POINT & CLICK ON BOLD LINKS

Edited by
Andrey Bizuykin
& Peter Symes

What's hot...what's next

Equipment

T2 from Atomic Aquatics

Says Atomic Aquatics on their web-site: "The T2 is designed to be the best performing and best looking regulator on the market—PERIOD. Built in durable and leightweight titatanium this sleek looking 300bar reg comes with a lifetime corrosion warranty. Can be used with Nitrox up to 40% without modifications.
www.atomicaquatics.com

Fashion statement

This eye catching dive computer, Xtender Lady, is an exclusive special edition of the probably smallest dive computer available on the market at the moment, the Scubapro Extender. Suggested retailprice is € 579,- Euro
www.Scubapro-Uwatec.com

Buzz Off

No, we are not being rude. Buzz off is the apt trade name of these special garments. They are insect-repellant, and as such, will come in very handy for any traveller that goes to areas where there are mosquitoes and other nuisances - as divers sometimes do. The are several different models, sizes and colours for ladies, gentlemen and kids. Typical pricerange usd 35 to 85 seen as seen at Ex Officios webshop. **www.exofficio.com**

Personal Locator Beacon

OK, so you are lost, stranded or in serious distress, stranded, injured or otherwise in need of rescue but your cell phone is out of reach of the network and you don't carry a radio either. What do you do? Enter this Personal Locator Beacon which use satellites to not only relay your distress call to the Search and Rescue services, but also provides them with a fix on your position. This Aquafix 406 GPS GPB comes a suggested retail price of USD 650
www.acrelectronics.com

Radiator

A new type of wetsuit material technology. It's a 4 layered construction, comprising a 'slipskin' inner lining reflecting body heat, a closed cell neoprene rubber core, a titanium lining which acts as a highly efficient barrier to the cold and a nylon jersey outer layer for durability. Put simply, you can now wear less. Radiator were selected by ISPO, the world's largest sport's trade fair, as the best new sportswear in their "Brand New" section in 2004. **www.radiator.net**

Out to dry

This portable, lightweight drying rack from H2Ice will not only store your gear between uses and keeps equipment dry and odor free. Their patented drying system, which comes with one or two blowers, will dry out even the wettest wetsuit in the matter of a few hours. From usd 225 **www.h2iceonline.com**

Singaporean ScubaPunk T's

Looking into making a different sort of dive fashion statement? Check out ScubaPunks streetwear inspired collection of t-shirts with an attitude. **www.scubapunk.com**

MK17AF

Scubapro writes about the new MK17AF that it is their most advanced overbalanced diaphragm 1st stage today and the first of a new generation of diaphragm first stages that offers exceptionally high performance in its class (up to 8000 liters/minute flow at 200 bar), close to the unrivalled overbalanced piston design.

www.Scubapro-Uwatec.com

Hello?

Ocean REEF has some adjustments to their The GSM (Global Submarine Messenger, underwater communcation unit for their Neptune full face masks and others') to make it louder and clearer than ever! The GSM has a new microprocessor that removes "dirty frequencies" such as noise from bubbles, water brushing rocks, boat motors, etc. **www.oceanreefgroup.com**

Clogs...erh.. Crocs

Ever needed some footwear, say on a diveboat, which you could easily slip into, which can get wet without being ruined and has a non-slip sole. Well crocs may be the answer. This model, the Highland, is "closed-top, portless, durable design ideal for cold, wet climates and/or bio- hazardous environments. Ventilated, fashionable and really, really comfortable." **www.crocs.com**

The Inevitable

With steadily more mobile phones being equipped with digital cameras it was just a thing waiting to happen: An underwater housing for cells phones with MMS capabilities. It it is depth-rated to 20 meters and there cases for Nokia, Siemens, Sony-Ericsson and Samsung - and in various colours. Check Wave cases' website for pictures taken this way.

www.wavecase.de

InView goggles

Keep track of your swimming laps with goggles these that displays lap count and time on the inside of the goggle lens, directly in the line of sight of a swimmer. An exiting new project from Katie Williams, an industrial design student at London's Brunel university. No production details yet, but nice thinking. Source: The Engineer Online

Nightvision?

A filter set from Night sea in front of a divelight, and one of these visors is all you need to experience one of the most amazing underwater sights: Corals' flouresence. Filter to fit onto your divelamp (not) shown and visor comes in packages priced at usd 135. Seperate visors cost usd 20 **www.nightsea.com**

Seek and ye shall find

The new UWATEC navigation slate is a real allrounder when it comes to precise underwater navigation. The slate with non-slip handle and pen holder can be used for your notes, directions, reef descriptions or simply your dive plan. But the main attraction is the angled rim that holds up to two different instrument capsules. You can read your notes easily and watch your most essential instruments like a compass and your dive computer at the same time. Fits the Aladin Tec and Aladin Prime, the Digital Bottom Timer as well as the Standard Depth Gauge. **www.scubapro-uwatec.com**

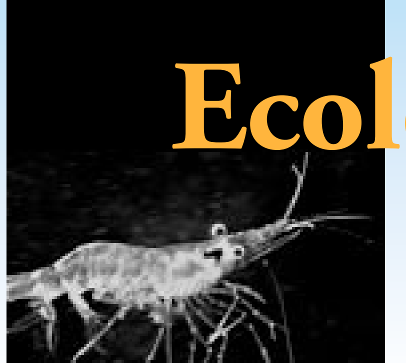
From the inventor of the VR3-computer

The Ouroboros rebreather is a fully closed circuit, rear mounted counterlung unit. Designed as an electronic control unit will full manual override. Advances in CO_2 canister design have been incorporated into the unit. A radial scrubber, the counterlungs and other sensitive parts are all enclosed in a carbon kevlar case. Electronics comes with a primary wrist mounted display, Head-up Display (HUD) a rear facing display and a completely redundant passive oxygen display showing true real time pO_2 independent of the main electronics.

www.ccrb.co.uk

In case of emergency apply ICE

East Anglian Ambulance Service have launched a national "In case of Emergency (ICE)" campaign with the support of Falklands war hero Simon Weston and in association with Vodafone's annual life savers award. The idea is that you store the word " I C E " in your mobile phone address book, and against it enter the number of the person you would want to be contacted "In Case of Emergency". In an emergency situation ambulance and hospital staff will then be able to quickly find out who your next of kin are and be able to contact them. It's so simple that everyone can do it. Please do. Please will you also forward this to everybody in your address book, it won't take too many 'forwards' before everybody will know about this. It really could save your life. For more than one contact name ICE1, ICE2, ICE3 etc

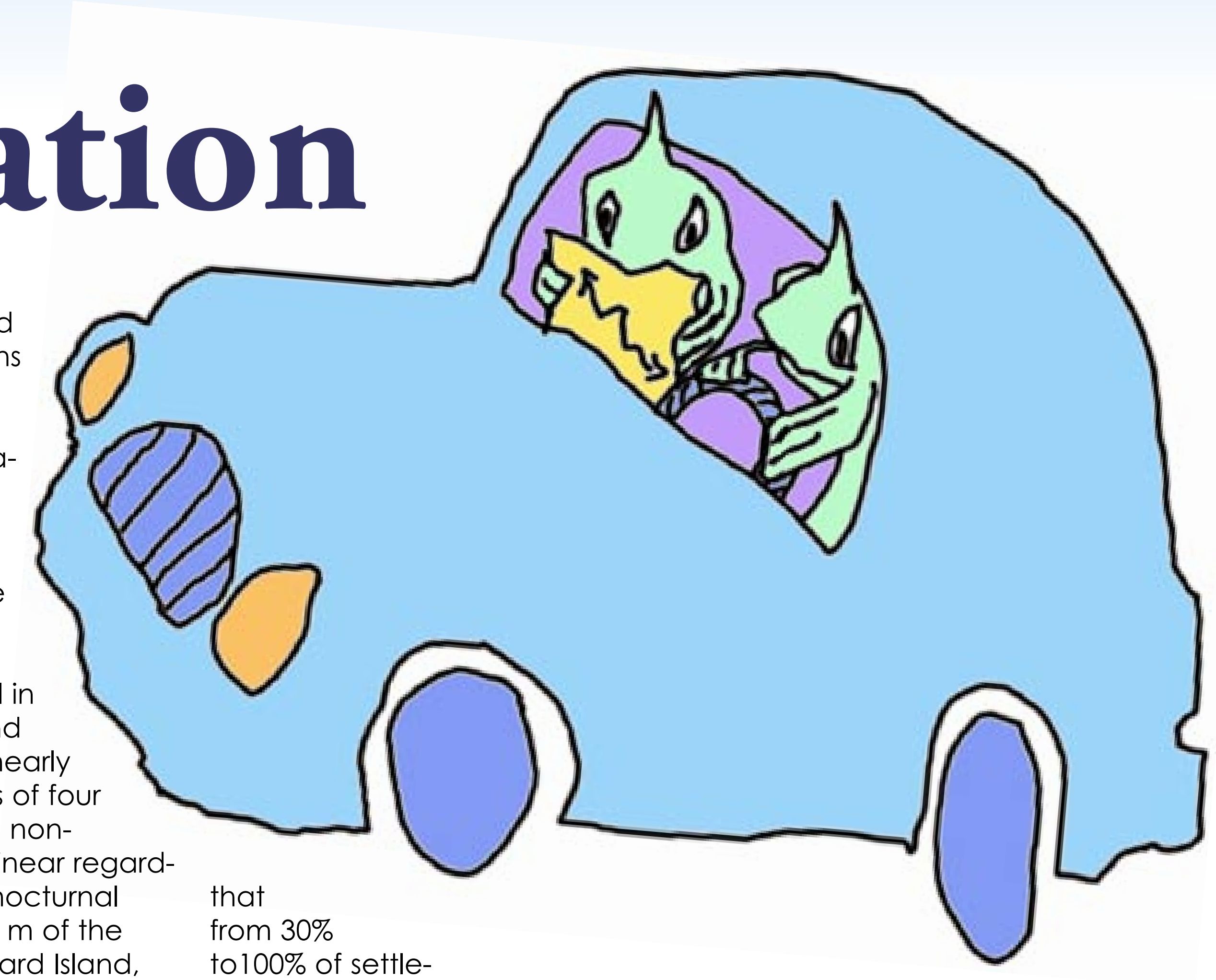


Edited by
Michael Arvedlund, PhD
and Peter Symes

ILLUSTRATIONS BY GUNILD AND PETER SYMES

Coral Reef Fish Larvae

Masters of Navigation



Coral reef fishes have a life cycle that is divided in two. They begin their life after hatching with a pelagic larval phase, lasting from a week up to two months depending on the species, and ends with a benthic phase, when the fish larvae settles to the coral reef one night. For decades the pelagic phase has been a black box to researchers. Only recently has the lid to this black box been opened.

In a recent article in X-RAY MAG, we looked at the astonishing swimming ability reef fish larvae have. However, long distance swimming is of little use without navigation. Orientation is necessary if a pelagic reef fish larva is to find a reef by other than chance, and orientation requires not only cues and the sensory means to detect a coral reef, but also the ability to determine the direction from which the cues originate. Recent research has shown that the swimming behavior of reef fish larvae on the open ocean indicates that they do orientate rather than just cruise about haphazardly. But exactly what cues reef fish may detect and use is not so obvious.

The well-known coral reef fish researcher Dr Jeff Leis, the Australian Museum, have in recent years caught, identified, and then followed released reef fish larvae off shore in many research projects, determining direction and swimming speed of reef fish larvae.

Some reef fish larvae swim away from the reef, out of sight of it, and then return. This behavior implies either a good memory for reef location, or the aptitude to detect a reef tenuously and return to it. For example at Lizard Island, the northeastern Great Barrier Reef, Dr Leis and his research team analyzed the swimming directions of a group of fish larvae of several coral reef fish species, each released individually, and showed that individual swimming patterns of most were not random but significantly towards one particular direction, and that on average, these swimming patterns differed among three locations on different sides of the island, and were offshore at each location. This implied that the fish larvae – all less than a few centimeters - could sense the Lizard Island from over 1 km offshore.

Recent research has shown that the swimming behavior of reef fish larvae on the open ocean indicates that they do orientate rather than just cruise about haphazardly

At an oceanic atoll in the Pacific, Dr Leis and his team found that nearly all swimming patterns of four reef fish species were non-random and usually linear regardless of location. In a nocturnal experiment, within 50 m of the coral reefs, also of Lizard Island, the Australian researchers Dr Stobutzki and Dr Bellwood could show that the majority of fish larvae swam toward the nearest reef indicating they knew the way to the reef.

Settlement

The transition from the pelagic (open water) environment to a reef, i.e. the settlement, is complex. Reef-fish larvae are highly selective about where they settle. Dr Leis and his team also found that from 30% to100% of settlement-competent larvae of a given species may reject a given reef and swim back into open water.

For example, some species will settle only on lagoonal reefs, whereas others reject shallow lagoon reefs, but accept deeper ones. Once over a reef, selectivity about settlement sites can also be great: some species only settle on live coral, whereas others only settle into schools of similarly-sized recent recruited, now juvenile reef fish. So ready-to-settle fish larvae certainly do not simply settle onto the first reef they bump into.

The above research on settlement behaviour was done during the day, and we have no idea how settlement behaviour might differ at night.

The combination of habitat selectivity and swimming abilities means that settlement-competent reef-fish larvae have the potential to actively examine a variety of reefs at scales of tens of kilometers to find a suitable settlement site.

But as Dr Leis expressed the situation for researchers studying the interesting life of reef fish lar-

Larval Navigation

LEFT: Goby larva, *Psilotris batrachodes*, 6 mm. Photo courtesy of Dr Benjamin Victor. **www.coralreeffish.com**

vae, "*matters are yet even more complex*." Behaviour also varies within a species depending on the situation. For example, larvae of a number of species released nearby to reefs swam much slower when approaching the reef than if they swam away from it, and larvae of one damselfish consistently swam faster in open water in an atoll lagoon than in ocean waters surrounding the atoll.

Vertical distribution

Vertical distributions can also differ between locations. For example, fish larvae may swim deeper in the ocean than in an atoll lagoon, or they may swim deeper off the windward than off the leeward side of a reef. We can expect that behaviour differs between night and day and probably at different stages in larvae development. This kind of behavioural flexibility further complicates any attempts to make realistic mathematical model dispersal – models which are very popular among researchers, because they may be an important tool in e.g. coral reef park management and fisheries management. However, it is of course necessary for these models to be based on correct assumptions.

