Sydney Fish Market Pty Ltd submission –

Enhancing conservation of marine biodiversity in the Hawkesbury Shelf marine bioregion – Discussion paper

Introduction

Sydney Fish Market Pty Ltd (SFM) appreciates the opportunity to provide input to the Discussion Paper on Part 1 of the Hawkesbury Shelf Marine Bioregion. We do so by considering this Discussion Paper in the context of the Implementation Phase of the NSW Marine Estate Management Strategy.

SFM has provided detailed input to each phase of the development of the Management Strategy, including to the Threat and Risk Assessment (TARA) component of it and the Draft Hawkesbury Shelf Marine Bioregion Initiative. At each stage we have expressed our extremely strong support for the evidence-based approach to addressing clearly identified threats and the risks associated with them that have underpinned the development of the Strategy: the logic of first describing a problem accurately before attempting to solve it is compelling. We have accordingly expressed the strongest possible support for the five-step approach on which the implementation of the Strategy is based.

In the interest of working cooperatively with MEMA to improve the Strategy we have previously highlighted our concerns with numerous parts of the Draft Strategy, particularly those that understate the value of seafood and those that negatively impact seafood supply through the over-regulation of commercial fishing. We readily acknowledge that quite a few of our suggestions for amendment to specific components of the Draft have been accepted and accommodated by changes in the final Strategy. We appreciate the amendments that have been made on our behalf: naturally we believe that they have resulted in improvement to the Strategy.

We congratulate MEMA on the final Strategy. It represents a relatively concise expression of the improvement in the approach to the conservation and management of the Marine Estate that has been made over the last five years or so. We do, however, have ongoing concerns, which we believe need to be addressed in the interests of improvement of the implementation of the Strategy.

We appreciate that the NSW Marine Estate Management Strategy released in August 2018 is a final document and further changes will not be made until the Strategy is reviewed in five years. We note however, that the implementation of the Strategy is an ongoing process and constructive input is encouraged. We are also mindful that the Discussion Paper on the Hawkesbury Shelf Marine Bioregion is open for comment. It is also particularly relevant that "The initial focus, in Stage 1, (of the implementation of the Strategy) will be on the establishment of a monitoring and evaluation program". SFM has great interest in how that program is constructed. Based on the success of our cooperative relationship with MEMA we are confident that an evidence-based exposé of our ongoing concerns will facilitate the broad implementation of the Strategy, including the pursuit of wise management of the conservation and use of the Hawkesbury Shelf Marine Bioregion.

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The perception of the threat posed by commercial fishing

The correct assessment of the optimum quantities of seafood that can be taken sustainably from the NSW Marine Estate is of fundamental importance to SFM. Confirmation of the sustainability of supply must include assessment and consideration of the environmental impact of fishing. It has been an ongoing concern of ours that the importance of seafood supply to the approximately seven million consumers in NSW has continued to be understated by the NSW Government and even by MEMA. Fresh local seafood is in extremely high demand. The consumption of local seafood delicacies is a priority heritage issue, particularly for coastal communities. But this prized local seafood is in short supply. It represents less than 10% of the seafood consumed in this State. Sustainable supply of local seafood at maximum levels must be an extremely high priority for Government. It must be made obvious to the people of NSW that the supply of seafood from fisheries in NSW is indeed sustainable.

At the same time as the importance of supply has been understated the threat posed by commercial fishing has been exaggerated across the social media and even the scientific literature. Unfortunately this bias continues to be reflected in MEMA's documentation, albeit at a reduced level. Fishing has been the subject of much of the increased management in the Marine Estate in the last decade and almost all of that in NSW marine parks. And yet the highest ranked threat from any form of commercial fishing, the ocean trawl fishery, is prioritised at number 17 (Table 1 in the Strategy)! Thus the total of the management actions that have been taken to date continues to be inconsistent with MEMA's current strategy to focus management on assessed priorities (discussed below).

The increased recognition of the breadth and severity of the many individual threats to the Marine Estate in the Final Strategy is an outstanding feature of the Strategy. The summary of the implementation process, albeit brief, including the two Case Studies, has increased our confidence that the implementation of the Strategy will see further realignment of management actions with the priority of threats. The selection of "Improve water quality, reduce litter and deliver healthy habitats" as the objective for Stage 1 of the implementation of the Strategy is also most reassuring. We believe the success of the Strategy will be dependent upon strict adherence to the principles MEMA has espoused, including the five-step process.

Of course we are pleased that in accordance with the progressively more rigorous prioritisation of threats and risks in the development of the Strategy the relative priority given to the threat posed by commercial fishing has been significantly downgraded. It is also gratifying to see that the outputs of the prioritisation process are being translated into the implementation phases of the Strategy. We attach great significance to the confirmation of this by the selection of restoration of the Richmond River as Case Study 1. Our support for the relevant priorities of the actions that are proposed in this Case Study is elaborated below, including in the Appendix. It is also comforting for the seafood industry to note that Case Study 2 is the Global Blue Growth Economy. We look forward to working closely with MEMA on the development of initiatives for growth in the supply of seafood under the umbrella of this Case Study.

