

Edited by
Michael Symes



Water is obviously important as a basic necessity for maintaining life. Quite simply, if you don't regularly take in water you can die within a few days.

Text by Michael Symes

Fundamentally, this all depends on the fact that water has a great ability to dissolve things. These solvent properties of water are vital in human biology, because many biochemical reactions take place only within aqueous solutions. Water is also used to transport the resulting biological molecules, such as the oxygen-carrying haemoglobin in the blood, not only around the body but also to carry away the waste-products of metabolism, such as urea in urine.

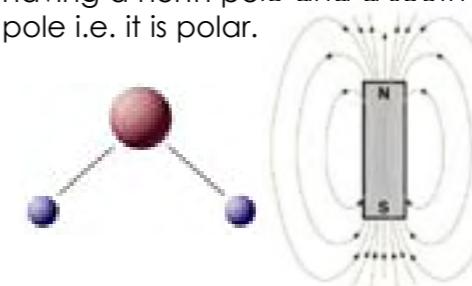
In a completely different context, this ability also enables us, for example, to keep ourselves and our clothes clean and free from pathological bacteria, thus helping us to maintain good health. Water can, in fact, dissolve more substances than any other solvent—that's what makes it unique. It has often been called the universal solvent, although this is something of an exaggeration. But what is it that makes water such a good solvent?

The solvent properties of water

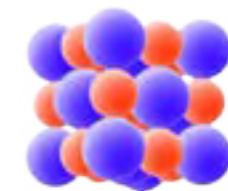
To put it briefly, water is a good solvent due to its polarity. This polarity arises from the shape of this relatively small molecule. As we have shown in previous articles, the shape of the water molecule is non-linear.

The significance of having 2 hydrogen atoms on one side of the water molecule is that oxygen, being a stronger attractor for electrons than hydrogen, is able to pull the shared electrons towards it. This results in an unequal sharing of the electrons. It will be seen that, due to this

uneven distribution of electron density, the molecule has a positively charged end and a negatively charged end. It thus acts like a small electromagnet having a north pole and a south pole i.e. it is polar.



The ability of ions and other molecules to dissolve in water is due to this polarity. Take, for example, the ionic NaCl molecule (sodium chloride, or salt). The solid NaCl crystal consists of a lattice of positively charged Na ions and negatively charged Cl ions. They are held together by attractive electrostatic forces, otherwise known as van der Waal forces.



When a crystal of NaCl comes into contact with water the small water molecules can penetrate between these ions and thereby

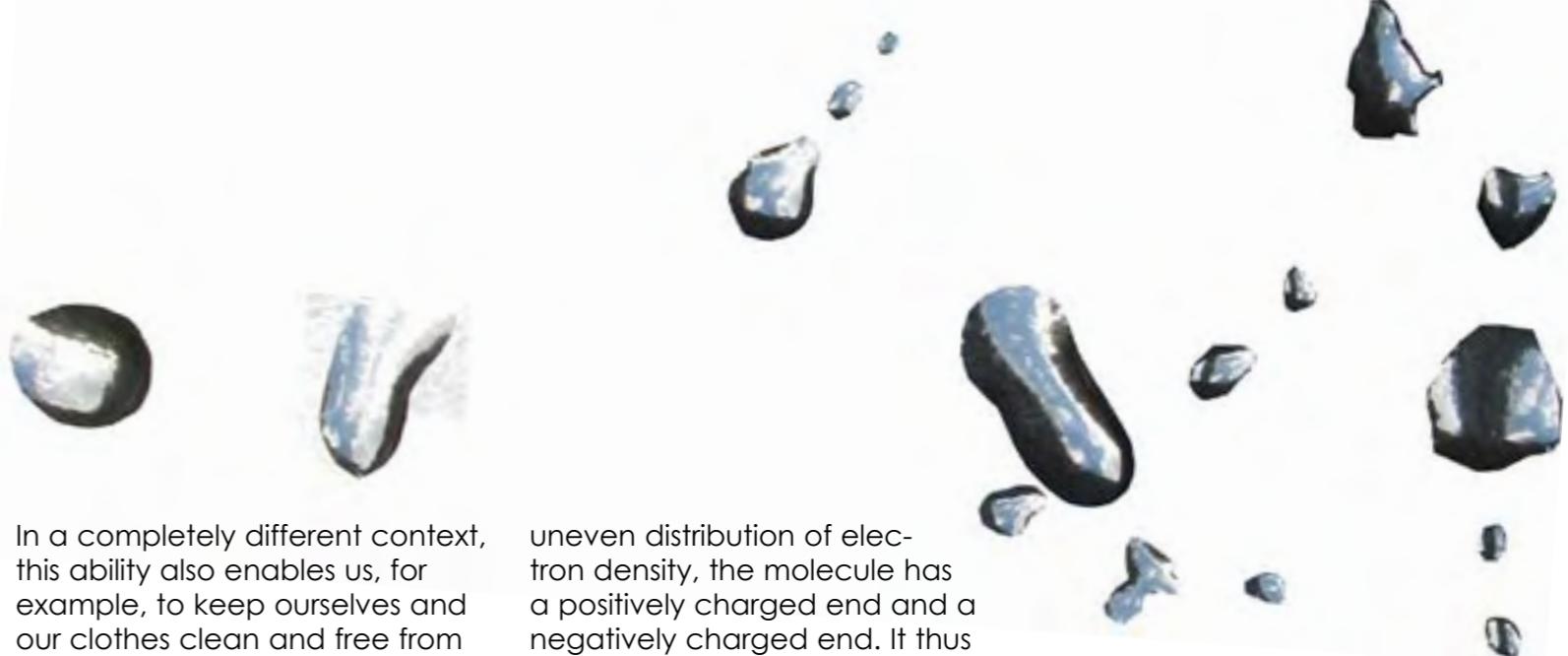
eliminate the effect of the van der Waal forces, allowing the ions to separate. On dissolving, the positive sodium ions then become surrounded by water molecules where the negative end of the polar water molecule is attracted to the positive sodium ion. And similarly, the positive end of the water molecule is attracted to the negative chloride ion. The relatively small size of the water molecule allows many water molecules to surround one molecule. An ionic or polar compound in water is thus surrounded by water molecules to give a stable solution of solute.

An example of a non-ionic solute is table sugar, where the water dipoles hydrogen-bond (see X-RAY MAG no. 7) to the dipolar regions of the sugar molecule thereby allowing it to be carried away into solution.

In general, ionic and polar substances such as acids, alcohols and salts are easily soluble in water, and non-polar substances

A Unique Solvent

Water



Water

such as fats and oils are not. Non-polar molecules stay together in water because it is energetically more favourable for the water molecules to hydrogen bond to each other than to engage in van der Waal interactions with non-polar molecules.

Salinity of the Oceans

For a diver, one of the most obvious facts about the water of the oceans is its salinity, due of course to the ability of water to easily dissolve all ionic salts. The salinity, as all divers know, has a great effect on buoyancy.

Salinity is a measure of the amount of dissolved salts in seawater, and is calculated as the amount of salts in grams dissolved in 1 kg of seawater. In the case of common salt, NaCl, for example, the maximum solubility is 357 grams in 1000 grams of water at 0 °C.

About 70 percent of the Earth is covered with water, with about 97 percent of that water in the oceans. The oceans contain about 3.5 percent of dissolved minerals, so it is nowhere near a saturated solution. However, the Dead Sea has a salinity of about 30 percent, which is getting close to saturation.

The following elements make up 99.99 percent of the total mass of Earth's



ocean water.

It will be seen that, apart from water of course, the major component of sea water is NaCl, some 85 percent of the total salts. This is because sea life has a strong influence on the composition of sea water. Crustaceans take out large amounts of calcium salts to build their shells, and diatoms remove silica to form their shells. Some elements,

however, are not affected to any real extent by plant or animal life. For example, no known biological process removes the element sodium from the sea, thus allowing it to accumulate.

Now, while the average salinity of the oceans is about 3.5 percent, varying from about 3.2 to 3.7 percent, there can be great differences in salinity between different bodies of water. For example, The Black Sea, which is greatly diluted by river run-offs, has an average salinity of only 1.6 percent, while the Caspian Sea has a salinity of only 1.2 percent. This is still quite salty, though, when compared to fresh water with a salinity less than 0.05 percent.

Not only are there slight differences between the oceans regarding their salinities, in much of the Earth's oceans there is a marked difference in salinity between the surface zone and the deep zone, with the salinity increasing with depth. Although salinity generally increases with depth, there is a distinct layer where salinity increases sharply, called the halocline. These sharp differences in salinity can be due to several causes, e.g. an excess of evaporation over precipitation which leads to surface water being saltier than deeper water. This again can lead to some strange oceanic effects, both physically and biologically.

