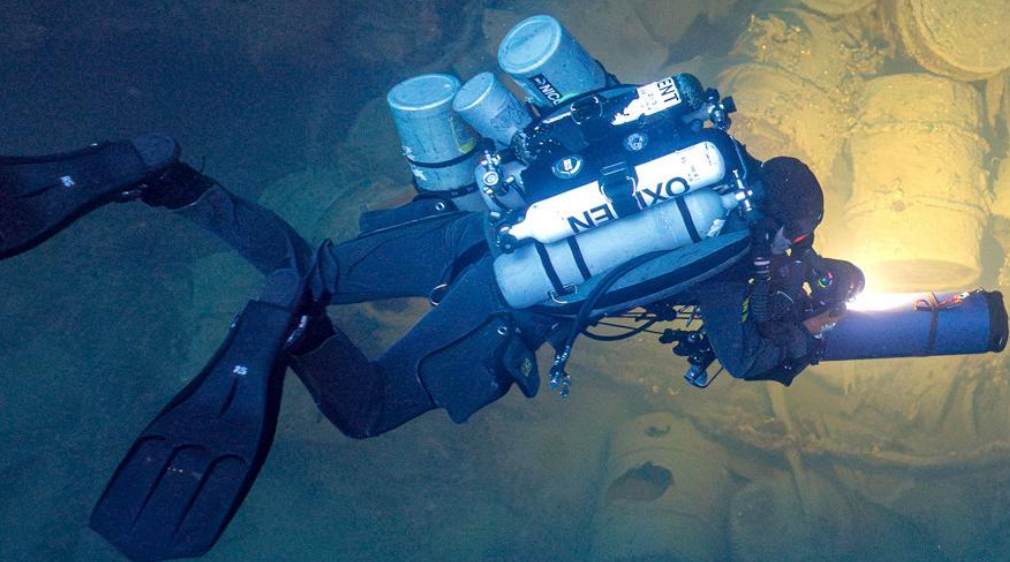


Inspiring People to Care for our Oceans Since 1995

DIVERS FOR THE ENVIRONMENT

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CONVOY COWBOYS

MAPPING MARITIME MEMORIES

• EDA EVENTS • **REEF CHECK** • INSPIRATIONAL YOUTHS • **SEAKEEPERS** • THE HISTORY OF DIVING
• **WHALE SHARKS IN QATAR** • RISK MANAGEMENT IN TECHNICAL DIVING • UPCOMING EVENTS



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UNITED ARAB EMIRATES



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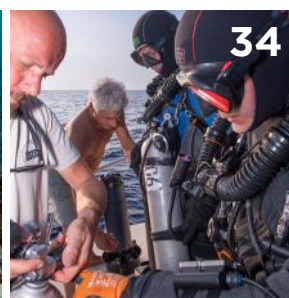
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DIVERS FOR THE ENVIRONMENT

Please note that EDA's magazine, 'Divers for the Environment' includes articles written by individuals whose opinions, whilst valid, may or may not represent that of EDA's. The magazine is a platform for individuals to voice their opinion on marine and diving related issues. You are welcome to suggest an article for the next issue released in December 2025. Send your articles, feedback or comments to: magazine@emiratesdiving.com



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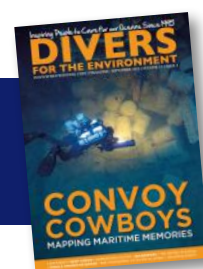
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EDITOR & GRAPHIC DESIGNER

ALLY LANDES

Ally is EDA's Project Director, Event Planner, Graphic Designer, Editor, and Photographer. She created and introduced 'Divers for the Environment' back in December 2004 as a free educational tool to share information by scientists, conservationists, underwater photographers, and other like-minded individuals from all over the world with a passion to conserve and protect our delicate marine life and underwater world.



THE CONTRIBUTORS

Meet the quarterly contributors who share their passions and stories with our readers. Want to contribute? Email: magazine@emiratesdiving.com

JESPER KJØLLER

Professionally involved in the diving industry since he started diving in the early nineties, Jesper ran a successful Scandinavian divers magazine for many years. His articles and photos have appeared in books, magazines and websites all over the world. Today he lives in Dubai, involved in marketing but finds time to teach diving for Global Underwater Explorers.



www.instagram.com/jesperkjoller

DR ADA NATOLI

Ada is a specialist in population genetics applied to conservation of species. Having been involved in whale and dolphin research since 1992, she is a member of the IUCN Cetacean Specialist List and founder of the UAE Dolphin Project.



www.uaedolphinproject.org

PATRICK VAN HOESERLANDE

Diving opens up a whole new world. Being a writer-diver and co-editor of the Flemish divers magazine, Hippocampus, Patrick personally explores our underwater world and shares his experiences through his articles. You'll find a collection of them on www.webdiver.be.



ARWA MOHAMMED

Arwa is an underwater documentary filmmaker, wildlife photographer, and marine advocate. She has worked with Dubai Tourism and Dubai Climate Change Authority, with features in Gulf News, Al Bayan, and CNN.



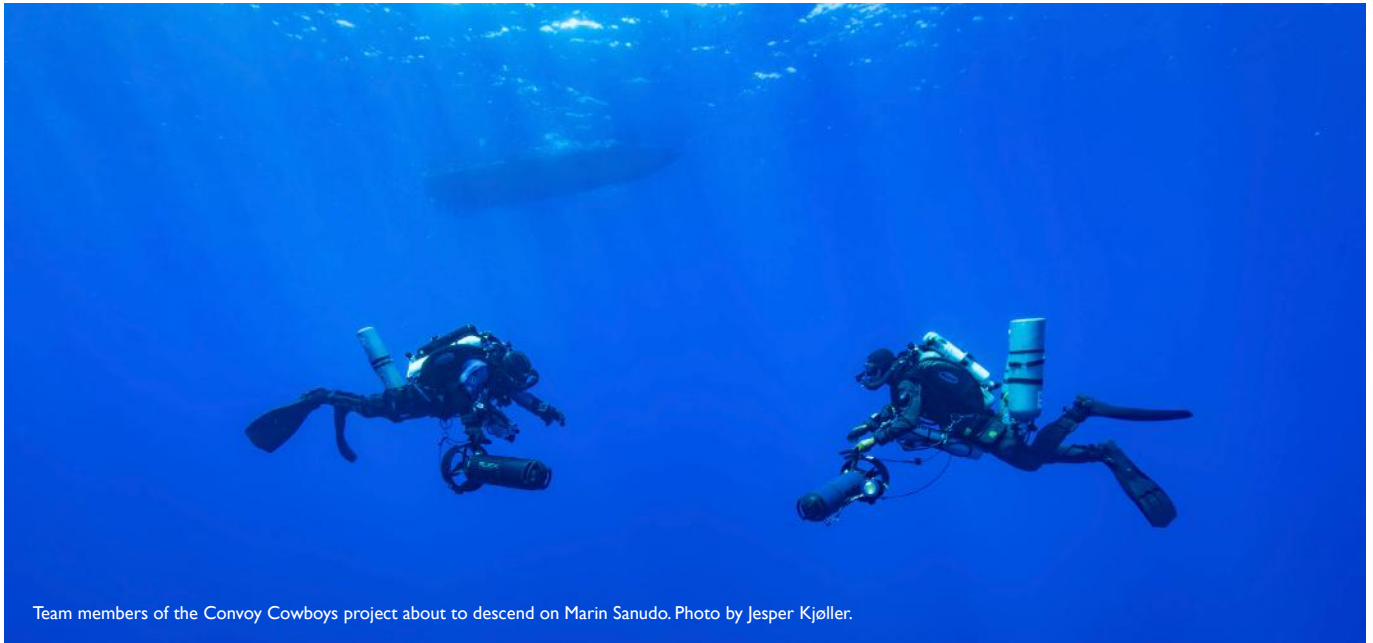
www.instagram.com/xphotodxb

GORDON T. SMITH

Gordon has lived and dived in the Middle East region for the past 36 years. He is a frequent visitor to south east Asia, in particular to Indonesia and the Philippines. Nudibranchs and seahorses are his favourite subjects, and he's always ready to dive in the UAE due to the variation in subjects he encounters.



www.instagram.com/gordon.t.smith



Team members of the Convoy Cowboys project about to descend on Marin Sanudo. Photo by Jesper Kjeller.

THE SUMMER IS QUICKLY COMING TO AN END



IBRAHIM AL-ZU'BI
Co-Founder

Welcome to this quarter's summer issue. I hope you've had the opportunity to explore somewhere new at this time of year, or at least had some time to recharge your batteries to tackle the final quarter of 2025.

With that said, we're looking forward to the start of the UAE's cooler months and getting back in to our outdoor activities! Cleanup Arabia starts back up in November, and the next 3 event dates are confirmed on our Upcoming Events page for you to add them to your calendars.

We are still finalising the details for the main Cleanup Arabia event on the 15th, so we'll leave the element of surprise to make more detailed announcements later on. We have tackled a fair few clean-ups this year already, with 4 beaches, and 3 underwater dive clean-ups completed, which now leaves these last 3 to go to mark our total collective efforts of 2025.

