Biodiversity Update

Issue No. 1 *A quarterly newsletter on aquatic biodiversity* 2000

Aquatic biodiversity research challenge

The launching of the New Zealand Biodiversity Strategy by the Prime Minister in February this year marked a significant milestone in New Zealand's approach to environmental management, both aquatic and terrestrial.

The strategy will provide a new framework for assessing the status of aquatic species assemblages and their responses to human interventions; for the inventory of living aquatic resources; and for the assessment and management of already established or newly arriving undesirable alien species that threaten aquatic biosecurity.

Meeting the aquatic research requirements of the Biodiversity Strategy raises significant challenges to address some large-scale issues. Aquatic environments and their biodiversity are more difficult to study, much less well known, and require different management regimes from those on land.

The challenges include the assessment of potential impacts of dredging and trawling on complex and potentially vulnerable macrobenthic populations on the seabed around New Zealand. The relationships between climate change and biodiversity, and the challenge of discriminating between climatic and human influences in the aquatic environment, are also important.

The Biodiversity Strategy also recognises our sphere of interest in the Ross Sea and the Southern Ocean, where improved understanding of marine biodiversity is important for predictive modelling and management of impacts such as commercial fishing, tourism, and global warming.

Improved knowledge of our aquatic biodiversity will also enable a more effective assessment of genetic and biotechnological opportunities in our seas, lakes, and rivers in the form of bioactive compounds as possible candidates for antitumour, antiviral, or bactericidal uses. Potential new species for aquaculture will also emerge.

A more synoptic approach to research on the status and changes of biodiversity over large scales in the aquatic environment will require new initiatives in data management — including improved access to historic datasets and improved processing and management of new research data. Collaborative approaches to data management and researching aquatic biodiversity — national and international — will be essential to enable the most effective use of the limited taxonomic and ecological research capacity in New Zealand to meet the goals of the Biodiversity Strategy.

NIWA believes that reporting regular summaries of research advances and issues in aquatic biodiversity in this quarterly newsletter will help the public, government agencies, and the science community keep abreast of developments as we move to meet the challenges of fulfilling the Biodiversity Strategy with respect to our marine and freshwater environments.

NIWA
Taihoro Nukurangi

Conserving marine biodiversity

Biodiversity and coastal management

Knowledge of biodiversity is essential for the sound management of coastal marine resources, yet is largely overlooked in fishery plans. One of the first questions asked when local communities wish to manage coastal areas is: "What is there?" NIWA is carrying out biodiversity research and habitat mapping in a proposed mahinga mataitai reserve at D'Urville Island, in conjunction with Ngati Koata. The purpose of this habitat mapping is to combine the research techniques of aerial photography, echosounding, and scuba surveys to effectively "map" the spatial distribution of different habitats, and the species supported by these habitats, to underpin future management of kai moana and other resources.

One of the outputs will be an interactive CD-ROM that displays species distribution by habitat, depth, and/or locality, and photographs of as many species as possible. This information can be a useful management tool for the mataitai reserve. For example:

- knowledge of habitat/kai moana species interactions can be used to enhance kai moana stocks;
- known biodiversity values and habitat types at various localities can be compared over time as kai moana stocks are managed;
- the species contained within an area become a source of information and taonga in their own right.

An aerial view of a small island off D'Urville Island showing subtidal reefs being used for biodiversity studies.

Scuba investigation of the first mapping locality (13 transects to 15 m depth along 600 m of shoreline) in the mataitai reserve has already revealed 87 different species of conspicuous flora and fauna. The invertebrates, fish, and seaweeds do not occur uniformly over the reef, but occur in 10 different habitat types defined by a combination of factors, including temperature, depth, water movement, and the abundance of other species. Relatively little is known about reef systems in New Zealand's central and southern coasts, so this study will make a useful comparison with the northeast coast of the North Island where previous studies have been carried out.