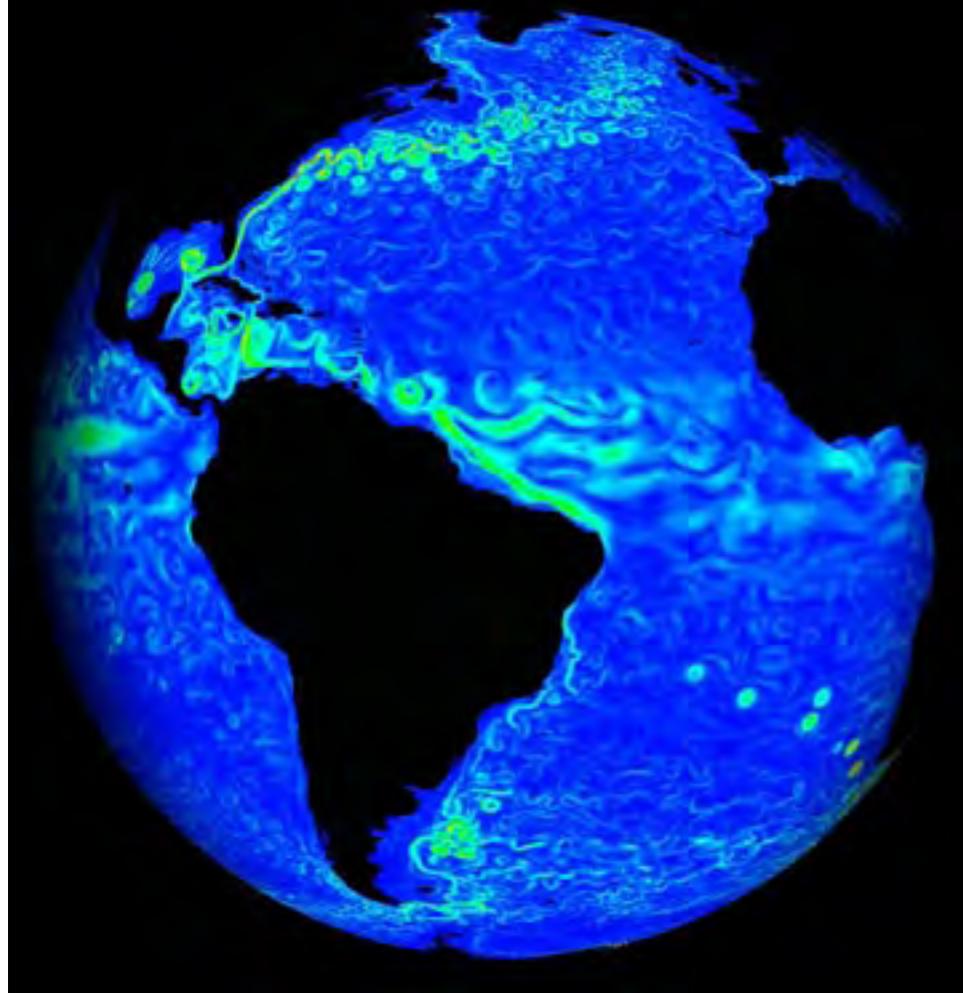
The salinity of the oceans is thus a very interesting and complex subject due mainly to the unique solvent properties of water. ■



The Dead Sea

Element	%
Oxygen	85.84
Hydrogen	10.82
Chlorine	1.94
Sodium	1.08
Magnesium	0.1292

Element	%
Sulphur	0.091
Calcium	0.04
Potassium	0.04
Bromine	0.0067
Carbon	0.0028



Short-circuit found in ocean circulation

A short-circuit in the circulation of the world's oceans has been discovered that could aid predictions about future climate change. This process in the Southern Ocean allows cold waters that sink to the abyss to return to the surface more rapidly than previously thought.

This affects the Southern Ocean circulation, which links all the other oceans, and is also relevant to uptake and release of carbon dioxide by the sea; transport between the deep and surface waters in the Southern Ocean is particularly important for this process.

The researchers made use of a unique signal—the spread of helium released naturally from the Earth's interior at deep vents in the Pacific. The helium dissolves in the deep sea and a plume of this marked water travels down the coast of Chile. It is injected at depth into the Antarctic current on the Pacific side of Cape Horn. It then streams through into the Atlantic with the current, but in the process is spread, shifted and diffused by the circulation. Measurements of this spreading of the helium were used to deduce the short-circuit. ■

Striking deep current reversal in the tropical Pacific Ocean

The near-surface currents of the Pacific Ocean are generated essentially by the winds, whereas the deeper ones (known as thermohaline currents) result from water-density variations induced by differences in temperature and salinity between the distinct masses. The prevailing winds in the tropical Pacific, the trade winds, blow from the American continent towards Asia, causing the warm surface waters to drift in a general East-West direction. As they approach the Asian continent, these waters accumulate, then change direction, part of them turning North, part going South, while another portion flows at depth, feeding the Equatorial Undercurrent (EUC), which runs between 100 and 150 m below the surface. The EUC flows along the Equator, from Papua New Guinea to the Galapagos Islands, counter to the trade winds, and extends over a width of nearly 300 km at a maximum velocity of around 3.6 km/h.

In two oceanographic cruises run in October 1999 and April 2000 as part of the IRD's ECOP programme, the Institute's researchers were able to study this region and, in particular, the El Niño-Southern Oscillation. The latter has a determinant effect on the distribution of ocean water masses, ocean/atmosphere exchanges in the tropical southern Pacific and many anomalies of climate that occur on the continents that border the Pacific. Physical determinations of currents and masses of water under transport were made from the surface down to 1200 m over a large area, 1700 km in length.

These series of measurements give a well-defined picture of the tropical circulation in this zone, but they also reveal a surprising variability of intermediate equatorial currents, which plunge at the Equator under the Equatorial Undercurrent and flow in the same direction between about 300 and 1200 m depth.

Between October 1999 and April 2000, these equatorial intermediate currents changed direction, between 2° S latitude and the Equator, over the 1700 km of the zone investigated. This reversal is already known, but its amplitude in this case is striking. The resulting variation in water mass transport is considerable.

What causes this reversal?

One hypothesis put forward involves the passage of an oceanic instability wave, but no disturbance of the EUC was detected during the research cruises and the reversal remains unexplained. Further current measurement campaigns in the future should shed light on this event and bring clues for unravelling the dynamics of these currents. ■



This reversal is already known, but its amplitude in this case is striking.

NZ scientists study Antarctic currents

New Zealand scientists have been getting close to the world's biggest ocean current in a bid to shed light on some unanswered questions about climate change.

A NZ research vessel is back in the country after travelling more than 3000 kilometres in rough southern seas, on a mission to anchor scientific recording gear in the sub-Antarctic ocean. The deepest mooring is in 4500 metres of water. The equipment will help study just how much water flows in the Antarctic circumpolar current, which is estimated to be 110 times bigger than all the water in all the world's rivers.

It will be a while before the initial data is analysed, and it is the next sail south that will reveal more about the world's biggest current. The data obtained will tell us about how currents vary and how the ocean temperature varies over a year, and that allows us to understand whether there are sudden changes, or whether things just change with the seasons. ■

The Antarctic circumpolar current is estimated to be 110 times bigger than all the water in all the world's rivers.



Ocean eddy observed off northern Baja California

Eddies are important because these giant swirling areas of sea-water are frequent in the world's oceans. Passing eddies can accelerate local currents, retain and transport plankton and nutrients, enhance open water productivity and stimulate fast, deep sinking. Quasi-permanent eddies can retain larvae in the lee of an island, for example. Important vertebrates like sea turtles, elephant seals, blue whales and sperm whales seem to track these pelagic features, presumably because they aggregate prey species.

Eddies are easily detectable by satellites, although a recent article in Geophysical Research Letters reports that some deep eddies can go undetected by satellite, because they remain submerged.

The authors conducted a 21-day hydrographic survey in the southern region of the California Current, and observed for the first time a subsurface anticyclonic (warm core) eddy off northern Baja California with the same water mass characteristics as the California Undercurrent. The core of the eddy was quasi-circular with radii of 35 km and thickness of 250 m. ■

Giant cold water eddy off Sydney lowers sea level

Australian oceanographers have discovered a giant cold water eddy off Sydney, which has lowered sea levels by almost one meter and impacted a major ocean current.

The eddy, which has a diam-

The sea surface was lowered by 70cm at its centre

eter of about 200 km and reaches to depth of 1 km, lies about 100 km off Sydney. It was stated that the eddy was so powerful, it had pushed out to sea the strong East Australian Current, although shipping traffic and fishing have not been affected.

The cause of the giant eddy was a mystery. The sea surface was lowered by 70cm at its centre, although the dip in the surface of the ocean was invisible to the eye, it had been accurately measured by European and U.S. satellites.

Ocean eddies can have a life of up to three weeks, although similar eddies off South Australia and Western Australia are known to have survived several months. ■

Arctic Deep Sea May Hold World's Largest Fuel Supply

The energy source of the future may lie beneath the ocean floor and under Arctic permafrost. Both places are sources of gas hydrates, strange ice-like substances that trap methane—the primary component of natural gas.

The hydrates were discovered in 1983, and no one knows how much of them exist. But there appear to be enough hydrates to represent a larger energy source than all of the world's gas, oil and coal combined. Because each cubic meter of hydrate releases 225 cubic meters of natural gas they are a very good storage system for methane.

Efforts to extract the methane are focusing on the Arctic, where tests have shown that gas can be produced from hydrates using conventional drilling and pro-

duction technology. Rather than mining solid hydrates, scientists are working on ways to melt the deposits underground. This would free the gas from the ice, allowing the methane to be captured in the same way ordinary natural gas is collected.

Because methane is a powerful greenhouse gas, some experts wonder if massive methane releases from melting seabed hydrates might have contributed to past epochs of global warming, while others are concerned that current global warming may heat the oceans enough to melt the hydrates,

causing similar methane releases today.

Unstable hydrates could also cause underwater landslides, which could damage offshore drilling equipment and possibly create surges large enough to generate tsunamis, according to some models. ■



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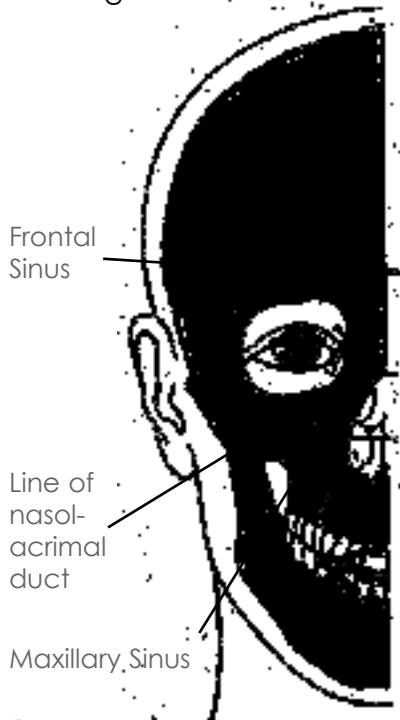
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Medical

Text by David F Colvard, MD
www.divepsych.com

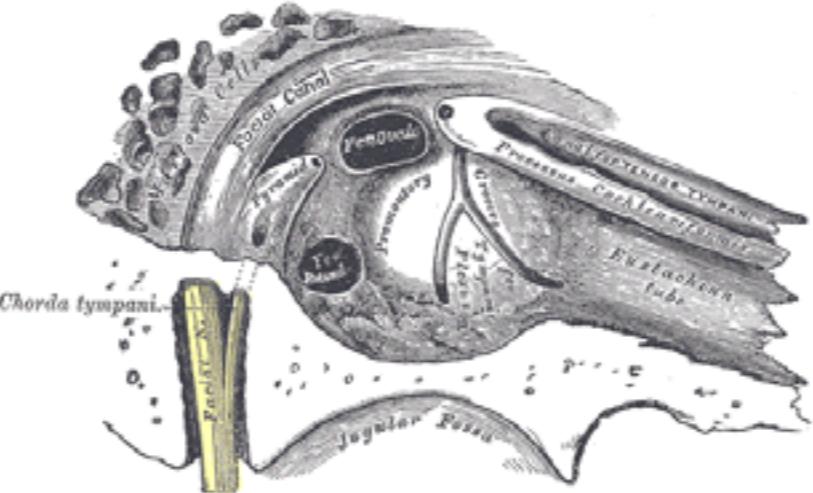
NeilMed Pharmaceuticals, Inc. of Santa Rosa, California, USA, sponsored the study to determine the efficacy and safety of buffered saline nasal irrigation among experienced divers to help equalize pressure in their middle ears and reduce their use of decongestants.



