

Stretching For Divers :: Fluoro Diving & Photography :: Tech—Bailout Gas



GLOBAL EDITION
July 2013
Number 55



Normandy
D-Day Wrecks

Costa Brava
Underwater Wine

Egypt
Red Sea Wrecks

Turkey
Uluburun

Portfolio
Lauren Kussro

Profile
Dr Mark Erdmann

INDONESIA
Raja Ampat

COVER PHOTO BY STEVE JONES

DIRECTORY

X-RAY MAG is published by AquaScope Media ApS
Frederiksberg, Denmark

www.xray-mag.com

PUBLISHER & EDITOR-IN-CHIEF
Peter Symes
Editor@xray-mag.com

**PUBLISHER, MANAGING EDITOR
& CREATIVE DIRECTOR**
Gunild Symes
Gunild@xray-mag.com

ASSOCIATE EDITORS
Scott Bennett, Toronto
Scott@xray-mag.com
Catherine GS Lim, Singapore
Cat@xray-mag.com
Michael Menduno, Berkeley
Michael@xray-mag.com
Barb Roy, Vancouver
Barb@xray-mag.com

Russia - Moscow
Andrey Bizyukin, PhD
Andrey@xray-mag.com
Svetlana Murashkina, PhD
Svetlana@xray-mag.com

ASSISTANT EDITORS
Roz Lunn, London
Roz@xray-mag.com
Robert Osborne, Toronto
Robert@xray-mag.com
Don Silcock, Sydney
Don@xray-mag.com

USA
Larry Cohen, New York City
Larry@xray-mag.com
Kelly LaClaire, Portland
Kelly@xray-mag.com
Bonnie McKenna, Houston
Bonnie@xray-mag.com

ADVERTISING
UNITED KINGDOM
Rosemary E Lunn, London
Roz@xray-mag.com

USA & INTERNATIONAL
Susan Kochan, Orlando
Susan@xray-mag.com
Matthew Meier, San Diego
Matt@xray-mag.com

SENIOR EDITOR
Michael Symes, PhD - *Science*

SECTION EDITORS
Michael Arvedlund, PhD - *Ecology*
Scott Bennett - *Travel, Sharks*
Andrey Bizyukin, PhD - *Features*
Larry Cohen - *Photo & Video*
Kelly LaClaire - *Marine Mammals*
Catherine Lim - *News, Books*
Roz Lunn - *Equipment News*
Bonnie McKenna - *Turtles*
Michael Menduno - *Tech*
Robert Osborne - *Features, Profiles*
Don Silcock - *Photo & Video*

COLUMNISTS
Gretchen Ashton - *Dive Fitness*
Pascal Bernabé - *Tech Talk*
Leigh Cunningham - *Tech Talk*
Andy Murch - *Shark Tales*
Mark Powell - *Tech Talk*
Cindy Ross - *GirlDiver*
Cedric Verdier - *Tech Talk*
Lawson Wood - *UW Photography*

CONTRIBUTORS THIS ISSUE
Gretchen M. Ashton
Scott Bennett
Rico Besserdich
Larry Cohen
Kevin Deacon
Dr Mark Erdmann
Steve Jones
Lauren Kussro
Steve Lewis
Catherine GS Lim
Rosemary 'Roz' Lunn
Bonnie McKenna
Brandi Mueller
Ila France Porcher
Barb Roy
Josie and Jason Ruth
Don Silcock
Gunild Symes
Peter Symes
Museum of Underwater
Archeology, Bodrum
360 Derece Research Group

Contacts page: Xray-Mag.com

SUBSCRIPTION

X-RAY MAG International Edition in English is FREE
To subscribe, go to: www.xray-mag.com

COVER PHOTO: Diver on vibrant coral reef, Raja Ampat, Indonesia
Photo by Steve Jones

contents

School of fusilier, Raja Ampat, West Papua, Indonesia. Photo by Steve Jones



9
D-DAY WRECKS
NORMANDY, FRANCE
BY STEVE JONES

55
RED SEA WRECKS
HURGHADA, EGYPT
BY BRANDI MUELLER

columns...

67
DIVE FITNESS:
STRETCHING FOR DIVERS
BY GRETCHEN ASHTON

17
ULUBURUN WRECK
TURKEY
BY RICO BESSERDICH

64
UNDERWATER VINTAGE
COSTA BRAVA, SPAIN
BY LARRY COHEN

81
CAVE DIVING & CCR
TRAINING: BAILOUT GAS
BY STEVE LEWIS

26
INDONESIA'S RAJA AMPAT
THE FOUR KINGS
BY STEVE JONES

76
WHAT ARE SHARKS
DOING WHEN NO
ONE IS LOOKING
BY ILA FRANCE PORCHER

84
FLUORO DIVING
AND PHOTOGRAPHY
BY KEVIN DEACON

35
PROFILE:
DR MARK ERDMANN
BY STEVE JONES

94
PORTFOLIO:
LAUREN KUSSRO
EDITED BY GUNILD SYMES

41
RAJA AMPAT:
INCREDIBLY RICH DIVING
BY DON SILCOCK

plus...	
EDITORIAL	3
NEWS	4
WRECK RAP	15
TRAINING	24
TRAVEL NEWS	25
EQUIPMENT NEWS	55
BOOKS & MEDIA	70
MARINE MAMMALS	72
TURTLE TALES	74
SHARK TALES	80
PHOTO NEWS	93

Not yet subscribed to
X-RAY MAG? Sign up now!
It's FREE! QUICK! EASY!
click here...

THE 8TH MALAYSIA INTERNATIONAL DIVE EXPO 2013

DIVE HERE



5 - 7 July 2013

**Tun Razak Hall 3
Putra World Trade Centre
Kuala Lumpur, Malaysia**

www.mide.com.my

An Exhibition For Diving, Water Sports And Travel Adventure

Exhibition Organizer: **AEE**

A Member of: **beadiver**, **SCUBADIVER**

Official Publication (International): **SCUBADIVER**

Official Venue: **Putra World Trade Centre**

Preferred Airline: **Malaysia Airlines**

Official Hotel: **SERI PACIFIC HOTEL Kuala Lumpur**

Official Radio Station: **red fm**

Official Contractor: **epico**

Official Dinner Venue: **Modesto's**

Endorsed & Supported by: **Malaysia Tourism**, **Malaysia Airlines**, **Putra World Trade Centre**, **Agility**, **Beyond Ocean Network**, **PADI**, **SSI**, **DAN I**

Official Freight Forwarder: **Agility**

In Association Of: **Beyond Ocean Network**

Association Partners: **PADI**, **SSI**, **DAN I**

Official Media Partners: **Action Asia**, **AsianDiver**, **DIVING**, **DIVELOG**, **DIVE**, **underwater**

In Support Of: **Diveguide.com**, **EZDIVE**, **ASWAQ**, **Travel**, **CEAN**, **KUNANG**, **SPARK SAFETY**

For Information Contact: **ASIAEVENTS EXSIC SDN BHD**
Tel: +603 7980 9902 / +603 7981 9909 Email: info@mide.com.my Website: www.mide.com.my

Photo: SDA/MIDE TTL Photo Competition 2012 Vanessa Migeon (Australia) Portfolio Honourable Mention

The dive community needs you ...



the full picture, as the dive industry was also struggling during many of the preceding years when the global economic climate was still upbeat. Diving could also just simply have fallen somewhat out of fashion. As in so many other matters, it is probably a mix of many reasons and mechanisms.

financed. Aside from setting up shop and trade wares, one would also have to organise classes and training and often also trips. And even when it is a labour of love, as is often the case, passion only goes so far. The bottom line is without enough customers coming in through that door, the economic realities soon put an end to any enterprise.

And this is where the dive industry now needs you.

Let's face it and call a spade a spade.

The dive industry is not faring so well, and the patient has been unwell for quite some time.

Since the glory days of the 1990s when every successive year saw a steady growth in reported certifications, the 21st century has been pretty much seen as one long, protracted contraction of business.

Industry bodies and trade organisations have long since recognised this worrisome trend, analysed its causes and attempted to come up with remedies—some more successful than others.

So what seems to be the problem? The ongoing financial crisis may have a role to play, as many like to point out, but it's not

This is, however, not the place to go into detailed macro- or micro-economic analysis or reflections on how the industry should get back on an even keel while facing the ever-mounting competition for attention from other leisure activities.

The matter at hand is what to do about it right here and now and get going.

Running any dive operation is quite capital and labour intensive and often comes with a meagre return on investment. One needs a premises, inventory, compressor, class room, equipment, access to a pool, zodiac or boat, vehicles, perhaps a trailer and a minibus, etc—all of which need to be

We need to recruit more new divers, so bring a friend. Diving has now been made easy to learn, and it is a great social activity for friends and families alike where you can share experiences, and once in a while, great life-changing adventures and mind-broadening encounters with underwater wildlife unequalled to what one can experience on dry land.

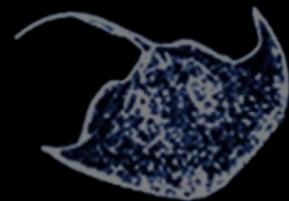
To that affect, DEMA created the Be a Diver campaign, which you can find on www.beadiver.com

So please spread the word

And let's make diving attractive and fashionable again.

—The X-RAY MAG Team

... to bring a friend



News edited
by Peter Symes

from the deep NEWS



PETER SYMES

How Coral Islands Form

Charles Darwin got it almost right when he, in 1842, hypothesized that coral atolls develop as coral grow settle in top of sand and lava from islands and grow upwards while the island itself ages and subsides creating first a fringing reef, then a lagoon-bounding reef and finally an atoll. But there is much more to it, a team of researchers from the U.S. Massachusetts Institute of Technology (MIT) has found.

Darwin did his research in the Society Islands in the South Pacific, where the sinking of islands and rising sea level create perfect atolls. However, Darwin's theory could not explain the wide variety of reef formations, which is where the new research comes in.

It turns out that many islands do

not follow this classic sequence, and reefs are shaped by many other factors than just reef subsidence. Rather, reef morphology is down to the combined effects of island subsidence, coral growth and glacial sea level cycles, a new model of the reef evolution demonstrates. The model shows that different combinations of reef accretion and island subsidence only produce results resembling the observed distribution of modern reefs if the model is coupled with sea level oscillations driven by ice age cycles.

While most of his contemporaries thought atolls were only thin sheaths of coral, Darwin correctly believed they can grow to thousands of feet thick and got it mostly right, but he didn't know about these glacially induced sea

level cycles. It later also turned out that the Society Islands where Darwin made his observations is one of the few places in the world where sinking islands and sea level rise create perfect atolls.

In cooler areas such as Hawaii, corals grow slower, and the underlying volcano is sinking quickly, and when the sea level is at its lowest, narrow fringing reef terraces form. But when a glacial melt occurs and the sea level rises fast, the combined effects are more than the corals can keep up with, drowning the reef each time.

Glacial cycles are the primary driving force behind the shaping of coral islands today. ■

SOURCE: MAY 9 GEOLOGY JOURNAL

Plants actively shape marsh landscapes to benefit themselves

Scientists have long believed that the distribution of plants within a marsh is a passive adaptation in which species grow at different elevations because that's where conditions like soil aeration and salinity best meet their needs.

But a team of scientists from Duke University and the University of Padova in Italy has found intertidal marsh plants in Italy's famed Venetian lagoon were able to subtly tune, or adjust, their elevations by producing different amounts of organic soil, and trapping and accumulating different amounts of inorganic sediments as part of a complex interplay with the environment.

Each plant species strives to build up the elevation of its substrate to within a favourable range for its survival in very much the same manner corals do.

The finding may help scientists better predict marsh ecosystems'

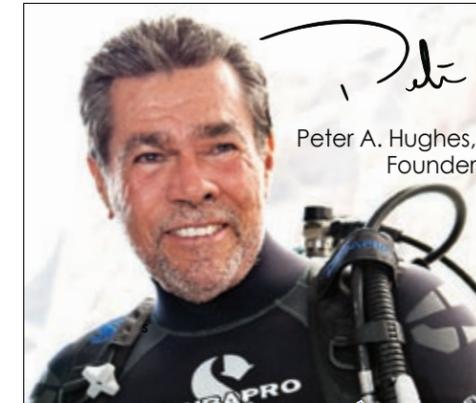
resilience to climatic changes such as sea level rise. The differences in substrate-building capabilities between species are often minute, but they allow each species to stabilize the soil within different stable states, or layers, in the marsh. Some species prefer elevations at or below mean sea level; others prefer higher elevations that are less often inundated.

"Obviously, this is not a conscious choice on the part of the plants," said Marco Marani, professor of ecohydrology at Duke. "It's a natural mechanism—how marshes work. We just didn't understand it in such detail until now." For the new study, the team used an electronic theodolite, which is able to measure elevations accurately to within less than one millimeter. ■

SOURCE: PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES



PETER SYMES



Peter A. Hughes,
Founder

Best LIVE-ABOARDS!



Galapagos



Socorro & Guadalupe Islands



Maldives



Indonesia



Philippines



Utila, Bay Islands

Best DESTINATIONS!

DIVENCOUNTERS
ALLIANCE
experience • knowledge • service
www.DivEncounters.com

Edited by
Catherine GS Lim

Mariana Trench not so dead after all

Anyone looking at pictures of the jagged surface of the Mariana Trench would naturally conclude that it is totally devoid of any organisms. At almost 11 kilometres deep—and as the deepest place on Earth—how on in the world could anything survive way down there?

On the contrary, new research has surfaced revealing otherwise. Recently, samples collected by an unmanned submersible contained a large number of microbes, prompting scientist Dr Robert Turnewitsch to state that "the deepest parts of the deep sea are certainly not dead zones".

In 2010, together with other scientists, Turnewitsch had sent the submersible into the depths of the Mariana Trench to retrieve samples of the murky sediment within. Then, back in their labs, examination of the oxygen levels of the samples revealed the single-celled microbes. Elaborating on this, Turnewitsch said, "These microbes, they respire as we do. And this oxygen consumption is an indirect measurement of the activity of the community."

The extreme depths didn't seem to bother the organisms, which were treated to an abundant supply of dead plants and animals that drifted down from the surface and become trapped within the trench's steep walls.

"The amount of food down there and also the relative freshness of the material is surprisingly high—it seems to be surprisingly nutritious," said Turnewitsch.

Twice as many microbes were found at the bottom of the trench than at a nearby site just six kilometres deep. The large population of microbes has given rise to the suspicion that the Mariana Trench might play a key role in the carbon cycle and in regulating the climate, by removing the carbon from the ocean and the overlying atmosphere.

