Biodiversity Update

Issue No. 5 — A quarterly newsletter on aquatic biodiversity — 2002

Haliphron atlanticus – a giant gelatinous octopus

Processing species that are new to science, or newly recorded from New Zealand waters, has become routine at NIWA's museum laboratory in Wellington. So, too, has the receiving of large numbers of very large animals from research-trawl bycatch. One such animal was delivered in November: a frozen 61 kg "squid" collected from a depth of 920 m southeast of the Chatham Islands. Just how unusual this animal would prove to be was not immediately apparent, at least not in its frozen state. It was no squid – it was a giant octopus.

Haliphron atlanticus.

Since the New Zealand octopus fauna was last revised in 1999, two new species have been caught in the deep sea – one a species of *Benthoctopus*, the other of *Opisthoteuthis*, both weighing about 1 kg. The present 61 kg frozen lump not only dwarfs everything else known from New Zealand waters, it dwarfs all known octopods worldwide – and it is incomplete!

The frozen lump proved to be the first confirmed South Pacific record of the very rare gelatinous octopus *Haliphron atlanticus*, and the largest specimen known. This species, also known as *Alloposus mollis*, has had a rather unusual history in New Zealand waters and in the literature. It was admitted into our fauna in 1995 on the basis of two erroneous citations. One was based on beaks attributed to this species recovered from sperm whales caught and processed in the south Tasman Sea, well outside the New Zealand EEZ; the other was based on a beak identified from regurgitations of a wandering albatross chick on Antipodes Island, whose parent had been sourcing food from Australian waters. As neither record localised *Haliphron* within New Zealand waters, and in situ captured specimens were not represented in collections, this species was struck from our faunal inventory.

The ecology of *Haliphron* is poorly understood, though it has been recorded that the female broods eggs within her arms, and that it is usually, but not exclusively, associated with island or continental slopes. Most known *Haliphron* are juvenile, caught at depths less than 33 m, although a few larger animals have been found at depths exceeding 250 m where they are thought to live on or near the sea floor. Very few adults are known. The species was thought to attain a mantle length of 0.4 m and a total length of 2 m. The incomplete specimen at NIWA has a mantle length of 0.69 m and a total length of 2.9 m. If it were intact, it would probably have been a further 0.5–1 m long.

A closer look at the giant cephalopod.

It is remarkable, given the predominance of juveniles in collections from areas where this species is known to occur, that they have not been collected before in New Zealand waters. But what is more remarkable is that the animal was caught on the Chatham Rise at a depth of less than 1000 m, an area and depth extensively trawled for decades. It is hard to believe that such a large animal, had it been caught before, could have gone unnoticed on a trawler deck. Either it has escaped trawl nets for decades or it usually resides in areas and/or at depths that we have yet to regularly sample.

As the morphology and anatomy of this species have not been reported in detail, especially based on a specimen so large and mature, this unique female will be fully described separately. This animal brings the total number of octopus species known from New Zealand waters to 42, a figure likely to increase as our collections include specimens from new locations and depths.

Capture details: NIWA Stn Z10911: F, ML 0.69 m, TL 2.90 m, weight 61.0 kg (pre-fix, wet measures defrosted; specimen incomplete), 44°33.8–33.2′ S, 175°45.3–44.2′ W, 922–920 m, 26/10/2001, bottom temperature 6.0 °C, R.V. *Tangaroa* Stn TAN0117/03.

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NIWA
Taihoro Nukurangi

NIWA biologist leads international sponge taxonomy workshop

New drugs to combat the world's most feared diseases may be found on the ocean floor in sea sponges. Scientists are investigating the potential of sea sponges to provide new drugs that can fight the bacteria that cause diseases such as anthrax, smallpox, tuberculosis, and malaria. Few scientists have the expertise to locate and identify sponge species, a necessary first step to unlocking the medical potential of these primitive creatures, so training workshops are necessary.

Dr Michelle Kelly Shanks from NIWA recently led a 3 day workshop at the University of Mississippi to help scientists develop the skills necessary to identify sponge species. She hopes this will lead to an international network of specialists working together on sponge biotechnology projects.

The workshop focused on Indo-Pacific and Atlantic sponges and was organised at the request of Dr Mark Hamann, of the university's Department of Pharmacognosy, whose group of staff and students have been working for some time on extracting compounds from sponges to fight various diseases. Students from China, Egypt, India, Japan, Korea, Nigeria, Pakistan, and the United States participated in the workshop. Many were pharmacologists, and some had a basic knowledge of plant taxonomy, but others had no experience with microscopy or animals.