SFM's ongoing concerns

As acknowledged above the evolution of the principles expressed in the TARA and the Strategy has seen a progressive diminution in the priority given to the threat posed by individual commercial fisheries to the Marine Estate (Table 1 of the Strategy). The 'fine print' of the Strategy however, continues to reflect a pervasive perception that commercial fishing represents a greater threat than the evidence supports. The detail in the discussion still projects fishing in NSW primarily as a threat and not as the well-managed realisation of one of the greatest assets of the Marine Estate. This inference is not consistent with the available evidence. It appears a hang-over from earlier misconceptions throughout Australia that marine conservation is primarily fisheries management under a different name. The Commonwealth Government's official statement that the terms 'marine park', 'marine protected area' and 'marine reserve' are synonymous is one telling example: close an area to fishing (a reserve) and it is automatically 'protected' (an MPA). It is also automatically a marine park with all the public accolades such a title engenders. It is particularly relevant to NSW marine parks that the initial scientific justification for establishing marine parks in this State was the infamous Government 'Science Paper' of 2007. This paper was completely discredited and was accordingly withdrawn from Government websites but at least some the false claims of benefits from fishing closures have not disappeared. The false perception that closing an area to fishing must be good for conservation no matter what the threats actually are continues to be prominent in public opinion.

Compelling evidence that any form of fishing as is managed in NSW is even a moderate threat to the assets of the Marine Estate is completely lacking. There is available however, compelling evidence of the health and dietary benefits of seafood (for example from the National Health and Medical Research Council) and also continuous market and restaurant data on the priority of seafood in the public's preferred culinary experiences. Fish and other marine species unquestionably constitute a high priority asset. Seafood represents the realisation of a high priority benefit.

In our earlier submissions SFM has exposed flaws in the assertion by MEMA staff that various forms of fishing are high or even moderate priority threats to the assets of the Marine Estate. As we have detailed, this assertion by MEMA has been based on inadequately researched acceptance that the managed removal of fish has a seriously deleterious impact on biodiversity primarily because it impacts fish abundances and assemblages. We have not questioned that fishing impacts the abundances of some fish and assemblages of others; commercial fishing is after all the process of transferring fish from the ocean to the plates of seafood consumers. We also have not questioned that in unmanaged or even poorly-managed fisheries the threat could represent a high priority risk. This is of particular concern if destructive fishing practices are permitted, which they are not in NSW. What we continue to oppose is the uncritical presumption that commercial fishing as managed in NSW is a significant threat to biodiversity simply because it removes scientifically assessed and Government approved quantities of relatively large fish from the ocean. We also remain opposed to the prominence being given to studies that use the reduced abundance of larger individuals of targeted species to claim a benefit to overall conservation of marine systems. Unless the level of fishing seriously exceeds that which produces the maximum sustainable yield (MSY) recruitment of larvae and hence abundance of smaller individuals of the same species are not threateningly reduced. The sustainability of populations is by definition not adversely affected by well-managed fishing.

What we have documented in our earlier submissions is the tremendous ability of fish to accommodate controlled harvest by techniques that are not inherently destructive of their habitats and environments. This ability is largely the result of the evolution over millions of years of marine species in an environment with few impenetrable lateral boundaries and where the abundances of individual species naturally fluctuate enormously in response to environmental variability over varying timescales, particularly in localised areas.

Even if some form of controlled harvest does have a greater than anticipated impact on abundances of fish this impact is not irreversible; recovery plans to correct overfishing, where and when it may have occurred, have been proven effective wherever there is concerted and adequate management effort. This effectiveness results from the actions in these plans being targeted at the properly assessed cause of a specific problem, not by indiscriminate management actions in areas not related to an identified threat.

We have also highlighted that not a single species of marine fish has ever been documented to have been fished to extinction anywhere in the world, let alone where there is fisheries management of the standard that is taken for granted in NSW. The managed reduction of the abundances of larger individual fish by tightly controlled commercial fishing to levels that maximise sustainable surplus production is the efficient realisation of the benefit from a sustainable asset. It is not a high level risk, or even a moderate level threat.

We have also stressed in earlier submissions the differences between the threats to fish abundances posed by commercial fishing to those represented by virtually all of the other identified threats to "environmental assets" and "social cultural and economic benefits" of the Estate (Tables 1 and 2 respectively in the Strategy). As stated above the highest priority threat from any form of commercial fishing is after all number 17! Not only are other threats to marine environments ranked much higher but unlike fishing the impacts of many of these threats are either irreversible or well beyond the scope of current, or even hypothesised, management. Many of them even have a direct impact greater than commercial fishing on fish abundances and assemblages, in particular the abundances of the critically important eggs and larvae of numerous species (discussed under Case Study 1 in the Appendix below).