Turnewitsch added that "the Hadal trenches [where the Mariana Trench sits] may play a more important role in the global marine carbon cycle than was previously thought". ■ SOURCE: BBC



WALLACE / NOAA / WIKIMEDIA COMMONS

Marine animals help disperse seagrass, new study says

Seagrass is important in so many ways. Much as we know of the biodiversity of coral reefs, seagrass ecosystems are gradually becoming known as critical habitats and nurseries for many marine species as well as powerful carbon sinks. Yet, seagrass is still a mystery. How does

Lead author of the study, Sarah Sumoski with the Virginia Institute of Marine Science, stated, "Traditional thinking is that eelgrass disperses by abiotic mechanisms such as floating seeds, floating reproductive shoots, or currents pushing seeds along the seafloor."

animals which carried the seeds further distances than perhaps wind and waves would, but the seeds germinated successfully after the journey. However, the distance the seeds were carried was also an important factor in the success of the seagrass colonizing new areas.



FILE PHOTO: NOAA

Researchers studied eelgrass (*Zostera marina*) found in the Chesapeake Bay, USA

seagrass spread its seeds? How does it colonize a new area? These questions and more were the focus of a new study published in the Marine Ecology Progress Series. The study findings showed that several marine species played a key role in dispersing seagrass. Prior to this discovery, it was assumed that seagrass was dispersed by wind and waves.

She continued, "Our study shows that eelgrass seeds can also be dispersed through consumption and excretion by fish, terrapins, and birds—providing a means to bring seeds to isolated areas."

Distance matters. Not only did the researchers find that seagrass seeds did indeed survive in the guts of these

"We estimate that the fishes could disperse eelgrass seeds 10s to 100s of meters, while the maximum dispersal distance for terrapins is around 1,500 meters, or about a mile. The scaup [seabird] was the champ, with a maximum dispersal distance of more than 10 miles," stated Sumoski.

It was also found that seagrass seeds dispersed by animals might have a better chance to survive than if dispersed by wind and waves.

"[Animals] prefer to live under the conditions that favor seagrass growth and thus will tend to carry seeds to areas where they'll germinate. Wind and currents can easily disperse seeds into areas unsuitable for seagrass growth," said Sumoski.

The study highlights the importance of understanding seagrass ecosystems, which have come to be some of the most threatened by water pollution, dredging and coastal development. While a third of the planet's seagrass ecosystems have disappeared, restoration in many cases is thought to be a possibility. ■ SOURCE: MONGABAY.COM

How do oysters make pearls round?

Pearls are being rotated as they grow within the pouch that holds them inside the soft mantle tissue of molluscs.

Pearls typically rotate once every 20 days or so, which creates the rotational symmetry; any differences in growth rate along the axis or rotation get copied around the entire circumference.

Pearl rotation is a self-organized phenomenon caused and sustained by physical forces from the growth fronts, Spanish and French researchers find.

Formation

Pearls are formed of nacre, more commonly known as mother-of-pearl. Nacre is an astonishing material. It is a composite that consists mostly (about 95 percent) of the

mineral aragonite, a form of calcium carbonate (the fabric of chalk and marble), together with five percent organic material: proteins, peptides, lipids and polysaccharides.

The nacre is made of chemicals secreted by the same kind of cells responsible for making the mollusc's shell. A crucial difference between shell and pearl nacre arises from the different geometries of the shell and the pearl; the pearl is immersed within its pearl sac and as such, unlike the shell, is free to move within it.

Several layers grow at the same time, creating terraces that can be seen on a pearl's surface when in-

spected under a microscope. These terraces hold the key to the pearl's rotation.

As new calcium and carbonate ions, or chitin or protein molecules, stick to the step of a terrace and become part of the growing crystal, they release energy, which warms up the surface. Water molecules in the surrounding fluid bounce off the step edge and impart a small force in the opposite direction.

Because the terraces make up a ratchet shape, the small kicks imparted by warmed water molecules act in the same direction causing the growing pearl to rotate. ■



Pearls are naturally formed by many species of molluscs in response to the presence of a foreign body such as a parasite

PRISTINE CORAL REEFS ✓
PELAGICS FROM MANTAS TO MOLA ✓
MACRO FROM PYGMIES TO BLUE-RINGS ✓
RAJA AMPAT ✓
AMBON, MALUKU ✓
KOMODO & ALOR ✓
LUXURY CABINS ✓
MASSAGE & SPA ✓
5 STAR SERVICE ✓

WWW.THEARENUI.COM

Brilliant in Black.



© Copyright 2013 SCUBAPRO / Johnson Outdoors Diving

MERIDIAN

The styling of a luxury wristwatch with the soul of our most advanced dive computer; now with exclusive, rugged Black Tech PVD finish. Find out more about Meridian's features like heart rate integration at: scubapro.com or your local authorized SCUBAPRO retailer.

SWISS DESIGN
ENGINEERING



SCUBAPRO

Breaching the Final Frontier

A gold rush of the 21st century is in the works, and it may come as early as 2016.

However, instead of gold, the nuggets in demand are nodules of mineral-rich rocks from the seafloor. Copper, manganese, cobalt—and yes, also gold—are just some

of the minerals that can be extracted from these nodules.

Although the possibility of deep-sea mining has been discussed for years, its implementation has only become more viable today with modern technological advances and the higher commodity prices.

In mid-May 2013, the United Nations published its preliminary plan describing its proposal on how the extraction of the mineral-rich nodules should be conducted.

Its International Seabed Authority (ISA)—which oversees deep-sea mining—acknowledged that “we are at the threshold of a new era of deep seabed mining”.

Seabed mining management

Established to manage seabed mining, the ISA has shifted its focus from handling bids for mineral exploration—17 licences have been issued so far—to figuring out how to license the first mining operations and how the proceeds should be shared.

Considering that actual mining operations hasn't even started, isn't it a tad premature to be issuing licences and discussing profit distribution?

Hardly. Take, for example, the Clarion-Clipperton Zone, a five-million sq km area in the eastern Pacific. It has been estimated



that more than 27 billion tonnes of nodules could be found there. With the huge profit potential, any self-respecting company would want their shovel to be first in the seabed.

This being a new industry, the ISA also faces the challenges of identifying companies with the necessary skills to mine the seabed. As it states, “Competence cannot be gained without actual mining at a commercial scale; but at the same time, mining should not be allowed without prior demonstration of competence.”

Environmental impact

The plan also mentioned the need of extending the benefits of the mining operations beyond commercial motivations, and also highlighted the fact that the mining would cause inevitable environmental damage.

Some of the mining will be conducted at underwater hydrothermal vents, which before 1977, were thought to be devoid of life. We have since learnt of the many diverse species that live at these vents, from two-metre long tubeworms, purple octopi and white crabs to snails the size of tennis balls, to name a few.

According to Professor Paul Tyler, a biologist at the National Oceanography

Centre, “If you wipe out that area by mining, those animals have to do one of two things: They disperse and colonise another hydrothermal vent somewhere or they die. And what happens when they die is that the vent becomes biologically extinct.”

Cindy Van Dover, director of Duke University's Marine Lab said, “We're still just grappling with this reality of commercialisation of the deep sea. [...] We haven't yet studied the ecosystem services and functions of the deep sea to understand what we'd lose.”

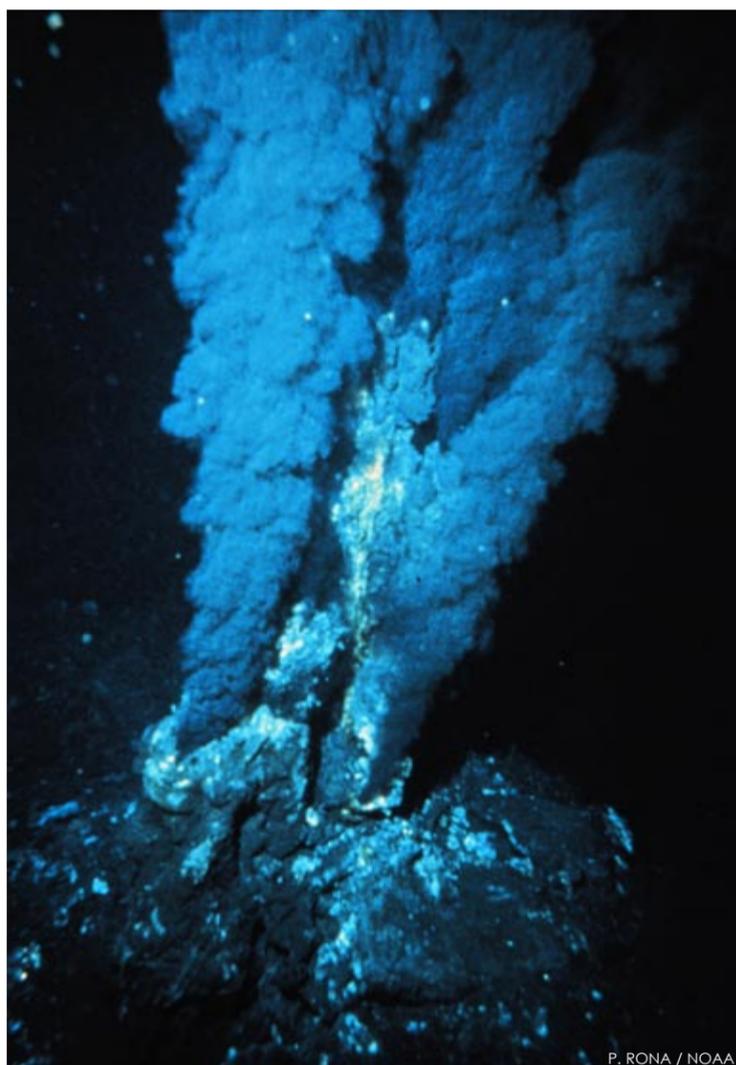
Conservation

The deep sea being a relative unstudied ecosystem, scientists are urging more debate and study into the impact of deep-sea mining on the environment and marine life before commercial extraction commences.

Dr Jon Copley, a biologist from the University of Southampton, said, “I don't think we own the deep ocean in the sense that we can do what we like with it. Instead, we share responsibility for its stewardship.”

He added, “We don't have a good track record of achieving balance anywhere else—think of the buffalo and the rainforest—so the question is, can we get it right?”

■ SOURCE: BBC



P. RONA / NOAA

Black smoker, mid-ocean ridge

☆☆☆☆
WORLDWIDE LIVEBOARD ADVENTURES

SPACE AVAILABLE!

WHALE SHARK SEASON

JUNE-DECEMBER 2013

AGGRESSOR FLEET DANCER FLEET

+1-706-993-2531
www.aggressor.com
www.dancerfleet.com

Sipadan Mabul Resort

www.sipadanmabulresort.com

NITROX CAVERN & CAVE DIVING COURSES PRIVATE VIDEO

Mabul Water Bungalows

EXPLORE ASIA TOURS SDN. BHD.

Chagos marine park ruled lawful

On 1 April 2010, the British government designated the Chagos Archipelago as a no-take marine reserve creating what was at the time the largest marine protected area (MPA) in the world. The declaration was, however, highly controversial. Fierce opposition has come from the native islanders (Chagossians) who have been battling the British government in the U.K. courts for the right to return to the islands ever since they were expelled between 1967 and 1971 to allow the United States to establish an airbase on Diego Garcia, the largest island in the Chagos archipelago. The eviction has been described by critics as one of the most shameful episodes in modern British colonial history.

Now, the U.K. high court has upheld the government's decision to create the controversial marine park. The Chagossians say the move, involving a ban on

commercial fishing, was unlawfully aimed at preventing them from resettling their former "paradise" homeland.

The marine park was created by British diplomat Colin Roberts in his role as commissioner for the British Indian Ocean Territory on the instructions of the then foreign secretary David Miliband in April 2010.

Chagossian lawyers said the move followed British consultations with the United States during which the Americans were assured that the use of their base on Diego Garcia would not be adversely affected by the MPA, BBC reports. Roberts denied under cross-examination at the high court that the marine park was created for the "improper purpose" of keeping the Chagossians out, as the United States wanted, and said it was for environmental and conservation purposes. ■



Painting of HMS *Challenger* by William Frederick Mitchell (1845–1914)

The Chagos marine reserve protects the world's largest coral atoll (the Great Chagos Bank) and has one of the healthiest reef systems in the cleanest waters of the world, supporting nearly half the area of good quality reefs in the Indian Ocean.

A U.S. air base, which has been established in Diego Garcia—the largest island in the Chagos archipelago—got the native inhabitants evicted from their islands

Century-old ship aids ocean and climate change research

Surprising results were found in a recent study by U.S. and Australian researchers who combined data collected by HMS *Challenger*, which carried out the world's first scientific survey of ocean life 135 years ago, with modern day climate science models. Findings of the study suggest that we are under-estimating the impact of global warming in a significant way.

"Our research revealed warming of the planet can be clearly detected since 1873 and that our oceans continue to absorb the great majority of this heat," said the study's lead author Dr Will Hobbs, who is a researcher at the University of Tasmania's Institute for Marine and Antarctic Studies. "Currently scientists estimate the oceans absorb more than 90 percent of the heat trapped by greenhouse gases, and we attribute the global warming to

anthropogenic causes."

Using data collected by *Challenger* as a base-line, researchers found that 40 percent of sea level rise is the result of expansion of sea water due to warming, further confirming the role of human-produced global warming in the past century.

"The key to this research was to determine the range of uncertainty for the measurements taken by the crew of the *Challenger*," said study co-author Josh Willis, who is a climate scientist at NASA's Jet Propulsion Laboratory. "After we had taken all these uncertainties into account, it became apparent that the rate of warming we saw across the oceans far exceeded

the degree of uncertainty around the measurements. So, while the uncertainty was large, the warming signal detected was far greater."

In the study, researchers were also able to demonstrate the amount of thermal expansion in sea level rise in the ocean prior to the 1950s. Climate models were the only way to estimate this change before this study.

"This research adds yet another suite of compelling data that shows human activity continues to have a dramatic influence on the Earth's climate," said Hobbs. ■

DIVE

with the best!

Mike Ball Dive Expeditions AUSTRALIA

Australia's best diving on Australia's most awarded liveboard 'Spoilsport'.






codhole
CORAL SEA
3, 4 & 7 Nights

www.mikeball.com

t: +61 7 4053 0500 e: resv@mikeball.com



Diver at the wreck of the USS *Susan B Anthony*

Text and photos by Steve Jones

On 6 June 1944, the largest invasion fleet ever assembled went into action off the coast of France, leaving a legacy that makes this area a wreck diver's paradise.

