been followed up, even in the studies sponsored by GBRMPA itself. Far too small a portion of GBRMPA's resources has been directed toward this essential need and the result has been management based largely on theory and unsubstantiated opinion with little determination of either the reality of the problem to begin with or the actual effect of the measures taken.

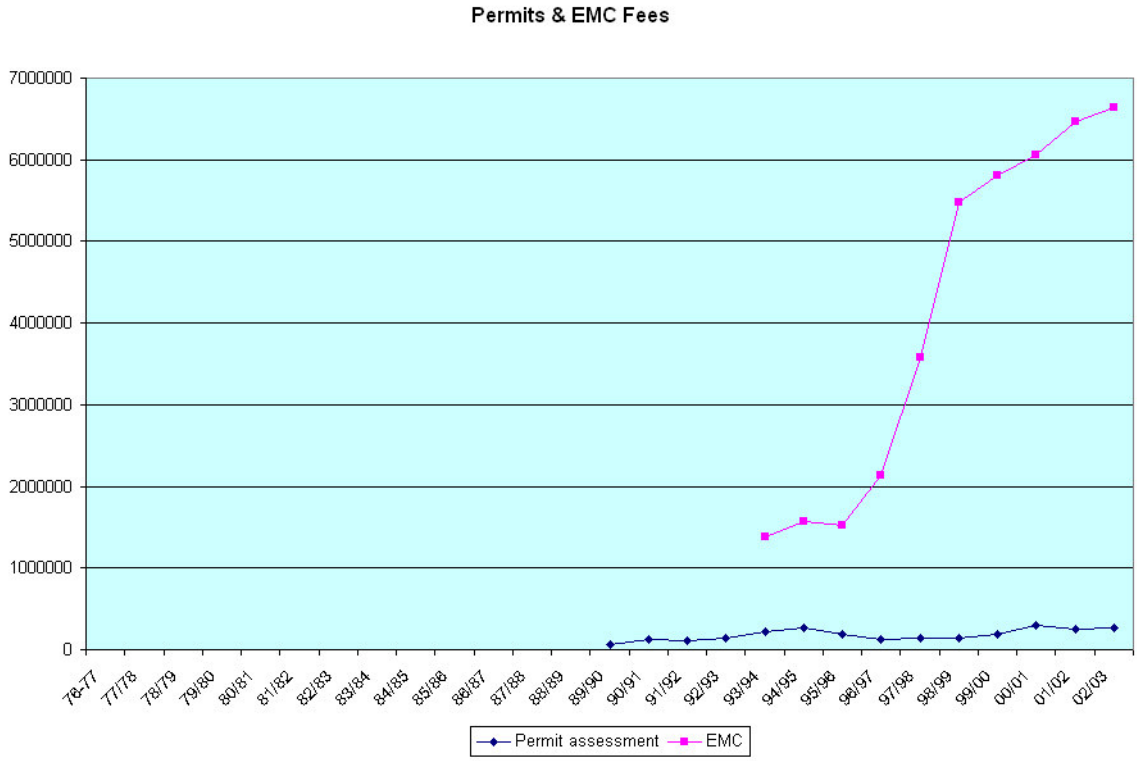
In 1992/93 the Cooperative Research Centre for the Ecologically Sustainable Development of the Great Barrier Reef (CRC), a consortium comprising AIMS, JCU, QDPI, AMPTO and GBRMPA, was set up with the aim of researching ecologically sustainable development within the Marine Park. Since that time an increasing portion of GBRMPA research has been conducted by the CRC. It is unclear from the figures given what portion of GBRMPA research funding has gone to CRC and after 1999 there are no figures for GBRMPA research and monitoring as a whole. In the current federal budget however, future Commonwealth funding for the Reef CRC has been terminated. The Cooperative Research Centre programme is intended to bring together federal, state, institutional and industry support for research targeted at commercial outcomes serving particular resources or industries. The Reef CRC has in fact not been conducting research aimed at the needs of industry but rather more basic environmental investigations. The only commercial outcome has been as supposed evidence of the need for substantially increased restrictions on a broad range of industry and development in the region. Not surprisingly the Commonwealth government has decided to redirect Reef CRC funds to other CRC effort that is more focused on solving problems than in proclaiming them.

In fairness to the Reef CRC is should be noted that the research itself has generally not called for such increased restrictions but rather it has been predominantly directed towards examining purported problems rather than aiming for solutions and GBRMPA has selectively used findings that suit its agenda even when the overall conclusions do not. For an example see Summary No. 4 of this series.

The Planning section of GBRMPA has been largely if not entirely involved in the zoning of the GBR. As may be seen in the above graph the expenditure for zoning and rezoning the reef has increased dramatically over the years. Most of the GBR is rarely visited by humans and zoning does nothing to address most of the purported concerns regarding the reef such as global warming, water quality, starfish outbreaks, storm damage, siltation, etc. In fact the only real activity being regulated is fishing and that, as detailed in Summaries 2, 3, and 4 of this series, is at such a low level as to be negligible or absent over most of the reef.

