



**Planning Strategic Research for
Fisheries, Aquaculture and Aquatic Conservation
in New South Wales • 2004–2009**



**NSW DEPARTMENT OF
PRIMARY INDUSTRIES**



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Fisheries, Aquaculture and **Aquatic Conservation**
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N.B. For updates of the priorities listed in the tables contained in this document visit:
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Minister's Foreword

Planning Strategic Research for Fisheries, Aquaculture and Aquatic Conservation in New South Wales, 2004-2009

The NSW Government is committed to ensuring that our commercial and recreational fisheries, aquaculture industries and the aquatic ecosystems on which they depend are sustainably managed using the best possible science.

Scientific research programs that adhere to world's best practice standards are required to underpin all our management strategies and the regulations that govern how we use and conserve our aquatic resources. In deciding how to apportion the resources available for research, the involvement of all stakeholders in identifying priorities is paramount. I am therefore delighted that this very comprehensive document Planning Strategic Research has been developed based on the contributions of all relevant stakeholders from the various commercial, recreational, Indigenous, aquaculture, marketing and university sectors in NSW.

I look forward to the many research providers and funders in NSW, from the university, public and private sectors, using this strategy when setting research and funding priorities. I look forward to the forging of exciting new partnerships in scientific research amongst scientists, funding agencies and all stakeholders so that the many priorities identified in this strategy can be achieved.

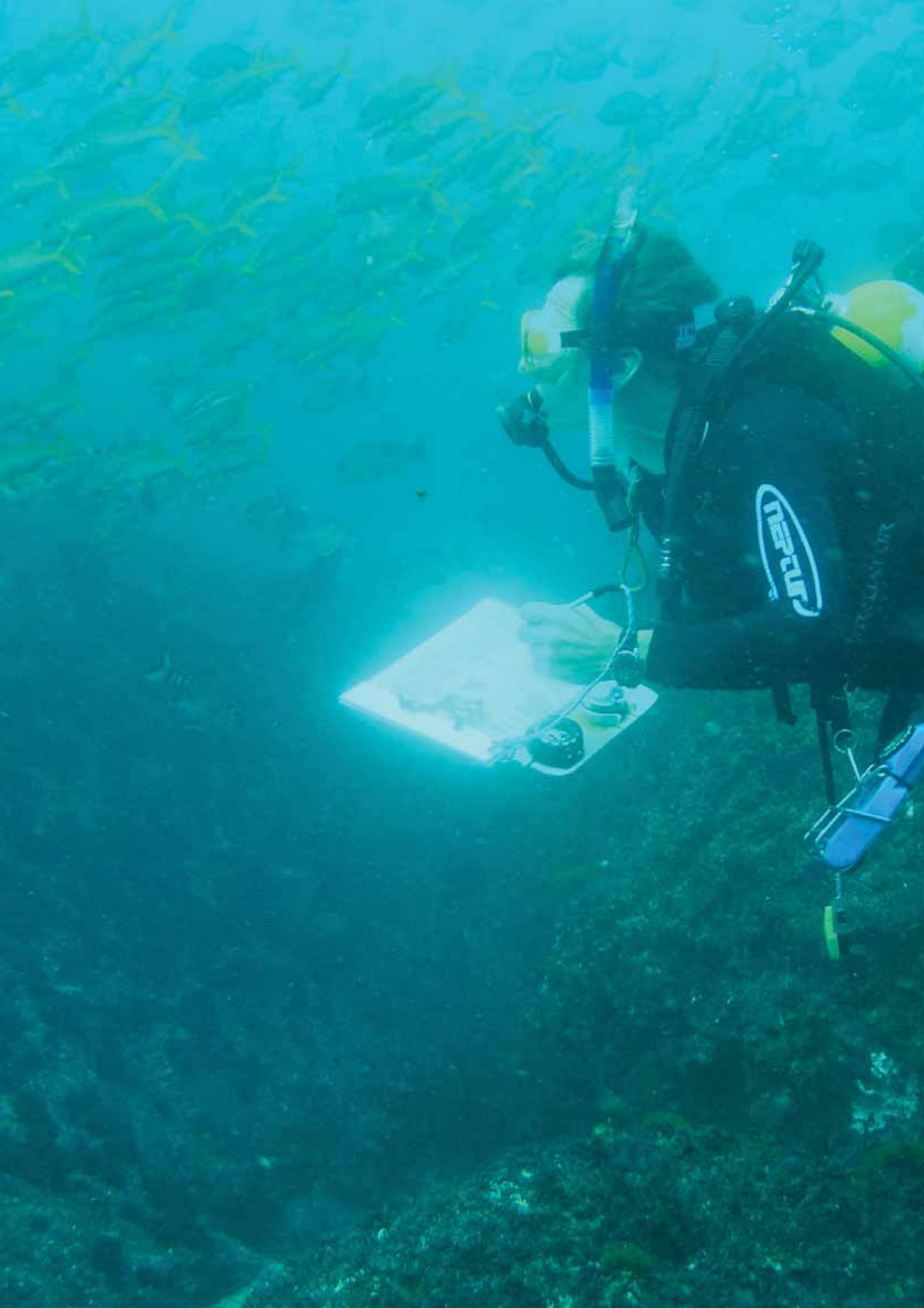


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The Hon Ian Macdonald MLC
NSW Minister for Primary Industries



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Planning Strategic Research for Fisheries, Aquaculture and Aquatic Conservation in New South Wales • 2004–2009

INTRODUCTION

Decision-makers who manage fisheries, aquaculture and aquatic conservation receive advice from many stakeholders, interest groups and experts. Whilst such advice and opinions come from industry, recreational, Indigenous, environmental and political groups, the most influential information upon which decisions are made usually comes from rigorous, objective science. That is, decision-makers require answers to complex, difficult questions about fisheries, aquaculture and aquatic conservation that need the “best available scientific information”. Because scientific research ultimately provides this scientific information, its future direction is one of the most important factors in framing future management policies and laws.

The questions that are asked of fisheries science are always far greater in number and scope than can be readily answered – particularly in a state like New South Wales with relatively small commercial fishing and aquaculture industries, and therefore relatively few resources



available for their scientific study. Unfortunately, however, the questions that require answering about our aquatic resources and systems do not adhere to this minimalist pattern but are almost as large in number and scope as those questions asked in regions with very valuable fisheries and, therefore, much greater resources available for research. The range and complexity of the questions asked by NSW stakeholders in fisheries, aquaculture and aquatic conservation mean that resources for research will always be a limiting factor in determining what can be achieved and, therefore, there will always be a need to direct available scientific resources towards those questions that are of the highest priority to answer.



Deciding which are the most important questions to answer, and how to answer them, are key processes in shaping future fisheries research and, ultimately, future fisheries management. The latter process (how to answer high priority questions) is usually accepted as being best done by professional scientists because they are trained to be objective, impartial and to base their interpretations on rigorous analyses of available evidence. It is also well-accepted, however, that the best group(s) to lead the former process (the prioritisation of which questions should be answered) should NOT be scientists – but rather the end-users of the research results and potential beneficiaries, i.e. the stakeholders and decision-makers themselves. This is because these groups are in the best position to decide which areas of inquiry would contribute to decisions that would lead to the greatest improvement in the particular “stakes” in which they have a “holding”.

This rationale was used in the development of this strategic research plan for NSW by consulting with as many stakeholder groups as possible (in 2002–03) regarding the research questions they have for their particular stakeholding. These priorities were then combined and re-circulated so that these stakeholder groups had an opportunity to prioritise each others’ research areas in addition to their own.





Most of NSW's various Ministerial Advisory Councils, commercial Management Advisory Committees, Indigenous groups, the marketing sector, other fisheries and aquaculture stakeholder groups and the university sector were involved in this process as well as relevant Government agencies. Most of these groups responded, with the net result that 234 different research areas were identified as requiring attention. It was not possible, however, to consult with every stakeholder – especially in the broad aquatic conservation area. In addition, recent changes to natural resource management in NSW have meant that new bodies (e.g. Catchment Management Authorities) will soon be responsible for implementing standards and targets for the sustainable use of many natural resources in NSW. This plan, therefore, primarily reflects the priorities that were current at its time of preparation (2002/03) and should be viewed as a 'living document' that will require regular updating as priorities change in the light of new research being completed, new questions being formulated and new feedback being received from stakeholders. To this end, regular updates of the priorities in this document will be available on the NSW Department of Primary Industries website (www.dpi.nsw.gov.au) and a complete revision will be done in 2007.

The tables in this document identify the various priority areas identified during the above consultative process, grouped into appropriate categories and sub-categories, and which stakeholder group(s) held particular areas as high priorities. For those research areas where some work is currently underway, an asterisk (*) is appended. We also provide a brief description of most of the general areas of inquiry raised and the sorts of scientific work that are required to do them. Finally, this document discusses the prioritisation of these research areas and the resources available to achieve them.

This document should be viewed as both a resource, for those interested in aquatic research processes in NSW, and as a guide for those wanting to do research or seek funding for research from granting bodies. It will also prove a useful tool for those funding bodies such as the NSW Recreational Trusts, the Fisheries Research and Development Corporation and the Australian Research Council as they decide which particular research projects should be supported.

Wild Harvest

This category of priorities refers to issues concerning NSW's many commercial and recreational fisheries. These two sectors differ in the way fish are caught and what happens to them after capture (sold, released or consumed) but are similar in the actual species exploited and the fact that the same stocks are usually fished.

