The Mesoamerican Barrier Reef

— *Xcalak, Mexico*

Text and photos by Farhat Jah

A long sandy track runs beside the sea, backed by small houses. A row of dirty pangas, local fibreglass skiffs, sit along the beach. A dog wanders sedately past an old but functional shipping beacon. A few children ride by on their tiny cycles and a military truck grumbles down the sand with a barrel of fuel in it. This is the village of Xcalak, the last settlement before the start of what was once British Honduras, now called the nation of Belize, which lies six miles to the south. Fishing has been the life of the community of Xcalak for over a century. In the first half of the 20th century, Xcalak was a prosperous town. A thriving coconut and fishing business created wealth and attracted traders. Shops, a cinema, an ice factory an electric generation plant and numerous other facilities helped the place to thrive. But in 1955, Hurricane Janet devastated the town. Many people lost their lives, and many of the business owning families who had inhabited the town, moved inland away from the risk.

Divers enter a cenote in the barrier reef and run into a school of silversides

Divers (above) explore the barrier reef tunnels and swim-throughs; Diver with school of Atlantic spadefish (top right)

Xcalak means *twins* in Mayan. This was the name given to the two cuts (passages) that lie in front of the village. These passages gave the villagers access to the sea.

The Bacalar Chico River provides access to the giant Chetumal Bay. This bay, which lies behind the town, makes Xcalak a peninsula, with a swamp to the north, Belize seven miles to the south, the Caribbean Sea on one side, and the bay on the other.

Two hundred fifty people live in Xcalak, and it is today what it was before the early 20th century boom—a sleepy fishing village with a few local shops, a small concrete jetty, a harbour master and a park office. The Mexican Marines have a small base a mile north of the Belize border, and a tiny post within the town.

A lighthouse stands on the sand to the south of town blinking a warning to passing ships. The Chinchorro Bank sits 20 miles off shore, part of the Mesoamerican Barrier Reef System—a salutary home to many a ship whose master failed to read his charts.

Since my youth, I was told about the Great Barrier Reef in Australia. Twenty years ago, I was lucky enough to learn to dive on it. Now, a generation later, I find myself on its shorter cousin. The Mesoamerican Barrier Reef stretches 600 miles from the coast of Honduras up to Mexico.

Diving

As our panga (an open fishing boat) sped out through the reef cut, I felt a certain affinity with this barrier reef. It reminded me of my first diving experiences. And yet, the Mesoamerican Barrier Reef was so different.

Seconds after Captain Moi opened the throttle to full, he backed off the power, and we arrived at our dive site. Bobbing around 500 metres from land, we were on the barrier reef. Sea grass waved visibly on one side of the reef. We had stopped over 60 feet of clear blue water and finger-like reef formations. We were about to dive, and yet I could clearly see mangroves. Compare this to the Australian Great Barrier Reef where mangroves are located 20 miles away.

A Spanish architect on permanent sabbatical was our guide. Named Jesus, he tolerated my diving habits. I fell back into the water, making a large splash.

Dramatic view of the Mesoamerican Barrier Reef off Xcalak

I grabbed my camera and finned down to 40 feet. The water was warm at 27°C, and I had exactly enough weight to keep my aluminium cylinder down. I did not need to add air to my BCD, but I did need to kick down. A school of spadefish sat in the slight current and waited. I swam gently up to them, flashing my camera. I was using an old Patima G11 housing that had seen better days. Thanks to some thieves, it now housed a G12, which while not ideal, seemed to work. After a bit of fiddling, I shot again. The boat came back overhead, and the last diver, Jesus, dropped into the water. I looked above me and saw dive buddies, Cisca and i-Mike Alt, descending with a delightful retired American scientist called Cathy.

Some spadefish circled me in a mesmerising manner. I wandered off to look at them. The 40ft deep water did not cause me any stress. The others took to looking at their own piece of reef and staring at a school of hubbs. Jesus rounded us up like sheep and gave me a direction to head toward. A pipefish popped his head out of the sand, and I snapped his photo. He ducked back inside his hole.

We rounded the corner of one of the fingers, and I stared at the green plants that covered the rock. At first, they seemed colourless, but upon further inspection, the plants played home to gobies, lobsters and small yellow snapper.

Jesus motioned us forward excitedly and pointed. I looked through the blue into the white sand between the reef fingers. A large black stingray shuffled sand from under itself. As I approached, it saw me and swam lazily away. My camera just captured its movement, and then the ray settled nicely in the rock "alley" next door. Its stinger was gone. "Eaten," gestured Jesus using underwater sign language. I wondered what would be big enough and immune enough to bite off a stinger that size—"Only a shark," I muttered through my regulator.

The barrier reef

At first glance, the reef was not an eye stopping, red coral affair. It was made up of walls, coral heads, cuts and spits that resembled fingers. The water was clear, and the scenery pretty, but the reef seemed brown. I wondered if there was any coral at all. But when I got closer, I saw the soft whips and hard brain coral, which shone in the light of my torch—red and green—surrounded by sponges and hundreds of soft waving fan corals. Each

CLOCKWISE FROM FAR LEFT:
Moray eel on reef; Blenny hiding in hole; Diver hovers over waving fan corals; Tiny goby on brain coral

had a beautiful red base. And then, while admiring these corals, a large school of porkfish slid by, circling me for a few minutes until they decided to move on.

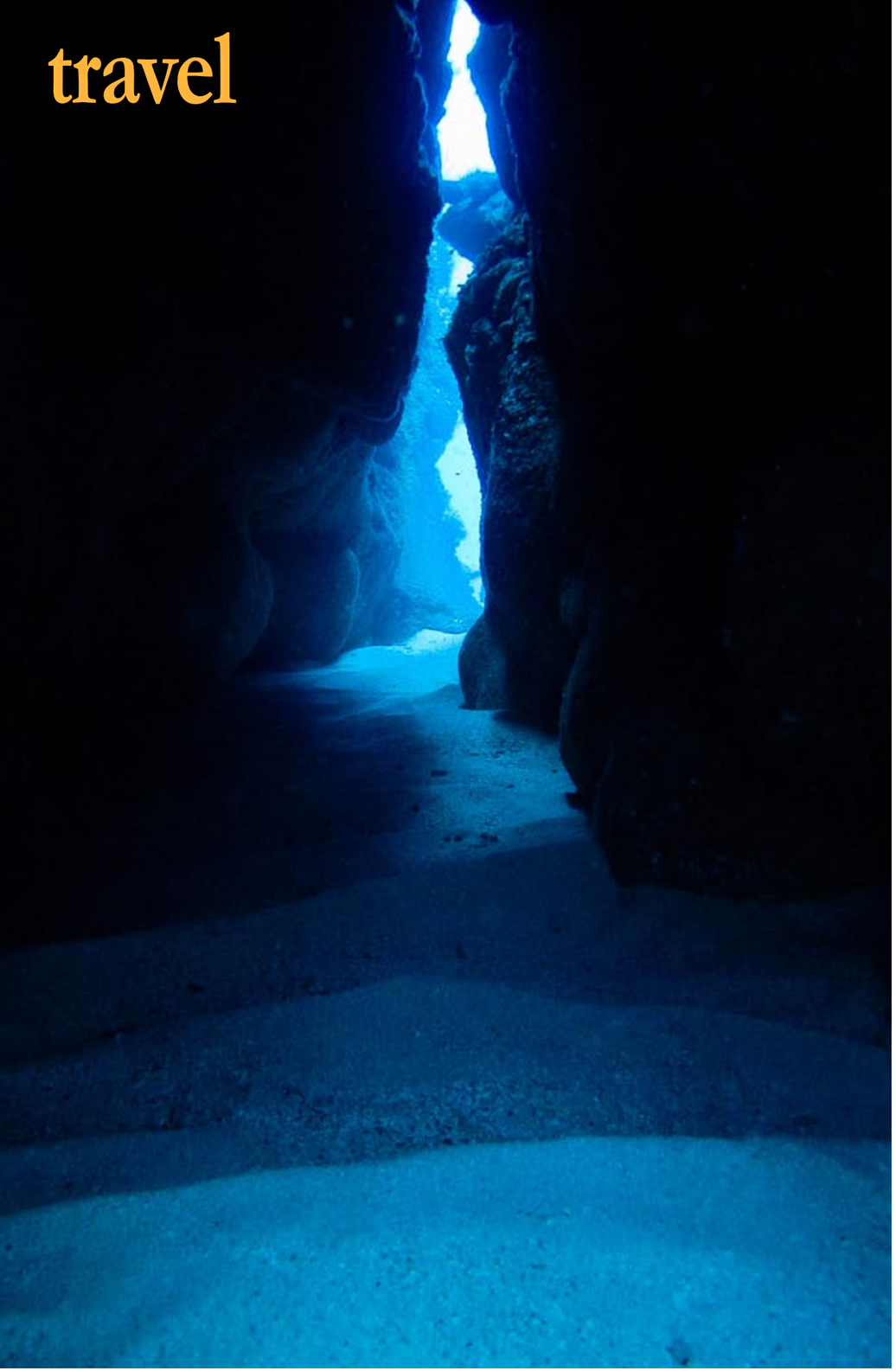
Beyond the reef, small turtles scuttled by. A lone barracuda sat in the water staring at me. My flash fired, and the barracuda did not move. Slowly, ever so slowly, it turned sideways toward me, only three feet away, and eyeballed me. Then, without a care in the world, it wandered off.

The Mesoamerican Barrier Reef is very different from the Indian Ocean, which is near where I live. There were few nudibranches. There was an infestation of lionfish, and table coral, or *Acropora*, was thin on the ground. And yet we saw dugongs, huge schools of snapper and silversides.

At La Chimenea, we dived a cenote within the barrier reef itself. Entering from the outside of the wall at 91 feet, we swam though a large tunnel. The top of the cenote had fallen through, making for an eerie cave with a pile of rubble in the centre. But the hole in the top lit the centre of the cavern with a delightful blue haze. The clear water revealed a fat barracuda sitting close to the ceiling and a school of bigeye jacks, which approached and swirled around me before choosing to bother the other divers on their exit. When we exited, we did so through another thin chimney that was full of silversides. Dive buddy, Mike, kicked up the dust, but still the view was clear.

We returned to do our safety stop with a few minutes before decompression. We climbed on board, and Jesus gave a command to the captain. He powered off along the reef itself and then entered a cut, or passage, in the reef. The Mexicans call this an *entrada*. Our boat sailed between the coral heads and then swung to the left and continued inside the reef at a sedate pace.

Entering the mangroves, we slowed to a crawl.



Steep walls line eerie swim-throughs and tunnels in the barrier reef

School of jacks on reef

The captain dropped us in a small bay 20 yards wide. A passage within the mangroves led to the left and right.