It's no easy feat to reach the descent line in even this mild current. With twin tanks and a stage cylinder adding to my considerable camera clutter, I may as well have been wearing a parachute.

Nonetheless, this is only a minor challenge when compared to what faced the men gathered in this bay on 6 June 1944. Not only did they each carry a huge weight of equipment as they stormed the soft sandy beaches, but they also had to contend with the hail of bullets pouring down on them from the German machine gun emplacements. Feeling somewhat humbled by this knowledge, I pulled myself down the descent line with renewed determination toward the wreck of the USS *Susan B Anthony*.

USS *Susan B Anthony*

Hand over hand we descended, being careful not to let go of the line until we reached the wreck. The dive boat captain's skill in plac-



ing the shot line became evident 60 feet down when I saw a large barrel appear out of the gloom—a heavy anti-aircraft

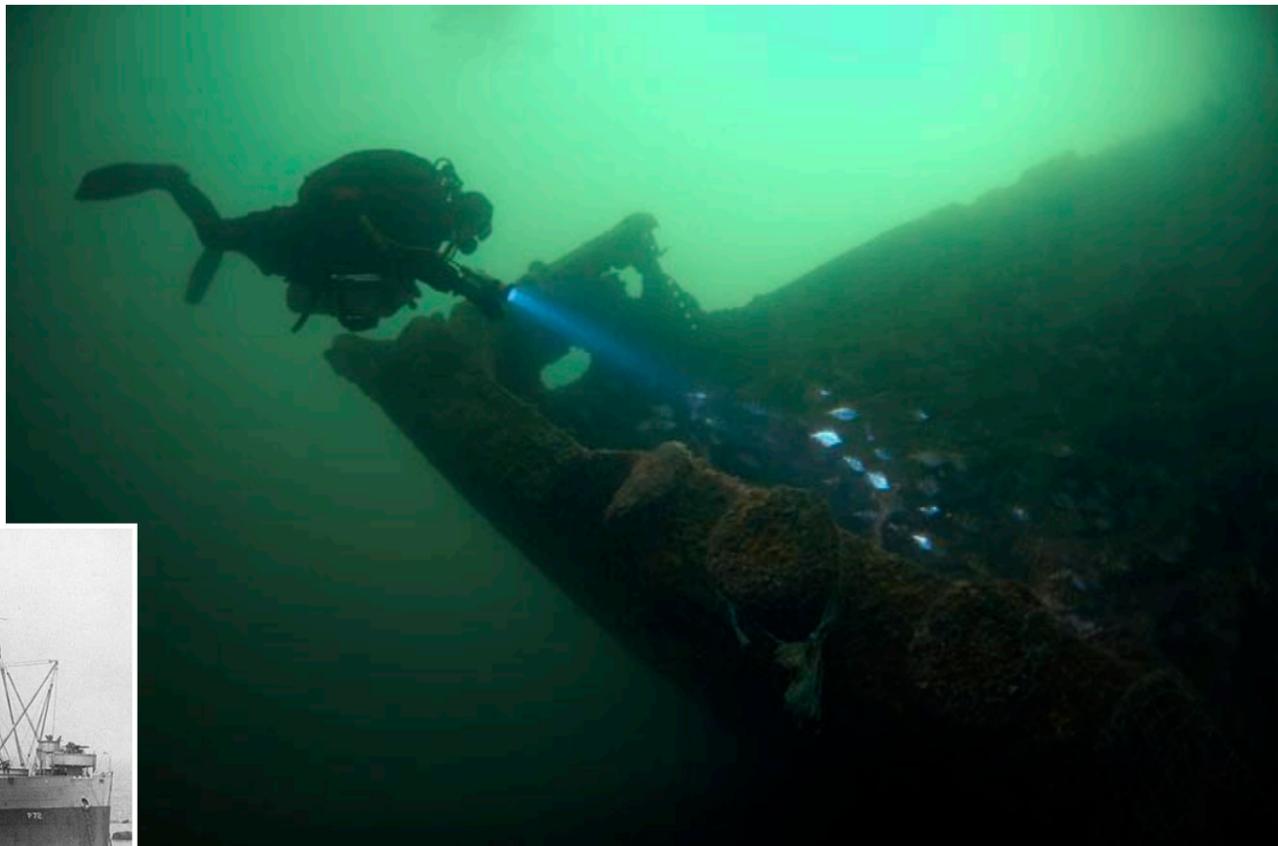
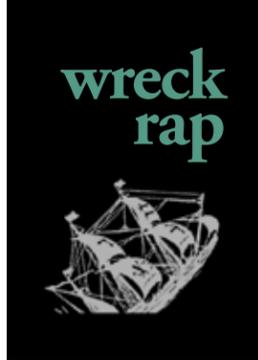
deck gun still pointing defiantly at the surface. My dive partner, Paul, illuminated the weapon's intact gearings with his torch

before we descended further into the mass of wreckage below.

Visibility was a clear 35 feet enabling us to appreciate the

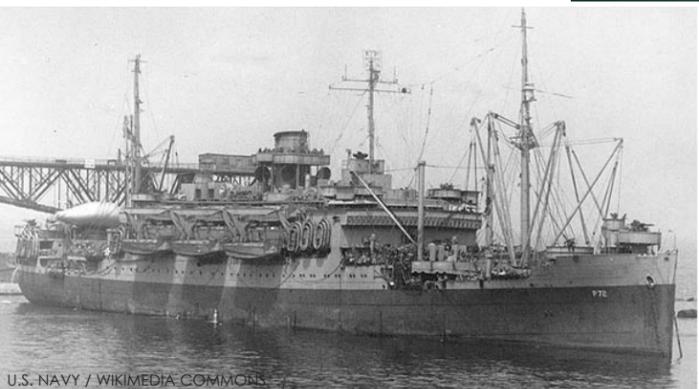
vast size of this former cargo ship. Weighing in at over 8,000 tons, she crept into the Baie de Seine in the early hours of June

7, carrying 2,288 troops, part of the "Force B" landing group. She struck a mine and despite attempts to save her, she dis-



D-Day Wrecks

USS Susan B Anthony



U.S. NAVY / WIKIMEDIA COMMONS

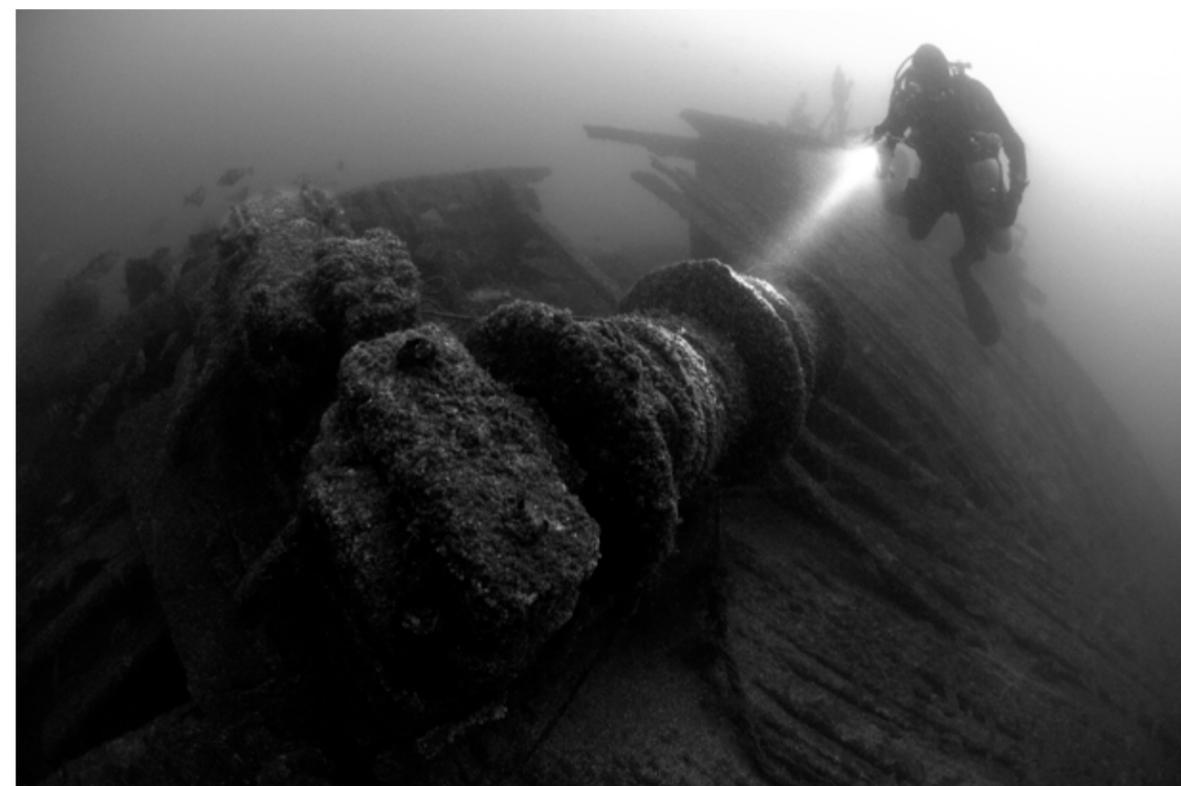
appeared beneath the waves within two hours. All 2,689 people on board were saved, setting a record for the largest rescue of people without loss of life—a small yet welcome miracle during such a destructive period in history.

Following the skipper's advice, we proceeded to the bows over teak decking, which have survived over 65 years in these cold North Atlantic waters. Swimming between the bow and the seabed, I emerged to be greeted by a large school of fish: pouting, which belong to the cod family. They seemed to swarm all over the wreck, in far greater numbers than I've seen on the other side of the English Channel, bringing color to an otherwise monochrome scene.



We now headed aft, and I noted that fish were not the only animals in abundance here. Every hole seemed to hold a lobster, crab or conger eel, a result of the French government's strict "no take" policy on the wrecks. Neither

marine life nor any other artefact can be taken from them, and the authorities have been known to impound and heavily fine dive vessels that do not comply. This may be bad news for souvenir hunters, but great news for those of us who want to see these



with live 20mm anti-aircraft shells. We were now just over an hour into the dive and had not even begun to explore the stern section of the ship. However, the current was really starting to pick up again, and we knew that if we stayed much longer, we'd be swept off the wreck or worse, into it. The stern would have to wait until another time.

We launched our delayed buoys and jumped off, watching the

wrecks as they were when they went down.

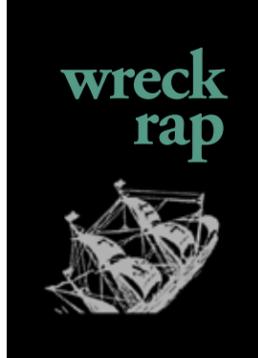
The wreck's superstructure started to open up as we approached the area of mine damage, allowing emerald shafts

of light to stream into the remains of the holds—a positively surreal scene. Intact wreck eventually gave way to twisted, torn metal interspersed with deck machinery. The seabed below us was strewn

wreck disappear into the distance, as we were carried away by the increasing flow of water. At this rate, we would have drifted some distance by the time we reached the surface, even

THIS PAGE: Scenes from the wreck of the USS Susan B Anthony





Sherman tank on LST 523 sunk by a mine (right); Point du Hoc, where U.S. Rangers scaled the cliffs on the morning of 6 June 1944 to knock out gun emplacements before the landings would begin (far right)

though our rich decompression mixes would have cut down our hang times considerably.

Interval

As with most of the English Channel, diving in this area can only be done at slack water, the window when the waters slow as the tides change. The currents are too strong to dive at any other time, so two dives a day would be the most we could achieve.



D-Day Wrecks



With our next diving window around five hours away, we began gas blending, using oxygen that we had brought from England since there were no facilities to buy nitrox nearby. The small on-board compressor made heavy work of the whole job, and the rebreather divers in our group did not miss the opportunity for some laughter at our expense. We whittled away the hours with a fine selection of French cuisine to help us on our way.

Landing Ship Tank 523

Gas mixing all finished, we found ourselves on station over the wreck of the LST 523. We'd be seeing the legendary Sherman tank on this dive, a full compliment of which went down when this heavy landing craft hit a mine. It was late afternoon now, and the light faded rapidly as we made our way down the 100 feet of shot line. Visibility was distinctly poorer than during our morn-

ing dive, and our powerful HID torches were needed to illuminate the wreck.

More than ten minutes in and there was no sign of a tank. Were we on the wrong wreck? Impatiently, I signalled my frustration to Paul who delighted in pointing out the upturned Sherman right below me. With my eyes more accustomed to identifying critters, I had completely missed it.

I took note of the distinctive wheel cogs, an easily recognisable feature of this tank. Thereafter, we seemed to run into tank wrecks constantly, intertwined with the mangled wreckage of the craft that carried them. Pollock and large sea bass looked on cautiously, unaccustomed to divers in this rarely dived area.

Empire Broadsword

The following day, we turned our attention to another giant, the 7,000-ton *Empire Broadsword*. This infantry land-



THE WRECKS OF THE BAIE DE SEINE

At 5.34 AM on 6 June 1944, 56 minutes before the D-Day landings would begin, a 5-inch shell was fired from a German gun emplacement near the pretty village of Saint-Vaast La Hougue. Seconds later, it tore through the engine room of U.S. Navy Patrol Craft PC1261. With the loss of 14 men, she became the first allied ship to be sunk on D-Day.

Many other small craft succumbed to enemy fire, mines and beach obstacles during the landings yet luckily only two large warships were lost on D-Day itself. Nonetheless, over the days that followed, mines and German counter attacks would take their toll on this fleet, as it continued to support the ground assault.