It is well-recognised that fisheries science concerning wild harvest resources is a particularly difficult field of science because many of the questions that require answering involve dealing with things that are invisible to normal methods of observation. For its entire history, the field of fisheries science has suffered by not having at its disposal non-destructive techniques for sampling and monitoring aquatic resources. This has meant that most avenues of inquiry involve indirect measures of stocks based on catch-per-unit-effort information and increasingly sophisticated predictive models to estimate fluctuations in nature. This reliance on information about animals that are already caught, dead and removed from systems, for use in analyses that try to predict what will happen to those systems, establishes significant problems that fisheries scientists have tried to deal with for decades.



Spanner Crab Research



Resource Assessment

PRIORITY PROJECTS	STAKEHOLDER GROUPS
Stock assessments of all primary and secondary species in the Estuary General Fishery*	EGMAC, MPAC, EPA, AM, NSW DPI
Stock assessments for the main species in the Ocean Fish Trawl fishery especially red spot whiting trevally angel & wobbegong sharks	OFTMAC, OPTMAC, MPAC, AM, NSW DPI
Stock assessment models for eastern king and school prawns and determine optimal sizes at first capture*	EPTMAC, OPTMAC, MPAC, AM, NSW DPI
Stock assessment of target species in the Ocean Haul fishery*	OHAULMAC, MPAC, AM, NSW DPI
Stock assessment of commercially caught sharks	MPAC, NCC, AM, NSW DPI
Stock assessments (including biomass-dynamics and length-structured models) for lobsters*	LOBMAC, MPAC, AM, NSW DPI
Stock assessment, distribution and vulnerability to overfishing of small pelagics (baitfish)*	ACoRF, MPAC, EPA, AM
Stock assessment distribution and population composition of yellowfin tuna	ACoRF, MPAC, AM
Stock assessments of all primary and secondary species in the Ocean Trap and Line Fishery	OT&LMAC, NSW DPI
Stock assessment of squid	NSW DPI
Develop fishery-independent surveys to complement fishery dependent stock assessment studies*	NSW DPI
Develop non-destructive fishery-independent technologies for monitoring fish populations in the wild	NSWF

Questions about the status of stocks are fundamental to the management of all fisheries and therefore formed a consistently requested item for research across many stakeholders involved in the fishing industry or concerned about the long-term sustainability of fishing. Stock assessments of all primary and secondary species in most of NSW's commercial fisheries are listed above which, because recreational fisheries often target the same stocks, means that such assessments would also be applicable to recreational fishing interests. Another consistent feature was the identification of priorities to develop new ways to do stock assessments that are appropriate for the relatively low value fisheries that characterise NSW's fishing industry.

Unfortunately, in many fields of science, the scientific needs that have the greatest potential to make the greatest difference also carry the greatest risk of non-success and often the highest price tag. This is inevitable because most research needs that are cheap and easy-to-do have already been done. The priority for developing non-destructive, independent measures of fish populations should probably attract a relatively high priority but, because it is an expensive, risky endeavour, other priorities should be addressed simultaneously using conventional techniques.

NSW Department of Primary Industries has recently developed a framework for stock assessment using conventional means that will address many of the high priority areas listed in the above table. This framework has three basic components: (1) a structured process for



the timely completion and interpretation of resource assessments; (2) models to assess fish resources (to provide mechanisms to interpret data); and (3) systems to collect and manage the data required. NSW is currently in a very strong position to advance the assessment of our fish resources because the Environmental Impact Statements and Fisheries Management Strategies that have been/are being developed for each fishery provide a prioritisation of the work required to achieve these assessments in addition to a management framework that integrates and uses outputs from them. Datasets currently exist that, with additional investment and frequent updating, will provide a sound basis for resource assessment, monitoring and therefore management.

One area in which datasets must be improved involves the establishment of long-term, fishery-independent surveys. These surveys are not only important for the resource assessment of exploited stocks but are also needed for the management and conservation of aquatic biodiversity (a fundamental consideration of Ecologically Sustainable Development). Whilst such programmes are expensive, they are necessary if NSW is to undertake "best practice" aquatic resource assessment.



Recreational fishing



Studying fish behaviour

Biology

PRIORITY PROJECTS	STAKEHOLDER GROUPS
Biology and fisheries of sea river and snub-nosed garfish*	OHAULMAC, NCC, NSW DPI
Biology and fishery for sweep	OHAULMAC, NSW DPI
Reproductive biology abundance and spawning biomass of sea mullet*	OHAULMAC, NSW DPI
Growth and mortality of school prawns*	EPTMAC, NSW DPI
Abundance size-distributions growth movements and puerulus recruitment of lobsters*	LOBMAC, NSW DPI
Black bream biology and the management tools required for this species*	ACoRF, NSW DPI
Biology of luderick*	NSW DPI, ACoRF
Age and growth of recreationally important fish species*	NSW DPI, ACoRF
Biology and fisheries of yellowtail kingfish and yellowfin tuna	OHAULMAC
Biology of freshwater yabbies and their harvest potential*	Inland MAC
Distribution abundance and habitats of spiny crayfish especially in relation to stocked salmonids	NSW DPI
Bream tagging program to determine growth, movements and biomass	ACoRF
Reproductive biology of primary and secondary species in the Estuary General Fishery and develop size limits where appropriate	NSW DPI
Identification, distribution and abundance of larval stages of fish and shellfish of commercial and recreational importance	NSWAERP



Information that is closely related to that required for resource assessments and many other management-related enquiries is information on the basic biology of exploited species. This information is a high priority for many commercial and recreational stakeholders and includes studies on characteristics such as a species' growth, reproductive biology, mortality, distributions, abundances and how these vary spatially and temporally.

Often the most efficient way to answer such questions involves species-specific studies (which usually make excellent post-graduate theses) but, because of the nature of the methodologies used, it is often possible to obtain data and samples on relevant characteristics of several species simultaneously using common, standardized sampling regimes.



Studying impacts of nets on fish

Influence of Habitats and Other External Impacts

PRIORITY PROJECTS	STAKEHOLDER GROUPS
Mapping and description of all fishing grounds to assist in management strategies involving spatial and temporal allocations of fishing effort	ACCF, EPTMAC, OPTMAC, NCC, EPA, NSW DPI
Mapping of reef areas along the NSW coast	OT&LMAC, EPA, NPWS, NSW DPI
Investigate the influence of deep ocean outfalls and increased regional development on wild fisheries	ACCF, SIAF, ABMAC, NSW DPI
Factors affecting the recruitment of prawns to estuaries	EPTMAC, OPTMAC, EPA, NSW DPI
Identify the causes of, and ways to eradicate or decrease the spread of, Perkinsus-related mortality in abalone	ABMAC, NCC, NSW DPI
Sources of primary productivity that support NSW estuarine fisheries	NSWAERP
Impact of nutrient enrichment and other stressors on fisheries production	NSWAERP



The mapping of reefs and other aquatic habitats is a key element of conservation-orientated research (see later in this document) but the issues identified here for wild harvest fisheries (location of key fishing grounds, influence of physical and biological factors on production) have significant relevance for the management, production and sustainable exploitation of stocks. This sort of work can be achieved via the collection of information on areas fished, and the distribution and abundance of organisms and physical variables that may be correlated with them. Once identified, mensurative and manipulative field experiments would be needed to show cause-and-effect relationships among such factors.

Impacts of Management and Manipulation

PRIORITY PROJECTS	STAKEHOLDER GROUPS
Effects of estuarine recreational fishing havens on key stocks and by-catch species and fishing in adjacent areas*	EGMAC, FRCAC, NCC, EPA, NPWS, FSC
Benefits of closure strategies	ACCF, NCC, EPA, NPWS, NSW AERP, NSW DPI
Fishery independent surveys to assess populations in estuaries open and closed to different fishing regimes	EGMAC, NCC EPA, NSW DPI
Applicability of spatial closures to conserve small prawns	OPTMAC, NSW DPI
Utility of alternative size limits and fish downs for abalone	ABMAC, NSW DPI
The relationship between the release of larger fish by recreational fishers and population fecundity	ACoRF, EPA
Assessment of kingfish stocks following the removal of pelagic traps	ACoRF, EPA
Investigate the viability of stocking fish into the marine environment (e.g. suitable species, methods, environmental impacts)*	NCC, NSW AERP, NSW DPI



Estuarine mesh netters



Studying survival of discarded fish

In recent years, there have been several significant changes in the management of fisheries in NSW (e.g. closures of commercial fishing in some areas, the creation of recreational fishing havens). It is not surprising, therefore, that significant priority has been assigned by many stakeholders to identifying the impacts of such changes on commercial and recreational fisheries and the species involved. These issues are, however, not the only research questions concerning changes in management (there are several species and fishery-specific priorities raised including the viability of artificially re-stocking wild populations).

The obvious conclusion from these priorities is that, ideally, all changes in fisheries management should attract a research program that examines them, so that the cost-effectiveness of the manipulation can be assessed in an adaptive management context. This applies equally to the Conservation and Aquaculture sections dealt with later in this document. Research such as this is, however, by its nature, long-term and large-scale because it should involve adequate surveys and monitoring of the particular fishery/stocks being managed well before, during and after changes occur, in addition to mirrored examinations of "control", unchanged fisheries/stocks. Such studies are all-too-rare throughout the world and it is unfortunate that changes to management are frequently made first and then research programs are subsequently established to monitor their effects – without prior information (nor controls) to compare against. To avoid the situation of trying to establish monitoring surveys for long periods before every individual change to management is made, large-scale, long-term, generic surveys (which are ideally fishery-independent – see page 13) should be established to provide the required before and control datasets against which any subsequent management changes to a subset of fisheries/stocks can be made.