Middle ear squeeze caused by difficulty equalizing the pressure in middle ears during descent and ascent is among the most common problems in recreational scuba divers. A recent study showed that buffered saline nasal irrigation can help naturally. Many divers use pre-dive oral or spray decongestants to help equalize pressure in their middle ears and sinuses.

Between November 2005 and September 2006, 100 experienced scuba divers completed web-based "Before" and "After" questionnaires. They were invited to participate after reporting difficulty equalizing the pressure in their middle ears or using decongestants in an earlier diver safety survey conducted by myself. After completing the "Before" questionnaire, the study participants were sent free samples of NeilMed's Sinus Rinse

The hollow space of the middle ear has also been called the tympanic cavity, or cavum tympani. The eustachian tube joins the tympanic cavity with the nasal cavity (nasopharynx), allowing pressure to equalize between the inner ear and throat.



Nasal Irrigation Helps Divers Clear Ear Squeeze

buffered saline nasal irrigation system. They completed the "After" questionnaire after using the product and diving.

- 44.0% reported less nasal congestion after using Sinus Rinse
- 10.0% reported more nasal congestion.
- 69.0% reported less frequent difficulty in clearing or equalizing their ears
- 5% reported more frequent difficulty.
- 60.3% for whom use of oral decongestants were applicable reported decreased or discontinued use.
- 55.3% for whom use of decongestant sprays or drops were applicable reported decreased or discontinued use.
- None reported increased use of decongestants in any form.
- 72.0% would recommend the Sinus Rinse system to other divers
- and 3% would not.

Experienced scuba divers continue to dive despite the medical risk of nasal congestion and difficulty clearing or equalizing the pressure

in their middle ears. Buffered saline nasal irrigation can effectively and safely reduce nasal congestion and decrease the frequency and difficulty in clearing or equalizing the pressure in the middle ears of many divers. Additionally, nasal irrigation can decrease the use of decongestants, either oral or spray or drops, and reduce the risk of rebound congestion and reverse middle ear squeeze during or after a dive when the effect of the decongestants may have worn off.

A buffered saline nasal irrigation system appears to be an economical, convenient, safe and effective natural alternative to decongestants for many recreational divers who have nasal congestion and difficulty equalizing pressure in their middle ears. The same may be true for airline passengers and flight crews, but that group has not been studied yet. ■

Warning: Do not rinse if nasal passage is completely blocked or if you have an ear infection or blocked ears.

Dehydration

A dangerous condition—even for a diver

Text by Michael Symes

During an average day in a temperate climate, a person's body loses about 2.5 litres of water through sweating, urination and loss of water vapour from the lungs. This must be replaced; if not, dehydration, to a greater or lesser extent, will occur.

Dehydration can be very insidious in its effects on the human body. Initial symptoms may only be a headache or slight dizziness. But if ignored too long, then suddenly —wham! Before you realise it, if it is not treated quickly by drinking up to a whole litre of water or more, it can result in unconsciousness and finally, if you are unlucky, in death.

Symptoms become increasingly severe with greater water loss. Dehydration symptoms generally become noticeable after about 2 percent of one's normal water volume has been lost. It is also at this point that the feeling of strong thirst begins to be felt. Thus, a feeling of thirst is a sign that you are already partially dehydrated.

At about 5 - 6 percent water loss one may become confused and get strong headaches.

With 10 - 15 percent water loss there will be cessation of urination and onset of delirium.

Losses greater than 15 percent are usually fatal.

Avoiding dehydration

As always, it is true that prevention

is better than cure. And so, dehydration is obviously best avoided by drinking plenty of water to maintain one's liquid balance, concurrently with the loss of water. Excess water is generally not harmful, as it is efficiently removed by the kidneys and expelled as urine.

However, when large amounts of water have been lost due to sickness, for example with diarrhoea, there may be a large loss of important electrolytes such as sodium and potassium ions, which can lead to malfunctioning of the heart. The re-establishment of the correct electrolytic balance in the body thus becomes important.

Commercial physiological electrolyte mixtures are available for dissolving in water and should always be carried with one's medicine supplies. (For example, in Denmark, Revolyt® can be bought over the counter at any pharmacist. Details of this formulation can be found on the Internet.)

Failing this, a useful rule of thumb in an emergency is to add the juice of two oranges to a litre of cooled boiled water together with a handful of sugar and a couple of large pinches of salt.

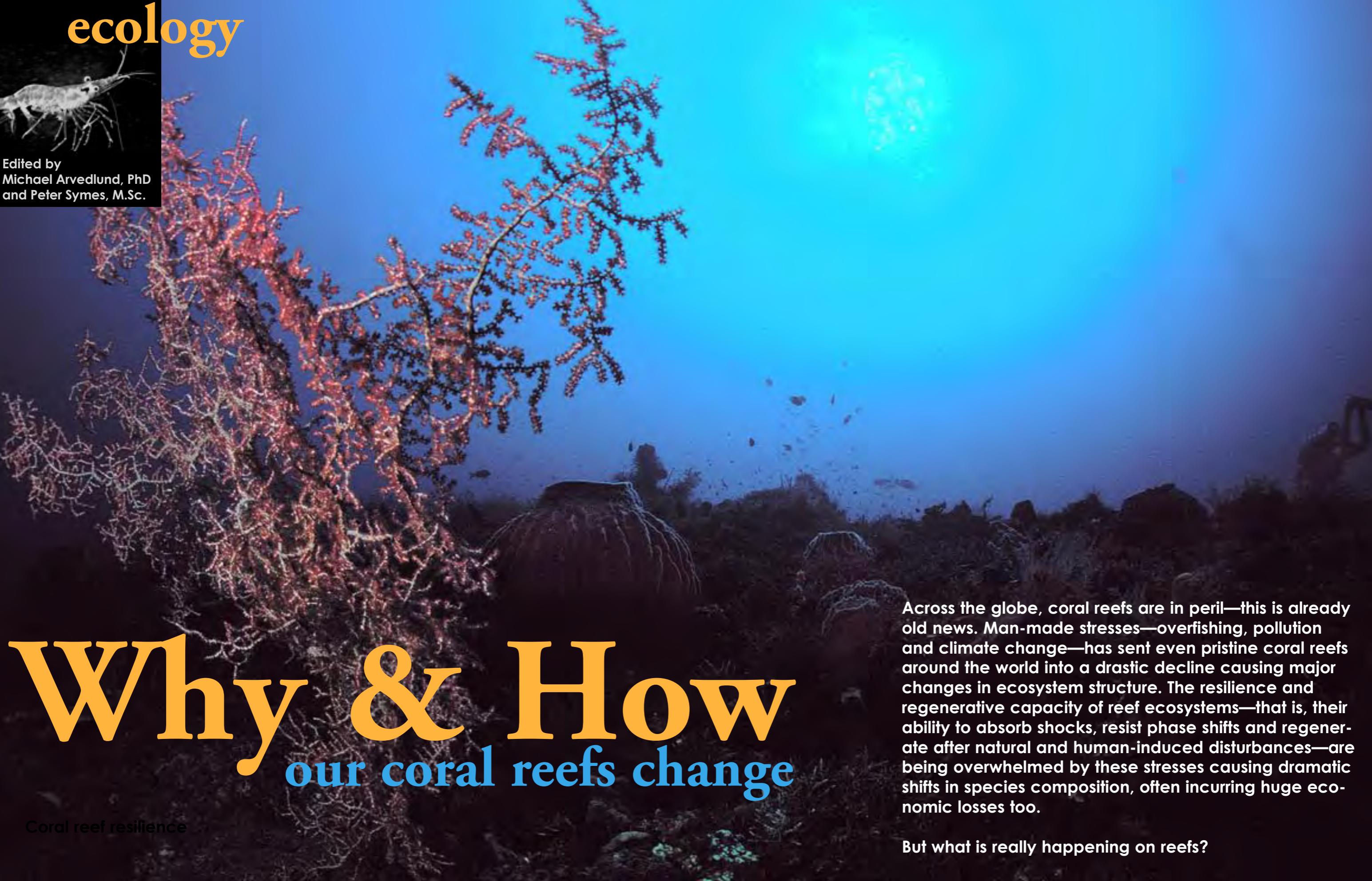
In any event, with continual large losses of body liquids medical assistance should be obtained as soon as possible. ■