The sheer number of wrecks that lie on the seabed in the Baie de Seine is testament to the destructiveness of this period in history and the variety is huge: large troop carriers, cargo vessels, landing craft and destroyers accompany oddities such as the temporary Mulberry Harbours—it's simply a mecca for wreck divers. ■

Sherman tank on Landing Ship Tank (LST) 523

Diver at wreck of the *Empire Broadsword*



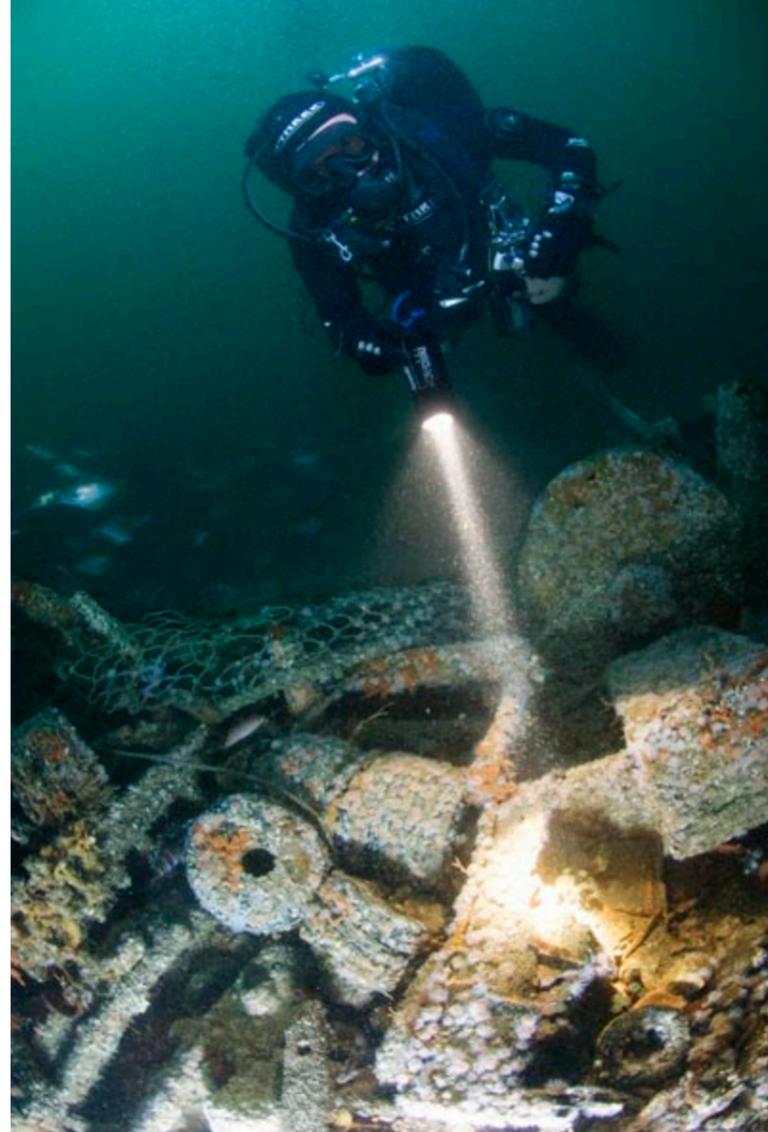
wreck rap



Diver on wreck of HMS *Computator*



Diver illuminates artefacts on wreck of HMS *Computator*



tion to the deeper wrecks, many of which have been hardly dived at all.

HMS *Computator* was an armed tug that went down in January 1945 and rests upright on the seabed in 115 feet of water, the deck machinery and a gun all still in place. The *Turquoise* was an armed coaster that was torpedoed in 1942 and now lies intact in 140 feet of water, shrouded in fish life. Both wrecks stand 25 feet from the seabed and although much smaller than the large troop carriers, they are excellent dives.

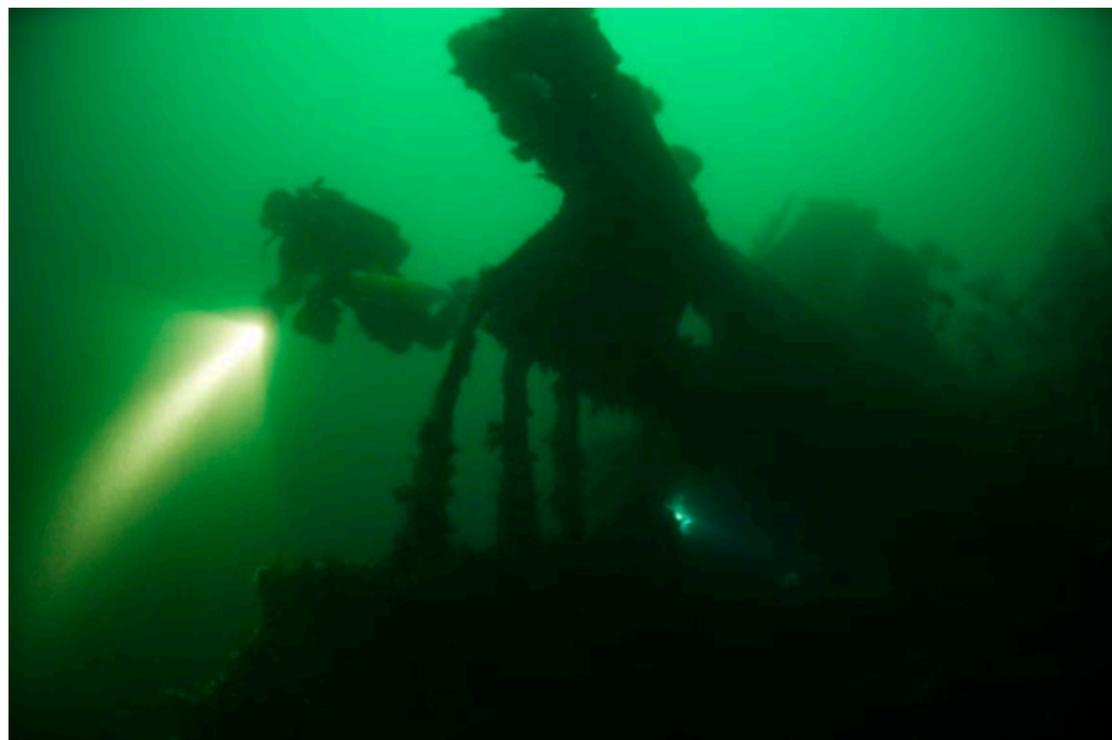
ing ship survived the June 6 landings, successfully deploying 18 landing craft to Sword beach. However, on July 2, the ship hit two mines causing such huge explosions that they blew several landing craft off the ship and inflicting heavy casualties.

We were now given a taster of the changing visibility in this bay. Long gone was the 35 feet of visibility we enjoyed yesterday. We could now barely see ten feet in front of us, with the plankton so thick I could see it between my mask and camera.

We dropped to the stern at 90 feet amongst a load of live ammunition, something I was getting used to very quickly here. My initial disappointment at the water clarity soon disappeared, as I soaked up the atmosphere of this dive. The mine damage opened the ship up considerably, so reeling off, we explored the catacomb-like bridge sections. Gradually, we made our way up the ship, and as the current started to flow, we found ourselves sheltered behind the huge mass. We finished the dive at the bow of the ship, in only 30 feet of water since this wreck stood 60 feet off the seabed.

Beyond D-Day wrecks

The ships that sank in support of D-Day are not the only wrecks of interest in this bay. Throughout the war, ships were lost in this area, and as a busy shipping region, a fair few casualties occurred in peacetime also. As the week progressed, we turned our atten-



Diver on wreck of the armed coaster *Turquoise*

During our week, we managed to explore 12 wrecks in the Baie de Seine, leaving over a hundred remaining for future visits. Before I came on this trip, my vision of D-Day centered on the thousands of troops trying to gain a foothold on the beaches, and in cases like that of Omaha, meeting fearsome resistance. I'd rarely spared a thought for the brave crews of the ships that took the troops to the beaches, those that faced the mines, fast attack boats and bombers whilst supporting the Normandy campaign. This trip changed that. The success of D-Day relied as much on the brave sailors who manned the ships as it did on the heroic troops who assaulted the beaches. Their combined sacrifice helped bring an end to one of the darkest periods in human history.

Two **epic** destinations, one great reputation—**Buddy Dive.**

AS LOW AS
\$680 pp/qd
7 NIGHTS / 5 DIVE DAYS

BONAIRE GALAPAGOS

AS LOW AS
\$4275 pp/db
7 NIGHTS / 6 DIVE DAYS

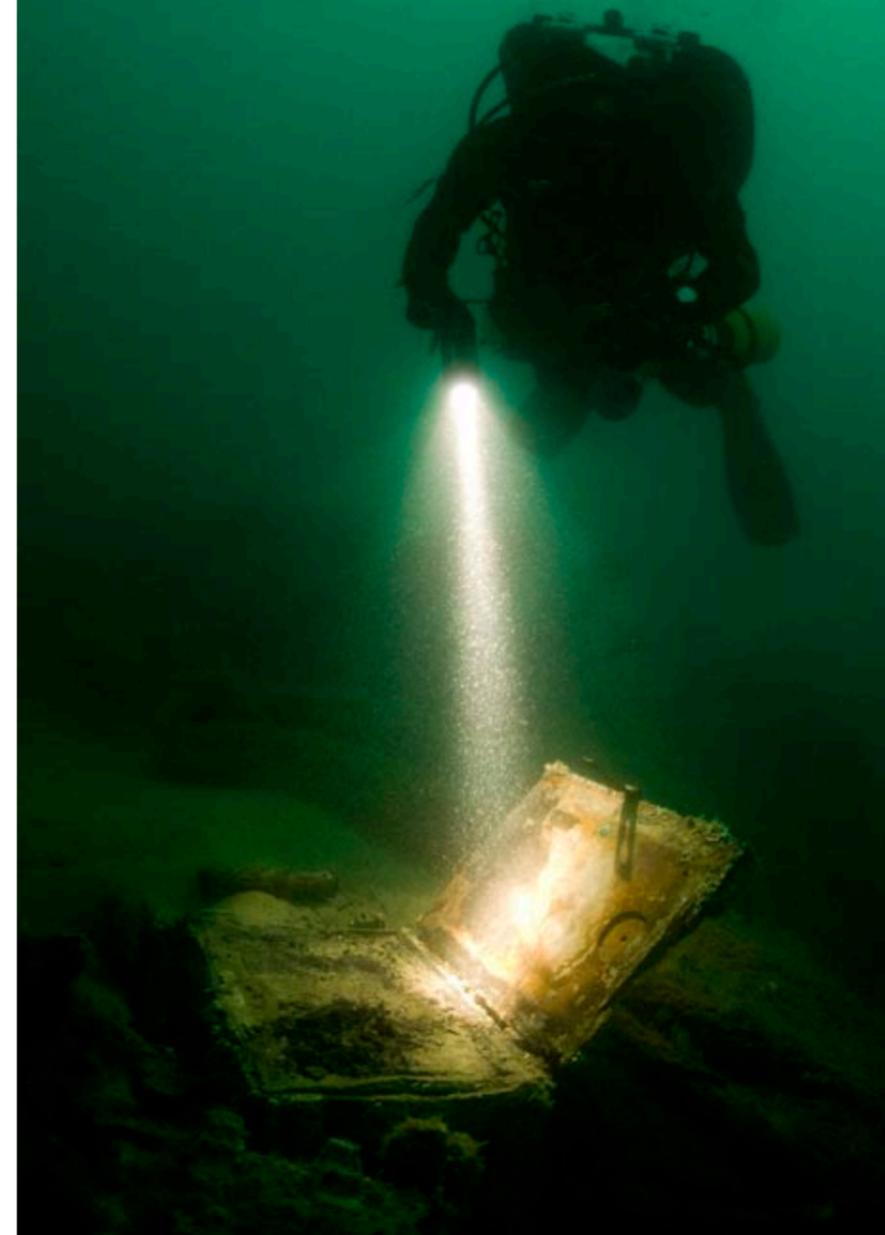
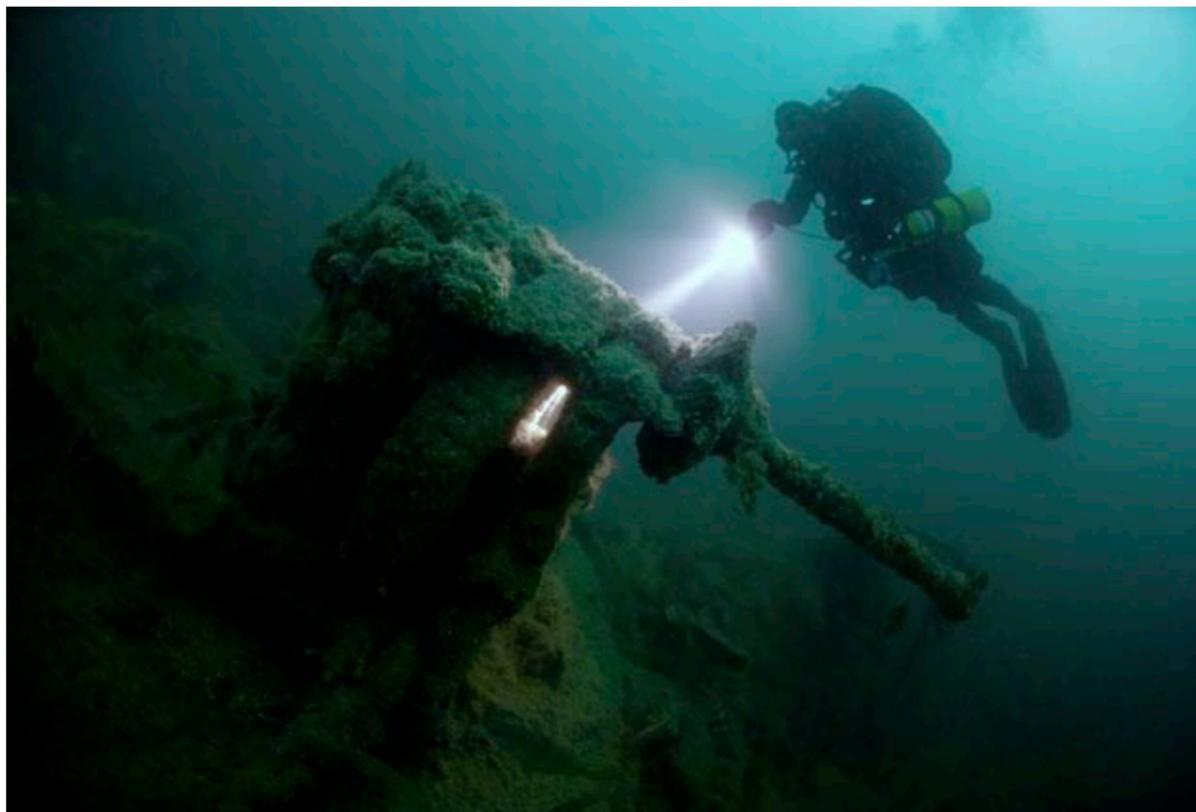
CARADONNA
WORLDWIDE DIVE ADVENTURES

www.caradonna.com
sales@caradonna.com
800-330-6611

Tanya Burnett



Diver on unknown wreck 137; Diver investigates artefacts on the wreck of mine-sweeper SGB-7 (far right)



What it takes

The variety of wrecks in the Baie de Seine offers something for experienced recreational divers through to technical divers. The shallower wrecks can be comfortably tackled with well-honed recreational diving skills, although you should be at ease in occasional low visibility and be adept at dealing with the

currents, which may be encountered at the beginning and end of your dive. Use of nitrox will ensure you get the most out of the two diving windows each day.