Reporting, Managerial and Policy Methodologies

PRIORITY PROJECTS	STAKEHOLDER GROUPS
Develop and evaluate indicators and performance measures for the impacts of fishing activities on biodiversity in the Estuary General, Ocean Haul and Estuarine Prawn Trawl fisheries	NCC, EPA, NPWS, NSW DPI
Improve catch & effort reporting and develop a daily logbook system in the Ocean Haul, Estuarine Prawn Trawl and Ocean Prawn Trawl fisheries*	OHAULMAC, EPTMAC, OPTMAC, NSW DPI
Evaluate performance indicators and trigger points in all Fishery Management Strategies and develop robust indicators	EGMAC, NCC, EPA
Estimation of catches of species for all sectors (including unreported recreational, Indigenous and commercial catches)	MPAC, EPA, NSW DPI
Survey of the recreational and unreported commercial catch of rock lobsters	LOBMAC, NSW DPI
Commercial fishery logbook program for lobsters*	LOBMAC, NSW DPI
Estimate the illegal catch of abalone	ABMAC, NSW DPI
NSW Angler Survey (based on data from the National Angler Survey database)*	ACoRF, EPA
Quantify the catch of spearfishers	ACoRF, EPA
Coordinate underwater harvesting programs to provide: (1) a comprehensive picture of competition and nonclub-based spearfishing activity and (2) estimates of recreational harvest	EPA, NSW DPI
Assessment of recreational baitfish usage*	EPA, NSW DPI
Monitoring recreational fishing effort in coastal waters using sea rescue bases	NSW DPI
Development of indicators of recreational fishing quality	NSW DPI
Developing a framework for the evaluation of recreational fishing survey design	NSW DPI
Develop protocols for analysis of charter boat logbook information	NSW DPI
Use of recreational licence data to provide the basis or frame for future survey and assessment work	NSW DPI
Collect historical/anecdotal information from older fishers regarding the biology and fishery of yellowtail scad	OHAULMAC
Determining the appropriate geographical size of management units	AM

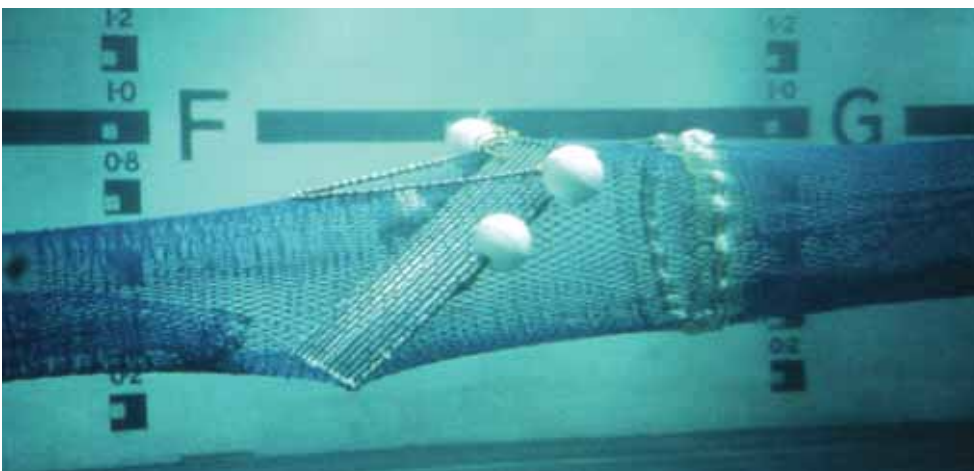
A large number of research priorities was identified by stakeholders concerning ways to improve the data and information available for scientists and managers in NSW. One of the most important of these involves the development of ways to assess and evaluate the performance of Fishery Management Strategies and the utility of their trigger points and performance indicators. Other key priorities involved estimating wild harvests by commercial, recreational and Indigenous fishers, as well as illegal catches from these sectors, using logbook systems, fishery-dependant and fishery independent surveys and creel surveys.

Concomitant Effects of Wild Harvest

This category of priorities involves the emerging high priority issues concerning impacts of wild harvest fisheries on other, interacting fisheries and their impacts on ecosystems and biodiversity. Many of the priorities identified in this category were identified as important by a large number of stakeholder groups, placing these issues as among the most important in this document.

Ecological Processes

PRIORITY PROJECTS	STAKEHOLDER GROUPS
Develop ecosystem-based fisheries management models for NSW*	NCC, EPA, NSW DPI
Develop ecological sustainability performance indicators to assist in the management of fisheries' impacts on ecosystems*	MPAC, NCC, EPA, NSW DPI
Review the trophic level of catch by the Ocean Haul Fishery and trophic interactions with other fisheries	OHAULMAC, EPA, NSW DPI
Determine the impacts of a possible sea urchin fishery on enhancing abalone populations and effects on other species	ABMAC, NSW DPI
Examine predatory impacts of Australian salmon on other commercially important fish species	OHAULMAC



The Nordmore Grid – used to reduce bycatch in prawn trawls



The new area of ecosystem-based management is probably the most important issue currently facing fisheries science throughout the world and is therefore one of the most important research priorities listed in the wild harvest section of this document. This area of inquiry requires the development of new modelling techniques and new datasets to feed them. Scientists in Australia's CSIRO and Canada's University of British Columbia are the leaders in the world in such work and, together with staff from NSW Department of Primary Industries, are engaged in two new projects that are beginning to address these priorities. However, the concept of ecosystem-based management involves all elements and influences in the ecosystem – not just the impacts of harvest fisheries. Thus, this approach will also have major relevance to many of the Conservation and Aquaculture priorities listed later in this document.

Some projects have also been identified by stakeholders that involve an examination of certain ecological processes (trophic interactions, competition, predation) and how they interact with commercial fisheries. These studies are far more complex than the biological studies mentioned earlier and are best done by field experimentation designed to identify and quantify impacts of certain processes on other species.



Oceanic prawn trawler



Nipper Pumping

Impacts of Fishing Methods

PRIORITY PROJECTS	STAKEHOLDER GROUPS
Observer programmes to monitor by-catches and retained catches for all commercial fisheries*	OHAULMAC, EPTMAC, OPTMAC, OT&LMAC, LOBMAC, MPAC, NCC, EPA, NPWS, NSW DPI
Impact of trawling, hauling and other fishing methods on other fisheries biodiversity ecosystems and habitats*	OHAULMAC, OFTMAC, OPTMAC, OT&LMAC, NCC, EPA, NPWS, AM, NSW AERP, NSW DPI
Investigation into the age-class interactions of by-product species in different sectors of commercial fisheries	MPAC, NCC, EPA, NSW DPI
Effects of nipper pumping in sensitive estuarine areas	ACCF, EPA, NSW DPI
The effect of 'riddling' on the mortality rate of discarded prawns*	EPTMAC, OPTMAC, NSW DPI
Studies of the effects of lobster trapping on the benthos including physical disturbance and potential effects on the ecosystem	LOBMAC, EPA, NSW AERP, NSW DPI
Investigate changes in biomass and species composition of affected species after reducing by-catch	ACoRF, EPA, NSW DPI
Hook mortality rate of released fish (species survival; best handling methods; hook patterns and sizes)*	ACoRF, NCC
Impacts of pollution from fishing activities (e.g. lost gear bait wrappers etc.) on the environment	EPA



Technology

PRIORITY PROJECTS	STAKEHOLDER GROUPS
Develop fishing operations and gear designs to minimize the impact of trawling in the Estuarine Prawn Trawl fishery on incidental species and small prawns*	EPTMAC, EPA, NPWS, NSW DPI
Develop appropriate gear for trawl whiting with particular regard to minimising captures of juvenile whiting and other incidental catch*	OFTMAC, EPA, NSW DPI
Investigate the selectivity of trawl nets for silver trevally*	OFTMAC, EPA, NSW DPI
Studies of lobster trap selectivity rates of ingress and egress and consequences for trap efficiency and ghost-fishing mortality	LOBMAC, EPA, NSW DPI
Development of a system for the remote release of submerged lobster head-gear	LOBMAC, NSW DPI
Develop appropriate mesh size and other dimensions for flathead nets*	EGMAC, NSW DPI
Describe retention/meshing rates of 28mm garfish hauling nets and determine appropriate mesh size*	OHAULMAC, NSW DPI

The priorities in the above two sub-categories include those concerned with identifying and quantifying concomitant effects of fishing (through observer programs of by-catches and issue-specific experiments to identify impacts) and those that seek solutions to those problems via technological changes to fishing practices. NSW has developed an excellent record in identifying and then finding solutions to such issues over the past decade and the methods for achieving answers to such questions are well-established and are becoming routine.



Developing nets that reduce the need to discard

Conservation

This category of priorities concerns the many ecological and environmental issues that arise when managing anthropogenic impacts on aquatic resources and habitats to ensure that such influences are sustainable. Many of these issues involve the importance of aquatic habitats to living aquatic resources, but issues concerning threatened species, the maintenance of biodiversity, alien species and the use of marine protected areas as management tools also provide major challenges for science because of the complex questions involved.