ecology

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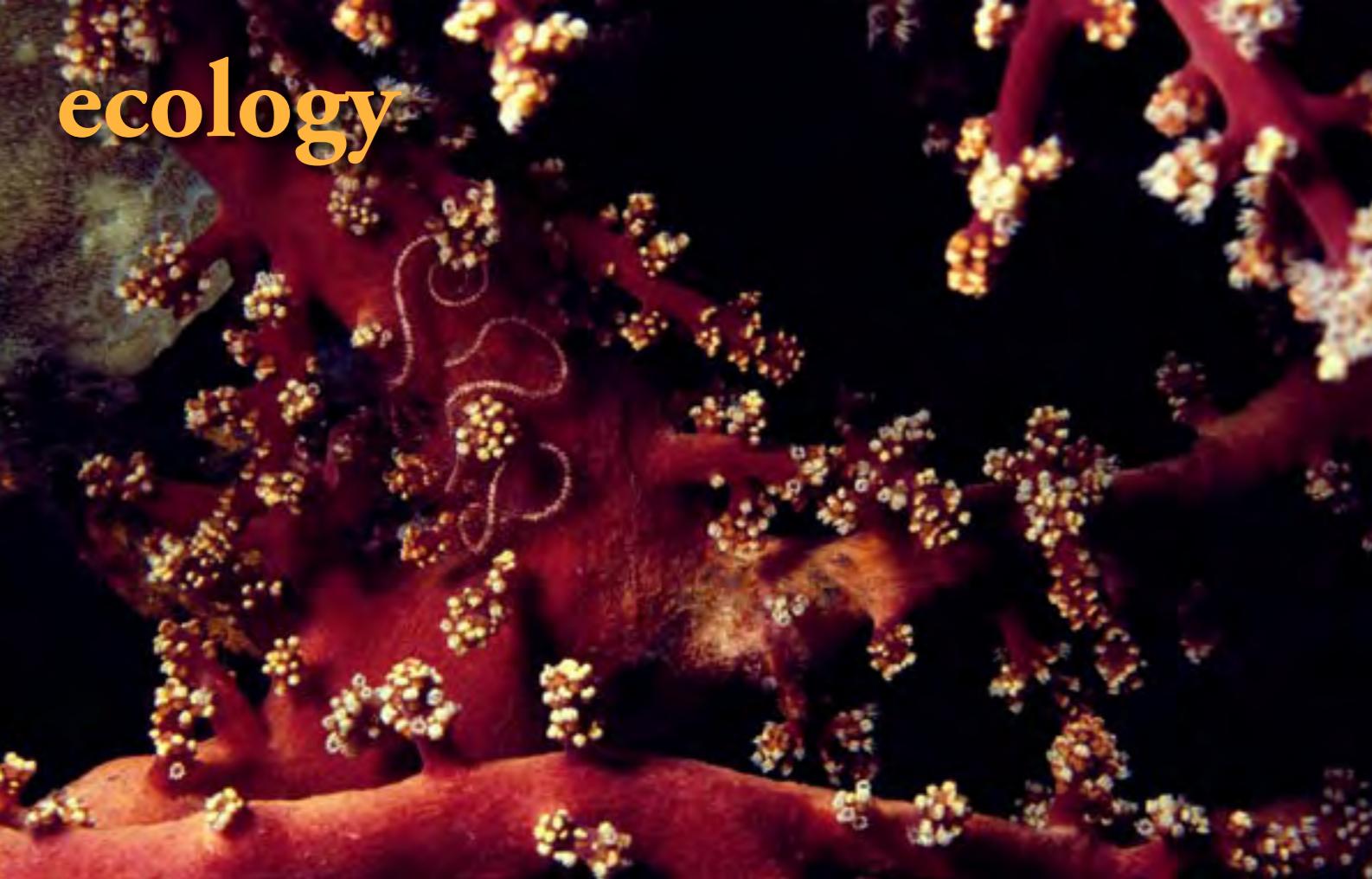
Why & How our coral reefs change

Coral reef resilience

Across the globe, coral reefs are in peril—this is already old news. Man-made stresses—overfishing, pollution and climate change—has sent even pristine coral reefs around the world into a drastic decline causing major changes in ecosystem structure. The resilience and regenerative capacity of reef ecosystems—that is, their ability to absorb shocks, resist phase shifts and regenerate after natural and human-induced disturbances—are being overwhelmed by these stresses causing dramatic shifts in species composition, often incurring huge economic losses too.

But what is really happening on reefs?

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We are well acquainted with the travel catalogue depiction of coral reefs as pristine and colourful shallow-water assemblages of structures and shapes, dominated by scleractinian corals teeming with diverse life forms. Like most other ecosystems in a stable state, reefs usually reassemble themselves after regular disturbances such as tropical hurricanes or disease outbreaks. However, with the addition of human impacts many contemporary coral reefs increasingly fail to regenerate after major impacts, and instead have undergone a rapid shift to an alternate state. In other words, they become something else and often quite different. The most familiar of these transitions is from dominance by corals to dominance by fleshy seaweed, although several other transitions have been documented. The extent to which alternate states are stable or reversible is presently

not well understood. Such a process during which an otherwise stable ecosystem changes into another stable state is called a phase shift.

Stability & phase shifts

Many complex systems—ecosystems, economies—exhibit a dynamic behaviour by which they revert back to a stable equilibrium after minor or lesser perturbations from the outside. This is thanks to various buffer and corrective mechanisms, which kick in with growing effect the further away from the steady state equilibrium the system are brought. A very simple model of this principle is a ball in bowl. The ball will always come to rest in



How we like to see reefs, healthy and diverse

In the news section of this issue of the magazine there is another, yet similar, case-story about a shifted ecosystem.

Scallops along the eastern seaboard of the US are now being overgrazed by cownose rays because the sharks that used to keep the ray population in check have been over-fished. That over-fishing can have such devastating knock-on effects all the way through the ecosystem is hardly surprising as it has happened numerous times in the past.

the middle. Unless, that is, you shake the bowl so violently that the ball falls out. And in that case, question is, where does the ball end up then?

Where do coral reefs end up?

Regarding coral reef ecosystems, on the other hand, there has been little success in predicting such regime or phase shifts. Mainly because the increased instability of coral reef ecosystems and their state prior to their collapses has often gone unrecognized, even on reefs which have been well studied.

A ball on three surfaces illustrate the three basic modes of stability. The ball on a flat surface will just roll and come to rest somewhere else. The ball in a bowl will come to rest in the middle—this is a stable equilibrium. The ball balancing on a peak is also in a equilibrium, but in a unstable one, as it will roll off at the slightest disturbance

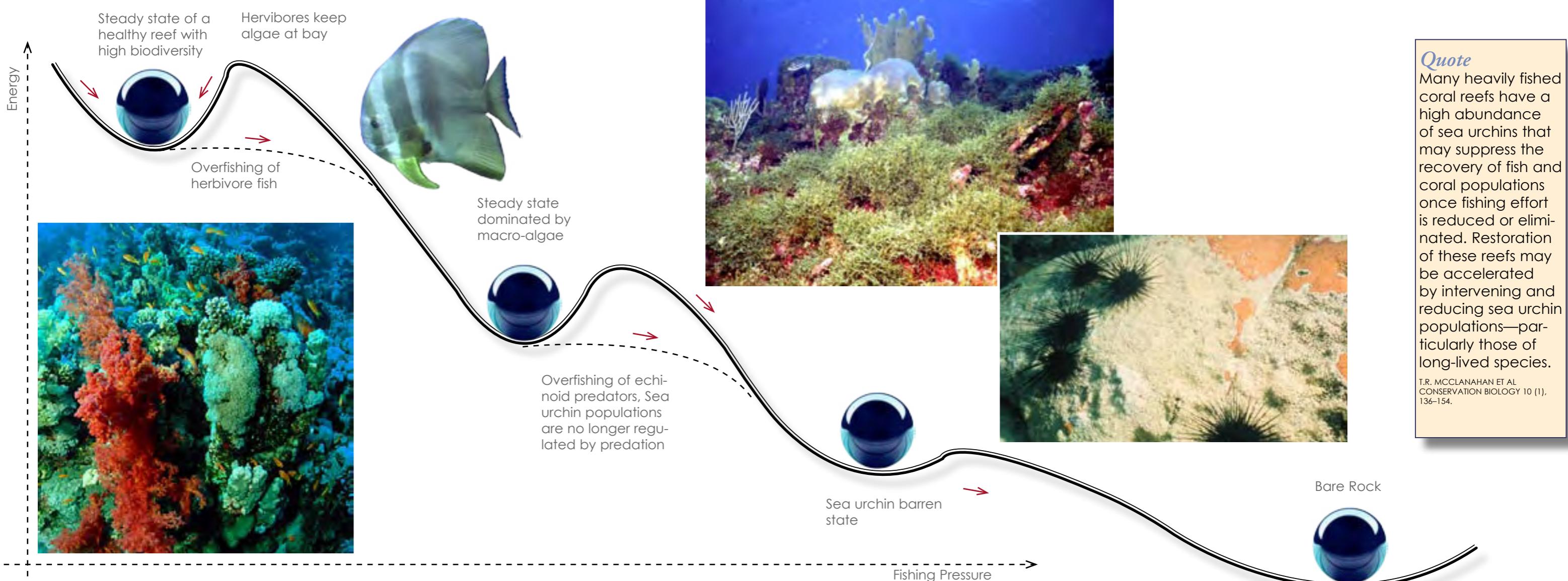


the Caribbean, leading to a near total collapse of the populations and precipitating macro-algal blooms that still persist today. In addition, remnant coral populations are further affected by increasingly prevalent coral disease and bleaching induced by global warming. The ball fell out of the bowl all together.

In retrospect, it is now clear that long before the present widespread loss of coral cover, many Caribbean reefs were on an unrecognized trajectory to collapse. The symptoms included loss of macro-fauna and reduced fish stocks. And as the fishes role as the dominant herbivores were gradually replaced by a single species of sea urchins, this led to destructive overgrazing and bioerosion by food-limited sea urchins, and reduced recruitment of corals. Let us look further into the dynamics of these phase shifts.



How did it come to this?
A reef laid barren by the overgrazing of sea urchins



A simplified model of the correlation between fishing pressure and the structure, or state, of the reef ecosystem. As the fishing pressure grows the reefs collapses into a succession of steady states in a process that is, at worst, irreversible, and at best, difficult and time consuming to reverse.

Restoration of ecosystems is very costly and takes many years. Once again, prevention is such a better strategy than curing after the fact.

As regards to the Great Barrier Reef, inputs of sediment and nutrients from land have increased fourfold since Europeans settled, while the numbers of turtles, dugongs and other macrofauna have greatly decreased. Comparisons of adjacent reefs open and closed to fishing today indicate that the biomass of targeted reef fishes has been reduced by up to 60 percent, causing substantial changes in the abundance of their prey.

Coral cover has significantly declined over the last 40 years, reflecting the impacts of three successive major outbreaks of crown-of-thorns starfish and two large-scale bleaching events in 1998 and 2000. In 2003, more than half the reefs sampled had less than ten percent cover.

But how is coral cover linked to the fish abundance and diversity?

It has something to do with nutrient cycling. A healthy coral reef is a diverse, highly productive community able of thriving in waters that are actually exceptionally poor in dissolved nutrients.

