

Tech Diving Mag

Research - Development - Exploration

Headaches and technical diving

Last mission of the Black Jack

Mother Nature is a bitch: beyond a pO₂ of 1.6

Exploration – not always conventional

Diving Pioneers & Innovators: A Series of In
Depth Interviews (Mike deGruy)

Issue 7 – June 2012

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Editorial

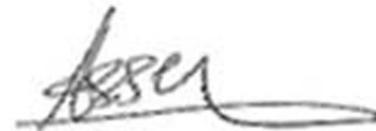
2 Welcome to the seventh issue of Tech Diving Mag.

3 In this issue, the contributors have, once more, brought together a wealth of information, along with some distinctive first hand experiences. The contributors for this issue are world renowned industry professional Bret Gilliam, technical diving instructor Albrecht Salm (PhD) and cave explorer Chris Jewell. Read their bio at www.techdivingmag.com/contributors.html.

5 This issue includes a book chapter about the successful, adventurous life of the late Mike deGruy. Sadly, Mike was killed in a helicopter crash in Australia on the third of February, 2012; a definite loss to the diving community.

16 Tech Diving Mag is very much your magazine and I am keen to have your input. If you have any interesting articles, photos or just want to share your views, drop me a line at asser@techdivingmag.com.

24 Please visit www.techdivingmag.com/communicate.html to subscribe to the newsletter in order to be notified when new issues are available for download.



Asser Salama
Editor, Tech Diving Mag

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Headaches and technical diving

By Asser Salama



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There are different causes associated with diving headaches, but fortunately, technical divers are already aware of the basic things that might cause these headaches, like mask squeeze, an excessive constriction around the neck caused by thermal protection, a dental issue, cold water around an inadequately insulated head, dehydration, saltwater aspiration, jaw clenching, muscle strain due to anxiety and/or muscular rigidity, or sinus squeeze during ascents and/or descents. Unfortunately, though, diving headaches could as well be as complicated as a symptom of DCS, so seek immediate medical attention if a diver complains of headache and has other signs of DCS like joint pain, swelling, skin rash, itching, dizziness, nausea, vomiting, ringing in the ears or extreme exhaustion. Here are other types of diving headaches:

Migraine headache

Symptoms include severe pain, visual changes, weakness or numbness of the arm and nausea. Also post-dive vomiting is one of the migraine headache consequences, but if coupled with other symptoms could indicate a DCS hit.

Many of the medications used to treat migraines contain drugs which will increase the risk of nitrogen narcosis. So take that into consideration when you're calculating your END and your gas mixes. As many people have only occasional migraine headaches, yet others have migraines which are not incapacitating, migraine should be evaluated on a case-by-case basis. Anyone who suffers from migraine headaches and wishes to dive must consult a physician, preferably one with knowledge and experience in diving medicine.

Carbon monoxide toxicity headache

Symptoms include severe pain accompanied by tightness across the forehead, dizziness, nausea and vomiting.

The majority of compressors used to fill in tanks are oil lubricated. Normal filtration does not guarantee the removal of all traces of oil. These traces contain CO and can easily accumulate inside tanks. If the compressor is faulty or not well maintained, the percentage of CO exceeds the safe limits and can cause CO headache. This should not be a problem in technical diving, because all proper facilities apply more filtration.

Get the diver out of the water, administer oxygen and seek immediate medical attention. Hyperbaric oxygen therapy is the best option.

Carbon dioxide toxicity headache

A dull pulsing head pain after diving is usually a symptom of this type of headache, which is caused by carbon dioxide build-up in the body. The increase in waste gas is usually due to hypoventilation (too little air intake). Hypoventilation usually happens when a diver doesn't take large enough breaths or doesn't breathe often. Simply put, not breathing enough to get rid of the CO₂ created in the body will eventually lead to this type of headache. This bad breathing habit should be avoided by technical divers.

CO₂ build-up is also caused by the usage of inefficient dive equipment, especially at these depths associated with technical diving. This creates greater work of breathing, which leads to creating more CO₂. Given that CO₂ is way more narcotic than nitrogen, sense dulling is a potential impact of excessive CO₂ build-up.

The best treatment here is to take slow, deep breaths to reduce the build-up. Also use high performance regulators with good flow characteristics. CO₂ headaches don't respond well to pain relievers.

Last mission of the Black Jack

By Bret Gilliam



Just after midnight on July 11, 1943 a U. S. Air Force bomber rumbled on to the flight line for takeoff from the Allied controlled field at Port Moresby, New Guinea. Capt. Ralph Deloach carefully eyed his instrument panel as the #2 engine sputtered and coughed before settling into a smooth synchronicity with the other three powerful propellers breaking the torpid tropical night's lassitude.

Deloach eased his throttles a bit and swung into the wind waiting for the aircraft in front of him to clear the runway. The veteran pilot was in command of one of WW II's most famous bombers in the South West Pacific theatre of operations. This was a B-17 four-engine workhorse, dubbed the *Flying Fortress*, that had made history from Europe to the Pacific as the U. S. primary airborne attack weapon in the war against the German and Japanese forces. Deloach was aboard the infamous *Black Jack*, a veteran of scores of bombing missions. Tonight's raid had him bound for New Britain Island to attack the heavily fortified Japanese airstrip at Rabaul on its northeast tip. They would also engage an enemy convoy with over 7000 troops aboard bound for Lae. From Port Moresby, the flight would be nearly 500 miles over mountain ranges topping 12,000 feet in height and then traveling blacked-out over open ocean before turning north to his target.

He quickly reviewed the course with his co-pilot Lt. Joe Moore who sat in the right seat opposite him. Moore was engaged in a quick run-through of the final checklist and grunted his confirmation of the outbound course to steer after takeoff. They would climb out to the west over the Gulf of Papua to gain altitude before scaling the mountain range that bisected the southeast peninsula that stretched down to Milne Bay and oblivion. The moonless night was clear but he hoped the darkness would cloak their approach from the sea before the Japanese army could detect their presence. A full load of munitions

rested in the bomb bays. Their release over Rabaul would light things up pretty well in a few hours.

Deloach's radio crackled in his headset and the clearance was given to takeoff. He firmly pushed the four throttles forward and the plane responded, sluggishly at first, then with increasing speed. Passing 100 knots, he dropped a few degrees of flaps from the wings and raised the nose. *Black Jack* lifted off into the night sky and disappeared over the water climbing rapidly. Deloach reduced the throttles at altitude and settled in for the flight. Even though he was nine degrees below the equator in the tropical latitudes, above 12,000 feet it was cold and he shivered lightly in his flight jacket. He reached for the cup of coffee he'd carried into the cockpit and sipped it gratefully as the plane leveled off and Moore took over to hold her on the northeast course. Deloach had time to reflect on his aircraft's war record and his predecessor that flew her to glory, the legendary pilot Capt. Ken McCullar.



It was McCullar who had established *Black Jack's* reputation and flew her into the history books. But McCullar was dead now, killed in a fiery takeoff crash in another plane and DeLoach commanded the B-17 this night. At that moment, he had no way of knowing that this flight would be the last mission of *Black Jack*.

The beginning

The B-17 *Flying Fortress* was a big bomber by any conventional measure, weighing in at over 20 tons. Four 1200-horsepower engines hung from her wings that spanned 103 feet in breadth. In fact, the wingspan exceeded the 74-ft. length of the aircraft by a considerable amount. Thirteen machine guns jutted from her turrets and gun ports along with a full complement of bombs. Her crew of ten typically was made up of a pilot, co-pilot, navigator, bombardier, flight engineer, radio operator, two waist gunners, a ball turret gunner, and an extra gunner who roamed within the fuselage as needed. B-17s became famous through the exploits of their heroic crews over Europe in such aircraft as the *Memphis Belle*, later immortalized in press and movies.

Black Jack was B-17 #41-24521, Model E. She rolled out of Boeing's Seattle factory in July of 1942 and six weeks later was assigned to the 43rd Bomb Group based in northern Australia. The 43rd was part of the 5th Air Force that had been specifically formed to provide aerial support for General Douglas MacArthur's return to the Philippines. This was considered crucial to the defeat of the Japanese Empire's forces in the western Pacific. But in September of 1942 the Japanese were within 30 miles of Port Moresby, the last major Allied position in New Guinea. This was the stepping-stone the Japanese hoped to use to invade Australia, only a short distance to the southwest. The 5th Air Force was engaged in a desperate holding action facing an overwhelming enemy force.

The new bomber was assigned to McCullar and was given a new nickname, *Black Jack*, derived from the last two digits in her serial number "21". Her name along with an artist's rendering of the Jack of Diamonds and the Ace of Spades was painted on her starboard nose proudly declaring her identity. It was one that the Japanese would get to know all too well over the next nine months.

There was a bond between the aircraft and her skipper that was palpable to her crew and other observers. McCullar enjoyed a reputation as a flamboyant gambler and fearlessly aggressive pilot. He even had a 14th machine gun mount installed in the plane's nose fired by a button on his control wheel so he could use the big bomber to personally duel with Japanese fighters that dared to challenge him. He pioneered a tactic called "skip bombing" where he would roar in at minimum altitude and release his bomb loads about a hundred feet short of the target ships. The bombs literally skipped off the water at high speed and slammed into their prey just at the waterline. It was highly dangerous, requiring split second timing, but devastatingly effective. McCullar's technique was picked up by the rest of the 43rd and sent thousands of tons of enemy ships to a watery grave.

Black Jack and McCullar became an awesome team, simultaneously respected throughout the Allied squadrons and feared by the Japanese. Flying as many as three missions a day, *Black Jack* and McCullar achieved near mythic status and always came back... sometimes against all odds.

A legend is born

In November of 1942 the Japanese decided to mount a troop deployment on the Allies and sent five destroyers laden with attack forces out of Rabaul into the Huon Gulf under cover of night. This would stage an assault on the undermanned Port Moresby less than 75 miles away

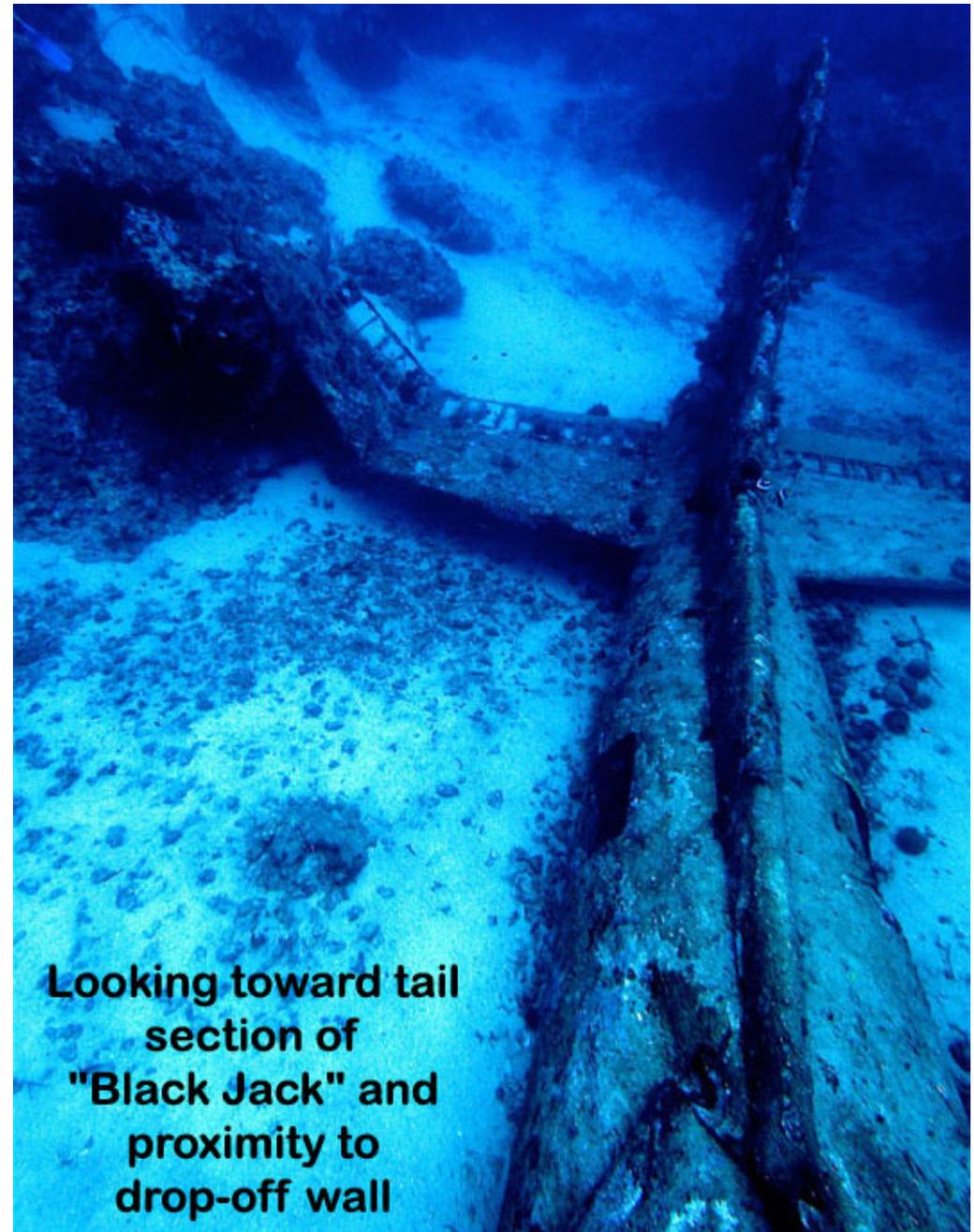
on the other side of the peninsula. The B-17s were sent to stop them. McCullar led the air group and located the destroyer convoy as they cleared Rabaul and headed west under New Britain Island. His first attack run was made at less than 200 feet skimming in over the ocean as tracer bullets from the ships outlined his approach. His bombs just missed the first destroyer and he decided to go around for a second bombing run. Enemy machine guns had set off ammunition stored in *Black Jack's* tail section and a fire broke out. Flames leaped out into the interior, but the crew managed to control it as McCullar lined up his second attack approach, this time barely above the wave tops.

McCullar waited until the enemy ship filled his entire view and then dropped his bomb load with a direct hit on the bow section. Rocked by machine gun fire and heavy artillery, *Black Jack* sustained several hits that wounded three crewmembers before they veered away barely escaping. The cool McCullar fought for control and swung the aircraft back around for a third attack run. This time the Japanese fleet put up a blistering wall of fire but more of *Black Jack's* bombs found a target with another ship. A geyser of explosions filled the night sky and the plane's left outboard engine was hit and the controls were shot away.