Biology

PRIORITY PROJECTS	STAKEHOLDER GROUPS
Population genetics, distribution, abundance, movements and biology of threatened marine and freshwater species*	ACoRF, NCC, EPA, NPWS, NSW AERP, NSW DPI
Protecting the genetic integrity of wild stocks of Australian native freshwater fish	ACoA, NCC, EPA, NPWS
Modelling the Grey Nurse Shark population	NCC, FSC, NSW DPI
Artificial propagation of Grey Nurse Sharks	NSW DPI
Distribution abundance and genetic studies of <i>Notopala sublineata</i> (snail) and <i>Archaeophya adamsi</i> (dragonfly)	FSC
Periodically survey the population status of protected or potentially threatened aquatic species	NCC, FSC, NSW DPI



Togging and measuring a Grey Nurse Shark



This sub-category of priorities identifies basic biological studies that relate to the conservation of biodiversity. Many projects have been identified as necessary to answer questions concerning marine and freshwater species that are formally listed as "threatened" in NSW. Key fish species currently in this category are Grey Nurse shark, trout cod, Macquarie perch, Oxylean Pygmy perch and Eastern Freshwater cod. These sorts of detailed biological studies are usually best done on a species-specific level and may make interesting post-graduate projects. An unfortunate characteristic of working on threatened species, however, is the fact that they are usually rare and may require sophisticated, non-destructive sampling techniques. Other priorities relate to determining the conservation status of other protected species (e.g. black cod) or potentially threatened species (e.g. Australian grayling) and, like the distributional work on threatened species, such surveys are best done in conjunction with broader scale surveys of biodiversity (see section below).

Ecological Processes and Biodiversity

PRIORITY PROJECTS	STAKEHOLDER GROUPS
Studies of estuarine ecosystem relationships and functions, including potential effects of climate variability	NCC, EPA, NPWS, NSW AERP, NSW DPI
Determine genetic and ecological effects of stocking in freshwater habitats	NCC, EPA, NPWS, NSW AERP, NSW DPI
Compile biodiversity inventories for marine and freshwater bioregions	NCC, EPA, NPWS, NSW DPI
Studies of biodiversity and environmental change	NSWAERP
Contribute to sustainable rivers audit and other freshwater biodiversity surveys*	NCC, EPA, NPWS, NSW DPI
Develop survey methods for marine biodiversity	NCC, EPA, NPWS, NSW AERP, NSW DPI
Develop genetic biodiversity procedures	NCC, EPA, NPWS, NSW AERP, NSW DPI
Develop ecosystem models for aquatic habitats*	NCC, EPA, NPWS, NSW AERP, NSW DPI
Initiate ecological investigations of key habitats in Marine Parks	NCC, EPA, NPWS, NSW AERP, NSW DPI
Develop tools for the assessment of the ecological health of estuarine and freshwater aquatic habitats	NCC, EPA, NPWS, AM, NSW AERP
Assessments of listed endangered ecological communities	FSC, NSW AERP

The research priorities listed in this group are much more complex than the former group because they involve studies of biodiversity and ecological interactions in aquatic systems. Whilst many of the listed priorities have quite short titles, to achieve them would require open-ended, large research programs requiring decades of study and millions of dollars (e.g. "develop ecosystem models for aquatic habitats", "develop tools for the assessment of the ecological health of estuaries", "assessments of listed endangered ecological communities"). While such a "wish list" of grand-scale initiatives will be difficult to achieve, such work (and some of the priorities listed in the next section) are being addressed by significant and world-leading research done by several university departments in NSW (e.g. the University of Sydney's Centre for Research on the Ecological Impacts of Coastal Cities). It is also possible to begin many of the items on this list by co-ordinating large-scale, long-term surveys of habitats and biodiversity in aquatic systems under an overarching ecosystem-based fisheries management framework.



Influence of Habitats and Other External Impacts

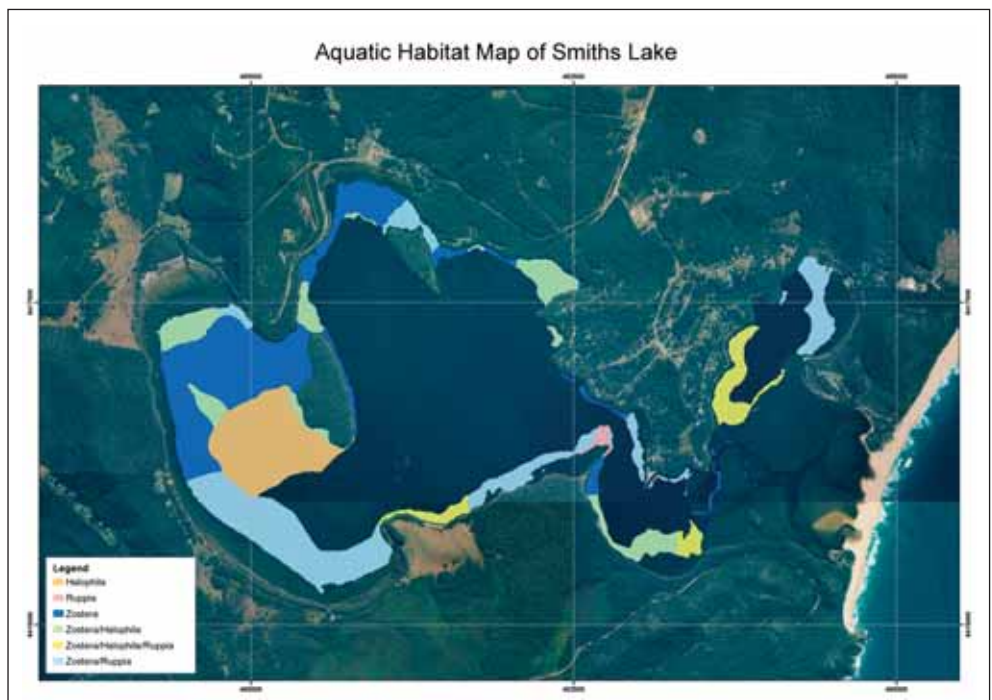
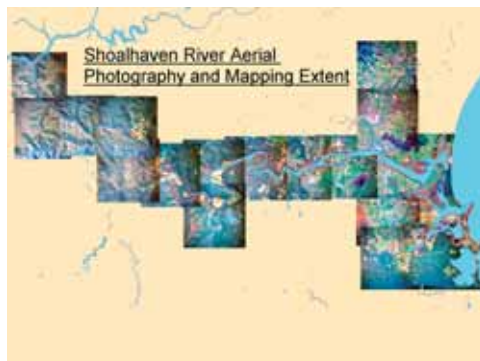
PRIORITY PROJECTS	STAKEHOLDER GROUPS
Determine and reduce the impacts of water extraction, flood mitigation, invasive species, blue green algae, flood events and land management practices on water quality, fish habitats, ecosystems and associated fisheries	EGMAC, OT&LMAC, ACORF, NCC, EPA, NPWS, NSW AERP, NSW DPI
Integrated monitoring and modelling of environmental flows and impacts on different life stages of freshwater fish*	NCC, EPA, NPWS, NSW AERP, NSW DPI
Determine effects of thermal pollution, altered water chemistry and boundary layer processes on key freshwater species	NCC, EPA, NPWS, NSW AERP, NSW DPI
Identify rivers with current/potential salinity issues and fish likely to be affected	NCC, EPA, NPWS, NSW DPI
Relate river discharge to estuarine production of fish and invertebrates	NCC, EPA, NPWS, NSW AERP, NSW DPI
Determine flow requirements for threatened freshwater fish	NCC, EPA, NPWS, NSW AERP, NSW DPI
Design regular monitoring programs for fresh, estuarine and marine waters	NCC, EPA, NPWS, NSW DPI
Determine whether FAD's and artificial reefs provide nursery areas for fish and their other effects on biodiversity*	ACoRF, NCC, NSW DPI
Develop habitat hierarchies for mapping marine and freshwater biodiversity	EPA, NPWS, NSW DPI
Investigate fish use of snags and develop 'resnagging' methodologies*	NCC, EPA, NSW DPI
Investigate recruitment and migration of fish into floodplains*	NCC, NPWS, NSW DPI
Develop methods to assess and monitor existing and potential marine estuarine and freshwater habitats as aquatic reserves*	NCC, NPWS, NSW AERP, NSW DPI
Improve modelling techniques for bioregional assessments	NCC, NPWS, NSW DPI
Determine the habitat requirements of fishes and invertebrates throughout their life cycle	EPA, AM, NSW AERP
Investigate potential impacts of sea level rise on rocky shores and salt marsh communities*	NCC, NPWS, NSW AERP, NSW DPI
Examine the effects on fish stocks of the management of Intermittently Closed and Open Lagoons	NCC, NSW AERP, NSW DPI
Assist Catchment Management Authorities to assess the status of river health and aquatic biodiversity associated with regional natural resource management reforms	CMA, NSW DPI
Assess the effects of seawalls on saltmarsh and seagrass	NCC, NSW AERP
Examine the potential impacts of stock access on saltmarsh and mangrove communities	NSW DPI

The quality and quantity of those aquatic habitats in which each life-history stage of aquatic species live affect the number, growth and reproductive potential of those species and



enhances overall diversity of the aquatic community. That is, healthy aquatic habitats usually lead to healthy fish, more productive fish populations and a greater diversity of assemblages of aquatic organisms. The factors that affect the health of aquatic habitats are characterised by being: (i) many in number; (ii) varied; (iii) mostly terrestrial in origin and (iv) managed by a variety of authorities (e.g. urban and rural runoff, sewage and other sources of pollution, clearing of habitats for construction, etc.).