In other words, reefs accomplish fixing high amount of carbon even in the relative absence of dissolved nitrogen and phosphate, which we all know as the main components of fertilizers. The secret to the success of the coral reefs is commonly believed to be the highly efficient recycling of nutrients in the system, particularly within the corals, where the symbiosis between the

zooxanthellae algae living inside the tissues of the cnidarian host has been fine-tuned to conserving key nutrients very effectively. The algae harness energy from sunlight and fix carbon by photosynthesis. Energy from this source is provided to the polyp host in return for exclusive access to the waste-nutrients produced by the host.

These wastes (N and P) function to fertilize the algae. Very little gets wasted to the outside.

Nitrogen

The most significant, and apparently "limiting" nutrient in the picture is fixed nitrogen, a critical element in the construction of all proteins. This why corals also capture prey and assimilate solid matter containing nitrogen.

Somewhat paradoxically, coral reefs are intolerant of liquid nutrient enrichment as it comes, for example, in run-off from agriculture or sewers (which may also cause smothering algae blooms). Corals need to have the nutrient converted into solid form. And this is where the fish comes in.

In this context, nutrients arrive in the sea from various sources in land, some diffuse, some point-like, in the form of run-off from rivers

and seepage of ground-water and discharge from sewers. Under normal circumstances, these nutrients pass through mangrove or seagrass areas before reaching the reef. It is these plants that are capable of utilizing the dissolved nutrients and incorporate them into living matter whereby it enters the food-web,

passing through plankton and ultimately ending up in the biomass of fish.

Of the dissolved forms of fixed N, ammonia is by far the most easily available for uptake from the water by the symbionts. Since living fish constantly excrete ammonia from their gills, it has been suggested that removing major amounts of fish from the system might ultimately deprive corals of needed nutrients.

Differences

If one looks closer at the major coral reef systems in the world, it soon becomes obvious that there are profound differences in their species richness and composition and in the dynamics and resilience of the ecosystems. For

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example, the Caribbean has only 28 percent of the number of fish species and 14 percent of the number of coral species found on the Great Barrier Reef. This is a striking difference, which is largely down to a biogeographic legacy of the evolutionary history of isolation and loss of taxa in the Caribbean basin. This leaves the Caribbean reefs much more vulnerable to the effects of human impacts and possible catastrophic phase shifts.



Batfish are herbivores that help keep reefs clean of algae and instrumental in reef recovery

NOAA Fisheries Service has listed elkhorn, *Acropora palmata* (right) and staghorn corals *Acropora cervicornis* (far right) as threatened under the Endangered Species Act

In the Caribbean, several critical functional groups are missing or represented by only a handful of species

Guilds & Functional groups

It is time to introduce a bit of terminology. In biology, *guilds* are groups of species in a community that exploit the same set of resources in a similar manner, but are not necessarily closely related taxonomically. In marine ecology, the related buzz term is *functional group*, which denotes a collection of species performing a similar function. Fish functional groups are generally synonymous with guilds of species from different trophic levels within a food chain (for example, predators and herbivores), reflecting their role as a major conduit for the flow of energy on reefs.

In the Caribbean, several critical functional groups are missing or represented by only a handful of species. There are, for example, no three-dimensional bottle-brush species and just one species of staghorn coral and one tall, tabular coral, elkhorn.

Importantly, these are the dominant habitat-creating functional groups on healthy reefs in both the Indo-Pacific and Caribbean.

High diversity undoubtedly provides the potential for functional redundancy. However, even in high-diversity systems redundancy in critical functional groups can be limited. What does this mean in plain language? Let's look at a metaphor: Human cities, towns and villages. In a big city—the diverse and healthy coral reef—there are many players performing the same roles in parallel. There are many bakers, smiths, etc., all having a functional part

in the fabric of society and all taking part in the flow of the economy. If one goes out of business, there are others to take over, the society doesn't collapse; it adapts. You find another bakery if the one on the corner goes out of business or go to the supermarket instead. This constitutes the functional redundancy in the system.

But if all the bakers close, and the supermarket stops stocking bread, and it is essential to your survival, then what do you do? You can have a town full of other sorts of stores, but you can't buy bread at a bookstore or a plumber's. That's when you have a high-diversity system with limited redundancy in critical functional groups. You move to another town—or die.

And this is the problem for many small villages in Europe. They hang on while all their shops close, one by one, since they can't cope with the competition from elsewhere. Once they lose their last supermarket, school, post office, pharmacy, bakery—which together constitute a form of economical functional group—the town starts to die as it stops functioning, and people have

to leave. It is the same case with reefs in our case story with the sea urchins, following the depletion of fishes. They became the principal herbivores on many Caribbean reefs, and they prevented the rapid phase shift to dominance by macro-algae that was precipitated by the die-off of Diadema.

Functional Groups & Resilience

Three functional groups play different and complementary roles in preconditioning reefs to permit recovery of corals. These three groups—bioeroders, scrapers and grazers—are a critical source of both resilience and vulnerability to phase shifts.

Bioeroding fishes remove dead corals exposing the hard, reef matrix for settlement of coralline algae and corals.



Foureye butterflyfish (*Chaetodon capistratus*) in a colony of staghorn coral. Some butterflyfishes feed primarily on corals by carefully picking individual polyps off the colony. The presence of butterflyfishes has been proposed as a means to assess the health of a coral reef system; in this role, they are known as an indicator species

Ecosystem resilience is the capacity of an ecosystem to tolerate disturbance without collapsing into a qualitatively different state that is controlled by a different set of processes.

Scrapers directly remove algae and sediment by close cropping, facilitating settlement, growth and survival of coralline algae and corals.

Grazers remove seaweed, reducing coral overgrowth and shading by macro-algae.

The extent to which reefs possess these functional groups is central to their capacity to resist phase shifts, regenerate and retain critical functions in the face of disturbance. A key element in resisting phase shifts to degraded alter-

nate states is the maintenance of successful larval colonization by the full range of coral functional groups characteristic of the region.

If coral reefs are to resist phase shifts after disturbance, it is imperative that critical functional groups of fishes, corals and other taxa are actively managed and sustained.

Meeting the challenge

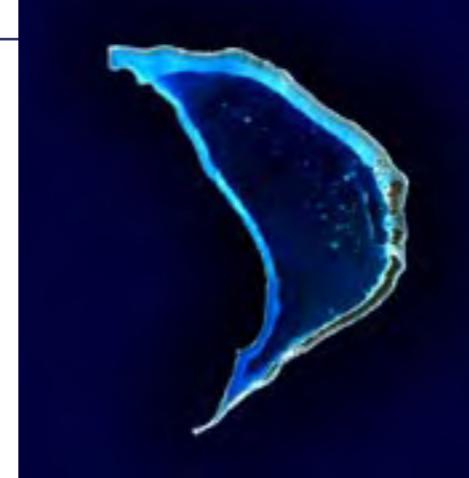
Much has been lost, and some of it forever, but much remains to be saved. Management of functional groups represents a radical departure from previous management philosophies. For example, wise management of herbivorous fishes can facilitate the regeneration of reefs after large-scale disturbances such as bouts of bleaching or disease that are impossible to regulate locally.

But it is imperative to scale up management and governance systems to secure the future of functional groups and their roles in supporting the resilience of coral reefs. Also the management of no-take areas (NTAs)—where fishing and other human activities are prohibited—are an increasingly prevalent approach to

“Today, a new generation of Caribbean researchers and managers may never have seen a decent stand of Caribbean Acropora coral, a manatee or a large shark, nor can they remember the destruction wrought in the 1970s by a million sea urchins per kilometre of coastline.”

D.R. BELLWOOD ET AL

The isolation of oceanic reefs renders them particularly vulnerable to loss of local broodstocks. On degraded reefs, the local loss of brood stocks is likely to select against self-seeding species and to shift the taxonomic composition of recruits in favour of those with longer planktonic durations, with potentially far-reaching consequences for community structure.



coral reef management. If they are adequately enforced, NTAs provide a spatial refuge from harvesting. Importantly, such protection may also permit critical functional groups to persist, and thus contribute to local ecosystem resilience.

However, even the largest NTAs in the world are not self-sustaining, because they are still too small relative to the scale of natural and human disturbances, and to the dispersal distances of many larvae and migrating adults. The rate of establishment and size of NTAs as a tool for resilience management needs to be hugely increased. The expansion of NTAs in 2004 from five percent to 33 percent of the Great Barrier Reef Marine Park in Australia, with a parallel focus on improving water quality, provides a good model.

Choosing the right areas to protect

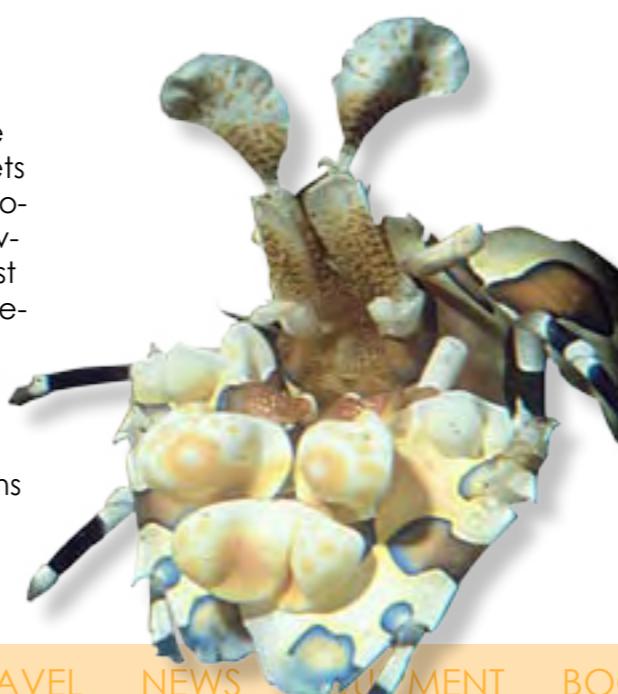
Hotspots, areas of exceptional species richness, are one of the most frequently identified targets for the protection of marine ecosystems. However, there are several lines of evidence to suggest that cool spots, areas of low species richness, are more vulnerable. Low-diversity reefs, such as in the Caribbean Basin, the Eastern Pacific and many high-latitude or remote locations in the Indo-Pacific have low functional redundancy where functional groups may be

If coral reefs are to resist phase shifts after disturbance, it is imperative that critical functional groups of fishes, corals and other taxa are actively managed and sustained.

represented by a single species. As explained above, in these systems even minor changes in biodiversity can have a major impact. ■

Acknowledgements

Substantial parts of this article is a popularisation that rests heavily on *Confronting the Coral Reef Crisis* by D.R. Bellwood, T.P. Hughes, C. Folke and M. Nyström in Nature, volume 429



...AND THE SECOND

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A background image of a tropical island with palm trees and a white sand beach, with a large white liveaboard boat anchored in the clear blue water.