Fish have evolved to accommodate major fluctuations in abundances, such as those caused by increased predation or decreased food supply, and environmental variability, including climate change. They recover relatively quickly from episodic catastrophes, such as volcanic activities or cyclones. Even episodic pollution events, such as chemical spills, can generally be overcome provided they are short-term and relatively localised. Fish populations can accommodate reduced abundances of individuals, particularly if reductions are managed within the limits of sustainability of individual populations. But they have little inherent defence against pervasive and ongoing human interventions, such as pollution in many forms and unnaturally translocated species and pathogens. The unprecedented nature and timescales of these types of impacts, coupled with the fact that they commonly affect multiple stages of the life-cycle, have prevented adequate evolutionary response.

SFM remains deeply concerned that the evidence that has been used by MEMA to justify further restriction of commercial fishing in NSW continues to suffer from being based on unjustified perception and/or has been inadequately evaluated. Even the evidence that was used to support the classification of the highest risk threat from commercial fishing, the Ocean Trawl Fishery in northern

NSW, has been demonstrated to be so irrelevant and uncritically evaluated that the conclusions based on it were distorted to the extent of being erroneous (correspondence from Professor Kearney to DPI Deputy Director General Fisheries of August 13, 2018). The evidence that was presented by DPI to Professor Kearney to support the classification of this fishery as high risk exposed a most unfortunate underlying bias against the capture of fish, no matter how well-managed it may be or how valuable it may be to the sustainable realisation of the assets of the Marine Estate.

Deviation from the evidence-based approach

SFM has repeatedly expressed its strong support for the evidence-based approach to the pursuit of MEMA's Vision for the Marine Estate; as acknowledged above the logic inherent in the approach is compelling. Common sense dictates that to solve a problem you must first identify the cause and then initiate action that effectively addresses that cause. What we do not support is deviation from this evidence-based approach to problem identification and solving, such as is evident in the management actions taken within the State's existing marine parks and proposed for the Hawkesbury Shelf Marine Bioregion.

Management within NSW marine parks is completely dominated by the closure of areas to fishing without prior identification of the priority threats to those areas or how further restriction of fishing in those areas could result in net benefit to the Estate as an entity. Furthermore, even though fishing, in all its forms, is the primary activity managed in those areas no evidence is provided to demonstrate that current management of commercial fishing is not protecting the environmental assets of the State against fishing, even in those areas.

SFM is not aware of any substantiated evidence of a high-risk threat to the environmental assets of the Marine Estate from any form of commercial fishing in NSW; each of the claims of serious threat put forward by MEMA has been discredited: we have not been advised of error in our assessments. It is also contrary to the available evidence to claim that even if some form of fishing should represent a threat to the assets of the Estate then area management in the form of indiscriminate fishing closures in parts of the area where the problem is manifest would represent an adequate, effective and efficient solution. It is illogical, and contrary to MEMA's five step process, not to base management on addressing a prioritised threat. It is equally illogical to predetermine management action solely on the contents of an area and not on the threats to these contents or where the threat arises. Closing an area to fishing does not provide protection against higher priority threats. Even the protection against fishing provided by a fishing closure is often not even adequate: fish abundances and assemblages in closed areas can be deleteriously affected by excessive fishing outside these areas, particularly for migratory and/or mobile species. In spite of repeated assertions by some senior marine scientists areas closed to all fishing are not totally protected, even against fishing.

Commercial fishing is already heavily discriminated against in the State's management of the Marine Estate. More than 98% of the State's estuaries is closed to at least some form of commercial fishing. 55% is closed to all commercial fishing. Numerous open-ocean areas are also closed. More closures are proposed in the Hawkesbury Shelf Bioregion. As stated above, all such closures in marine parks have been mandated or proposed without critically evaluated evidence of any significant unmanaged threat from commercial fishing to the areas in question or the Marine Estate generally. Evidence to support the assertion in the Hawkesbury Shelf Discussion Paper and in the media release

of August 16, 2018 by the Premier of NSW and the Minister for Primary Industries and Minister for the Environment, that biodiversity will be enhanced by these closures is similarly completely lacking (discussed below).

The influence of perception over evidence was acknowledged in earlier drafts of the Strategy and the TARA. In the final Strategy acknowledgement of the influence of perception has been removed, but unfortunately the impact of ill-informed perception has not been effectively compensated. As we stressed in earlier submissions poorly informed perception is the antithesis of evidence-based assessment.

The prominence given to area management in the form of zoning

The use of area management in the form of zoning remains extremely prominent in existing marine parks and in the proposed Hawkesbury Shelf Bioregion plan. This plan includes the statement that "zones will be used to manage the network of 25 sites". Three types of zones are described; Sanctuary, Conservation and Special Purpose Zones. Their prominence in the strategy for the management of the Hawkesbury Shelf Bioregion is confirmed in the Media Release by the Premier and relevant ministers.