Though crippled and fighting to keep his B-17 in the air, the unflappable McCullar made a fourth low level attack run scoring more hits on the remaining Japanese warships. With two bombs left, a final fifth pass was made from 4000 feet. That cost him the inboard engine on the right wing that was hit in the fuel system and shut down.

Now down to only two engines, *Black Jack* began to lose altitude and McCullar faced the long haul back to Port Moresby that would require him to somehow clear the Owen Stanley mountains... over two miles high. It was a grim scenario: only two engines working, a third on fire, the aircraft shot to hell, half the crew wounded, and

unable to maintain altitude. A quick glance at the altimeter confirmed the worst... they had slipped below 3000 feet.



Looking toward tail section of "Black Jack" and proximity to drop-off wall

McCullar ordered the crew to throw out all remaining ammunition and loose equipment in a desperate attempt to slow their descent. The damaged left engine smoldered and sparked threatening to explode at any moment. Ditching in the ocean seemed the only way out but would mean certain capture by the Japanese and McCullar doubted if his wounded could make it out alive on the crash landing. The command came to rip out seats, tables, emergency gear, even their machine guns, and throw it from the amidships hole in the fuselage.

Slowly *Black Jack* leveled off and began to climb on her two remaining engines. The left outboard propeller glowed cherry red and finally sheered off spiraling into the sea. It took two and a half hours to wrench their way to 10,000 feet, just enough to make it through a mountain pass and set down safely in Port Moresby. McCullar's gritty persistence brought his crew back safely and his unprecedented five attack runs sank the Japanese destroyer *Hayashio*.

The last mission

Tonight's mission had already started badly when the #2 engine failed to run smoothly during takeoff run-ups. Deloach snapped to attention when the right inboard engine faltered two hours into the flight. He adjusted the fuel mixture and it finally stabilized. Engine troubles and he wasn't even over the target yet? Was that an omen? To add further stress, a violent weather system could be seen approaching as they neared the southeast coast of New Britain.

Now flying in violent winds, driving rain, and flashes of lightning Deloach fought to keep his plane aloft. He finally caught sight of the enemy convoy and lined up his bombing run. The squadron of B-17s roared in from the storm and caught the ships by surprise. The enemy was almost completely annihilated, less than 900 of 7000 Japanese combatants survived.

Victory was fleeting however. As Deloach maneuvered for his return to Port Moresby, the full fury of the storm erupted on *Black Jack*. Rocked by turbulence and with visibility so reduced that the other planes were obscured, a battle ensued just to remain in the air. First one, then the second engine on the right wing failed. Dodging the dense main storm clouds and pockets of lightning, Deloach was blown off course and finally became hopelessly lost. With fuel low and the plane struggling to maintain altitude, the pilot knew they would never clear the mountain range even if they could establish their position.

Shouting to Moore as a sounding board for options, the two men grimly decided that ditching was their only choice. In the early dawn light they peered below them looking for a potential site to put down in shallow water. Sweeping over a finger of land known as Cape Vogel, Deloach caught a glimpse of a native village perched on a sandy beach next to a shallow lagoon.

"That's it," he thought. "If I can grease her into the lagoon behind the barrier reef, we can get out before she sinks and swim to shore."

He quickly relayed his intentions to the crew and told them to secure for a crash sea landing. With two engines out and fuel down to fumes, Deloach lined up his approach. He knew he'd only get one shot at it and better make it good. Cranking in full flaps, he brought the plane in nose-high and as slow as possible. It touched down briefly inside the lagoon and skipped into the air again to land just outside the barrier reef in deep water. Three crewmembers were injured on impact, but all nine scrambled out of the sinking hulk and fell into the black water as the morning sun rose from the storm-tossed ocean. But fortune smiled on Deloach and his men as the natives saw the plane crash and launched their canoes to rescue them.

View of "Black Jack" right wing showing both engines



All were safely recovered and they spent the night sheltered from roaming enemy troops in Boga Boga village. Their escape was facilitated the next day by an Australian coast watcher named Eric Foster who called for a small seaplane to set down and take out the three wounded men. Later a P.T. boat came in and rescued the remaining crew dropping them off on nearby Goodenough Island. Another small plane landed there and brought them back to Port Moresby, a fitting end for a courageous crew and a legendary B-17.

Deloach was awarded the Silver Star for his flying skills and valor saving his men. He later embarked on another career as the "Marlboro Man" in a series of ad campaigns that celebrated his craggy good looks as a symbol of American rugged individualism.

The dive

I had the chance to dive the *Black Jack* in November of 2004 while aboard Mike Ball's *Paradise Sport* out of Milne Bay. We anchored just inside the barrier reef allowing easy access to the drop off wall face. My wife Gretchen and Capt. Larry O'Driscoll would accompany me. First we secured two nitrox cylinders for decompression to a stage line off the anchor rode. A steep wall precipitously fell away from the shallow reef top and we glided down to about 75 feet where we picked up the first glimpse of the massive tail of the wreck looming up from the sand bottom at about 150 feet.

As we descend, a strong current makes itself known and it's necessary to kick vigorously to overcome it. We approach the wreck from the tail that towers nearly thirty feet above the main aircraft frame. The tail machine gun turret is clearly visible and I indicate that Larry should take up a position nearby and illuminate it up with his dive light. I gesture for Gretchen to take a high position on the tail to add more size perspective. This is the hardest assignment since she has to



**Nose of "Black Jack" showing
left inside engine and cockpit,
165 fsw**

constantly fin into the streaming current.

We shoot a few frames aft and begin making our way along the fuselage. The *Black Jack* is in almost unbelievably good condition after over 60 years submerged. The aluminum structure is largely completely intact and only sparsely covered with a bit of marine growth here and there. Incredibly, the ammunition belts remain fed into the 50 caliber machine guns and their barrels still rotate freely. The right tail section horizontal stabilizer is bent slightly upwards from the impact of settling in next to the drop off wall. Swimming forward we can easily see into the fuselage compartment where the crew had braced for the landing.

The cockpit is intact as well and I can reach in to move the pilot's controls. Both seats are in place, pushed all the way back to allow Deloach and Moore to escape from the overhead hatch after setting down. The nose has bit of an upward bend to it from the initial impact and all four propellers are in still on their mounts to the massive engines. The blades show evidence of crumpling and bending from their first contact with the ocean surface at nearly 90 knots. The entire forward section of the wreck is swarming with bait fish schools, snapper and adorned with some layers of bright soft corals. Attracted by our intrusion, a few sharks sweep into view to check us out.

Eighteen minutes into the dive we are well into decompression obligations and I signal Gretchen to precede us on the ascent. I watch her and Larry drift with the current back to the tail and follow the ascent line up the wall. Alone on the wreck now, I fight my way back into position to shoot some wide shots of the wings and nose-to-tail perspectives. The current increases slightly and I angle to intercept the ascent guideline. Checking my air supply, I note that I have nearly 1000 psi remaining and decide to indulge a few more minutes to

capture the entire B-17 lying placidly on the seabed.





Skull cave dating back over 600 years of burials for tribal elders

It looks like *Black Jack* could have landed last week... not six decades ago. Firing off a few more frames, I drift up towards the deco tanks and rendezvous with my partners. We surface 30 minutes later into a blazing sunny morning and ease our way back to the stern of *Paradise Sport*.

Boga Boga village

As we toss down breakfast, Larry asks if we'd like to visit Boga Boga village and we eagerly accept the invitation. The natives of the village swarm around our launch as we come ashore. Other divers from the liveaboard have preceded us ashore while we were diving and we find that the entire village has turned out on the rare occasion that outside visitors appear.

I'm fortunate to be introduced to one of the village elders who was a small boy when *Black Jack* swooped over and splashed into their lagoon. His father was one of the first to paddle out and haul the floating crew to safety. He tells me that Capt. Deloach returned to Boga Boga after 45 years had past to see again the place of his narrow escape. I tell him that I had seen a video that chronicled Deloach's visit.

The concept of "video" is not one he's familiar with and I snap back to his reality where no electricity exists and only a handful of mechanized equipment is to be found. This is mostly limited to a few outboard motors that are rarely used due to the logistics of obtaining gasoline supplies from hundreds of miles away. This is still an outpost only barely removed from the Bronze Age and cook fires burn lowly as the evening meal simmers with a fragrant aroma. After dusk, candles and lanterns provide the only lights and they are extinguished a few hours after sunset as the villagers retire *en masse*. It's a simple life of modest gardening, fishing, and tending a few goats and pigs.

A one-room school dominates the north end of the village bringing education and literacy slowly to the newest generation.

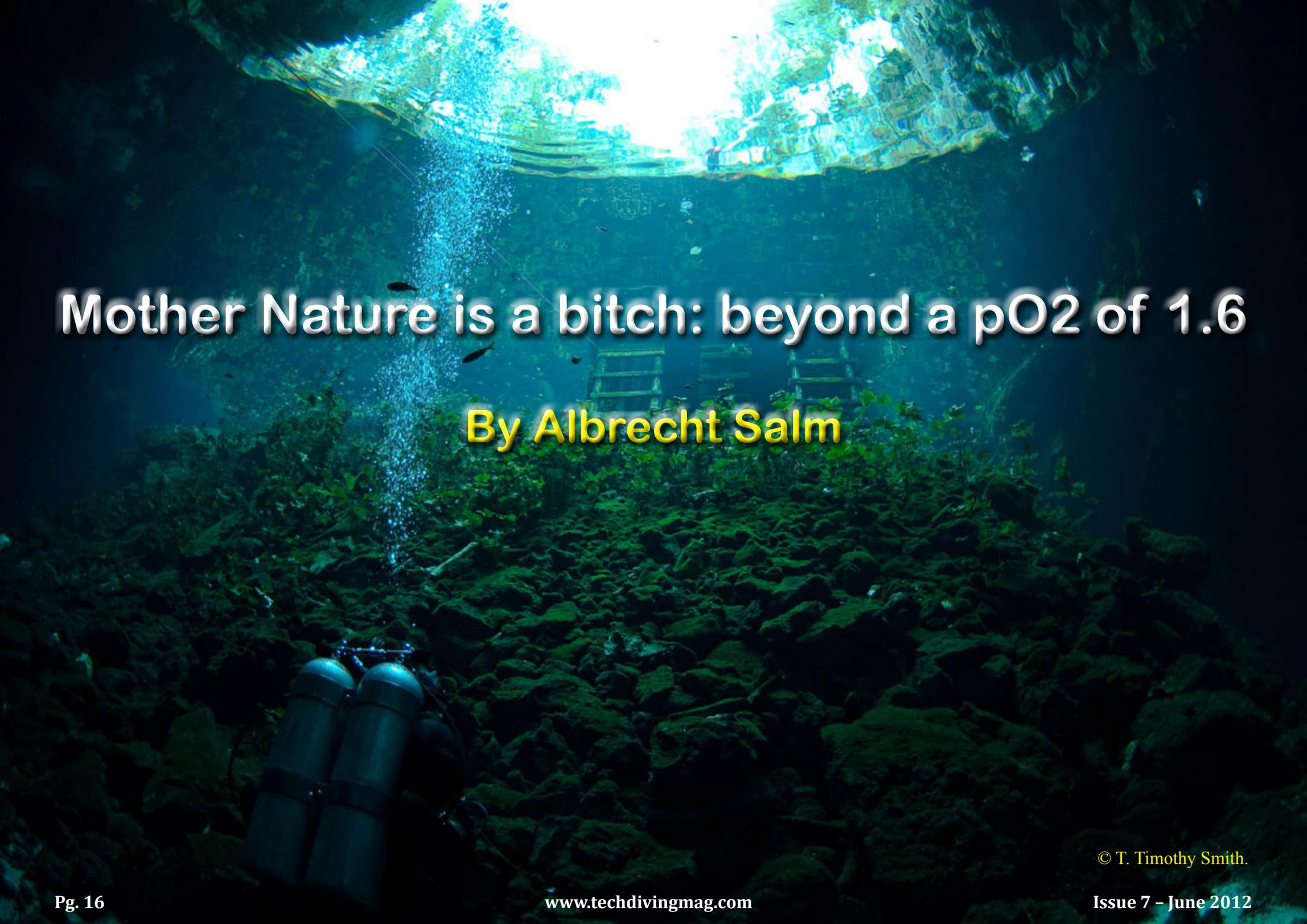
Our group spends a several hours ashore in the warmth of the sun and the village's hospitality. Finally, we bid our farewells and clamber back aboard the launches to ferry us out to the vessel. With the sun well overhead, I peer over the drop off as we approach *Paradise Sport* wondering if I can make out the wreck far below. The cobalt blue water rewards me with a clear distant image of *Black Jack* resting serenely in the depths.

The villagers saved Deloach and his crew in 1943 in spite of the very real threat of reprisals from the Japanese. The calmness of the ocean and the tranquility of the village belie the fury of war that brought Deloach and his men to this distant outpost in faraway New Guinea. A handful of divers will visit the aircraft but this relic of a conflict long over sleeps peacefully... a testament to a gritty Air Force crew and the local village that reached out from another simpler existence and rescued them.

Author's note: Since my chance to dive the "Black Jack", virtually all access to the wreck has been cut off. No liveaboard vessels currently visit the Cape Vogel at all anymore and it's beyond the reach of any land-based resorts. Boga Boga village has fallen on hard times since no outsiders can visit anymore either thus cutting off the valued economic impact of visiting divers. It's a sad story... Meanwhile the infamous B-17 sleeps peacefully intact on the bottom nearly 70 years after her plunge to depth.

Sunset over Boga Boga village



An underwater photograph showing a diver's tank in the foreground, a stream of bubbles rising towards the surface, and a wooden structure in the background. The water is clear and blue.