Edited by
Gunild Symes

Super protection for divers having fun under the sun

POINT & CLICK
ON BOLD LINKS



Sun Protection & Body Care

All photos are courtesy of the manufacturers



EcoLips

Sport SPF30 with Eco Clip is perfect for divers since it is designed for extreme outdoor sports enthusiasts. It protects your lips under the roughest conditions, keeping the sun out and the moisture in. Get 30 times your skin's natural ability to protect itself from the sun's UV rays on your most vulnerable features, your lips, with SPF 30 sun protection. The aluminum carabiner clip is an ideal way to remember care about your lips. Clip it to your gear, belt loop, keychain, backpack, or anywhere for a fast Eco Lips fix. Contains moisturising organic vegetable oils and healing organic herbs. All-natural formulas and certified organic ingredients ensure protection from all the harsh elements: sun, wind, and cold. (The Carabiner is not for climbing and the clip colour may vary.) Price: £3.50 www.ecolips.com



Sport Cosmetics by Chung Shi is a special line produced by Tanja Lang Cosmetics for the sportive woman. Has Aloe Vera as a hydrating agent. The Sports Women Cosmetics packet includes: Sport Women Skin Re-Balancer, Sport Women Beauty shower, Sport Women Energizing Gel, Sport Women Leg Relaxation Gel, and Sport Woman Cool Starter Gel. Price: €29.00 www.hartslagmetershop.nl



Aloe Up

Aloe Up Pro Sport SPF 30 Sunscreen was specifically developed to meet the rigorous demands of a diver's lifestyle. Based with 35 percent Pure Aloe Vera Gel, this highly water resistant sunscreen lasts up to eight hours and is certified biodegradable and reef friendly. Available in a 4oz and 1oz. Aloeup.com



Ahhhhh... Massage

BTS 3 is a pure massage cream containing antioxidant vitamins E and C in a base of mineral salts—sodium, potassium, calcium, magnesium—from Tuscany. To aid recuperation, it also contains free-chain amino acids. Serious athletes use it for daily massage in order to remove tension and muscular fatigue caused by hard training over a long period of time. According to the manufacturers, BTS 3 is the most widely used sports massage cream in Italy. To restore muscular equilibrium, apply it during regular massage treatments. Aids in achieving high performance. Price: €16

A delicate shower gel with a fresh scent, **BTS Doccia** is intended for athletes that shower often and need a product that is gentle on hair and skin. Available in several scents for discriminating tastes. Price: €6.80 www.btssport.com





cosmetics

*UV Protection
& Sunglasses*



UV Protection for Kids

Junior surf brand Lion in the Sun stocks sun protective swimwear for children, teens and adults. The fabric all rates UPF50+, and styles include one and two piece surf suits, rash vests and boardies, sun hats and swim jackets. The fabric is top quality, fast drying Italian lyra. Secure online shopping and fast, free delivery from www.lioninthesun.com

Equator Sun offers an extensive range of excellent quality UV protective swimwear for all ages, including stinger suits, long-sleeve rash shirts and swim leggings. The fabric provides excellent sun protection of UPF50+ and is durable, cool, soft, quick drying and is suitable for a wide range of watersports. Equator Sun is a UK based business.

www.equatorsun.com

Smith MHC

With a name inspired by adventures at 5,280 feet, the MHC is the newest addition to Smiths growing metal collection. In this 8-base lens curve piece the standard stuff you expect from Smith Optics is all there: optical grade metal-frame construction, Tapered Lens Technology (TLT) Carbonic Lenses, stainless steel hinges, 100% UV A/B/C protection and adjustable silicone nose pads for a custom fit. And of course, the MHC is loaded with details that make it pure Smith, including custom acetate temple tips with an inlaid logo, laser etched Smith wordmark, and pad-printed MHC on the lens front. Available frame and lens combinations include Silver with Polarized Gray (\$99), Gold with Brown (\$80), or Blue with Platinum Mirror (\$80). Visit Smith Optics at SmithOptics.com



Dirty Dog Wetglasses

"Tube" Dirty Dog Wetglasses with Hydrophobic Green Polarised PC lenses, Superstrong TR90 frame and headstrap to keep the glasses on are ideal for active divers. Hydrophobic coating is a state of the art lens coating that causes water to bead and run off with a similar effect to that of old watercoating sprays on carpets and fabrics. Hypo-allergenic flexible plastic frames are stress-resistant, strong yet lightweight with a snug fit around the face for optimum comfort and maximum protection from glare. Decenterised impact-resistant distortion-free polycarbonate lenses provide 100% protection from damaging UVA and UVB rays and 70% infrared (heat) protection. Superb visibility into the water. Comes with cloth pouch and protective case. Price: GB£45.00 www.dirtydog.com



Body Glove Polarized Sunglasses

Hanauma, Shiny Solid Black, Smoke Polarized.
Price: \$30.00 USD www.bodyglove.com



Dive Shades

The GRAND CAYMAN II is the newest style to be added to the Dive Shades series. It features a .75mm lens and a soft silicone nose piece for comfort. Available in 4 different frame colors. Crystal Gradient Brown shown here. Combines good looks, superior eye protection and value. New Dive Shades Neoprene Sunglass Retainer also available at: www.diveshades.com



Tough T's

A typical 100 % cotton T-shirt has a sun protection rating of only SPF 6, far below the recommended level of SPF 15. Solar Protective Factory's breathable 100% cotton t-shirts are the only totally cotton shirts certified by independent laboratory tests to exceed both AATCC and ASTM standards—the U.S testing and labeling organizations—earning a UV protection rating of UPF 40-50+, which is the highest possible. SPF® co-founder, Terry Breese says, "Our SPF® shirt looks like a T-shirt and feels like a T-shirt, but when it comes to blocking the sun's dangerous UV rays, it's more like a coat of armor." www.SunProtectionCenter.com



cosmetics

Skin & Hair Care



John Masters Organics

John Masters Organics hair, face and skin care products use no harsh chemicals or artificial colour. Take three essential products on your next dive trip in this nifty travel set, which includes Lavender Hydrating Mist for Skin & Hair, Green Tea & Rose Hydrating Face Serum, Lip Calm. Regularly a US\$51 value. On sale now for US\$40.00

Rosemary & Peppermint Detangler has a luxurious light organic conditioning formula. Detangles and conditions without weighing down your hair. Contains protein and vitamins for strength and shine. Hair growth is stimulated by rosemary. Great for dry or fine hair. Only high quality, 100% certified organic ingredients.

Herbal Cider Hair Rinse & Clarifier revitalizes your hair leaving it clean and fresh by eliminating residue build-up including lime from hard water. Sebum and product build-up is removed by a delightful mix of organic apple cider vinegar with wild cherry bark, nettles and rosemary. Lemon oil removes unwanted oil from the scalp. Nettles give the hair a wonderful thickness and shine. This unique organic rinse neutralises the scalp's PH level—especially good after swimming in a chlorinated pool.

www.johnmasters.com



Kiwi Products

of New Zealand offer the best in skin and hair care using the natural resources and ingredients found on the beautiful islands.

Envigorating multi-colored Mud & Mineral Rock Soap contains pure Rotorua Thermal Mud from the geothermal area of Rotorua, 6.80 NZD. Thermal Mud Soap is a gentle rich-lathering soap with lots of thermal mud for deep cleansing and enriching your skin, 40g, 4.90 NZD. Get the goodness of Kiwi in Kiwifruit Shampoo & Conditioner for shiny, vibrant hair, 13.80 NZD.

Products with Paua!

Paua Deep Down Nourishing Creme: luxurious, therapeutic, rejuvenating, nourishing, highly enriched with marine vitamins and minerals—helps slow down the visible signs of ageing, 15.40 NZD. Paua & Sea Kelp Soap with Paua Abalone Extract and Sea Kelp for the moisturising and healing of your skin, 10.40NZD.

Exhilarating Paua Facial Scrub Sea & Sand Stimulating Facial Scrub combines collagen and allantoin with natural marine protein, vitamins, minerals and trace elements found in Paua extract. Thoroughly cleanses skin and removes dead cells leaving your complexion glowing, 14.40 NZD. www.kiwiproducts.co.nz

Let's face it, mud is great for skin

Mud for Men skin care line has been especially developed with men and mud in mind. The sulphur content of the Rotorua thermal mud used as an ingredient actively kills bacteria on the skin, assisting in the prevention or elimination of dreadful acne. Try Mud for Men Moisturiser with SPF15 sunblock—it's enriched with Rotorua mud to condition and hydrate the skin against daily environmental damage, 15.40 NZD; Mud for Men Aftershave Balm enriched with Rotorua Thermal Mud to help heal and soothe razor stressed and sensitive skin, 14.40 NZD; Mud for Men Facial Scrub with pumice particles and Rotorua Thermal Mud to deep cleanse and exfoliate, for a smooth and healthy appearance, 15.40 NZD; Mud for Men Soap with Rotorua Thermal Mud provides a natural cleanser for the face and body, 7.95 NZD. Give all four in the Mud For Men Gift Box II, 59.50 NZD.

www.kiwiproducts.co.nz



Cool off with Skyn Iceland

In Iceland—the land of balance and harmony, pristine, unspoiled nature and clean water and air—the term "skyn" translates to "senses" in English. Skyn Iceland wants to point out the direct link between the senses and how your skin looks and feels, especially when overloaded by stress. Winner of this year's Indie Award for innovation, the beauty industry's highest honor, Skyn Iceland is the only skincare line specifically formulated to counteract the detrimental effects of chronic stress on skin. Try the Antidote SPF18 Mineral Sunscreen with Biospheric Complex (anti-oxidants Arctic Cloudberry Seed oil, Red Cranberry Seed oil, Butterfly Bush and Thyme extracts; Icelandic glacial water infused with minerals and Angelica Archangelica—an Icelandic medicinal herb) US\$55, Hydro Cool Firming Eye Gels \$45, Angelica Lip Repair \$15 and the award-winning Stress Defense Cream \$100. www.skyniceland.com



mermaid matters

Edited by
Gunild Symes



While we may not wear mascara as artistically as the model in this TUSA ad does, diving divas may still find a few beauty tips from GirlDiver helpful...