This was the latest in a series of workshops run by Dr Kelly Shanks (the last one was at the University of the South Pacific in Suva). It was taught using a combination of lectures and practical exercises to help the participants recognise characteristics that identify sponge species. After three intensive days the participants were able to identify the sponge species that they were using in their own research.

Background cover photo:
Gorgonian sea fans, sponges, and other filter feeding invertebrates, Three Kings Islands.
Photo by Malcolm Francis

A new species of *Petrosidae* which provides an antimalarial compound.

Dr Kelly Shanks says that the potential to find new drugs is only as good as our understanding of their taxonomic relationships, and thus the differences between species. The more species that we can recognise, the better we can target related sponges that might have related chemical compounds with similar or better biochemical activity. The potential is huge. Sponges don't move, but are able to use their own metabolites to fend off fungal infections, predators, and bacterial invaders. Some of these compounds have amazing specificity to human diseases. The deep-sea Atlantic sponge *Discoderma* produces a compound with great potential for the treatment of breast cancer which is currently undergoing clinical trials in the United States.

Dr Kelly Shanks worked with Harbor Branch Oceanographic Institution scientists in Florida in the search for potential new drugs in the early 1990s. She is now involved in one of NIWA's major research programmes, to discover similar drugs and materials of use to humans and animals. Only about 1% of compounds from sponges have drug potential because they are often too toxic to living cells and it takes a long time to test and develop them. However, even if the compounds found do not lead to clinically useable drugs, they can still help scientists to design better drug molecules to target specific diseases.

Dr Kelly Shanks has studied sponges for 25 years and is one of only a handful of scientists worldwide with a broad knowledge of the world's sponge biodiversity. She works closely with Dr Hamann, who is currently investigating whether a compound extracted from a range of new sponge species from Indonesia is safe and effective for the treatment of malaria and tuberculosis. The prognosis for their research is exciting, and the programme has the backing of the World Health Organization.

There are over 700 sponge species known in New Zealand waters. Many are rare and under threat from coastal dredging and seamount fishing. We are finding new species all the time and most are endemic to the New Zealand region.

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Bioturbation is a key process in soft-sediment ecosystems

What happens to marine organisms of mudflats and offshore soft-bottom areas when mud and silt are deposited there by human activities or storms? Experiments by NIWA ecologists are clarifying the crucial roles of *bioturbators* in maintaining or restoring biodiversity in these habitats.

Mounds of sediment expelled from ghost-shrimp (*Callianassa filholi*) burrows on an intertidal mudflat.

Some of the species in soft sediments are responsible for the structure and functioning of their habitats. These organisms, known as bioturbators, constantly disturb the sediment by burrowing and feeding. Their activities mix the sediment layers and cause substantial resuspension of the sediment and its transport by waves and currents. At the same time, bioturbation enhances organic decomposition, nutrient cycling, redistribution of organic material, and oxygenation of sediment, rather as earthworms do on land. These changes greatly affect estuarine and seafloor habitats, with repercussions for the entire soft-sediment ecosystem.

Bioturbators range from crustaceans, such as burrowing crabs and shrimps, to small polychaete worms and microscopic meiofaunal organisms. Deposit-feeders are the most prominent group of bioturbators as they constantly process sediment for food, resulting in horizontal and vertical movement of particles in the sediment.

Sediment bioturbation is evident as conspicuous burrow holes, sediment mounds, and depressions at the surface which result in a crater-like landscape. Bioturbation may have positive or adverse effects on other animals whose susceptibility to sediment disturbance depends on feeding mode, size, and mobility. Small, mobile species may benefit from improved mobility in unconsolidated sediment, whereas filter-feeding organisms may have their sensitive feeding apparatus clogged by fine sediment particles. Burial on the one hand, and the provision of burrow refuges on the other, both affect larval survival, and thus influence recruitment patterns. It is not surprising, therefore, that the presence and activity of bioturbators can play a central role in determining benthic community structure and biodiversity.