1 *Sanctuary zones*. The Premier's media release states "Sanctuary zones would enhance biodiversity and allow a range of activities such as snorkelling, diving and boating". This statement is derived from the definition and predicted output from zones provided in MEMAs detailed documentation, such as on page 1 of the Hawkesbury Shelf Discussion Paper. It could be accepted that creation of a true 'sanctuary' would likely enhance biodiversity. However, closing an area to fishing while ignoring many higher priority threats does not create a sanctuary. The name 'sanctuary zone' in the context in which it is used is emotive, not evidence-based and factually incorrect. The exclusion of fishing is the primary management action anticipated in the proposed sanctuary zones. The reference to allowing snorkelling, diving and boating is further misrepresentation of the actions being taken; all three activities are already allowed in these areas.

How the closure to fishing will affect enhancement of biodiversity is not detailed. How the primary espoused outcome, 'enhanced biodiversity' is to be measured, or even confirmed to have happened, is also not described in the Media Release or any of the supporting documentation. How the enhancement of biodiversity is to be measured is made the more obscure by the failure to even define biodiversity. The word biodiversity is actually used imprecisely, and even inconsistently, throughout the documentation. This is most unfortunate, disappointing and surprising. The actions proposed in MEMA's Strategy as a whole reflect much better understanding of the breadth and complexity of biodiversity and the threats to it than that which underpinned earlier marine park development. Departure from the complete domination of management in previous parks on restricting fishing and the subsequent use of fisheries management outputs as measures of success of zoning is an outstanding feature of the Strategy.

The lack of evidence of how the espoused enhancement of biodiversity is to be achieved and confirmed exposes the claim as unjustifiably optimistic, or even wishful. It is difficult to accept that biodiversity will be efficiently enhanced in sanctuary zones if the threats to that biodiversity in each zone are not accurately described before the most appropriate action for each is identified and then applied in priority order.

The expressed objective of enhancing biodiversity is of course a laudable goal, but as used in the media release and supporting documentation it is little more than an elusive abstraction. It has a high level of 'feel good' appeal but little demonstrated relationship to an evidence-based approach to "Protecting the future of our marine estate" (the title of the above-mentioned media release by the Premier and Ministers). The assertion that actions in sanctuary zones that are restricted to addressing very minor threats (the highest ranked form of commercial fishing is at number 17) in only limited parts of the Marine Estate is an efficient approach to "Protecting the future of our marine estate" is hardly logical: it is not consistent with the available evidence. The lack of a definition of biodiversity, description of what biodiversity will be enhanced in sanctuary zones and how that enhancement will be measured means that the whole objective and its realisation remain largely immune from evidence-based evaluation. It is particularly worrying that the consistency throughout MEMA's documentation in the obscurity of how biodiversity is to be measured and enhanced suggests that this obscurity is not accidental. This shortcoming could unfortunately detract from the level of acceptance of the principles that underpin the Strategy.

Imprecise and inaccurate claims of benefits to biodiversity are not limited to the proposed Hawkesbury Shelf plan; they have been a feature of existing marine parks. For example, the claimed benefits from fishing closures in zones within in the Batemans Marine Park were dominated by the standard output from fisheries management, i.e. in areas closed to fishing there were more large fish of those species that would have been taken by fishing. Enhancement of biodiversity was not confirmed. In fact the documentation used to support the claim of benefits actually stated "The richness of fish species (a common measure of biodiversity) was significantly greater in general use zones than in habitat protection zones" and the richness of species "did not differ significantly between sanctuary zones and fished areas". Detail on the inaccuracy and misrepresentation in the claim of benefits from zoning in the Batemans Marine Park was provided to NSW DPI in the form of correspondence of June 18, 2018 from Professor Kearney to the Narooma Port Committee and the Batemans Marine Park Advisory Committee.

2 *Conservation zones.* The anticipated output of this category of zone is defined in the media release as "Conservation Zones would provide a high level of conservation benefit". The lack of identification of the threat to conservation that is to be addressed distances this action from a threats-based approach. The anticipated 'conservation benefit' is not identified. The failure to describe a relationship between the asserted, but unidentified, conservation benefit and the action proposed, predominantly the restriction of most forms of commercial fishing, exposes the statement as unjustified and unrealistic optimism. As for sanctuary zones the lack of description of how benefit is to be measured further distances the proposed action from 'evidence-based' evaluation.

3 *Special purpose zones*. It is only in this third category that the wisdom in having action designed to address a specific threat is acknowledged. This category is the only one for which threats are not presumed. These zones do not automatically exclude fishing.