Sensational Senses

But what senses enables minute reef fish larvae to navigate in such astonishing complex ways and over several kilometres? Dr Leis suggests that many possible cues associated with reefs could provide clues for navigation. These include smells and sound which comes from reefs; differences in wind- or wave-induced turbulence; gradients in abundance of fish, plankton, or reef detritus; and differences in temperatures of lagoonal or reef flat water flowing from a reef. In some cases, a magnetic compass or sun compass could help in increasing chances of fish larvae encountering a reef (e.g., a larva in the Coral Sea would increase its chances of encountering one of the reefs on the Great Barrier Reef by swimming to the west), but it seems unlikely either could assist orientation toward a particular reef.

One possible exception is that a magnetic sense could allow a fish larva to detect an oceanic basalt island (or, some volcanic islands on continental plates) on which reefs were growing, because basalt islands have a magnetic anomaly.

Although fish can sense via the lateral line that they are moving through water when they are swimming, unless they have an external reference, such as a view of the bottom, they will be unable to determine that they are being moved by and with the water, as when being carried along with a current. Therefore, currents are potentially detectable using vision near the bottom or near a reef, but it is unlikely that currents or movement by them will be detectable in blue water, i.e. offshore, and thus they are unlikely to be an aid to orientation.

Some of these possibilities seem intrinsically more general and therefore more likely in a evolutionary sense to have been utilized. For example, sound is almost current independent, travels in all directions from the source, and spreads over long distances, so it could be a very general cue.

Smell

In contrast, smells are current dependent, must travel with water movement, and would be of little use "up-current" of any reef. However, where currents are weak, each reef might be surrounded by a diffusion-maintained "halo" of smell that could provide cues that a reef was near, and a similar halo could be established by current reversals such as those caused by tides.

Electromagnetivity

Magnetic anomalies are current independent, and more likely to be associated with reefs on oceanic islands than with continental-shelf reefs. Most reef fish species have wide distributions i.e. they live on a variety of island and shelf habitats, and in a variety of current regimes that differ in their predictability over many scales. In addition, changes in sea level over time can result in radical changes in reef systems and associated currents. Therefore, it seems likely that any cues to which reef fish larvae have become adapted to use in finding reefs would be general ones, useful over much or all of the range of the species.

However all these predictions based on theoretical arguments should be treated with caution until they can be tested with reef fish larvae. Reef fish researchers have been misled by similar theory-based predictions in the past.

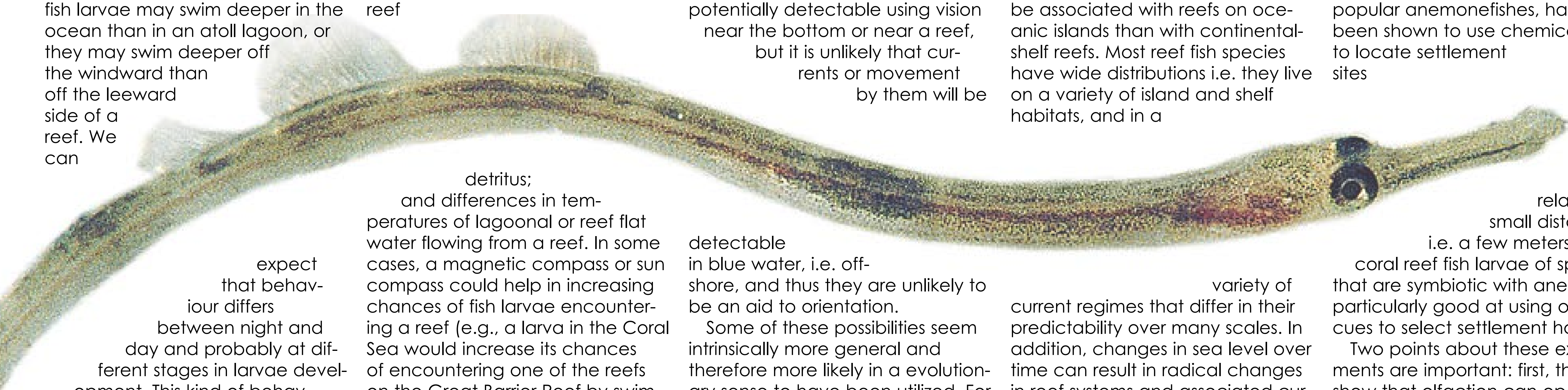
Owing to Oders

Olfaction has the potential to operate over larger scales, as has been known with salmons for many years. If odors are carried by currents and structured by fronts between water masses, olfaction operating at a small scale could result in orientation over larger scales.

This may also be the case with temperature differences. Damselfishes, among them the popular anemonefishes, have been shown to use chemical cues to locate settlement sites over relatively small distances, i.e. a few meters. Are coral reef fish larvae of species that are symbiotic with anemones particularly good at using olfactory cues to select settlement habitat?

Two points about these experiments are important: first, they show that olfaction can operate over scales of up to a few tens of meters - perhaps even much longer distances; second, they were done over the reef habitat.

We do not know yet if olfaction can be used in the pelagic environment in the find reefs. Olfaction is clearly important in the location of specialized habitats such as anemones or corals, and in the location of conspecifics all over



INSET: Juvenile pipefish. Photo: Peter Symes

Larval Navigation

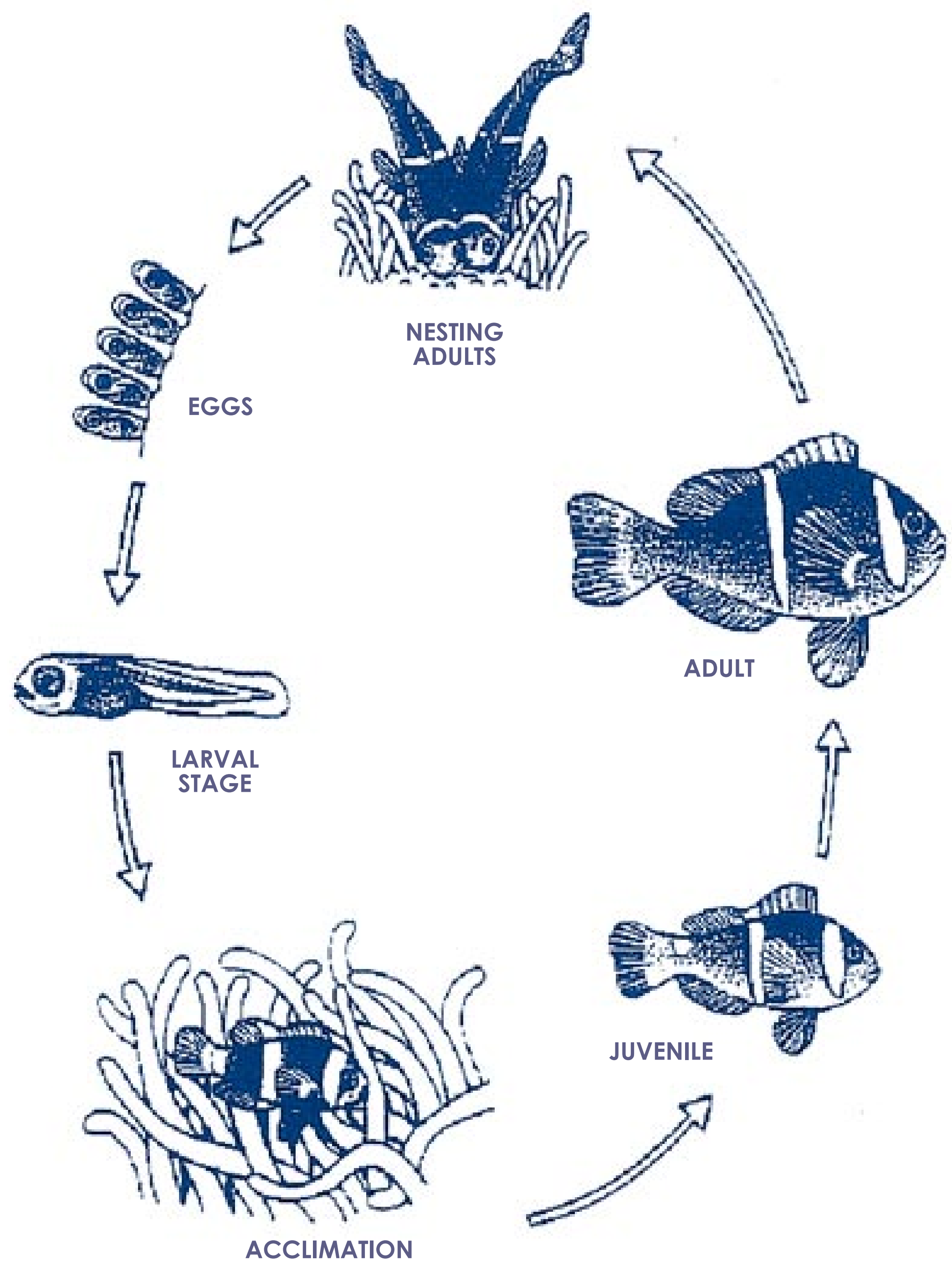


ILLUSTRATION COURTESY OF FAUTIN AND ALLEN 1997

Figure 1. Coral reef fish life cycle, exemplified by an anemonefish

small scales within reef habitats.

Use of olfaction for orientation by other than a few species of pomacentrids, or over larger scales, or in the pelagic environment, is a real possibility given the results to date, but this has not yet been demonstrated by reef fish researchers.

Sound

Reefs are noisy places and sound has the potential to provide orientation cues over a wide range of scales. The lateral line is sensitive to water movement, but is capable of detecting this over only small distances, on the order of 1–3 body lengths. Vision is used by many reef fish larvae on short distances, i.e. less than 50 m and even at night in dim light. A magnetic sense could potentially operate over a variety of scales, from very large (oceanic), as has been shown is the fact for some species of tunas and salmon, to relatively small (local), as shown in hammerhead sharks. It is likely that different cues are used at different scales even by a single individual: a possible scenario is use of sound to locate the reef, vision and the lateral line to avoid predators near the reef, smell to locate the settlement habitat, and vision to locate the settlement site in the habitat.

Sound has proven one to be a cue used by some reef fish larvae. By playing bio sounds from the reef, i.e. sounds from snapping shrimps, fish grazing and fish making sounds with the swim bladder, from underwater speakers next to light traps, which are known to attract many reef fish larvae, and then compare with light traps without bio sounds, Dr Leis and several other researchers have shown that reef bio sounds provide useable cues for settlement-stage larvae searching for settlement sites.

Conclusion

As with the olfactory cues, many details remain to be determined, including when in the development the ability to hear and use sound for navigation develops, and what sounds (frequencies and intensities) larvae can hear and use, and over what scales. It is, however, clear that sound and chemical cues can be an important orientation and navigation cue for larval reef fishes in both temperate and coral-reef environments.

Summed up, aside from olfaction, hearing, and vision, none of all these cues mentioned has yet been shown to be used by reef fish larvae for orientation, and even with these, the use has been at either relatively small or unknown scales. However, based on our current knowledge of the very complex biology of reef fish larvae, researchers are looking forward to conduct many more experiments with these fascinating creatures. It is certain that they have yet many more surprises waiting for us. It is a research area only in its very beginning.

Literature

This text has mainly been based on: Leis, J.M. & McCormick, M.I. 2002. The biology, behavior, and ecology of the pelagic larval stage of coral reef fishes. In: Coral reef fishes. Dynamics and diversity in a complex ecosystem (ed. P.F. Sale) San Diego & London: Academic Press p 171–199.

Figure one is from Fautin, D.G. & Allen, G.R., 1997. Field guide to anemonefishes and their host sea anemones. 2nd edn. Perth, Australia: Western Australian Museum. A free electronic version is available from this website: **http://biodiversity.uno.edu/ebooks/intro.html** ■

RIGHT: Albacore larva, *Thunnus albacares*, 5.2 mm. Photo courtesy of Dr Benjamin Victor. **www.coralreeffish.com** manufacturer

Text and photos by Andrey Bizyukin, PhD
and Svetlana Murashkina, PhD

The Cressi Empire

Brilliant quality built with pride under the Cressi logo—top fins made in Italy

Portofino, Italy, the Cressi-sub motherland

Cressi-sub sets itself apart by being a company that is entirely controlled by one Italian family, the Cressi family. Since it was founded, to the present day, it has been built on a principle of not basing business on bank loans but on family money alone.

Great diver of the world,
Mr. Antonio Cressi, owner

The classical philosophy of Italian diving

The huge mountain valley, the majestic bridges, the many cars and motorcycles, and people rushing to work are all first impressions of the industrial zone of Genoa. Here, we find the headquarters of the Cressi empire and their factory.

The Cressi trademark draws attention from afar, and the enormous building, located directly in the foothills, is impressive, with its hundreds of square meters of industrial workshops and many huge warehouses, nine meters high, well stocked with various sorts of techno polymers and boxes with finished products. In a three work shift cycle, the plant is kept in continuous operation around the clock producing, among other items, more than a million masks, making the Italian brand one of the most popular in the world, supplying snorkels for scuba divers and a hundred thousand of the most well-known models of Cressi fins.

The plant

The plant is virtually fully automated. Along the conveyor belt, robots seem to do everything. Computers are everywhere. Fins and masks are seen on the screens. The staff on duty have only to enter into the computer the type, the sizes and the colours of fins, masks or snorkels, to start the manufacturing process by simply pressing *Enter* on the keyboard.

We see how smart machines, not unlike giant vacuum cleaners, soak up polymer granules, which are heated up and melted into a liquid that is then filled into a pressing form. After cooling, the mould opens, and a robot moves the component onto the conveyor belt bringing it to the next process.

Every fin from Cressi-sub consists of three components, and consequently, it passes three sites on the conveyor belt. Thee-component fins have better characteristics and are more effective and durable than simpler and cheaper models.

The Cressi fins have variable elasticity depending on the direction and force applied to the blade. Underwater, it becomes visibly clear that Cressi's fins are strong, elastic and have a powerful spring action. They are easy to use, even in strong currents, making them a real pleasure to wear. Snorkels and masks are manufactured in a similar manner. Pure liquid silicone (clear or black colour) is injected into a special mask mould under high pressure.

Every accessory for fins, snorkels and masks such as fasteners, straps, holders, glasses and other little items are also made here at this plant.

The most expensive components of this method of manufacture are the moulds of which there are several types and colours for the fins, masks, and snorkels respectively. The quality, smoothness and functional characteristics of the items all depend on the quality of the mould. Therefore the creation of each mould from design to a finished model that it is good enough for production can easily run into the tens of thousands of dollars. This is an area where Cressi-sub excels.