As many of you will have noticed, the EDA website has taken on a fresh new look. Most significantly, members will now be able to log in to their own accounts. There will be some trial and error in this first phase, so please bear with us as we iron out the kinks. We welcome any feedback regarding your user experiences.

This issue introduces two rich articles on the subject of history. This quarter's cover story takes you back in time to an important forgotten chapter of Mediterranean history in North Africa, marked by World War II. With dedicated research and advanced underwater technology, these stories are preserved, revealing their historical significance.

The History of Diving explores the marvel of how we have come to venture below the surface of water. It very much relates to the heritage of pearl diving in the UAE, and makes for good conversation. I look forward to Part 2 scheduled for print in December.

Happy reading and safe diving,

Ibrahim Al-Zu'bi

Ibrahim Al-Zu'bi

AN EDA MOVIE SCREENING THE WITNESS IS A WHALE

PHOTOGRAPHY BY **ALLY LANDES**



We had a fantastic EDA Movie Screening on the 14th of August to watch *The Witness is a Whale*! We finished the evening off with a short presentation and Q&A by Dr Ada Natoli from the UAE Dolphin Project to discuss the presence of whales in our waters and what we can all do to help further the ongoing research.

It was great catching up with our members and guests at Deep Dive Dubai, we want to thank you all for coming!

Thank you to Terra Mater Studios for making this award winning film available to us. It really was an eye opener to how human greed and destruction nearly led these very sensitive and intelligent mammals to near extinction!

SYNOPSIS

A thousand years ago there was an ocean full of giants. Whales were at the heart of a global

web, connected to everything. They were the architects of the sea, and in places, even the land. A whale's past glory is written in their behaviour, their character, their community, and the world that was formed around them.

In a basement in Odessa, top secret Soviet whaling reports are hidden. During the cold war, illegal whaling was out of control, run by the KGB, and few suspected how many whales were killed. In a thrilling and interwoven story, ships logs appear from garages, attics and cellars. For the first time, we know how many whales were killed, and so, how many there once were.

We used to think that whales were rare specialists that reach gigantic size, a natural curiosity. But if there were ten times more than was thought, or a hundred times more, then their role in the ocean was more important than anyone imagined. Suddenly, the whales themselves, their behaviour, make more sense.

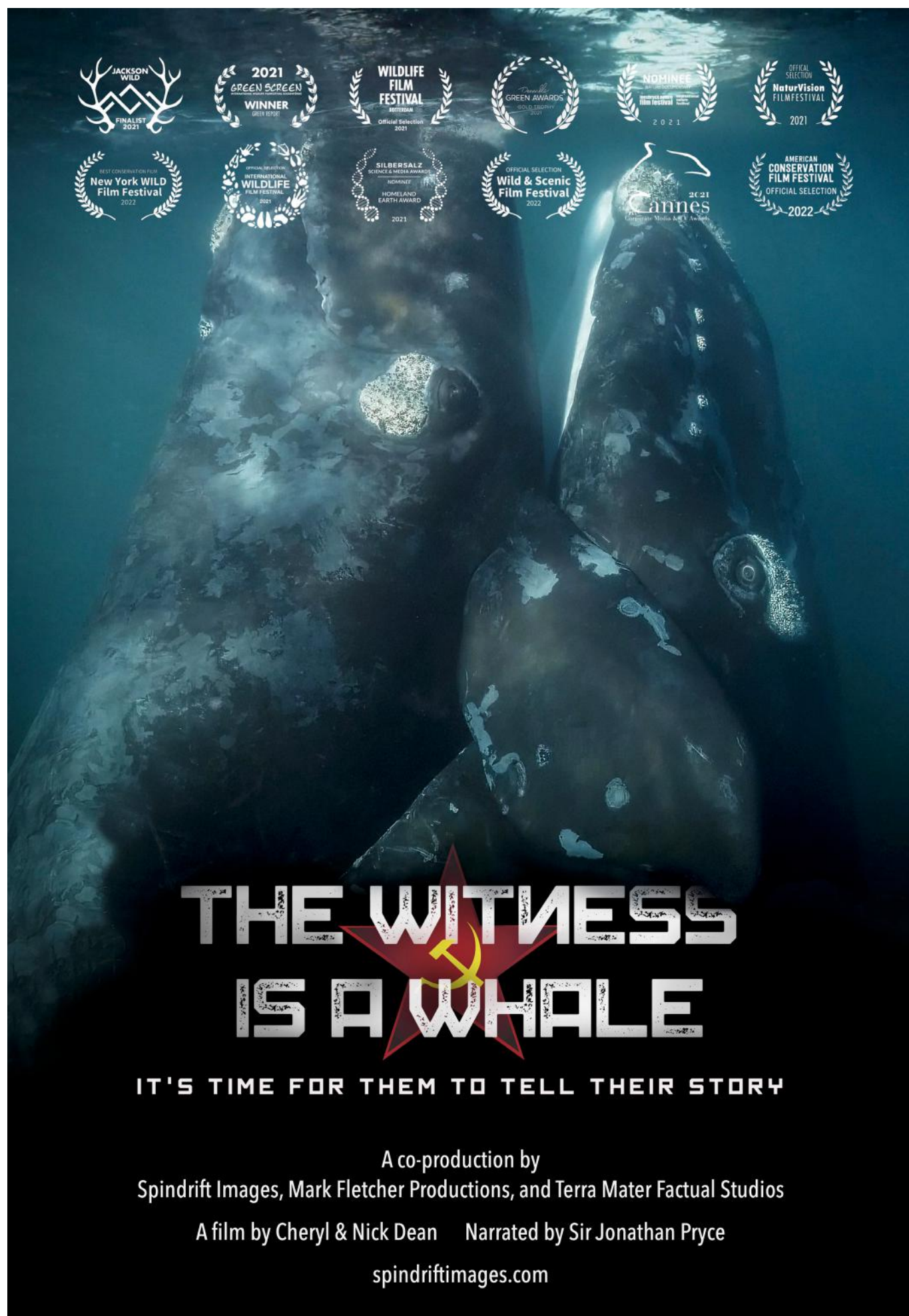
They are the witnesses, not only to Soviet and Japanese secrets, but to their own past.

Sperm whales were the most valuable and secret catch. In a state archive in Vladivostok, an undercover researcher risks all, and finds the shocking truth.

The threads are tied together. The discoveries of cold war secrets reveal a bigger truth. A thousand years ago many millions of whales dominated the sea. An early description is of so many whale blows, plumes of spray, that the surface of the ocean resembled a forest. The implications to how we think of the modern ocean, and help it back to health, are profound.

WANT TO JOIN OUR EVENTS?

Acquire EDA membership, or renew it here to register to all our social events and activities:
www.emiratesdiving.com/membership



ARE THERE WHALES IN THE ARABIAN GULF? Q&A REVIEW ON WHALES IN THE GULF REGION WITH THE UAE DOLPHIN PROJECT

WORDS BY **ADA NATOLI**, ASSISTANT PROFESSOR AT ZAYED UNIVERSITY & FOUNDER OF THE
UAE DOLPHIN PROJECT INITIATIVE EVENT PHOTOS BY **ALLY LANDES**



As an added bonus to our August EDA Movie Screening of 'The Witness is a Whale', Dr Ada Natoli, assistant professor at Zayed University and founder of the UAE Dolphin Project Initiative, gave a presentation with a Q&A to touch on whales sighted in our local waters and the invaluable role of citizen scientists in better understand these amazing creatures.

WHALES IN THE GULF:

The Arabian Gulf may not be the first place you'd expect to find whales, but recent research has revealed a rich and surprising diversity of cetaceans in these waters. Thanks to the efforts of the UAE Dolphin Project Initiative, hosted by Zayed University, whales occur in the Gulf and in the UAE waters more frequently than thought and some of them are in real danger of extinction.

ARABIAN SEA HUMPBACK WHALE

Following the moratorium on commercial whaling in 1986 and the International Whaling Commission (<https://iwc.int/en>) efforts towards population recovery, humpback whales across the world are finally increasing in numbers.

Except for the Arabian Sea humpback whale population. This is the only humpback whale population in the world that does not migrate or mix with other populations and genetic analyses revealed that it has been genetically isolated for over 70,000 years. It is the most endangered humpback whale population in the world, with fewer than 100 adult individuals remaining.

In the UAE, the first sighting occurred in 2017 with a mother and calf just a few hundred metres from Dubai's shores. In 2023, a deceased male was found in Dubai waters, underscoring the urgency of conservation efforts across the region. The Arabian Sea Whale Network (<https://arabianseawhalenetwork.org>) is a regional initiative raising awareness about this species and cetaceans in the region promoting conservation action.

IUCN Red List Status: ENDANGERED
(<https://bit.ly/3HQfdmg>)

BRYDE'S WHALE

Often referred to as the "tropical whale,"

Bryde's whales prefer warm waters and are recognised by three clear ridges on their head. They are present across all oceans and its taxonomy is still unclear. Two forms are currently recognised: a larger offshore type, and a smaller coastal type but population estimates for each of them is still unclear.

Recent genetic studies have led to the identification of Rice's whale in the Gulf of Mexico, raising questions about whether similar cryptic species exist in the Gulf or in other regions and raising concern on the real status of each type. The UAE Dolphin Project is working to determine which species we have here in the Gulf waters. Bryde's whales have been sighted a number of times in UAE waters, with an individual visiting the new Dubai Harbour in January 2022 (check out the March 2022 magazine issue of Divers for the Environment for the story here: <https://heyzine.com/flip-book/8ce734f0bd.html#page/38>).