"This is where we see dugongs," said Jesus. "Oh and this," he pointed to the southern trees inches from his fingers, "is Belize, and this," he pointed five yards to the north, "is Mexico."

"This is the border," Jesus said. "Sure, dive boats from both sides come here for tea and water between dives."

Properly degassed, we entered the tunnels of Alexandros playground. It was a series of long swim-throughs nearby the collapsed cenote. It was famous for its large schools of tarpon that swirl around minding their own business. This time, though, the large menacing fish came at us in the restricted space of the tunnel—my heart fluttered slightly as the four-foot-long fish bared their teeth—and then they were over us. Gone.

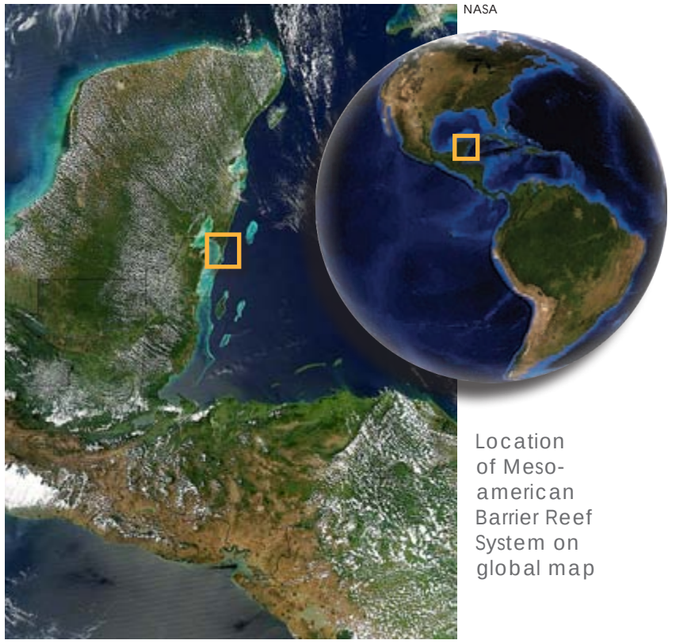
We swam through a final tunnel and popped out onto the reef wall. Strangely, this was the most vibrant section. The outside and the top of the wall contained some of the most intricate gobies—orange and yellow—along with the now obligatory barracuda and yellow snapper. I dropped down to 70 feet and swam along the lines of soft waving whip corals.

Fellow diver Cisca spotted a green moray eel. It was huge and sat at 50 feet. Fully outside its hole, the serpent-like creature looked menacing, as a cleaner shrimp took the muck from its mouth. I kept my distance and let the camera flash. The moray looked at me, and I waited a few seconds before firing again. Then my gas was low, and time was short.

We ascended as a trio, and I twisted the bezel on my Momentum dive watch to set the first stop. The deco chamber was a long drive away, so I did a long double depth safety stop. On the stop, I noticed the hard coral formations, which sat on top of the reef at 15-20 feet.

As we surfaced, Moi, the captain, was waiting. He manoeuvred the panga expertly and hauled our equipment over the side. A current was running, but he was not fazed. Soon, we were all in the boat and speeding back to base for coffee and a shower. ■

Farhat Jah is an underwater photographer based in Pemba, Tanzania. He leads specialist bush walking safaris and operates a dive resort on the island of Pemba. See: ***www.swahilidivers.com***



Location of Meso-american Barrier Reef System on global map

Location of Xcalak, Mexico, on satellite map of Yukatan Peninsula

Why is scientific diving safer?

Review of decompression illness in 10 years of scientific diving

BRETT SEYMOUR

Text Neal W. Pollock, PhD. Introduction by Rosemary E Lunn. Images courtesy of Brett Seymour, National Park Services and Vallorie J. Hodges, Oregon Coast Aquarium

Scientific diving appears to be one of the safer forms of diving, a recent study of incidences of decompression illness over ten years has found. This safety seems to be facilitated by a combination of relatively high levels of training and oversight, the predominance of shallow, no-decompression diving and, possibly, low peer or institutional pressure to complete dives under less than optimal circumstances.

A paper has just been published in *Diving and Hyperbaric Medicine* reviewing decompression illness (DCI) in ten years of scientific diving. A team of four members of the American Academy of Underwater Science (AAUS) Board of Directors analyzed a decade of diving records (January 1998–December 2007) submitted by AAUS member organizations.

One of the authors, diving physiologist Dr Neal W Pollock, said that whilst the AAUS (www.aaus.org) was not capturing data from all scientific dives conducted globally, this report was a reasonable snapshot of what is happening in the scientific diving community.

The paper concluded that it does appear that scientific diving is one of the safer forms of diving. This is likely due to a number of factors including:

- Low peer or institutional pressure to complete dives in less than perfect conditions
- The majority of the dives being shallow, no-decompression profiles
- Relatively high levels of training and ongoing supervision

The following is a summary of the paper, *Review of decompression illness in ten years of scientific diving*.

Scientific diving is conducted as part of a scientific research or educational activity under the auspices of a scientific diving program. Scientific dives are conducted worldwide using a wide range of modalities to address a wide range of goals. The incidence rates for decompression illness (DCI) in scientific diving are generally held to be low when compared to estimates for commercial and military diving communities, but the published data are limited. The American Academy of Underwater Sciences (AAUS) represents organizational members, primarily but not exclusively U.S.-based, involved in scientific diving. AAUS members submit annual summaries of dives and any incidents, making AAUS a major source of data on scientific diving in North America. This article is based on a paper evaluating AAUS records that was published in the scientific literature. Additional details, statistics and complete references are available in the source paper.

Methods

The study reviewed ten years of diving records reported by AAUS organizational members, from

1998 through 2007. The research was approved by the Divers Alert Network institutional review board. All submitted incident reports were reviewed by a panel and classified by injury. The goal was to investigate the incidence of DCI. Contentious or incompletely documented cases were further investigated through interviews with involved persons. Ambiguous cases were considered to be cases of DCI for the computation of incidence rates. The rates are based on person-dives, that is, as individual exposures even when diving is typically conducted in teams of two or more.

Results

The number of person-dives tallied annually ranged from 68,598 to 126,831. The ten-year study period captured 1,019,159 person-dives and 102 incidents occurring in conjunction with these exposures. Ultimately, 33 of the incidents were classified as DCI, 25 with clear symptoms and eight with ambiguous symptoms. Recompression therapy was reported to be successful in 28 of the 33 DCI cases; 19 with a single treatment and nine with multiple treatments.[1]

BRETT SEYMOUR

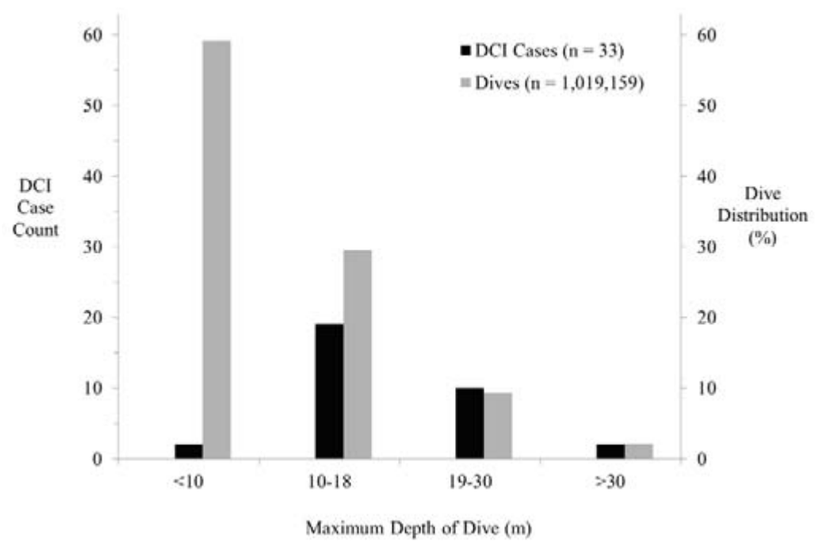


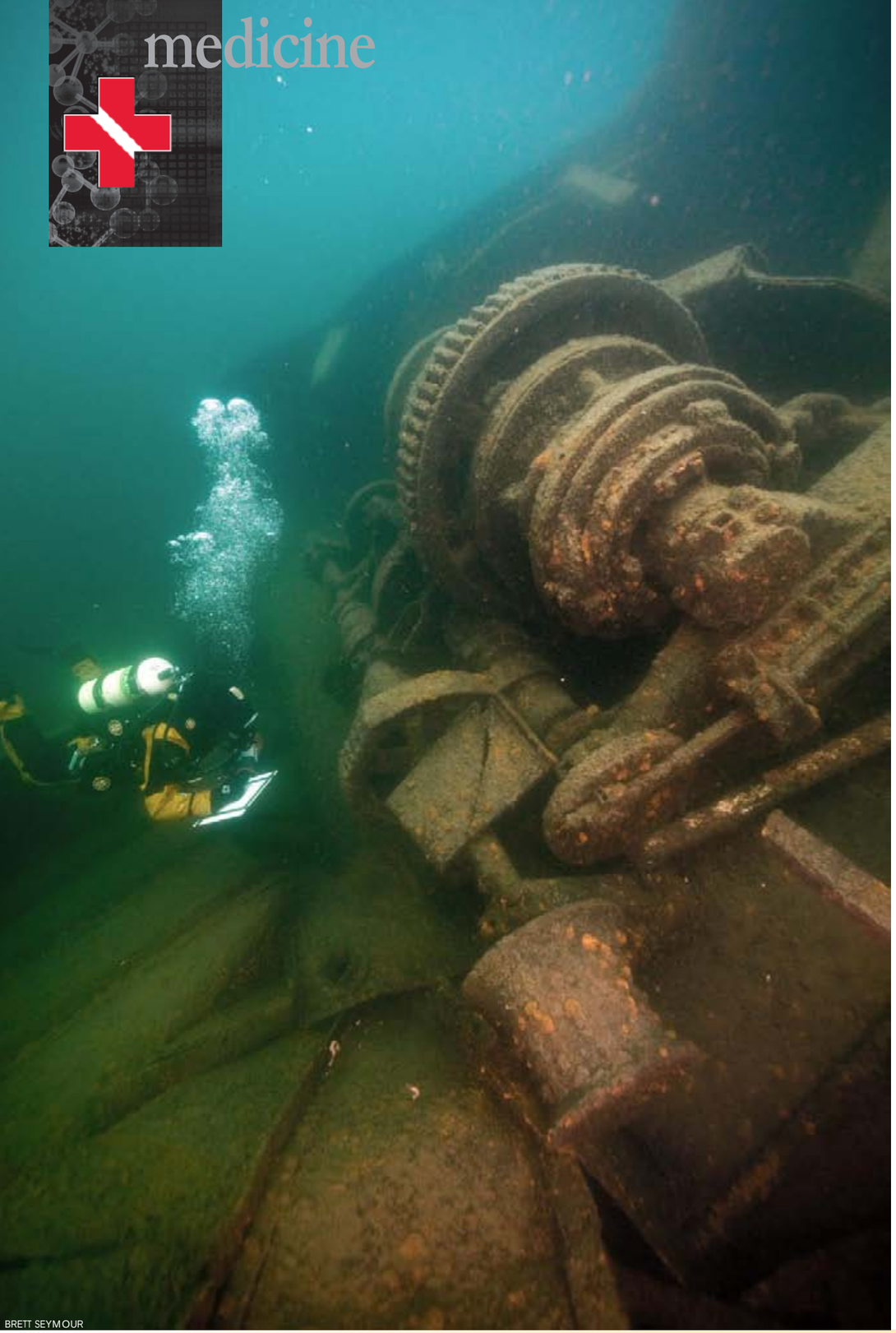
Figure 1

The 33 DCI cases yielded a DCI incidence rate of 0.324 per 10,000 person-dives. The distribution of maximum depth for all reported dives and for those followed by reports of DCI are found in Figure 1.