The company has put huge capital investments, millions, into the manufacture and develop-

The Cressi-sub empire building

manufacturer

RIGHT TO LEFT: Cressi rebreather; World famous Cressi-sub wetsuit designer Marino Bernardino—Cressi's "Armani"—with two Russians admirers; Mr. Antonio Cressi prepares for a test dive with new equipment designs

Cressi-sub

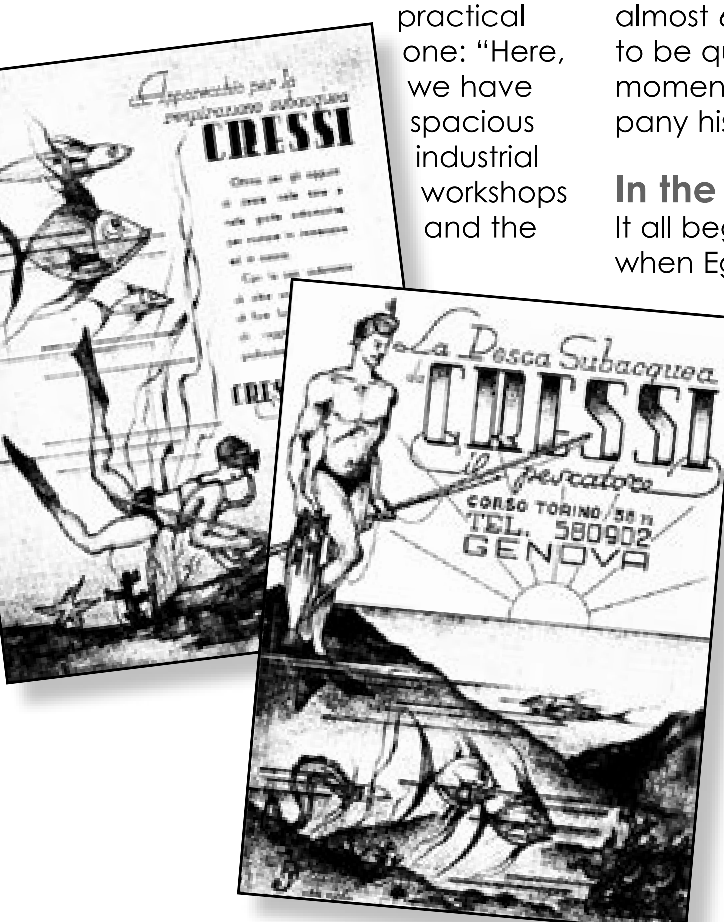
ment of the top quality diving equipment. They take pride in being an entirely Italian manufacture and, as a symbol of quality and reliability, all Cressi-sub products come with a lifetime warranty.

Cressi-sub has become the legislator for diving fashion

Cressi history

Many of the old manufacturers have a company museum, but when you ask the question why Cressi doesn't have one, the employees just shrug their shoulders. Their stance seems to be a practical one: "Here, we have spacious industrial workshops and the research laboratories are crammed with smart technology, the warehouses are full of raw materials and finished goods; offices with employees and a showroom with new product samples—in essence, everything that the strict laws of the effective manufacture require. But a museum, on the contrary, is just nostalgia and poetry that does not increase production speed."

However, all the employees, from the bottom up, feel like they belong to one big Cressi family and take pride in the fact that the company has already existed for almost 60 years. Everyone seems to be quite familiar with the key moments of the family and company history.



In the beginning

It all began as far back as 1940, when Egidio Cressi developed, in his home, the first mask, called Sirena. Then in the following years, from 1941-1945, the two Cressi brothers, Egidio, who was the diver of the pair, and Nanni, who was the business representative (and the father of today's "boss", Antonio Leopoldo Cressi) began the production of underwater equipment in their home.

In 1946, the business extended into the establishment of the company Il Pescatore Subacqueo Cressi, later to be renamed Cressi-sub Spa. It is a little known fact that in 1947, the company created their first rebreather called ARO 47.

For some reason this and some of the other activities in the postwar years seem to be kept a family secret, although the developments of rebreathers apparently continued. The ARO 57B was later introduced in 1956. Also in 1947, we saw the first full face masks, the Medusa G1 and G2, with integrated snorkels. The next significant step came in 1951 when the first modern fin, the Rondine, came to light. It was the first fin with an inclined blade and an open footpocket.

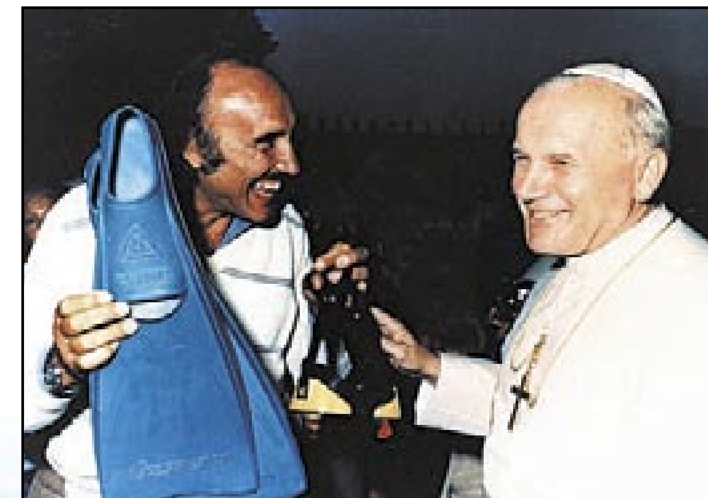
At that time, the project manager at Cressi was Luigi Ferraro, who later went on to found Techni-sub, another one of the big old dive equipment manufacturers. Also, at this same time, a former officer in the Austrian army, Ludwig Mares, came to the Rapallo to open a little shop, and later to found the Mares company.

In 1953, the first mask with optical lenses and a nose within the skirt was introduced. This was the Pinocchio, which is still in production today in more modernized forms.

In the middle of the 1960's, the company created their first regulator and then decided to go into the creation and production of a full line of diving equipment including masks, fins, snorkels, neoprene suits, regulators, rebreathers, cylinders, knifes, spear guns, harpoons and torches.

For the first time, a diver had the choice and the opportunity

Mr. Francesco Odero, manager



INSET: Cressi-sub meets the Pope. ABOVE: The Mediterranean sea is full of beautiful bays that make attractive places for holidays and pleasure diving

Mr. Luca Falco, manager, demonstrates the top quality of the Cressi-sub fins

Cressi-sub

to be equipped totally with Cressi-sub equipment from top to toe. And as time has later shown, this was a good idea. In 1970, Cressi also made a splash when they marketed, as one of the first, a BCD that had an inflator hose connected to the first stage.

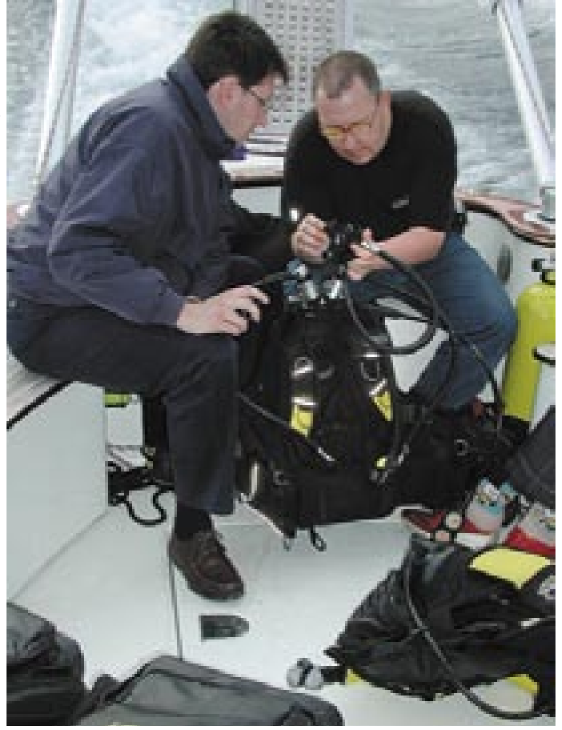
Cressi's history can be characterized as one of creative work, new ideas and experiments all aimed at the development and popularization of scuba diving. Persistence, enthusiasm, belief in correctness and passionate desire to make the world's best diving equipment have occupied the minds of the Cressi family throughout their company history.

Cressi-sub today

The many current successes of the company can be attributed mainly to one person, Mr. Antonio Cressi, who has headed the company for two decades. Mastering all the stages of manufacturing, logistics, sales and business management, he can be said to have graduated from the manufacturing floor. He is not hiding in a fancy office either, as a business executive would often do, but leads, as an expert, where all the action is.

In the early morning, it is possible to meet him practically in any of the production "hot" spots: at the conveyor-belt, in a warehouse, at the workshop where the suits are manufactured, in the shipping department or at orders and deliveries.

Without any much ado, he warmly greets the employees as he makes his rounds of the factory, dynamically solving questions and giving necessary instructions on the fly. The factory now has 16,000 square meters covered with sophisticated robotic production systems, and their highly specialized R&D department is equipped with the latest computers and testing equipment.



Dive writer, Andrey Bizyukin, checks out the new Cressi regulator construction before the first check dive

Nonetheless, like his father before, Antonio believes that any new product, even if designed by today's computers, must pass the test of extensive use in the sea before it qualifies to carry the name of which he is so proud. "Do not drop the majestic name of Cressi," is the motto and philosophy of the company.

Today the company is recognized as one of the global leaders in dive equipment design from masks, fins and snorkels to suits. Cressi-sub has also just opened a completely new venue in the production of dive masks. Only safe non-allergenic silicone is used. It is profoundly changing the quality of sealing, new shapes of masks, glasses, frames and even the snorkel-holders.

The use of new technologies has allowed Cressi to combine three types of materials in one product and to make new composite types of fins, which among other things are about 30 % lighter, than the competitor's models, yet they pack a powerful stroke and offer less resistance in the water. Cressi fins are created especially for the ocean, for diving and swimming in currents with less fatigue. They do indeed stand out with their ideal shapes, magnificent design, surfaces as smooth as mirrors, faultless quality and a lifetime guarantee. These are the fins of the new century, and they are technological marvels.

No right to make mistakes

Cressi-sub, being one of the world's largest private dive equipment manufacturers, also has a high influence on diving fashion. But how are decisions made as regards to which models and what equipment will appear on

Cressi-sub masks and regulators on the conveyor belt

the diving market? What are the secrets behind Cressi's successes?

Luca Falko, from Cressi's export department explains:

"Cressi is a family business, and if our company is going to start production of some new dive equipment, we want to be absolutely sure that we get a positive result. We should be certain that our innovations will be well received by divers, and here again, quality equipment should be irreproachable, it should have great looks and faultless long-term quality. A private company, such as Cressi-sub, does not have any right to make mistakes. New samples of equipment are tested thoroughly, sometimes for months or even years. All products, regardless of being tested rigorously by machines or on special equipment, will also be tested personally by the boss. Mr. Antonio Cressi wants to be absolutely sure that the quality, reliability, convenience, stylishness and operation of the equipment are flawless for all types of diving.

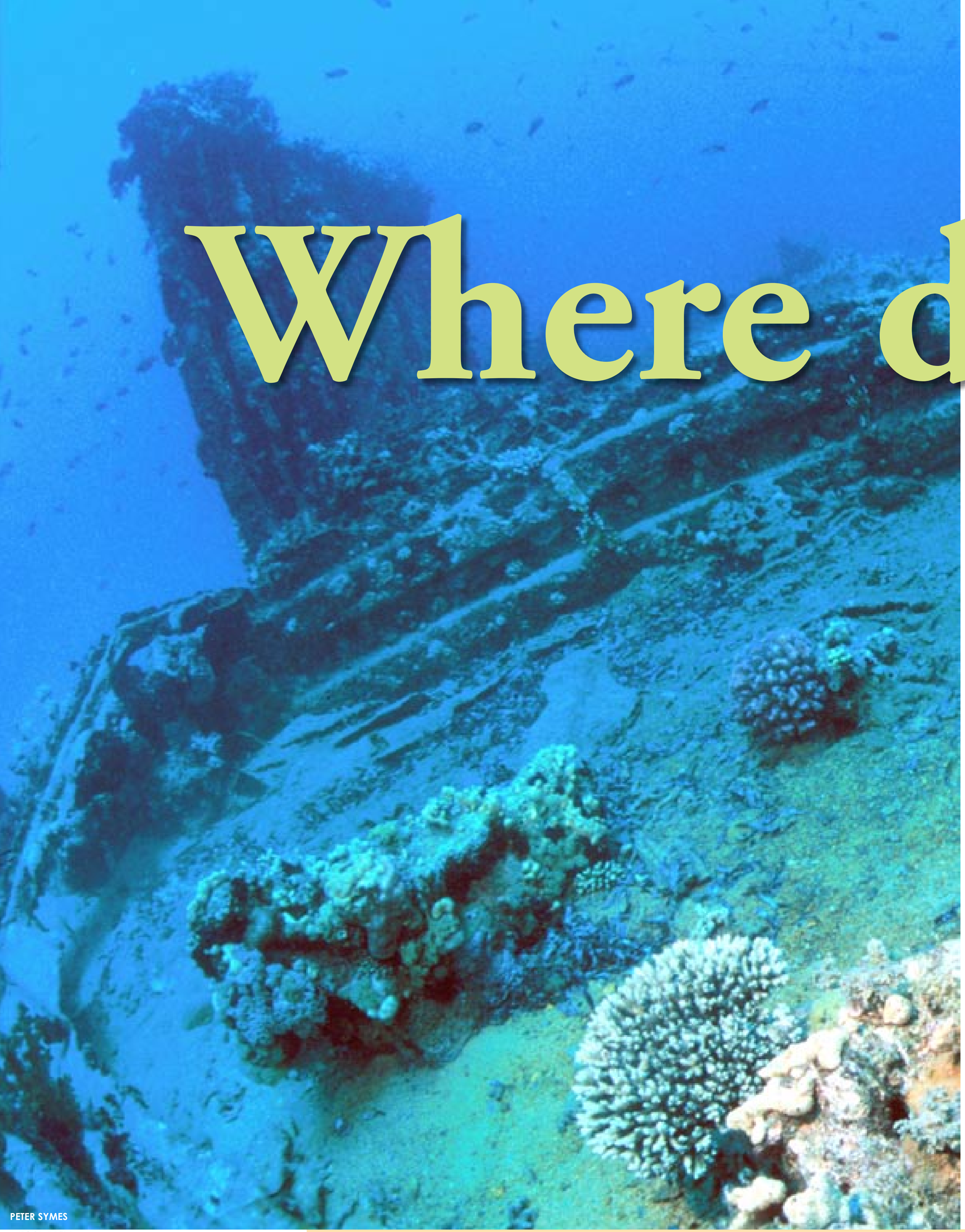
"The next very important aspect of our philosophy has to do with the opinion and responses to the use of our equipment by world famous people. So, Hollywood stars Chuck Norris and Pierce Brosnan, dive with Cressi-sub. National Geographic teams use Cressi-sub equipment in their projects. Free diving world champions, Umberto Pelizzari and Deborah Andollo, have all chosen Cressi-sub. This also contributes to the basis of the family business, which is determining the success for our company."