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What biodiversity means

Biodiversity is the variety of genomes, species, and ecosystems occurring in a geographically defined area. The term encompasses not only the variety and abundance of elements (genes, species, habitats), but also the roles that these elements play within the ecosystem. Marine organisms have crucial roles in many biogeochemical processes that sustain the biosphere, they provide a variety of products (goods) and functions (services), including the production of food and natural substances, the assimilation of waste, and the regulation of the world's climate. The rate and efficiency of these processes are determined by interactions among organisms, and between organisms and their environment, and therefore by biodiversity. Marine biodiversity does not necessarily comply with terrestrial paradigms.

See A European Science Plan on Marine Biodiversity (http://www.esf.org/ftp/pdf/Emaps/EmapsPlan.pdf) and Understanding Marine Biodiversity, National Research Council, Washington, 1995.

Ecosystem effects of fishing

Are we fishing down marine biodiversity?

In NIWA's research programme *"Fishing: Ecosystem effects and resource sustainability"* we are learning more about the relationships between marine biodiversity and fishing, so that we can help develop better management strategies for the sustainability of fisheries and the conservation of biodiversity. Research is being conducted in coastal waters at different locations around New Zealand, especially in soft-sediment habitats. These, in their many forms, cover most of the planetary surface and make a significant contribution to marine biodiversity.

Our focus on the seafloor and its associated and dependent species led to our assessing changes in seafloor communities due to trawling and dredging. These activities are significant threats to marine benthic biodiversity. Apart from directly killing marine life, trawling and dredging reduce the complexity or heterogeneity of the seafloor. A large component of seafloor biocomplexity is created by immobile organisms that either grow up into the water (e.g., sponges, bryozoans, hydroids, black corals) or dig down into the sediment (e.g., worms, shrimps, clams, echinoderms), thereby modifying their immediate environment and that of other animals.

Our studies showed that, in the soft sediment typical of much of our coastal waters, habitats structured by the organisms themselves have a very significant positive influence on seafloor biodiversity. This finding demonstrates important ecological reasons to keep these key species in seafloor ecosystems. It also shows the possibility of using these organisms as indicators to rapidly and cost-effectively assess these ecosystems. Our results suggest that removal of habitat structure, even in relatively low-complexity soft-sediment systems, will significantly decrease their biodiversity, and consequently that of the wider marine ecosystem.

Dredging and trawling remove epifauna and homogenise surficial sediments.

Marine environments are dynamic and complex, the knowledge base is small, and many changes are not noticed until it is too late for a rigorous demonstration of cause and effect. Observations are often at the wrong scale to identify connections between exploited species and habitat features. Fisheries assessments seldom include the role of interactions between habitat features and the survival of juveniles of exploited stocks. Management options to reduce the threat to marine biodiversity include the creation of marine protected areas, the spatial and temporal active management of the seafloor, and gear limitation or modification. Given the extent of marine soft-sediment habitats and the degree to which they are subjected to bottom fishing, the creation of marine protected areas alone is unlikely to be sufficient to maintain or enhance biodiversity. We need to use a variety of strategies to conserve our marine biodiversity. Inevitably, there will be uncertainty, but management actions are often made in an uncertain environment.

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Three dimensional complexity on the seafloor, created by epifaunal bivalves, soft corals, and sponges. These features, along with small-scale variations in surficial sediment characteristics, are positively related to biodiversity.

Can fishing and biodiversity hotspots coexist in our coastal zone?

Spirits Bay (Piwhane) is an area of great cultural significance for Maori. It also supports several commercial fisheries, including an occasionally important part of the Northland scallop fishery and some bottom trawling for snapper and trevally. The bycatch of the first scallop assessment survey there in 1996 was so unusual that the Ministry of Fisheries commissioned research to assess the nature and extent of the benthic community, with a view to assessing the potential effects of fishing for scallops. Surveys in 1999 showed that exceptionally diverse communities of benthic invertebrates exist out to a depth of at least 80 m; over 220 species of sponges and 300 species of bryozoans have been identified, as well as numerous rare hydroids, ascidians, corals, gorgonians, black corals, and a wide variety of other taxa. The seafloor life includes unusually high numbers of local and New Zealand endemics, including about 10% of bryozoan species and up to 50% of sponge species, which have not been found elsewhere.