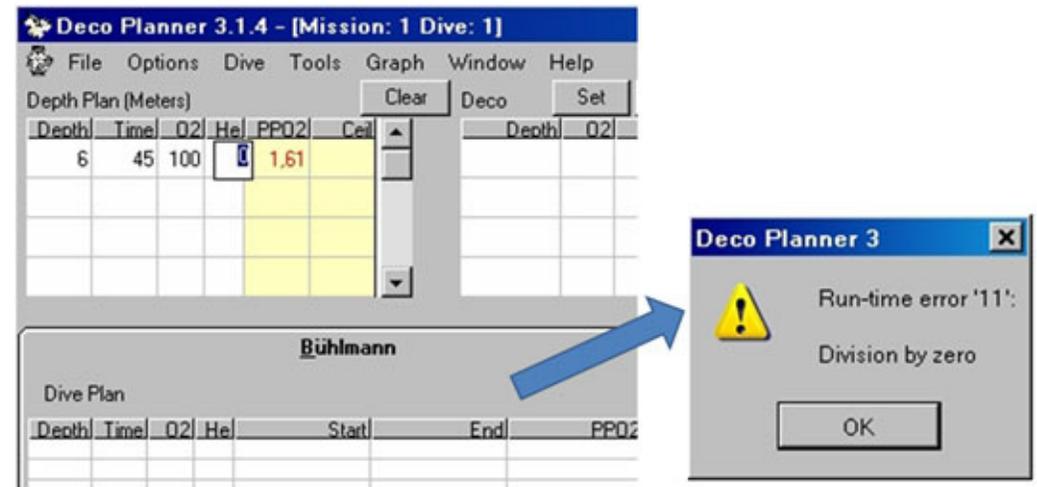
Mother Nature is a bitch: beyond a pO₂ of 1.6

By Albrecht Salm

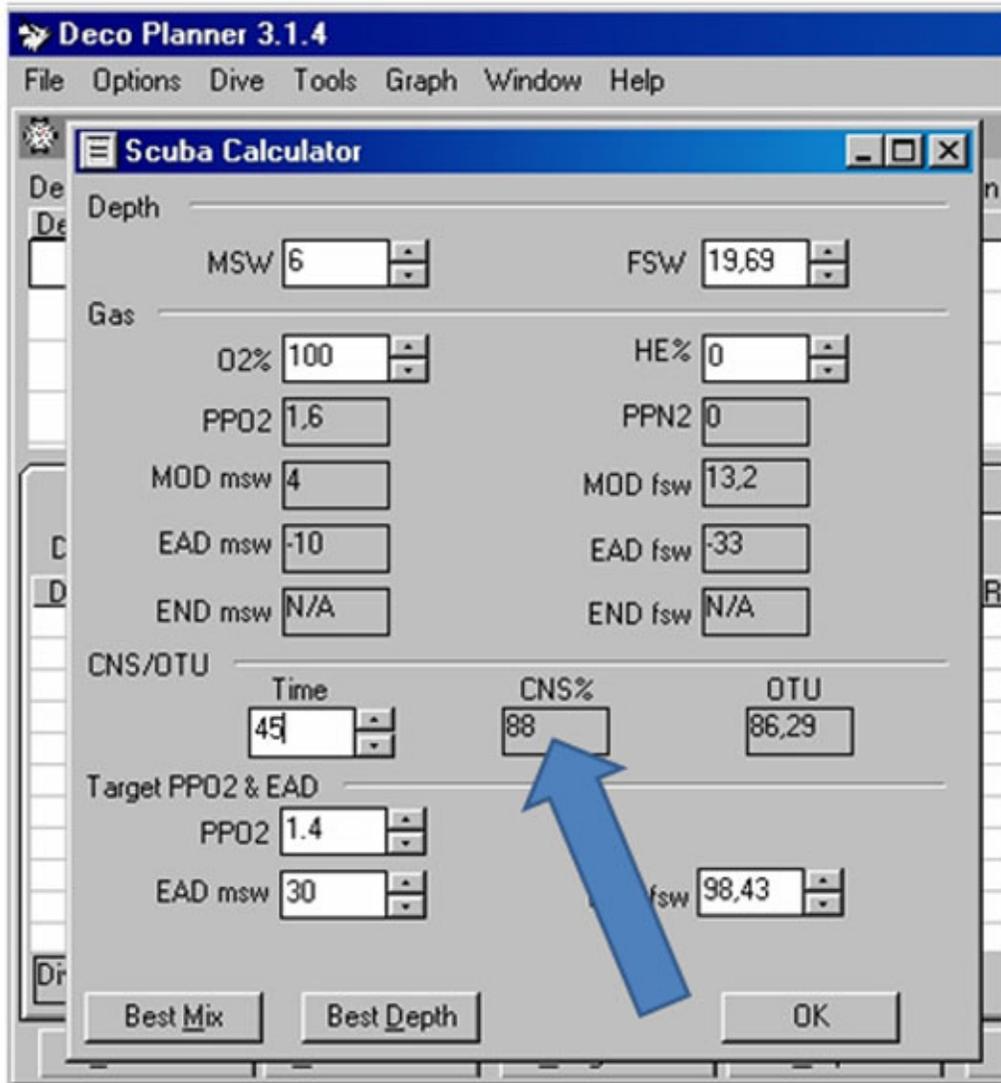
Let's consider the following scenario: you are a technical diving instructor having a bunch of enthusiastic divers, and you're diving with them all weekend long. The next day early morning you should go on a scheduled flight to your next job at another dive site. So waiting the recommended 24 hours is way out of any possibility. What are your options? Cancelling the last dive doesn't only give you hassle with re-scheduling the whole set-up with tanks and transportation, but you will as well lose customers and money. Cancelling the flight even more so!

How about that one: you do the dives, but you handle the shallow decompression stops of the last dive aggressively with oxygen, resulting in a far more expedited inert gas off-gassing (with a high risk of a CNS ox-tox hit, for sure). Anyway, you have the equipment, the expertise, the experience with thousands of dives and the bravado to do it. Your TEC students will not notice it, when you start breathing down your oxygen tank at, say 9 or 12 m. The guys are fumbling with their reels and trying to deploy their SMBs ... So, you even stay longer at 6 m, doing all the stops there for the last stages. Why did you choose 6 m? Well, besides the much higher oxygen partial pressure than at 3 m and thus a higher efficiency, there you have as well a higher ambient pressure, which gives, thinking in terms of avoiding micro bubbles which would hinder the off-gassing an even more efficient decompression(*).

Well, everything went fine this time. You sit comfortably in your jump-seat enjoying the flight, but now you switch on your laptop and try to assess your ox-tox risk from this very dive. You take your latest piece of PC deco-software and try to simulate just the oxygen decompression, nothing else (the fractions F being: $F_{N_2} = F_{He} = 0$, $F_{O_2} = 1$). You key that in, and:BOOOOOM! Off we go:



Well, you blew the software: not your fault! Due to an error, obviously sloppy work on the programmers side who did not initialize very-well all his variables with an inert gas saturation as a boundary condition for dive time $t = 0$ min, so you try something else out of the tool-box:



of pressure; instead of the [Bar] to which us regular diver folks are easily accustomed to. But as the expert you are, you know that approximately 2% are missing, pressure wise (1.308 to be a little bit more accurate), so you add a little bit to the deeper side. In terms of depth you add at 6 mca. 0.2 m to receive the requested 1.6 atm for pure oxygen.

p [Bar]	amb @ f = 1.0 O2	pO2 [atm]
1,5000		1,4804
1,6000		1,5791
1,5199		1,5000
1,6212		1,6000

This is all but just „circa“! Why? Well, even 10 m of water column do not give exactly one Bar. For pure (fresh) water the conversion factor is 0.98065, for seawater it is 1.00522 [(4), p. 893], everything dependent on the specific density of the water you dive in (or your deco software thinks, you are in ... ☺).

OOOOOOOOOOOps: wow! Shouldn't there be something like 100% of a CNS dose with a $pO_2 = 1.6$ and 45 min? Well, another oops: by checking your NOAA diving manual (1) on p. 3-23 (4th edition, section 3, table 3-4), you see that these guys are always talking about atm, which, in this case, is not the automatic teller machine you searched for urgently at the airport but: [Atmospheres], a unit

Scuba Calculator

Depth
MSW FSW

Gas
O2% HE%
PPO2 PPN2
MOD MOD fsw
EAD EAD fsw
END END fsw

CNS/OTU
Time CNS% OTU

So, this one above goes from 88% to 149%. WOW: now you get suspicious and you double-check with a completely other piece of new deco-software, keying in a couple of depths, increasing from 6.0 to 6.2 m:

Dive calculator
Units | EAD | MOD | OTU | CNS | metric

= CNS (O2%, Depth Time)

Dive calculator
Units | EAD | MOD | OTU | CNS | metric

= CNS (O2%, Depth Time)

= CNS (O2%, Depth Time)

Dive calculator
Units | EAD | MOD | OTU | CNS | metric

= CNS (O2%, Depth Time)

Here we have 84.4% to 83.1%: decreasing with increasing depth! And, as well with a somewhat peculiar peak in between at 98% and with 8 cm more depth we reach a certain trough at 79%. Well, well: we shall not split hairs here and a deviation of, say +/- 3% would be

still in the green. But this one is far, far away from the NOAA rules and seems to be not very reliable ... Even if you have right away 1.6 atm of pO₂: this is just reached at the mouth-piece from your second stage. Down your trachea the oxygen becomes quickly diluted with air saturated with water vapor, further down the airways it becomes even more diluted with your old, used air i.e. with carbon dioxide and the residual N₂ or He from your previous inert gas uptake.

And, as well concerning the dive time we could exceed the 100% CNS limit. Say at 1.6 we would stay 49 min instead of the 45, thus giving around 110%. Computational-wise this should be a piece of cake since the NOAA rule is linear in time: for half the time we would expect half the dose, i.e. 50%, or, in this example with 4.5 min the result should be 10% of the CNS dose. For your convenience, we checked a couple of deco software also in various releases concerning these two aspects, putting the results together for comparison; that is around the 100% limits in the pressure- and the time-domain to check the linearity:

pO ₂ [atm]	divetime [min]	NOAA CNS dose [%]	DIVE V2_903	GAP V 2.3	GAP V 3.0.425.6	Deco Planner V 2.0.40	Deco Planner V 3.1.4	Ultimate Planner V 1.1
d = 5.2 m			(d = 5)					
1.5	108	90	90	90.4	96.00	98	98	90.4
1.5	120	100	100	100.4	106.60	109	109	100.4
1.5	132	n.a.	110	110.5	117.30	120	120	110.4
d = 6.0 m								
1.58	40.5	-	90	89	76.00	80	80	90.1
1.58	45	-	100	100.3	84.40	88	88	100.1
1.58	49.5	-	110	109	92.89	97	97	110.1
d = 6.2 m								
1.6	40.5	90	90	n.a. (*)	74.80	134	134	102.9
1.6	45	100	100	n.a.	83.11	149	149	114.3
1.6	49.5	n.a.	110	n.a.	91.42	164	164	125.7
exceptional exposures, Extrapolation #3 d = 7.2 m			(d = 7)					
1.7	33.75	90	89	336	371.70	389	389	198.1
1.7	37.5	100	99	377	413.00	432	432	219.9
1.7	41.25	110	108	417	454.40	475	475	241.6

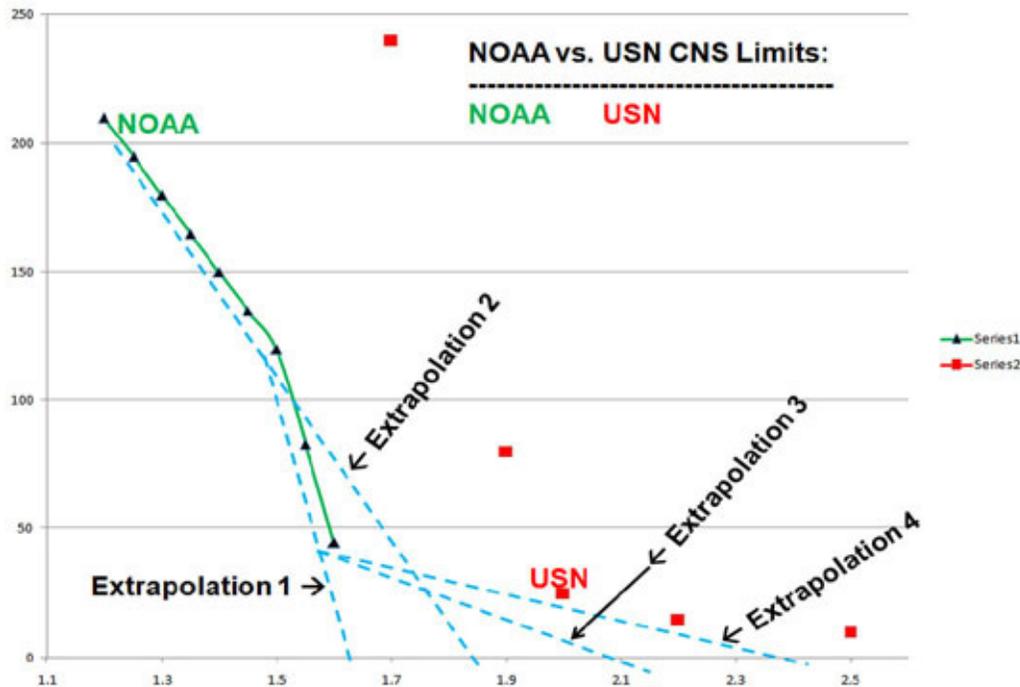
Ultimate Planner's data provided by Asser Salama

To make a long story's end: obviously there is ample leeway for a programmer to implement the ox-tox scene. To put it even more bluntly: nobody told these guys, especially around the 100% and the 100%+ dose. So let's go back to the old masters, the NOAA (1) and the USN (3): this is how they did it around 1.2 < pO₂ < 2.5 atm:

pO ₂ [atm]	NOAA [min]	USN [min]
1,2	210	
1,25	195	
1,3	180	
1,35	165	
1,4	150	
1,45	135	
1,5	120	
1,55	83	
1,6	45	
1,65		
1,7		240
1,75		
1,8		
1,85		
1,9		80
1,95		
2		25
2,05		
2,1		
2,15		
2,2		15
2,25		
2,3		
2,35		
2,4		
2,45		
2,5		10

Remark: the NOAA exceptional exposure limits are suggested from Dr. C. Lambertsen and were published in the 1991 Version of the diving manual. Bob Hamilton once described them as "best judgment" in the DAN Tec proceedings ((2), Session D2-3). The USN limits however ((3) Volume 4, table 19-4, p. 19-14) are single depth exposure limits on pure oxygen for standard procedures, not for exceptional exposures

(and, as well not for mixed-gas diving!). How could we proceed with our scenario from the beginning of this story: obviously there are a couple of ways to look at it in the high-pressure regions:



Let's discuss these extrapolations. But, please keep in mind: these are just mathematical things! That is not a recommended diving procedure! (Well, I still want to keep my instructors licenses, at least a couple of them). But we want to suggest a reasonable algorithm a programmer or developer of deco-software could easily follow. The added value would be that with various deco-software, at least the ox-tox doses would become comparable ... Well, there is much more on the road that the inert-gas doses resp. the decompression times become comparable: even if the deco software tools share the same basic algorithm there is much space for interpretation! (This is already covered in your favorite TEC-magazine: have a look at Tech

Diving Mag, Issue 5, page 41).

These extrapolations are a simple and linear by nature. Why? Well, we could have used some polynomial or another complex exponential approach. But this would not have helped us either: it just complicates the matter. The other important boundary condition is not to violate the USN limits!