Future Cressi

Millions of people in the world go to the seaside for recreation. Consequently a mask, fins and a snorkel are already an integral part of equipment for many a holidaymaker. Diving with a complete set of ABC equipment is the first step into the underwater world and a way to introduce the wider audience to scuba diving. And here, Cressi-sub is an undisputed global market leader. As the number of holidaymakers and active divers worldwide seem to grow from year to year, Cressi's future seems to be quite bright.

For more information, please visit:
www.cressi-sub.it ■

ALL PHOTOS THIS PAGE: Scenes from the Cressi-sub manufacturing plant



Where did she go?

The Quest for the Yolanda Wreck

Text by Mark Andrews
Dive photos by Valentina Cuchiera
Archival photos of *Yolanda* wreck supplied by Leigh Cunningham
File photos of Yolanda reef by Peter Symes

I was on a deco stop in the cold waters of the national dive centre in the UK when my thoughts turned to diving the warmer waters of the Red Sea and particularly the wreck of the *Yolanda*, or should I say, to the question of where the wreck of the *Yolanda* came to rest.

That same evening, I e-mailed my deep diving buddy, Leigh Cunningham in Sharm-El-Sheikh, and suggested we searched for the wreck of the *Yolanda*. He immediately responded with a "cool-cool," his usual reply to something that sounds like a good idea.

The search was planned for the week of May 21st, and while I undertook some deep, dark and cold warm-up dives here in the UK, Leigh was busy down in Sharm planning the logistics for the week. The Red Sea is not short of highly skilled technical divers wanting to be involved in such a project and as such a multinational team was quickly put together.

Mark Andrews, the author (right) with buddy Leigh Cunningham, our technical diving columnist

Yolanda reef is a very well known dive location in Egypt's famous Ras Muhammad national park, which is at the very tip of the Sinai peninsula, and not far from Sharm el Sheikh.

For most holiday divers this spot is virtually unforgettable due the fact that a ship's cargo (the *Yolanda's*) of sanitary porcelain, most notably toilets, have been spilt and strewn across the shallows between some coral heads where they sit as somewhat grotesque and misplaced sculptures—an odd sight, but nonetheless, a quite amusing one.

The *Yolanda* herself was a Cypriot cargo vessel of 75m in length and is believed to have had engine trouble resulting in her being forced upon the reef at Ras Mohamed on the first of April 1980. She rolled onto her port side with her stern resting in 25m. It seems that she has been regularly visited by divers until sometime in 1985 when she, following a storm,

LEFT: The *Yolanda* wreck as it once was before it slipped off the edge of the cliff

Yolanda

LEFT: Glorious sunsets can be enjoyed on the Red Sea
RIGHT: One of the infamous porcelain artifacts found on the *Yolanda*

slid off the reef and down into the abyss never to be seen again.

The plan

The plan for the weeks of diving was to spend the first two days preparing the equipment and generally getting comfortable at depth with the dive rigs.

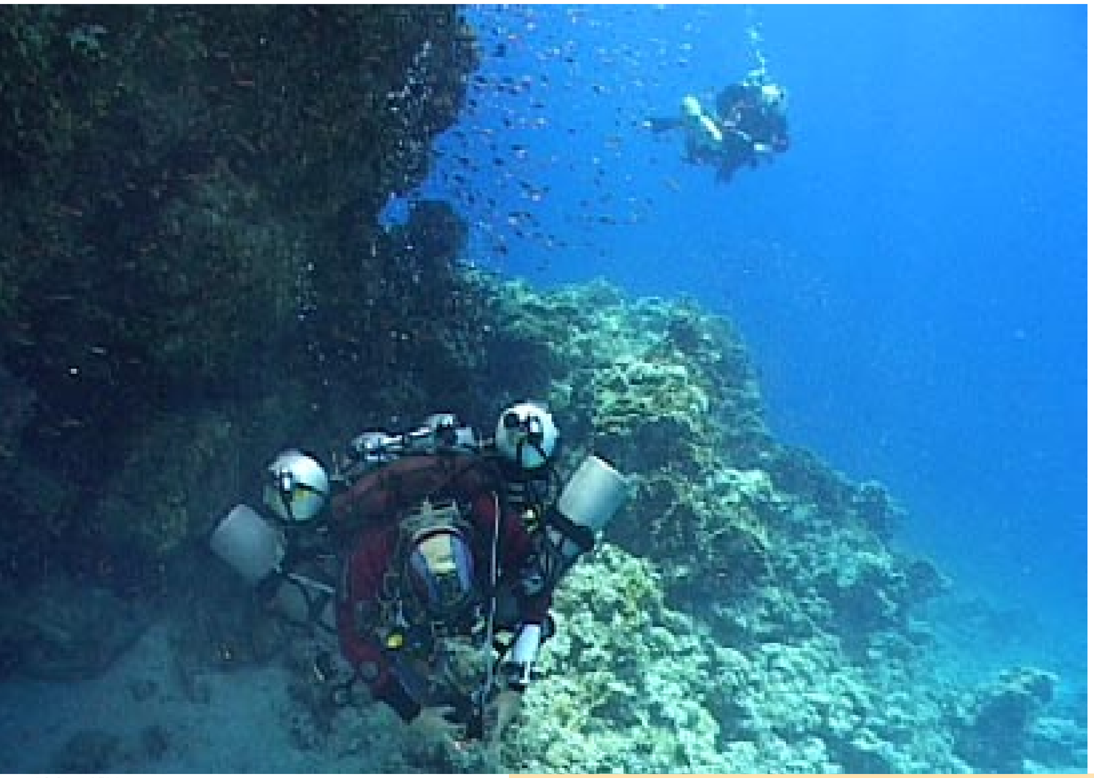
On Sunday, the 22nd, both Leigh and I made up our dive rigs. Leigh's rig was a 12L twin set with a single 12L strapped to either side of the twins. Added to this were a further two 12L tanks carried as stage cylinders making up his familiar six-tank rig. My own dive rig consisted of a 12L triple set and two 12L stage tanks—a dive rig that I often use in UK waters.

Our main problem with these large dive rigs is that the profile they offer in the water results in a need for substantial amounts of lead both in order to enable us to leave the surface in the first place, and, more importantly—due to the positive buoyancy of an empty alloy cylinders—to enable us to remain at our shallow decompression stops without being dragged towards the surface.

Once we were weighted correctly, we made an 80m check dive at a local dive site, Ras Katy. The dive went perfectly, and we were both happy with the dive rigs and the weight. Monday the 23rd saw the team at another local dive site, Far Garden.

This time we planned to go a little deeper, and we were both shocked to discover a wall at a depth of 100m. As we swam along the edge, we looked at each other with a knowing thought that the other was also wanting desperately to go over the edge and check it out! However, at this stage, we both simultaneously gave the up signal and reluctantly headed back up the slope toward the reef wall.

Once on the boat, we couldn't get our gear off quickly enough to begin talking about the drop off and how it must be a dive for the future.



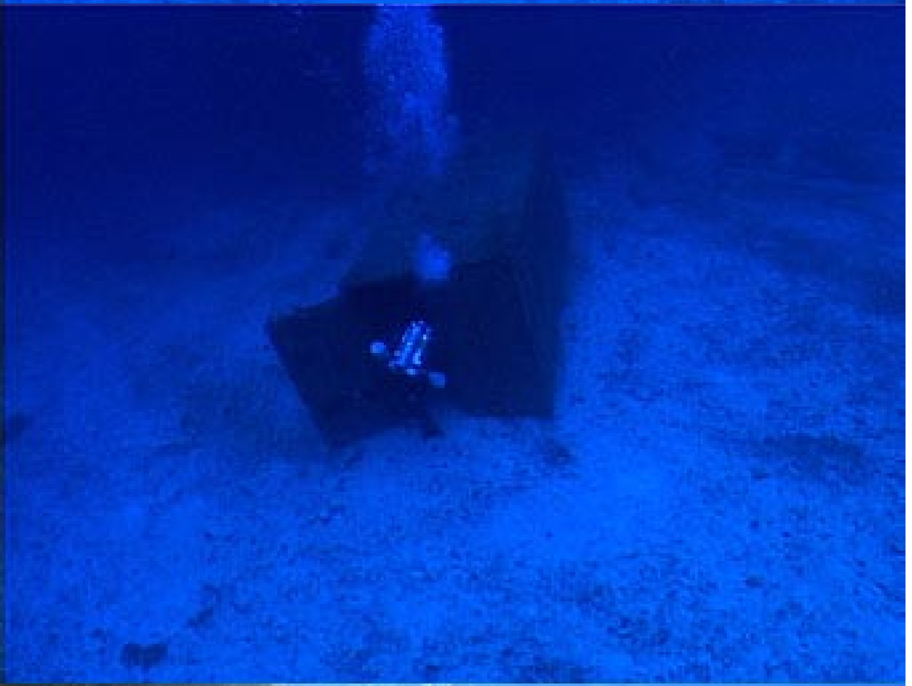
Check dive at Ras Katy. Leigh Cunningham in front with his typical six-tank configuration. Mark Andrews follows in back

Tuesday 24th saw us out at Yolanda reef, the site of our goal. Yolanda reef is a very busy dive site with many hundreds of recreational divers spilling from dozens of day boats all over the reef like a swarm of bees to a honey pot. We stationed the *Colona* dive boat away from the crowds and the ever present long swell to kit up in comfort. We decided to hit the water around 12:00 pm, which is when most of the recreational divers return to their day boats for lunch.

Leigh and I would each be accompanied by two safety divers and a videographer, who in turn each have their own safety diver. Getting everyone ready for such a dive can be a logistical nightmare and is the sole responsibility of the dive co-ordinator. In our case, we were fortunate to have Doozer, a well seasoned and experienced organiser of deep dives as well as an accomplished deep diver himself.

The preparation for the dive was run with military precision, as on this dive site we did not have the luxury of a mooring and had to rely on all the support divers to be ready to jump on the given signal by the skipper, Yassir, who skilfully manoeuvered the *Colona* boat into position some 100m away from the reef to assure us a deep water drop. The count down began, and each team made their way to the back of the boat where Leigh sat on the dive platform in full kit, exposed to the scorching sun in his O'three dry suit. As I am a lot more susceptible to the heat, I positioned myself just behind him, also fully kitted up in a drysuit and swamped with dive tanks.

Skipper Yassir works his magic as he expertly maneouvers the dive boat to the perfect entry and exit points for the dive team



Yolanda

RIGHT TOP TO BOTTOM: Leigh Cunningham checks out a second container; large gargonians decorate the wreckage; Leigh and Mark meet

Yassir, the skipper, sounded the horn, which was the signal to jump, and the back of the dive boat erupted into action with heavily equipped divers entering the water on Doozer's signal.

Leigh and I followed shortly and were immediately met by our support team who proceeded to make the all-important bubble check on our dive rigs. Once completed, Leigh and I gave the descend signal and vented the air from our wings. We slowly slipped into the silent liquid world. We both feel more at home here than in the noisy hustle and bustle on dry land.

The sea was warm and clear as we descended into the dark blue waters past shoals of inquisitive fish. We descended roughly 30m apart and occasionally gave each other the okay signal to show that all was well. As I looked down from 40m, I could see the wall in front of me some 50m away and a sandy bottom in the depths below.

The bottom came rushing up towards me at 50m per minute and we slowly pulsed air into the wings to bring ourselves to a halt just short of the bottom.

> *The condition that she was found in was surprising to us all and definitely warranted further investigation*

The Wreck

As I turned, I immediately saw a large intact ship's container. I couldn't believe that we had dropped directly onto the wreckage, and as I looked further down the slope I began to see more and more wreckage.

Leigh headed off to the left of the container, while I swam inside to take a look. This first container was at a depth of 73m and was completely intact with one door open but empty of all cargo.

I exited the container to find Leigh some distance down the slope in deeper water, so I decided to head off to the right and explore a separate area. I quickly came across a large scour in the seabed heading off into the dark area below me. I came across a further container this time, broken up at 86m and surrounded by wreckage of various shapes and sizes.

Ascent

I ascended slowly up the sandy slope and met one of my safety divers and gave him the okay signal that all was well with me.

As I ascended, I was also met by one of the videographers. We came across a very large Danforth anchor at 63m and a hospital stretcher at 55m along with some very large batteries.

After completing the majority of the decompression schedule, I bumped into Leigh and his safety divers at 15m on the reef wall where we compared our dive slates.

Leigh had been to 100m but slightly to the left of where I dived. He had come across a large metal plate with a rope attached that ascended to who knows how far, but not much else in the way of wreckage. He had, however, seen a further drop off which began at 110m and quickly dropped away at almost a 45 degree angle.

We completed our decompression stops around the remainder of *Yolanda's* cargo, which most Red Sea divers have visited at some time. It consists of toilets, wash basins and bath tubs scattered along the reef amongst parts of the ship's superstructure.

The decompression was complete after 90 minutes, and both Leigh and myself surfaced with our respective safety divers. Yassir, the skipper of the *Colona* dive boat, again masterfully manoeuvered the large dive boat stern towards us for an effortless pick up.

The safety teams, well-versed in removing our large dive rigs in the water, handed up our rigs piece by piece to the ever ready boat crew and surface support team.

The post dive de-brief was full of excitement and amazement of just how much wreckage there was down there. Each team member gave an account of the items they saw and the depths they recorded. We were very quickly able to draw a rough map of

LEFT TOP TO BOTTOM: Mark Andrews checks out an intact container; looking inside; on the way down

Yolanda

wreck debris. From this rendering, an obvious path of the main wreck soon emerged.

Wednesday 25th saw the team return to the site of the wreckage minus myself who was now laid up in bed with stomach cramps from the local Egyptian cuisine.

While I spent the day backside on the toilet and head in the sink the dive team was busy preparing for another adventure.

Leigh decided to make a dive to 115m and follow the deep scour in the seabed.

Grim reminder

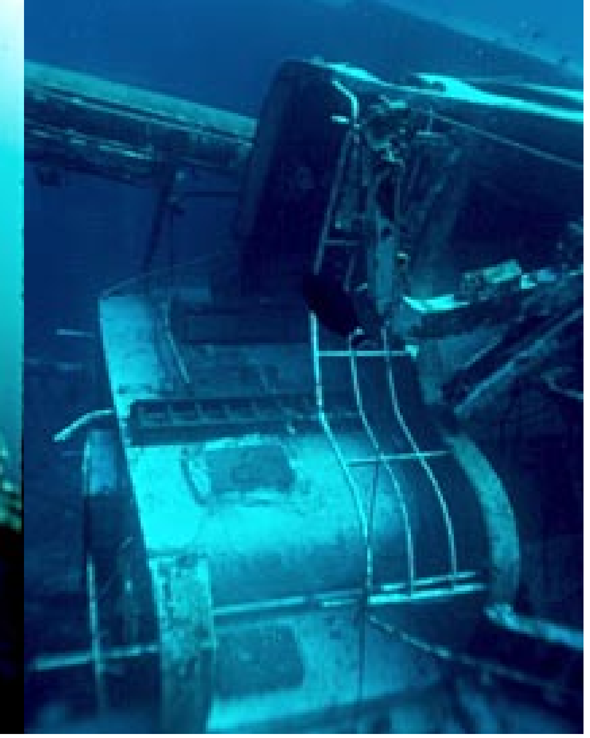
As Leigh descended, he noticed that he had dropped too far to the right of the scour, and as such, needed to make a substantial effort to swim his large dive rig in the direction of the wreckage.