Part of the diverse collection of colonial filter feeders in Spirits Bay.

However, statistical analyses suggest that something other than natural variation in depth and substrate type is important in structuring the invertebrate assemblages, especially sponges, throughout the bay. An index of dredge-fishing for scallops often explains more variance than an index of substrate type. Trends in the bycatch of scallop dredging between 1996 and 1998 support the hypothesis that one area, previously rich in sponges and the large hydroid *Nemertesia elongata*, has been affected by the dredging activity. The number of sponge species caught per dredge tow has declined by at least an order of magnitude. Reduction in the variety and abundance of colonial filter-feeding invertebrates by fishing may have adverse consequences for ecosystem functioning and productivity as well as for the conservation of local, regional, and national biodiversity. Life-history traits typical of these species assemblages (great longevity, patchy recruitment, and restricted dispersal ability) probably mean that changes in the marine life resulting from fishing may be very persistent and take decades to restore.

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New Zealand seamounts – what makes them biologically special?

There are over 800 topographical features termed "seamounts" around New Zealand, reflecting the extensive volcanic history of our region. About 400 species of invertebrates are now known from these seamounts, and additional species, either new to science or new records for New Zealand waters, are continually being recognised. Their geographic distributions range from the cosmopolitan to those that appear to be endemic to individual seamounts. Isolated seamounts, or those with specialised environments (such as active volcanic venting), have a higher number of unusual or rare species than those seamounts that are in groups or part of ridges. The bathymetric distributions of seamount fauna vary from those restricted to a depth band of several thousand metres to those restricted to several hundred metres. The density and variety of life on these seamounts, especially those with present volcanic activity, can be remarkable.

The invertebrate fauna on seamounts is very different from that on the surrounding soft sediment of the continental shelf and slope. Data from northeastern New Zealand show that only about 10% of genera and 2% of species are common to soft-sediment and rocky seamount reef environments. Although many of the species recognised from seamounts also occur on areas of comparatively flat rocky reef, seamounts can host large aggregations of commercial fish species, such as orange roughy, and are often the target of deepwater trawling operations. Many of these deepwater invertebrate species are large, often slow-growing (ages of 300–500 years for some corals), and cemented to the substrate. This can make them particularly susceptible to bottom-trawling, with recovery times almost certainly measurable in centuries. Seamounts will need to be carefully managed to avoid irreparable damage to the habitat and its biodiversity.