As you're gazing into the eyes of your buddy, hanging at your 15' safety stop for three minutes, what is he looking at? Is it the brilliant sparkle emanating from your eyes as the overhead light pierces the waves? Or is it the black-around-the-eye raccoon look, causing him to muse about the possibility that you did indeed suffer a mask squeeze on your descent?

GirlDiver has searched for the answers to the best waterproof mascaras. She has asked fellow female divers, looked for information online, and tried hit and miss with the brands that happened to be in her make-up bag. Some worked, some didn't. So, in the quest to provide proof positive on waterproof mascara, she dove the top recommendations and came up with her own "Top Waterproof Mascara's for Scuba Diving".

First, let's understand what waterproof mascara is. Water-proof mascara contains synthetic polymers that instantly freeze around each lash, creating a water resistant barrier. Keep in mind, these mascaras will dry out your lashes if worn constantly, so unless you live

in rainy Seattle, as GirlDiver does, you should wear these only when embarking into the deep blue.

Now, onto the test. The mascara's in this trial were chosen based on range of price, manufacturer and convenience. These were each tested on five dives in the chilly waters of the Puget Sound. GirlDiver likes to keep the water out of her mask, so full mask flood and clear exercises were not performed during the test. The removal of the mascaras were done the night of the dive, not the morning after, so sleeping in your make-up could skew the results. See sidebar (right) for GirlDiver mascara test results.

Hoods & Hair

Dive Diva's everywhere have questioned how to tame their wild tresses. While we know that we aren't going to look like the Sports Illustrated models after a dive, we certainly shouldn't surrender to a shaved head either. Saltwater wreaks havoc on our hair leaving a salt residue that depletes the hair of its natural moisture. Add blowing wind into the equation and the result is split ends and brittle hair that feels like straw.

Hair care for Girl Divers is three fold. You must treat your hair before you subject it to the elements, manage your hair during the dives, and restore your hair after the dives.

Chlorine and saltwater can discolor

Lancome L'Extrême Waterproof Mascara and Estée Lauder Illusionist Waterproof Maximum Curling Mascara

LEFT: Clinique Gentle Waterproof Lash Intensifier; CoverGirl Professional Waterproof Mascara; Marathon Waterproof Mascara and Remarkable Mascara

and dry out the hair's cuticle. Before diving, wet down hair with cool tap water, which will seal the cuticle. Hair is like a sponge; it can only absorb so much water. If it's wet to begin with, it won't absorb as much damaging chlorine and saltwater.

Swear by leave-in conditioner and never leave for the dive without it. Protecting skin with sunscreen is good sense, and the same goes for hair. If you can find a conditioner with a sunscreen in it, all the better, as the UV rays will turn your hair a brassy shade. Also, using some hair crème or pomade as a conditioning barrier will reduce the amount of salt that can adhere to the hair follicles.

During the dive, if you have long hair, you'll want to secure it before pulling and tugging



GIRLDIVER'S TOP 5 WATERPROOF MASCARA'S FOR SCUBA DIVING:

#1 COVERGIRL Professional Waterproof Mascara

Glide on: 4.5/5
Wearability: 5/5
Removal: 3.5/5

#2 MAYBELLINE Illegal Lengths Mascara

Glide on: 5/5.
Wearability: 5/5
Removal: 3.5/5

#3 MAYBELLINE Full & Soft Mascara

Glide on: 4.5/5.
Wearability: 3/5
Removal: 4/5

#4 CLINIQUE Gentle Waterproof Lash Intensifier

(Good for a very natural look—not a lot of length)
Glide on: 2/5
Wearability: 4.5/5
Removal: 4/5

#5 SEPHORA Waterproof Mascara

Glide on: 4/5
Wearability: 4/5
Removal: 5/5



ABOVE: Sephora Waterproof Mascara
LEFT: Maybelline Full 'n Soft

mermaid matters

TOP TO BOTTOM: Two DoWraps and three ScubaDoRags give hair good protection from the elements. Lots of styles and colors available. www.dowrap.com and www.scubadorag.com



on your neoprene hood. Putting hair into a braid or a series of pony holders keeps hair from becoming caught in the hood. Using the conditioner before braiding, will help to hold the braid in place. You may want to wear

a lycra "doo rag" over your hair before putting on your hood.

Alternatively, a "shark skin" or "titanium" lining in the hood will also ease with removal of the hood off at the end of your dive.

If you're diving a tropical destination, you may consider a



beanie for night dives (as this will only tame your tresses but avoid getting blood worms tangling in your locks). For day use, a "slap strap", available at most dive stores will keep the mask strap from catching on your hair.

We are told to rinse our gear thoroughly after a dive, but any good Girl Diver knows, that beauty comes before gear rinsing. As soon as possible, rinse out your hair with fresh water. You may find a fresh water shower on the boat or at the dive site. There are also a myriad of shampoos made to remove harsh elements from your hair at your local salon.



L'Anza Magic Bullet

This deep-penetrating light-weight mist strengthens your hair from inside the cortex and out, instead of just making it look healthier on the surface. Spray it into your damp or dry hair and leave it in. Apply prior to styling and blow drying.

www.lanza.com

Hi Shine Leave-In Conditioner Mist

A nourishing, vitamin-rich, naturopathic micro-brewed formula from Australia with keratin and pure silk protein leaves hair with an incredible shine and feeling weightless. To condition and protect your hair from environmental stress, spray over towel-dried or dry hair. Comb through and finger style your hair.

www.thenaturalsource.com



Put a wide-toothed comb in your Save-A-Dive kit, so that you can get through those tangles on your way to the pizza place. Again, if you've got some spray in conditioner with you, now would be a great time to add another round to the hair, as it's just been through the dehydration routine.

Keep your hair trimmed of split ends and use a clarifying shampoo weekly to keep your hair looking great.

Even the divas of diving have to treat their locks. "I'm not very good with my hair and don't think about it much," Tanya Streeter said from her home in Austin, Texas. "When I know I'm going to be in the water, I just coat it with a ton of conditioner, braid it, and wear it down my wet suit."

Cindy Ross is a dive instructor and writer dedicated to promoting the scuba lifestyle for women of all ages worldwide. For more information, please visit: Girldiver.com ■

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If you have captured a piece of our ocean's splendor, don't let your images be like the trees that fall in the woods with no one to hear them. Send your entries now. Our invitation remains open until 21 August 2007, for you to be part of this prominent event by entering the prestigious international competitions. There are over \$50 000 worth of prizes up for grabs. Exceptional quality prizes from sponsors like Rolex, PADI, SEACAM, Dive Silver, the Department of Tourism Philippines and more. There are special dive package holidays for this festival from MV Odyssea I, Anilao Outrigger Resort, Atlantis Divers, Asia Divers, Expedition Fleets, Bahura Resort, Minahasa Lagoon to name but a few. Book Now! Awards for each category are: OUTSTANDING ACHIEVEMENT: MERIT OF EXCELLENCE: HONOR OF DISTINCTION: HIGH COMMENDATION. The Best Image Maker of the Festival (US\$2000 cash prize): The 'President Grand Award for Highest Achievement' Entry at www.celebratethesea.com



Official host hotel

shark tales



Edited by
Edwin Marcow

Captive shark did have 'virgin birth'

Female hammerhead sharks can reproduce without having sex, scientists confirm.

The evidence comes from a shark at Henry Doorly Zoo in Nebraska, which gave birth to a pup in 2001 despite having had no contact with a male.

Genetic tests by a team from Belfast, Nebraska and Florida prove conclusively the young animal possessed no paternal DNA, Biology Letters journal reports.

The type of reproduction exhibited had been seen before in bony fish but never in cartilaginous fish such as sharks.

Parthenogenesis, as this type of reproduction is known, occurs when an egg cell is triggered to develop as an embryo without the addition of any genetic material from a male sperm cell.

The puzzle over the hammerhead birth was reported widely in 2001, but it is only with the emergence of new DNA profiling techniques that scientists have now been able to show irrefutably what happened. ■

Stingrays and Sharks May See in Color

Stingrays may see the world in colour rather than be colour blind, which until now, has been the prevailing consensus. A team of researchers at the University of Queensland, under the direction of Dr Nathan Hart, Professor Shaun Collin and Professor Justin Marshall, began behavioural tests on Shovelnose Rays and Reef sharks at the Heron Island Research Station. At the Centre, the sharks and rays were being trained to associate coloured light with food, and to see if the subjects could distinguish between the training colour and a random colour. Susan Theiss, a PhD student at the University of Queensland remarked, "seeing in colour could help rays find mates,

detect prey and avoid predators".

Due to an unfortunate fire at the Research Station, the findings have been delayed, but they hope to repeat these experiments in the near future. Though the rays have the apparatus to see in colour, further tests should confirm if they could disseminate this colour information. "Knowing more about ray and shark vision could eventually help in the design of wetsuits and surfboards to reduce attacks on divers, surfers and swimmers".