Understanding biodiversity and ecological processes like bioturbation is particularly important in the management and conservation of soft-sediment environments. NIWA's experiments have shown that sediment reworking by burrowing crabs (*Helice crassa*) and common cockles (*Austrovenus stutchburyi*) is essential in mixing and remobilising land-derived clay deposits in estuaries. In Okura estuary, just north of Auckland, mud crabs were the only surviving benthic animals after the deposition of layers of clay up to 9 cm thick. Burrowing by the crabs resulted in reworking of the clay layer to provide traps for natural sediment, which enhanced the recovery of the macrofauna. Similarly, the activities of cockles in Whitford estuary in speeding up the erosion of thin (less than 1 cm) clay deposits were evident within one tidal cycle.

A variety of crustaceans construct temporary and permanent burrows in seafloor sediment: a scampi (*Nephrops norvegicus*) is seen here at the entrance to its burrow.

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Extreme midges: chilled, heated, and acidified

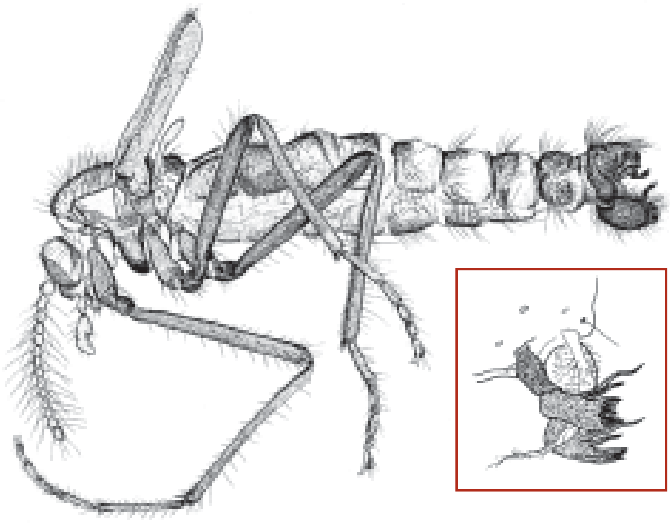
New Zealand's extreme environments – glaciers, snowfields, geothermal waters – have resulted in a variety of animals and plants becoming specifically adapted to live in these seemingly inhospitable places. Sometimes adaptation is so specific that they cannot live anywhere else (obligate), but others use these environments as opportunists and can thrive in other environments (facultative).

Amongst the more common insects living in these environments are the chironomids. The adults of these insects are gnat-like flies related to mosquitoes, but they do not bite! Their larvae are found in almost all freshwater habitats, from rivers, streams, lakes, and wetlands to springs, waterfalls, waterlogged tree trunks, small seepages, spouting of houses – even waterlogged lawns!

The "ice worm"

At one environmental extreme are the frozen waters and chilling temperatures of the west coast glaciers. Here, in the surface meltwaters and caves of the ice, lives the "ice worm", which, despite its name, is a chironomid, *Zelandochlus latipalpis*. These small insects are found in great abundance between 400 and 600 m above sea level. The larvae are most plentiful in shaded light in ice caves and crevices, amongst fine, wind-blown material at the bottom of pools, or in early morning shade in meltpools, avoiding direct sunlight.

The adult males of *Z. latipalpis* are unable to fly because they have reduced wings. However, they appear to be able to hop a fair distance, and, unlike other chironomids, have very long, stout legs, as well as comb-like claws to give a better a grip on the icy surface. The females, on the other hand, have enlarged wings, suggesting a strong ability to fly and disperse across the surface of the ice to find males to mate with, and suitable places to lay eggs.

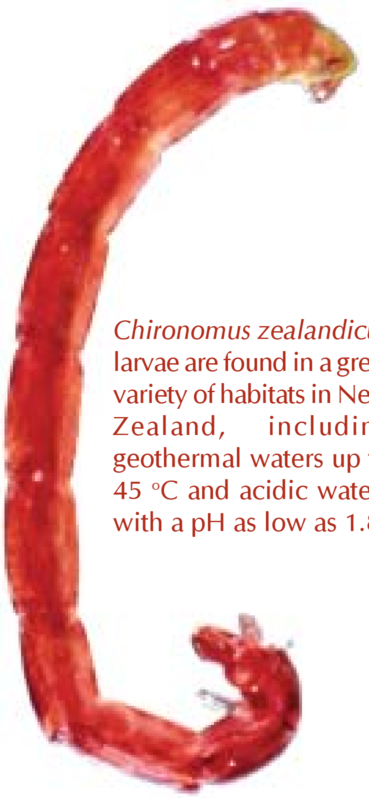


An adult male of the ice worm (reproduced from Brundin (1966)). Note the reduced wings. The insert shows the comb-like claws used for grip on the icy surface of the glacier.