If we look at the chart: the green line is the NOAA standard, the red dots are the USN marks and the blue-dashed lines are 4 linear extrapolations. Ex #1 ends at ca. 1.7 atm, Ex #2 at 1.9 atm. Those two do not give us much freedom in terms of depth: a small surge, a little wave, a quick helping hand for your diving comrades... The 9 m depth line can be easily exceeded. On the other hand, Ex #4 ends at 2.5 atm and is relatively near to the USN limits: let's avoid this one. So the straight line of choice would be Ex #3: giving ample leeway up to 2.2 atm of pure oxygen pressure but nevertheless a little bit more conservative than the USN limits.

<u>p O 2</u> <u>[atm]</u>	<u>NOAA</u> <u>[min]</u>	<u>NOAA</u> <u>except.</u> <u>exp.</u>	<u>USN</u> <u>[min]</u>	<u>Ex. 3</u> <u>[min]</u>	<u>Ex. 4</u> <u>[min]</u>
1,2	210				
1,3	180	240			
1,4	150	180			
1,5	120	150			
1,6	45	120		45	45
1,7		75	240	37,5	40
1,8		60		30	35
1,9		45	80	22,5	30
2		30	25	15	25
2,1				7,5	20
2,2			15	0	15
2,3					10
2,4					5
2,5			10		0

Bottom line is:

- we thought: let's share this information about the shortcomings of the deco software
- and: let's challenge a feedback from the wild
- and: let's suggest a possible and easy way out

- (1) NOAA Diving Manual, U.S. Department of Commerce, 2001, Fourth Edition
- (2) DAN Technical Diving Conference Proceedings, January 2008 (available for free as a PDF at: www.diversalertnetwork.org)
- (3) US Navy Diving Manual, SS521-AG-PRO-010 0910-LP-106-0957, Revision 6, 15. April 2008
- (4) The Underwater Handbook, Charles W. Shilling (ed.), 1976, Plenum Press New York

(*) At least, mathematically wise. After ca. 15 min or so your heart beats a little bit slower than normal and your blood vessels become a little bit narrower, thus reducing the efficiency a little bit. The doctors call the former “bradycardia” the latter “vasoconstriction”. These things have been investigated as well through the USN, the DCIEM and the NMRI since long. But up to now not much deco software have implemented these “oxygen correction” factors.

A large, stylized biohazard symbol in a yellow-green color is positioned on the left side of the page. It overlaps the text 'ULTIMATE' and 'PLANNER'.

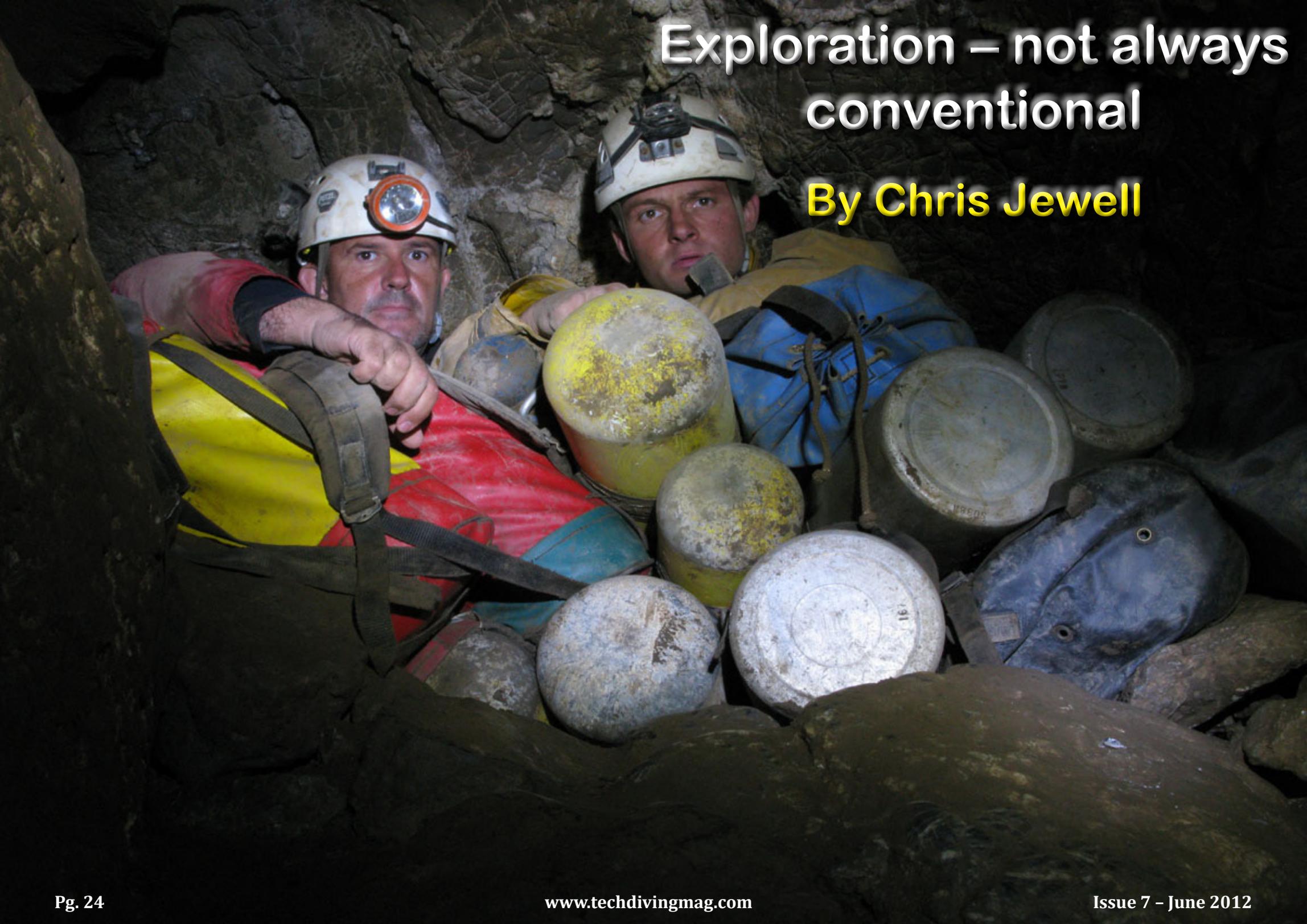
ULTIMATE PLANNER

Your Decompression Planning Software

www.techdivingmag.com/ultimateplanner.html

Exploration – not always conventional

By Chris Jewell



A small dedicated community of cave divers exist whose goal is to explore new underwater cave passages. These divers often employ unconventional tactics and equipment is often adapted for specific goals. These divers focus on 'getting the job done' and are extremely passionate about exploration. In 2009 and 2010 cave divers Chris Jewell and Artur Zoklowski made a series of exploration dives in a Spanish Mountain cave called Fou de Bor. Here Chris gives us antells the story of two friends, two explorers and gives an insight into the challenges that underwater explorers must overcome for the reward of discovery.

“Hello Chriiss” said a very sleepy Artur Kozlowski in a Polish accent unsoftened by several years of living in Ireland. It was about 9.30am and I'd had to phone three times to wake him up!

Dispensing with pleasantries I got straight to the point “This is going to sound crazy but do you want to come to Spain on Friday to push some underwater caves?”

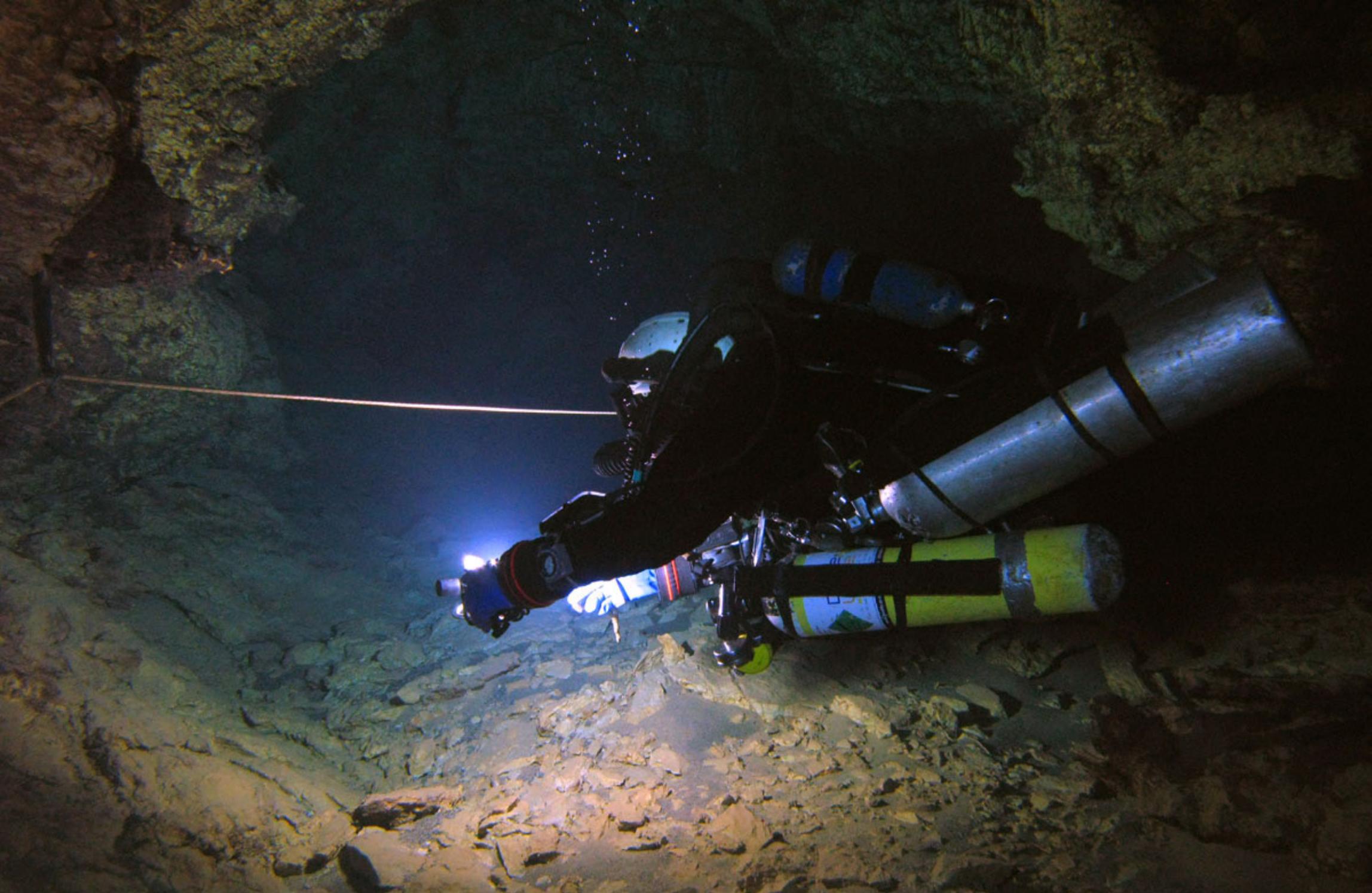
I'd been planning a cave diving expedition to Northern Spain in the autumn of 2010 for 4 months. John Volanthen was to be my diving partner but at the last minute he was called to go to France to assist in the attempted rescue of Eric Establie. Suddenly my trip fell apart and I could think of just one person with the experience necessary who could drop whatever they were doing and go to Spain with only a few days' notice – Artur Kozlowski.

Of course he said yes and after explaining the project and the plan ferries were hastily booked. To add to the sense of rushing around we were recruited to collect diving kit from Rick Stanton and John Volanthen's houses enroute to Dover in order to drop it off in the Herault. In case the reader is not familiar with the geography of

the UK, I can assure you that - that Bristol is not on the way from Manchester to Dover!

Our contact in Spain was David Magdalena, a Spanish caver and cave diver that I'd met on another expedition in 2008. He'd invited us to dive in Fou de Bor a resurgence site in the Catalonian Pyrenees near Andorra. A resurgence is the term used to describe a cave where the water comes out of the mountain rather than goes in. Some caves resurge into rivers or large pools but in other cases it is necessary to travel through a section of dry underground passage first. Fou de Bor was such a cave. Furthermore it was very well known in the local area as the dry section of the cave is a very popular beginner's trip. The cave has also been known for a long time and exploration first started in 1885. The sump however was far from a beginner's sump. It was the site of Spain's first cave diving fatality in 1965, a reminder of which can be seen by the plaque at the entrance remembering the two divers who lost their lives. Since that time the last explorer was Xavier Garza in 1998 when he had used open circuit scuba to reach a point 367m from base at 60m depth. Artur and I planned to use rebreathers to carry on past this point.

Equipment decisions are one of the key things a cave diving explorer must deal with. When diving open circuit the simple third in, third out rule ultimately dictates the amount of gas a diver can use whilst exploring and related to their depth this equates to an amount of exploration time. Simply put to dive longer and deeper bigger cylinders are required. Beyond diving thirds on a pair of cylinders an explorer can utilise several stage cylinders to increase the amount of exploration time. Added to the calculations need to be the potential for decompression requirements and extra gas carried for this eventuality. With open circuit scuba these cylinders will be consumed during the dive and need replacing before subsequent dives can take place. When



Artur in the excellent visibility of the Fou de Bor sump

cylinders need to be carried a reasonable distance into and out of the cave the size and quantity of these becomes a factor in how realistic it is to accomplish a project.

Using rebreathers helps with the volume gas required and the logistics of transporting cylinders to the dive site but introduces greater uncertainties. The principle of a safe exit in the event of equipment failure needs to be maintained. E.g. the diver needs enough bailout gas to get out of the cave from the furthest point. However calculating this requirement is not always so easy. In a cave with a known profile calculations on turn points based on gas consumption factoring in depth and swimming speed can be made. When exploring this is harder but generally a diver can however make some calculations beforehand using their estimated swimming speed and SAC rate and then set themselves some turn points based on distance and/or time. As the cave was trending deeper we also had to factor in the decompression requirements in Fou de Bor. Ultimately therefore our exploration time would be governed by the distance we swam and corresponding dive time but also by our decompression obligation. The equipment we selected for the first dive had to be sensible for transportation into the cave, give us flexibility to deal with different scenarios and be practical to carry underwater. It isn't simply a case of adding as many cylinders as possible as you reach a point that this slows you down and hampers your ability to move through smaller passages. Therefore in addition to our rebreathers we each had a 12ltr of TMx and an Ali80 of EANx. Finally on the first dive we also left a single Ali80 of O2 at 6m. In a cave like this this one to conserve the O2 for future dives we generally do our decompression on the rebreathers. However open circuit oxygen in case of failure is very important.