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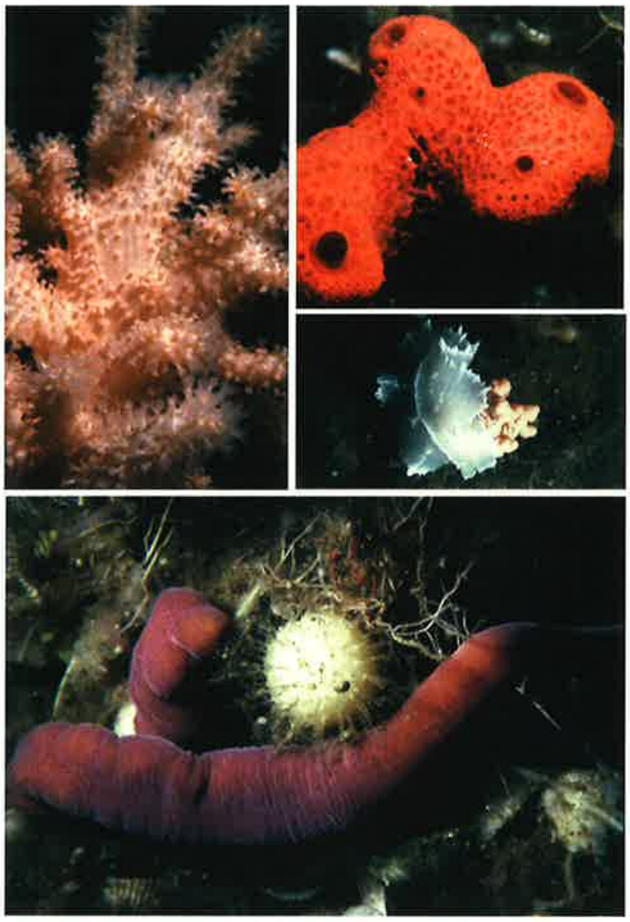
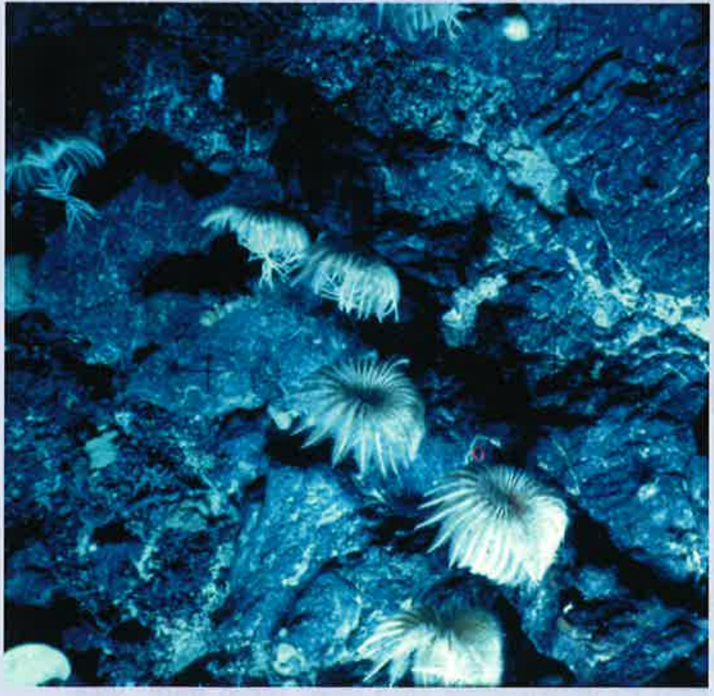
Ross Sea and the Southern Ocean

Renewed interest in biodiversity

Although remote, the Ross Sea is coming under growing risk of human impacts. Tourism and fishing activities are increasing, and permanent bases can have an intense local effect. Climate change is expected to have an increasing impact due to changes in both weather and climate that will have a profound influence on the Ross Sea, its biodiversity, and ecological richness. For these reasons there is a renewed interest in reviewing and advancing our knowledge of Ross Sea biodiversity and the ecological processes that maintain its integrity. This knowledge will lead to better evaluation of the vulnerability of these sensitive ecosystems to human impact and the potential to avoid, remedy, and mitigate adverse effects. Much of the information on the biodiversity of the Ross Sea is scattered widely in New Zealand and international literature. Archives of biota and underwater photographs are held at NIWA, in the U.S., and by scattered individuals and institutions. NIWA's excellent library and databases enhance our ability to draw all this material together, and to develop a research programme to acquire new understanding relevant to the aims of maintaining biodiversity in this special environment.


Marine invertebrates from the McMurdo Sound seafloor.

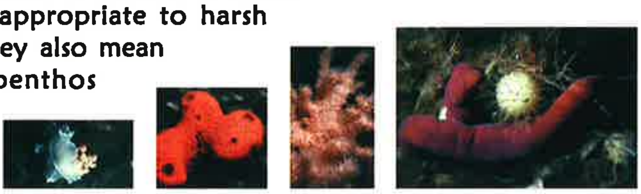

Crinoids (feather stars) on Clark seamount at about 900 m, photographed during the Sonne cruise SO-135 in 1998.