IUCN Red List Status: LEAST CONCERN
(<https://bit.ly/4IUWmog>)



Arabian Sea Humpback Whales

Omura's Whales by S. Cerchio | www.omuraswhale.org

OMURA'S WHALE

Identified only in 2008 as a different species, Omura's whale is distinguished by striking asymmetrical markings characterised by a white lower jaw on the right, and black on the left. It is smaller than the Bryde's whales and information on its global distribution is still patchy. It is one of the few cetaceans that is still labelled Data Deficient, meaning that we do not even have enough information to assess its status. The Omura Whale Project is concentrating its effort to better understand this species (<https://www.omuraswhale.org>). Its presence has been confirmed in Pakistan and Iran and researchers are working to verify its occurrence in the Gulf. This elusive species adds another layer of mystery to the region's cetacean diversity.

IUCN Red List Status: DATA DEFICIENT
(<https://bit.ly/45A7lJp>)

BLUE WHALE

The blue whale is the largest animal on Earth and found in the Indian Ocean where a pygmy subspecies has been identified, and a population appears to be resident in Sri Lankan waters. Interestingly, a new population was recently discovered in the western Indian Ocean, identified by a unique song not shared with the other populations. In September 2024, the first sighting of a blue whale just a few miles from Dubai was reported by a sailor to the UAE Dolphin Project Initiative and was confirmed the first sighting of a blue whale in the Gulf we know of so far – an extraordinary milestone that expands our understanding of their range and behaviour, and testifies to the power of citizen science!

IUCN Red List Status: ENDANGERED
(<https://bit.ly/4fQsuYt>)

WHY IT MATTERS

Whales dolphins and porpoises are not only sentinel species, hence indicators of ocean health, they are active contributors to nutrient cycling, carbon sequestration, and marine productivity. In a nutshell, they are essential for marine ecosystem functioning. Still, they are facing global threats that hamper their survival: 26% of cetacean species are threatened with extinction, and many regions – including the Gulf – lack sufficient data to inform conservation.

YOU CAN HELP – YOUR SIGHTINGS ARE IMPORTANT!

The UAE Dolphin Project encourages citizen science. Divers, boaters, and beachgoers can report sightings by sharing:

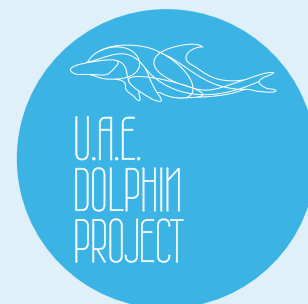
- Date and time
- Location (Google Maps pin preferred)
- Photos or videos
- Number of individuals spotted
- Presence of calves

Next time you're out on the water, keep your eyes open. You might just witness a piece of marine history. And if you do, remember to Be Dolphin SMART – stay respectful, keep your distance, and share your sightings. Because in the Gulf, the ocean still holds many secrets worth discovering to protect them for the future generations.

IMPORTANT UPCOMING EVENT

The IUCN World Congress is coming to Abu Dhabi from the 9th-13th of October. The IUCN Cetacean Specialist Group will have its own booth at the exhibition centre to showcase all the global efforts in protecting these species. Come and visit us!

<https://iucncongress2025.org>



REPORT YOUR SIGHTINGS!

If you encounter a whale or dolphin, collecting information is extremely useful.

1. Take videos or photos. You are there in that moment so you become the scientist. Every image of any quality is better than nothing and will help experts to confirm the species. If you can take photographs and videos when you are on the side of whales or dolphins when fins are clearly visible, it can help scientists track the individuals, but please keep a safe distance!
2. Please call if you witness a special sighting, or if you encounter a dead animal so experts can try to reach the site and gather more information.
3. Take note of the date, time, and approximate location – if GPS is not available, a dot on google maps works great!
4. Report how many individuals you see.

SEND YOUR DATA VIA:

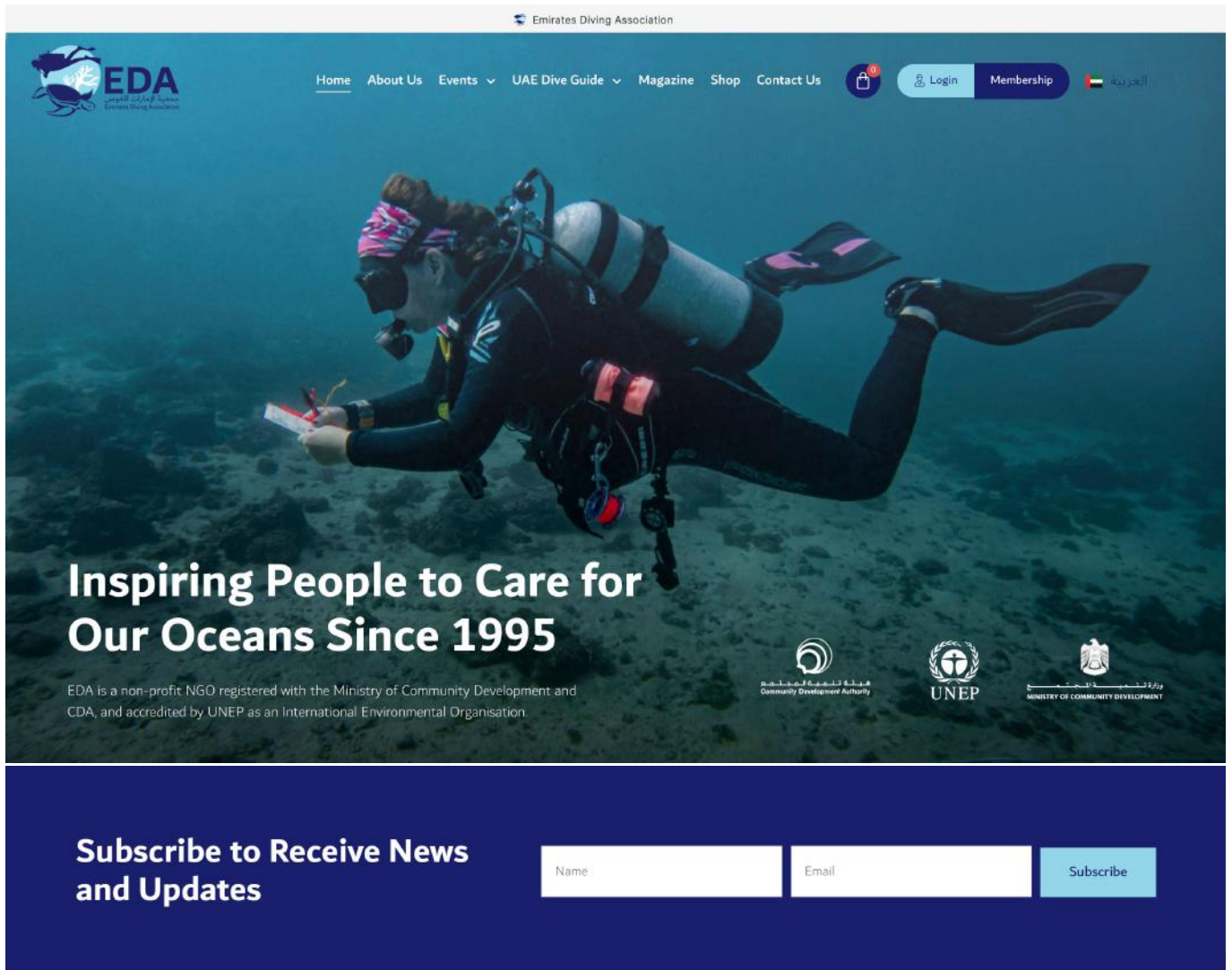
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THE EDA WEBSITE GOT AN UPDATE



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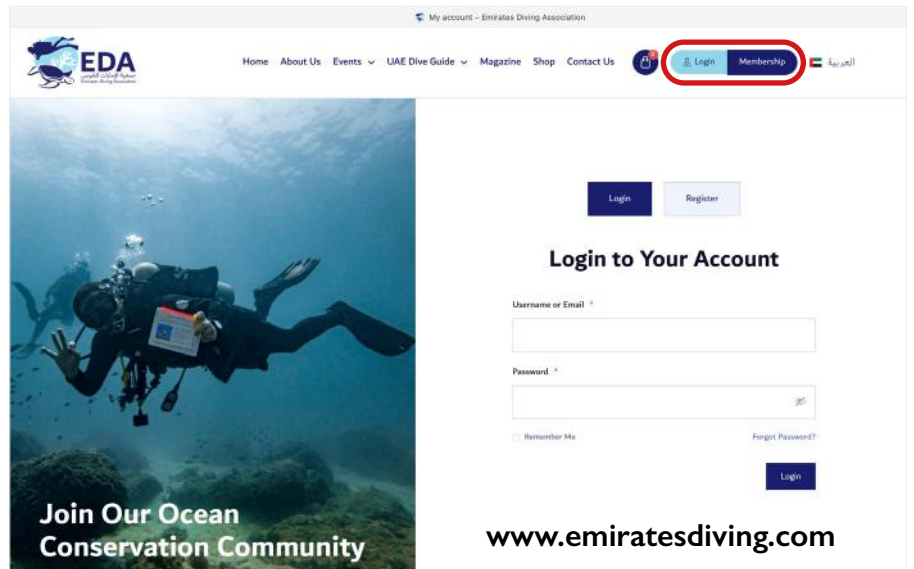
Name Email Subscribe

The EDA website has been revamped for a more personal member experience.