The lack of relevance of zoning of fishing to the management of the priority threats to the Marine Estate is confirmed in the first Case Study to be undertaken in the implementation of the Marine Estate Management Strategy, Restoring the Richmond River (discussed in detail in the Appendix). This Study logically begins with identification of a problem; the estuary is in poor health. The stressors to that river are then identified and the actions that address each to enhance its damaged

biodiversity and general health are addressed. The actions proposed do not include zoning. Rather they are based on the management of threats where they arise, not where they impact. It is noteworthy that in this Case Study fishing is identified and treated primarily as an asset that is threatened, not as a threat.

Evaluation of zoning in accordance with MEMA's evidence-based approach?

Management of NSW marine ecosystems to date has been disproportionately concentrated on the use of area management in the form of declaration of marine parks. The consistency of this approach with evidence-based management is highly questionable. MEMA actually acknowledges that area management is ineffective for addressing most of the highest priority threats to the Marine Estate. Management within these marine parks is concentrated on zoning that restricts fishing. The selection and declaration of these zones and the actions within them have not been based on addressing the highest priority threats to the Marine Estate as an entity or even to the areas in question. The Great Barrier Reef Marine Park Authority made this same mistake several decades ago. It concentrated management on closing extensive areas to fishing, simply because it could and it sounded good to the ill-informed public. This was unfortunately at the expense of attempting to manage, or at least focusing attention on, major threats, such as run-off from agriculture and mining, that would be much more difficult, expensive and politically unpopular to address. The current plight of the Reef is testimony to the fundamental flaw of not managing threats in priority order. It also reflects the negative impact of unjustified optimism in the outcomes from zoning of fishing.

The process of zoning as implemented in existing marine parks in NSW and that proposed for the Hawkesbury Shelf Bioregion is so obviously questionable that it should be evaluated against the five step process that is the foundation of MEMA's whole strategy for management of the Marine Estate.

The first three steps in this process are:

1. *identify community benefits and threats*,

For the implementation of this step to be efficient all major benefits and threats must be clearly identified and the relationships between each benefit and the threats to it described unambiguously.

2. *assess threats and risks to benefits*

The assessment of threats and risks requires precise identification of benefits (Step 1) and adequate description of the mechanisms whereby each threat becomes a risk to each benefit. Effective assessment, including prioritisation, requires measures of the relative risk to each benefit.

There is no evidence that the assessments prescribed in steps 1 and 2 have preceded the declaration of marine parks and the zones within each. For example the major threats to the assets in each zone have not been identified. Even the relationship between the threats from each form of fishing to community benefits has not been described for each zone is each marine park even though major management of fishing has occurred in all earlier marine parks and is proposed in the Hawkesbury Shelf Bioregion.

3. *assess current management.*

To effectively evaluate management of the Marine Estate as an entity the management of at least the highest priority threats to the most valuable benefits must be assessed across the whole Estate. There is little evidence of detailed assessment of the impacts of the highest priority threats but there is acknowledgement of broad management failure of many of them; for example estuaries are acknowledged to be generally in poor health. Why there has been disproportionate concentration of additional management on threats that are acknowledged to be lower priority, such as fishing, must be evaluated. The extent to which this deviation from adherence to assessed priorities has distracted effort from addressing higher priorities must also be assessed.

NSW commercial fisheries are currently well managed. They are unquestionably more adequately, efficiently and precisely regulated than at least the great majority of the 16 threats listed by MEMA above the first form of commercial fishing (Table 1 in the Strategy). Furthermore the evidence to support the assessment of the status of the management of commercial fisheries (such as effort and catch statistics), the asset it represents (market and restaurant sales statistics) and the management of the threat to other assets it might pose (assessment of its environmental impact) is far more precise and compelling than that available for other threats and assets. Every fishery in NSW is required to have an Environmental Impact Assessment. This Assessment is in turn used to inform a Fishery Management Strategy for each fishery. Furthermore every fishery that exports product, which most managed by the NSW Government do, must be separately assessed under the Commonwealth Environment Protection and Biodiversity Conservation (EPBC) Act. Commercial fishing is already very tightly regulated under the State Fisheries Management Act and Commonwealth and State environment acts. It is arguably already over-regulated under these acts.

No evidence is provided in any of MEMA's public documentation to support the assertion that further management of commercial fishing by additional indiscriminate prevention of access by zoning constitutes appropriate and efficient regulation. Rather there is considerable evidence to demonstrate that zoning as managed in NSW marine parks, under the Marine Parks Act, is duplication of the management of fishing under the NSW Fisheries Management Act (all fishing closures in marine parks or elsewhere could be enacted and enforced under the Fisheries Act). The regulation of the same fishing activities under two separate acts is duplication. Particularly as NSW fisheries are acknowledged to already be well managed under the Fisheries Act. It is inefficient and in this case, largely inappropriate. The duplication of the regulation of fishing and the enforcement of these regulations is overregulation. Furthermore, the concentration of management on regulating fishing at the expense of addressing higher priority threats contributes to the management of these other threats being inadequate. These conclusions must be considered in the context of MEMA's list of "Statewide priority threats to social, cultural and economic benefits" (Table 2 of the Strategy). This Table identifies "inadequate, inefficient regulation or overregulation" as the number 11 priority threat to these benefits.