We arrived in the Pyrenees in the middle of a storm which set the

scene for the rest of the trip (it was the middle of October so perhaps I'd been optimistic during my planning). I'd promised Artur sun in Spain but all we seemed to get was drizzle. On the first day we carried our diving kit up to the entrance of Fou de Bor with help from our Spanish hosts. The rain did stop for us and we began to get hopeful. After many short but very sweaty caving trips we had kit set up at the sump and began to put it all together. To make matters more difficult in the cave there is a steep muddy slope down to the water and no dry land at the bottom. It was getting late by the time everything was ready but we dropped below the surface of the water to find out what the cave was like. Visibility was terrible but we expected as much as the water in the pool was static. We passed two underwater squeezes at -9 and -12m respectively and we hoped we'd meet nice clear water pretty soon. However when we got below 20m and into the full flow of the underground river it was clear that conditions and visibility were terrible. We turned the dive and headed out to wait for a better chance. For 3 days we waited for conditions to improve whilst we were given a guided tour of the local area by David Magdalena. It was pleasant but really wasn't what we'd travelled to Spain to do and it sapped my morale.

Finally though we got to make our big dive, conditions above ground had improved slightly but I still wasn't optimistic of good visibility underwater. However when we reached the sump pool the water level was 1m lower than on the previous visit – a very good sign. Once underwater, at the squeeze at -9m the fast flowing river was met and we emerged out of the gloom into clear(ish) water with around 5m of visibility. The old dive line was followed down to -40m as the survey drawn by the previous explorer indicated. Then rather than carry on directly to 60m as had been reported, at 50m depth an elbow was passed and the dive line was followed back up to 30m. Here we tied on our own reel and set off into the unknown.

Following dive line



Almost immediately a deep shaft loomed ahead – the dark blue of the pit leading us straight down to 60m before the gradient eased off (this was the 60m point reached by the previous explorer but the line has been washed out). I had the line reel in my hand and descended the shaft feet down whilst I watched the spool turn slowly, depositing the fine white string along the cave wall. At the bottom we followed the sloping passage to 80m depth and a gravel floor before the cave finally started to rise in a series of steep steps. The passage was large here and we rose up above boulders in the steeply ascending cave. At 35m depth after laying 210m of new line and having significant decompression already racked up we voted to turn back for surface.

During decompression a problem with my chest-mounted rebreather meant I needed to use some air from my bailout cylinder for 15minutes at -9m before swapping back to the rebreather to complete the decompression. The 9m stop was made halfway through the squeeze, with our feet in clear fast flowing water and our torsos and heads in the murky static part. At -6m the visibility was 30cm and an extremely cold 100minutes was spent in the 8 degree water, leading to a total dive time of 5hours. The end of the line after dive was now approximately 588m from dive base.

I expected I wouldn't get a chance to return to Fou de Bor for several years but when we postponed an expedition to Meixco in 2011, heading back to Spain in the summer seemed like a good idea. Artur was also up for it. We'd taken my car in 2010 and even though I was now driving a more sensible estate car we weren't sure it would be large enough. Artur however had just purchased his first car – a long wheel base bright yellow Ford Transit van -The thing was huge! The Van however was also rather untested and considering we were planning a several thousand mile trip he booked it in for a service/checkup which thankfully showed up no problems!

I soon got used to driving the Yellow monster and we took it in turns to drive through the night and day to Spain, finally arriving at our campsite on a Saturday evening. David Magdalena wasn't able to join us until the middle of the week but another local cave diver had become interested in our exploration. Joel was not a caver and had never been in a dry cave, he was used to diving in sites with quite easy access and his equipment showed this. He was also a keen videographer and I was a bit reluctant to invite Joel to help us as I knew we'd end up carrying more kit but Artur was instantly attracted by the idea of filming. So Joel appeared on Sunday morning after a tour of all the local campsites and watched us fettle kit for several hours.

After driving to the cave and piling the gear by the side of the road our first bit of good luck happened. Four cavers appeared, two of them on their first caving trip. When they saw the pile of diving cylinders and tackle bags their eyes were wide but they offered to help with a few bags and saved us a couple of journeys.

We knew we'd need more equipment to explore further this year. This included extra diving cylinders and in my case a Santi heated vest with large battery pack to combat the cold water during the long decompression stops. Because of the extra equipment we decided to do a set up dive to make the main exploration dive easier. We put two Ali80s of Oxygen in the water at 6m depth and two 7ltr cylinders with EANx32 about 380m from base in case of needing to bailout. On this setup dive I also took some underwater photographs and the visibility (once passed the static sump pool) was excellent compared to last year.

On our first exploration dive we were accompanied by Joel who wanted to do some filming. After the first 100m of passage we waved

Artur checking his computer during decompression



goodbye to our cameraman and headed off for the end of the line. I was using my chest-mounted rebreather, one 12ltr cylinder of 10/50 Trimix and one 12ltr of EANX32 Nitrox. Artur used his Megalodon rebreather with two similar large cylinders of off board diluent, with both of us swapping gases based on depth. We got passed our deep point of 80m found last year with only a maximum depth of 78m due to the lower water levels. In the much better visibility the ascending passage beyond could be fully appreciated – there were very large piles of boulders stacked up steeply with a winding path between them. Artur reached the end of the line first at -35m and we followed the cave upto -12m. On the way we now had to make decompression stops of several minutes at -18m, -15m and -12m. Once passed the 12m point some horizontal passage was followed to -10m and after a short descent the cave headed up again and it looked like it might go to surface.

As a cave explorer with a background in ‘dry’ exploration this is the ideal scenario. Once out of the water we could spend hours exploring passages and reduce our decompression for the dive home. Although cave diving solely for the purpose of underwater exploration has long been established, originally sumps and underwater passages used to be seen just as obstacles to be passed. With the majority of UK based exploration divers coming from a ‘dry’ caving background this view often prevails and for many reaching surface beyond a sump is the ultimate goal.

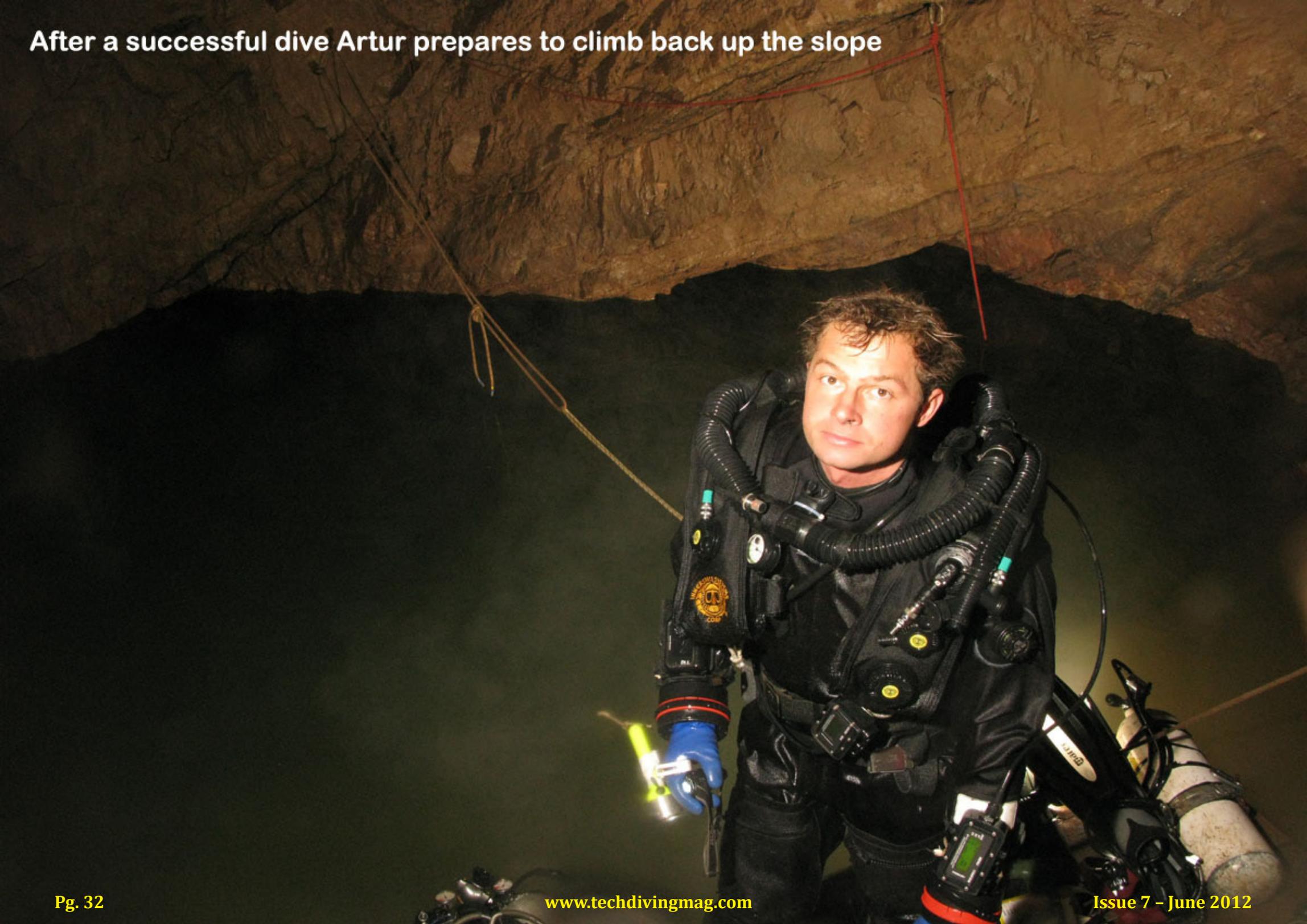
My dive computer showed me that if we wanted to surface we would need to make a total of half an hour of decompression stops – considering the longer length of our previous exploration dive this was great news and it looked like everything was going perfectly! However just at this point a long gradual descent began. After 260m of new line the cave was back down at -44m and Artur finished his

reel. I tied on my reel and ran out another 70m until -52m was reached and we called it a day. We ended up with a total dive time of four hours with 330m of new line laid.

The plan was have a rest day the following day but we needed to carry some kit in and out of the cave to be ready to dive again. Plus Joel had arranged for us to meet a local TV news crew at the cave so we found ourselves back at the site early(ish) the next day. David Magdalena arrived to help us and keep the news crew and the excitable Joel at bay. After some posing for the camera and a short interview they went away so we could get on with the real work of swapping depleted cylinders over and bringing damp dry suits out into the sun. For our second push dive we also wanted some extra emergency gas and so another large cylinder was carried in so that it could be left after the first deep section.

That evening after another portering trip to the sump we found a note on our windscreen in Spanish with a name and phone number. Not sure what to make of this we dialled the number and spoke in broken English/Spanish to a gentleman who told us to wait in the village. I wasn’t sure if we were in trouble somehow and thought we’d look very foolish if we turned out to be waiting for the police to arrest us. Fortunately however an elderly gentleman appeared in a 4x4 and beckoned us over. He had a house in the local village and from the caving magazines he pushed into our hands we worked out that he was involved in the early exploration of Fou de Bor. Ramon Canela turned out to be the local caving godfather. Back at his house he produced surveys, books and photographs of caves nearby and we quizzed him about the history of Fou de Bor. It was one of those wonderful chance encounters that cave exploration creates. Meeting a caver from a different generation and culture we were able to connect over our exploration in one of his favourite caves.

After a successful dive Artur prepares to climb back up the slope



The next day our push dive went ahead as planned. Apart from laying line we were also under pressure to do some survey work.

The amount of dive line laid in a cave will tell you the distance to swim but without compass bearings and depths it is impossible to tell where the cave is actually headed inside the mountain. In order to do this and produce a map of the cave, explorers need to survey their finds. This is done by recording the distance between two points, the compass bearing and the depth at both of them. With well tagged dive line the distance part is easy – the rest just involves stopping and writing down the depth and bearing every 10m.

Surveying however is time consuming and combining this survey job with exploration was not ideal. We hatched a plan to take it in turns to survey on the way in down to a depth of 40m then swim quickly through the deep section and complete this survey on the way back. This however affected our required decompression. Previously on the ascent to -12m beyond the sump elbow the total time to surface had been half an hour. Now the extra time taken with the survey meant this had already doubled before we'd even reached the end of the line. Then at 800m from base one of my PPO2 displays flooded. Combined with the extra deco we'd racked up this was enough of an excuse to turn back for me. There was still survey work to be done in the deep section and if we split up we could achieve both an extension to the cave and the crucial survey.

To some readers this action of splitting up will seem to go against everything they have learnt. However solo diving in 'UK' cave diving is a well-accepted practice and actually the norm for very good reasons. Although the conditions in Spain were much better than we were used to, we were both equipped and very comfortable with diving solo when the need arose as it did here.

Artur therefore headed on till he reached our previous limit at -52m where a fresh reel was tied on. After a short shaft down to -65m two ways on could be seen – up an ascending canyon to the right or down a smaller passage to the left. Looking for depth Artur chose left and found himself at -96m shortly afterwards and in a massive chamber. He described the cave at this point as a massive collector with what looked like several passages coming in. Having now laid 140m of new line and bearing in mind he was now over 1km into the sump he called it a day. In total I ended up with a 5hour dive whilst Artur was in the water for over 6hours. The survey was completed upto 800m though the end of the line is now 1,050m from base and down at -96m.

We were very pleased with the dives but we couldn't relax and rest on our laurels until we had the kit out of the cave. Knowing how much there was I was secretly dreading this. However the next day when we arrived at the sump we found a large party of visiting cavers stood around. With just a little effort they were persuaded to grab a few bags and take them out with them. Meanwhile Artur, David and myself began to carry the heavy cylinders out. We moved the mountain of bottles near to the entrance and then made a chain through the smaller sections of cave. Finally once the bottles were near day light our next bit of luck came along. Ramon's son appeared from the town with lots of local lads who all grabbed the kit and took it off to the Van. Ramon was there as well and once we had everything back at the van the entire group departed for a well earned celebratory drink in the local bar. With lots of hand shaking and promises of "see you next year" we left Bor satisfied with the dives we'd done and the delighted by people we'd met along the way.

I'm afraid this story doesn't have a happy ending. Not long after we returned from Spain Artur made an exploratory dive in Pollonora 10,

a cave in Kiltartan in Ireland. Unfortunately he never returned from that Dive. He was well equipped, prepared and well trained. However nothing can remove the inherent risks of cave diving and Artur knew and accepted those risks. His death is a sad reminder for all of us of the dangers but equally Artur would not want it to deter anyone else from cave diving exploration. This article tells the story of our last dives together and writing it is something he and I discussed and planned. I know that Artur would never have wanted a good story to go untold!