Members will now have their own accounts to login to on the new website by including a username and password on the new information form. Members renewing or acquiring first time membership will first have to have their accounts approved by admin before they can login. Please be sure to attach a copy of your bank transfer for this stage of the registration.

Please Note: You will still be required to make payments via bank transfers while we wait for an online payment gateway to be approved for our organisation. We are hoping to make transactions a much easier process soon.

Send us your feedback!



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Username or Email *

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www.emiratesdiving.com

ENVIRONMENT AGENCY – ABU DHABI COMPLETES AERIAL SURVEY COVERING 8,000+ KM² OF MARINE HABITAT



Environment Agency – Abu Dhabi (EAD) has wrapped up its latest aerial survey, covering more than 8,000 square kilometres of marine habitat. These efforts reflect the agency's dedication to safeguarding marine species and ecosystems, further reinforcing Abu Dhabi's status as a regional leader in marine biodiversity conservation and environmental stewardship.

EAD is the only entity in the Middle East conducting long-term, systematic monitoring of marine species through regular surveys. Since 2004, it has been carrying out comprehensive aerial assessments – an initiative aligned with the emirate's vision that strengthens its environmental database to support conservation strategies and ensure the sustainable management of marine resources.

Ahmed Al Hashmi, Executive Director of the Terrestrial and Marine Biodiversity Sector at EAD said, "The findings of this survey reflect our ongoing efforts and commitment to leveraging advanced technology to reinforce Abu Dhabi's leadership in environmental conservation. More than a 20 percent increase in the dugong population and a rise of over 30 percent in sea turtle numbers stands as clear

evidence of the success of our science-based strategy. These achievements are a source of pride and motivation as we continue our mission to protect our natural heritage."

The aerial survey was conducted by a dedicated team of six researchers, who covered a distance of 1,630km over a total of 26 hours to gather vital data. The survey focused on tracking the population, distribution, movement patterns and seasonal migrations of dugongs and sea turtles. It also included the monitoring of dolphins, whales, sharks, rays and birds.

Following international best practices, these surveys serve as an effective and systematic tool for observing marine species and detecting environmental changes. The insights gained support data-driven decision-making, help monitor human activities impacting marine life and enable the implementation of necessary measures to safeguard the environment and preserve biodiversity.

The results of the aerial survey underscore the thriving state of marine life in the emirate, with the dugong population estimated at over 3,500 individuals in 2024. Notably, mother-calf pairs accounted for 20 per cent of the

total sightings. These findings reinforce Abu Dhabi's position as the second-largest habitat for dugongs globally, after Australia, further highlighting the success of EAD's conservation measures, which include a fishing net ban in the emirate's waters to prevent accidental capture of this vulnerable species.

Similarly, the survey revealed a significant increase in the number of sea turtles, with an estimated population of 8,000 in 2024 which is a 30 per cent increase in comparison with EAD's survey results within a 10-year timeframe. It reflects the effectiveness of nesting site protection measures and the successful management of marine protected areas across the emirate. The survey recorded sightings of a Bryde's whale near the Barakah area, Hammerhead sharks in the Al Dhafra Region, and various species of sharks, rays and dolphins – further showcasing the rich biodiversity of Abu Dhabi's marine ecosystems.

These regular aerial surveys are a vital tool in supporting EAD's mission to position Abu Dhabi as a global leader in environmental conservation. The data collected not only guides conservation strategy but also sets a new benchmark for regional marine protection initiatives.

EAD RECORDS 97.4% SUSTAINABLE FISHERIES INDEX, REAFFIRMING ABU DHABI'S LEADERSHIP IN SUSTAINABLE FISHERIES MANAGEMENT



Under the directives of His Highness Sheikh Hamdan bin Zayed Al Nahyan, the Ruler's Representative in the Al Dhafra Region and Chairman of the Environment Agency - Abu Dhabi (EAD), EAD has recorded significant achievements for the sixth consecutive year in its marine monitoring and conservation efforts to mark World Oceans Day.

EAD has achieved an increase in the Sustainable Fisheries Index, reaching 97.4% at the end of 2024, up from just 8.9% in 2018. This performance reaffirms Abu Dhabi's leadership in sustainable fisheries management.

His Highness Sheikh Hamdan bin Zayed Al Nahyan said, "This achievement reflects our unwavering commitment and the diligent efforts of the Environment Agency - Abu Dhabi to safeguard our natural wealth and optimise sustainable marine resource stewardship. It reinforces Abu Dhabi's ambitious vision to strike a harmonious balance between

economic growth and environmental sustainability, serving as a global model for confronting environmental challenges for a prosperous and resilient future."

Her Excellency Dr Shaikha Salem Al Dhaheri, Secretary General of EAD said, "The significant progress recorded in the Sustainable Fisheries Index underscores Abu Dhabi's leadership in environmental conservation. We are committed to deploying best-in-class management practices and leveraging scientific capabilities to restore fish populations and protect marine ecosystems. This success affirms the importance of evidence-based policy and global best practices in conserving our natural heritage for future generations."

EAD's recent monitoring efforts also yielded notable findings that further validate the success of its marine sustainability agenda. These include the landing of 55 nuaimi fish – a species rarely sighted in recent years – as

well as the first recorded presence of the white-spotted grouper in Abu Dhabi, now officially registered on the international Fish Base database. Additional sightings include rare species such as the large-scaled triggerfish and the spotted oceanic triggerfish, as well as the general presence of larger fish, indicating healthier marine ecosystems.

EAD has implemented a comprehensive series of internationally aligned policies for fish stock recovery. These measures include regulating commercial fishing activities through sustainable methods, as well as implementing new regulations for recreational fishing.

The Agency has also established 6 marine reserves within the Sheikh Zayed Protected Areas Network where fishing is regulated, enhancing sustainable aquaculture and fish stocks through coral culture and artificial reefs as part of the Abu Dhabi Coral Gardens initiative.

FROM NICE TO ABU DHABI:

GLOBAL FORUM BUILDS MOMENTUM FOR OCEAN ACTION BEYOND UNOC3



With momentum building around ocean action at the Third United Nations Ocean Conference (UNOC3) in Nice, a high-level forum titled, "The Ocean Relay: From Nice to Abu Dhabi" emerged as a defining moment, convening global and regional leaders to map out a bold, coordinated path for marine and coastal health and sustainability.

Held at La Baleine at the Palais des Expositions de Nice and convened in strategic partnership by the Environment Agency - Abu Dhabi (EAD) and the Republic of France, the forum – facilitated by MENA Oceans, an initiative by Goumbook – featured the official announcement of the Nice - Abu Dhabi Manifesto, bridging outcomes from UNOC3 with the upcoming IUCN World Conservation Congress (Abu Dhabi, October 2025), and the UN Water Conference (UAE, December 2026).

During the event, Richard Brisius, Race Chairman of The Ocean Race handed over the Nature's Baton to HE Dr Shaikha Al Dhaheri, Secretary General of the Environment Agency - Abu Dhabi. Nature's Baton is a symbol of the Relay4Nature joint initiative between Peter Thomson and The Ocean Race, which helps give the ocean a voice on the critical issues affecting our planet at landmark events where decisions are made about the environment.

This pivotal event underscored the urgency of sustaining focus on ocean action beyond UNOC3, and aligning priorities to advance ecosystem health, foster a regenerative Blue Economy, and enhance interlinkages between critical nature agendas.

In her remarks, HE Dr Shaikha Salem Al Dhaheri, Secretary General of Environment Agency - Abu Dhabi and the Global Vice Chair of SDG 14, emphasised the UAE's commitment to international cooperation, "As we convene in Nice and look ahead to Abu Dhabi, it is clear

that our collective future depends on unified action for our oceans. The UAE is proud to lead and champion this momentum through international partnerships that align coastal and marine priorities. By building bridges between regions and reinforcing science-based policies, we are laying the groundwork for lasting impact – where ocean health becomes a cornerstone of global climate resilience and sustainable development."

"After the One Ocean Summit in 2022, and as co-host of the third United Nations Ocean Conference this week in Nice, France remains strongly committed to protecting the ocean as a crucial climate regulator and reservoir of invaluable biodiversity," HE Barbara Pompili, France Ambassador for the Environment said, "The IUCN is a long-standing partner and a key ally in preserving ocean resources. Through this Nice - Abu Dhabi Manifesto, we reaffirm together our shared ambition to safeguard the ocean."

"After UNOC3, we are accountable to the commitments made in Nice. The Ocean Relay has affirmed that the ocean agenda is continuous, and it needs to be carried forward through sustained commitment, credible, science-based action, and collaborative partnerships across sectors" said Dr Grethel Aguilar, IUCN Director General. "With only five years to achieve the 30x30 target, partnerships like the one that underscores this Manifesto are vital to keep ambition high and step-up actions to protect oceans. The IUCN and France have been allies for decades, and we are pleased to continue working together to advance the mandates forged here and translate them into coordinated, equitable pathways to transformative change, as we look towards the IUCN World Conservation Congress in Abu Dhabi, and beyond."