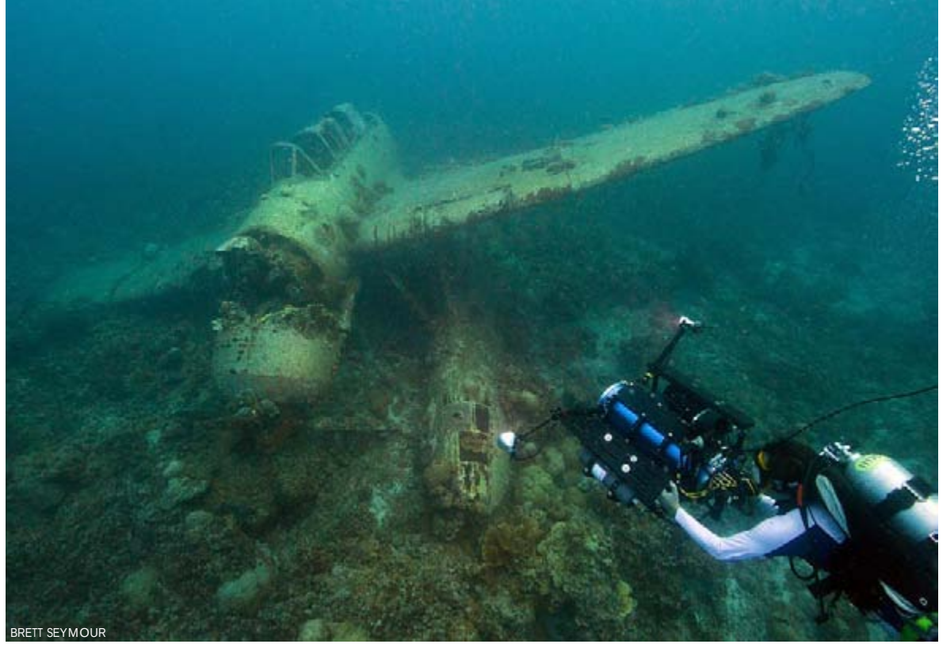
Discussion

DCI is a relatively rare event, requiring long term study to capture a substantial number of cases. DAN's Project Dive Exploration provides such a long term study, yielding estimates of DCI incidence rates in the recreational community between 2.0–4.0/10,000 person-dives. DCS rates among divemasters and instructors have been estimated at 12.7-15.2/10,000 person-dives. Shallow no-decompression dives among navy divers has produced DCS incidence rates of 2.9/10,000 person-dives. The DCS incidence rate in commercial decompression diving has been reported to be as high as 35.3/10,000 person-dives. The estimate ranges for the other diving disciplines were higher than found for the AAUS scientific diving.

Supervision of scientific diving activity includes oversight at community, organizational and team levels. At a community level, AAUS consensual standards



BRETT SEYMOUR



BRETT SEYMOUR

THIS PAGE: Scientific diving is conducted as part of a scientific research or educational activity under the auspices of a scientific diving program

for scientific diving require periodic medical examination, recurrent training in diving accident management and documentation of diving proficiency. At the organizational level, Diving Control Boards set institutional policy and Diving Safety Officers review and approve dive plans, often providing direct on-site supervision of dives. At the team level, individual divers, trained in dive accident management and advanced diving techniques specific to their scientific diving tasks, ultimately have the responsibility to terminate any dive they consider unsafe. A good safety record is expected for scientific diving given the layers of oversight and, hopefully, a prioritization of safety over operational completion.

There are several limitations to risk estimate studies. Risk estimate efforts typically suffer from a lack of information on the total number of dives conducted, the so-called denominator of the equation. This problem is largely absent in the study of scientific diving described here since both the injuries and all dive counts were regularly reported.

There is also the possibility of under-reporting adverse events. However, since there is no punitive action associated with reporting incidents, accuracy is favored.

Misdiagnosis is another potential issue, but one that was reduced by the review panel using all information available after the fact.

Fair representation of the community is another issue of any study. The AAUS partially addressed this by representing a diverse and substantial number of dives, but it is important to acknowledge that there are many agencies and organizations conducting scientific diving that do not report diving activity to AAUS.

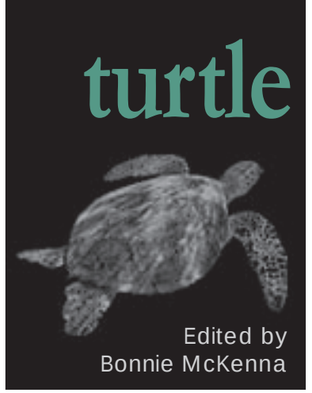
Despite the limitations of this study and many others evaluating diving risk, it does appear that scientific diving represents one of the safer forms of diving. This safety may be facilitated by a combination of relatively high levels of training and oversight, the predominance of shallow, no-decompression diving and, possibly, low peer or institutional pressure to complete dives under less than optimal circumstances.

Additional research to compare the decompression stress of actual exposures, the pressure to conduct dives, reporting practices, and other variables that exist between the diving sub-fields could provide useful insights to understand the real risks. ■

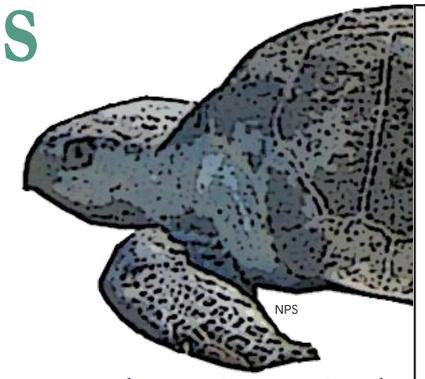
REFERENCES
1. DARDEAU MR, POLLOCK NW, MCDONALD CM, LANG MA. THE INCIDENCE OF DECOMPRESSION ILLNESS IN 10 YEARS OF SCIENTIFIC DIVING. DIVING HYPERB MED. 2012; 42(4): 195-200.

VALLORIE J. HODGES

turtle tales



Edited by
Bonnie McKenna



NPS

Hypothermic sea turtles rescued on Cape Cod

Sea turtles, mostly large loggerheads and green sea turtles become stranded from early November through December off the northeastern coast of the United States. Volunteers from the Massachusetts Audubon Sanctuary stake out the coast each year in order to same them.

Despite the fact that sea turtles are cold-blooded, they are susceptible to infections at low body temperatures. The aquarium takes the reptiles and warms them up five degrees a day until their body temperature reaches slightly more than 70 degrees. Almost 90 turtles have been rescued so far this season.

Kemp's ridley sea turtles frequently strand on the shores of Cape Cod in Massachusetts in late autumn in a state of 'cold-stunning' exhibiting low body temperature and related clinical issues. Stranded turtles are transported to the New England Aquarium for treatment and rehabilitation.

A recent study tested the hypothesis that cold-stunned sea turtles might exhibit high corticosterone (stress hormone) or low thyroxine (which is often affected by temperature), or both. The monitoring of both hormones may be useful for assessing recovery and readiness for release. ■

U.S. FISH AND WILDLIFE SERVICE

Sea turtle slaughter in Fiji

Turtles continue to be slaughtered despite protective measures with some villagers unnecessarily seeking approval to eat the turtles during functions.

Fisheries officer Ului Tuinamata said the number of sea turtles is dropping rapidly, and some are on the verge of extinction. Some people are slaughtering turtles for trivial events.

Slaughtering of sea turtles is illegal and is only approved for traditional functions. Applications go to the Minister for Primary Industries for approval. The permits take 14 days.

"People need to realize that our turtle numbers are rapidly dropping and to appreciate the value of these creatures including the vari voce (sea wrasse) and dairo (bêche-de-mer). They should think of the future and contribute to their sustainability," said Tuinamata.

Tuinamata also said that there was a need to establish an active network of villagers to monitor the sea turtles. ■

Orientation of migrating leatherback turtles relates to ocean currents

During their offshore movements, leatherback sea turtles associate frequently with ocean currents and mesoscale oceanographic features such as eddies, and their movements are often in accordance with the current flow.

To investigate how individual turtles oriented their ground and water related movements in relation to currents encountered on their journeys, oceanographic techniques were used to estimate the direction and intensity of ocean currents along the course of 15 leatherback turtles during their long-distance movements in the Indian and Atlantic Oceans.

For turtles in the North Atlantic, the ground related movements largely derived from the turtles' active swimming, while in the Indian Ocean currents contributed substantially to the observed movements. The same pattern was shown when distinct parts of the routes corresponding to foraging bouts and travelling segments were considered separately.

These findings substantiate previous observations of leatherback movements, by revealing that turtles were not simply drifting passively, but rather swam during most of their journeys. Our analysis did not provide any indication that leatherbacks were able to detect the current drift they were exposed to, further highlighting the navigational challenges they face in their oceanic wanderings. ■

ROGER WOLLSTADT / CREATIVE COMMONS

Cayman Turtle Farm under scrutiny

The Cayman Turtle Farm (CTF) is under intense scrutiny from the World Society for the Protection of Animals (WSPA) a London-based international organization dedicated to the welfare and elimination of animal cruelty. The Sea Turtle Conservancy has also criticized the Cayman Turtle Farm for the same lack of welfare for the sea turtles at the farm.

Since the allegations, an independent review of the CTF by four invited vets and scientists was initiated and took place in December 2012 to find out if standards of care are being met by the center. Their report is due at the end of January 2013.

WSPA has cited the turtle farm for not meeting the welfare needs of animals under their care and for being a threat to the wild turtle population.

The report states that various diseases that were observed are attributed to high stress loads, sub-optimal welfare conditions and poor water hygiene associated with commercial farming. In terms of water quality, the report states that enclosures at the farm are not cleaned properly, leading to contamination of the living environment through uneaten food and body waste.