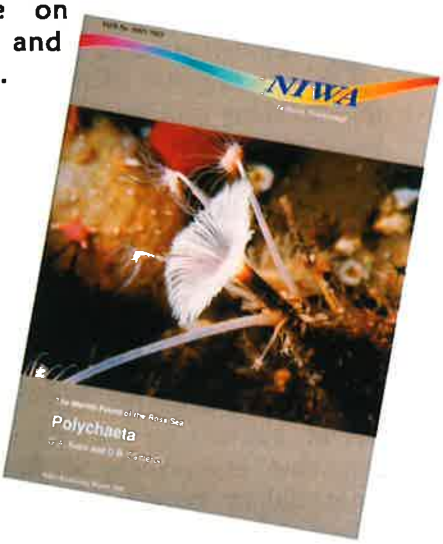
In contrast to the Northern Hemisphere, marine biodiversity does not show a general decrease from the tropics to the polar region. The Ross Sea is a very special area with a very deep continental shelf and the shelf break at 800 m. Marine plants and animals there are adapted to extreme cold, complete darkness for about three months of the year, ice-covered sea for the long cold season, discontinuous primary production, high UV radiation, and low land-derived sediment. Despite these apparently harsh conditions, the Ross Sea supports high biodiversity and high productivity.

The sea-ice community is one of the most important parts of the Ross Sea ecosystem because it contributes a strong burst of organic matter to the system when the sea ice melts. The consumers of the rich microbial populations in and beneath the ice are themselves ultimately fed on by larger organisms (e.g., adult and juvenile fish, larval and adult krill, young seals, penguins, petrels, and animals living on the seafloor). Climate change could severely affect the vital role that the sea-ice community plays in biodiversity maintenance in the whole marine system.

The seafloor of the Ross Sea is notable for its rich community of suspension feeders, especially sponges and bryozoans. Many of the mobile invertebrates, not usually noted for their habit of feeding on dead bodies, are necrophages in the Antarctic winter. Most Antarctic invertebrates have no pelagic larval stage and have a strong tendency towards protected development. Small numbers of large yolky eggs are produced, and, to ensure a high level of survival, they are usually brooded. This tendency is probably a response to the availability of food on the seafloor long after the phytoplankton bloom is over. These adaptations are appropriate to harsh polar conditions, but they also mean that the Ross Sea benthos probably has a low rate of recovery after gross disturbance.

Improved understanding of Southern Ocean biodiversity is also important so that we can develop predictive modelling and management of activities such as commercial fishing, tourism, and global warming. Examining Southern Ocean biodiversity in the context of latitudinal gradient changes shows promise as a research framework within which we could assess the effects of short- and long-term changes of climate on aquatic populations and biophysical processes.





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Vessel hulls: continuing vectors of exotic marine organisms?

NIWA scientists have shown that at least 159 species of exotic marine organisms have been introduced into New Zealand waters. Some, such as the cord grass *Spartina* spp., the Pacific oyster *Crassostrea gigas*, and the Asian seaweed *Undaria pinnatifida*, have had economic and ecological effects. The ballast water of ships is regularly blamed for new introductions of exotic species because of the large volumes of water that must be discharged in ports during cargo loading. However, the principal historical pathway for marine introductions has been via the hulls of ships. The study estimated that only 3% of the recorded introduced marine species in New Zealand arrived in ballast water, and 69% arrived attached to hulls.

Close-up of the invasive hull-fouling bryozoan Watersipora subtorquata, *which provides a flat settlement surface for other fouling species.*

Until quite recently, the transfer of species on ships' hulls has received little attention because of the perception that opportunities to be transported in this way had been reduced by modern antifouling paints, by the relatively high speeds attained by modern cargo vessels, and by the short periods that vessels spend in port. However, the NIWA study showed that the number of exotic species that reached New Zealand in the past 40 years is similar to the number that arrived in the previous 50 years, suggesting that the risk of new introductions has not necessarily been reduced. Does this mean that our belief in the efficacy of modern antifoulant paints is misplaced? Or is it that not enough attention is paid to vessels other than large cargo ships, such as recreational yachts, chartered and joint-venture fishing vessels, and cruise ships?

Fouling on the hull of an overseas yacht.

A more recently completed NIWA study has confirmed that exotic marine organisms are arriving in New Zealand attached to the hulls of vessels, and some vessel types (e.g., ocean-going pleasure craft) present a particular risk because they are generally slower, spend longer in port, and have a more variable history of antifouling treatment than large cargo vessels. The hulls of such vessels are often cleaned at anchor, and any fouling organisms may drop to the seabed. There is an urgent need to quantify the current risks of exotic species introductions through hull fouling on all vessel types, and to review hull-cleaning practices.