Tatiana Antonelli Abella, founder and

managing director of Goumbook and Chair of the MENA Oceans Initiative, highlighted the importance of sustained momentum for lasting progress, "Taking the outcomes from UNOC3 here in Nice forward, The Ocean Relay has helped lay the foundations of a purpose-driven agenda that bridges science, policy, and ground realities. As we look toward Abu Dhabi and the milestones ahead, the imperative is to build collaborative pathways that drive this momentum onward and turn our shared ambition into coordinated, measurable progress for ocean health and coastal resilience."

SESSION HIGHLIGHTS

Following keynotes by HE Dr Shaikha Salem Al Dhaheri and Minister Barbara Pompili, the panel discussion centred on transformative efforts and opportunities for global collaboration that would turn the tide on ocean conservation beyond the midway point of the UN Ocean Decade (2021-2030).

AMONG THE FORUM'S KEY OUTCOMES WERE COMMITMENTS TO:

- Align ocean and water conservation priorities across global milestones and within broader environmental policies both regionally and globally.
- Mobilise state and non-state actors to collaboratively accelerate progress on the United Nations Sustainable Development Goal 14 (SDG14).
- Drive forward initiatives, strengthen partnerships, and advance practical solutions for lasting ocean health and coastal resilience.

Looking ahead towards Abu Dhabi and the evolving trajectory of the global ocean agenda beyond it, "The Ocean Relay", and the commitments highlighted therein, set the tone for actionable and forward-looking frameworks to deliver lasting change for ocean and coastal systems globally.

RACING AGAINST TIME:

THE INTERNATIONAL CALL TO SAVE THE WORLD'S MANGROVES



In Abu Dhabi last December, more than 300 global experts, policy makers and community leaders came together with one resounding message: we are racing against the clock to save our mangroves. At the first International Mangrove Conservation and Restoration Conference (IMCRC), organised by the Environment Agency - Abu Dhabi (EAD) under the umbrella of the Abu Dhabi Mangrove Initiative (ADMI), delegates from 82 countries sounded the alarm! Nearly 50 per cent of the world's mangroves are at risk of collapse by 2050 due to relentless human-driven pressures. Their interventions emphasised the need for urgent collective action to protect these vital ecosystems, rehabilitate those affected and promote sustainable management practices.

The IMCRC also highlighted Abu Dhabi's growing role as a global hub for mangrove science and restoration leadership. Through ADMI, a comprehensive programme that includes all projects and research concerned with protecting and restoring mangrove and blue carbon systems in the emirate, and under the leadership of EAD in partnership with The Global Mangrove Alliance, the IUCN Mangrove Specialist Group, Zoological Society of London (ZSL), the Global Ocean Decade Programme for Blue Carbon, and other international partners, the conference underscored the urgent need to accelerate global efforts on mangrove conservation and restoration, as well as the UAE's leadership position as a centre for innovation, research and large-scale ecological restoration.

Coinciding with the International Day for the Conservation of Mangroves, which is celebrated annually to raise global awareness of the importance of these coastal ecosystems and enhance international efforts to protect and restore them, the call was renewed to unite efforts to conserve this vital resource. Mangrove forests are more than just coastal greenery – they are powerful natural shields against rising seas and storms, vital nurseries

for marine life and powerful carbon sinks critical for mitigating climate change. The planet cannot afford to lose these irreplaceable ecosystems. Protecting what we have left is no longer optional – it is a global imperative.

Despite sobering warnings, the conference sparked a sense of optimism. Scientific breakthroughs, successful community-led initiatives, and a growing wave of political momentum are offering a blueprint for mangrove survival – and perhaps even a large-scale comeback.

SCIENCE-BASED RESTORATION

Over the past three decades, more than one million hectares of mangroves have been lost, but experts at IMCRC emphasised that about 70 per cent of this loss, which is over 800,000 hectares of mangroves, are available for restoration globally.

At the heart of this transformation is Ecological Mangrove Restoration (EMR), an approach rooted in science, community engagement, and deep respect for natural processes. EMR prioritises restoring the essential ecological conditions of hydrology, soil health, and tidal flows that allow mangroves to naturally regenerate. Scientific studies confirm that nature has an innate ability to recover when the appropriate conditions are available, without the need for human intervention, but only through protecting sites or rehabilitating hydrological systems. When nature leads the way, the results are stronger forests, richer biodiversity and real resilience against climate impacts.

In this context, the importance of mangrove restoration programmes based on accurate scientific foundations emerges. These programmes are among the most prominent tools for positive intervention to accelerate the pace of environmental recovery. By selecting appropriate sites, adopting local species and applying modern agricultural techniques, these programmes contribute to the rehabilitation of damaged habitats and enhance the ability of

these ecosystems to adapt to climate change and ongoing pressures.

CONNECTING NATURE, EMPOWERING PEOPLE

Another major outcome of the conference was the recognition that mangrove conservation cannot happen in isolation. Experts championed a coastal and seascape approach: restoring corridors from mangroves to seagrasses to coral reefs and ensuring upstream river connectivity.

Crucially, the conference placed local communities at the centre of future mangrove strategies. Across sessions, speakers echoed a simple truth: successful mangrove conservation must be by the people and for the people.

Communities who depend on mangroves for fisheries, storm protection, and livelihoods must be engaged from the start – with clear land tenure rights, capacity-building programmes, and diversified income opportunities like eco-tourism and sustainable fisheries. Mangroves and local communities are interdependent and when communities thrive, so do mangroves.

FINANCING THE FUTURE

One of the stark challenges highlighted was funding. To scale up restoration to the required level for success, large and diversified investments – from governments, private companies and philanthropic organisations – must flow faster. The Mangrove Breakthrough, introduced at COP27, aims to mobilise \$4 billion for mangrove protection and restoration by 2030, bridging critical gaps between policy, finance and action.

But financing must go beyond carbon credits. Delegates called for financial models that recognise the full suite of mangrove ecosystem services – from biodiversity protection to disaster risk reduction – and channel funds into long-term, science-driven, community-anchored projects.

The reality is stark: \$8 trillion in investment is

needed to tackle the biodiversity crisis, and annual financing for nature must quadruple by 2050. Small-scale projects alone cannot meet this challenge – scaling up investment is key.

In this context, the ADMI Partnership Programme represents a promising model. It enables organisations within and outside the emirate to collaborate on joint initiatives to rehabilitate and protect mangrove trees, enhancing their ability to have a tangible

positive impact on nature, climate and society. This programme is based on a scientific approach to effectively and sustainably restore coastal areas and calls for the integration of efforts between the public and private sectors and various stakeholders.

Speakers were clear-eyed: urgent action must follow urgent words. The final message from the conference declared, “We have the knowledge. We have the tools. What we need

now is scale, speed and solidarity.”

The world has a narrow window to secure the future of mangroves. The IMCRC marked an important milestone – a rallying point for a rising global movement committed to protecting one of nature’s most extraordinary, life-giving ecosystems. The race is on – but with science, community and political will aligned, the future can still be one where mangroves not only survive, but flourish.

ENVIRONMENT AGENCY – ABU DHABI BECOMES THE FIRST UAE REGULATOR TO ACHIEVE CARBON NEUTRALITY FOR THE SECOND TIME



The Environment Agency – Abu Dhabi (EAD) has received its second Carbon Neutrality Certification from Applus+, a verification agency accredited by the United Nations Framework Convention on Climate Change (UNFCCC). This achievement means EAD has become the first regulatory body in the UAE to receive this certification twice, further solidifying its commitment to combating climate change and promoting environmental sustainability in Abu Dhabi.

Commenting on the milestone, Her Excellency Dr Shaikha Salem Al Dhaheri, Secretary General of EAD said, “Receiving the Carbon Neutrality Certificate for the second time underscores EAD’s deep commitment to building a sustainable future for Abu Dhabi. By offsetting our carbon emissions for the 2020-2022 period, we are not only setting a benchmark for government entities, but also inspiring our peers in government, and challenging the private sector to embed

sustainable practices into their core operations. We believe this milestone will accelerate our collective journey towards net-zero emissions, solidifying Abu Dhabi’s role as a regional leader in environmental stewardship.”

Any greenhouse gas emissions generated by EAD were assessed by GE3S and verified by Applus+. The Agency’s comprehensive approach to achieving carbon neutrality includes identifying emission sources such as energy consumption in buildings, the use of chilled water, waste generation, fuel use in vehicles and generators, as well as the implementation of targeted emission reduction measures.

The Agency is focused on significantly reducing its energy consumption and environmental footprint through the adoption of eco-friendly technologies and sustainable practices. As part of this commitment, EAD is transitioning its vehicle fleet to hybrid power, thereby reducing

fuel consumption and emissions. Additionally, all existing lighting systems have been upgraded to energy-efficient LED technology and lighting sensors, and smart water have been installed to optimise resource use and minimise waste. Environmentally friendly air-conditioning systems have also been adopted across all EAD facilities.