The turtles are being fed a diet of food pellets shifting the animals from being omnivores in the juvenile stage to becoming herbivores as an adult.

It was also noted that visitors of all ages can handle the turtles as part of the tourism experience triggering stress responses that lead to significant injury to the turtles.

Overcrowding was also noted, with too many turtles occupying the same space and not having enough room to express their natural behavior.

It should also be noted, the Cayman Turtle Farm's business also includes the harvesting of turtle meat.

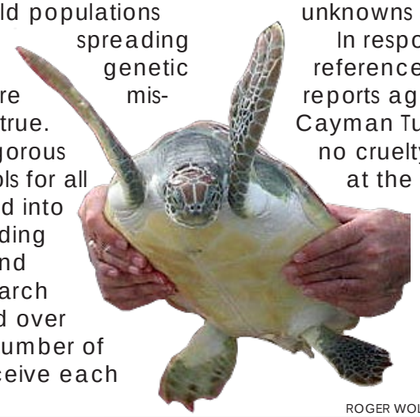
The CTF has responded to the allegations that the turtle releases endanger wild populations by potentially spreading disease and genetic abnormalities are misleading and untrue.

CTF follows rigorous release protocols for all animals released into the wild. According to CTF, "We stand by the 150 research papers released over the years, the number of requests we receive each year for educational internships and research partnerships, the ongoing research partnerships we have in place, our release of more than 31,000 turtles into the wild, and the collated evidence of increased numbers of turtles returning to the Cayman Islands to nest."

This year has been a record year for turtles nesting on Cayman island beaches. It has also been a positive nesting season for the CTF with more than 41,000 eggs being laid at the facility with an extremely high hatch-out rate.

The CTF remains committed to the future release of turtles into the wild to maintain and increase the wild population and to foster ongoing research into the unknowns about sea turtles.

In response to the STC's reference to the WSPCA's reports against the Cayman Turtle Farm, there is no cruelty to the animals at the farm. Animal husbandry is carried out according to all international accepted humane standards. ■



ROGER WOLLSTADT / CREATIVE COMMONS

Sea turtle protection device plans shelved by NOAA

The National Oceanic and Atmospheric Administration are withdrawing plans that would have forced shrimpers in the bays and marshes of the Gulf of Mexico to install "turtle excluder devices" or TEDs.

The information suggests that the conservation benefit does not justify the burden this rule would place on the industry.

The rules had been set to take place this spring (2013). Gulf of Mexico shrimpers said the requirement could push them out of business. The change would have affected 2,600 fishermen, including 2,300 vessels in Louisiana.

In the past two years, more than 1,100 dead sea turtles have been found in Louisiana, Mississippi and Alabama waters. Federal scientists estimate 28,000 sea turtles are caught each year in nets.

The Center for Biological Diversity, a national conservation group criticized the decision saying further delay will cause unnecessary turtle deaths. The agency's failure to protect these species is tragic.

TEDs have been required for larger shrimp vessels that work in federal waters, but not in state waters with shallower areas and smaller turtles.

Instead of devices, fishermen are supposed to lift their nets out of the water every once in a while to help trapped turtles breath and escape. NOAA officials say they have trouble with compliance and difficulties in enforcement.

Fishermen have long resisted moves to force the use of TEDs saying there is little evidence that they are responsible for the spike in turtle deaths and the cost of the devices could destroy the industry. ■

NOAA

Sea turtle escapes net with TED

Genetic turtle tags reveal mother and daughter nesting at the same time

"It's something we never anticipated," said Matthew Godfrey a North Carolina Wildlife Resources Commission biologist in regards to the unexpected findings during genetic tagging of sea turtles the prevalence of mother and daughter nesting at the same time.

The average age of maturity for a loggerhead sea turtle is 30 years. If a mother and daughter are nesting at the same time, the mother must be 60 years old. The higher than expected prevalence of siblings nesting in the same area was also surprising. With only one out of 1,000 sea turtles surviving to adulthood, it seems unlikely that two siblings would survive and nest in the same region. This finding suggests that genetic factors may play a role in deciding which turtles survive.

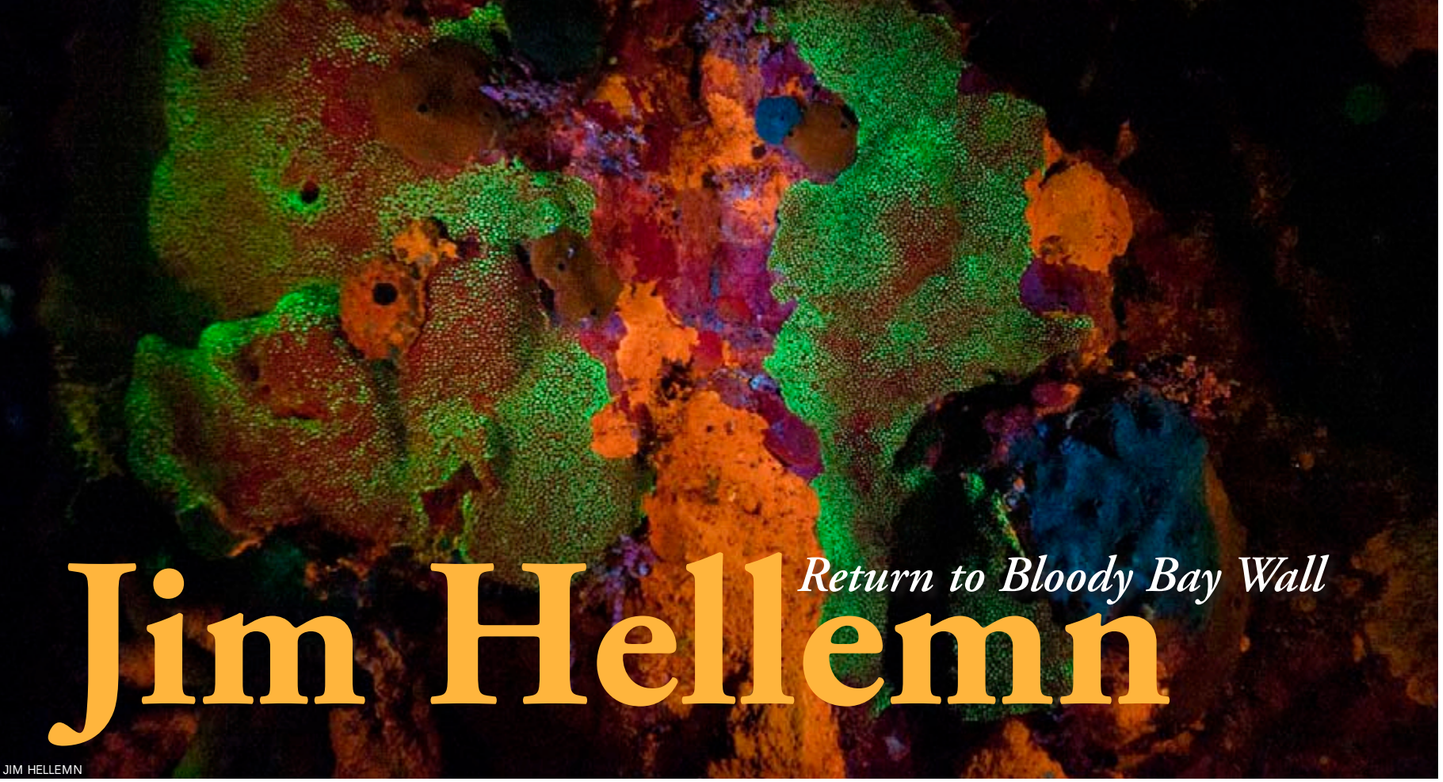
The national recovery plan for loggerhead turtles, for the region, set the goal of 2,000 nests per season. Currently, the average is around 750 nests. Godfrey said to reach the goal of 2,000 officials are hoping to see a two percent increase in nests found during the next 40 years.

One of the most telling indicators of the species improving is the number of nesting females. However, with so much coast line and few volunteers, it is impossible to find all the nests.

Since 2009, the project has sampled 2,954 nests and identified 828 nesting female loggerheads. It has determined that the average number of nests per season, per female is three nests and the internesting interval is about 15 days. ■

NPS

Baby loggerhead sea turtle



JIM HELLEMN

Jim Hellemn

Return to Bloody Bay Wall

Text by Matthew Meier
Images by Jim Hellemn, Jason Belport, Jeff Caroli, D. Finnin, Courtney Platt

In 1999, underwater photographer Jim Hellemn travelled to Little Cayman Island and photographed a large section of the Bloody Bay Wall in an effort to create a life size reproduction of the coral reef. This "Portrait of a Coral Reef", as dubbed by National Geographic in their October 2001 issue, measured 20 feet high and over 60 feet wide. The final image was comprised of over 280 individual photographs, which were manually stitched together over the course of nearly six months to construct this massive underwater landscape.

The Bloody Bay Wall is located northwest of Little Cayman Island and starts just 20 feet below the surface. The one mile long wall has dozens of dive sites and a sheer vertical face dropping down thousands of feet. Colorful marine life, sponges, corals and sea fans create a visual spectacle that is difficult to portray in a single traditional photograph.

Hellemn chose this site with the intent to better depict the magnitude and beauty he saw while diving there and also for technical considerations, like having a flat plane for controlling depth of field, distortion and perspective, when stitching the images together. The section of reef Hellemn photographed was between approximately 70 and 90 feet in depth and roughly 68 feet wide.