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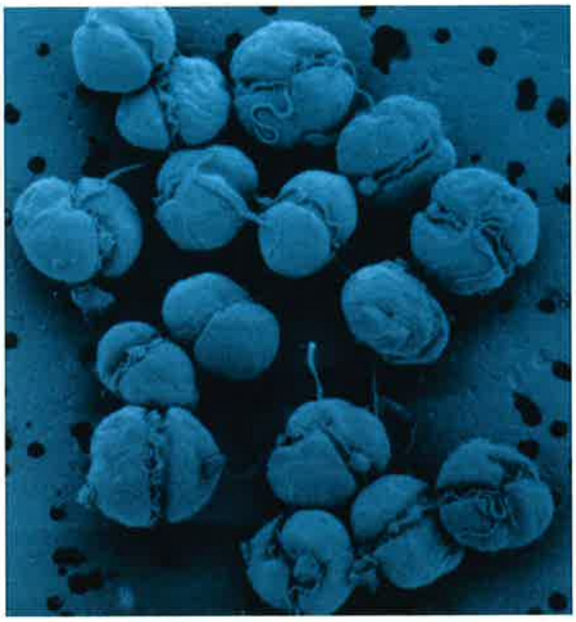
"Chemical warfare" waged against human and marine life

Remember the massive die-off of marine life in Wellington Harbour in summer 1998? For a couple of weeks from mid-February to March a huge number of fish and marine invertebrates were washed up dead on the Petone foreshore. Almost simultaneously, cultures of a large range of marine organisms, including microalgae, brine shrimps, rotifers, seahorses, and juvenile turbot at NIWA's aquaculture facility at Mahanga Bay were poisoned by filtered sea water taken from the harbour. These cultures all collapsed within days. In March, divers noticed a large number of seaweeds, particularly giant kelps, rotting in the harbour. Most notably, at the end of March, long streaks of foam were observed both on beaches and in the harbour, a clear sign of the decimation of marine life. During the same period, onshore wind, which presumably contained the "aerosol" toxin, affected over 150 people who reported suffering from a respiratory syndrome consisting of a dry cough, severe sore throat, a burning nasal sensation, puffy eyes, itching dermatitis, and feverish "influenza-like" symptoms. "Sunburn" facial sensation was also experienced by some divers, and some of the staff at Mahanga Bay suffered headaches.

The event sounded almost like science fiction. Judging by the effects of the so-called "Wellington toxin" on human health and marine organisms, it is fair to say that this was "chemical warfare" waged against humans and marine life.



A scanning electron micrograph of Gymnodinium brevisulcatum (x1250).

Close examination of water samples collected in the harbour revealed large numbers of a toxic microalga — a species of dinoflagellate new to science. This new species was subsequently named *Gymnodinium brevisulcatum*. The recognition and naming of this toxic microalga is part of NIWA's ongoing biodiversity research to describe and to improve the identification of both useful and harmful species, and to establish the occurrence and distribution of microalgae important to fishing and shellfish industries in New Zealand and in oceanic food webs. Harmful microalgal species make up only a very small proportion of the whole algal community (about 2%), but they are species that cause problems for aquaculture industries. It is important that other countries know of any new species that have the potential to spread to their parts of the world. This ongoing biodiversity study also contributes to knowledge of important bioactive compounds (including toxins).

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Marine biotechnology

Biotechnology depends on biodiversity

NIWA's Marine Biotechnology Programme seeks to optimise the value of New Zealand's marine biodiversity by applying biotechnology to produce new products and opportunities for New Zealand industry.

The programme is multifaceted. Under its umbrella we collect the specimens, taxonomically identify the species, and conduct bioassays for the identification of bioactive targets. Once a target has been identified, the structure of the compound is elucidated. Work on determining the optimal method to supply adequate amounts of target compound to industry is also investigated, and this includes cell tissue culture, fermentation technology, and aquaculture, the latter through links with a related NIWA programme. Finally, links with industry are established with a view to commercialisation of the target compound.