Beyond its dubious utility in the first place one also has to wonder why zoning has required a quarter century of increasing expenditure with no end in sight nor any evaluation of its effectiveness. By 1998 over 25 million dollars had been spent on zoning and it still continues. It is also worth noting that in 1999 the GBRMPA financial statements ceased providing breakdowns of expenditure for a variety of activities including Research and Planning thus effectively concealing them from further public access. Even assuming no further increase in annual zoning expenses the total would now amount to over $50 million with no end in sight.

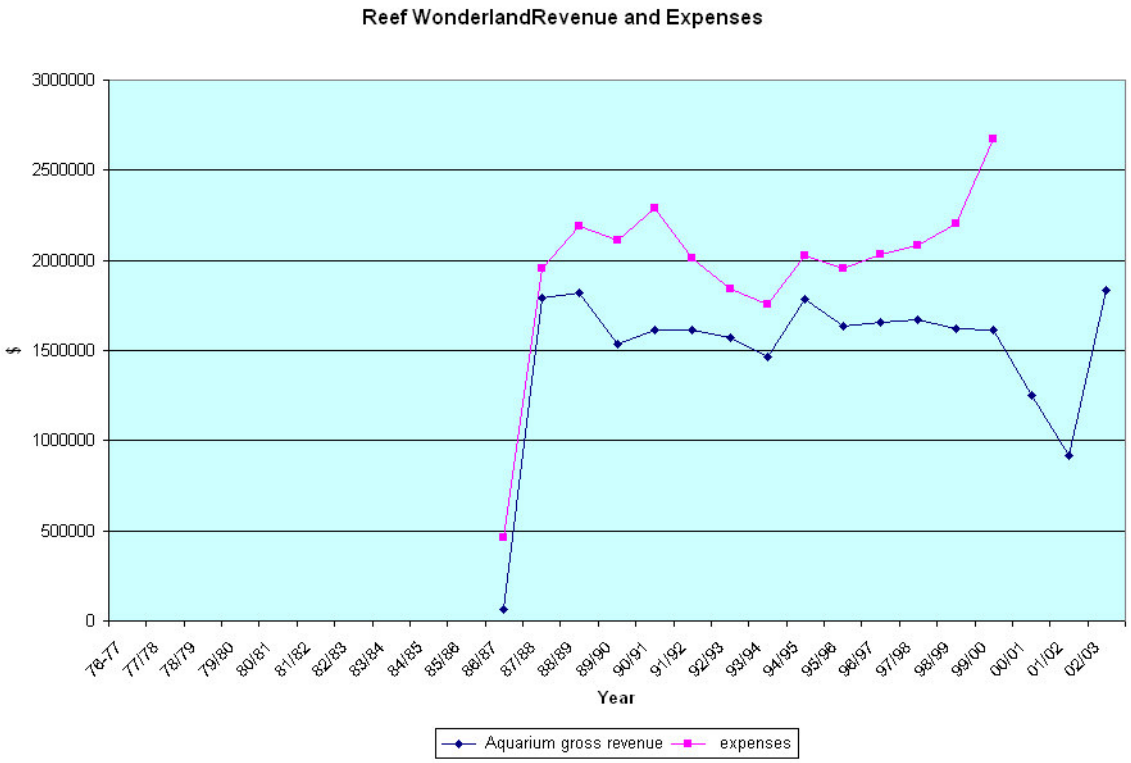
Permit Assessment Fees and the EMC



Permit assessment fees first appear in 1989/90 at $60,500 for the year and trend only slowly upward. For 2002/03, the most recent year available, they total $270,045. In terms of the GBRMPA budget the fee is a trivial source of revenue representing less than 1% of their budget. However, in view of the often lengthy and laborious process involved in obtaining permits and the number of personnel involved this fee must surely fall well short of the actual cost involved. One cannot help but question why after a quarter century of experience in issuing permits the assessment of common activities has not become simple and quick or even necessary at all where repeated experience indicates no adverse effects.

In 1992/93 the Authority began collecting an Environmental Management Charge (EMC) or head tax on reef visitors. Amounts collected are paid into the Consolidated Revenue Fund and then paid back to the Authority as a Special Appropriation. In 1998 this fee was increased from $2 to $4 per person per day. This tax now brings in over $6 million annually. As can be seen from the graph this revenue has escalated rapidly. Despite the user pays rationale used to justify this tax it has simply become additional revenue for GBRMPA with no added responsibilities beyond what is already being funded by state and federal government support.

Reef Wonderland



In 86/87 GBRMPA was successful in seeking a special Bicentennial grant of $7,176,516 to aquarium build a public aquarium at its headquarters in Townsville. The Reef Wonderland (or Reef Blunderland as it is known informally) has operated at a loss in all of the 18 years since its inception. Elsewhere oceanaria are universally popular and the Reef Wonderland is perhaps the only one in the world to have never shown an operating profit despite having no costs for rent or interest.

The fundamental problems are twofold. The Marine Park Authority is trying to run a business within the institutional culture of a public service body and without the necessary management ability. Most importantly the facility is located in a remote regional centre with neither the local population nor the tourist numbers to support it.