Approaching his bottom time, he found himself at target depth looking over a steep slope. Leigh stared hard into the darkness below willing his eyes to make out some form of recognisable shape, but what appeared below, although recognisable, was definitely not a ship wreck. As Leigh's eyes focused on the object 20-30m below him, the shape of a human figure emerged.

The body of a diver lying on the sandy bottom at a depth of around 130m was a stark reminder of what can happen when things go wrong.

Leigh's ascent and decompression time passed by without incident, accompanied by the usual entertainment provided by the local dive guides who were herding customers along the reef edge like sheep.

Thursday 26th After spending 28 hours in bed, I returned to the dive boat. I was unable to dive, but I would rather be ill and with company than



spend another day staring at the green walls in my hotel room. This was to be the first mix dive of the project with a planned depth of 150m.

The problem here would be hitting the depth within the planned run time. All the dives are being made as free descent and ascent. No shot line is used due to the fact that we do not know where the wreck rests and have no access to echo sounders. Besides, this part of Ras Mohamed is also one of the busiest dive sites in the area, and as such, shot lines and large buoys are not a viable option.

We rely entirely on the information gathered from previous dives to determine the drop site and the skill of the skipper to place us right on the mark.

Bull's eye

Once Leigh and the team were ready, the boat positioned and the horn sounded, the divers hit the water at 11:00 am. Leigh descended into the blue.

He found himself descending too far to the right of the scour and decided to head out into the blue before hitting the slope, this would be the only way to assure obtaining the depth required. Concentrating on swimming, he took in very little of the surrounding sea bed. Then, he reached 150m with 1 minute to spare on his run time.

Focusing his eyes to the dimmed ambient light, he scanned the sea bed below for any signs of wreckage but could see nothing until he turned to his right and noticed a crack in the sea bed with two different levels. Thinking this was bizarre, Leigh took a closer look and noticed a number of metal protrusions emerging from the sand. The more he looked, the more it became obvious that this was in fact the wreck of the *Yolanda*.

Time to go had come around all too soon, and Leigh had to start his 103 minute ascent to the surface looking on the way back for any signs of the body sighted on the previous day's dive, but it was no longer there. The decompression schedule went without complication, and he emerged safely from the water with the good news that the *Yolanda* was truly re-discovered.

An amazing facility

That evening, the team met up at Rawasett to undertake the important task of gas blending for the following day. The facility provided for the project was Mix unlimited run by Chad Clark. It is the most amazing gas blending facility I have ever laid eyes on. It consists of two membrane compressors

ALL PHOTOS THIS PAGE: Views of the *Yolanda* wreck as she lies in her new resting place on the ocean floor

GUNILD PAK SYMES

ABOVE: A white ibis stealthily crosses the beach at the Red Sea
INSET: Aerial view of Ras Muhammed, Red Sea, Egypt

Yolanda

pumping out a constant flow of Nitrox 32 and four air compressors. Also contained in this one unit is a Trimix blending panel along with Haskell booster pumps. The crème de la crème comes in the form of a military specification oxygen generator that can turn normal air into oxygen.

With the blending complete, the team headed off for a good night's sleep to be ready for the next day's dive, which was planned for a depth of 160m. I, on the other hand, ended up at the doctor's office and was diagnosed with severe gastro-enteritis. What a week of torture I was having, listening to Leigh talk about the wreck brimming with excitement and all the time looking at my dive rig bone dry on the back of the deck.

Safety first

Friday 27th, the team assembled on the *Colona* dive boat as usual and started assembling dive kits. The boat motored out toward Yolanda reef on a calm blue sea. The excitement mounted as the reef drew nearer.

EGYPT SIS

As Leigh prepared to enter the water, the search and rescue team boat (SAR) appeared on scene to provide medical safety cover and fast evacuation in case of an emergency. This was backed up with doctors Adell and Ahmed back at Travco in the Chamber facility.

We had provided them with a copy of the gasses used and the dive plan so as to be sure, in the case of an emergency, the appropriate treatment would be administered quickly. Nothing on this project, or any of the other deep dives we undertake, are left to chance.

Leigh entered the water shortly after his safety divers, and it was instantly apparent that a strong current existed along the reef. Leigh made an instant decision and began his descent. His safety team followed in hot pursuit and positioned themselves at their predetermined depths to wait for his return.

As he descended, Leigh could see that this was a better drop than the previous one and descended straight into 130m of water. After getting his bearings, he swam down and along the reef at a depth of 160m. Slowly, the wreck came into view and he was able to settle on the wreckage and take a good look around.

Mark Andrews and Leigh Cunningham meet to make air and equipment checks

Wreck check

The wreck itself is almost completely buried in the sand with very little remaining above the sea bed except some of the twisted superstructure and, off to the left, the crows nest. Below, on the slope, lies scattered poles similar to those we had seen in the shallow water whilst decompressing.

The visibility was almost infinite and the ambient light enough not to require a dive light. Leigh looked up the slope and could easily see the ship's path down to her deep-water resting place. He could see the outline of the deepest container at 86m—some 74m shallower!

The time to leave came around all too soon. The12 minute leave time and a push on the wing inflator saw the beginning of the ascent and almost 2 hours of decompression.

Bang on time, the surface support team spotted the DSMB (Delayed Surface Marker Buoy , ed.) on the surface, but out in the blue and not on the reef as expected. Due to the strong current, Leigh had been unable to reach the reef wall and was forced to make a blue water ascent.

The next shift of safety divers were already kitted up on the back of the boat when the DSMB surfaced and were dropped right on top descending down to spend the rest of the decompression time with him should he want for anything like spare gas.

The decompression went without a hitch and two hours after entering the water, he surfaced with the safety divers and film crew to be met by the SAR team to make sure all was well before they departed back to their base quarters.

On deck, we drew out the new information on to our rough sketch and discussed the next phase of the project.

The next step

We will be returning to the *Yolanda* in August to film her stern to bow and survey the wreck to try and capture her demise as best we can. The condition that she was found in was surprising to us all and definitely warrants further investigation. ■

The cast and crew of the *Yolanda* wreck project aboard the *Colona* dive boat

DUE CREDIT

The *Yolanda* wreck project was a complete success due to the team effort and the professional way it was run. It had the full support of the SAR team and the doctors at the Sharm chamber facility. We thank you all and look forward to the next chapter.

DEEP DIVERS

Mark Andrews is a Professional Scuba Association (PSA) instructor trainer examiner and the technical director for the London School of Diving in Chiswick and can be contacted at : **technical@londonschoolofdiving.co.uk**

Leigh Cunningham is a TDI instructor trainer based in Sharm-El-Sheikh and can be contacted at **highpp02@yahoo.com**

DIVE TEAM

SAFETY DIVERS:
John kean (England)
Doozer (England)
Schniffer (Scotland)
Adrian Curran (Australia)
David Wilke (Australia)
Robert Bohlin (Sweden)
Mattias Andersson (Sweden)
Johan Nilsson (Sweden)
Per Nielsen (Denmark)

VIDEOGRAPHERS:
Valentina Cucchiara
Tracey Medway

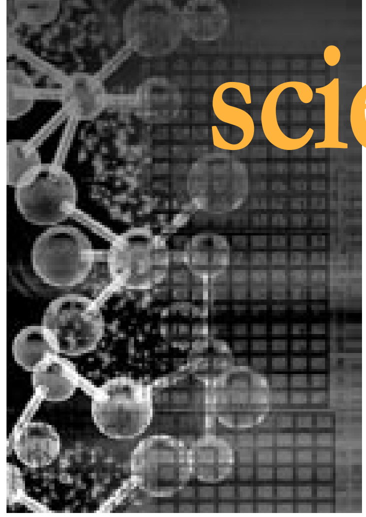
PHOTOGRAPHER:
Adam Butler

GAS BLENDING:
Chad Clark

SEARCH AND RESCUE CO-ORDINATOR (SAR): Sammy

CHAMBER SUPPORT:
Doctors Adel and Ahmed

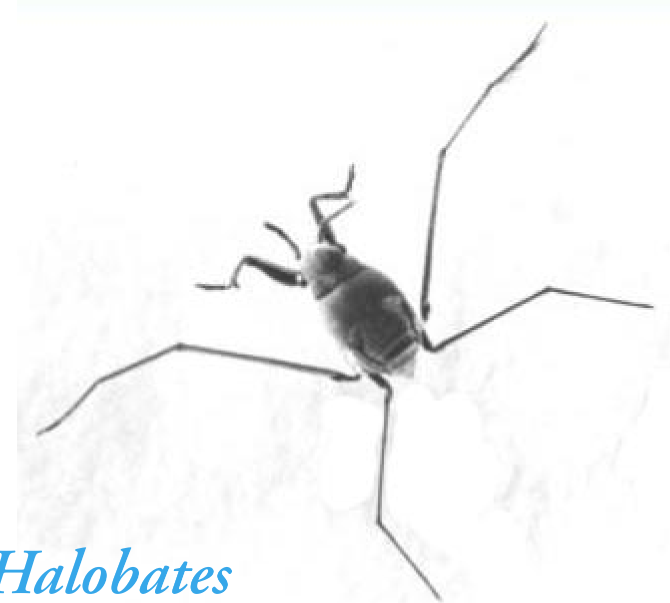
BOAT CREW:
Captain Yassir
Mahmoud
Mohamed



Walking on Water

Marine Insects

—and the strange case of the Halobates



Sea skater, *Halobates*. Photo courtesy of Scripps Institution of Oceanography, La Jolla

Text by Michael Symes
Photos courtesy of Dr Lanna Cheng, University of California-San Diego and Scripps Institution of Oceanography-La Jolla

When we think of the animals of the oceans our first thoughts are generally of whales, sharks, dolphins, tuna fish, and perhaps octopusses. All these have been in the news lately, also in this magazine, for reasons regarding their behaviour or exploitation. These are large animals, and like the lesser food fishes such as salmon and herring, we have many reasons for our interest in them. However, even the very small acquatic creatures such as krill and zooplankton are important because they are at the bottom of the food chains of the larger fish which themselves again are food for those at the top of the chains, we humans. Thus, all marine life in someway or other is important to us.

A Marine Chironomid (midge)
Photo by Dr Lanna Cheng, University of California-San Diego

There is one important common factor in the examples of marine life given above. They all have their prime existence *in* the water, i.e. at least partially below the surface. We rarely, if ever, consider the other sort of animal life associated with the oceans, that which lives by or on the ocean but not in it at all. Here I am thinking about the marine insects.

According to an excellent, newly published book (Evolution of the Insects, D Grimaldi, M S Engel, Cambridge University Press) there are approximately 926,400 described species of extant hexapods i.e. insects. Estimates of the total number of insect species vary from about 2 million species to 30 million species and more. However, an estimate of about 5 million species is probably the most accurate. (Gaston, KJ. 1991. The magnitude of global insects species richness. Conservation Biology 5: 283-96). Thus, only about 20 % of the global insect fauna is probably known and named.

Big numbers

Insects comprise more than 75 percent of all described animal species. Some 30,000 to 40,000 insect species, i.e. just 3 to 4 percent of all insects, are aquatic, or have aquatic larval stages, and live in all sorts of watery habitats. About 9,000 species (mostly bugs and beetles) have all stages under or on water. In about 30,000 species only the larval stage is aquatic (flies, mosquitos).

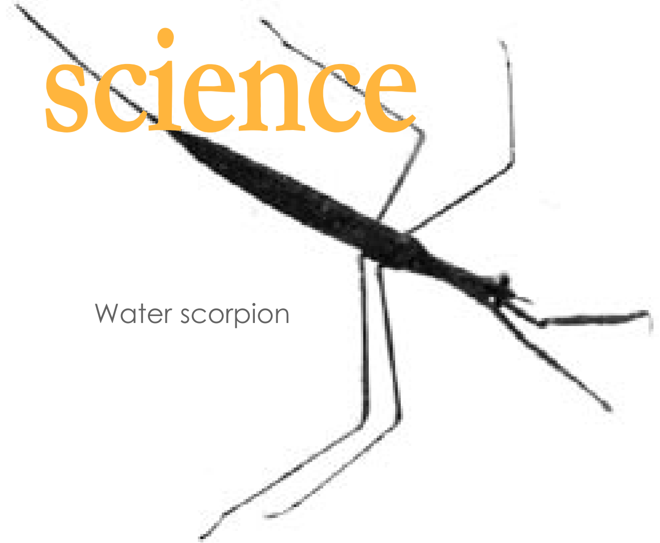
Insects are found throughout the world except near the poles and, with but a single exception, pervade every habitat except the sea. Some are found at depths of 1,300 meters in Lake Baikal, some are to be found only in rain-filled tree holes, while others inhabit caves and underground aquifiers.

Freshwater habitats are the only aquatic habitats where insects dominate. In saltwater and brackish habitats, crustacea (the next most numerous arthropod) dominate. Although only 3% of all insects are aquatic for some part of their life cycle, insects make up more than 90% of small creatures found in mountain streams.