In a major step forward, EAD is integrating solar panels into all new projects, harnessing renewable energy to power its operations. This is complemented by sustainable design principles aligned with LEED Zero Carbon standards – further contributing to reduced energy consumption and lower carbon emissions.

This achievement serves as an inspirational milestone for broader climate efforts, encouraging other organisations to integrate targeted carbon management strategies into their operations. The Agency continues to lead the way toward net-zero emissions while maintaining its leadership in environmental stewardship.

FROM SHORELINE TO PURPOSE

BREAKING BARRIERS BENEATH THE SURFACE – MY JOURNEY IN DIVING, CONSERVATION, AND COMMUNITY EMPOWERMENT

WORDS BY **NANCY KADZO NIRO**



Growing up in a small coastal village in Kenya, the ocean was my playground, yet I never imagined it would one day become my purpose. What started as a childhood fascination with waves, has transformed into a mission to protect marine life, empower communities, and make scuba diving accessible to everyone – including those who are often left out of the conversation.

DISCOVERING DIVING AND FINDING PURPOSE

My journey began when I traded my hospitality career for a wetsuit, earning my first scuba certification in Kenya and the second in Dibba, in the United Arab Emirates. From there, I pursued professional training relentlessly in the UAE, eventually becoming a PADI Master Scuba Diver Trainer. But diving, for me, was never just about exploration; it was about connection – with the ocean, with people, and with a larger purpose.

As a PADI Master Scuba Diver Trainer, my work goes far beyond teaching skills. I have inspired, mentored, and certified divers who are now working onboard cruise ships, ocean-going yachts, and marine parks – transforming their livelihoods and opening new horizons. Seeing my students progress from nervous beginners to confident professionals, is one of the greatest rewards of my career.

I've also trained children as young as eight, given women their first breath underwater, and introduced the deaf community to scuba through 'Try Dives.' Watching someone's eyes widen in wonder when they encounter a turtle or coral garden for the first time is a reward far greater than any certification card.

The ocean has also called on me in moments of urgency, rescuing stranded whale sharks, freeing turtles entangled in ghost nets and also rescuing near-drowning victims, ensuring they return safely to their families. I've also helped recover valuables lost at sea – wedding rings, mobile phones, and other precious items – because sometimes, the ocean gives back when approached with care and skill.

I've participated in beach clean-ups, coral and mangrove restoration projects, and artificial reef initiatives in both Abu Dhabi and Kenya. Each effort is my way of giving back to the waters that have given me so much.

Breaking barriers is personal to me. As a PADI Instructor and Commercial Boat Skipper, I have always been the only woman in a male-dominated field. Today, I'm proud to see more women stepping aboard, both as yacht captain, yacht crew, commercial boat skippers, PADI instructors, advanced certified divers for the environment groups, freedivers, ocean

guardians, marine engineers and boat owners. Representation matters – especially when young girls are watching.

My dream is to establish junior scuba diving programmes in school swimming pools and marine education hubs where skills, environmental awareness, and opportunity meet. The ocean belongs to all of us, and protecting it requires all voices – especially those too often unheard.

I dive for purpose, for the environment to make the world a better place. And my message to every reader is simple: find your own way to leave the shore better than how you found it.



MUSANDAM INTERNATIONAL DIVING FESTIVAL A CELEBRATION OF DEPTH, PASSION, AND PURPOSE

WORDS BY **ARWA MOHAMMED**



Khasab, the heart of Oman's Musandam Peninsula, has long been known as one of the top diving destinations in the region. With its crystal-clear waters and thriving marine ecosystems, it offers an unforgettable experience for divers, snorkellers, and ocean explorers. This summer, Khasab made a new mark on the map – not just as a dive site, but as the host of one of the region's most meaningful marine events: the Musandam International Diving Festival.

Held from the 25th-28th of August 2025, this first-of-its-kind festival brought together divers, adventurers, photographers, environmentalists, and families from across the world. Founded by Bader Al Shehi – diver, environmentalist, and owner of Musandam Discovery Diving Centre – the event was organised under the umbrella of Musandam Season, in collaboration with the Musandam Governorate.

What set this event apart wasn't just the location – it was the intention. The four-day festival showcased how diving, sport, and conservation can come together to form a movement.

Visitors had the opportunity to take part in four unique competitions:

- The Freediving Challenge invited breath-hold enthusiasts to test their limits below the surface.
- The Kayak Race took paddlers through the Musandam's majestic fjords along a stunning

route from Bassa to Qada.

- The Underwater Photo & Video Contest gave certified divers a platform to capture the beauty and biodiversity of the region.
- The Cleanup Dive united volunteers and professionals in an impactful ocean conservation effort – removing plastic, ghost nets, and debris from coral-rich areas.

These activities weren't just about sport or prizes – they were about connection. Bader Al Shehi explained, "We don't just show people the ocean – we show them why it needs us."

The festival also welcomed renowned guests, including world record holders Ahmed Gabr and Faisal Jawad, along with acclaimed underwater photographers Hussain AlQallaf and Alex Dawson. Their achievements and artistry brought global prestige and inspiration to the Musandam International Diving Festival.

A central part of the festival's success was its community involvement. Children from local schools were invited to dive for the first time, guided by certified instructors from the Musandam Discovery Diving Centre. Educational booths and workshops surrounded the festival grounds, offering lessons on coral restoration, marine debris, and the importance of preserving biodiversity. Visitors didn't just leave with memories – they left with a mission.

The success of the Musandam International

Diving Festival would not have been possible without the support and vision of Musandam Season – a government-led tourism initiative designed to promote eco-tourism, culture, and nature-based experiences throughout the region. The Musandam Season team continues to develop opportunities for locals and visitors to explore Oman's north – from diving and hiking, to paragliding and heritage tours.

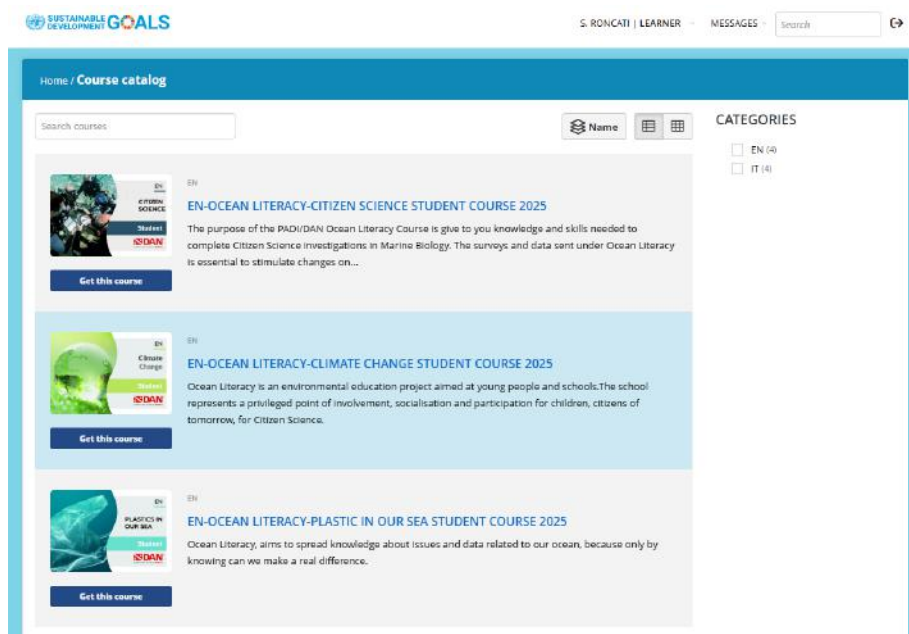
Following the overwhelming success of this year's edition, the Musandam International Diving Festival is set to return in 2026 with expanded challenges, deeper conservation campaigns, and broaden participation opportunities for youths and professionals alike.

Whether you're a diver, an underwater photographer, a conservationist, or simply a sea lover – the waters of Musandam welcome you. Join the growing ocean movement that's making waves not just in Oman, but across the Gulf region.

FOR MORE INFORMATION:
Musandam Discovery Diving Centre
Bader Al Shehi
Tel: +968 9968 2932

www.instagram.com/musandam_discovery
 www.instagram.com/governormusun
 www.instagram.com/Musandam_season

UNESCO ENDORSES OCEAN LITERACY PROJECT BY LEADING DIVING ORGANISATIONS



The DAN.PADI programme brings ocean knowledge to all through a free eLearning platform.

The DAN.PADI Ocean Literacy Project has officially been recognised as an Ocean Decade Action by UNESCO's Intergovernmental Oceanographic Commission, joining the prestigious Ocean Literacy With All (OLWA) programme under the United Nations Decade of Ocean Science for Sustainable Development (2021-2030).

This endorsement is a significant recognition of the scientific value and social relevance of the programme. It also plays a vital role in extending the project's reach and impact, helping to spread marine culture across all ages, languages and nationalities – a goal at the heart of DAN Europe and PADI's shared vision to achieve balance between humanity and ocean.

The DAN.PADI Ocean Literacy Project is an international educational initiative designed to raise awareness and empower younger generations to become stewards of the ocean. Through a dynamic e-learning experience, its mission is to make ocean knowledge accessible and engaging by combining science, sustainability and storytelling. The programme features high quality content developed by DAN Europe in collaboration with university professors and marine science researchers. Available in English and Italian, it is currently being used by DAN and PADI instructors in schools, dive centres and youth initiatives.