Table 2 in the Strategy also affords considerable priority to the threat posed by diminished access to the States marine assets. The need to protect and even improve access is explicitly expressed in priorities 6 and 10 (in Table 2) and implied in several others. Diminution of the access of the State's seven million seafood consumers to seafood is a direct outcome of closing areas to commercial fishing.

Assessment of the regulation of commercial fishing by zoning against the requirements of MEMA's five step process for the management of the Marine Estate demonstrates contravention of at least the first three steps. As this five-step process is the platform for the whole of the Marine Estate Management Strategy a comprehensive review of the utility of zoning as a priority tool for the protection and use of the Marine Estate is warranted.

The value of commercial effort and catch data

Not only is commercial fishing the most heavily regulated of the threats listed by MEMA but the data on its activities are far superior to that for other threats. Every individual commercial fishing activity in NSW generates data on at least catch and effort on at least a trip-by-trip basis and in most cases a daily basis. Much of this data is validated by Fish Receiver data at Coops and SFM. Commercial fishers are actively working with DPI to progress towards having all catch and effort statistics available on a real-time basis with likely completion in 2019. Commercial fishers represent the most comprehensive source of scientific quality data on the status of a high priority asset of the NSW Marine Estate.

While SFM strongly supports the intent of Phase 1 of the implementation of the Strategy we are concerned that there is need for care in how progress with implementation is assessed. Our concern with the prominence given to inappropriately assessed fish abundances and assemblages as indicators of ecosystem wellbeing has been repeatedly stressed. We note MEMA's intention within the Implementation Phase to "monitor changes in fish assemblages along the coast using citizen science programs". We again stress that commercial fishers are the citizens with the very best scientific data and also far superior experience and expertise in evaluating fish distribution and behaviour; their livelihoods depend on their abilities to not only monitor relative abundances but to anticipate them and interpret changes in abundances. We would be deeply concerned if input from other citizens was not subjected to the same rigor and discipline afforded the capture and analysis of commercial catch and effort data. We stress that citizen science must be governed by rigorous experimental design with adequate before-and-after components and assessments of data controlled by appropriately qualified and independent scientists.

The need to give greater prominence to nursery species and habitats

Wetlands, saltmarsh, mangroves and seagrass are more than just 'support for coastal biodiversity' as stated in the Management Strategy (FAQ p2); they are in their own right extremely important components of that biodiversity. The underrepresentation of the importance of aquatic habitats in the management of NSW marine systems to date goes well beyond this apparently superficial comment.

The public expression of the management of NSW coastal ecosystems has since the turn of this century been dominated by the declaration of marine parks. The primary actions taken in these parks have been the closure of areas to fishing in multiple zones. The dominant measure of the outputs from these parks has been the abundances of selected, relatively large, species of fish. As a consequence of this misguided selection of performance indicators the outcomes that have been claimed from the marine parks process are dominated by relatively minor fisheries management outputs. Changes to the abundances and assemblages of larger species of fish unfortunately continue to be unjustifiably prominent in the prescribed indicators of the health of the Marine

Estate. The selection of restoration of the Richmond River as the first Case Study in the implementation stage of the Management Strategy provides an excellent opportunity to improve greatly the assessment of the effectiveness of management of the priority threats and risks to the Marine Estate (further discussed in Appendix 1).

From the brief outline of this Case Study that has been provided it is already evident that the principles depicted in MEMA's five step process have been much more rigorously adhered to than in the previous management strategies that have resulted in the current poor health of our estuaries. The assets represented by the Richmond River and the priority threats and risks to the health of the River have been broadly described (Steps 1 and 2 of the five-step process). Current management has been found wanting (Step 3). Step 4 is well underway and the management responses that have been outlined appear aligned with the priority threats. Step 5 'monitor, evaluate, report' is naturally less well defined; the process is just beginning. An effective Step 5 is critical to the determination of the outcomes of this Case Study, and hence the evaluation of the effectiveness of MEMA's whole Management Strategy.

The first component of Step 5, monitoring, is by definition an ongoing process that is implemented to assess change, or lack thereof. Effective evaluation of the magnitude of that change and the benefit it may or may not represent, the second component of Step 5, requires a baseline for comparison. The more precise this baseline and the tighter its relationship to the anticipated change the more accurate will be the assessment of cause and effect.

MEMA has already established that the Richmond River is in poor health so presumably there are metrics to establish a baseline before the restoration of the River begins. Details of these metrics are however, understandably not presented in the brief summary of the Case Study. In the interests of accuracy and precision in the outputs of Step 5 it is imperative that the established baselines are sufficiently comprehensive in terms of representing the full suite of assets that are being protected and yet precise enough to enable measurement of change and attribution of cause and effect. Time taken, within reason, to ensure adequate and appropriate baselines before management commences is most unlikely to be time wasted.