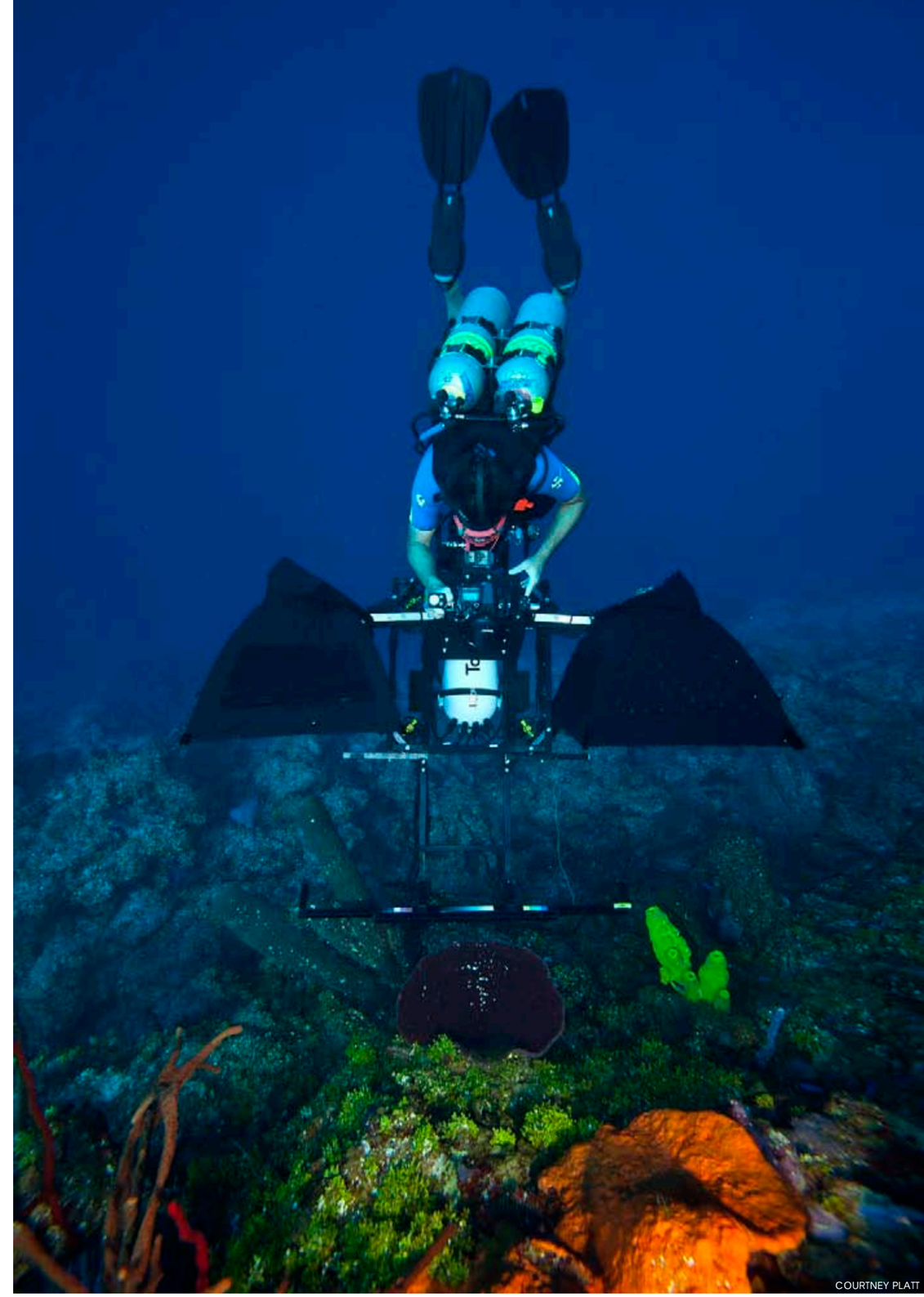
In the summer of 2010, Hellemn returned to Little Cayman with the goal of photographing the same section of the Bloody Bay Wall and constructing another life size image, from which researchers could study the changes to the reef. In addition, as part of a project with the National Science Foundation, the same section of wall was photographed yet again, with special lighting, to record biofluorescence emitted from the coral reef.

Dr Carrie Manfrino and other researchers at Kean University in the U.S. state of New Jersey are studying the image produced from this Return project, and they will present a quantitative analysis of the two images as part of their ten-year study on coral health in Little Cayman.

One obvious, major change that occurred over the ten-year span was the introduction of lionfish into Caribbean waters. This Indo-Pacific invasive species has no natural predators in these waters, and their numbers are increasing problematically.

Technical challenges

The technical challenges to create such an image underwater are immense and required months of preplanning, testing and innovation. Lens choice, depth of field and lighting all had to be considered. Proper resolu-



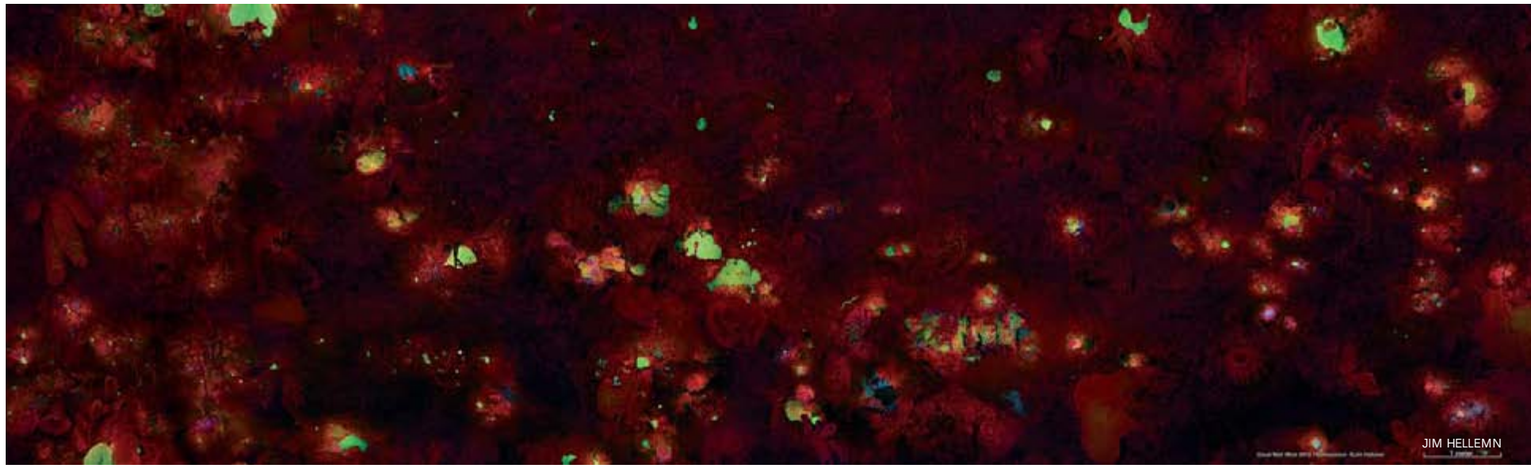
COURTNEY PLATT

Jim Hellemn underwater with his camera rig; Fluorescing corals (top left)


JASON BELPORT


JIM HELLEMN


JIM HELLEMN


JIM HELLEMN

Hellemn underwater with his camera rig (above); 1999 original Bloody Bay Wall image (top right); 2010 Return to Bloody Bay Wall image (right); 2010 Bloody Bay Wall image with green fluorescent corals and red fluorescent algae (lower right)

tion to achieve a life size image had to be maintained. Distortion and perspective also had to be accounted for and corrected.

Stitching software did not exist in 1999, so all of the digital compositing had to be done by hand. Not to mention, that the first image was created using film, so each dive was limited to 36 exposures, which then had to be drum scanned to generate the high resolution digital files needed.

Today, on dry land, it is possible to set up a tripod and shoot as many photos as you wish, left to right, up and down, before importing those photos into stitching software that will automatically generate an enormous panoramic image. Underwater, the physical properties of light traveling through water make this impossible.

Even if it were feasible to simultaneously light up a 20 by 60 foot section of reef and photograph it from one central point, the vibrant colors would fade to greens and blues as you moved away from the lens. This is due to the fact that red, orange and yellow wavelengths of light are absorbed in water and are significantly degraded even after just ten feet. Focus is also diminished with distance underwater as light waves are disrupted by the fine particles floating in the water column. It is therefore necessary to get close to your subject and shoot with a wide-angle lens for best color rendition and sharp focus.

These factors, along with other technical considerations discovered in the testing process, limited each individual photograph to an area of coverage only four to five feet across. An elaborate grid of images was then required to properly cover the entire area. Even with today's technology, the perspective problems created from shooting each object on the reef from so many different angles necessitated the final image be manually stitched together.

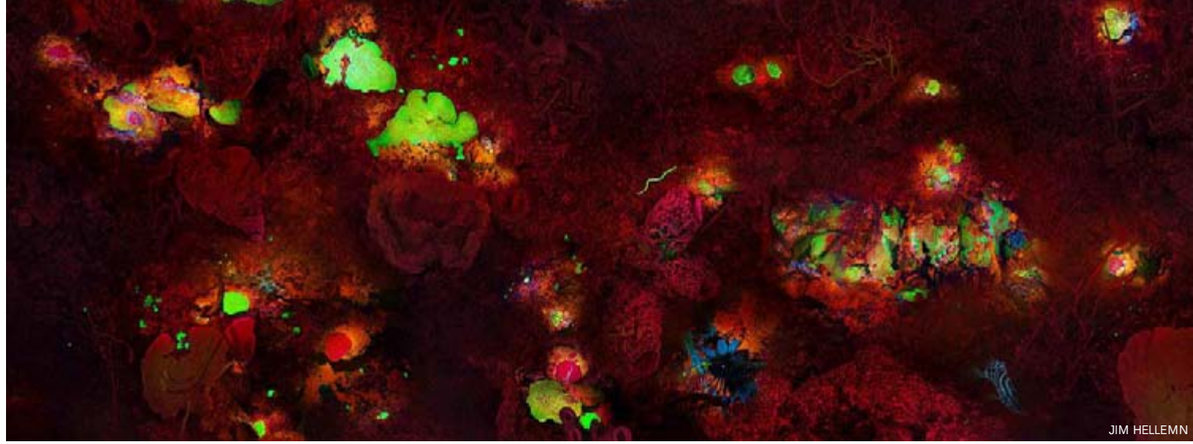
Images

The individual photos from the Return trip were captured over three weeks of shooting in July and August of 2010. The final image generated measured 82,875 by 25,350 pixels and was 11.7 GB in size. Nearly 400 hours of labor were required to complete the digital compositing process needed to create this enormous image.

Hellemn and his team developed an elaborate camera rig for the Return project in order to meet their needs for even lighting, a fixed camera to subject distance and ease of use. The platform measured approximately four feet by five feet by three feet high, weighed 110 pounds and yet was weightless in water. The frame was fabricated out of hollow aluminum square tubing and filled with hydrostatic foam. Additional floats were

JEFF CORALI

Jim Hellemn with his gear



JIM HELLEMN

The limited edition print of the *Great Wall West Coral Fluorescence*

strategically used around the platform to achieve neutral buoyancy and balance. The camera to subject distance was maintained with a fixed bar out in front of the rig and also provided a gray scale and color reference, used in post processing, at the bottom of each frame.

A Canon 5D Mk II digital camera with a 17-40 mm f/4.0 lens was used in a Nexus underwater housing. Modified soft boxes were mounted on either side of the camera for even illumination and each contained three Ikelite 400 strobes to generate enough light for the desired depth of field. Eight SeaBotix thrusters, controlled by a microprocessor built into a dive scooter, stabilized the platform and allowed the operator to hold position in the water with a touch of a button.

Bioflourescence

The biofluorescence component of the Return trip was part of continued research started in 2004 by David Gruber, Ph.D, from Baruch College in New York City. Gruber had used Hellemn's original Bloody Bay Wall image as a baseline for his study of biofluorescent proteins in corals. In addition, The National Science Foundation provided grant funding as part of a project to create an educational exhibit to communicate science to the public.