The deeper wrecks are more challenging and therefore rarely dived. This

is prime Advanced Nitrox territory where decompression skills, twin tanks of back gas and stages full of rich deco mix were needed for us to get the most out of our dives.

All divers need to be skilled in deploying delayed surface marker buoys from depth since fixed ascent lines are not used in these waters due to the currents. Drysuits were essential for us to stave off the cold during long run times. Finally, gas blending skills proved a huge bonus since nitrox was hard to find in this area.

Five photography tips

1. Go wide

Visibility is often poor in the bay, so you need to get as close as possible to your subject. Fisheye lenses perform best in these conditions, enabling you to get close to your subject while getting as much of the wreck in as possible.

2. Shoot with natural light

High sediment levels in the water makes

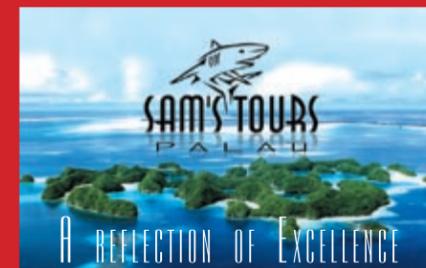
strobe lighting a challenge in these waters—backscatter is almost unavoidable. Try leaving your strobes on the boat, and instead, focus on the form and contrast of the wreck. This technique lends itself to black and white photography, but with some thought on your subject choices, you'll also get great results in color. Without those strobes, you'll also keep your clutter levels under control.

3. High ISO's

Cameras with excellent high ISO performance, such as Nikon's D700, are in their element in these conditions. On these wrecks, you'll want to be shooting at ISO 3200 or higher in order to get your shutter speed high enough to avoid camera shake. Even so, you will still need to keep



Diver on unknown wreck no. 137; there are hundreds of unidentified wrecks in the Baie de Seine



Sam's Tours and the Palau Siren are Palau's premier dive center and newest, most luxurious liveaboard. Guests can experience amazing dive excursions everyday from our dive center in Koror or 7 to 10 day diving expeditions aboard our new 40 meter yacht.

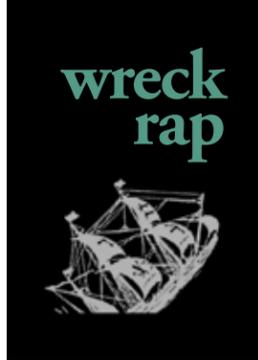
For more than 20 years we have been providing tremendous customer care and professional service to travel professionals, groups and individual travelers. Contact us for weekly packages, hotel and airline reservations and customized itineraries for diving, snorkeling, kayaking, sight-seeing and more. Let Sam's Tours and the Palau Siren show you the amazing wonders of Palau!

Sam's Tours is a Palau Visitors Authority licensed Tour Operator and a Member of Palau Chamber of Commerce and Belau Tourism Association.

www.samstours.com



Email: reservations@samstours.com



Diver on unknown wreck number 137 (below); Diver on wreck of *Cornacopia* (lower right)



The Normandy American Cemetery and Memorial sits on a cliff overlooking Omaha Beach (left and below)



NEED TO KNOW

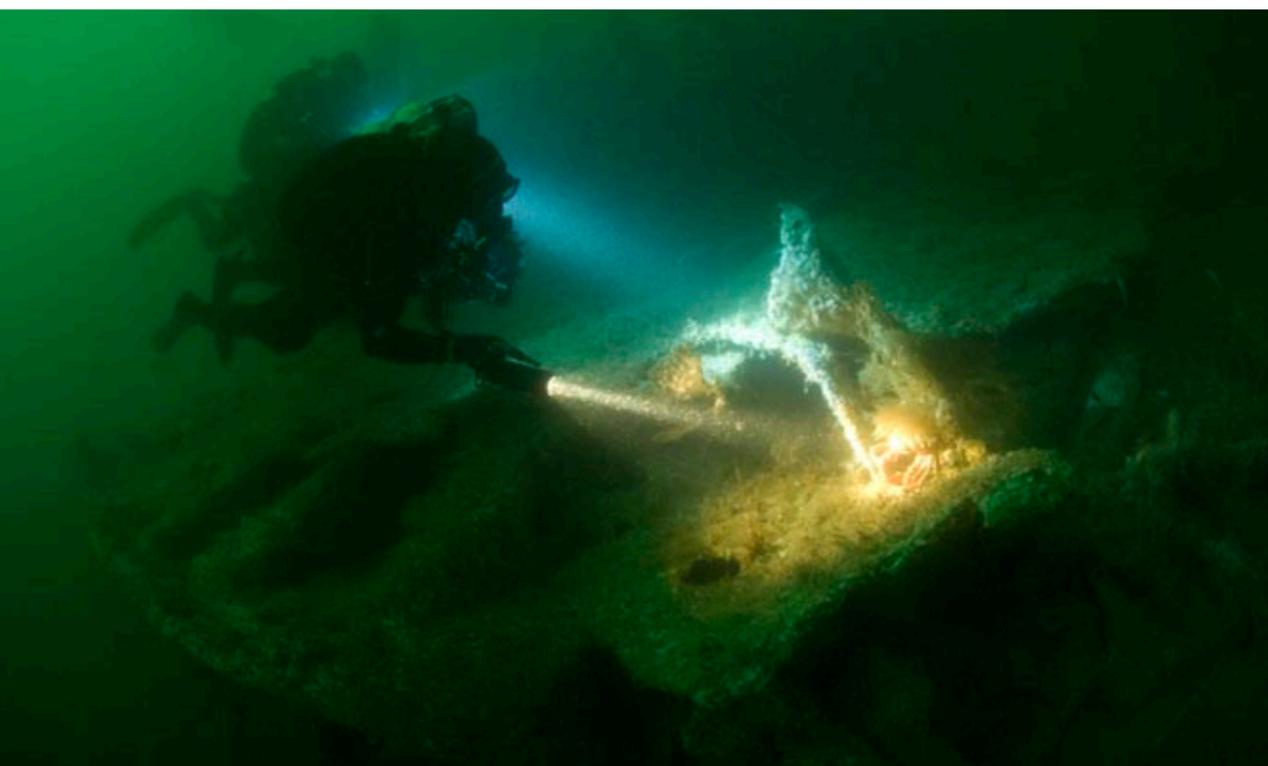
WHEN TO GO: May through September offers the best diving and weather conditions. The water may be subject to increased plankton levels in early and late summer. The bay is exposed and diving is at the mercy of local weather conditions, although there is plenty to do topside if the weather prevents diving on any day.

DIVE CONDITIONS: Diving can only be done in the windows when the tide changes, so only two dives a day are possible. Visibility can vary greatly from 5-18m/15-60ft and water temperatures range from below 10°C/50°F in early spring to a maximum of 17°C/62°F by September.

OPERATORS: The best way to dive the D-Day wrecks is via one of the British vessels that cross the Channel. We used Steve Johnson's excellent outfit, Channel Diver (www.channeldiver.co.uk), and based ourselves in the fishing village of Saint-Vaast la Hougue.

PRICE TAG: Boat hire for six days diving is approximately US\$700 each based on ten divers. Accommodation is approximately \$550 for a twin room based on two people sharing for the week. Hire of tanks and weights is extra.

TOPSIDE MUST-SEE: Be sure to visit the U.S. cemetery overlooking Omaha beach; it is an incredibly moving experience. Pointe du Hoc, where U.S. Rangers scaled the cliffs to knock out German artillery emplacements, is also thoroughly worth the visit, and the 30ft-deep craters will leave you wondering how any German troops managed to survive the preceding aerial bombardment. They did, and the subsequent fighting was fierce. Coupled with the historical interest, the Normandy countryside is beautiful, and French cuisine is world-renowned. Just make sure you include enough days to take it all in. ■



top quality aluminium housing is more than tough enough for a challenging life in the hands of a technical diver, and the optical glass dome is among the best available. The excellent ergonomics of the housing make it easy and intuitive to operate even with gloved hands. ■

Steve Jones is a widely-published underwater photographer and journalist based in the United Kingdom. For more information, visit: Millionfish.com

REFERENCES AND FURTHER READING:

- M. JAMES. *D-DAY WRECKS OF NORMANDY*. ISBN: 0953185605
- M. HASTINGS. *OVERLORD*. ISBN: 978-0330390125
- A. BEEVOR. *D-DAY: THE BATTLE FOR NORMANDY*. ISBN: 978-0141048130
- LT H. V. BARRETT, USNR. *EXPERIENCES ABOARD THE FIRST SHIP SUNK IN THE D-DAY INVASION OF FRANCE*. (OUT OF PRINT BUT TRANSCRIPT CAN BE PURCHASED ON LINE FOR DOWNLOAD)



the camera's aperture wide open, often needing to shoot at F2.8, so a big dome port (8 inches or bigger) is also desirable, as these perform best at such wide apertures.

4. Use models

Do you want to shoot color images without strobes? Then let your dive partner light the wreck for you, picking out key features with their dive lamps. Focussing on your dive partner's lamp will also greatly aid autofocus, which can struggle down there in the dark and murky conditions. This technique requires practice. Medium-powered dive lamps are more suitable

since high-powered HID and LED lamps can blow the highlights out completely from your image unless aimed properly.

5. Monopod and tripods

Even with high ISO's and shooting at F2.8, the deepest wrecks will still only give you shutter speeds of around 1/10th of a second. Monopods and tripods come into their own here and will increase your hit rate, but you will need to think carefully about whether you want that level of equipment clutter on a deep dive.

Ideal Equipment. SEACAM Silver housing for Nikon D700 with SD Superdome—this



WIKIPEDIA COMMONS

Designed in the early 1930s, the Do-17 was one of the three main Luftwaffe bomber types used in the first three years of the war

German WWII bomber raised from English Channel

The Dornier Do-17 aircraft was shot down off the Kent coast more than 70 years ago during the Battle of Britain.

Designed in the early 1930s, it was one of the three main Luftwaffe bomber types used in the first three years of the war. The Dornier Do-17, sometimes referred to as the "flying pencil", was a World War II German light bomber produced by Dornier Flugzeugwerke.

On 3 September 2010, the Royal Air Force Museum London announced the

discovery of a Dornier Do-17 buried in the Goodwin Sands off the coast of Kent, England.

Attempts by the RAF Museum to raise the relic over the last few weeks have been hit by strong winds but the aircraft was successfully raised from the seabed on 10 June 2013. ■

Shipwreck in Sweden revealed to be 15th century Danish Royal Yatch

Identification of the wreck is a global sensation, according to Swedish researchers.

Over 30 years after divers stumbled upon a centuries-old shipwreck, Swedish researchers have revealed that the wreck is the Danish Royal Yacht *Gribshunden*, (Griffen), which sank in 1495, according a report in Swedish media.

The wreck of the vessel, which was discovered back in the 1970s, is located near the Swedish town of Ronneby, about 180km northeast of Malmo.

Professor of marine archeology Johan Rönby is the man behind the revelation. He said it was a once-in-a-lifetime find.

"For all who are interested in ships and marine archeology, this is a world-wide sensation," he told the Swedish newspaper *Expressen*.

Property of King Hans

The Royal Yacht *Gribshunden*



WIKIMEDIA COMMONS

The ships of Columbus by Gustav Adolf Closs, 1892

belonged to King Hans and was on its way to Kalmar in 1495 to negotiate with Sweden details of the Kalmar Union.

Researchers had long suspected that the wreck found off Ronneby in the 70's was indeed the Danish Royal Yacht. "It has surpassed all our expectations," said Rönby.

"It's almost as if, as a researcher, one might feel guilty that we had not understood it sooner."

"A Columbus ship"

The ship is unique, as it is one of the first

Scandinavian wooden ships that was built using a technique in which boards were stacked edge to edge—the so-called carvel built style. Incidentally, it is the same type of ship that Christopher Columbus used when he discovered America in 1492.

"Simply put, it is a Columbus ship. It's a *Santa Maria*, we're talking about," said Rönby about *Gribshunden*.

"*Gribshunden* is of the same era as the *Santa Maria*, and there is no ship of this kind as well-preserved anywhere in the world," Rönby told *Expressen*. ■

SOURCE: JYLLANDS-POSTEN

New underwater historic wreck trail being developed off southern coast of England

A conservation group in the United Kingdom is creating what will be one of the largest underwater tourist trails in the world. By 2018, divers will be able to enjoy a well-signed trail of shipwrecks from the 17th to mid-20th centuries.

Currently, there are three sites to explore including the Georgian

warship HMS *Colussus*, sunk in 1798 off the Isles of Scilly; the *Coronation*, built in 1685 and lost in 1691 off Penlee Point near Plymouth; and the *Resolution*, which sank off East Sussex during the great storm of 1703. Soon a fourth site will be added—Britain's first submarine, the HMS *A1*, which sank in 1911 and was rediscovered in 1989 at Bracklesham Bay. All in all, the conservation group English Heritage aims to include more than a dozen underwater

attractions, each with underwater signposts and waterproof guide books.

More attractions will be added to the trail in the future, as there are over 61 sites designated under the Protection of Wrecks Act 1973—which is only a small fraction of what is believed to be the total of wrecks around Britain. A license from English Heritage is required before divers can visit the sites, as unlicensed visits to any of the sites are illegal. ■

"Цифровой" журнал IV Digital

непечатный, экологически чистый журнал для разумных дайверов, которые любят жизнь
www.ivmag.org/ivdigital

IV Digital magazine - paperless eco-friendly magazine for Diver Sapiens, who enjoy life.
www.ivmag.org/ivdigital





Panoramic shot of *Charles Brown* wreck marks tenth anniversary of Caribbean artificial reef

A decade ago, the Caribbean island of Sint Eustatius bought the *Charles Brown* for a buck. While a symbolic exchange, it was a bargain at one cent per meter of steel. However, the board and specifically AT&T wanted to go further and make the vessel an artificial reef.

Almost everyone on the island helped clean and prepare the vessel for sinking, which took place on 25 July 2003. It was a prime example of how a little island could accomplish big things.

At 100m (327ft) in length, the *Charles Brown* is one of the largest and most awe-inspiring wrecks in the Caribbean. Ten years later, the wreck has been overgrown with reef life, attracting not only divers but large schools of horse-eye jacks, sea turtles and a huge resident barracuda named Charlie. Over the years, thousand of divers have

explored the wreck and observed the transformation of the naked white steel ship into a living reef, according to local operators.