The ice worm is the only midge known to live exclusively on the surface of glacial ice, despite phylogenetic relationships with similar species in South America and Australia, and represents yet another unique feature of New Zealand's biodiversity.

Geothermal midges

At the other end of the temperature scale are the midges that survive in New Zealand's geothermal environments. Volcanism and associated activity has occurred throughout New Zealand's geological history. The Taupo Volcanic Zone was formed in the central North Island about 1 million years ago: it is a geological complex less than 50 km wide extending 250 km northeast from Mt Ruapehu, south of Lake Taupo, to White Island in the Bay of Plenty, and, along with Iceland and Yellowstone National Park, is one of the few places containing a diverse array of geothermal waters in a small area.



Chironomus zealandicus larvae are found in a great variety of habitats in New Zealand, including geothermal waters up to 45 °C and acidic waters with a pH as low as 1.8.

Geothermal waters are characterised by their extreme temperatures and pH and high sulphide and heavy metal concentrations. Amongst the organisms tolerant of these geothermal conditions are several chironomid species: at times their larvae are extremely abundant, and occasionally they may be the only animal species present.

Chironomid larvae that occur exclusively in geothermal habitats can tolerate temperatures up to 45 °C, and include species of *Chironomus* and *Polypedilum*, which are also well represented in almost all freshwater habitats in New Zealand. Only single species of *Tanytarsus* and *Polypedilum* appear to be truly obligate thermophiles in New Zealand, living only under geothermal conditions.

Chironomus zealandicus is amongst the more commonly occurring midges in geothermal environments. This ubiquitous insect is the large midge which often annoyingly invades homes and barbeques, especially close to lakes or ponds.

Waiotapu pond near Lake Rotowhero – pH 2.7, a temperature of 34 °C, and home to *Chironomus zealandicus*.

Acidic habitats

Amongst other extreme environments inhabited by chironomids are low pH (highly acidic) waterbodies. These vary from the cold geothermal waters of the Taupo Volcanic Zone, to the streams draining past and present mine workings, to the peat streams that occur throughout New Zealand. In west coast streams draining old mine workings, *Eukiefferiella* species are found at a pH of 2.6, and *Chironomus zealandicus* has been found in geothermal waters with a pH of 1.8.

Biodiversity

Although few midges are obligate thermophiles or acidophiles, the ice worm at least is confined to the glacial surfaces. As with much of our aquatic fauna, chironomids are general opportunists, being able to feed, grow, and reproduce in highly disturbed habitats. The ability of chironomids, and many other aquatic insects, to tolerate such seemingly adverse environments is a distinguishing feature of the aquatic biodiversity of New Zealand.

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New biodiversity memoirs target echinoderms

Three new *NIWA Biodiversity Memoirs* have been published describing New Zealand echinoderms. Memoir 115 (price NZ$30) covers basket-stars and snake-stars in the order Euryalinida: Ophiuroidea). All 33 species are described and illustrated, including 4 new species, 2 new records, and 1 new genus (*Astroniwa*). Memoir 116 (NZ$69) covers two of the seven orders of sea-stars (Asteroidea), the Paxillosida (38 species, 8 new) and Notomyotida (12 species). Memoir 117 (NZ$90) covers the large order Valvatida (96 species and subspecies, 10 new), in which 2 new genera are described. All species are illustrated, with keys to the genera and species. One final memoir, not yet published, will cover the remaining four orders. In all, there are now 221 species of sea-star recognised in the New Zealand region, compared with only 75 species known in 1970. Among the Valvatida, which includes the well known cushion-stars, the most speciose family is the Goniasteridae (38% of the species). Perhaps the most famous (or infamous) member of the Valvatida in the region is the crown-of-thorns, which occurs at Raoul Island in the Kermadec Islands. Behaviourally, however, one of the more interesting members is the endemic cushion-star *Stegnaster inflatus*. This predatory species arches above the substratum and when a small fish or crustacean enters the inviting "cave" under the animal it immediately flattens, trapping the prey. This behaviour is shown in one of the colour plates in the memoir. The authors, NIWA echinodermologists Don McKnight and Helen Clark, have also documented other behaviours and, through dissections, ascertained dietary items in many of the species.