Studying, understanding and then communicating the role of these influences on aquatic species to relevant decisions-makers can lead to very effective, positive results for living aquatic resources. The methods for achieving such results, whilst large-scale and expensive, usually involve correlative survey work of habitats and biota, mensurative and manipulative field experimentation to establish causes-and-effects and, most importantly, the communication of results to the public and those groups who can influence the external impacts that affect aquatic habitats. A necessary first step in getting this information for many aquatic habitats in NSW are large-scale habitat-mapping projects, augmented with information on various physical factors and water quality measures and coupled with targeted surveys of biodiversity.





Scientific sampling by electrofishing

Impacts of Management and Manipulation

PRIORITY PROJECTS	STAKEHOLDER GROUPS
Baseline and ongoing habitat/species monitoring programs to assess performance of each marine park and the zones within them*	MPAC, NCC, EPA, NPWS, NSW DPI
Evaluating marine protected areas' contribution to sustaining fisheries ecosystems and the conservation of threatened species	MPAC, NCC, EPA, NPWS, NSW AERP, NSW DPI
Monitor improvement of fish abundances after the water reform process	NCC, EPA, NPWS, NSW DPI
Investigate effects of weir removal on improving fish passage	NCC, NPWS, NSW DPI
Assess the effectiveness of aquatic habitat and fish passage rehabilitation techniques	NCC, CMA, NSW DPI
Determine effectiveness of rehabilitation in ASS areas and floodplains*	NCC, EPA, NSW AERP, NSW DPI
Use existing and new data to determine optimum size and arrangement of MPA's	NCC, NPWS, NSW DPI
Determine the effects of reclamation jetties and other structures on benthic habitats and biodiversity	NCC, NSW DPI
Assessing the benefits of fishing restrictions at Grey Nurse Shark critical habitat sites	NCC, NSW DPI
Determine the effectiveness of existing aquatic habitat protection and management policies	NSW DPI

As was the case for wild harvest issues, there is a need to develop the databases required to assess the impacts of any management strategy on those aquatic species and/or habitats that they are designed to enhance. Whilst this is common sense in any sort of adaptive management framework, it is an all-too-common situation that measurements of the effectiveness of management strategies takes second place to the drive to implement the strategies. The methodologies for achieving such ends are not new but usually require the establishment of scientific monitoring protocols well before management changes occur, in control places where no changes are expected, and they need to continue well after the implementation of any given strategy. It is also becoming apparent that stakeholders and an ever-increasingly informed public expect such programs to be in place so that management initiatives that are shown to work through rigorous science can be encouraged, and ones that do not work, can be replaced.



Technology

PRIORITY PROJECTS	STAKEHOLDER GROUPS
Develop and assess new designs for fishways and the effectiveness of existing fishway designs*	NCC, EPA, NSW DPI
Evaluate effectiveness of by-pass channels	NCC, NSW DPI
Assess modified lock operations and weir design in ameliorating fish passage*	NCC, NSW DPI
Assess the effectiveness of new fish passage remediation options such as active floodgate management and new designs for waterway crossings	NCC, CMA, NSW DPI
Continually improve efficiency of electrofishing and other fish sampling techniques to minimise mortality or harm	NCC, FSC, NSW DPI

There were relatively few priorities identified that involved research into novel technologies designed to achieve conservation-orientated outcomes. One could argue that this is because many of these sorts of advances have already been made, but the reality is that many of these kinds of priorities appear elsewhere in this document (e.g. development of by-catch reduction devices, new designs of fishing gear to conserve species, etc), or are enconced in broader priorities (e.g. managing carp in water storages, etc.). The methods to develop technologies such as these, and those listed here that involve fishways and other techniques to encourage fish migrations, involve relatively straightforward field experimentation, often after initial work in aquaria.



Trout Cod and its habitat



Alien Species

PRIORITY PROJECTS	STAKEHOLDER GROUPS
Research into the control/eradication of <i>Caulerpa taxifolia</i> *	EGMAC, ACoRF, EPA, NPWS, NSW DPI
Determine impacts of <i>Caulerpa</i> on habitats, biodiversity and commercial fish*	ACCF, EGMAC, NPWS, NSW DPI
Map growth & spread of new and existing <i>Caulerpa</i> outbreaks*	EPA, NPWS, NSW DPI
Determine impacts of dredging in <i>Caulerpa</i> areas	NPWS, NSW DPI
Management of carp in water storages including the testing of carp management pellets containing rotenone*	EPA, NPWS, NSW DPI
Environmental benefits of carp reduction	EPA, NPWS, NSW DPI
Population structure and distribution of carp*	Inland MAC, NPWS
Responses of carp populations to reduction (e.g. can carp compensate for reduction in adult density by increasing recruitment)	NPWS, NSW DPI
Identification of habitats where carp do not occur to prevent invasion or to eradicate new invasions before they are established	NPWS, NSW DPI
Determine distribution patterns and impacts of introduced freshwater alien fish species on habitats & biodiversity	NPWS, NSW AERP, NSW DPI
Targeted biodiversity surveys in ports to detect presence of introduced species	NPWS, NSW DPI
Develop control techniques for <i>Gambusia</i>	NPWS, NSW DPI
Develop control techniques for redfin, goldfish, weatherloach, banded grunter & other freshwater pests	NPWS, NSW DPI
Determine impacts and develop management and control techniques for all alien species	NCC, NPWS, NSW AERP



The alien European Carp



Testing gears to remove carp

This group of priorities deals with those challenges facing managers in NSW as they try to develop ways to ameliorate the effects and numbers of harmful, invasive species like *Caulerpa taxifolia*, carp, *Gambusia*, etc. Introduced pests such as these have usually evolved elsewhere but, when introduced into NSW's unique aquatic systems, are free to live and reproduce without the natural checks and balances of their native locations. Removing these species, or at least ameliorating their impacts, is a major ongoing challenge for aquatic managers that will probably never be fully realised. Nevertheless, there are a variety of techniques available to deal with such issues (including targeted removals in well-defined areas) and it is sometimes possible to develop innovative methods (such as new ways to kill *Caulerpa* using osmotic shock or producing daughterless carp). The issues involved in dealing with these problems are so large, complex and difficult that the programmes required are usually characterised by being long-term, expensive and involve substantial laboratory work followed by long periods of field testing before solutions can be safely implemented into natural systems.





Aquaculture

As in most countries, production from wild harvest fisheries in NSW will probably not be able to increase to meet expanding demand for seafood. Already some of NSW's most important aquatic resource industries are based on aquaculture (in particular its largest – the oyster industry) and it is recognised that aquaculture has the greatest potential for growth as a provider of seafood. Farming fish in ponds, tanks and sea-cages is a very different discipline to the harvesting of wild stocks by commercial and recreational fishers because it requires animal husbandry to raise large numbers of a few species to market size in captivity. As a consequence, the priorities for aquaculture research are mostly technologically based (see below), involving the development of methods to: (i) close the life-cycle (in laboratory aquaria) of candidate species for aquaculture (i.e. species that can grow quickly and easily in dense populations in captivity and that have high market appeal); and (ii) grow these species to a size and in numbers that are profitable. This involves the development of cost-effective feeds and feeding strategies and managing fish health to minimise losses.

There is a strong link between aquaculture science and more traditional fisheries biology. Aquaculture science, at least during the initial stages of domesticating a species, usually relies on information about reproduction, feeding patterns, migration and growth potential that has been established via research on animals in the wild. In turn, aquaculture research informs wild harvest fisheries science, particularly by identifying larval stages, environmental cues for spawning, growth characteristics and nutritional requirements.

Overall priorities for aquaculture research are largely driven by the need to overcome constraints to profitable culture. This involves a close interaction between scientists and existing and potential aquaculture farmers. Prioritising research topics involves identifying the species that should be studied and those aspects of hatchery, growout technology or post-harvest issues that are most important. In a general sense, priorities need to be assessed on the basis of the estimated potential for environmentally-sustainable growth of the industry and the cost-benefit of studying a particular topic (i.e. how much the research costs versus the potential economic benefit).



Oyster lease

Technology – Oysters

PRIORITY PROJECTS	STAKEHOLDER GROUPS
Develop a model to calculate "optimal" oyster stocking densities within part or all of an estuary	ORAC, EPA
Develop techniques to maximise survival of oyster larvae and juveniles within a hatchery*	ORAC, NSW DPI
Solve problems with hatchery production of SRO's (ie larval and spat mortality)	ORAC, NSW DPI
Selective breeding for oysters to achieve faster growth*	ORAC, Aqua. Ind. Gps, NSW DPI
Improve methods of farming akoya pearl oysters*	Aqua. Ind. Gps, NSW DPI



Pearl Aquaculture



Inland Saline Aquaculture Research at Wakool

Technology – Prawns

PRIORITY PROJECTS	STAKEHOLDER GROUPS
Develop sustainable prawn feeds (and reduce dependence on fishmeal)*	ACoA, Aqua. Ind. Gps, NCC, NSW DPI
Domesticate prawn species suitable for culture*	ACoA, Aqua. Ind. Gps, NSW DPI
Genetically improve prawn culture species	ACoA, Aqua. Ind. Gps, NSW DPI
Improve prawn broodstock performance	ACoA, Aqua. Ind. Gps, NSW DPI
Enhance access to prawn spawners	ACoA, Aqua. Ind. Gps, NSW DPI
Optimise prawn pond preparation and improve sediment management practices	Aqua. Ind. Gps, EPA, NSW DPI
Improve survival, growth rates and food conversion ratios of prawns	Aqua. Ind. Gps, NSW DPI
Understand prawn farming pond dynamics and identify key pond stability criteria.	Aqua. Ind. Gps, NSW DPI