The lack of adequate baselines has been a most unfortunate feature of the attempts to date to assess changes to NSW marine and estuarine ecosystems and the assets they support. This has been most obviously expressed in the marine parks process in this State. Adequate baselines representing the full spectrum of biota were not established in the areas that were to be managed before management actions were implemented. Comprehensive before and after assessments, the most effective tool for measuring cause and effect, are therefore not possible. As a consequence assessments of the impacts of area management have been dependent on comparisons of selected biota in managed areas with the same or similar species in unmanaged areas. The irregular way in which areas were selected has been such that areas that were used as reference sites seldom represented adequate or even appropriate comparison. Because there was no standardisation in the selection of managed and unmanaged areas in terms of the threats to them, such as proximity to the many and varied sources of pollution such as sewage outfalls, resulting comparisons were commonly little more than indicative of differences, or the lack thereof. The outputs of such comparisons are of limited value for the description and assessment of change in biodiversity in the areas in question. They can even be more misleading than helpful. In the absence of identification of the threats they

are also of limited value in evaluating the causes of changes in these areas. This greatly diminishes their value to the determination of the wellbeing of the Marine Estate as an entity.

By establishing adequate baselines for before-and-after comparison of all proposed management actions MEMA has the opportunity to establish a time-dependent measure of change that greatly enhances evaluation of cause and effect. Ensuring that sampling protocols include adequate representation of all life forms will also greatly enhance the attribution of change to each specific threat. This should definitely be of the highest priority for a case study, such as that of the Richmond River (see Appendix 1).

Accordingly the multiple threats to plant abundances and assemblages should be given at least equal weight to that afforded the direct threats to fish abundances and assemblages in this Case Study and elsewhere. Aquatic plants and other lower levels of biodiversity are resident in estuaries and hence far more reliable indicators of the status of habitats in that area than are the more mobile higher life forms, such as iconic fish species. Furthermore, in view of the relatively slow recovery of plants and sedentary invertebrates, as demonstrated in the Richmond River following major pollution events, their priority as indices of the health of the ecosystem should arguably be even higher than that afforded popular species of fish.

Suggested additional management initiatives

1. Given the prominence that MEMA has afforded to the management of litter in the Implementation Phase of the Strategy it is beholden on all fishers, both commercial and recreational, to ensure that litter is greatly reduced, particularly that attributed to fishing. In accordance with the priority that is given to the assessment of outcomes, including the efficiency of management, it is important that reductions in litter can be measured. It is not unreasonable, nor difficult, to task fishers with demonstrating that fished areas have less litter than unfished ones. This is one cause and effect assessment where relatively superficial visual evidence should reflect reality. Citizen science may well play a significant role! All fishers are after all citizens.

2. If scientific reference sites are to become a major component of the monitoring and assessment program then it is imperative that they are well chosen and well monitored. The specific purpose of each site must be clearly described and aligned with the evaluation of the impact of a specific threat or threats. In accordance with the threat and risk assessment strategy the level of monitoring should be aligned with the priority of each threat, i.e. there should be many more scientific reference sites for the number 1 threat than for the number 17. The threats to be assessed in each reference site should be unambiguously described and the management actions taken to ameliorate each threat clearly determined. Areas should not be closed to fishing under the guise of scientific reference sites unless it is specifically the impact of fishing that is to be assessed.

If reference sites are to involve fishing closures then it is imperative that the impacts of commercial and recreational fishing be clearly differentiated. For this to be effective there must be adequate, presumably equal, representation of sites that are open to commercial fishing but closed to recreational fishing. As many sites are already closed to commercial fishing the selection of new reference sites should not involve additional closures to commercial fishing. Currently closed sites could also be sampled for five years and then opened to commercial fishing and monitored for an additional five.

APPENDIX 1

Case Study 1; Restoration of the Richmond River.

The decision to begin the implementation phase of the Management Strategy with the restoration of an estuary appears sound. Estuaries are the life-blood of much of the Marine Estate's biodiversity, but many of them are in poor health. Evaluation of the process of restoration of the Richmond River will provide a critical test of the efficacy and effectiveness of the whole of MEMA's Management Strategy.

A large percentage of the State's species of fish, crustaceans and aquatic plants live in estuaries and many species of vegetation are dependent on wetlands, saltmarshes and other forms of aquatic, or riparian, environments associated with estuaries. Several oceanic species also rely on estuaries as nursery grounds. It must therefore be assumed that the health of estuaries is critical to the total aquatic life (biodiversity) of the Marine Estate, including abundances and assemblages of individual species.