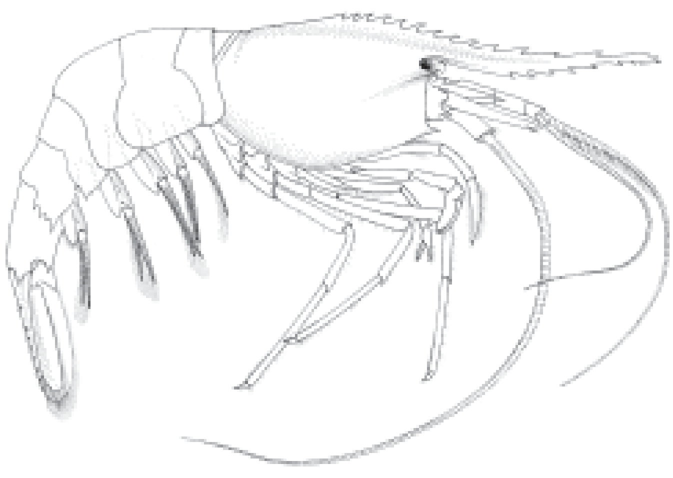
To purchase these reports, please send Visa or Mastercard details, or a cheque payable to NIWA, to:
Science Communication, NIWA,
PO Box 14 901, Wellington,
New Zealand

Thriving blind – New Zealand's first volcanic vent shrimps

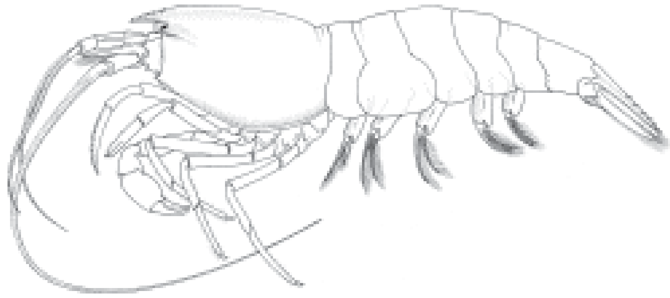
Last May, NIWA's research vessel *Tangaroa* captured almost 500 shrimps from 11 deepwater stations on volcanic slopes and hot vents on the Brothers and Rumble seamounts, north of the Bay of Plenty. A taxonomic study has shown that they are typical of shrimps found living around seeps and hydrothermal vents elsewhere, deep in the Pacific and North Atlantic Oceans. The *Tangaroa* specimens include at least two species of the genus *Alvinocaris* and one of *Chorocaris*, of which one or more are new. They clearly belong to the alvinocarid-group of shrimps. Alvinocarids are pinkish-white, blind, and have thin and flexible exoskeletons. They are equipped with serrated, spoon-like front chelae that are adapted to scrape bacteria from rock surfaces, other invertebrates, or the shrimps themselves, for sustenance.

This recent find was not the first – a geological expedition by *Tangaroa* in 1996 dredged two damaged *Alvinocaris* specimens from the Brothers Caldera – but it is now obvious that New Zealand has shrimps characteristic of many of the teeming invertebrate communities found around deep-sea hydrothermal vents, cold-water seeps, and hydrocarbon seeps in other places. Interestingly, these communities are more or less independent of the photosynthetic food that supports virtually all life on Earth. Instead they rely on chemosynthetic bacteria that oxidise sulphides expelled in the fluids of seeps or hydrothermal vents. Free-living and symbiotic bacteria abound, particularly in molluscs or large tube-worms. Worms, molluscs, crustaceans, and other invertebrates form circumscribed but dense communities around these food sources. These communities are many times higher in energy turnover than surrounding seafloor communities, which largely rely on the fall-out of food from upper layers of the sea.

More than 16 species of alvinocarid shrimps, including the New Zealand material, are known worldwide. Alvinocarids



Alvinocaris sp. B from Brothers and Rumble calderas.