Special filters were used over the strobes to narrow the full spectrum white light down to a very narrow wavelength of pure blue light. This wavelength of light caused specific corals to fluoresce green, while various algae on the reef emitted red light.

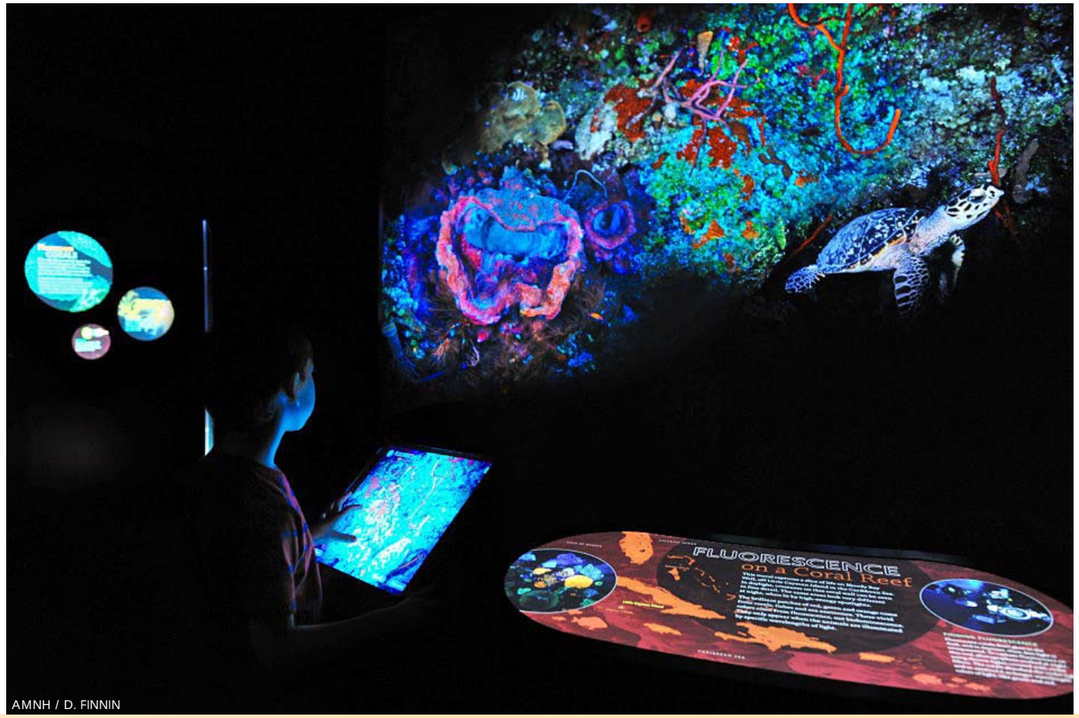
Biofluorescence is a phenomenon where light is emitted by an organism in response to an external trigger, such as a particular wavelength of light. This differs from bioluminescence, which is an organism's own ability to produce light by way of a chemical reaction. Examples of bioluminescence include the well known firefly, while others such as glowworms, anglerfish, flashlight fish and dinoflagellates are perhaps less familiar. Very few organisms in this world have both bioluminescent and biofluorescent properties, and it seems corals are almost exclusively biofluorescent.

The images produced by Hellemn and Gruber are now the centerpiece of the *Creatures of Light* exhibit on display at the American Museum of Natural History in New York City. A 10- by 16-foot, life size section of the Bloody Bay Wall was created to allow visitors to switch between the white light and fluorescent views of the reef, using iPad kiosks to navigate the image.

The exhibit features examples of both biofluorescence and bioluminescence existing in the natural world. Immersed in darkness and surrounded by soothing music, visitors leave the outside world behind as they explore elaborate displays featuring organisms from above and below the surface. The exhibit opened in March 2012 and has been sold out every day since. *Creatures of Light* will be on display until January 2013 and then it is scheduled to travel to other museums over the next ten years.

Hellemn continues to produce life size underwater images around the globe. His project called, *Portraits of Biodiversity*, is an effort to photograph all of the world's top ten marine biodiversity hot spots, as identified in a 2002 study released by the Center for Applied Biodiversity Science (CABS) at Conservation International. As part of this project, Hellemn created additional images in the Caribbean, as well as the Philippines and Malaysia in 2008. He is also currently creating a giant kelp forest mosaic with photographs taken in the waters off Southern California. ■

To learn about Hellemn's ongoing projects and view more of his work, please visit his website at: ***Portraitofacoralreef.com****. See the American Museum of Natural History at:* ***Amnh.org***



AMNH / D. FINNIN

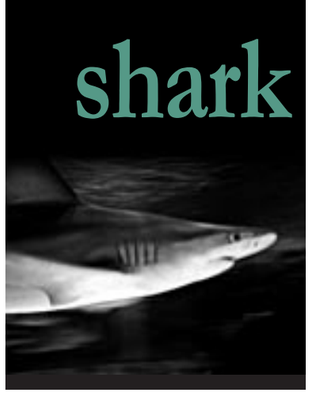
AMNH *Creatures of Light* exhibit

FINE ART PRINT

In order to help create awareness of coral reef conservation, a limited edition print, *Great Wall West Coral Fluorescence,* by Jim Hellemn is being offered. The Central Caribbean Marine Institute is given part of the revenue from all sales of the print. The donations aid this non-profit organization in their efforts to help sustain and understand the marine ecosystems surrounding the Cayman Islands.

The print comes in four different sizes—18x48in, 26x70in, 33x90in and a dramatic, large format of 40x110in. In every size, the visual resolution and the vivid color of the print is stunning and reveals even the smallest details of the marine life. Mounted to a thin, rigid aluminum substrate, this elegant archival giclée print is protected with a super-gloss UV laminate and is backed with a one-inch aluminum frame, which is hidden from the viewer, so that the image seems to float off the wall. To order, visit: **Portraitofacoralreef.com/GWWCoralFluorescence.shtml** ■

SOURCES:
ASMP.ORG/ARTICLES/BEST-2011-HELLEMN.HTML#.UILT8U1_IFS
BLOODYBAYWALL.COM
GOTHAMIST.COM/2012/03/30/PHOTOS_VIDEO_GLORIOUS_GLOWING_CREAT.PHP#PHOTO-12
BLOGS.SCIENTIFICAMERICAN.COM/ANTHROPOLOGY-IN-PRACTICE/2012/03/29/LET-THERE-BE-LIVING-LIGHT-BIOLUMINESCENCE-IN-NATURE
NEWSWATCH.NATIONALGEOGRAPHIC.COM/2012/04/03/LOVE-AND-WAR-THE-ESSENCE-OF-LUMINOSITY
PORTRAITOFACORALREEF.COM



When Sharks Really Attack

Text and images
by Ila France Porcher

Anyone who has faced an gitated shark has felt the power of communication through bodylanguage. The response is so immediate and so physical, that emotion, expressing through body language, is revealed as an important medium of pre-vocal communication among animals.

I had some curious experiences with blackfin reef sharks (*Carcharhinus melanopterus*) while observing them in Tahiti's lagoons, where they were easy to watch in two meters of water, and sneaked for years through the lagoons and depths off the island to learn what they do when no one is looking. Finally, I conducted a seven-year ethological study. Of all of the startling things that happened, one of the strangest began to unfold after three years had passed.

Shark encounters

The resident sharks had always met my kayak, and when I slid underwater, three of the females—Martha, Madonna and Bratworst—would glide up to my face one after another, turning away just before touching me.

Then one evening, they all did it! Underwater, I found the entire community of three dozen sharks converging on me at high speed and was instantly in a mass of flying torpedoes that whipped around my body. To distract them, I finned hard to push some fish scraps out of the kayak and felt my instep slam one of them with all of my force.

Expecting her to turn and slash, I peered underwater to scrutinize the situation. Martha was curving down to the food, showing no reaction to having been kicked. She had glided between my legs, as I finned upward. Carrellina shot up to my face and away again, and I pushed in the rest of their scraps.

Yet, in spite of the initial excitement, the sharks only picked and circled through the area, departing as night fell. No others came to the food left lying on the sand.

Carrellina was an exceptionally bold shark who visited annually from December to April—she had just rejoined us. It was her influence, along with the heightening excitement of the breeding season, that seemed to have triggered the unprecedented rush by the sharks.

A week later, they shot up to me again in high excitement when I appeared underwater. They fed, then began darting up to my face, and going to the boat to sniff it. Holes in the well of the hollow craft where their food was kept were plugged on the way out, but when the scraps went overboard the plugs loosened, so if I held any back, they could smell it.

As night fell, the sharks patrolled watchfully instead of leaving and often rose behind the kayak to sniff it.

The seed of change had been planted when one of them had fallen ill. I had waited each evening in a whirl of sharks with the sick one's medication hidden in a chunk of food. Though the others had had their weekly feeding session, they began to behave, with increasing conviction, as if they thought I had food I was not giving them—as if I was being tricky.

Finding patterns

I had wanted to find out what they were like, not only as animals, but as individuals. Yet, until I had begun the weekly feeding sessions, I had remained the suspicious alien in their world. This gesture of benevolence had gained their trust and allowed me to see what I had been unable to observe before—what they were doing when no one was watching. Because around me they began to behave as if no one was watching!

Yet, never had a pattern been established in which they had a regular meal at my weekly sessions. They often missed sessions or came too late to eat, and sometimes the scraps, which contained little real nourishment, were not even eaten. By the time of this story, I had identified most of the sharks who used the lagoon, and could recognize 300 individuals on sight.

Weeks passed while I watched the sharks' evolving behaviour with

puzzlement. Infrequent visitors joined the resident sharks in swarming up to me, and then made repeated charges by themselves. Fast charges by the shy older female visitors were unprecedented. Carrellina was joined in her bad behaviour by several females who, like her, were in their first year of reproduction—I began thinking of them as "the juvenile delinquents".

Then one night, the sharks' relentless circling reached new heights of tension. They repeatedly charged while Carrellina orbited my head, and her buddy Chevron passed me again and again. I dared not move a muscle for fear of triggering a mass charge, and faced each shark, scarcely breathing, as she swam up to my face. Finally, when they circled away, I flew to the kayak, leaped in and tossed in the tuna heads I had brought for the nurse sharks. The lagoon boiled, as the sharks pounced in darkened waters that obscured the wild melee beneath.

Just three days later, I was unexpectedly given some fish scraps and returned, accompanied by a young seabird I had rescued. Carrellina and her gang undulated around the boat, as I prepared. The bird alighted on the shark-food, stared down at the sharks and flew. She glided low over the surface, and the sea actually quivered, as the fish startled. So I failed to see how it happened, that just at that moment, the sharks attacked the boat!