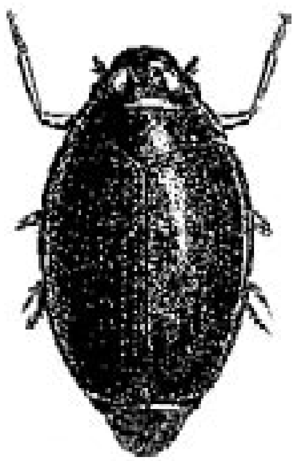
Map of A Marine Chironomid (midge) habitat. *Pontomia* are found only in lagoons or tide pools in the Indo-Pacific. Illustration courtesy of the University of Nebraska-Lincoln Department of Entomology

Impact

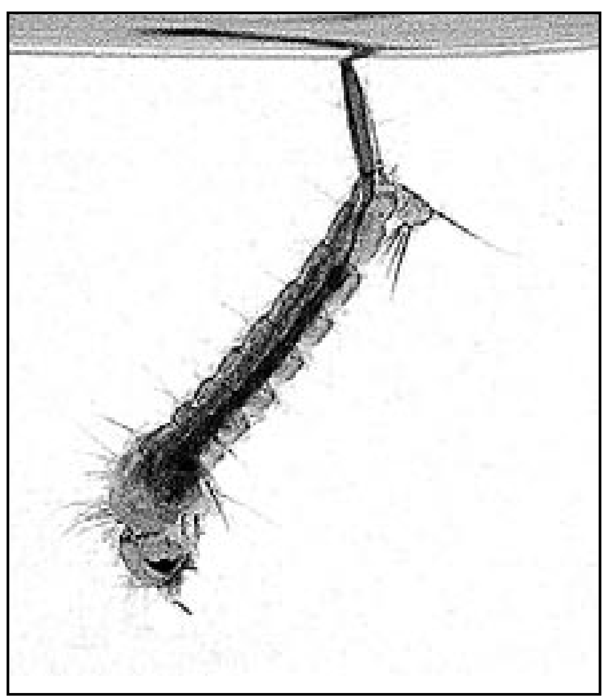
Despite their low numbers compared to the terrestrial insects, marine insects still have a tremendous impact on man. Flies



Water scorpion



Whirligig Beetle live on the surface of the water at the edges of lakes and streams. They are 5-25 mm long and are named so, because they swim in circles



A mosquite larva uses a snorkel-like breathing tube at the posterior end of its abdomen

Marine Insects

are the most numerous and economically important species of marine insects. The disease-bearing mosquitoes, biting horse flies, deer flies, and midges have impeded the human development of enormous areas of coastal land. And other marine flies can transmit diseases such as Leishmaniasis.

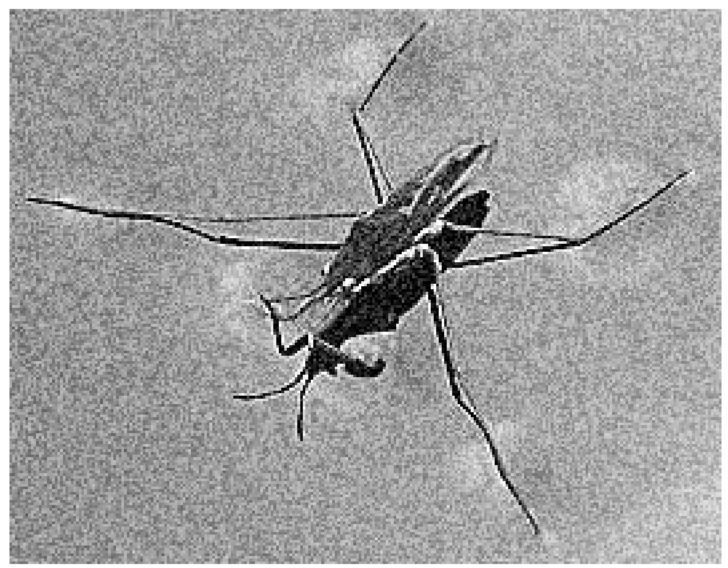
Unlike the dominating land-based insects, however, the marine insects have additional problems to overcome in their fight for survival. For example, how do aquatic insects avoid drowning? Most insects that land on water are trapped by the water surface tension and tiny ones can even drown inside a water droplet, unable to break out of the bubble surface.

Aquatic insects cope by having a waterproofed skin so the water doesn't get into the body. Many are covered with a water-repellent waxy layer. They also usually have hairy or waxy legs which repel water so they don't get trapped by the water surface tension.

The oxygen problem

There is very little oxygen in water (as low as 0.4% and often zero). Water contains less oxygen the warmer it is. This is why there is often more life in a cool pond shaded by trees and in temperate climates. There is much more oxygen in air (20%), and water is much heavier than air.

So, to extract oxygen from water, an animal will have to process a lot of water to get the same amount of oxygen. That is probably one reason why adult aquatic insects continue to breathe air instead of developing gills. Usually only aquatic insect larvae develop gills to absorb oxygen from the water. So, how do aquatic insects obtain their oxygen?



Pond Skater

Like mosquito larva and water scorpion, they can snorkel with a breathing tube. The end of the tube usually has bristles to break the water surface tension and keep the tube open. This method, however, doesn't allow the insect to travel far from the water surface.

Others have a scuba tank. These "divers" create an "air tank" for greater freedom of movement underwater. A skin of air that is trapped by hairs on the body or under the wing covers (Water Beetle). The insect breathes the air in the bubble through the holes in its abdomen (spiracles) just like other insects.

Making the best of both worlds

Living on the margin of water and air, many aquatic insects have developed ingenious ways to sense the world and to move around.

Most aquatic insects are sensitive to water ripples to detect predators or prey. Some even create their own ripples on the water surface and process the returning "echoes" to detect prey. Many also create ripples to find mates and communicate with each other (Whirligig Beetle, Pond Skater).

In a double-vision adaptation the Whirligig Beetle has eyes divided horizontally to see both under and above water. This is very useful when predators can attack you from both below and above.

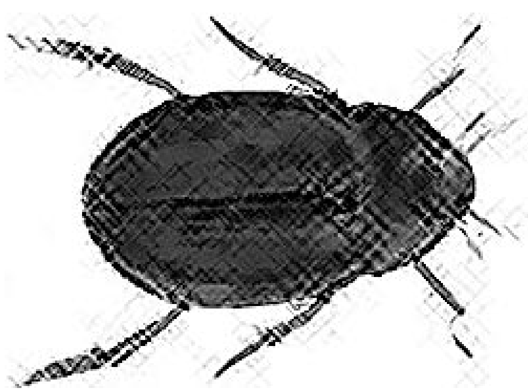
Many paddle underwater with oar-like legs. These legs are long, flattened and fringed. The hairy fringes spread out on the power stroke increasing the surface area, and bend in on the

Marine Insects

Marine Skater Eggs on a floating Spirulla shell. Even though *Halobates* live their entire lives on the ocean, they require floating objects upon which to place their eggs. These objects can include floating seashells, sea bird feathers, pieces of wood, plastic or lumps of tar. The eggs, which are often crowded on small objects due to the lack of available egg deposit sites, are rather large in size compared to the body size of the female who produces 10 to 20 matured eggs at a time. Photo by Dr Lanna Cheng, courtesy of the University of Nebraska-Lincoln Department of Entomology

return stroke to reduce water resistance. (Water Beetle, Water Boatman). These insects usually have flattened streamlined bodies or are torpedo-shaped.

The Camphor Beetle (Stenus) also skates on the water surface but has a neat trick to enhance its speed. When alarmed, it releases a chemical from its back legs that reduces the water surface tension. In this way, the water surface tension on the front pulls it forwards. It shoots forwards on its front feet which are held out like skis, and steers itself by flexing its abdomen. This tiny beetle is the size of a rice grain but can travel nearly 1m a second this way. It doesn't hunt on water, but at the water's edge, and saves this trick to escape predators.



Lesser Water Beetle

The *Halobates*

As we have seen above, marine insects have developed succesful strategies for survival in an aqueous environment. However, if we read further in 'Evolution of the Insects' (referred to above) one finds the very surprising statement (page 317) "*Halobates* is the only pelagic insect"—i.e it is the only insect that lives on the open oceans!

Halobates, or sea skaters as they are called, are a group of wingless insects that can "skate" on ocean water. Sea skaters feed primarily on zooplankton trapped at the sea surface, grasping their prey with their short front legs and sucking them dry. They have never been observed breaking the water surface to feed—i.e they do not dive.

While members of the coastal species deposit their eggs on fixed materials such as mangrove tree trunks or rocks, open-ocean species lay eggs on just about anything that floats, including empty seashells, wood, feathers, seeds and even lumps of tar.

Walking on the ocean

Among the most interesting aspects of the *Halobates* is how they manage to walk or skate across the surface of the ocean. The secret is the tiny water-repellent hairs on their legs and feet that allow them to "tiptoe" across the surface of the water. These hairs also help to spread the insects' weight over a larger surface area, preventing them from sinking.

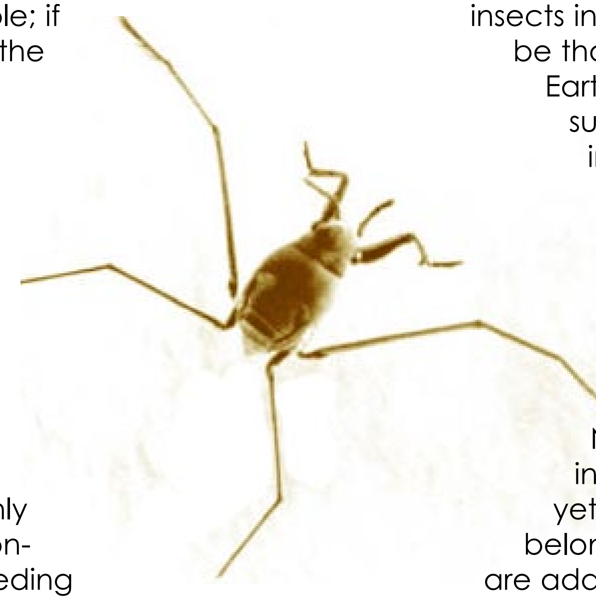
The surface tension of the air-sea interface allows them to stand or move on the water at a speed as fast as one meter per second. As long as the surface tension is maintained, sea skaters are able to move normally. If the surface tension is lowered by pollutants or detergents, they flop on the surface and eventually sink. Tiny hook-shaped hairs, about 1.5 microns long, also cover the sea skaters' bodies. These trap a layer of air surrounding the insect, making them buoyant. Thus, they are basically enclosed in an air bubble; if they are pushed under the water, they quickly pop up again. If sea skaters are caught in rough seas and trapped beneath the surface for short periods, this jacket of air provides them with enough oxygen to survive.

No other animal on Earth lives in such a vast two-dimensional habitat. They are the only marine invertebrates constrained to traveling, feeding and reproducing only at the surface of the ocean. Among the dificulties of living in such a vast world is how the *Halobates* find each other to breed and lay eggs.

A map of the world-wide distribution of the marine insect, Sea Skater, *Halobates*. The known distribution is displayed in white. There are five known species of *Halobates* distributed around the earth approximately between latitutdes 40-degrees south and north of the equator. Questions remain about whether the insects require the warm ocean waters in this region or whether they are distributed more widely but scientists have not yet been able to find them through sampling. It is also not clear why there are only a few species and how they live in a habitat where no other insects are found. Some hypotheses state that the insects may be currently adapting to life on the ocean and *Halobates* is just the first to make the transition. Illustration courtesy of the University of Nebraska-Lincoln Department of Entomology

Just one genus living on the oceans

But why is there only just this one single genus of insect living on the open oceans? The five known species of Halobates are distributed around the world roughly between latitudes 40-degrees north or south of the equator. Do Halobates require these warm waters, or are they more widely distributed but have not yet been detected? Why are there so few species, and how do they live in a habitat where no other insect occurs? Given the diversity of insects in freshwater, it might be thought that the Earth's oceans would support an almost infinite number if insect species. Only 0.0091 percent of the Earth's surface water is contained in lakes and rivers, and 95.96 percent is in the oceans. Nearly 30,000 insects inhabit freshwater yet only five species belonging to one genus are adapted to living freely in the world's most vast ecosystem. This is very strange indeed.



Hot hypotheses

Dr Lanna Cheng, a well-known long-time expert on marine insects at the University of California, San Diego, with others, gives several hypotheses as to why this is so.

The first hypothesis suggests that insects are limited by salinity. While this may be true for the majority of insects, many flies have effecient osmoregulatory mechanisms that allow then to tolerate salinity in excess of 3 times that of the ocean.

The second hypothesis suggests that ocean depth limits an insect's ability to complete its development. This is true of many insects and yet chironomid fly larvae survive at depths below those that even the deepest diving mammals can

INSET IMAGES: A sea skater, *Halobates*. Photo courtesy of Scripps Institution of Oceanography, La Jolla

Marine Insects

Marine Skater, *Halobates*. Photo by Dr Lanna Cheng, University of California-San Diego

reach.

The third hypothesis suggests that the combination of salinity and depth imposes a further limitation of oxygen content in ocean water. Again, certain fly larvae are able to survive months without oxygen, and numerous aquatic insects survive in polluted waters with similar or lower oxygen concentrations.

Finally, a fourth hypothesis considers the fact that insects were successful because they colonized land. By moving away from the ocean, they adapted to a terrestrial existence while their major competitors the crustaceans stayed in the sea and continued to adapt. As millions of years passed, insects lost their ability to successfully compete in the ocean while crustaceans have had only limited success in invading land. Dr Lanna Cheng believes that this is the most likely explanation for the abscence of insects in the oceans. As potential evidence, it is noted that the only insects that live on the open ocean, live on its surface. As such, they never come in contact with the crustaceans living beneath its surface.

Final thoughts

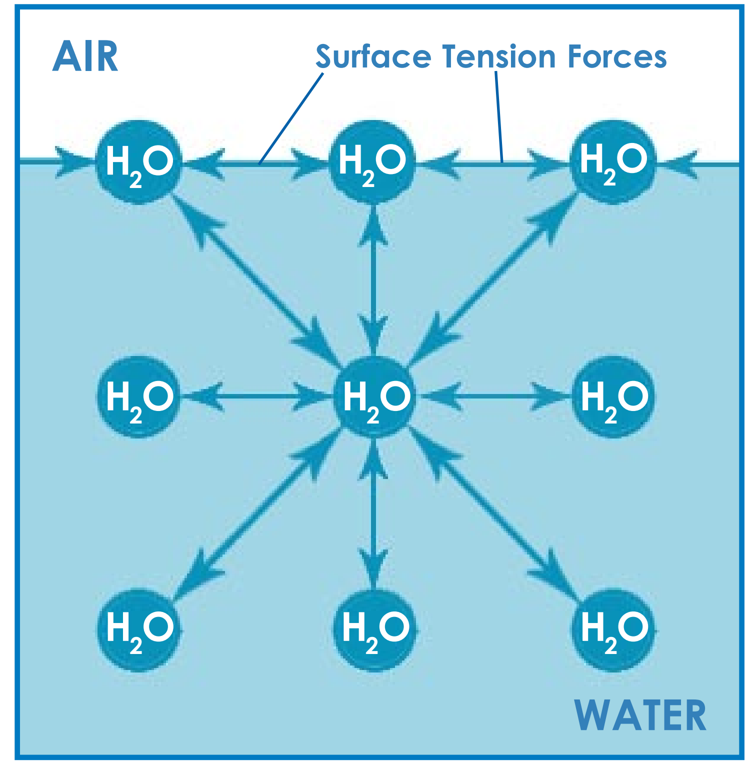
There are many questions still unanswered about this strange case of the *Halobates*. How come that they alone of the so many insects managed to adapt to life on the oceans? Whatever hypothesis is true, though, if any of them are, the *Halobates* are a really remarkable example of marine life rarely, if ever, to be observed by divers.