"Like a good bottle of wine, it's getting better and better every day," said local underwater photographer, Mike Harterink, in a press release. Harterink, who is a PADI Course Director and DAN Instructor Trainer at the Scubaqua Dive Center on Sint Eustatius, has compiled a panoramic image of the *Charles Brown* to mark its tenth anniversary as an artificial reef.

"To get this photo, I was hanging on my SMB at ten meters below the surface, pushing the shutter about every ten meters while swimming over the wreck," stated Harterink. "Stitching the photo's together afterwards took a whole lot longer."

For more information: Scubaqua.com ■

Burning tanker *Potrero del Llano* Photo taken on 14 May 1942 by U.S. Army Air Corps



IMAGES COURTESY OF NATIONAL ARCHIVES, COLLEGE PARK, MD

NOAA identifies 36 wrecks as possible oil pollution threats

There are over 20,000 shipwrecks in U.S. waters. Some of them are leaking oil, according to a new report submitted by the National Oceanic and Atmospheric Administration (NOAA) to the U.S. Coast Guard.

In a press release, resource protection coordinator for NOAA's Office of National Marine Sanctuaries Lisa Symons said, "This report is the most

comprehensive assessment to date of the potential oil pollution threats from shipwrecks in U.S. waters." Symons added, "Now that we have analyzed this data, the Coast Guard will be able to evaluate NOAA's recommendations and determine the most appropriate response to potential threats."

In the report, NOAA found 36 sunken vessels resting on the U.S. seafloor that may pose an oil pollution threat, risking the health of the nation's coastal marine ecosystems. Seventeen of these wrecks were recommended for further assessment and possible removal of oil and oil cargo.

Over a hundred years of U.S. commerce and war



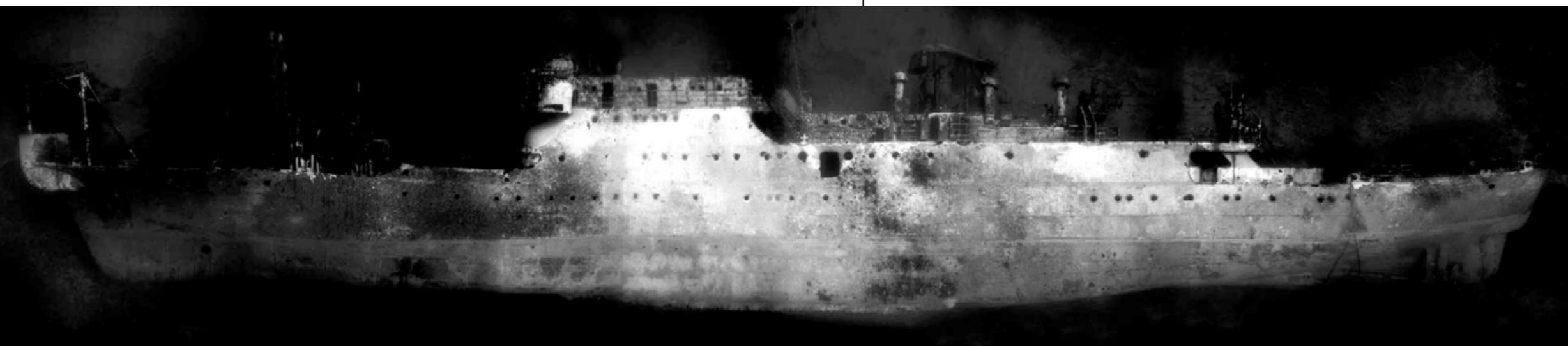
Map shows over 20,000 shipwrecks in U.S. waters

history are represented in the wrecks of the sunken vessels. Some were lost at sea in rough storms or in collisions and explosions. Others were lost during WWII, most of them off the east coast in the Atlantic Ocean and south in Gulf of Mexico.

NOAA's report will help oil response planning efforts, as well as resolve some mystery spills in which the source of the oil was not identified.

"The Coast Guard is pleased to receive these risk assessments from our partner agency NOAA and looks forward to our continued coordination on the matter of potential pollution associated with sunken vessels in U.S. waters," stated Captain John Caplis, the Coast Guard's chief of marine environmental response, in a press release. "Coast Guard federal on-scene coordinators receiving the risk assessments will carefully review the data and incorporate it into their area contingency plans."

So, who pays for the clean up? If the particular wreck still has an identifiable owner, that owner is responsible for the clean up. If there is no owner, then the Oil Spill Liability Trust Fund will most likely be tapped, according to the U.S. Coast Guard, who are charged with not only protecting those at sea and the sea itself but also response to maritime oil spills and the release of hazardous substances. ■



Wreck of the *Charles Brown*. Panoramic shot by Mike Harterink



The Oldest Wreck in the World **Uluburun**

Text by Rico Besserdich.
Images courtesy of the Museum of Underwater Archeology in Bodrum and the "360 derece" research group in Turkey

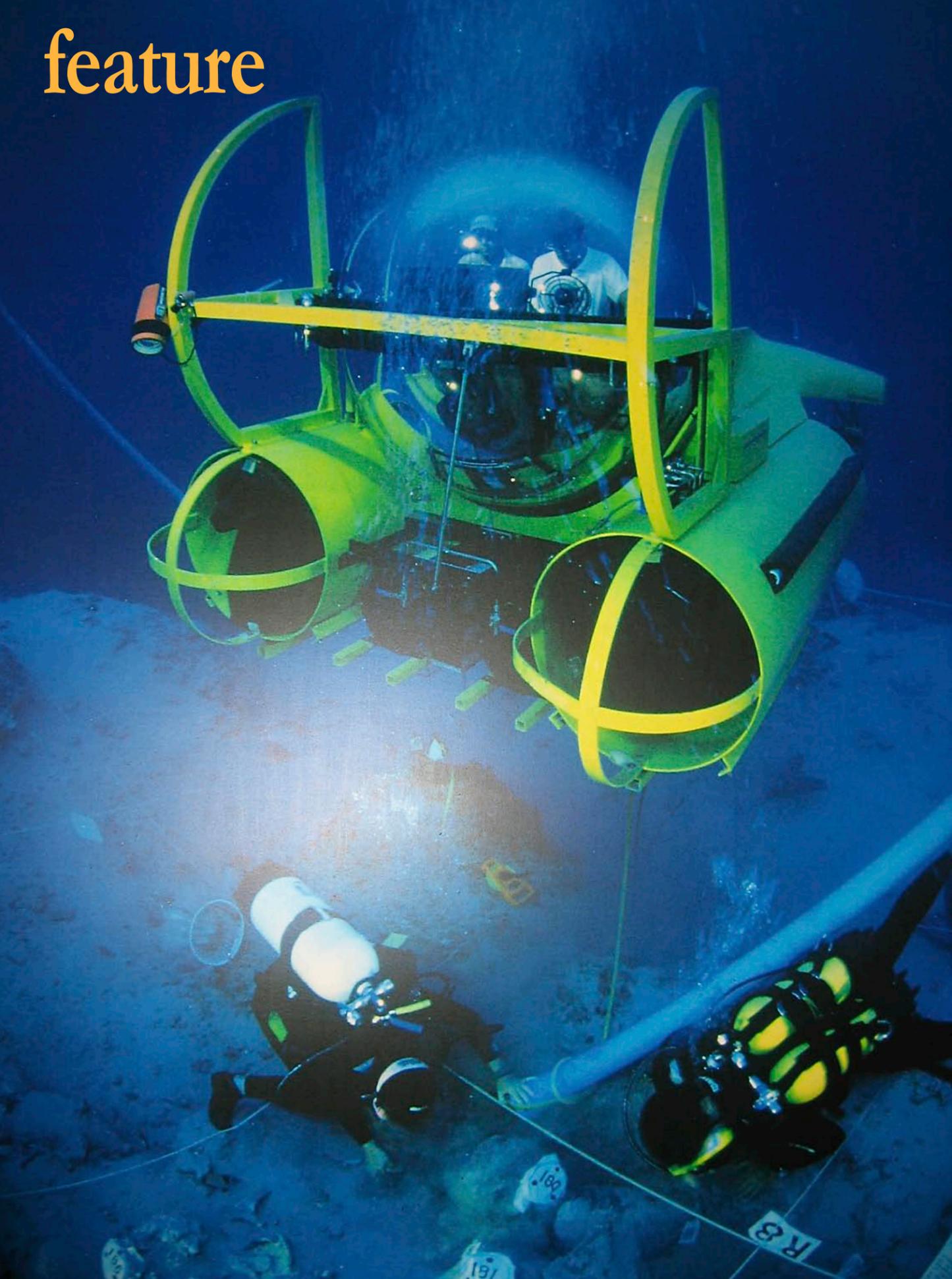
1300 BC—A merchant ship, laden with treasures from seven different cultures and commodities of Cypriot origin was traveling on a 1,700-mile trade route when it sank for unknown reasons at Cape Uluburun (near Kas on the south coast of the Antalya region of Turkey). Much knowledge about prehistoric trade and nautical navigation during the late Bronze Age, including secrets that could rewrite the whole story, began a sleep on the sea floor—a 3,300-year-long sleep.

1982 AD—A Turkish sponge diver discovered the remains of the wreck. This triggered euphoria among archaeologists around the world, and the later recovery and analysis of the findings definitively established underwater archeology as a serious science. Science was able to answer 1000-year-old questions, driving traditional analysts into desperation and changing the existing historic world view substantially.

Named after the place where it was discovered (Cape Uluburun), the *Uluburun* is the oldest known shipwreck in the world and a finding of superlatives. She brought answers to many questions, but she also introduced many new mysteries

A 1:1 replica of the *Uluburun*, built with the use of Bronze Age materials and craftsmanship, sails the Mediterranean Sea. Image provided by the "360 derece" research group, Turkey





Submersible *Carolyn* (left) of the U.S. Institute of Nautical Archeology at excavation site of *Uluburun* shipwreck and camp of the archeologists (right) during the ten-year period of excavations, Cape Uluburun, Turkey

that science has yet to explain, even today.

The Bronze Age

The *Uluburun* sank during the so-called Late Bronze Age. The Bronze Age—it sounds terribly old, doesn't it? Indeed it is! It was a time when the invention of the wheel was as remarkable as the invention of social networking is today.

The Bronze Age in itself was the successor to the Stone Age and the predecessor to the Iron Age. It lasted from about 2200 to 800 BC, but did not occur everywhere at once, because different cultures experienced different stages of development in terms of bronze. We are talking here about a general and broad time window.

The namesake of this period

was the metal alloy bronze, which comprises 90% copper and 10% tin. The use and processing of metals was already known to humanity, but it was limited to sterling metals (naturally occurring pure metals), such as gold, silver and copper.

The “invention” (mainly in Europe and the Middle East) of humanity's first alloy (which was much harder than copper) triggered a worldwide change with lasting consequences.

We could say the last trip of the *Uluburun* was in some way a consequence of these changes.

Along with the invention of bronze, the necessity to organize a “metallurgy chain” became apparent. Production needed tin, which was rare and not available everywhere. The appropriate logistics became essential.

With bronze, it became possible to accumulate wealth that was easy to transport; Bronze ingots were a common payment currency of the time, and where there is wealth, conflicts arise. The simultaneous emergence of heavily fortified settlements and the invention of the sword shows that our ancestors experienced troubles with jealous neighbors who tried to get their “undeserved” share.

Bronze also caused a serious upheaval in the social structure. The access to, and control of, resources (such as metals, metallurgy, communications and trade routes) resulted in the emergence of an upper social class and induced differentiation among people, the consequences of which we still feel



Archeologists working on first excavated findings

Uluburun



Replica of the *Uluburun* (right and left)—how the finding looked underwater; Excavation works (below). Images taken with special permission at the Museum of Underwater Archeology, Bodrum, Turkey

and transport at the time.

However, a fine structural difference with the *Uluburun* is that its pegs were not secured by wooden pins. This technique would later be called “Fenike-mortising” by the Romans. The *Uluburun* was certainly built for use at sea, which refutes the thesis that sailing in the Bronze Age was done exclusively within sight of the coast.

Because only about three percent of the ship’s original hull was recovered, drawings from ancient Egypt, specifically the pictorial representation of the “fleet of Queen Hatshepsut in the land of Punt” (1500 BC), provided a significant visual reference for reconstructing the ship.

After extensive research, we now know:

- The *Uluburun* was 15 meters long, 5 meters wide and had a draft of 1.4 meters. Her cargo is estimated to have been 20 tons. The width of the ship’s trim was 6cm, and the pegs were at a distance of 20cm.
- The ship used a triangular sail, which provided a maximum speed of two nautical miles per hour, and two rudders to maneuver.
- The Turkish research group “360” proved this ship was oceangoing in 2005. By using techniques and materials from the late Bronze Age only, the “360” group built an identical

even today.

The geographically uneven distribution of metal deposits (particularly tin) resulted in a far-reaching and almost global trading network that also spread cultural ideas in addition to goods. Bronze was essentially pioneering the cross-border communication of knowledge between cultures. Even today, good ol’ bronze has an essential word to say in the world of digital communication: No computer works without the elements of bronze. No bronze would mean no online social networks.

While our *Uluburun* sailed the seas, the world-famous bust of Nefertiti was made in Egypt. Odysseus returned home from his long odyssey. The Egyptian Pharaoh Echnaton established the first monotheistic religion. Moses’ successor Joshua led the Israelites, and the Hittites dominated an area five times larger than Germany. These were turbulent times—from Haithabu to Karnak, as well as at Cape Uluburun on the southern Turkish coast, where a merchant ship with a cargo of priceless goods sank to its grave.