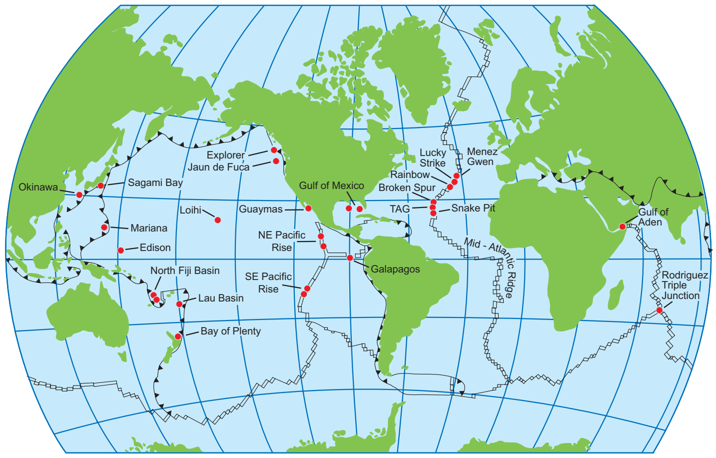
Alvinocaris sp. A from Brothers and Rumble calderas.

are small to medium sized (adults range from less than 2 cm to 9 cm long) and the New Zealand species are within this range. Most have been caught deeper than 1000 m, the maximum depth of sunlight penetration, so their lack of sight is quite understandable. Alvinocarids have been found at depths of almost 4000 m, but the New Zealand *Chorocaris* (not illustrated here) occurs at 520 m or even less. Most alvinocarids have eyestalks, but are blind because they lack the eye facets essential to functional compound eyes. The eyestalks are fused together, not independently moveable as in sighted shrimps, but in some species they contain a scattering of pigment which may or may not have a light-detecting function. In two Mid-Atlantic Ridge *Rimicaris* species, all remnants of eyes have disappeared, but they do have organs on top of the carapace that can detect "black light" given off by hot vents at wavelengths well outside those of visible light.

Alvinocarids were first discovered at the Galapagos Rift in 1977. They are now known to occur extensively in the Pacific and Atlantic Oceans at numerous vents on spreading ridges and subduction zones, as well as in cold and hydrocarbon seeps such as those in the Gulf of Mexico. They have been found quite recently (2000) in the Indian Ocean and unpublished reports indicate these shrimps are also present in the South Atlantic. Alvinocarids do not occur at all the deep-sea vents and seeps known to support chemosynthetically based communities. It is highly probable, however, that more will come to light as further seeps are discovered and vents are located on unexplored ridges, trenches, and deep-sea volcanoes.

Populations of shrimp species are fragmented by living on "islands" of bacterial abundance, but there is a high level of genetic uniformity among them. The alvinocarids include nine species of *Alvinocaris* that are all very similar, yet they are spread between the North Atlantic, Indian, and North and South Pacific Oceans. How these shrimps disperse is an intriguing question and it appears their larvae take the key role in this. Some shrimps in extreme habitats have an abbreviated free-swimming larval phase, which ensures that larvae won't drift too far from the adult habitat. In contrast, alvinocarids have small eggs similar to those of most carid shrimps, and probably a protracted development. Larvae are born with normal, functional eyes and are found in the water column far away from seeps and vents. The postlarvae, the adult-like phase which makes its way back to the adult habitat, are also sighted and eat food derived from photosynthesis rather than chemosynthesis. It appears that alvinocarids have retained a rather conventional mode of development which maintains wide geographical gene flow while the adults have sacrificed mobility by evolving unique features to exploit the rich pickings of vent and seep communities.

The New Zealand alvinocarids are an exciting find and only the first in an area with many more possibilities. We have just two specimens of the third (unillustrated) species, so more are needed. It is known that some species of alvinocarid shrimps scavenge, as well as eating bacteria, and can be reliably captured by the use of baited shrimp traps. Such trapping produces good-quality specimens that could well yield yet more species and genera, as well as material that could be used to study gene flow between separate seamounts and vents.



The current known distribution of alvinocarids.

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Tools and resources on NIWA's Freshwater Biodiversity web page

The web page for the FRST-funded programme Biodiversity of New Zealand Freshwater Organisms has recently been updated and now includes a Tools and Resources section. The new web page contains identification guides for some groups of freshwater organisms, information on the New Zealand Freshwater Fish Database, and species checklists of selected freshwater groups. Some checklists have been compiled by external collaborators and we are keen to receive contributions for other groups of organisms.

Links are provided to web-based atlases of aquatic plants and freshwater fish, and there are now "quick-guides" to several invertebrate groups based around the level of taxonomy commonly used in biomonitoring. Quick-guides for other groups of freshwater invertebrates and plants are under development and will be added to the website as they become available. Experimental interactive identification guides for diatoms and a caddisfly group will be added later.