The heavy weight of the loaded kayak with me on it was bashed with shocking force first one way and then the other, as they slammed it from multiple directions. Somehow, they had acted in synchrony. The surface was solid with sharks emerging at high speed, twisting and bashing the kayak, while more replaced those shooting away. Then, they leaped out of the water to snatch at the food behind me. All around me in the air, their jaws were loudly snapping shut, and one got a good bite of a scrap that overhung the water.

The heavy blows came mostly from beneath, and it was hard to turn in the narrow craft to see behind me, where the sharks surged out to snatch at the scraps. Carrellina passed repeatedly at high speed. She had been the instigator, and among those I was able to identify were the juvenile delinquents.

Instead of sliding in, I began throwing the food to them, hoping they would calm down and feed. But even after I finished, Chevron shot up to slam the kayak over and over again.

When she went into search mode, I slid underwater. Golden sunlight flickered over the coral, and the graceful sharks soaring through. Each snatched up a scrap and accelerated to shake out a bite, while the falling piece was caught up by one in pursuit. Several visitors were among them, adding to the excitement, and none paid attention to me, as I drifted, writing down their names.

Shark rage

Their attack confirmed that I had been right about their subjective state when they had circled me so tensely three days before. The way Chevron had repeatedly torpedoed the kayak after I had fed them suggested that she was finally venting intense feelings of shark-anger or rage. The desire for food was not the motivation for slamming the kayak; it was their anger toward me.

At home I found that some of the kayak's straps had been cut, punctured and sliced by their sharp little teeth.

I went with dread to the next shark session. There was a slight bump, as I prepared, then silence. But before I could feed them, Carrellina slammed the kayak hard, and the rest joined in.

They began to leap out of the sea while I twisted in the narrow craft to grasp the slippery scraps from behind me, and throw them. Watching and listening to their jaws snapping shut with loud clapping sounds, it was obvious that in a kayak, it was not easy to keep all of one's body out of the edible zones. I had thrown in quite a bit of food when Martha suddenly broke through the surface beside my right elbow and snapped her jaws closed on a trailing scrap. The power of the movement was shocking. She had come so close to catching my arm in her teeth.

For the very first time, I didn't want to get into the water, roiling with blood and sharks. But eventually I slid in. The same sharks I had known for so long were whirling, feeding in the site, and I began to wonder whether their actions were due more to impatience to get the food by themselves, than rage this time.

Indeed, I theorized, they were like excited children helping themselves to birthday cake without waiting to be served. Once their spontaneous attack had begun on the boat, they had found that their food was right there, so on the next leap, they targeted it. Could this latest incident be the confirmation of a new foraging method? The species normally does not breach, look above the surface, nor feed above the surface, so their behaviour was all the more remarkable, and actually reminiscent of a cultural development!

New foraging methods

To be sure, I verified that the behaviour of the sharks attending the commercial shark feeding dives had not changed—only among my sharks had the change in behaviour occurred.

By the next session I had decided that they would no longer be rewarded for their bad behaviour with food raining down. Instead, I would photograph their new foraging behaviour and time it. When they stopped their bashing and leaping, I would feed them.

But no sharks met me, and underwater I found a peaceful gathering of mostly juveniles and males. As night fell, I was floating a treat to Martha when Madonna zoomed around a coral, and

they collided, hard, head-on, within arm's length. Madonna turned to me, I put a gentle hand on her head, and she soared over my shoulder. It was a good example of how absolutely unpredictable things could happen.

Each session was different, but Carrellina and the juvenile delinquents were usually in attendance, leading ragged lines of sharks up to me and orbiting my head. Formerly shy sharks began to charge me at unacceptable velocities. There seemed to be no escaping the conclusion that the next step in the long, long string of events leading up to the present moment, was that it would be me, instead of the kayak, that was attacked. Carrellina or Chevron would make the first move and be instantly joined by everyone else.

Emotional nature

The news reports "shark attacks" whenever an incident occurs, yet these attacks involve biting, usually in an act of sensing, or eating behaviour in sharks. Eating is not the same as attacking, which implies aggression. Never had I heard of a group of sharks knocking someone senseless in an unanimous, angry attack.

I had reported cognitive behaviour by sharks and learned that such an ancient line of animals was considered incapable of cognition, so knew that no one would believe that sharks could feel as well as think. Yet, I was seeing evidence that sharks did feel emotions—they shared them and they acted on them. Their emotions had been dictating much of what had happened at our sessions for several weeks.

Further, though my species is far removed in evolutionary time from theirs, I could understand the sharks' body language. The intimacy that had developed during hundreds of hours spent alone with them, involved feelings. I was still two years from the moment when Carrellina slammed the boat, and the juvenile delinquents undulated against it and raised their heads from the water to be caressed, rather than joining her. But the sharks' emotional nature had shown itself.

Sharks observe us

Weeks passed, and the mating season drew to a close. The times that they had attacked the boat began to seem incidental. I clung to the hope that things would soon be back to normal, but at each session there was some reason not to return, at that moment, to my earlier routine of pushing the food into the water with the sharks all around me.

Then one evening, Carrellina and her gang were coiling around the kayak as I threw in the food and suddenly came straight up through the water toward me and began slamming the boat with the same power as before and leaping out, though their food was in the water!

Underwater, Carrellina flew to meet me. She did not leave me alone throughout the session, and her repeated charges made it difficult to watch or follow any other shark. When she came to the end of her repertoire, she just circled around my head. She came at me from different directions, and since she was smaller than the large females I had always been closest to, her speed was alarming. I tried holding the kayak between us and banging on it, but that had no effect on her, nor did it make much sense now that the sharks had begun attacking it. Splashing my hand on the surface in front of her nose had no effect. I was afraid to push her away physically because she was so swift, and she dodged faster than the eye could follow.

April ended and Martha left to mate. I brought a treat for her to a feeding session when she was due back, and when the excitement faded she came to me.

So I decided to get her treat, as she circled away. But at that moment, she came shooting back. So, I waited. A few minutes later, however, the same thing happened. When she accelerated back four times in 15 minutes when I decided to get her treat, I was mystified. So the next time I decided to go, I watched what happened closely. First, I looked around and moved my hands. Then I glanced above the surface to see where the kayak was—it shifted constantly in the wind and current, so I checked for the direction in which to swim. And these subtle signals brought Martha back. She was observing me!

I got the plastic bag and opened it. The water pressed the plastic tightly against the food, so I had to hold it open while blood and fluids poured out, and shake it to waft the food out for the shark. Martha came in without accelerating, and coiled through the water in front of me, taking the pieces one after another and paying no attention to the plastic nor the movements of my hands.

Shark intelligence

Many such incidents demonstrated the sharks' ability to concentrate on something if they cognited (thought) that it could benefit them. Their intelligence is the theme of the book I wrote about them when they were finned, entitled *My Sunset Rendezvous : Crisis in Tahiti*.

Martha had mated, and the reproductive season was over. The waters had cooled, and the sharks' behaviour would settle down, I was sure. Yet, one evening I was cruising around with my escort of fish, and found that a tuna head had been swept under a coral. So, I moved it 30 centimetres back out.

A big blackfin who had left long before soared in, grabbed it, and shook it. Instantaneously, several tons of nurse sharks converged on this tiny scrap, while my forty blackfins shot into the site and dove onto the fish head. Then they orbited at top speed as the nurse sharks rose vertically, tails thrashing the surface in their urgent efforts to scrape out a crumb. I drifted backward, aghast at the turmoil caused by just that one movement of the scrap from under the coral. It had been lying there ignored, all during the session!

The shadowy green waters were shot through with speeding blackfins, orbiting the nurse sharks like stars around a black hole. There were so many present that there was not enough space; multitudes were zooming by as if I weren't there. I retreated and watched in awe, as the shadows of night obscured the scene.

Escalation

Not long after that, I arrived with difficulty in high winds for the Saturday feeding session, and threw the food into wild waters that rushed over the kayak. Then, I slid in.

As I fell through the water, several sharks appeared at my side with more coming beyond, obviously assuming that I was food descending. But when they saw it was me, they adjusted their trajectory.

I found myself in a fairly deep region where two three-meter nurse sharks undulated in midwater, and the soaring blackfins appeared and vanished in the cloudy light. A large nurse shark was vertical, presenting a weird centrepiece as it flung its enormous tail around and flailed its fins. In most places, the water was not deep enough for such a huge fish to balance vertically. Everyone was unnaturally excited.

I drifted, watching, beginning to manoeuvre for a photograph as several sharks tore a large scrap apart.

Suddenly, Bratworst, Madonna, and Martha left the feeding area and swept up toward me. The gesture was so swift, so full of conviction, that I instinctively lowered the camera. They came in triangular formation, as they had in our first moment of meeting more than three years before. Bratworst was in front. Normally, I faced the shark until she turned away, but Bratworst didn't turn. And the approach was far too fast. As she flew under my hands, I hit her on the back of her head. It was amazingly hard!

Like lightning she turned at right angles and shot away, and Madonna was soaring in. I raised my knees between her and my chest, and finned water into her nose, but she just dodged slightly and kept coming! I finned harder, and finally she turned away. Martha was beside her, and I pushed her away—she continued in the new direction in which I had pointed her. Back in triangle formation, tails waving, the three disappeared into the whirling sharks.

I swam away, realizing that I couldn't leave in the boat because of the wind! But when I came sneaking back, Martha zoomed up to me and Bratworst circled. Many residents joined her. The large nurse sharks were still vertical at the vortex of a tornado of blackfins.

Trembling, as one shark after another flew up to my face or tightly circled, I wrote down all of their names. Most such excited sessions concerned many visitors, but this time, I had only 38 names, the names of all of my sharks.

They could not have been upset because there was not enough food—there had been plenty; my three favourites would have caught it as it fell through the surface. So why had those sharks, the most familiar with me, spontaneously left the feeding in triangular formation to assault me?

While I was sure that they had not intended to bite me, it did appear that they would have rammed me if I had not defended myself. Bratworst, a large, high-powered missile driving straight into my solar plexus would have been crippling. With Madonna and Martha right behind, their action could have become a general attack like the one made on my kayak, given the mood of the sharks and the speed at which they can suddenly move.

The sharks' behaviour was not returning to normal. The breeding season had ended more than a month before, and the water was markedly colder, but at this session, more sharks than ever had been charging and harassing me at a level of excitement that was higher than I had ever seen it. The problem had not been restricted to the incidental gesture of Martha, Madonna and Bratworst.

Like a tangle of string too big to trace all the strands, I could not unravel the different influences, the many events involving different individuals that had precipitated the situation. Nor could I discern why my favourite three sharks had acted as they had. But because of their gesture, I changed the location of my feeding sessions, and restricted future visits to unexpected ones without food.

Communication without harm

Yet in spite of my long-term intimacy with the sharks, never had I been bitten. *C. melanopterus* was the only species I had intimately known that had never hurt me, either through accident or a fit of pique, no matter what had happened; even my dog sometimes took my hand in her teeth along with a cookie. The sharks did not bite each other and seemed to have an inhibition against biting companion animals, while mammalian behaviour is so often the opposite.