The Ship

The ship was built of cedar using the so-called “spigot technique,” which involves building the outer hull first and adding the

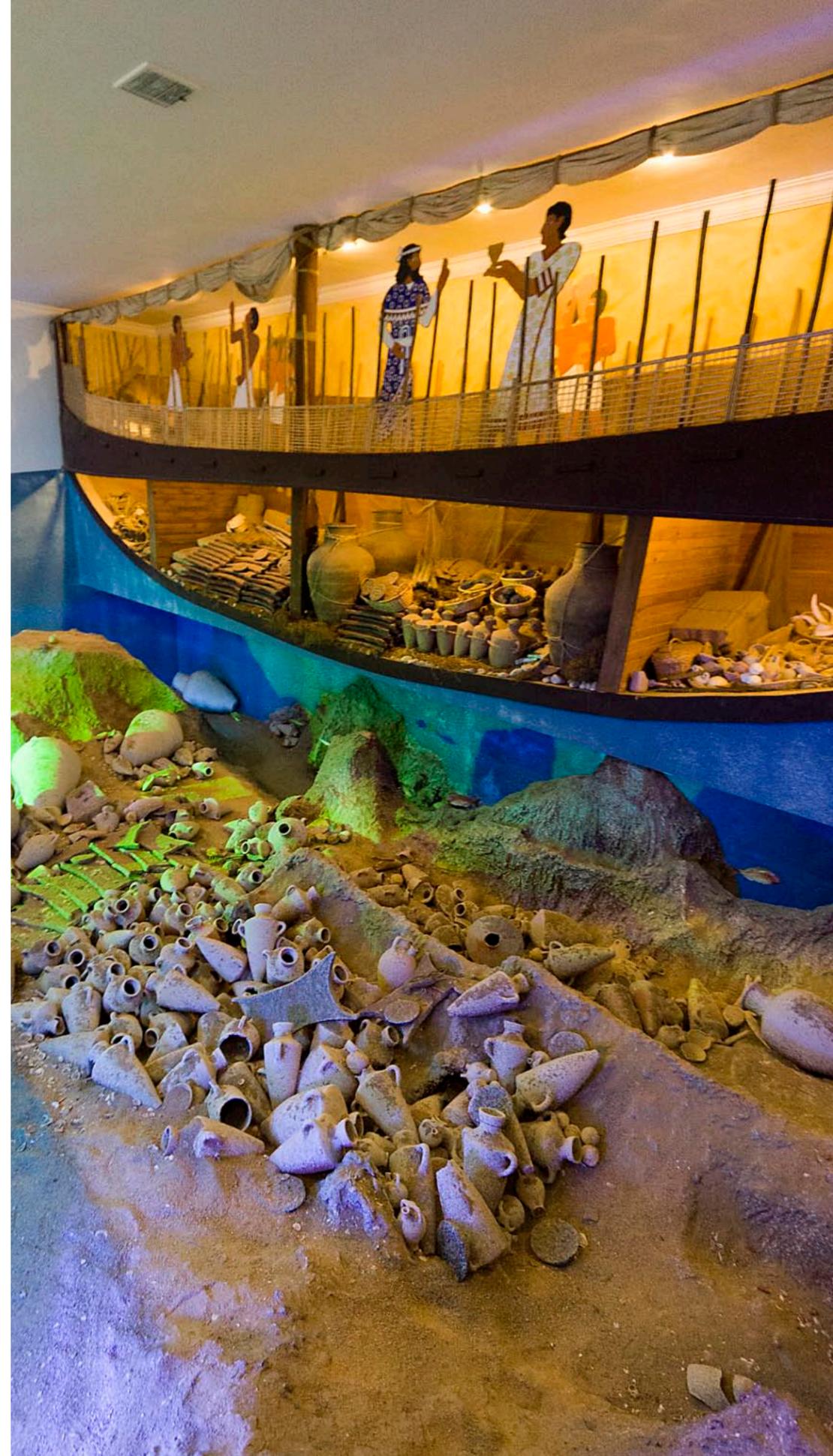


underlying “skeleton” (the frames and bars) later. Even 1,000 years after the demise of the *Uluburun*, this technique was still used to build Roman and Greek ships.

Archaeological finds in Egypt suggest that the archetype for this ship probably came from ancient Egypt. In particular, Pharaoh Echnaton drove the development of more resilient oceangoing ships to advance trade

replica of *Uluburun* and successfully sailed the Mediterranean.

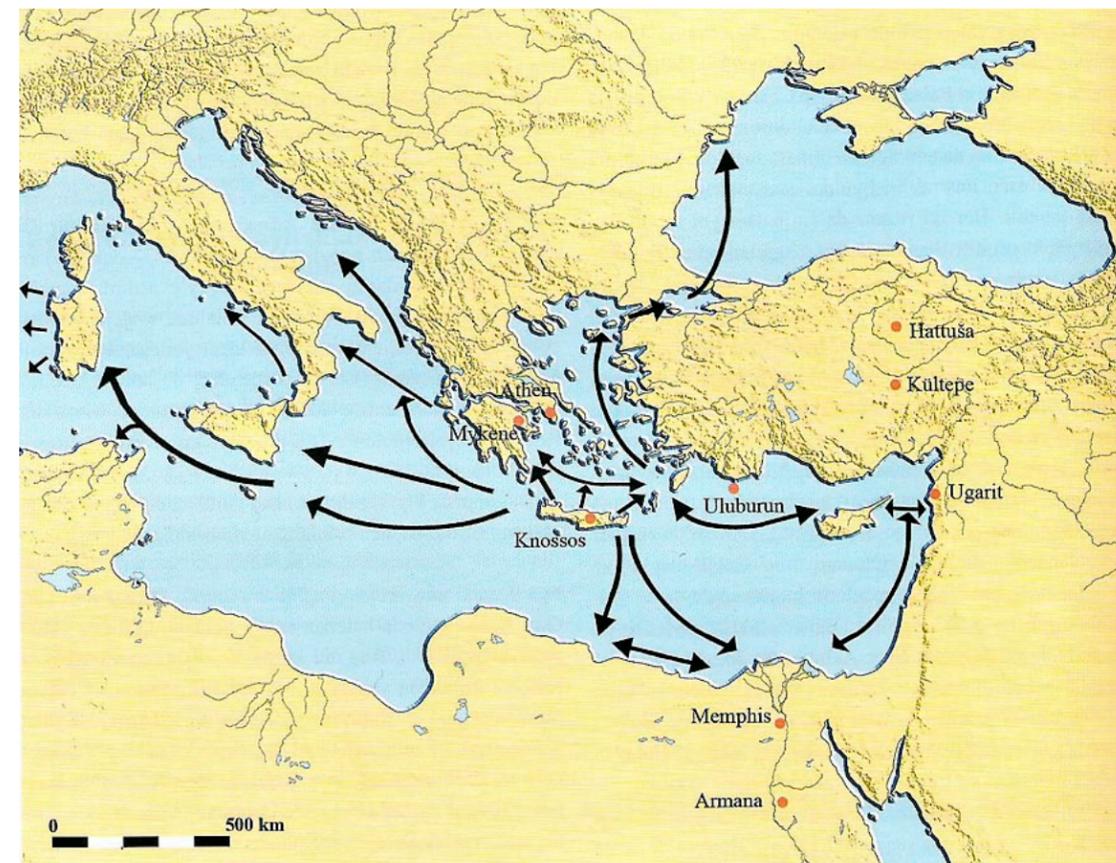
The following is the probable route of the *Uluburun*. From her home port on the Levantine coast, she sailed fully loaded to her (unknown) Mycenaean destination port. At night, she anchored in ports along the Turkish coast. The planned way back may have then taken her towards Marsa Matruh in northwest





Amphorae—Ancient cargo storage. Image taken with special permission at Museum of Underwater Archeology, Bodrum, Turkey

Trading routes of bronze during the late bronze age



common way to transport metal at that time, making carrying and securing the precious resource on pack animals and ships easier.

News of this discovery brought the Turkish archaeologist Cemal Pulak M. on the scene. Cemal was at that time an assistant to George F. Bass, the founder and director of the Institute of Nautical Archaeology (INA) in Texas, USA. After checking the “biscuit with ears” description, Pulak also dived at the site to see the ingots and also noticed several amphorae and ancient stone anchors. He initiated, together with George Bass, one of archeology’s most complex excavation projects at the time.

The discovery of the *Uluburun* was, and still is, regarded as a major discovery of the century, and neither means nor effort has been spared to finally obtain answers to so many unanswered questions about the late Bronze Age. The archaeological significance of *Uluburun* is compared with the grave of Pharaoh Tutankhamen. Two years after the discovery, the excavation was initiated.

As technical capabilities and know-how in Turkey were limited at the time, George F. Bass (known as the “father of underwater archeology”) provided extensive support and technology on behalf of INA.

INA sent its own research vessel,

the *Virazon*, to Turkey. The *Virazon* was equipped with a decompression chamber, side sonar, a proton-Magnometer, a compressor, an echo sounder, GPS, underwater scooters and a two-person submarine, *Carolyn*. It was the best that money could buy at the time.

On the rocks of Cape Uluburun, only 50 meters from the wreck’s location, a mobile village was built on stilts where the Turkish–American team of archaeologists experienced a veritable Robinson-Crusoe-style life far from civilization. During the ten years of excavation operations (1984–1994), archaeologists lived three months every year on a windy cliff, miles from the nearest village. In this solitude, George Bass and his wife, Ann, even spent their honeymoon.

Yasar Yildiz, now director of the Underwater Archaeology Museum in Bodrum, was actively involved as an archaeological diver in *Uluburun*’s excavation. Yildiz found a gold medallion of Egyptian origin at about 45 meters deep. He was also present during the salvage of the very first artifact in 1982. The wreck’s excavation comprised 22,413 dives over 6,613 diving hours at

depths between 44 and 61 meters (134 to 210 feet).

Dives at the wreck were done “barefoot” (without fins) to protect the artifacts and avoid disturbing the sediment as much as possible. TriMix was already around, but at the time, it was reserved solely for military use, so all dives were made with standard air, usually with double 12- or 15-liter tanks.

The data from each dive was recorded manually, not only to monitor the recovery, but also to ensure the safety of the divers. Each diver had a limited bottom time and mandatory surface breaks. The staff responsible for dive safety had a tricky job keeping enthusiastic archaeologists safe.

After mapping the wreck and its artifacts, each diver was assigned a grid square for which he was responsible. Recovery occurred only after surveying and documenting everything. Major findings were salvaged using lifting bags, while smaller

Author Rico Besserlich and Yasar Yildiz, who was one of the archeological divers during the excavation of the *Uluburun* and who is today the director of the Underwater Archeology Museum in Bodrum, Turkey



Egypt. The currents and winds in the area suggest such a route, as the *Uluburun* was unable to cross winds due to her simple sail.

Discovery and rescue

—Coordinates 36 ° 7 '43 "N, 29 ° 41' 9" E. A Turkish sponge diver named Mehmet Çakir was the official discoverer. In 1982, while

diving for sponges, he noticed an “odd structure” at a depth of 45 meters. He described it in his own words as “looking like a metal biscuit with ears”. It turned out that these “ear cookies” were oxhide ingots, which are ancient plates of raw copper with a shape reminiscent of dried ox hides. Oxhide ingots were a



The oldest ship logbook in the world. All images this page taken with special permission at the Museum of Underwater Archeology, Bodrum, Turkey



Gold findings; Golden amulet showing Egyptian pharaoh Nefertiti (right)

artifacts were transported by the archaeological divers to the light of surface.

A total of 18,000 artifacts were recovered, some fully preserved and others fragmented. According to INA, after three months of excavation work underwater, two years of scientific work for the restoration, preservation and determination were needed. A total of 30 months underwater work resulted in 20 years of scientific

and archaeological reworking. Although the excavation was completed in 1994, the follow-up work still continues today. After 3,300 years rest on the sea floor, the *Uluburun* will not give up her secrets in a "short time" of just 20 years.

Treasures of *Uluburun*

The cargo of the *Uluburun* contained artifacts from seven different cultures: Mycenae, Kenan, Cyprus, Egypt, Kessiten,



Assyria and Nubia. This diversity of the various trade goods from different countries demonstrated how a very brisk trade took place over the sea 3,300 years ago. It is speculated that the *Uluburun* was a royal ship or of royal commission, but this cannot be proven.



The main cargo was ten tons of copper of Cypriot origin, divided into 354 oxhide ingots. There was also a ton of tin stored in 150 jars of Canaanite origin. Prior to this discovery, it was unknown to science how tin was transported at the time.

Part of the cargo was 175 glass ingots of various colors. Assuming that glass production had just been invented in Egypt, the glass items alone must have been priceless at the time.

Egyptian ebony, several ostrich eggs, elephant tusks, more than a dozen hippopotamus teeth and various processed turtle shells were almost certainly intended as an ensemble for early stringed instruments.

Also present were Cypriot ceramics, a huge amphora (130cm high) bearing the seal of Nefertiti, pomegranates and olive oil, gold jewelry, spices, 149 trade weights in the form of animals, cosmetic containers made of ivory in duck form, arrowheads, bronze swords and spears, oil lamps, a small bronze sculpture of the goddess Astarte (probably a

of personal use, such as fishing equipment, blades, needles for repairing fishing nets and typical boating features in the form of 24-stone anchors (two actually used as anchors, and the rest probably used as ballast).

The *Uluburun* carried the finest goods from the advanced civilizations of the Mediterranean. Its sinking must have hit its owner (or his client) hard financially.

If we measure the value of the ship's cargo by today's standards, we could imagine a 200-meter freighter loaded with 250 Ferrari 612 Scagliettis, 100 Hasselblad H4D medium-format digital cameras, two or three paintings by Da Vinci, 500

lucky charm), hundreds of other ornaments (made from glass, cobalt, gold, bronze and electron), amber, pearls, and a gold scarab with the cartouche (name seal) of the Egyptian Queen Nefertiti.

In addition, there were many articles

Rolex Yacht Master watches, 100 bottles of Mouton Rothschild (1945) and 100 bottles of perfume No. 1—Imperial Majesty Edition by Clive Christian (which goes for 250,000 AUD per bottle). Its sinking would cost the owners 275 million Euros (about 349 million AUD) and drive them into the deepest depression.

Many artifacts found threw up a new mystery. It was assumed at the time of the *Uluburun* pharaoh that Nefertiti was already dead, and the new Pharaoh Haremhab had left no stone unturned to eliminate all evidence of the existence of Nefertiti and her husband Akhenaton. Nevertheless, a golden scarab and



"Metal cookie with ears" —Bronze ingot



Golden statue of the goddess Anastarte

several sealed jars were found with her name on them. An unaccredited but persuasive argument suggests that the name of the great pharaoh, even after her death, was still a great force of protection, and therefore her name was used to protect the merchandise.

Similarly, two high-quality swords and ceremonial sticks indicate the presence of at least two high-ranking passengers, possibly of Mycenaean origin, possibly a royal emissary?

to look at chaos. The structure would not be recognizable to a layman as a shipwreck, and even the copper cargo seems at first glance more like a pile of scrap metal ("metal biscuits with ears"). Only through persistent and extremely careful archaeological and scientific work could salvaged treasures and secrets be revealed.

Three percent of the original hull had been preserved, which we lay people would not even have recognized as timber. Nevertheless, these wood

Age determination

We have to distance ourselves from the romantic notion that an aging shipwreck stays stylish and decorative, or that it waits in its entirety on the ocean floor for our discovery. Looking at the *Uluburun* initially was

residues made determining the age of the wreck possible at all. For this purpose, dendrochronology—from the Greek dendron (meaning tree), chronos (time), and logos (science)—was used to assign the pattern of the annual tree-rings (based on their different widths) to a particular known growth time. This of course also works on wood already in processed form (planks). The findings sparked controversy at the end, with fluctuations of plus or minus 200 years in determining the age of the *Uluburun*.