The web page contains links to some on-line articles pertaining to freshwater biodiversity, and the news and noticeboard sections provide bulletins of recent taxonomic advances and information on upcoming identification workshops, conferences, and other biodiversity web site links. News bulletins, covering workshops and advances in local taxonomy and biodiversity research, will be sent out to subscribers to the web-page Email Forum. This forum is a way for end-users, stakeholders, scientists, or anyone with a special interest in the topic to keep in touch with the freshwater biodiversity programme.

So, if you have a freshwater leaning and a biodiversity bent, check out our new web page on:
http://www.niwa.co.nz/pgsf/FreshBiodiversity/index.html

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Parasites or predators? New Zealand's aegid isopod crustaceans

Aega monophthalma.

The Aegidae is a small family of marine isopod crustaceans. Worldwide, about 140 species have been named in seven genera, but two, *Aega* and *Rocinela*, make up nearly 90% of all the species. Aegids are from 1 to 7 cm long, placing them among the largest of marine isopods. They are impressive animals, mostly found in the deeper waters of the continental shelf and slope, and can often be recognised by their strongly hooked anterior legs and their large eyes. In some species the eyes unite to form one huge cyclopean eye. There are also a few eyeless mesopelagic species.

Aegids are the only isopods reputed to have therapeutic or medicinal powers. In mediaeval times Nordic fishers knew these animals as "fiske bjørn" or fish bears, and attributed healing powers to the dried, blood-filled gut taken from them. Old Icelandic tales refer to this dried gut being used as a "wishing stone", but there is little known about its success, therapeutic or otherwise.

Aegids have been little recorded in New Zealand waters, though not infrequently collected in recent years. By the end of the last century only five species were known locally, but three were of uncertain identity and one was a misidentification, leaving one valid and recognisable species for New Zealand. Recent work on collections made by NIWA, particularly the recent collections from the NIWA Seamounts Project, and material from Te Papa, has revealed 32 species in the genera *Aega*, *Rocinela*, and *Syscenus* from the New Zealand EEZ. This is a massive increase in the number of species, about two-thirds of which are new to science.

The North Atlantic and the east Pacific can be considered well known with regard to diversity of Aegidae, with 28 and 14 species respectively. South Africa, also well documented, has 11 reported species and Australia, less well studied, 20.

Aega monophthalma Johnston, 1838.

In essence, the relatively small area of New Zealand's EEZ is proving to have the world's greatest diversity for this isopod family.

Aegids are fairly uniform in appearance and do not appear highly diverse. In part, this is due to the lack of specialist taxonomic attention, and the predicted total worldwide number of species, based on present knowledge of diversity and distribution patterns, is probably only two or three times that known at present. Despite their size, many species are inadequately characterised. Some purportedly widespread species are proving to be groups of similar "sibling species", such as the widely recorded *Aega deshaysiana* which is in fact a complex of about 16 species (work is still in progress). In contrast, other species do appear to have genuinely wide distributions, both regionally and globally.

New Zealand sits just to the north of the Antarctic Circumpolar Current which sends flows of water northwards into the Atlantic Ocean, the Western Indian Ocean and the Southwest Pacific. These currents form part of the Great Global Conveyor (GGC) current system. *Aega monophthalma* is just one of several species that appear to have a GGC distribution as shown by new material from New Zealand and southeastern Australia, together with earlier records from South Africa, Scotland, Iceland, and Florida. Another (undescribed) common species with a GGC distribution occurs in New Zealand and around the Southern Ocean, extending up into the South Atlantic and the tropics of the Indian Ocean and the Southwest Pacific.

Aegid isopods have long been considered to be parasites. They are often taken in association with, or attached to, fish, but there are few data on their trophic relationships. As they detach readily there are few accurate records of which fish they attack. Indeed, attack is the appropriate word to use to describe their feeding behaviour, as what little is known indicates that those species that are feeding on fish blood feed much in the manner of mosquitoes, taking a blood meal and then detaching. There is even a record from the Caribbean of aegids attacking human bathers. Other species are commensal, some feeding on fish mucus, others living in association with hexactinellid (glass) sponges.

Work is in progress for a New Zealand monograph on these interesting crustaceans, including electronic keys, and a worldwide assessment of diversity for this family.

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