NIWA has a library of several thousand extracts from marine organisms, and we add to these at the rate of about 500 each year. The organisms, mostly sponges, bryozoans, ascidians, seaweeds, and microalgae, are collected from coastal, deepwater, and seamount habitats in the New Zealand EEZ. The organisms are currently being screened for bioactive compounds for use as pharmaceuticals (anticancer and antibiotic), agrochemicals, and antifoulants. The programme holds several patents and is in the process of establishing industry links for the commercialisation of these compounds.

New Zealand has a huge potential for the discovery of novel therapeutic or industrial compounds. We have the fifth largest EEZ in the world, spanning 30° of latitude, including warm subtropical to cool subantarctic waters, and covering a wide range of habitats from intertidal rock platforms to deep submarine canyons and seamounts. Outside the tropics, the New Zealand marine environment is among the most biodiverse in temperate regions, yet the vast volume of our EEZ is largely unexplored, and many species are undescribed.

The "yellow slimy" sponge Lissodendoryx *n. sp. collected off the Kaikoura coast.*

Poor taxonomic knowledge is a great limitation to biotechnology research. Without precise identification or information on how different species are related it is difficult to focus investigations on those species with the greatest potential, and ultimately to target related taxa for materials or biological activities of a similar nature. The situation is especially relevant for research on sponges, bryozoans, ascidians, cnidarians, and algae.

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Discovering our freshwater fish biodiversity

Historically, New Zealand's native freshwater fish fauna was considered depauperate and relatively uninteresting. In recent decades, however, there has been lively interest in this fauna as new findings have revealed its special character and opened up further avenues of research, especially into the taxonomy and relationships of the species. In the past few years, NIWA biologists have been involved in:

- the description of four new species of *Galaxias*;
- the redescription of *Gobiomorphus* and *Galaxias* species that had each previously been regarded as variants of other recognised species;
- the identification of an Australian species of anguillid eel that has begun migrating into our river systems;
- the recognition of an Australian dart goby of the genus *Parioglossus*, first collected from Great Barrier Island in March this year;
- the identification of a feral population of the South American caudo, *Phalloceras caudimaculatus*, which seems to be a release or escapee from aquaria.
- another feral population of exotic fish is also being studied.


Four formally described species of Galaxias *from Otago.*

These projects form part of the research aimed at understanding and conserving New Zealand's freshwater biodiversity. Data management is supported by the New Zealand Freshwater Fish Database, which is an historic and contemporary archive of data on the distributions of all freshwater fish species found in our rivers, lakes, and wetlands. The database, initiated in the late 1970s, now contains information on over 15 500 sites throughout the country. Integration of these data with the taxonomic and identification expertise in NIWA provides a basic and essential resource for understanding our freshwater biodiversity.

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Biodiversity and taxonomy workshops

NIWA will be running annual training courses on the taxonomy and biodiversity of New Zealand's aquatic flora and fauna. The aim is to improve standards in animal and plant identification, and therefore improve our understanding of the aquatic environment. The need for quality control in the rapidly growing field of ecological research and monitoring is widely recognised, and this is the first training course that specifically addresses biological identification skills for freshwater researchers.

The courses will be held annually, and each year will feature different groups of animals and plants. It will be modular, and it will be possible for participants to select appropriate modules (groups of animals or plants), or attend all modules to become fully conversant with the range of animals and plants in New Zealand. Training in the identification of each animal and plant group will be given by taxonomic experts drawn from NIWA, universities, and elsewhere. The courses will feature hands-on learning rather than examinations, and they have been developed to encourage more training in basic practical taxonomy. We hope to build the course into an accreditation scheme which awards certificates of competence when each module is completed, and which can be collated into a comprehensive qualification of competence in aquatic biological identification skills. It is our hope that accreditation with these skills will lead to greater confidence in individual work and publications, better quality control, and will be a sought-after qualification by employers.