The dendrochronological analysis of the wood (the remains of the hull and extra firewood the sailors carried) showed a date of 1306 BC. It may have been two to three years later that the *Uluburun* sank, but the ship itself may have been even older. The generally accepted estimate is 1323 BC.

History is rewritten

"The *Uluburun* writes the story in a roundabout way," said Cemal Pulak, field director of the Institute of Nautical Archaeology (INA) in Texas. "So far, we

considered Greece to be the cradle of modern civilization, the glorious Bronze Age Greeks. The Mycenaeans were seen as paving the way for almost everything that our society makes: our thinking, our political actions, and even our lives. Now we have the first evidence of an overwhelming influence from the East."

The sailors of the *Uluburun* were not Mycenaeans, but Canaanites, ancestors of the Phoenician Semithischen. This little-known people developed the first long-



Bronze Age farming tools. All Image this page taken with special permission at Museum of Underwater Archeology, Bodrum, Turkey

Uluburun

distance trade over sea. The discovery of amber from the Baltic Sea area in the *Uluburun* wreck shows the extensive reach of the trading network.

"This ship is the king," wrote the Minister of Alaschija (Cyprus) as agent of Egypt. This correspondence is known as the "Amarna letters". In 1887, clay tablets were found showing the active exchange between the Egyptian court and foreign kings. Was the "ship of the King" meant to mean the *Uluburun*?

"I will bring you a gift of two hundred talents of copper," the king wrote to the Egyptian Pharaoh of Alaschija. Was this the *Uluburun*'s primary mission?

Before the discovery of the *Uluburun*, it was unclear how much a "talent" (an ancient unit of weight) actually was. The 354 copper ingots found brought light onto the matter; Each ingot weighed 27–28kg, and the cargo of approximately ten tons of copper corresponded closely to the amount of 200 talents. It is clearly evident that 3,300 years ago, an early "DIN standard" aimed to define a talent as 28kg. Two hundred talents was enough



Golden amulett

Findings from the Uluburun: Oil lamps.
All images this page taken with special permission at the Museum of Underwater Archeology, Bodrum, Turkey



were only found in royal courts. There were at least three literate dealers on board, which

was proven by the discovery of a wooden diptych, a double panel of boxwood with ivory hinges. This diptych is the earliest notebook known in human history. Text was written on wax tablets, but they

of classical archeology. Now, 3,300 years after her demise and 29 years after her discovery, the *Uluburun* is still a mystery that keeps the world of archeology in suspense, even



to equip a small army. Sufficient metal for 5,000 spearheads, 5,000 helmets, 5,000 swords, and 5,000 sets of armor. This was a truly royal gift, and the basis of the "Amarna letters" increases the likelihood of this being the mission of the *Uluburun*.

George Bass was in his early days often derided, because back in the 60's, he promoted the theory that the people of Canaan were influential in terms of navigation, commerce and industry, and that they were far more influential than the Mycenaeans. With the discovery of the *Uluburun* and its findings, the laughter stopped. Bass said, "Fortunately, this shipwreck surfaced during my lifetime."

This vessel contained the

largest ever collection of raw materials found. Other finds in the Mediterranean area consisted mostly of already processed materials, often of Mycenaean craftsmanship. The *Uluburun* proves the powerful Mycenaeans of the Kanaanärn were in some way dependent on others. A far-reaching consequence was, among others, that the work of Homer, including his *Iliad* had to be re-dated. He was previously thought to have lived in the Iron Age, but the events of the *Iliad* are now clearly Bronze Age.

The precious gifts of the *Uluburun* were so ostentatious that these were probably intended as additional gifts for a royal house. Also, the skills to craft ebony (which was also part of the cargo)



Skull decorated with gold; Jewellery from the Uluburun (top right)

have unfortunately not survived the thousands of years.

It is believed that a battleship would take a more direct route from A to B, rather than trading goods and commodities in different ports like you would expect from a merchant ship. However, this would only apply if the Amarna letters actually referred to the *Uluburun*. Finally, we know it, but it seems questionable whether a direct relationship would ever prove the crux

if what they have revealed so far is phenomenal! The exhibits and a full-size replica of the ship *Uluburun* are displayed in the Museum of Underwater Archaeology in Bodrum, Turkey.

Our only consolation is this: After our freighter with our beloved (and expensive) Mouton Rothschild 1954 wine bottles has sunk, we inform our insurance company quickly by e-mail from our computers, with bronze (the bringer of all evil or all joy—who knows?) ensuring a clean data transmission. ■

Rico Besserlich is a widely published dive writer and underwater photographer based in Izmir, Turkey. For more information, see: Maviphoto.com



Hollis Gear and NAUI team up on new Prism rebreather training

A new rebreather certification course has been announced by Hollis Gear and NAUI. The Prism 2 CCR Diver and Instructor certification course is now available for divers and instructors.

"I have been diving a Prism CCR since 1997," said Director of NAUI Technical Training Division Tim O'Leary in a statement. "We think that the Prism 2 will be a great addition to the training programs that NAUI has to offer."

John Conway, Training Director

of Hollis said, "We are very excited to have NAUI professionals offering training on the Prism 2. NAUI professionals are known for their dedication to training around the globe."

For more information, visit NAUI.org and Hollis.com. Interested dealers can contact their regional managers for additional information on becoming Hollis Prism 2 dealers or call Hollis Gear at 888-383-DIVE. ■



Pool session with a Hollis Gear Prism Rebreather

DEMA and DAN offer diver awareness poster

In order to keep divers safe this season, DEMA and DAN have joined together to offer a Dive Flag Awareness poster as well as a 15- and 30-second public service announcement, with assistance from the National Safe Boating Council and the United State Coast Guard. The spot educates divers and boaters of the correct way to use a dive flag to warn boaters that divers are in the water and should keep a safe distance.

"Our goal in sharing this important message is to remind both divers and boaters that they often share the same waters and in order to ensure an enjoyable experience, all must adhere to necessary safety precautions," said Executive Director of DEMA, Tom Ingram. "By increasing the awareness of the divers-down flag we hope to keep diving and the waterways safe for everyone this summer."

You can download the Dive Flag Awareness poster and get more information at: Dema.org ■



WWW.ADCON.COM.MY

DIVE INTO THE POSSIBILITIES.

4 - 5 DECEMBER 2013 KOTA KINABALU, SABAH, MALAYSIA

New SSI/Poseidon professional program marks big change in recreational scuba diver training

Scuba Schools International (SSI) and Poseidon have joined forces to improve bottom time for divers by developing the Mark VI rebreather partnership. Once the domain of highly technical, analytical divers, the new rebreather technology is making waves in the dive industry as easy-to-master rebreather units are swiftly replacing standard open water scuba.

"The Mark VI unit is designed with the recreational scuba diver in mind," said Steve Newman, SSI International Technical Training

Director. "There is a revolutionary change happening in the scuba marketplace and the Mark VI rebreather is at the forefront of these changes."

Newman recently conducted the first 80-hour "Full Immersion" Mark VI training program in Grand Cayman in which a group of elite SSI training professionals came together to learn how to "migrate" from being standard open-circuit scuba instructors to full Mark VI Open Water Rebreather Instructors. The program included 12 dives and over 20 hours

bottom time with the new SSI/Poseidon training materials.

"The first part of the recreational rebreather revolution is helping the instructors to 're-think' the entire training process," said Newman. "Rebreather divers speak their own language and this 'immersion' program is the first step in transforming the process."

The Mark VI is lightweight and designed especially for recreational divers so that new divers can actually start their journey into the underwater world as rebreather divers and not as

scuba divers—a concept that is revolutionary in the dive industry.

"In the past, rebreather divers needed to be open-circuit, open water certified recreational divers first. Then, they would learn about the many elements of becoming a rebreather diver," said Newman. "This unit and the cooperative training between SSI and Poseidon means new divers can start with rebreathers if they choose to."

For more information visit: www.divessi.com ■





FCC to improve in-flight Wi-Fi

Tired of paying a stout fee for sluggish in-flight Wi-Fi? Well, there's good news—the U.S. Federal Communications Commission (FCC) wants to increase Internet speed for airline passengers. Their new proposal would free up 500 megahertz of airwaves for use in air-to-ground broadband—a vast improvement from, say, Gogo Inflight Internet's current utilization of just 3 MHz for 3G data service connection, further slowed by being spread out over hundreds of in-flight Wi-Fi users.

Julius Genachowski, the FCC's outgoing chairman, said in a statement: "This service would help meet consumer demand by

offering airline passengers access to better in-flight broadband and will increase competitive pressure on current systems to improve the quality of their in-flight services."

The proposal is fully backed by Qualcomm, the telecom giant that developed much of the current in-flight Wi-Fi technology. In fact, the company has been pushing for the freeing up of airwaves for this purpose for years. Qualcomm's senior vice president of government affairs, Dean Brenner, said in a statement: "The FCC's proposal for a next generation air-to-ground broadband service ... would greatly expand in-flight high speed broadband connectivity for airline passengers."

In the FCC's proposal, one or two companies will be awarded the 500 MHz in a license auction. The only obstacle that may arise is that the spectrum is currently being used for satellite communications. Rather than pushing satellite uplinks off the frequency, the new proposal would find inactive spectrum blocks and set them aside for air-to-ground mobile broadband service.

However, opponents of the FCC plan from the Satellite Industry Association complain that the new proposal would lower quality of service thereby costing satellite companies \$1 billion in lost revenue. ■

SOURCE: CNN MONEY

Airlines get shark-friendly

As the anti-shark finning campaign in the Asia Pacific region gains momentum, more and more airlines are jumping onto the bandwagon. First, it was Cathay Pacific, then it was Air New Zealand that decided to stop flying shipments of shark fins to Hong Kong, the world's largest market for shark fins. Now, we see Fiji's national carrier and Korea's top two airlines join the fray.

"We suspended shipments of shark fins on our cargo flights from March," said Korean Air spokesperson Cho Hyun-mook to Korea Real Time. Asiana Airlines said it would follow suit, hopefully stemming the import of shark fins to the country. According to the Korea Customs Service, 76 tons of shark fins were imported last year alone, worth US\$582,000.

In Fiji, spokesperson for Air Pacific Aubrey Swift said in a statement, "We believe a ban on the shipment of unsustainably sourced shark fins is the right thing to do, and have implemented this policy effective immediately."

In New Zealand, exposure in the local press got the ball rolling, as the New Zealand Shark Alliance reported that the Air New Zealand was making shipments of shark fin. The airline's spokesperson Andrew Aitken told CNN: "Air New Zealand has taken the decision to suspend the carriage of shark fins while we undertake a review of the issue."

Changing attitudes

While shark fin soup, considered a delicacy in many parts of Asia, is still offered by many establishments in Asia, some of Hong Kong's hotels and restaurants are

removing the item from their menus. Airlines such as Hong Kong's main carrier, Cathay Pacific, have followed their example, stating last September: "Due to the vulnerable nature of sharks, their rapidly declining population, and the impacts of overfishing for their parts and products, our carriage of these is inconsistent with our commitment to sustainable development."

The anti-shark finning campaign continues to raise awareness of the importance of sharks in the fragile marine ecosystem and educate the public on the cruelty of the practice in which around 72 million sharks

are captured each year for their fins, which are removed followed by the dumping of the live shark back into the sea to drown a slow and horrible death.

Conservationists praise the airlines' decision. Claire Garner, director of Hong Kong Shark Foundation, told CNN: "We were delighted to hear that Air New Zealand is following suit of the

Cathay Pacific announcement." Garner added, "Airlines need to know what they're carrying and how they are impacting envi-

ronmental sustainability." Doug Woodring of the Ocean Recovery Alliance in Hong Kong said, "Decisions [like Air New Zealand's] can have a big impact on reducing consumption in Hong Kong." ■

SOURCES: WALL STREET JOURNAL, CNN

Siren Fleet

Liveboard Safaris in Fiji, Indonesia, Palau, the Philippines & the Maldives

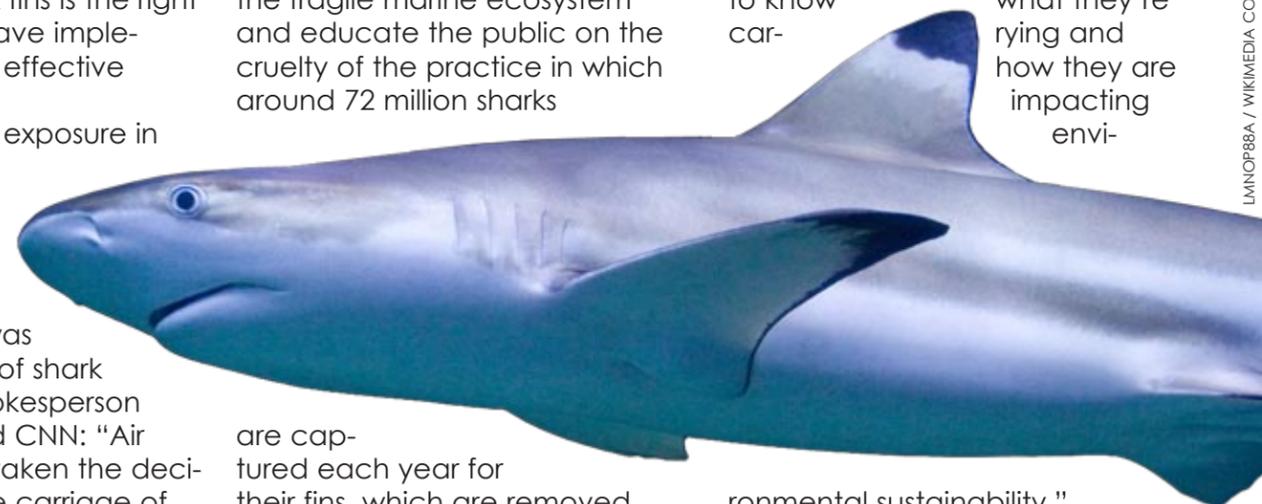
6-13 night trips offer:-

- Up to 4 Dives per Day
- Free Aqua Lung Equipment Rental
- Free Nitrox
- MKVI Rebreather Courses & Rental
- Specialist Photography Workshops

Affordable Luxury in Asia & the Pacific

Make Siren Your #1 Choice

www.sirefleet.com
info@sirefleet.com



Saving space for souvenirs since 1946.

- Mask
- Fins
- BCD
- Regulator
- Wetsuit

CRESSY

MOBY 5

LMNOP88A / WIKIMEDIA COMMONS