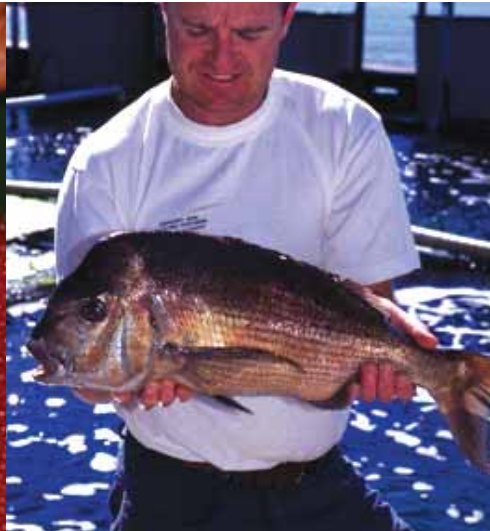


Technology – Silver Perch

PRIORITY PROJECTS	STAKEHOLDER GROUPS
Maintenance of genetic separate lines of silver perch broodstock*	Aqua. Ind. Gps, NSW DPI
Selective breeding of silver perch for faster growth	Aqua. Ind. Gps, NSW DPI
Improve health management strategies*	Aqua. Ind. Gps, NSW DPI
Investigate techniques to minimise "off" flavours in silver perch culture	Aqua. Ind. Gps, NSW DPI



Fertilizing fish eggs



Aquaculture snapper

Technology – Marine Fish

PRIORITY PROJECTS	STAKEHOLDER GROUPS
Develop and improve broodstock management techniques for marine species, including Australian bass, mulloway and kingfish for improved production of high quality eggs on a year-round basis*	Aqua. Ind. Gps, NSW DPI
Evaluate use of extensive green water systems for culture of snapper, mulloway and other marine fish larvae*	Aqua. Ind. Gps, NSW DPI
Develop improved and cheaper diets for grow-out of marine fish including snapper, mulloway and kingfish*	Aqua. Ind. Gps, NSW DPI
Develop genetically (and sterile) superior stocks of key species	Aqua. Ind. Gps, NSW DPI



Technology – Other Species

PRIORITY PROJECTS	STAKEHOLDER GROUPS
Evaluate crayfish strains for farming and assessment of issues such as sterility of hybrids that would affect approvals to farm strains out of their range or hybrids	Aqua. Ind. Gps, NSW DPI, ACoA
Develop improved supplementary diets for intensive crayfish aquaculture	Aqua. Ind. Gps, NSW DPI
Rock lobster aquaculture and enhancement*	LOBMAC, ACoA, NSW DPI
Abalone aquaculture and enhancement*	ACoA, Aqua. Ind. Gps, NSW DPI
Sea Urchin aquaculture and enhancement	ACoA, Aqua. Ind. Gps, NSW DPI
Develop techniques for culture of alternative species to <i>P. monodon</i>	ACoA, Aqua. Ind. Gps, NSW DPI
Investigate the integration of alternative species into normal oyster farming regimes to enhance and diversify production from a lease*	ORAC, NSW DPI
Industry research on silver perch and native species including selective breeding/genetics; health management and sterile stock	ACoA
Evaluate production systems for eels	Aqua. Ind. Gps





Technology – General

PRIORITY PROJECTS	STAKEHOLDER GROUPS
Development and evaluation of recirculation technology for NSW species (freshwater and marine)*	Aqua. Ind. Gps, NCC, EPA, NSW DPI
Evaluate and develop commercially viable inland saline aquaculture*	ACoA, Aqua. Ind. Gps, NSW DPI
Evaluate potential for polyculture of crayfish and fish	Aqua. Ind. Gps, NSW DPI
Development, improvement and extension of hatchery technology	ACoA

Several of the above technological priorities identify generic attempts to enhance aquaculture opportunities and production (i.e. development of recirculation systems, inland saline aquaculture, polyculture). But the majority of priorities are species-specific, focussing on problems associated with the major species currently farmed in NSW (oysters, prawns and crayfish) and the potential for new candidate aquaculture species (like abalone, sea urchins and rock lobsters).

All these research areas require significant laboratory- and pond-based experimentation. The basic procedures for much of this work is well-established, although individual studies have to be done for individual species. Further, once the experimental work is done, farm-scale trials are required before results can be ultimately translated into industrial-scale production.



Cronulla Fisheries Centre's Heritage-listed research aquarium



Health Management

PRIORITY PROJECTS	STAKEHOLDER GROUPS
Increase industry access to affordable diagnostic tools and laboratories for aquaculture species*	ORAC, Aqua. Ind. Gps, NSW DPI
Survey of farmed and wild marine crustacean populations in NSW for evidence of white spot syndrome virus (WSSV) or yellowhead virus (YHV) infections*	Aqua. Ind. Gps, NCC, NSW DPI
Determine the distribution of the EHN virus	Aqua. Ind. Gps, NSW DPI
Investigate the potential that sewage, stormwater and agricultural runoff may lead to an accumulation of viruses and bacteria within oysters and/or the environment that will cause human health issues	ORAC, NCC, EPA, NSW DPI
Develop simple testing procedures for the presence of marine biotoxins to assist aquaculture, especially farming filter feeders like oysters	ORAC, EPA, NSW DPI
Understanding the occurrence of QX and winter mortality in oysters within NSW*	ORAC, NSW DPI
Develop QX disease resistant oyster stock through genetic selection*	ORAC, NSW DPI
Develop an assessment process for relaying of oysters which considers the disease status of each waterway*	ORAC, EPA
The relationship between the occurrence of an oyster disease (QX, Winter Mortality, etc) and the environment of an estuary and model/predict the severity of an outbreak*	ORAC, EPA
Develop monitoring and/or management tools that will provide the capability to better manage QX and winter mortality infections in oysters	ORAC
Identify better planning and management regimes to prevent or respond to human health threats from eating contaminated oysters	ORAC
Develop farm management tools to deal with diseases of silver perch	Aqua. Ind. Gps, NSW DPI
Develop appropriate protocols for on-farm disease prevention, control and treatment for prawn diseases*	ACoA, Aqua. Ind. Gps, NCC, NSW DPI
Identify potential disease threats to prawn farming*	Aqua. Ind. Gps, EPA, NSW DPI
Develop disease resistant prawn post-larvae	Aqua. Ind. Gps, NSW DPI
Produce Specific Pathogen free (SPF) prawn post-larvae	Aqua. Ind. Gps, NSW DPI
Develop a rapid diagnostic test for VNN to allow certification of disease free status on all life stages of barramundi	Aqua. Ind. Gps
Study of microbial ecology in aquaculture	NSWAERP



In addition to the above technological problems facing aquaculture science in terms of growing species economically, significant challenges face the large-scale production of seafood through the impacts that various diseases can have. Recent massive losses of Sydney Rock Oysters from estuaries in NSW highlight the devastating effects of diseases if they take hold in mono-specific aquaculture ponds, cages and leases.

The priorities for research on diseases identified by NSW stakeholders mostly refer to specific diseases affecting particular aquaculture or fishing industries, especially those affecting the oyster and prawn industries. Constant monitoring is required to combat such problems, as is the development of tools to fight diseases should they occur. Diagnostics, biotoxins, genetic selection and genetic engineering are all involved in addressing such problems which all require unique expertises and skills that are very different to those in traditional fisheries science and ecological work. Further, the application of these skills needs to be applied at disease- and species-specific levels.



Oyster lease

External Impacts

PRIORITY PROJECTS	STAKEHOLDER GROUPS
Develop a unified Whole of Government waterway classification model with defined assessment criteria with relevance to oyster farming	ORAC, EPA
Identify estuaries or areas which are affected by water quality problems like acid sulphate releases, nutrient run off, chemical run off, sediment, etc. which affect the productivity of oysters*	ORAC, EPA, NSW DPI
Assess the impacts from agricultural, wild fisheries and urban development on aquaculture	Aqua. Ind. Gps, NSW DPI



Two priorities were identified which highlighted the importance of external impacts to aquaculture and, whilst this is understandably far fewer than those identified for wild harvest fisheries (which rely so heavily on natural conditions), it does recognise that water quality is one of the most important factors affecting NSW's most valuable seafood resource – oysters. Tackling such problems, however, is not simple and involves many groups and industries that reside outside the oyster industry itself. As identified by ORAC and the EPA, a whole-of-government and multi-industry approach is required to deal with this issue and involves scientific expertise that, in many cases, will reside outside traditional fisheries or aquaculture science. A major challenge, therefore, is to establish such priorities as research questions for other relevant agencies and industries so that a unified approach to resolving these problems can be initiated.

Concomitant Effects

PRIORITY PROJECTS	STAKEHOLDER GROUPS
Effects on wild populations from aquaculture fish, pond run-off or artificial feeds escaping or being released	OTLMAC, EPA, NSW DPI
The environmental influence of prawn farm management practices at a range of scales from molecular to regional	Aqua. Ind. Gps, EPA, NSW DPI
Assess non-lethal methods of excluding predators from aquaculture activities	NPWS
Environmental impacts of aquaculture on water quality and coastal environments	EPA, NSW AERP
Assess the benefits of mixed species aquaculture to decrease pollution	EPA
Evaluate and/or develop alternative commercially viable products to replace timber and tar where applicable for oyster farming	ORAC, NCC, EPA

Certain stakeholders (most of whom are not actively engaged in the aquaculture industry) identified research priorities involving the impacts that aquaculture activities may have on other species and the surrounding environment. Whilst such issues as pollution, escapees from aquaculture ponds and nutrient enrichment can be difficult to quantify, methods to do so involving field experimentation are available. Further, because of the artificial nature of most aquaculture activities, replicated experimentation to determine cause-and-effect relationships can be implemented in industrial operations to answer such questions. It is also worth noting that it is a requirement for most aquaculture operations in NSW to undergo detailed environmental impact assessments prior to establishment, followed by ongoing monitoring of environmental impacts.