For more information on marine insects, visit the Marine Insects Home Page of the Department of Biology at the University of Nebraska at Kearny: **www.unk.edu**
Or visit the Marine Insects page of the Department of Entomology at the University of Nebraska at Lincoln: **entomology.unl.edu** ■

A DIVING BELL

The Water Spider (Argyroneta aquatica) is not an insect, but it is an aquatic expert. It lives underwater by creating an underwater air chamber. It gathers a small bubble of air from the surface on its hairy hind legs, then releases it into a web woven among water weeds. It waits inside this underwater lair to catch passing prey. The spider mates and lays eggs inside this air chamber which works like a gill and allows the insect to absorb oxygen directly from the water. As the insect uses up the oxygen in the bubble, dissolved oxygen in the water diffuses into the bubble so the insect actually get more oxygen than originally in the bubble. However, nitrogen must be present for this to happen. The nitrogen provides stability to the bubble (it diffuses more slowly out into water than other gases). So, the insect goes back to the surface to replenish nitrogen rather than to get fresh oxygen. In an experiment, an aquatic insect provided with pure oxygen survives only 30 mins underwater, while with air it can survive 4 hours. ■

Water Strider



Model illustrating bond forces of water

Text by Micheal Symes

Water Facts

Surface tension

Surface tension is a quantity which we often meet in daily life without thinking too much about it. It plays a large role in washing and cleaning procedures, for example, as well as in lubrication, cosmetics and rainwear. Among the numerous anomalous properties of water is its very high surface tension. This has great consequences for all life forms, both human and otherwise. In the article on Marine Insects in this issue of Xray-mag the ability of insects to 'walk on water' is ascribed to its surface tension. The effect of this phenomenon is thus of vital importance to these insects.

Surface tension has properties resembling a stretched elastic membrane. This is due to the fact that water molecules at the liquid–gas interface have lost potential hydrogen bonds directed at the gas phase and are pulled towards the underlying bulk liquid water by the remaining stronger hydrogen bonds, of which there are many. (An explanation of hydrogen bonding was given in the previous number of Xray-mag.)

In the bulk of the liquid each molecule is pulled equally in all directions by neighbouring liquid molecules, resulting in a net force of zero. At the surface of the liquid, the molecules are pulled inwards by other molecules deeper inside the liquid, but there are no liquid molecules to balance these forces, so the surface molecules are subject to an inward force of molecular attraction which is balanced by the resistance of the liquid to compression. There may be a small outward attraction caused by the air molecules, but as air is much less dense than the liquid, this force is negligible.

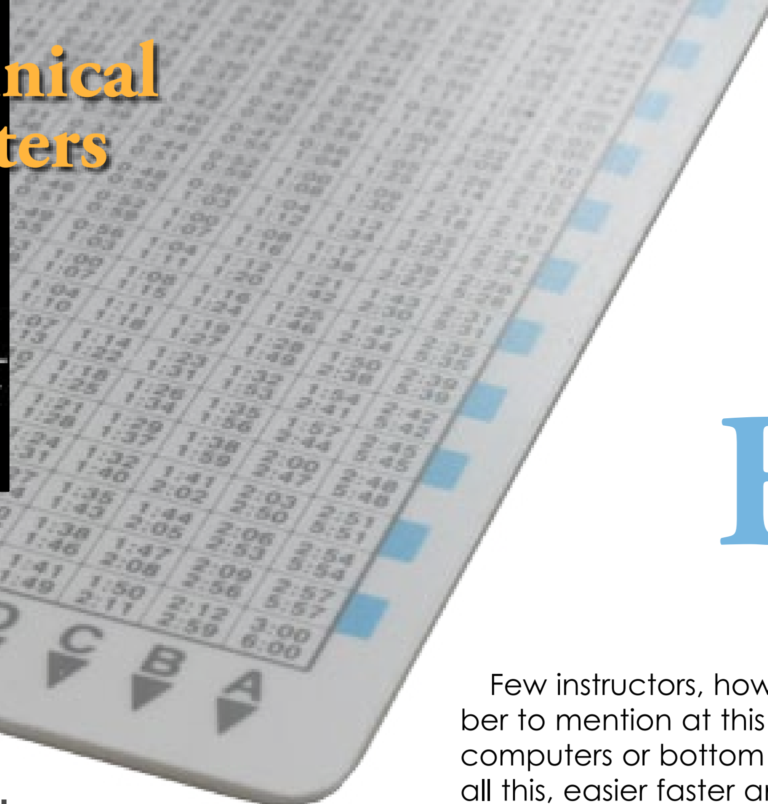
As the forces between the water molecules are several and relatively large on a per-mass basis, compared to those between most other molecules, the surface tension of water is large.

Surface tension is measured in newtons per meter ($N\,m^{-1}$) and is defined as the force along a line of unit length perpendicular to the surface. At 20°C it has the value $7.29 \times 10^{-2}\,N\,m^{-1}$. For comparison, mercury, in which the intermolecular bonds are electrostatic rather than hydrogen bonding, has the value of $46 \times 10^{-2}\,N\,m^{-1}$ i.e. about 6 times greater. This is why mercury forms bigger spherical drops than water on, for example, a glass surface.

Dimensional analysis shows that the units of surface tension, N m-1, are equivalent to joules per square meter ($J\,m^{-2}$). This means that surface tension can also be regarded as a surface energy. Energy is required to increase the surface area so it is minimised and held under tension. As a sphere has the smallest surface to volume ratio i.e. the least surface energy, this will make the sphere the most stable shape for a bubble.

The hydrophobic legs of a water strider

A water strider can walk on water because its feet do not break through the surface. This is because its feet and legs are hydrophobic i.e. water repelling. It has been shown that the water resistance of the legs is due to their special structure, being covered by large numbers of oriented tiny hairs with fine nanogrooves. It is this physical structure that is more important than the chemical properties of the waxy coatings of the legs. It has been calculated that the maximal supporting force of a single leg is 0.00152 newton, which is about 15 times the total body weight of the insect. This shows that the surface of the leg is strikingly water repellent. It is no wonder, then, that these insects are so good at dashing around on the surface of water. ■



Divetables, Computers or Bottom timer?

Leigh Cunningham is the technical manager and TDI Instructor Trainer for Ocean College, Sharm El Sheikh.

Probably best known for his records - Leigh once held the record for the deepest dive in the Red Sea - and attempts of reaching extreme depths, he also has a wide range of teaching credentials to his curriculum:

TDI instructor trainer, DSAT Tech Trimix instructor, PADI MSDT IANTD Technical diver instructor CMAS 3 star instructor.

Dive Tables

During our initial open water training, we were all shown how to use a dive table. But did we ever use it again - and is the right tool?

Doing the table excercises during our first open water course, we could establish an NDL (No Deco Limit) and pressure group, find a repetitive pressure group based on our surface interval, and see how long we could safely spend on our second or next dive, without exceeding the NDL, and what not.

Few instructors, however, remember to mention at this point that dive computers or bottom timers can do all this, easier faster and safer. And in reality, on the next adventure into the abyss, most will be indeed be equipped with a computer and/or be supervised and led by a dive master anyway.

So what are the chances that we will actually look at any tables again?

The dive table

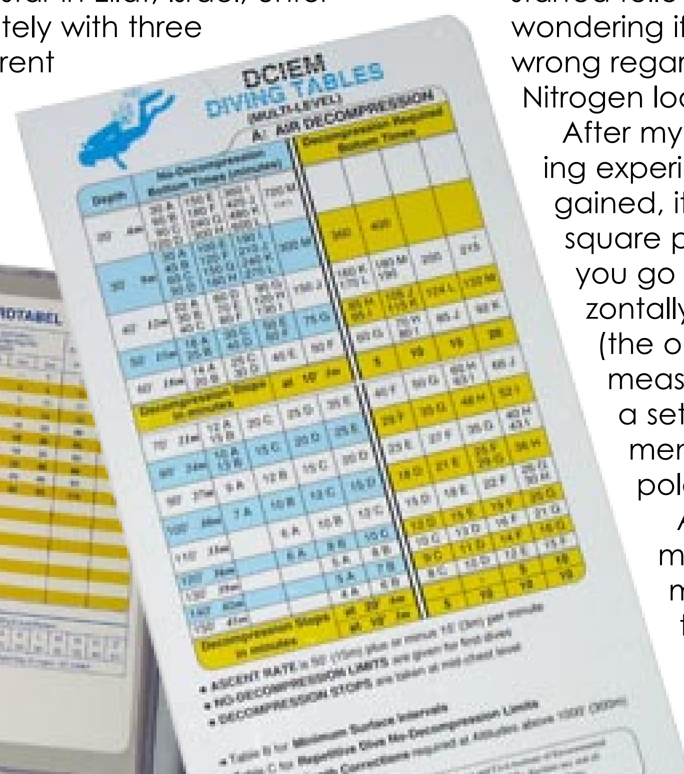
Looking back into my own experiences, I remember shortly after completing my own first diving course, CMAS one-star in Eilat, Israel, unfortunately with three different instructors, that spoke English as well as I speak Hebrew, I started working as a chef on a liveaboard dive safari boat. Unfortunately, there wasn't so much in the way of dive leadership on this boat either, but it was a long time ago, and that's another story.

So, after trying to plan initial dives with my nice new shiny table, I came to the realisation that I didn't speak Hebrew, and this table wasn't much use for planning the multi-level profiles, which the other recreational divers on the boat were planning.

I therefore soon put the dive table to the bottom of my dive bag and started following other divers around wondering if I'd got the whole story wrong regarding decompression, Nitrogen loading and DCS.

After my initiation, with some diving experience and knowledge gained, it was clear to me that square profile diving—in which you go straight down, swim horizontally and then go straight up, (the only way to accurately measure nitrogen loading with a set table)—in this environment was about as rare as a polar bear in the Sinai.

And for good reason—most of the corals and marine life were located in the first 20 meters.



The dive wheel

A number of years later, I was introduced to the PADI wheel (a method of planning multilevel dives with a set table, see illustration next page)—*fantastic*. Later still, I had the pleasure of instructing students in the use of the wheel. After a short while, I noticed numbers fading on this high tech device due, I think, due to the combination of sun and sand that seemed to get in everywhere.

Particularly for new divers who are diving in warmer water reef environments and following the dive master or leader around, it is a good idea not to exceed the planned depth, ascend to a decreasing depth level and when you reach 100 bar cylinder pressure, head to your five meter safety stop with around 60 bars left.

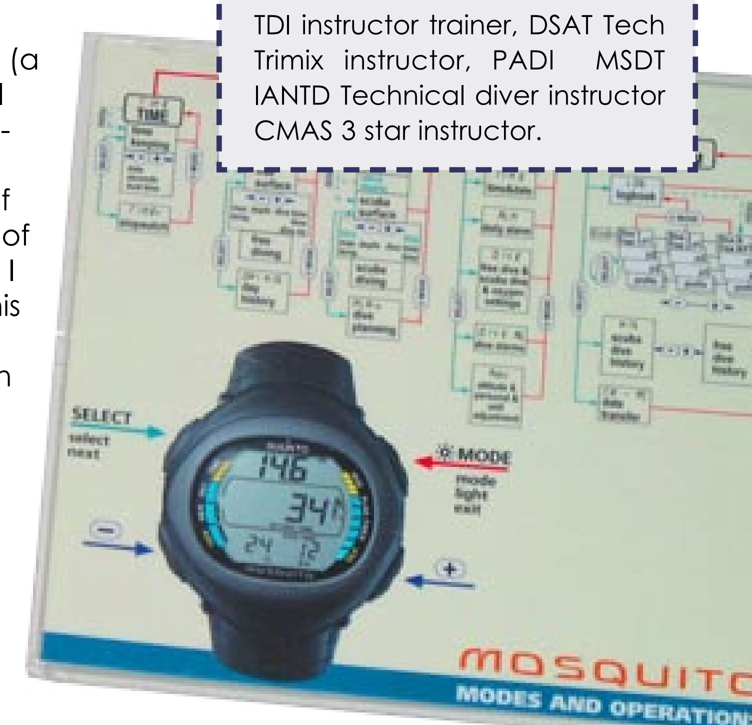
No more talk of pressure groups, and you didn't seem to get bent. But let's get on to the next rung on the ladder of technical evolution and get digital

The dive computer

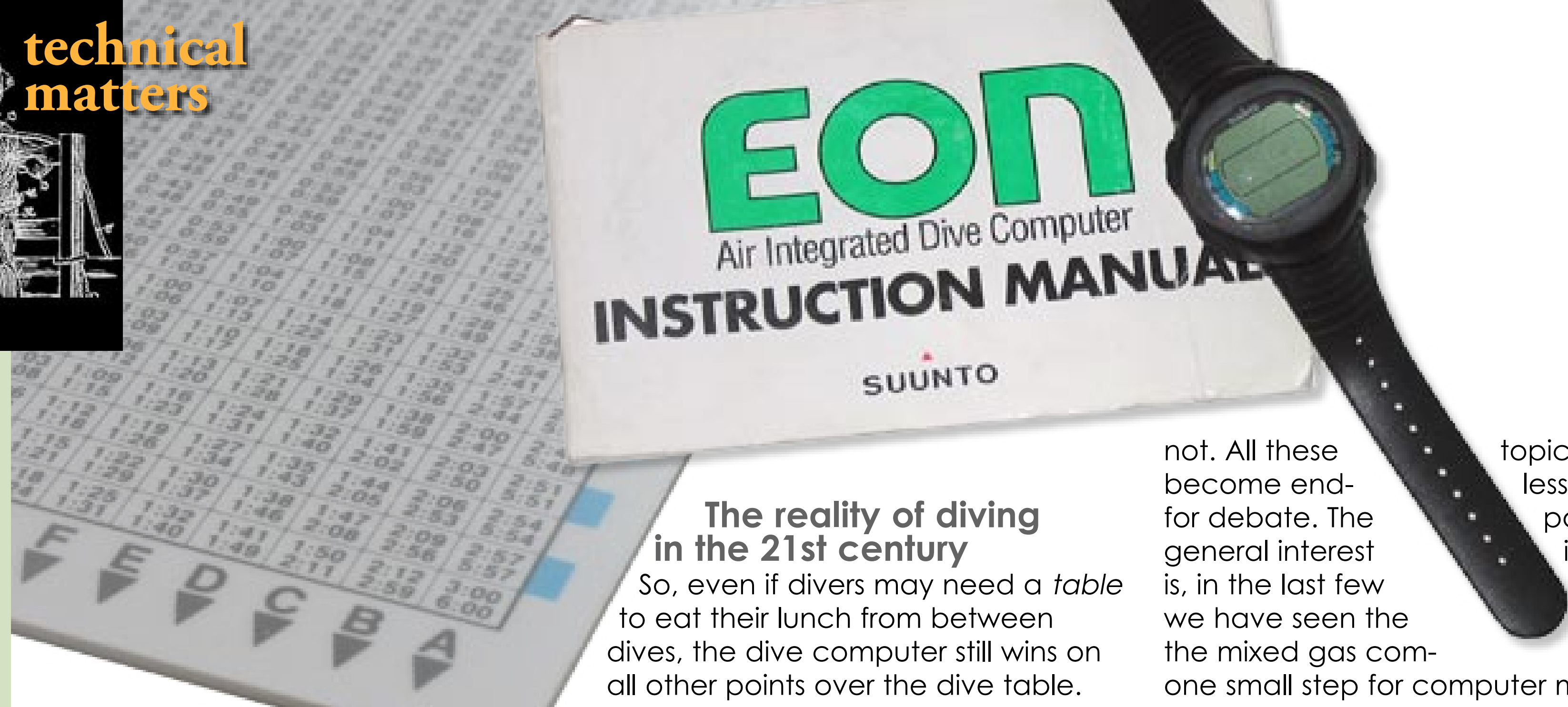
Let's begin with a word of caution: The only way to really gauge nitrogen absorption and elimination, establish an accurate NDL and predict residual nitrogen levels, which needs to be taken into consideration on repetitive dives, is to wear, or have somewhere on your person, *a dive computer*. It's better to be safe than sorry and have an annoying itch and a blotchy red rash.