IT CONSISTS OF FOUR CORE LEARNING MODULES:

- Citizen Science: Encouraging students to

take an active part in marine research.

- Plastic Pollution: Highlighting the impact of human waste on marine ecosystems.
- Climate Change: Understanding the ocean's role in the global climate crisis.
- Underwater Archaeology: Exploring history through underwater cultural heritage.

The project is based on a successful initiative – Scuola D'Amare – launched in Italy in 2019 by a local PADI association, with the approval of MIUR (Italian Ministry of Education). 180 PADI instructors were trained to deliver the programme, which used diving as a gateway to environmental education and discovery. In just five years, Scuola D'Amare has introduced over 80,000 students in 17 regions to the wonders of the Mediterranean Sea.

From this successful start, the project evolved into the DAN.PADI Ocean Literacy Project – a scalable, international programme that embeds ocean literacy into diving education. The aim is not only to equip students with environmental knowledge, but also to instill a deep, personal sense of responsibility for ocean conservation.

Now, with UNESCO's official endorsement, the programme is expanding its original scope to provide wider access to ocean education for people of all ages, backgrounds and nationalities. With freely accessible content, the programme pushes the boundaries of traditional learning environments and aims to inspire curiosity and promote awareness of the ocean far beyond schools and into communities around the world.

This collaboration brings together DAN Europe's expertise in dive safety and scientific

outreach with PADI's global reach, supported by a network of 128,000 dive instructors and more than 30 million certified divers in 186 countries over the last 50 years. Together, the two organisations aim to embed ocean literacy into the educational journeys of new generations and global communities, promoting sustainable ocean use, climate action and collective responsibility.

"UNESCO's support is a powerful boost to our mission," said Laura Marroni, Exec. Vice President of DAN Europe. "It strengthens our ability to spread marine culture on a global scale – reaching new audiences, in new places, and inspiring a deeper connection with the sea."

"This recognition by UNESCO reinforces the critical role divers play as ambassadors for ocean protection," said David Murray, Managing Director of PADI EMEA. "Through the DAN.PADI Ocean Literacy Project, we are making ocean education more inclusive, accessible, and impactful – empowering individuals of all ages to become true Ocean Torchbearers. Together, we're creating positive ocean change in everyday life, not just for divers, but for the global community."

TO ACCESS THE PROGRAMME, GO TO:
<https://oceanliteracy.edu.daneurope.org/index>

The platform is also accessible via the **TalentLMS** app, available for iOS and Android. When using the app for the first time, mobile users must enter the full domain <https://oceanliteracy.edu.daneurope.org/> to log in and begin their learning journey. Whether learning on desktop or mobile, course progress is automatically synced across devices for a seamless experience.

PADI'S INDUSTRY STIMULUS PROGRAMME: 2025 MASTER SCUBA DIVER CHALLENGE OFFERS ULTIMATE RECOGNITION AND INCENTIVES



To keep invigorating the global dive market during this unprecedented time for the industry, PADI® has launched the 2025 Master Scuba Diver Challenge. This challenge incentivises scuba divers around the world to reach the peak of recreational scuba diving and obtain their PADI Master Scuba Diver rating™, where they will join an elite circle that less than 2% of divers achieve.

"The PADI Master Scuba Diver rating is considered the 'black belt' of recreational diving," says Kristin Valette Wirth, Chief Brand and Membership Officer for PADI Worldwide. "We are challenging scuba divers to continue their education and be transformed into confident and prepared divers ready to seek adventure and save the ocean anywhere in the world."

BECOME ELITE AND WIN A DREAM DIVE TRIP TO FIJI

Until the 31st October 2025, participants have the opportunity to work towards earning their PADI Master Scuba Diver rating while obtaining entries into the giveaway for a dream dive trip to Fiji. To become a certified PADI Master Scuba Diver, students must complete their Open Water, Advanced Open Water Diver course, five Speciality courses, and the Rescue Diver course – in addition to having completed 50 logged dives.

This giveaway is a continuation of the referral programme and is open for all students working towards receiving their PADI Master Scuba Diving rating during the competition period.

To enter the giveaway, participants will sign up at padi.com and answer the question "Why do you want to be a PADI Master Scuba Diver?" Additional entries will then be given to participants based on the amount of PADI Courses completed en route to becoming a PADI Master Scuba Diver.

This includes:

- PADI Master Scuba Diver rating – 10 entries
- PADI Rescue Diver certification – 5 entries
- PADI Club member – 5 entries
- PADI Advanced Open Water Diver certification – 3 entries
- PADI Speciality certification – 2 entries
- PADI Open Water certification – 1 entry
- Purchase a PADI Certification Card – 2 entries
- Take the Save the Ocean Pledge – 1 entry

Grand Prize: With the support of Tourism Fiji, one grand prize winner will receive a round-trip airfare for two people to Fiji and six nights' accommodation and four days diving with PADI Dive Resort Paradise Taveuni. Two additional winners will receive a recreational PADI eLearning course of their choice.

"Fiji is a diver's dream – where some of the world's most breathtaking underwater ecosystems meet the warmth of our islands and people," says Srishti Narayan, Chief Marketing Officer at Tourism Fiji.

"Recognised globally as the Soft Coral Capital of the World, Fiji offers newly rated PADI Master Scuba Divers the chance to explore iconic sites with more than 1,200 species of fish, vibrant coral cities, and world-class PADI Dive Resorts across our islands. There's no better place to celebrate this elite diving achievement than in Fiji's thriving, technicolour waters and, now, with even more direct flights from key North American gateways Fiji is easily accessible for divers ready to take their passion to the next level."

PADI MEMBERS HAVE THEIR OWN MASTER SCUBA DIVER COMPETITION

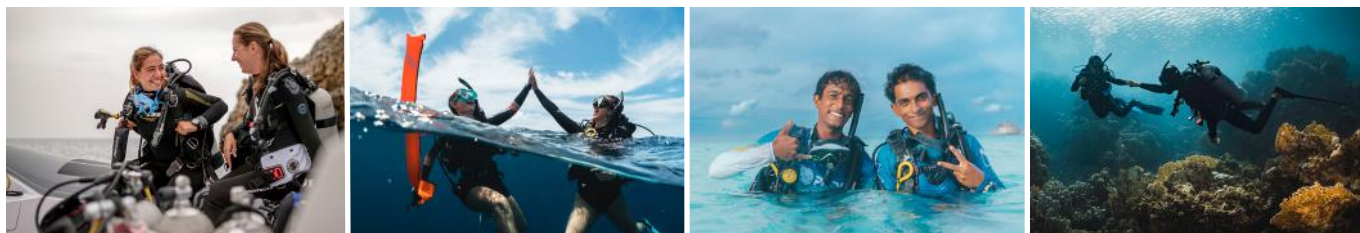
PADI Members can also win big by taking part in their own version of this competition, with those who demonstrate the most Master Scuba Diver rating growth with their students year on year in their region earning a free 2026 PADI Membership.

For more details on how to enter PADI's Dream Dive Trip Giveaway to Fiji visit:

www.padi.com/education/continue-learning#msd

PADI'S INDUSTRY STIMULUS PROGRAMME:

WORLD'S LARGEST DIVING ORGANISATION TEAMS UP WITH INDUSTRY STAKEHOLDERS TO LAUNCH NEW DIVER REFERRAL PROGRAMME



PADI® teams up with several dive equipment manufacturers to launch an unprecedented diver referral programme to drive industry growth. PADI provides unparalleled support to its global membership base and industry by launching the Refer A Friend campaign – a referral programme that encourages scuba divers to recruit their friends and family as their new dive buddies with added incentives of scuba gear and trips.

"PADI is investing in creating more business for our members and the diving industry as a whole, this time inviting scuba diving gear manufacturers to take part, which they have enthusiastically joined," explains Kristin Valette Wirth, Chief Brand and Membership Officer for PADI Worldwide. "It's a true testament to the strength and solidarity of the diving industry when so many stakeholders come together to support the need to stimulate business for all. We are stronger together, and the latest diver referral campaign demonstrates it."

A DATA-DRIVEN AND DIVER-BACKED PROGRAMME

New diver surveys indicate that word-of-mouth remains the number one influencer in a person's decision to become a diver. In fact, 52% of newly certified PADI Divers cite a friend or family member as a key influencer in their decision to get certified.

"This referral programme taps into the genuine excitement divers feel about sharing the underwater world with others," says Valette Wirth. "We're making it easy and rewarding for divers of all levels to invite friends and family into the world's largest community of ocean lovers and rewarding them every step of the way."

Beginning in June 2025, several gear manufacturers will be taking part in the campaign, including TUSA, Fourth Element, SUUNTO, Garmin International and Shearwater Research. Every month, referrers and referees will have the chance to win a collection of branded scuba gear to further fuel their passion for the sport.

"We're committed to growing a global community of dedicated divers – from open water beginners to advanced technical

enthusiasts and believe every underwater experience can be safe, rewarding, and exceptional from day one," says Jason Leggatt, CEO of Shearwater Research.