Chris Jewell lives in Manchester in the UK and has been cave diving for 6 years. He is currently planning an expedition to Sotono San Agustin, a deep cave in Mexico and you can find out more on www.facebook.com/cavedive



Chris, Artur and David at the cave entrance
Photo by Ramon Canela



Mike deGruy

LITTLE BIG MAN

BY BRET GILLIAM

As a highly successful filmmaker for over 25 years, Mike deGruy has had his ups and downs. He's won dozens of awards both domestically and abroad and his work has appeared everywhere, BBC, PBS, TBS and National Geographic Television. But along the way he's spent a few nights in Heartbreak Hotel.

Early in his career, deGruy was viciously attacked by a shark and narrowly escaped death. He's lost over a half a million dollars worth of filming equipment due to circumstances beyond his control in the field. And he's even had his support ship sink out from under him into 2,000 feet of water. Yet, like a true pro Mike has always come back with the footage. From his dramatic images of orcas snatching sea lion pups from the beach to his elaborately detailed studio sets, deGruy's career has taken him to the world's most remote and spectacular locations.

Although a bit "vertically challenged", at about five and a half feet in height, Mike is also perhaps the most boundlessly enthusiastic person in diving. Whether onstage narrating a film segment or appearing in his numerous documentary productions, there is no mistaking when he makes his appearance. Audiences are snapped to attention. Children crane their necks to get a better view. Even dogs and cats strain to figure out what all the ruckus is about. The man is like a Tasmanian Devil on speed. And once he gets going... well, it's best to just get out of the way.

We met in February 1996 while we were both working on a *National Geographic Explorer* documentary on humpback whales out on the Silver Bank, north of the Dominican Republic. He was the Director of Photography and I was the designated "whale expert" whose mission was to shepherd host Boyd Matson into camera frame with the leviathans and, hopefully, bring him back alive. I also had to train

all the film crew to dive on rebreathers, a product that was new to most divers at the time. We've been close friends ever since.

Our trip started out steeped in humor and only got funnier. In an article I wrote back then called *On the Road* with *National Geographic* I noted our departure from Grand Turk in rough seas: "I knew right away that Mike deGruy and I were going to get along as we both stifled laughter observing the rest of the *National Geographic Explorer* film crew trying to cope with seasickness. Mike is one of the world's top nature cameramen both above and below water. And he's spent his fair share of time bouncing around boats in various ends of the earth. He even had a shark try to chew off his arm a few years back leaving enough scars to win any bar room contest of diver stories. So I didn't expect the 10 foot seas we were battling today to bother him too much.

But Boyd Matson, the show's host and resident talking head, was a bit less experienced. When he boarded the expedition vessel at 5:00 AM that morning, I had already placed him under "fashion arrest" for carrying more than 50 lbs. of hair care products in his luggage. Boyd has hosted the *National Geographic Explorer* series for about a year now and he's got to be one of the nicest guys you'll ever meet. He kind of looks like a Nordic cross between Robert Redford and Huck Finn with a tousled head of blond hair right out of the J. Crew catalog. For a balding guy like me, it was disgusting.

But seasickness had Boyd's full attention. Right now he was wiping the fruits of his last "heave ho" out of that million-dollar hairdo and working on his best thousand yard stare while silently praying that the damn boat would stop rocking. Lined up next to him in white-knuckled angst were producer Claire Van dePolder and sound technician Eddy O'Connor. Both were engaged in spirited Technicolor projectile vomiting. As Mike and I turned away giggling inanely, Eddy flashed

me a look that said, “Who do I have to screw to get out of this movie?”

Yeah, we were off to a good start. And before you could say “Sasoon Herbal Cream Conditioner”, Boyd and his cosmetics were on the way to the whale petting zoo.

All kidding aside, Boyd’s got a pretty tough job. He basically has to learn a new extreme sport every week and try to look good doing it. The week before he had been traveling by dog sled in mid-winter blizzards in Minnesota and then was shipped off to be hurled off some high altitude mountain peak to bring back some gut-wrenching hang gliding footage. So I guess, we *should have* cut him some slack when he showed up to learn to dive with rebreathers... and 60 ton whales... in the open ocean... in one day. But, of course, we didn’t.

Mike, being a professional diver, got used to rebreathers in a heartbeat. Boyd’s learning curve was a bit steeper. Think of looking back on Everest’s north face route and that might put it in perspective. But sort of like an eager golden retriever, Boyd would try anything and keep going at it until he almost got it right. I swear I contemplated tossing a Frisbee off the stern of the boat once just to see if he would fetch it.”

When I launched *Fathoms* magazine in 2001, I asked Mike to be our first interview subject. He agreed, “As long as we don’t have to discuss that hot tub incident at your house during the snowstorm.” In the dialogue that followed, Mike spoke frankly about his life, filmmaking, and what it’s like to take a deep submersible into the ocean’s depths. His encounter with my treacherous hot tub remains forever sealed.



Fifty-foot female Humpback whale dives inches away from Gilliams’ camera during National Geographic Explorer television shoot

Mike, we've found out that you're originally from Mobile, Alabama. How did a Southerner make it in the California film scene?»Hmmm... That's a bit strong. Certainly I have not made it in Hollywood. I may have lucked into a few dollars and filmmaking opportunities in my little natural history documentary world, but after 20 years, who wouldn't? Mobile was important to what I do today. I grew up, on and in the water in the many rivers around Mobile Bay and the Gulf. I had a mad obsession of flying and since I couldn't afford a plane, I bought a regulator. It's the same thing really, only you're flying underwater, and much cheaper. School and the urge to see and study coral reefs took me away from the South and to Hawaii. I never left the Pacific.

Kidding aside, how'd you get started in filmmaking and not, say, lumberjacking?»Let's get something straight here: kidding is never an aside. Okay, here's the brief scoop: while I was a lowly grad student at the University of Hawaii, thinking I was headed for a career in Marine Biology, fighting my friends for tenure at some plum spot in the tropics, teaching Zoo 101 the rest of my life, I met a madman who sent me, Bruce Carlson (current Director of the Waikiki Aquarium) and Paul and Gracie Atkins (who took the same career path as me) to Palau to collect live chambered nautilus (my research animal at UH). At the last minute he threw a couple of old Arriflex S cameras at us and said, "Make a movie of this."

So we did. It had to be the worst piece of crap you'd ever seen, but it was a blast to do and upon returning I immediately dropped out of school and started making films. I never told anybody I didn't know what I was doing, so I kept getting hired. I have to say, however, that splitting logs was a close second.

How long were you in the Marshall Islands?»I lived in the Marshalls for three years as the resident manager of a marine lab. This was a wild period of my life. I took a year off from school for the job and after three years made that trip to Palau and, well, never returned to UH. I was in my mid-20s, had free run of a spectacular atoll, managed about 10 boats, had full diving facilities and dove my butt off in some of the most spectacular waters and reefs I have ever seen. Never mind that little shark thing.



In a protective mobile shark cage deGruy designed and built, deGruy filmed sharks in the Marshall Islands for a BBC and National Geographic film, *Sharks on their Best Behavior*

Speaking of that, what's it like having a reef shark chewing on your arm like it was a chicken wing?» Grey Reef sharks just have no sense of humor. What's it like? What the hell do you think it was like? Well, that's not entirely fair since you have experienced a shark attack first hand as well. You know, between the two of us and friends like Al Giddings, Rodney Fox, Jimmy Stewart... we ought to start our own club for shark survivors. That would be a neat little fraternity.

But back to my own personal little *Jaws* incident. I innocently took a picture of a shark that was some 20 feet away, admittedly it was in a threat posture, but jeez... and the little five footer shot right in and ripped off the top of my arm! I couldn't believe it! At first everything was happening in super slow motion and I watched with unbelieving eyes. The shark's head approached, brushed my camera aside, and at the very last nanosecond, opened its mouth and engulfed my right forearm. After the mouth closed and it began shaking like some rabid dog, things sped up really fast and I was being jerked around like a rag in a mad dog's mouth. It ripped off the top of my arm, did a loop, and attacked again from below. As I futilely kicked at it, thinking "aloha world," it grabbed my fin rather than my lower thigh, again shook like a paint shaker and tore out a semi-circle of rubber. This, apparently it didn't like, as it spat it out and went after Phil Light, my diving partner. I'd never imagined I would be happy to see someone attacked by a shark, but I sure was then! Phil was cut, but okay.

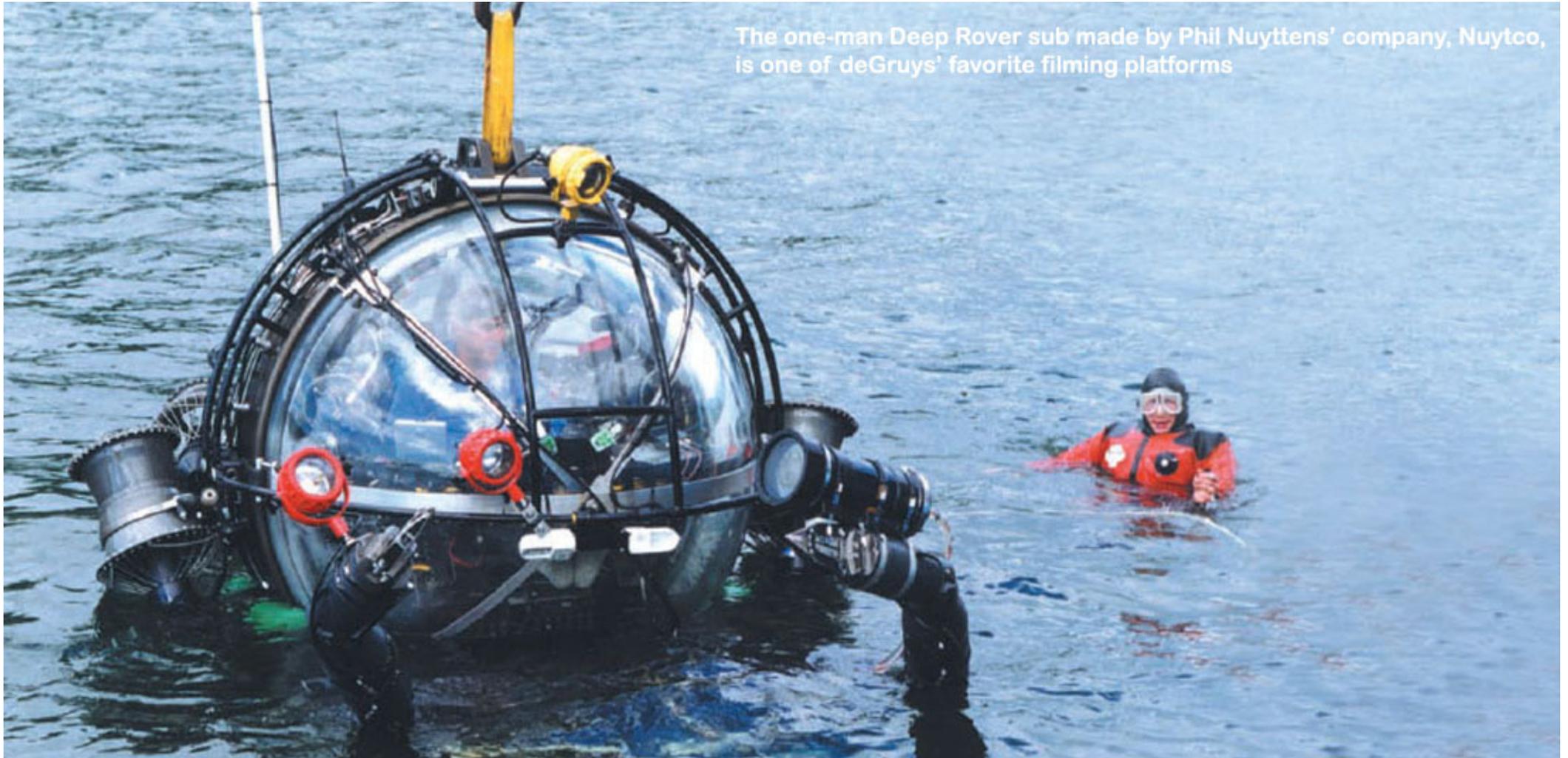
After the accident, how long did it take before you could go back into the water without getting the willies?» I had 11 operations over a two-year period, but got back into the water after about a year. Interestingly, one of my first, if not the first, dives was again in the same place with this little-known cameraman named Al Giddings. We were on the dropoff near the Deep Passage and Al was filming Grey Reef sharks. Suddenly I noticed the Greys had vanished... a

bad sign. Out of the deep came a rather large Silvertip shark, about 10 feet long. I pulled out my trusty powerhead, which was only about two feet long, and watched as the shark cruised right at us and passed straight over my head. I literally had to back up to keep from being scraped. I couldn't believe this... my first dive back, into THIS! Of course, Al just kept filming.