If you don't have a dive computer and this sounds like your type of profile or dive plan, or for anyone whose actual dives do not accurately simulate the pre-planned, depth and time plan—GET A DIVE COMPUTER.

Buy one before your next dive trip. ▶



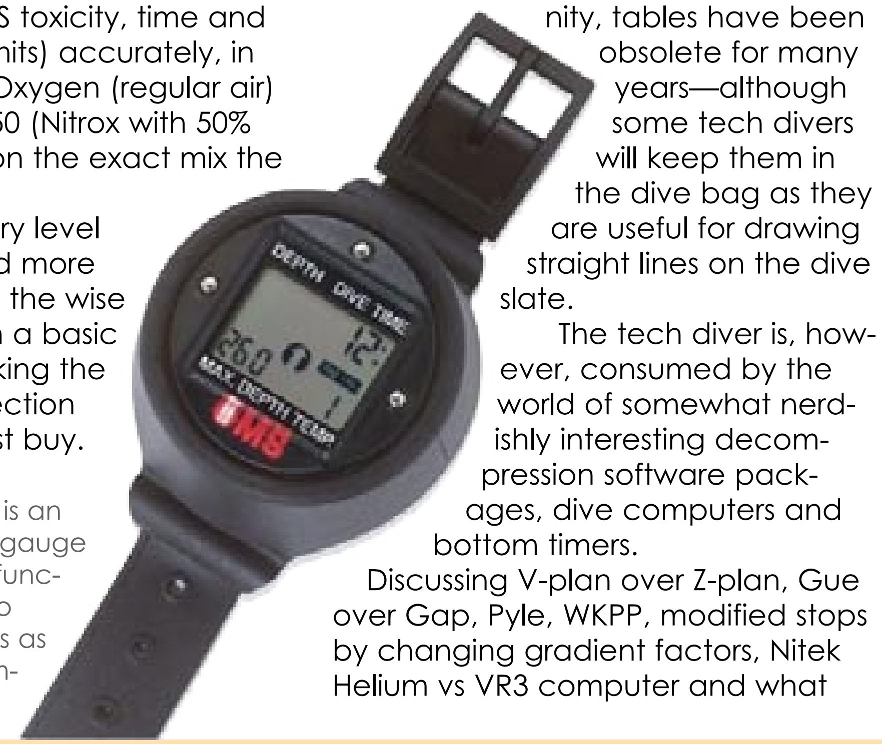
ALL PHOTOILLUSTRATIONS BY PETER SYMES



But do consider *an appropriate computer*—which is one for your experience level and the type of diving you will be doing in the near future. The most expensive computer in the dive shop may not be your best choice. I would recommend a "single mix", that is a basic nitrox computer to begin with. With recent advances in technology, all but the most basic dive computers will have an FO_2 (Fraction of Oxygen in breathing gas, usually set as %) selection option.

This also enables divers to track both Nitrogen and Oxygen parameters (such as CNS toxicity, time and partial pressure limits) accurately, in blends from 21% Oxygen (regular air) through to EANx 50 (Nitrox with 50% Oxygen), based on the exact mix the diver is breathing.

Shortly after entry level training, more and more divers are making the wise choice to enroll in a basic nitrox course, making the optional FO_2 selection computer the best buy.



The bottom timer is an electronic depth gauge with a few basic functions. It doesn't do any computations as regards to decompression or limits

The reality of diving in the 21st century

So, even if divers may need a *table* to eat their lunch from between dives, the dive computer still wins on all other points over the dive table.

The theory behind Nitrogen absorption, elimination and bubble formation can be gained without the necessity for dive table explanations and use during the entry level course.

Entry level diving courses with some training agencies include dive computer explanations and use instead of the dive table which is now optional reading. In the future, all training agencies will consider set tables to be optional and eventually deem them obsolete.

Technical diving

For the technical diving community, tables have been obsolete for many years—although some tech divers will keep them in the dive bag as they are useful for drawing straight lines on the dive slate.

The tech diver is, however, consumed by the world of somewhat nerdishly interesting decompression software packages, dive computers and bottom timers.

Discussing V-plan over Z-plan, Gue over Gap, Pyle, WKPP, modified stops by changing gradient factors, Nitek Helium vs VR3 computer and what not. All these topics have become endless subjects for debate. The part of general interest in all this is, in the last few years, we have seen the birth of the mixed gas computer—one small step for computer manufacturer's, one big step for mankind.

Everybody's a winner

Aside for the faithful bottom timer, which has been cruelly rejected by divers, the blessing has been the mixed gas computer.

No longer will mixed gas divers need to carry wet tables with an array of back up plans or back up slates.

No longer will mixed gas divers need to spend hours generating numerous bail out plans taking into consideration exceeding planned depth or time, loss of gas scenarios and appropriate checks along the way.

No longer will mixed gas divers need to travel into the unknown *hostile abyss* without the added security of having a computer on their wrist that is tracking gas absorption and elimination based on a mathematical formula or algorithm that simulates the rate at which our body tissues absorb and eliminate He and/or N_2.

Dive tables and the dive computer offers a simulation only. Diving an accurate plan is no absolute guarantee DCI will not occur

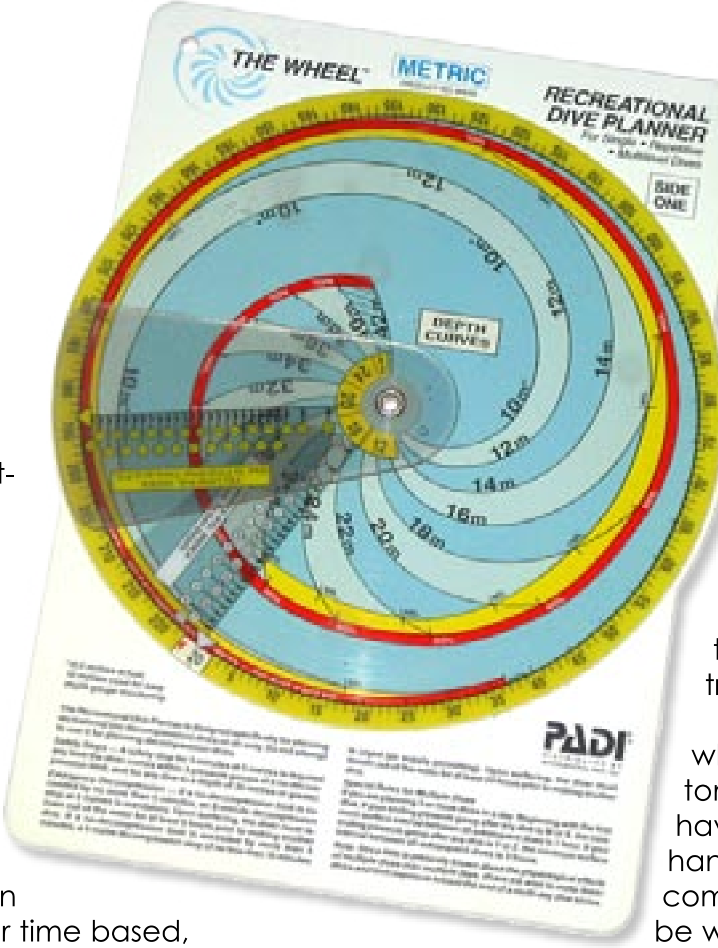
With up to 10-mix pre-programmable gas switch options and whatever ratio of He to N_2 you so desire, the mixed gas computer is the true *Ferrari* of dive computers. Divers now have a re-adjusted plan based on the exact digression from the primary plan, whether the digression was depth or time based, or due to loss of a particular gas ie because of equipment malfunction. With this in mind, the dive can now be treated the same as an air/EANx decompression dive with the diver using two multi mix air/EANx computers.

Another word of caution: Don't slip into the habit of making a plan on the fly—deciding upon exact depth and time during the dive. The mixed gas computer could encourage this bad habit. Trimix diving must be shown the same degree of respect. Dives must be executed with the same high degree of accuracy and maturity as they always have been.

The Bottom timer

So where does this leave the bottom timer? *A paper weight*—much more useful than the dive table. *No!!!*

The bottom timer will always deserve its rightful place as a very good back up depth/timer for the recreational or technical diver and for the new mixed gas divers whose budgets might not stretch to two-mix gas computers directly after paying for the formal Trimix training.



Have you ever thought of this: The Wheel is actually an analogue computer

One minor area where a bottom timer may still have the upper hand over the dive computer could be when divers are pushing the depth envelope. The diver may not agree with the specifics regarding modifications to the algorithm that a type of computer incorporates, which dictate the type of schedules generated by the computer. Or, the computer may simply not have the required range. A depth timer or the computer in gauge mode may have greater range than the dive computer itself or the computer in computer mode.

Conclusion

In my opinion *set* dive tables are a thing of the past. The appropriate computer for you and your type of diving has to be the way to go. The bottom timer has got it hard, but still a very useful tool.

One last thing: Dive tables and the dive computer, if used correctly, ***simulate*** the rate at which our body tissues absorb and eliminate nitrogen based on a number of theoretical tissue compartments. *Diving an accurate plan is not an absolute guarantee decompression illness will not occur.*

P.S. Keep fit and drink lots of water. ■

LEFT: A close-up view of the newly discovered siphonophore reveals several of the glowing red lures and tentilla

INSET: Close-up view of the lure. It closely resembles a swimming copepod

STEVEN HADDOCK © 2004 MBARI

Text by Michael Symes
Photos courtesy of Monterey Bay Aquarium Research Institute

Glowing Jellyfish

Glowing red lures are used by deep-sea jelly to catch fish

ROV observes siphonophores in their native habitat

Probably about 90 percent of deep-sea animals are bioluminescent. Some jellies use bioluminescence as a defense, i.e. they glow when disturbed in order to light up their predators, making their attackers vulnerable to even larger animals. A few deep-sea fishes and squids have glowing organs that look like lures, but even these animals have never been observed actually using their glowing organs to capture prey.

A microphotograph of the newly discovered siphonophore shows a tentacle with tentilla—tiny filaments branching off the main tentacles. Each tentilla has thousands of stinging cells. On separate stalks are red lures that move up and down. In this manner, they wiggle to look like swimming copepods, which are a typical food of small midwater fishes

Glowing Jellyfish

LEFT: The deep-sea siphonophore is around 45 cm (18 inches) long. Swimming bells that pulse like jellyfish make up the upper half of the colony and keep the colony moving through the water. White stinging tentacles make up the lower half. The tentacles capture small deep-sea fishes

Now a new species of jelly-fish has been discovered in the deep sea that attracts fish by wiggling hundreds of glowing red lures. This is the first time any marine invertebrate has been found to use a bioluminescent lure or to display red bioluminescence.

Marine biologist Steven Haddock of the Monterey Bay Aquarium Research Institute (MBARI) has studied glowing marine animals, focusing on gelatinous animals such the siphonophores. Related to the typical round "jellyfish" that sometimes wash up on beaches, siphonophores are colonial animals, arranged in chains that in some species can be dozens of meters long. The members of a colony specialize at different tasks. Some form swimming bells, which pulse slowly, pulling the colony through the water like a long, fluid freight train. Others specialize in feeding, and sport stinging tentacles. Siphonophore colonies are difficult to study as they often break into pieces when disturbed or captured, and they were therefore also studied in their native habitat, thousands of meters down, using an ROV.

The siphonophore discussed here, an unnamed species in the genus Erenna, lives at depths of 1,600 to 2,300 meters, where fish are few and far between. It was therefore surprising to observe small fish in their guts because how could these jellies capture enough fish to survive in their sparsely inhabited environment. Most siphonophores set a big web of tentacles to catch animals that happen to swim by. But this jelly doesn't deploy its tentacles very far. It uses deception to attract fish instead of casting a wide net to capture them.

Microscopic examination showed that interspersed among their stinging tentacles were thin rod-like structures which were tipped with red, glowing blobs. Several lines of evidence eventually led to the conclusion that these red blobs served as lures for small deep sea fish. The first clue lay in the siphonophore's behaviour. Jellies that use bioluminescence for self defense tend to have lights distributed all around their body, which flash brightly when disturbed. The Erenna siphonophores, however, keep their bioluminescence very localized and under tight control, suggesting that their lights had an entirely different function.

In addition, the red, glowing blobs were shaped remarkably like the bodies of deep-sea copepods, a major food item for small deep-sea fish, and were flicked back and forth repeatedly so that the glowing lures darted through the water just like swimming copepods. Finally, at least one siphonophore's digestive system contained both fish and lures, suggesting that the lures were ingested along with the fish.

Erenna's glowing red lures may also force scientists to take a new look at the role of red light in the deep sea. Red bioluminescence is extremely rare, and the prevailing view among marine biologists has been that most deep-sea animals cannot detect red light at all. However, because deep-sea fishes are so hard to bring to the surface intact, we know very little about their physiology. Haddock's work suggests that some deep-sea fishes may not only see red light, but routinely use it in finding food.

It is strange that in the deep sea they are using red light, which doesn't travel very far. Possibly the red light might be drawing in fish because they could be mistaking it for the red glow that comes from the algae in the stomachs of shrimp-like copepods, their prey.

The red fluorescent lights of Erenna are only found on the animals' fully grown, branch-like stalks. When the stalks are immature they only give off blue-green luminescence, but as they mature, the blue-green luminescing parts become surrounded by tissues containing red fluorescent material.

Further details can be found in the July 8, 2005 issue of Science magazine ■