The situation is in fact even worse than the above figures suggest in that they include nothing for depreciation or long term employee obligations and do not reflect the entire value of all costs and services to the aquarium operation provided by the parent authority. In addition, on 22 May 2001 the Government announced a further funding of $4.9m for Reef HQ (*i.e.* the Reef Wonderland and Imax theater) in the 2001-02 Budget. This was to refurbish the facility which after some 18 years of operation was looking pretty shabby. The dip in revenue in 2001/02 is the result of an extended closure for renovation however, the fall in the previous year occurred before the closure. Likewise the jump in 2002/03 is attributable to Townsville residents wishing to see the refurbished facility.

It should again be noted that while aquarium revenue has continued to be detailed in the annual reports, expenses ceased being reported after the 1999/2000 report thus nicely hiding the ballooning deficit.
The GBRMPA aquarium strongly deserves a serious rethink. Since its inception it has cost taxpayers over $20 million in establishment, refurbishment and operational losses. A major new function for it might be as a research facility. This would not preclude its current public viewing function but that alone can simply not justify its ongoing existence. Not only could it become a valuable tool for research the research could in turn greatly enhance its interest to visitors.

Some Additional Points of Interest from the 2002/03 Annual Report

- Employees in 02/03 cost $11,554,997.
- There were 171.11 employees of which 148 were full time ongoing positions.
- The average GBRMPA employee costs over $67,000 per year.
- There are 9 officers in the $100,000 to $170,000 per annum salary range.
- The chairman received between $200,000 and $210,000. (The Prime Minister receives $267,000.)
- Over a half-million dollars was spent on media advertising.

Summary

Examination of GBRMPA annual reports for the past 25 years reveals a classic case of bureaucratic empire building with no increase in function accompanied by exponential growth of the organization and its budget. In reality almost all their generous budget is spent on maintaining and promoting themselves plus covering the deficit of their ill conceived and poorly managed aquarium and theater complex. Only about 10% of their budget goes to research and surveys to produce the real information necessary to make competent decisions regarding the reef. Even this is contracted out and results ignored if they do not support their established agenda.

GBRMPA has been operating in a climate of ignorance employing hypothetical solutions to problems that exist only in the imagination. In truth if GBRMPA never existed at all the situation on the reef would be little different. The only real world result of all this has been to create an ever increasing morass of regulations, permits and fees. With broad power, little oversight or accountability, an ever expanding budget, idyllic working conditions and no duty other than a self defined agenda it's a bureaucrats dream.

The entire organization needs a shake up. It should be made to become reef oriented, not just a sheltered workshop of office workers. Competent management requires first hand knowledge and experience of the business at hand. An injection of broad knowledge and experience of reefs into high level management is sorely required. The focus on permits and zoning should be de-emphasized. Surveys, monitoring and research deserve much greater emphasis. Decisions should be based on what is actually happening on the reef not theories, fads and opinions. Intervention and regulation should be applied only where a demonstrated need exists and results should be monitored and evaluated. It is time too that provision was made to seek oversight and advice from reef users and researchers with genuine relevant knowledge and experience.

GBRMPA badly needs restructuring to serve the reef, reef users and the regional economy not just itself. It can become a real asset or it can be just another obstacle to our use and enjoyment of the reef. It's up to us.

References

The GBRMPA Annual Reports from 1996/97 through 2002/03 may be downloaded as .pdf files at:
http://www.gbrmpa.gov.au/corp_site/info_services/publications/annual_reports/

Key Points/Soundbites

- GBRMPA now spends nearly 10 times as much to do the same job it did a half-dozen years after it began.
- If permitted to follow the exponential trend of the past 25 years GBRMPA would in another 25 consume the entire federal budget.
- GBRMPA should either be cut back or restructured in accord with accountable performance aimed toward clearly defined objectives.
- The Queensland state contribution to GBRMPA revenue and the Environmental Management Charge they receive each now amount to as much as their total budget of only 15 to 20 years ago.
- The only commercial outcome of Reef CRC research has been as supposed evidence of the need for substantially increased restrictions on a broad range of industry and development in the region. Not surprisingly the Commonwealth government has decided to cease funding Reef CRC in favour of other CRC effort that is more focused on solving problems than in proclaiming them.
- For a quarter of a century GBRMPA has been zoning and rezoning the reef at a total cost of over $50 million with no end in sight nor any evaluation of its effectiveness.
- Despite the user pays rationale used to justify the reef visitor tax it has simply become additional revenue for GBRMPA with no added responsibilities beyond what is already being funded by state and federal government support.
- The GBRMPA aquarium has operated at a loss in all of the 18 years since its inception. It may well be the only ocenarium in the world to have never shown an operating profit.
- The GBRMPA aquarium has cost taxpayers a total of over $20 million in establishment, refurbishment and operational losses.
- The entire organization needs a shake up. It should be made to become reef oriented, not just a sheltered workshop of office workers.
- GBRMPA badly needs restructuring to serve the reef, reef users and the regional economy not just itself.