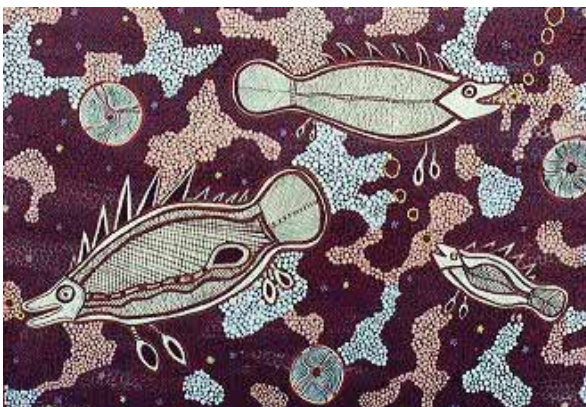


Inland saline aquaculture research

Indigenous Fisheries

This category of research priorities involves developing an understanding of the nature, dimensions and characteristics of Indigenous fisheries and their interaction with other commercial and recreational fisheries. This is a new and challenging category of fisheries research in NSW (and, indeed throughout the world), having been ignored as a separate issue for much of the history of fisheries science and management.

The establishment of the NSW Indigenous Fisheries Strategy and Implementation Plan (IFSIP) in December 2002 marked a major step in developing ways to manage Indigenous fisheries in the state. The success of this plan in managing Indigenous fisheries issues, enabling other sectors to adjust to them and justifying the historical association between Indigenous communities and aquatic resources will depend on reliable and accurate information about such things as Indigenous harvest rates, cultural and spiritual values of traditional target species and Indigenous participation in commercial and recreational fisheries and aquaculture operations.



"This painting shows river fish swimming and searching for food. These fish were a Bakandji well sought after dish for our tribe, the River People. Our people used rocks in the shallow part of the river to trap the fish. Circles shown in this painting represent part of the fish trap that was used." – Eddy Harris



"This painting represents the river fish, which were of course a major food source of the Bakandji, or River People, along the Darling River near Wilcannia, in western NSW." – Eddy Harris



Establishing the techniques to get the above information will be challenging because there is currently a lack of expertise in this area, significant suspicion in Indigenous communities about the role of fisheries research, and intellectual property issues concerning the "ownership" of the information gathered. The kind of research that is needed also requires culturally appropriate methodologies that have to be negotiated with individual communities. Progress in such work will probably be relatively slow initially but the first steps will be to identify existing research expertise in these areas and encourage the development of focused, Indigenous fisheries research centres where such expertise can gather, develop and expand.

The Indigenous Advisory Committee advises on the implementation of the IFSIP and is the first contact point regarding research into Indigenous fisheries in NSW. In the near future, this group will oversee the development of a specific Indigenous Research Plan which will identify existing research activities and future priorities.

PRIORITY PROJECTS	STAKEHOLDER GROUPS
Facilitate the development of a centre for research into Indigenous fisheries	IFSAC, NSW DPI, ATCIC, NSWALC
Develop a research plan for Indigenous fisheries	IFSAC, NSW DPI, ATCIC, NSWALC
Consolidate any existing research on Indigenous fisheries	IFSAC, NSW DPI, ATCIC, NSWALC



Ricky Johns at the Mudgee Yabby and Native Fish Farm

Post-Harvest and Value-Adding

Research priorities concerning the products from fisheries and aquaculture after harvesting usually fall outside what is considered conventional "fisheries science". Despite this view, such issues form a vital component of the research needed to ensure the optimal and most beneficial use of fisheries resources. Concepts such as "whole-of-chain" approaches to achieving "triple-bottom-line" benefits for the environment, economy and society require solutions to problems associated with enhancing the economic returns that commercial fishers and aquaculturists receive for their efforts.

General priorities identified in this section included several that involve a variety of issues concerning the operation of the entire post-harvest seafood sector in NSW. Not surprisingly, however, many of the research priorities for post-harvest and value-adding concern the most important and well-established aquaculture product in NSW (oysters) although the EGMAC has also identified the need to explore ways to enhance their numerous wild-harvest products after capture.

The sorts of research needed in this area involve market research methodologies, economic analyses of margins and ways to enhance harvested product as it makes its way from the water to the retailer. There is a great deal of expertise and experience available in this area for other food-types in NSW and, to achieve the research priorities identified in this category, such expertise needs to be more tightly focused on the seafood industry.





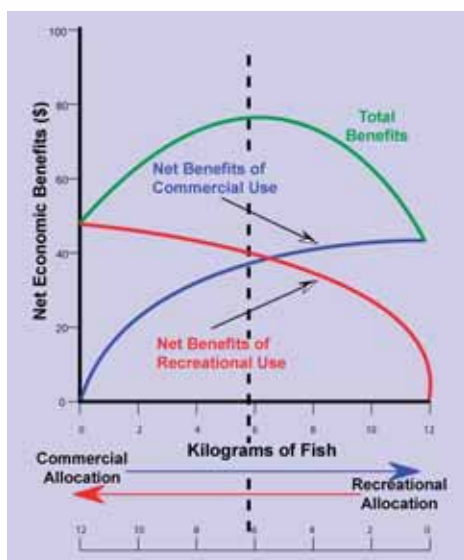
PRIORITY PROJECTS	STAKEHOLDER GROUPS
Census of the structure of the post-harvest sector including sellers, product popularity, value, staff and impeding factors	MFMA
Develop a Strategic Research Plan for the post-harvest sector	MFMA
Investigate and inform consumer perception of the health benefits of seafood	MFMA
Examine the dynamics of value-adding margins along the whole marketing chain for wild harvest and aquaculture products	NSW DPI
Investigate and/or develop oyster depuration techniques that will ensure a high quality safe food product is delivered to the consumer*	ORAC
Evaluate and develop an effective oyster marketing strategy which will assist industry and provide a platform for increasing investment opportunities and consumer confidence in the industry	ORAC
Develop a standardised oyster marketing process and grading criteria of product	ORAC
Identify and implement processes for adding value to oysters and byproducts	ORAC
Establish an equivalence comparison of the internationally accepted bacteriological mean probable number method (MPN) with the proposed direct plate method (DPN) to assist in oyster quality assurance programs*	ORAC
Identify and develop available markets and identify critical factors limiting growth of export markets for Australian farmed prawns	Aqua. Ind. Gps, NSW DPI
Investigate strategies to enhance product and add value to the Estuary General Fishery	EGMAC, NSW DPI
Development of improved tanking and marketing of abalone	NSW DPI

Socio-Economics, Education and Communication

This category of research priorities involves the very important issues surrounding the "human dimension" of fishing. These issues concern: (i) answering questions about the socio-economic nature and cultural impacts of commercial, recreational and Indigenous fishing and aquaculture and the management decisions that affect these sectors; (ii) educating stakeholders and the general public about the myriad of issues concerning fisheries and aquaculture; and (iii) communicating information amongst stakeholders so that commercial, recreational and Indigenous fishers, aquaculturists, managers, scientists, decision-makers, environmental groups and the general public can provide advice and understand issues with the benefit of the knowledge possessed by each other.

Establishing techniques to achieve these priorities are challenging, although significant expertise exists in the field of socio-economics to address most of the socio-economic questions raised. Education and communication amongst stakeholders are also areas for which established techniques exist, and applying them to fisheries, aquaculture and aquatic conservation in NSW should be a relatively straightforward process, especially in the current environment where a myriad of advisory committees and councils exist for most stakeholder groups.

Educating and communicating the broader public of NSW (a very populous state) is, however, much more difficult as the use of the mass media (which are the most effective, albeit costly, techniques available), do not easily lend themselves to communicating the sorts of complex, multi-faceted information that characterises fisheries issues. Nevertheless, we live in an age of ever-improving communication and an ever-more discerning public, so there exists far fewer impediments to communicating fisheries information to the public than at any time in history.