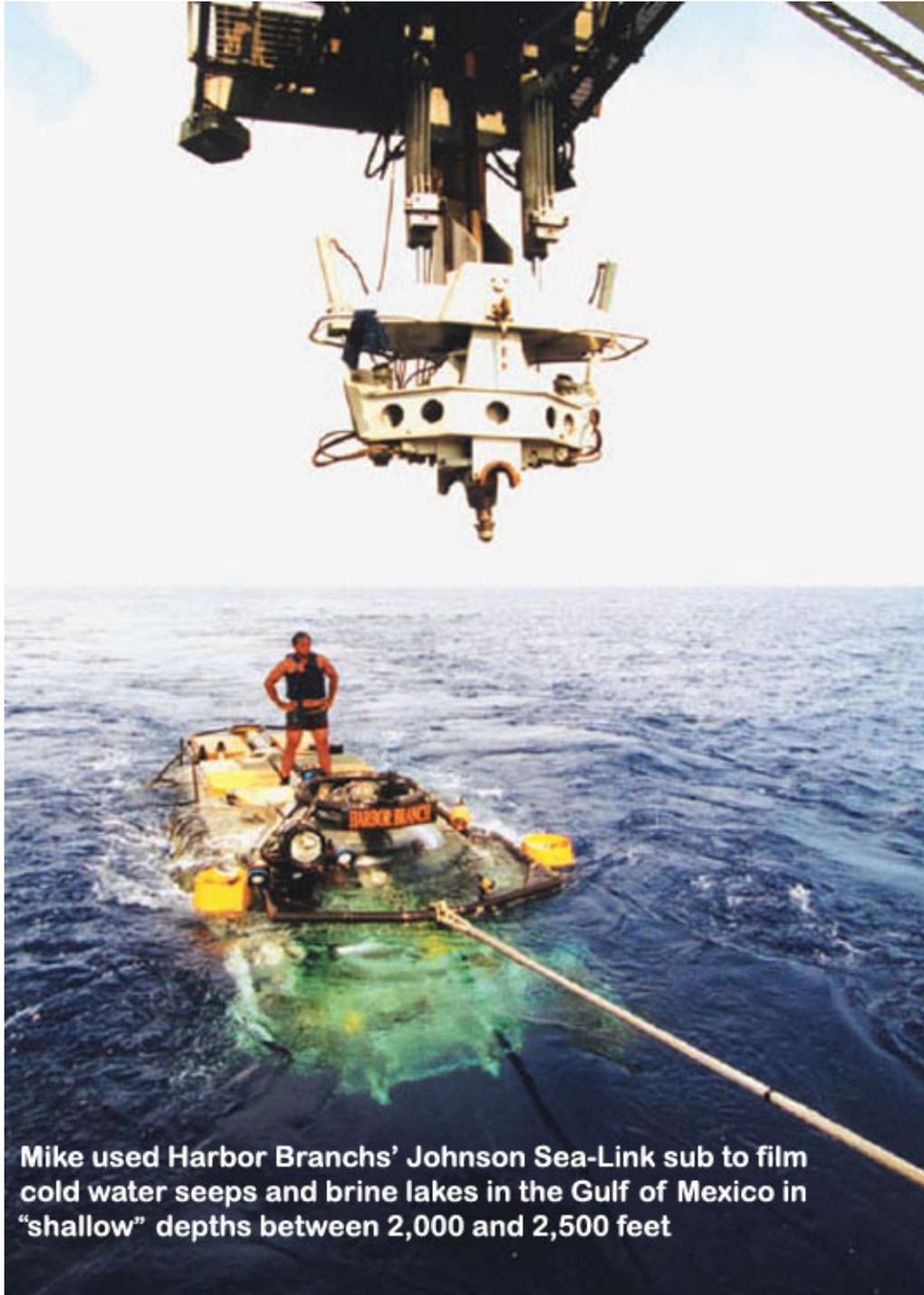
But to answer your question, I still react differently to sharks. Before my incident, I never really thought about them, except as photographic subjects, as well as marveling at their unique and awesome beauty. After nearly getting killed by one, I am acutely aware of them and swimming around in shallow water at night is no longer fun. And swimming in your hot tub after dark is pretty conflicting, too!

The one-man Deep Rover sub made by Phil Nuyttens' company, Nuytco, is one of deGruys' favorite filming platforms



After the Marshall Islands, what direction did your career take?»The Marshalls were literally a life-changing experience. Almost from life to death, in fact. I officially wrote off school and the career that a Ph.D. would have given me. I left everything I had trained for (Marine Biology) entirely. This was a tad intimidating, but must speak volumes about how much I loved that collecting/filming trip to Palau. Paul Atkins and I both quit graduate school and along with his now wife, Gracie, managed to twice return to Palau and finish

the film we started on the chambered nautilus. We sold it to PBS and the BBC and never turned back. I became a freelance cameraman for the BBC working extensively on major series like *Trials of Life*, *The Living Planet*, *Life in the Freezer*, and began producing my own films shortly thereafter. I got hired by this foxy little lass at *Turner Broadcasting* in Atlanta for a shoot in Samoa and ended up marrying her. Mimi and I now produce a film about every three years.

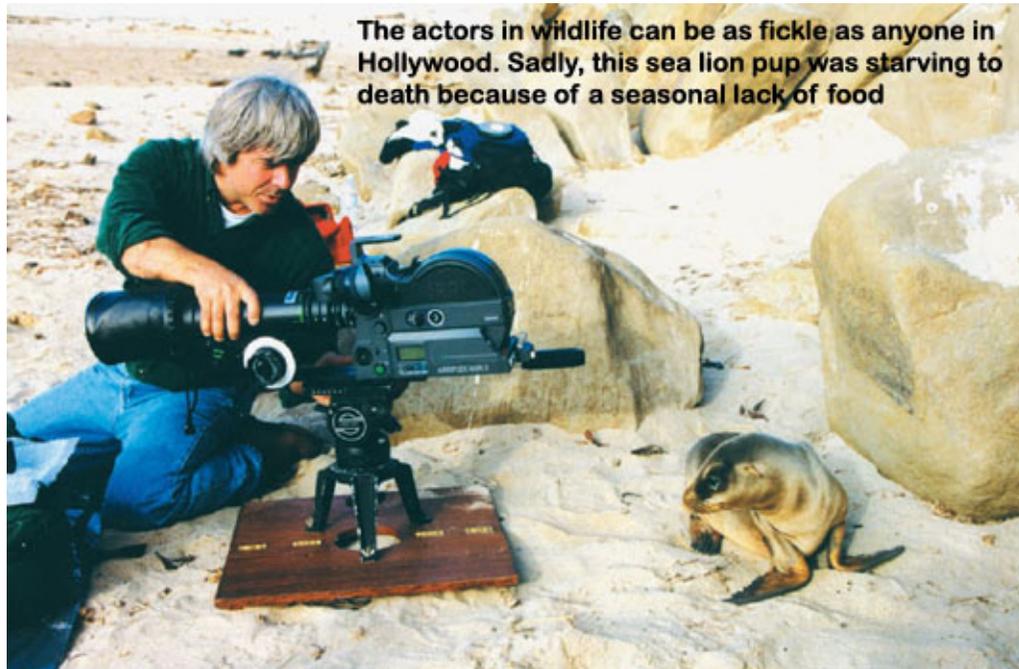


Mike used Harbor Branches' Johnson Sea-Link sub to film cold water seeps and brine lakes in the Gulf of Mexico in "shallow" depths between 2,000 and 2,500 feet

What are your current projects and where will they be taking you?»I am travelling to Punta Norte in Patagonia to film killer whales literally rushing out of the water to grab hapless sea lion pups from the dry beach. I filmed this some eight years ago for *The Trials of Life* and have to say I still get a lot of comments about that sequence. Of all the natural history phenomenon I have filmed, or even witnessed, this has to be right at the top. When you are laying in the surf zone, wearing a wetsuit and a camera and 40-ft. whales are screaming out of the water right next to you, grabbing scurrying sea lions and violently slapping them back and forth, ripping them apart, then returning to sea where they flip them 30 feet into the air with their tails... well, this has a lasting memory. So I return, this time with a 35mm movie camera for an upcoming feature film on whales. Wish me luck.

When and how did you get started filming from deep submarines?»Maui Divers is a jewelry manufacturer in Hawaii, who uses exotic corals as stones. To acquire these precious corals, they owned and operated a little submarine, the *Star II*. I was a diver helping launch and recover the sub and had several opportunities to dive in it as well. I had experienced nothing like this before. At 1,200 feet in Hawaii's beautiful blue Pacific, there was a dim moonlight glow over the bottom. Surrounding us were huge bushy gold coral trees that sparkled like Christmas decorations with their bioluminescence. Then there were the bamboo corals – as you might imagine from the name, these spectacular creatures had a skeleton beginning at the bottom of about an inch thick. But what most impressed me was their bioluminescence. If you gently nudged these corals with the sub, a ring of blue-green light appeared at their base and traveled right up the stalk, took the 90 degree turn and spiraled its way off the tip. Spectacular! This was the seed that took 20 years to germinate.

Four years ago I got a call from the BBC, who were producing a film for *The Discovery Channel* on a search for the giant squid. They told me they were taking a one-man sub to New Zealand to try to film a giant squid, and was I interested in going to Kaikura for a month, learning how to drive the sub and be the pilot/photographer! At this point I just have to ask... is this a great job or what?! Anyway, I said I didn't know, I'd check my schedule and get back to them in a month. Right. Needless to say, I signed on and that turned out to be a defining moment for me. I am totally and completely hooked on small submersibles and expect the rest of my life to revolve around them.



What's the deepest stuff you've filmed?»The deepest stuff I have filmed is off Panama, on the mid-ocean ridge. These dives were just over 10,000 feet and I did four or five of them from the Woods Hole sub, *Alvin*. We were diving on the hot vents, characterized by extraordinary black smokers, towering underwater volcanoes

violently belching what looks everything in the world like thick black smoke from a 1950 steel mill stack gone bad. It is a place of extremes. Extreme conditions, needless to say, as there is no light, great pressure, you do the math (some 4,500 psi), and near freezing conditions. Not to mention very little oxygen. But the greatest extreme has to be the contrasts. The vents are dispersed along the East Pacific Rise, part of the submarine mountain range encircling the earth. It is now generally agreed that these rift zones produce the earth we now drive and grow tomatoes on. Anyway, the hot spots are ephemeral and seem to have about a 20-year life span, then they quit spewing – like terrestrial volcanoes, just a different time scale.

As you cruise along the bottom, your porthole reveals lava. Huge fields of black lava which looks exactly like the lava fields in Hawaii. Nothing seems to live there, just bleak, stark basalt with the occasional rattail, sea cucumber or bizarrofish oozing by. Then you start seeing tiny white specks on the bottom. These specks increase in number and soon you recognize them as crabs and funny looking lobster. Within 30 feet from starkness, you hear a “Holy shit, there it is!” from the pilot (he has the best view) and out of your little window emerges an entire community of creatures thriving on the noxious gases and chemicals super heated by the earth's molten core. Masses of tube worms, 12-feet long, pure white with brilliant red plumes hide many species of fish, gastropods, other types of worms, crustaceans of all sizes and shapes and perhaps my favorite, octopus like you've never seen before. What a place that is. Perhaps what made it so special was the equipment I was using on the *Alvin*. Woods Hole has invested a substantial amount of money toward superb imaging and we rigged the sub with high definition camera systems. We saw details of this unique community that had never been seen before.

What's the most interesting subject you've filmed?»That's a tough one. So many elements are involved in making a place interesting, the animals, the conditions, the physical elements... But as far as subjects go, I have to say that the phenomenon I am about to embark on again has to be right up there. In Patagonia, a group of killer whales have cued in on the "fledging" of a population of sea lion pups, which are just learning to swim. I was there with Paul Atkins, who was also filming the event and perhaps the busiest Assistant Cameraman known to man, Keith Turner. Keith was loading magazines for the both of us, and running roll after roll of film at 150 frames/second kept the poor guy mighty busy. Several things impressed me about this extraordinary phenomenon; the whales were not there except for the two weeks when the pups dared to enter the water, then they showed up right on cue. How did they know the pups were ringing that dinner bell? The same whales return year after year, at exactly the right time, so they must be cueing in on something – certainly not the calendar. Then the behavior itself is amazing, if not downright morbid. The big males hunt individually, while the smaller females hunt in an organized pack.

There is a break in the reef about 100-foot wide and even at this break the whales can only make it over at high tide. So they wait, as did I. At high tide, when the pups foolishly enter this "dead zone," they are history – better frame up your shot and start rolling because the black and white freight train is coming through. Their speed and inertia bring them literally out of the water and up onto the beach, where they grab an unsuspecting pup. With a violent shaking of their head and bodies they slam the little sea lion time and time again against the beach while they work their hulk back into the water. But it doesn't end there. They take the pups out to sea and release them offshore. This is the morbid part – they breach on top of them, take them in their mouths and sling them 30-to-40 yards across the water and

swim beneath them and flip them 50 feet into the air with their tails. The pups are still alive during this punishment, which may go on for 10-to-15 minutes. Then the telltale blood arrives at the surface and it's over. This cycle repeats itself for over a week.

How did you make the *National Geographic* connection?»In 1989, my lovely bride and I produced a film on sharks called *Sharks on Their Best Behavior* for the Hawaiian PBS station, KHET. About a year into the three-year project, *Geographic* bought into it and I have worked on and off with them ever since.

Weren't you competing against Boyd Matson for that hosting spot?»How embarrassing. I'd hardly saying I was competing with Boyd, because he clearly is perfect for that *Explorer* position and obviously I was no competition as they chose him, but I did audition. We were considering moving to Annapolis, Maryland at the time and the *Explorer* spot seemed a reasonable idea. Fortunately, I came to my senses and moved to Santa Barbara instead, a city that I love living in.

After they picked him over you, didn't you ended up shooting him repeatedly - photographically that is?»Yeah, for a while I was shooting quite a few of the openings and links for *Explorer*. That was back in the days when they were still using film and we had an absolute blast travelling all over the world doing three-minute pieces. Then they went to video and after one of those video jobs I never heard from them again! I guess that speaks for itself... I still shoot film.

Besides yourself, who are your favorite underwater filmmakers?»I can't possibly answer that. This is such a small world and everybody knows each other and to single out one of two without naming the whole lot would be, well, I just can't do that. I can say this, however,



Filming a television commercial for Chevron Oil titled, People Do, deGruy used California's kelp forests with a Pace housing to illustrate the program

as far as watching programs in an auditorium setting and listening to the filmmaker narrate their footage, I have never heard anyone come close to Stan Waterman. That man is elegant, funny and totally entertaining. I also have to mention Peter Scoones. Now here is a cowboy. He's got to be in his mid 60s by now, still diving 300 days a year, builds all his own housings, takes Sony's \$70,000 cameras and turns them into a stream of screws, circuit boards and glass on his bench, reconstructs them inside a slick little bit of metal he turned on his lathe, designs his own ports and optics, installs that and goes out and shoots the most beautiful pictures you can imagine with these contraptions that are truly one-of-a-kind. Although I did catch him once with an off-the-shelf still housing.

Early in my career, a filmmaker once told me that shooting pictures is all about light but isn't it really all about money?»Sure, it's all about light and exposure if you don't want to eat, take lovely cruises through Greece, drink nice wine and live where you want. Seriously though, in this business, especially today with the explosion of extremely inexpensive video cameras that produce "broadcast" images, there are a hundred people out there making films where 10 years ago there were two. So the competition for an hour of broadcast time has skyrocketed, which, in general, I think is good. This proliferation of filmmakers, especially the younger ones, adds an edge to the programs that the older gang just does not.

Having said that, I personally think there has also been a proliferation of crap being broadcast and this is, in large part, is directly related to the budgets these new filmmakers agree to make programs for. A typical high-end natural history film, like a BBC or *National Geographic* special, has a budget of around a million bucks. So here you have a new cable channel offering \$100-150 thousand for an hour film and there are 50 people standing in line for that slot! At one-tenth of the

budget, what do you think you get for the product? Yeah, it is about the light, but certainly the money helps.