Restoration of the Richmond River must be considered in the context of MEMA's determination that 75% of the estuaries in the Hawkesbury Bioregion and 35% of the estuaries on the north and south coasts have been assessed as having poor health. In the Richmond this poor health has at times been so extreme that all aquatic biota including not only fish but also aquatic plants such as sea grasses, in extended reaches of the River (30 km or more) has been killed or severely damaged. Similar 'fish kills' have been reported in numerous other estuaries, including, but not limited to, the Tweed, Clarence and Manning Rivers. In several instances, such as in the late 1960s in the Tweed River, these incidents were even more extreme than those reported in the Richmond. Acid-sulphate run-off and associate low oxygen levels resulting from poor agriculture practices and inappropriate 'development' in the river catchments have been identified as the primary cause.

The reduction in the abundances of plants that were in, or adjacent to, wetlands that are an integral part of the river systems has also been extreme. Much of this additional impact has, however, been over a different time-scale to that of the episodic and visibly obvious 'fish kills'. MEMA reports extensive deliberate drainage of the floodplain of the lower Richmond River since the early 1900s. As a consequence of this ongoing activity the floodplain vegetation is now dominated by dryland species. Thus not only have the abundances and assemblages of fish, crustaceans and plants been impacted but the whole ecosystem has been changed culminating in the displacement and translocation of species.

Evaluation of this Case Study provides an opportunity to review the exaggerated prominence that that continues to be given to impacts on fish abundances and assemblages in the identification of threats from fishing to the assets of the Marine Estate. It should also facilitate assessment of the efficacy of using abundances of predominantly larger fish as the primary indicators of the overall health of the Marine Estate and the effectiveness of the measures that are taken to protect and enhance it. Three key points warrant elaboration:

1. It is significant that the catastrophic pollution events in north coast estuaries were described as 'fish kills', including by MEMA. This was a direct result of the obvious visibility of the considerable numbers of large fish that were indeed killed and then floated to the surface or

washed up on the banks of the rivers. The title 'fish kills' however, misrepresents and understates reality. Almost all aquatic organisms in the river, and many adjacent to it, were killed, many in much greater numbers and even biomass that that of large fish. There would be little doubt that the numbers of eggs and larvae that were killed would also have been much greater than those of the larger individuals that were more visible. "Biota kills" or "biodiversity kills" would be far more accurate descriptions of the devastation of the broader ecosystems that occurred.

The disproportionate influence of the presence of large fish on the assessment of the extent of the devastation is symptomatic of wide-spread distortion of the role abundances of large fish continues to play in marine assessments. This problem is pervasive in MEMA's Management Strategy and particularly the approach to marine parks (discussed above). It is the role of scientists to look beyond the obvious, but unfortunately perception, even by scientists, is too often influenced by 'evidence' that supports uncritical assumptions. For the general public, in the absence of compelling analysis of the evidence, 'seeing is believing'.

2. When considering the relevance of abundances of large fish to the evaluation of the management of biodiversity it is important to note that large fish returned in impressive numbers relatively quickly to many areas of the Richmond River that were completely devastated by the acid-sulphate-induced kills. Many large individuals of numerous species were evident in the River within a few weeks. Recreational fishing resumed less than five months after the massive kill in 2001. Commercial fishing recommenced after eight months. In contrast the abundances of species that are lower in the food chain, less mobile and more dependent of the health of the substrate, such as nippers and several species of worms are reported to not have recovered almost two decades after the event. Commercial fishing effort statistics support a conclusion of slow and limited recovery in lower order species: there were 16 prawn-haul fishers in the Richmond River prior to the 2001 kill and only 4 in 2018.

   Significant irregularities in the abundances of prawns in north coast estuaries continue to be reported in numerous locations, including in the Richmond, Clarence and Camden Haven Rivers. Widespread evidence of low abundances of estuarine prawn stocks suggest that the negative impacts of the poor health of NSW estuaries, including from, but not limited, to acid-sulphate run-off and deoxygenation of waterways, is more prominent and persistent than widely recognised. In view of higher vulnerability of eggs and larvae of estuarine and marine species to pollutants (fish eggs do not even have a highly protective shell) the impacts of poor water quality in estuaries must be assumed to be far greater and more widespread than the abundances or health of large fish would indicate.
3. Recent reports on the health of communities of seagrasses and other aquatic plants in the Richmond River strongly suggest that the recovery of plant species has been even slower than that of crustaceans; the distribution of seagrasses has still not recovered in numerous areas where they were devastated almost two decades ago. As stated above, whole riparian ecosystems have been changed. Assessment of the true status of biodiversity necessitates much more than superficial acknowledgement of fish kills and rudimentary evaluation of remaining abundances of predominantly large fish.

The Richmond River Case Study provides an excellent opportunity to undertake extensive and intensive sampling before decisive management actions are taken. In combination with the

implementation the Monitoring Program the Case Study represents compulsion to undertake the necessary sampling to fulfil the requirements of a thorough BACI design, the outcome of which will greatly facilitate attribution of cause and effect. This will greatly facilitate the necessary adaptive management of the impacts of each of the priority threats to the Marine Estate.