Attendance will benefit research scientists, consultants, technicians, and post-graduate students in tertiary institutions, museums, regional councils, and DoC conservancies, as well as professionals seeking a refresher course, iwi, and others. Accurate identification of animals and plants is of fundamental importance in ecological monitoring, impact assessment, research, and conservation work because it often underpins the data from which subsequent analyses and interpretations are made. The identification of the freshwater flora and fauna is no exception, but until now there have been no opportunities for training in this specialised area, or for refresher courses to build on secondary and tertiary education.

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Biosystematics – the foundation of biodiversity science

NIWA has active programmes in biosystematics — the crucial science of naming, classifying, and describing life that underpins all biodiversity studies. Often referred to as taxonomy, this science requires specialist knowledge of particular groups of organisms, not only nationally, but also regionally and often globally, and a library of specialist literature.

It is perhaps not widely appreciated, but most of Earth's genetic diversity is found in the sea, in a wide diversity of habitats ranging from the highest mountains to the deepest trenches. Here lives the greatest variety of organisms at higher taxonomic levels (phyla, classes, and orders). In fact, many major groups of animals are found only in the sea. Globally, some 160 000 species of marine life have been described in all seas, a fraction of the estimated 300 000 to one million or more species likely to exist. In New Zealand, about 11 600 marine species have been described out of an estimated 22 000 to 23 000 (i.e., about 50%). At the present rate of discovery and description it will take another century to complete the task of inventorying our marine life. However, NIWA aims to have completed an inventory of most macrofaunal groups by 2020.

If we are serious about maintaining and enhancing New Zealand's aquatic biodiversity, we must be both diligent and effective in improving our knowledge of our living aquatic resources, their distribution, and their abundance. This requires taxonomic inventory, characterisation of benthic and planktonic assemblages, mapping of benthic distributions, and ascertaining key ecological interactions. This information, when correlated with environmental data, allows direct application of biosystematic knowledge to conservation needs, biosecurity, human health, biotechnology, human impacts in aquatic environments, and spatial-temporal biodiversity responses to climate change. The information produced by NIWA's systematists contributes not only to national goals, but also to international conventions, agendas, and initiatives.

NIWA publishes taxonomic monographs (faunal identification manuals) called *NIWA Biodiversity Memoirs*. Recent issues describe New Zealand's sea spiders, giant squid, planktonic copepods and hydromedusae, octopods, hermit crabs, basket-stars, and Ross Sea polychaete worms. CD-ROM and web-based keys and identification posters are planned.

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Data-management challenges

A number of institutions over many years have accumulated large numbers of data sets, for a variety of purposes, that will be relevant to future research on New Zealand's aquatic biodiversity. Some of these data sets are well managed and accessible, some are not. It is important to have access to both existing and new data to address biodiversity questions. New synoptic research approaches will be required to define and model status and changes of biodiversity over large spatial-temporal scales in the aquatic environment around New Zealand and in the Ross Sea. This will require new initiatives in data management to improve access to historical data sets and improve processing and management of new research data. Collaborative approaches to data management will also enable more effective use of limited numbers of biosystematic and aquatic ecological research staff within New Zealand to meet the objectives and action plans in the Biodiversity Strategy. To facilitate long-term protection of, and access to, relevant New Zealand data, NIWA, with the Maritime Safety Authority, has developed a strategy for a National Aquatic Biodiversity Information System (NABIS).

NABIS will make data on New Zealand and Ross Dependency freshwater and marine biodiversity available to stakeholders through an integrated system of databases. Implementation of NABIS will involve intra- and inter-organisation integration of aquatic biodiversity data sets, as well as linkages with associated data sets (e.g., bathymetry, sediment types). NABIS will allow more direct access to information necessary to address important research questions. For example, associated data linkages through NABIS will provide correlation of species and habitat temporal-spatial information to facilitate species-habitat mapping and spatial modelling. Examples of such large data sets are the NIWA N.Z. Freshwater Fish Database (*see* p. 9) and the Ministry of Fisheries marine fisheries research databases, managed by NIWA and including data from more than 145 000 sites back to 1961.

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