Let's talk about filmmaking gear. There's been a lot of buzz about High Definition camera systems. Are you using them? What do you think the next big breakthrough will be?»In a nutshell, I am still a firm believer in the image that film delivers over anything I have seen in video. However, I now have serious conditions to that statement that I did not have five years ago. Video is making huge strides toward looking at life the way humans see it. I think this has as much to do with the myriad customizing capabilities on the new cameras as it does with the vastly improved image quality itself. My biggest complaint with video has been its poor ability to handle contrast ratios – shooting in the tropics with harsh sunlit subjects with dark shadows and heaps of bright highlights has always produced a video image that looks like crap to me – blocked up shadows and blown out skies, etc. Film has trouble with these harsh subjects as well, but does a far better job than video.

However, you put yourself at 150 feet in the murky Galapagos, at four in the afternoon, and a different picture emerges, pun intended. This is the world, low light, low contrast situations where I think I'd rather have a nice video camera over my trusty Arri. In the last two years I have been using High Definition video and have learned to love it in some situations. Still, on that beach in Rangiaroa, give me my Arriflex. But low contrasty situations underwater, especially at thousands of feet where I have been working with it lately, high def is the only way to go.

I swear, when I first saw Billy Lang's camera system at the hot vents, the jumbo octopus, screaming black smokers and masses of vibrant tube worms, for the first time I felt the technology had been removed

For his film, *Tempest From the Deep*, deGruy employed this 30-ft. Jimmy Jib boom to film elephant seals

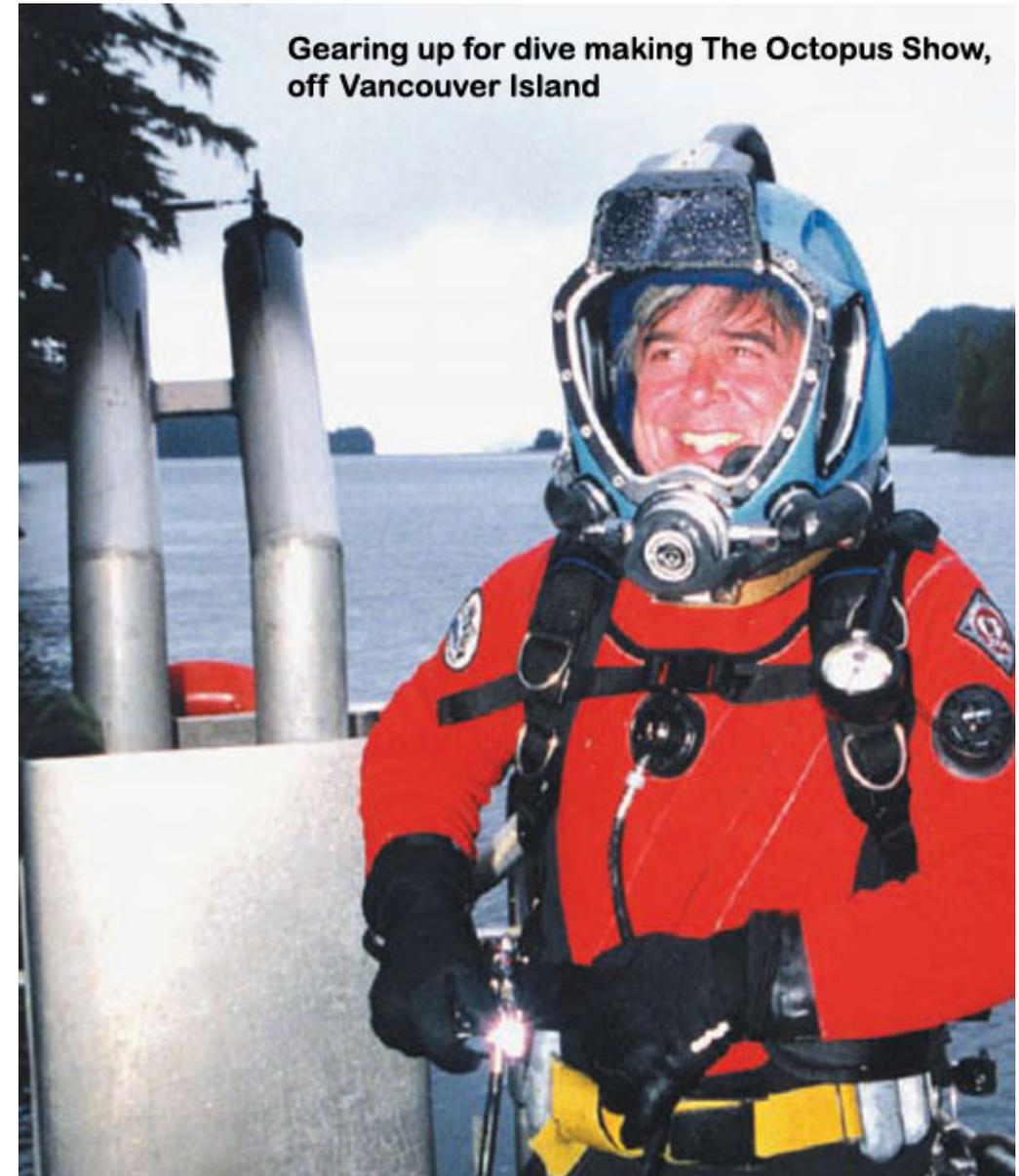


from the television system. I saw little or no difference from my high def monitor to my view out the porthole. It was astonishing and I'd never felt that emotion delivered from video before. Then it grew better and better as I was able to fill the frame with fingernail-sized creatures and see them in far greater detail than they have been seen in before, not to mention from out of a little porthole.

The major drawbacks of this new technology are that it is inherently complicated and expensive to use and maintain. And in many ways it is old technology polished up. By this I mean the cameras are still plastic things with funky viewfinders, they are large, heavy and still fragile and susceptible to environmental elements. I'd like to see them beefed up physically, sealed better and feel more like their price. Then there are the recorders. A high def camcorder is about \$90,000 and a good studio deck costs more than that. Why do we still have to record on such electronically and mechanically sophisticated machines, not to mention large and heavy and finicky? I anxiously wait for the "chip" recorders that have to be in the near future.

Even with the proliferation of cable and satellite channels is there consistently enough market for well-produced, high-end documentaries?»In a word, no. Not in the natural history genre that I tend to dwell in anyway. I remember clearly when the cable explosion began, a lot of people began rubbing their hands together thinking there would be heaps more work to go around. In a sense they were right, but one minor detail slipped off the radar screen. There were heaps of new outlets all right, but the pot of money stayed the same. So what happened is that the budgets began to shrink across the board because to fill all the new slots, broadcasters began to put more money into quantity rather than quality. For a while this had little effect on the people who were producing the high end "blue chip" films as there were still the same outlets for those, but the economics

of those programs, which take a long time to make and therefore are expensive, began to make less and less sense to the funders. They have a hard time getting their money back, as the various outlets they sold to internationally, became cheaper and cheaper as well.



Since camera gear is obviously foremost on your list of necessities, what about the support equipment you need to wear while you dive to get you in position for your shots? What type of scuba system do you employ? Are you into rebreathers? Nitrox? Inflatable doll lift bags?»We spend long stretches in the field, so inflatable dolls are a necessity, of course. And they better be good looking! As for dive gear, it varies greatly according to the shoot. About six years ago we bought three rebreathers, the Biomarine CCR500s. I think Al Giddings took delivery of the first two and I got the next three. I don't know Al's experiences, but mine was less than pleasant. I sent them back three years ago for changes and upgrades and one came back a year later and I have never seen the other two again. After literally a hundred calls and faxes I can only speculate on what happened to them. Anyway, before the manufacturer stole them, we used them very effectively on a film shot extensively in the California kelp forests. What they brought to us above all else was time underwater.

I tend to light extensively, but well away from the camera, creating strong back and highlights, but try to be subtle enough to make the lighting invisible. To accomplish this, I may use up to 10, 1200 watt HMIs and a couple larger and a few smaller ones. This scheme can be maddening when you are diving in kelp, as you might imagine, considering these are all AC lights with cables to the support boat. The rebreathers gave us four hours at 60 feet to set up all this, with no decompression required. No bubbles are nice and the air is warm but the time is what I liked best. Anything that gives you more time, whether it is a good drysuit, nitrox or rebreathers get my vote. When you are paying for a boat, full crew and there is something great happening beneath you, an hour underwater just doesn't cut it.

Al Giddings once told me he refers to you as “Black Cloud deGruy,” a thinly veiled reference to the misfortunes that have

sometimes accompanied your work. In addition to having survived a shark attack, tell us about the time you had the unique experience of watching your own support vessel sink in front of your eyes in Palau.»Thanks Al, I really needed that. I seem to have lost three Arriflex SR's, three underwater housings for them, two full stills packages and then there was that pesky little boat thing. What do they say? “Shit happens?” Maybe the reputation is deserved, but I feel pretty good about some of the stuff we've pulled off, and if a little gear goes here and there, well that's better than lives! I've been diving in subs a lot recently and I remember a funny feeling I got in New Zealand while about 1,000 feet down in the one-man sub, *Deep Rover*. I wondered how I'd get out of the thing if, on my way back to the surface during inclement weather, I saw our boat on its way down. Maybe it was the Palau experience that put that thought in my head.

We were shooting for a film on cephalopods called *Incredible Suckers*. That was a name I gave it as a joke about the guys who funded the project, and somehow it stuck. I had studied the chambered nautilus, captured many with traps, but never had seen them *in situ*. So we rented a ROV from Harbor Branch and flew it to Palau with a tech and pilot named Jerry Neeley. As often happens, on the very last day of filming: Viola! Nautilus! We were nailing the sequence, shooting them against the vertical reef at 900 feet and I was in the control room of the 40-ft. boat we chartered screaming with delight. Then Peck Euwer, my assistant cameraman, stuck his head in the door and said, “Hey Mike, there's a lot of water on the back deck.”

“Water??!” I jumped up and to my horror saw scuba tanks and diving gear sloshing around on the afterdeck. I pulled open the cover to the engine room and it was half full. The captain yelled to “Lose the ROV” and I went into the cabin and told Jerry. He was calmly filming away with the ROV and said, “Okay.” So we disconnected the ROV

Down she goes! During a shoot in Palau for the BBC's Nature, deGruy's 40-ft. support vessel sank taking all of the filming equipment with it

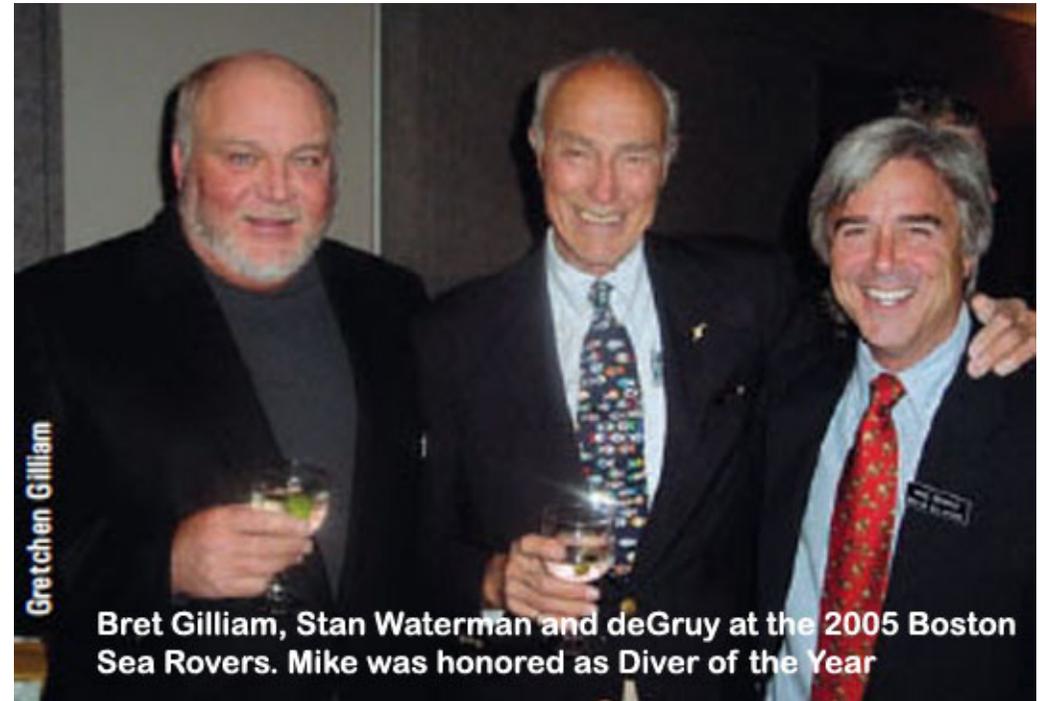


and threw the cable overboard. Within 10 minutes the boat was resting at her new home at 1,000 feet. Dang. Never knew why.

In addition to your reputation as a cameraman and director, you're also widely sought after as a commentator and color man in underwater documentaries. In fact, in 1999's *Discovery Channel* live broadcast from Bikini Atoll during *Shark Week*, you actually stole the spotlight from Giddings. What's it like to have to work with the pressure of live TV with millions in the international viewing audience?»When you are live, there is an intimidation factor that I have felt in no other situation. The moment you screw up, the world sees it, so there is obviously an edge. The first time I did a live broadcast, I was the host and we were in the Red Sea broadcasting from a ship. I was talking to Martha Holmes from the BBC while she was 40 feet down and wearing a bobble helmet. Ten minutes into the 30-minute broadcast, she surfaced with a helmet half full of water; there goes the show! So I get this stuttering whisper in my ear, ...”Mike... uh.. cover for a bit while we sort this one....” Cover! Hell, I had never done anything like this in my life and suddenly everyone was looking at me, all cameras on me and all I could think of was... nothing! I yabbered on a bit and thank God Eugenie Clark was there to talk to.

You're living in Santa Barbara with an interesting collection of dive pros. How do you like this compared to your old digs in LA?»Santa Barbara is great. Bev and Connie Morgan and the DSI gang are there, Bob Kirby, and a lot of stills and filmmaker types. It really is hot spot for diving innovation and filmmaking. Brooks Institute is there, the Marine Tech Dept. at City College is fantastic, UCSB has a great diving program and now we're getting a pretty good influx of Hollywood. It is a beautiful city with fantastic support for diving. We have the Santa Barbara Channel which is brimming

with cetaceans, pinnipeds, kelp forests, then there are the Channel Islands offshore where I swear, when the conditions are right, is the most beautiful diving I have ever done. I love that place. I know quite a few people working over there and am impressed with some of their programs, especially the educational elements they bring to ours and other communities.



Finally, at a whopping five-foot-seven-inches tall, tell us once and for all, does size really matter?»Nope.

Editor's note: There are about 50 copies of the original book still in Bret Gilliam's personal inventory. They are available as a Signed/Numbered Limited Edition personalized to each buyer by Gilliam at \$200 each, including shipping. He can be contacted for purchase at bretgilliam@gmail.com.

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