While studying the sharks alone, I was always trying to understand their behaviour. There was no one to ask, only the sharks to look to for understanding. In the end, what was remarkable was that understanding was possible across the species barrier. That I could sense their subjective states and predict that their behaviour was evolving in a particular direction indicated that they had communicated across the species barrier. Emotion, via its expression as body language, appears to be an important form of communication in multi-species communities. ■

A native of British Columbia, Canada, Ila France Porcher spent much of her life as a wildlife artist. While in Polynesia, Porcher formed connections with sharks and witnessed the atrocities happening to them. These experiences inspired her to write the book, My Sunset Rendezvous.

WIKIMEDIA COMMONS

French Polynesia bans shark fishing

In a decision hailed by environmental groups, the government of French Polynesia has banned shark fishing in its waters, creating the world's largest shark sanctuary. Especially significant is the inclusion of the mako, the last shark not protected in its waters, on the list of fish banned from capture or trade in its vast territorial zone in the South Pacific.

The proposal was announced at the annual meeting of the Western and Central Pacific Fisheries Commission meeting in Manila, where nations also agreed to take steps to protect whale sharks from tuna nets.

"At more than 4.7m km² of ocean, this designation doubles the size of the area already protected by all six existing shark sanctuaries," said Josh Reichert, head of the Pew Environment Group. But, he said, "Sharks are threatened throughout much of the world's oceans, and there is a great need to protect them before they slip below levels from which they may never recover."

According to the conservation group of the World Wildlife Fund (WWF), about 73 million sharks are killed every year. The majority is killed only for their fins, a practice that has threatened a third of all shark species with extinction.

The United States banned finning in its waters in 2000, with several states banning the trade in shark fins. The European Union (EU) has had a finning ban since 2003, but has endorsed even tighter shark fishing rules obliging fishermen to bring sharks to port intact. The total ban on endangered deepwater shark fishing would be maintained for an additional two years applying to both E.U. waters and E.U. boats in international waters. ■

SOURCE: PEWENVIRONMENT.ORG

Healthy natural river systems help keep bull sharks away from man-made canals

In Queensland, Australia, a tracking project of the Nerang River and the Gold Coast canal system it feeds has shown that sharks have a preference for natural waterways. Twenty-four newborn and juvenile sharks were tracked over three years by researchers from Griffith University who discovered that the sharks were more inclined to remain in the river, with only some making excursions into adjoining canals.

The larger sharks tracked in the study ranged a bit further and occasionally ventured into canals closer to the river mouth.

The study suggests that maintaining the Nerang River system will ensure the shark population isn't forced into the canals in greater numbers.

"These findings—that juvenile bull sharks have a significant preference for less modified river habitats over the residential canals—points to a strong imperative for conserving those natural habitats," said Joe Lee, deputy director, Australian Rivers Institute. ■


WIKIMEDIA COMMONS

World's largest shark sanctuary created

Cook Islands declared a 1.9 million sq km sanctuary, contiguous with one established last week by neighbouring French Polynesia. Shark fishing and possession or sale of shark products is now banned in an area totalling 6.7 million sq km—almost the size of Australia. The sanctuary is the result of a partnership between the Pew Environment Group and the Pacific Islands Conservation Initiative and the support of many local community and political leaders.

"This is hopeful news for the world's sharks and our efforts to protect them. We are thrilled to see the Cook Islands become part of this global movement during a time when so many shark populations are threatened," said Jill Hepp, director of shark conservation for the Pew Environment Group.

Hundreds of signatures were collected on a local petition, and students submitted letters and drawings bearing the message "Akono Te Mango" (Protect Our Sharks).

The Cook Islands joins Palau, the Maldives, Tokelau, Honduras, the Bahamas, the Marshall Islands and now French Polynesia in establishing shark sanctuaries. They cover a combined area of more than 11.4 million square kilometers (4.4 million square miles) of ocean. ■

SOURCE: PEWENVIRONMENT.ORG


WOLFGANG LEANDER

SCOTT BENNETT

Tourism has no effect on Ningaloo Reef whale sharks, study says

A five-year study has concluded that tourism is not affecting Ningaloo Reef whale sharks. Since 1993, tourist numbers participating in whale shark activities have increased from 1,000 to 17,000, generating about US$6 million per season.

The first multi-year study on the effects of ecotourism on whale shark populations determined that sharks which frequently encounter tourists are just as likely to return to the reef as sharks that have little interaction with humans.

"Our research shows that the code of conduct used by the Department of Environment and Conservation to protect whale sharks is very effective with no detectable impacts of tourists on their aggregation behaviour at Ningaloo across years," said Rob Sanzogni, the report's lead author.

Conservation organization WWF's marine spokesman Paul Gamblin said the report was encouraging and showed the industry was receiving appropriate attention. However, he stressed more had to be done to assist Coral Triangle neighbours such as Indonesia and the Philippines.

"Australia has played an important role but needs to up the ante to protect the whale sharks when they leave our waters," he said. "We need to help support local community tourism projects up there because the whale sharks enter more dangerous waters when they leave Australia," he added.

Despite the positive findings, Gamblin was still concerned about the impact of resources projects in waters near Ningaloo Reef. "It increases our concern about the increasing development of the oil and gas industry which is getting ever closer to Ningaloo, including areas where the whale sharks migrate through," he said.

Researchers hope the report will provide a blueprint for similar work on the impact of ecotourism on other marine megafauna such as manta rays and whales. ■

Versatility, in diving as well as beyond it, makes you perform better and smarter and become more open to new experiences.

dive for pleasure—yours and that of your buddy or team.

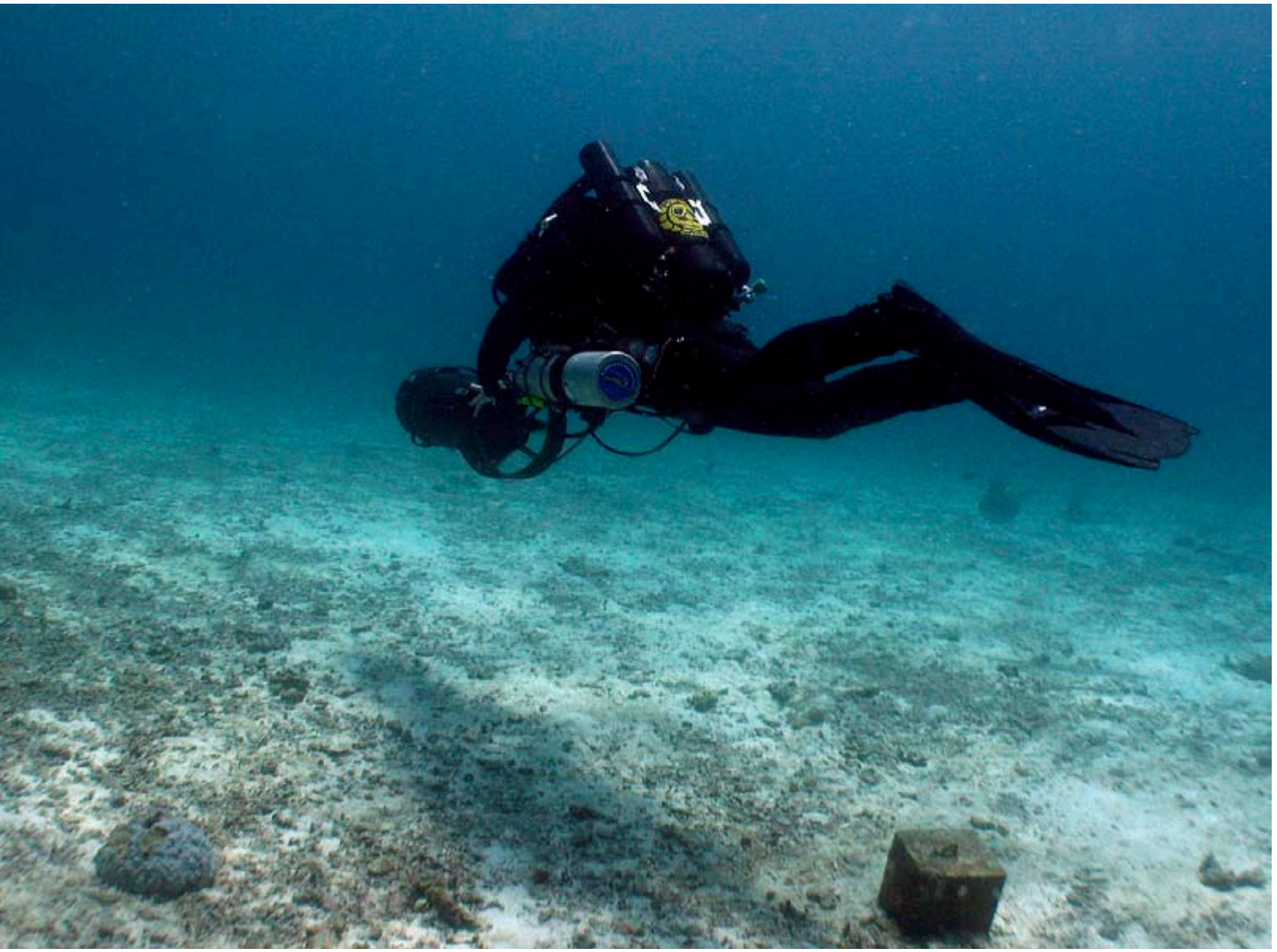
10. Try to gain new experience, become versatile, and make a college try at all aspects of tech diving. For example, let's say, try diving sidemount. It's in fashion nowadays! The tanks are mounted at both sides of the diver, below the shoulders and on the belt instead of on the back of the diver. Thus, you can carry tanks separately to the water, and it is much lighter than a twinset on your back. You can put them into the water without any effort. Two 6-liter tanks can replace one 12-liter tank, with double the safety and an easy access to the valves in case of any problem. And what freedom it is underwater! Pure pleasure.

Or try diving with nitrox—under ice, in caverns, while cave diving. Simply put, it is the mother discipline of tech diving. Test new equipment, dry suits, rebreathers, etc.

Use a propulsion vehicle. Far from being a gadget, it can be very useful in reducing your gas consumption, as it decreases your efforts. It can expand your action range, as it goes much faster than you can with fins, and it can offer you a new feeling underwater, comparable to aerial acrobatics.

By the way, the very first book on scooters by D. Rebikoff was entitled, *Underwater on a Plane*.

Versatility, in diving as well as beyond it, makes you perform better and smarter and become more open to new experiences. ■



Diver on rebreather with underwater scooter

Pascal Bernabé of France holds the world record depth on a deep dive using self-contained breathing apparatus. He dived to 330m on trimix on 5 June 2005 off Propriano, Corsica.