Professor Collin added, "The design of trawler nets could potentially be altered to reduce shark and ray catches". ■

PETER SYMES

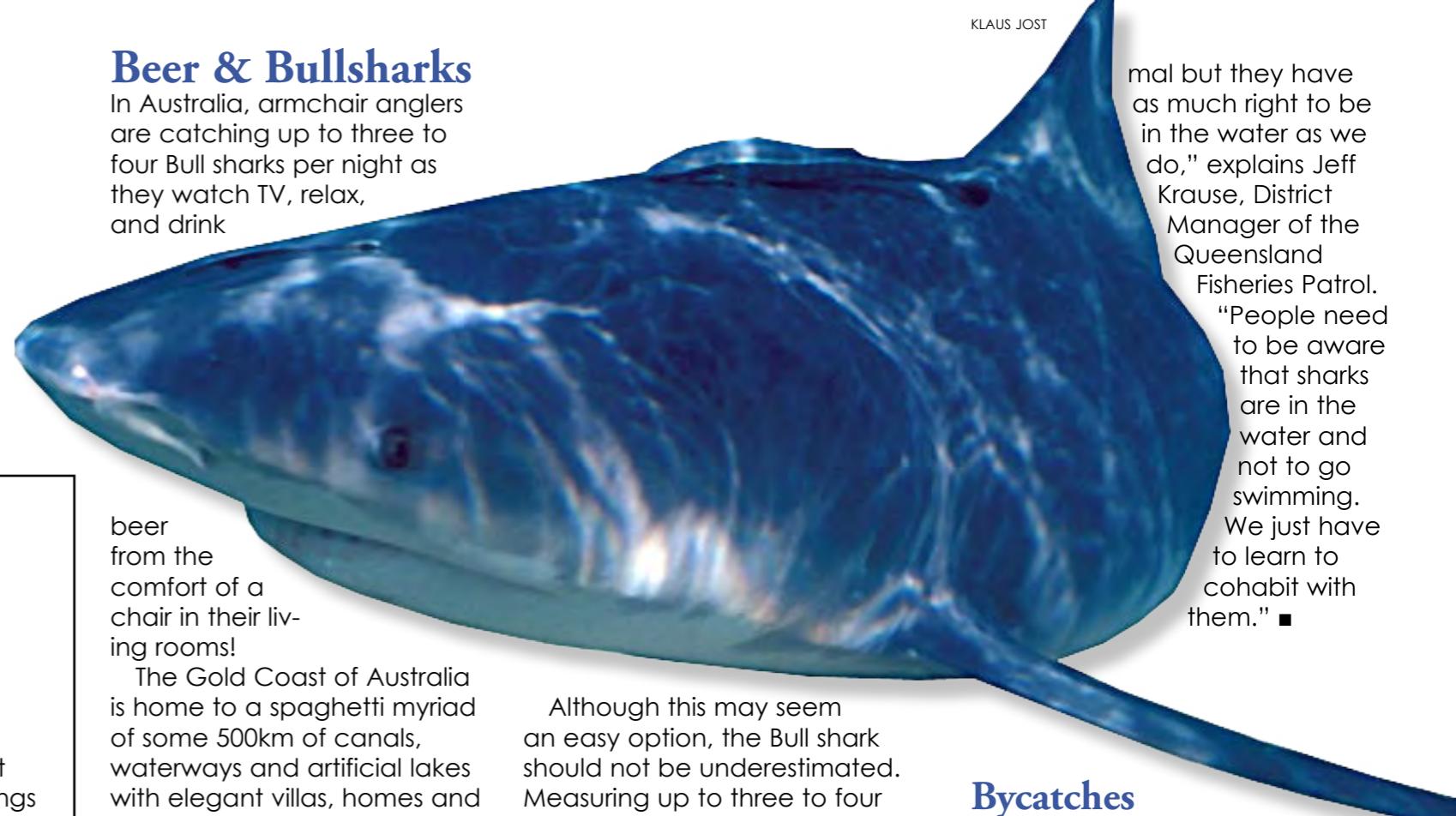


The Blue-Spotted Maskray has the physical framework to see colour vision

Recreational anglers have caught three meter sharks with nothing more than a cooked pork chop taken from the barbecue and dangled from a simple rod and reel resting from a sixth floor balcony.

Beer & Bullsharks

In Australia, armchair anglers are catching up to three to four Bull sharks per night as they watch TV, relax, and drink



beer from the comfort of a chair in their living rooms!

The Gold Coast of Australia is home to a spaghetti myriad of some 500km of canals, waterways and artificial lakes with elegant villas, homes and apartment blocks backing onto the brackish water. With the increasing development of new homes, new canals are excavated, and with them, the Bull sharks' territory and population has grown exponentially.

Recreational anglers have caught three-meter sharks with nothing more than a cooked pork chop taken from the barbecue and dangled from a simple rod and reel resting from a sixth floor balcony.

Ranked as the easiest game fishing in the world, architectural student, Saeed Granfar, has caught 100 bull sharks since his childhood. His technique is simple. With a baited line of chopped eel, he fixes his rod to a pontoon and sits back to watch his favourite film, or listen to a CD keeping an ear out for the ratcheting sound of the line playing out. "It's definitely lazy man's fishing," said Granfar.

Although this may seem an easy option, the Bull shark should not be underestimated. Measuring up to three to four meters in length, this blunt-snouted, barrel-shaped predator with a fearsome aggression and power, is an apex predator. Responsible for the deaths of two bathers swimming in the canals in 2003 and a young woman killed near Stradbroke Island in 2006, the fear among some is that new arrivals to the Gold Coast will be unaware of the potential dangers lurking under this tranquil setting.

With growing pressure from local game fishing operators to create the "Bull Shark Classic" tournament with various prizes for the largest shark caught and the most sharks caught in one day, their future may be bleak.

As mentioned in a previous Sharktales, the call for the "Bull Shark Classic" has regrettably gained momentum in Queensland, and local anglers are free to catch and kill as many bull sharks as they wish. Thankfully, the Fisheries department is opposed to any cull. "There have been calls to eradicate the ani-

mal but they have as much right to be in the water as we do," explains Jeff Krause, District Manager of the Queensland Fisheries Patrol.

"People need to be aware that sharks are in the water and not to go swimming. We just have to learn to cohabit with them." ■

Bycatches of sharks are at critical levels

At least 7.8 million sharks are killed off the shores of Southern Africa each year by hooks intended for other animals. This by-catch also includes some 34,000 sea birds and 4,200 sea turtles, according to WWF South Africa and Birdlife South Africa. With an estimated 6.6 million open-ocean sharks (mostly blue and shortfin mako), and a further 1.2 million coastal sharks (dog sharks) unintentionally caught in this region by longlines and netting, the situation is critical.

Some estimates for by-catch



Long line hook



Shark fin shop in central Bangkok



PETER SYMES

are that a hundred million sharks and rays are caught and discarded every year. Beth Babcock of the University of Florida stated recently, "About a third of the fish caught around the world are discarded as by-catch".

Coupled with an increase in aggressive poaching of Hammerhead and various threatened shark species in protected Colombian waters off the island of Malpelo and in the waters of Balabac in the Philippines, to fuel the demand for shark fin soup in Asia, what links the two separate issues of by-catch or intended catch is that the recent arrest and detention of the Vietnamese poachers caught in the Philippines were long lining!

This problem is not unique to Southern Africa, South America, or the Far East. The dual issues of long lining and by-catch being discarded is now a world-wide problem.

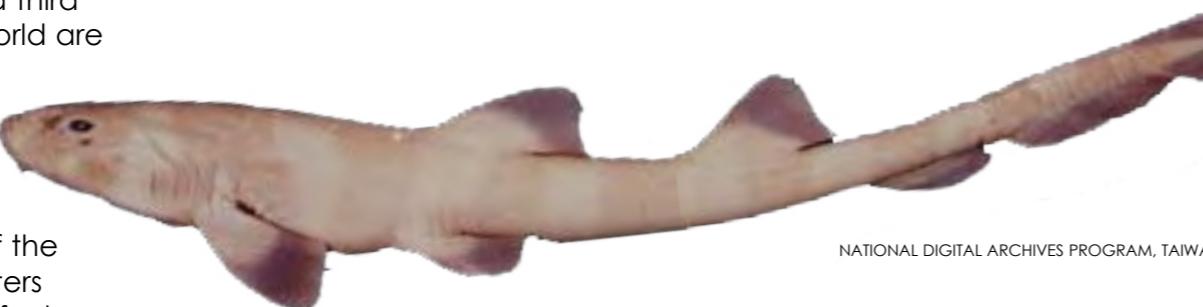
There has been a sharp decline in Great Shark populations in the Atlantic Ocean with eleven species having all but vanished from over fishing. Bull, Dusky and Smooth Hammerhead numbers are also in sharp decline according to a scientific study.

"I am not using the word extinction at this point. The ecological terms we

would use are functionally eliminated," said the co-author of a recently published study, Julia Baum. There are simply not enough sharks in this region to keep the environmental balance in check.

Researchers have linked declining shark numbers with a boom and bust cycle for other marine life species by allowing more lowly fish species to flourish in numbers such as skates, rays and smaller sharks. The food they predate on—shellfish, scallop, clam and oyster populations—are now also in sharp decline.

The research suggests that with the fall of shark populations, the negative affect it will have further down the food chain will have far reaching consequences. ■



NATIONAL DIGITAL ARCHIVES PROGRAM, TAIWAN

Changing Fins

Infant Brown-Banded Bamboo sharks can see a month before they leave their eggs and change their fins as they grow. Working on his Ph.D. thesis graduate student, Blake Harahush, has made a discovery, which is about to be published in the Journal of Fish Biology. The sharks showed signs of fins at about 53 days. This is about one third into their hatching period of 153 days, though this was variable depending on the incubation period. The function of the early development of two long fins Harahush believed, was to circulate fresh water and oxygen and clear any waste products from the egg case. These fins would then morph into dorsal, pelvic and

caudal fins.

Warmer temperatures did speed up the growth cycle with one shark hatching after 101 days. Most other species take between several months and two years to develop before birth. The findings also discovered that one month before hatching from their egg cases, the sharks' eyes are fully developed. "It's still a mystery why they develop their eyes so early before they hatch," Professor Shaun Collin, a fish vision expert, stated that the research was useful for identifying the best conditions for shark husbandry, which could help replenish stocks. ■

Sharks die in aquarium—the water was too cold

Three black tipped reef sharks died during their 70-mile move from Great Yarmouth to their new home at the Hunston Sea Life Centre in Norfolk. The centre said that the deaths were "almost unprecedented in the Sea Life network over 100 shark transports over the past 20 years". Manager Nigel Croasdale also added that he was "deeply concerned" at the loss.

Tragically, the centre confirmed that the water was two degrees Centigrade below the minimum required for the sharks. Though not conclusive, this is the likely cause of the sharks' death. This was due to human error by a staff member. Action has been taken to ensure this cannot happen again, including a retraining and assessment programme for the relevant personnel" a spokesman said. ■



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