Economic models for fisheries



PRIORITY PROJECTS	STAKEHOLDER GROUPS
Independent assessment of the economic value of the NSW commercial fishing industry and undertake extension and promotion activities to increase the public awareness of commercial fishing (including its value) and the results of relevant research to reduce conflict	ACCF, EGMAC, EPTMAC, OPTMAC
Socio-economics of the Ocean Fish and Ocean Prawn Trawl fisheries and the likely impact of fisheries management strategies and Marine Parks*	OFTMAC, OPTMAC, NSW DPI
Economics of the commercial lobster fishery (costs of catching lobsters, profitability, impacts of management and community contribution on trading of quota and sales of shares)	LOBMAC, NSW DPI
Survey of fishers' costs and earnings to quantify their terms of trade	NSW DPI
Examine the technical capacity and efficiency in the NSW fishing fleet*	NSW DPI
Economic assessment of the impact of the abalone fishery	NSW DPI
Examine fisher-attitudes towards the environment and consequent education programmes	EPA
Survey of economic benefits of recreational fishing to coastal communities*	ACoRF
Assess the benefits of declaring a species 'recreational only' (do recreational benefits outweigh the value of the commercial catch?)	ACoRF
Training and extension of recirculation systems in aquaculture*	Aqua. Ind. Gps, EPA, NSW DPI
Increase awareness and utilisation of sustainable prawn farming practices	Aqua. Ind. Gps, NCC, EPA, NSW DPI
Increase farmer awareness and adoption of relevant R & D outcomes (extension) for all aquaculture species*	Aqua. Ind. Gps, NSW DPI
Evaluate the economic effectiveness of relocating oysters to achieve faster growth rates	ORAC
Evaluate the structural processes within the oyster industry	ORAC
Economic analyses and models for aquaculture	ACoA
Evaluation of the socio-economic impact of non-Indigenous fisheries on Indigenous fisheries	IFS Indigenous Advisory Committee, NSW DPI
Socio-economic study of the value of cultural fishing to Indigenous communities	IFS Indigenous Advisory Committee, NSW DPI



Priority-Setting and Resourcing

This document has concentrated on identifying and discussing (quite superficially) those research priorities that stakeholders have identified for wild harvest fisheries, aquaculture and aquatic conservation in NSW and the basic sorts of scientific inquiry that would be required to achieve them. However, to achieve results for all the priorities listed in this document would require many more resources than are available. Furthermore, these lists will grow as policies to achieve the sustainable development of natural aquatic resources are developed and implemented and also as research on particular priorities is completed. That is, as one question is answered in science, it is quite common that many more questions arise from it. This all means that there will always be questions that need answering and insufficient resources to do so, which in turn means that it will always be necessary to choose which questions need to be answered before (or even instead of) others, using the resources available.

This document has not attempted to do this prioritisation because particular priorities for research depend on the point-of-view held by any particular stakeholder group. For the authors of this document to provide such a prioritisation would be simply placing their priorities above all others. Instead, we present the whole list, identifying which stakeholders hold particular priorities as important at the present time so that researchers, decision-makers and granting agencies can weigh the costs and benefits associated with answering particular questions (rather than others) in the light of knowing which stakeholders will be satisfied and which ones will not.



An archival tag on a Grey Nurse Shark



Recreational beach fishing

Of course, one way to maximize the number of priorities that can be achieved and, therefore, decrease the difficulties in assigning priorities, is to fully exploit (and even expand) all possible resources available for research, especially through the many granting bodies that fund research. There are several granting bodies that provide significant funds for research into fisheries, aquaculture and aquatic conservation in NSW – by far the two most important being the NSW Recreational Trusts and the Fisheries Research and Development Corporation (FRDC) (approx. 8% and 7% of total research expenditure in 2002–03, respectively). The NSW Recreational Saltwater and Freshwater Trusts are funded from NSW recreational fishing licences and have regular calls for project proposals (including research projects) that are designed to enhance recreational fishing in NSW (for details see

www.fisheries.nsw.gov.au/rec/committees/rft-guide.htm). The FRDC is an Australian Government agency funded from levies paid by Australia's seafood industry and the Australian Government. The FRDC operates an annual funding cycle involving project proposals that are administered through its NSW Department of Primary Industries Research Advisory Body (NSW FRAB) – for more details, see www.frdc.com.au.

In addition, there are a variety of other current and potential sources of funding for doing research in NSW including the Australian Council for International Agricultural Research, the Natural Heritage Trust, the Australian Government's Department of Agriculture, Fisheries and Forestry, the Australian Fisheries Management Authority, the Murray Darling Basin Commission, the CSIRO, the state's many universities and a variety of other state and Australian Government departments. Certain government departments share responsibilities for achieving some of the research priorities listed in this document (including, for example, the Department of Infrastructure, Planning and Natural Resources and the Department of Environment and Conservation in NSW) and some resources for doing research on shared interests should, therefore, be forthcoming from such agencies. There are also substantial funds contributed (as cash or in-kind) from numerous industries and these continue to grow as more and more research projects are done in close collaboration with commercial fishers and aquaculture farmers (often using their vessels, gears, ponds and expertise).



Mulloway



Snapper



However, whilst there are many sources of funds available for research into fisheries, aquaculture and aquatic conservation in NSW, the majority of resources (over two-thirds in 2002–2003) is provided by the NSW Government via NSW Department of Primary Industries. Whilst the NSW Government has the overriding responsibility to manage and monitor the aquatic resources of the state on behalf of its owners (the public of NSW), such a domination of the provision of fisheries research by NSW Department of Primary Industries would, ideally, be decreased by increasing the fisheries research capacity of other providers. In particular, whilst several university departments and consultants do excellent research in various fields that are of a "conservation" or "ecological" nature (and therefore can and do execute much of the work outlined for those particular priorities listed in this document), there exists little capacity outside NSW Department of Primary Industries for aquacultural science nor for traditional, wild harvest fisheries research such as resource assessment and modelling, recreational creel surveys, etc. This is not ideal for two reasons: (i) the benefits of healthy competition among research providers in these areas are minimal; and (ii) the significant leveraging possibilities on funds that exist for universities, etc. are not fully exploited. As a consequence, in recent years, the NSW Government has adopted a policy of expanding the research capacity of agencies external to it in these areas and NSW Department of Primary Industries has allocated significant resources to assist in such capacity-building.

It is worth noting, however, that research into fisheries, aquaculture and aquatic conservation in NSW does not happen in a vacuum. NSW is Australia's most populous state, is located centrally on the eastern seaboard and contains a large proportion of the country's freshwater habitats. These attributes position NSW's research issues into aquatic resources as highly significant at a national level, ensuring that NSW remains a major player in national research efforts as co-ordinated by bodies such as the Australian Fisheries Management Forum and its Research Sub-committee, the FRDC, MDBC and CSIRO. Such a prominent national position provides significant and on-going opportunities for the focussing of interstate and Australian Government research expertise and resources towards NSW-centric issues and a proportionate attraction of investment into their resolution.

Whilst such national foci (and their many consequent collaborations) are important to NSW, it is nevertheless true that, in an ideal world, the overall funding of research into fisheries, aquaculture and aquatic conservation in NSW would be enhanced generally. However, in a state with relatively few fisheries resources, a relatively small aquaculture industry and a very finite amount of funding available for a massive number of conservation issues, opportunities to increase funding for aquatic research remain limited.

In the foreseeable future, therefore, the majority of resources for aquatic research (which, as noted above, are provided by the NSW Government) have to be assigned to the most pressing and core issues facing our wild harvest fisheries, aquaculture industries and the conservation of aquatic biodiversity and habitats. For wild harvest fisheries and aquatic conservation issues, this must involve monitoring wild stocks, aquatic biodiversity and habitats to: (i) identify if and when changes to management are warranted; and (ii) determine the success (or otherwise) of such management changes. For aquaculture, enhancing the existing and developing aquaculture industries of NSW is the priority and therefore the technological work needed to improve production for existing and new aquaculture species should attract the greatest attention.

Acknowledgements

The production of this document would not have been possible without the priorities that comprise it. These came from NSW's many Advisory Councils, Management Advisory Committees, aquatic industries, other committees, individuals and agencies. In particular, the authors acknowledge the contribution of members of the NSW FRAB in assisting with the compilation of this document and the FRDC for assisting with funds for its production.

The pieces of indigenous art are courtesy of Eddy Harris, the talented aboriginal artist of the Bakandji people who currently lives in Corowa, NSW.

This document was compiled by Dr Steve Kennelly, Chief Scientist, NSW Department of Primary Industries.

Appendix – List of Acronyms

ABMAC	Abalone Management Advisory Committee
ACCF	Advisory Council on Commercial Fishing
ACFC	Advisory Council on Fisheries Conservation
AcoA	Advisory Council on Aquaculture
ACoRF	Advisory Council on Recreational Fishing
Aqua. Ind. Gps	Aquaculture Industry Groups
AM	Australian Museum
ATSIC	Australian Aboriginal and Torres Strait Island Commission
CMA	Catchment Management Authorities
EGMAC	Estuary General Management Advisory Committee
EPA	Environment Protection Authority
EPTMAC	Estuary Prawn Trawl Management Advisory Committee
FRCAC	Fisheries Resource Conservation Assessment Council
FRDC	Fisheries Research and Development Corporation
FSC	Fisheries Scientific Committee
IFSIAC	Indigenous Fisheries Strategy Indigenous Advisory Committee
IFSIP	Indigenous Fisheries Strategy Implementation Plan
Inland MAC	Inland Management Advisory Committee
LOBMAC	Lobster Management Advisory Committee
MDBC	Murray Darling Basin Commission
MFMA	Master Fish Merchants' Association
MPAC	Marine Park Advisory Council
NCC	Nature Conservation Council
NPWS	National Parks & Wildlife Service
NSWALC	NSW Aboriginal Lands Council
NSWAERP	NSW Aquatic Ecology Research Programme
NSW DPI	NSW Department of Primary Industries
NSW FRAB	NSW Fisheries Research Advisory Body
OFTMAC	Ocean Fish Trawl Management Advisory Committee
OHAULMAC	Ocean Haul Management Advisory Committee
OPTMAC	Ocean Prawn Trawl Management Advisory Committee
ORAC	Oyster Research Advisory Committee
OT&LMAC	Ocean Trap & Line Management Advisory Committee
SIAF	Seafood Industry Advisory Forum

NSW DEPARTMENT OF PRIMARY INDUSTRIES

To be a partner in the development of profitable, sustainable primary industries for NSW to ensure that:

- Primary industries have appropriate access to natural resources;
- Communities benefit from the use of natural resources;
- Regional economies are enhanced.