"Garmin's cutting-edge dive products provide the technology and support adventurers need to explore below the surface," says Audra Ratliff, Garmin Director of Product Marketing. "We remain committed to helping people pursue their passions and are proud to collaborate with PADI to create even more momentum and awareness for the diving industry and give divers the tools to reach even greater depths together."

"At Suunto, we believe that exploration is more meaningful when it's shared," says Lena Bergendahl, Head of Dive Products at Suunto. "That's why we're proud to support this referral programme, it aligns perfectly with our mission to inspire new adventures and grow the global dive community."

"When we discover our love for diving and the ocean, most of us want to share it with others – I think we are just wired that way," says Jim Standing, co-founder and CCO of Fourth Element. "This is a great way for Fourth Element to be part of growing a community of like-minded ocean adventurers and protecting our playground for the future."

"At TUSA, we believe that the future of scuba diving lies in building a passionate and inclusive global community," says Crystal Gutierrez, Marketing Manager at TUSA. "That's why we're proud to support PADI's Refer a Friend Campaign, an initiative that speaks directly to the heart of what drives our sport: personal connection and shared adventure. By encouraging divers to bring friends and family into the underwater world, we're not only growing the diving community but also inspiring a new generation of ocean advocates. Together with PADI and our industry peers, we hope to energise participation, deepen engagement, and ensure a vibrant future for scuba diving around the world."

HOW IT WORKS

The newly updated global referral programme launched in June and is designed to send new

diving recruits to the 6,600 PADI Dive Centres and Resorts and 128,000 PADI Professionals using word-of-mouth from the 30 million certified PADI Divers around the world.

Starting today, PADI Divers can log into their PADI Account to send referral links to friends and family and will be able to:

- Receive 20% off PADI continuing education eLearning when a friend enrolls in Open Water Diver eLearning.
- Earn one entry into a monthly prize draw for new scuba gear for each friend referred.

Those potential new diver candidates that are referred will then:

- Receive 20% off PADI Open Water Diver eLearning when activating the referral link.
- Earn one entry into the monthly prize draw of scuba gear.
- Are eligible to refer others and earn additional entries.

As an extra incentive, all divers who refer a friend will automatically go into the grand prize competition, where the diver who refers the most new PADI Divers in 2025 will win a dive vacation for two to any Sandals St Lucia property of their choosing for five days.

GROWING THE INDUSTRY TOGETHER

"This is more than a promotion – it's a movement to seek adventure and save the ocean more together," adds Valette Wirth. "By encouraging students and divers to refer a friend and teaching more courses, we are sharing what we all love and helping ensure the underwater world remains accessible to all."

PADI Members now have access to a dedicated marketing toolkit available on the Marketing Hub on the PADI Pro Site that supports this wider incentivisation programme.

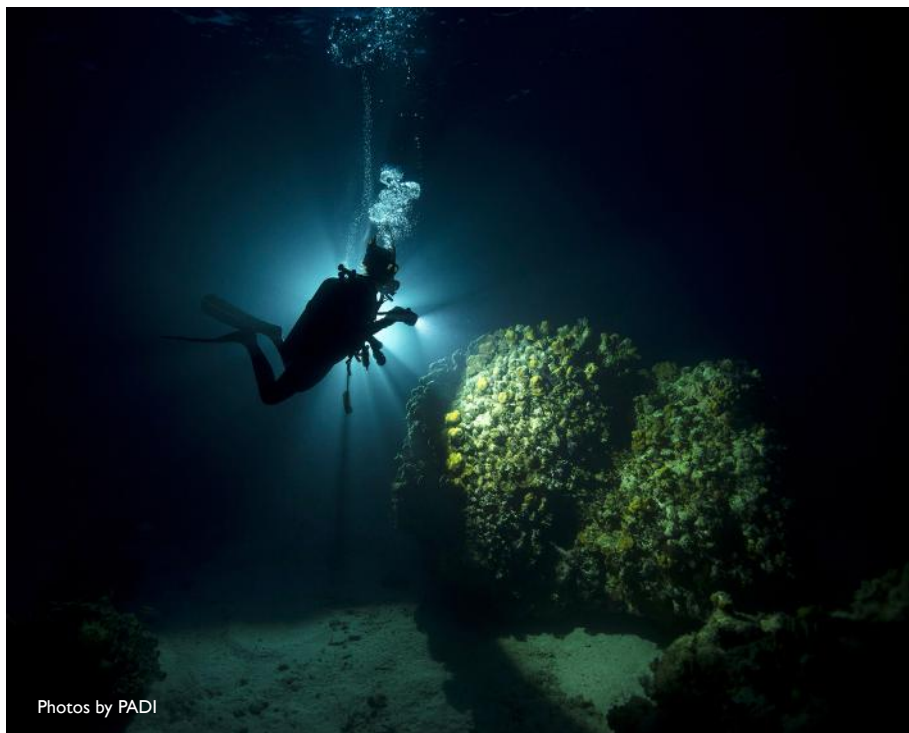
To access the marketing toolkit visit the Marketing Hub on the PADI Pro Site.

Visit the PADI Pros Blog for more information on how to incorporate the referral programme into your business and earn more for every certification issued.

www.padi.com/dive-together

DON'T BE AFRAID OF THE DARK

DISCOVER THE ALLURE OF THE OCEAN AT NIGHT WITH PADI



Photos by PADI



Noctourism is on the rise.

Not familiar with the term? It's a growing travel trend focused on discovering unique, transformative experiences that happen after the sun sets. Whether it's escaping the crowds, seeking something novel or tapping into the quiet magic of the night, more travellers are turning to the dark hours for adventure and the ocean is no exception.

If you're looking to step off the beaten path and explore a new dimension of the underwater world, night diving might be your next unforgettable experience.

Though it may sound extreme or exotic, night diving is surprisingly accessible. PADI Dive Centres around the world offer guided night dives and in most cases, all you need is your PADI Open Water Diver certification to take part.

Although you may have been scuba diving at a site many times before, at night you drop into a whole new world and watch it come to life under the glow of your dive light. The scene changes as day creatures retire and nocturnal organisms emerge.

During the day, bright and colourful fish flock to the reefs, feeding and cleaning. Rays and sharks bask in the warm sunlight, and animals play in the shallows. At night, all these creatures go to sleep, and a whole new set of creatures emerges. You will see sleeping fish and creatures, as well as bioluminescent

organisms making their way through the water. Certain animals give off eerie glows, which can be seen from far away.

Safety is of the utmost importance during a night dive so if you've ever wondered what happens underwater after the sun goes down be fully prepared and sign up for the PADI Night Diver speciality course.

Eric Albinsson, Instructor Development and Training Executive, PADI who helped write the PADI Night Diver Certification Course tells us, "You truly feel like you are experiencing inner space when night diving, with the chance to witness the glow-in-the-dark nocturnal marine world. It is normal for divers doing night diving for the first time to feel nervous, but many find it to be an extremely peaceful and meditative experience – and you'll never get better sleep than after this incredible diving experience."

We dive in with PADI to discover some night dives to add to your bucket list!

Pelagic Magic Night Dive in Kona, Hawaii: Where your night dive will have you drifting through the glow in the dark ocean (one of the most epic yet undiscovered night dives in the world). You can also get your PADI Pelagic Magic Speciality Course there.

Coral spawning, Curacao: You can witness the annual coral spawning event at a dive site known as mushroom forest. Occurring a few days after the full moon, an underwater fireworks show takes place as new reefs are formed –

something certified divers can witness at night.

Fluorodiving: Fluorescent diving is a relatively new concept in the world of scuba. Using UV lights and mask filters, scuba divers light up coral reefs under the dark of night. The result is an underwater party. Shrimps, eels and all manner of marine life reflect the UV rays in brilliant pinks, purples and greens. Bonaire is on the cutting edge of this technology and one of the pioneering locations for its use. If you don't happen to be in the Caribbean, you can also try this type of diving in Indonesia, Thailand and the Maldives.

Bioluminescent Bay, Cayman Islands: Seemingly otherworldly, glittering bioluminescent particles gather together in fantastic light displays in the Cayman Islands. Kayaking is particularly popular here, as the water is fairly shallow, and easily seen from above. Swimming, snorkelling, and diving is available as well.

Because of the fragility of these organisms, it is highly recommended not to wear sunscreens or lotions during your trip, as the chemicals can harm them.

Cancun, Mexico: Shining your dive light on the reefs off the coast of Cancun transforms them from blue tinted to vibrant colours at night. Neon pinks, oranges and yellows are brought out by the artificial light. After the incredible variety of creatures make their beds for the night, a new, unusual bunch emerge. Bring your underwater camera, as you can still capture images of these weird animals.

EDA'S REEF CHECK SURVEY AND CLEAN-UP DIVE

WORDS AND PHOTOGRAPHY BY **ALLY LANDES**



To mark this year's World Environment Day and World Ocean Day, we ran a Reef Check Survey and a clean-up dive along the UAE's East Coast.

We had a fantastic day out on the water with Divers Down in Khorfakkan for a Reef Check survey at Shark Island done by 6 EDA certified Reef Checkers: Ali Salman, Matthew B. Nobles, Damien Basa, Alison Smith, Tony Sidgwick, and Ally Landes; and Om Kishan Manoj was able to join the trip to complete his pending practical exam, led by our Reef Check Trainer, Rania.

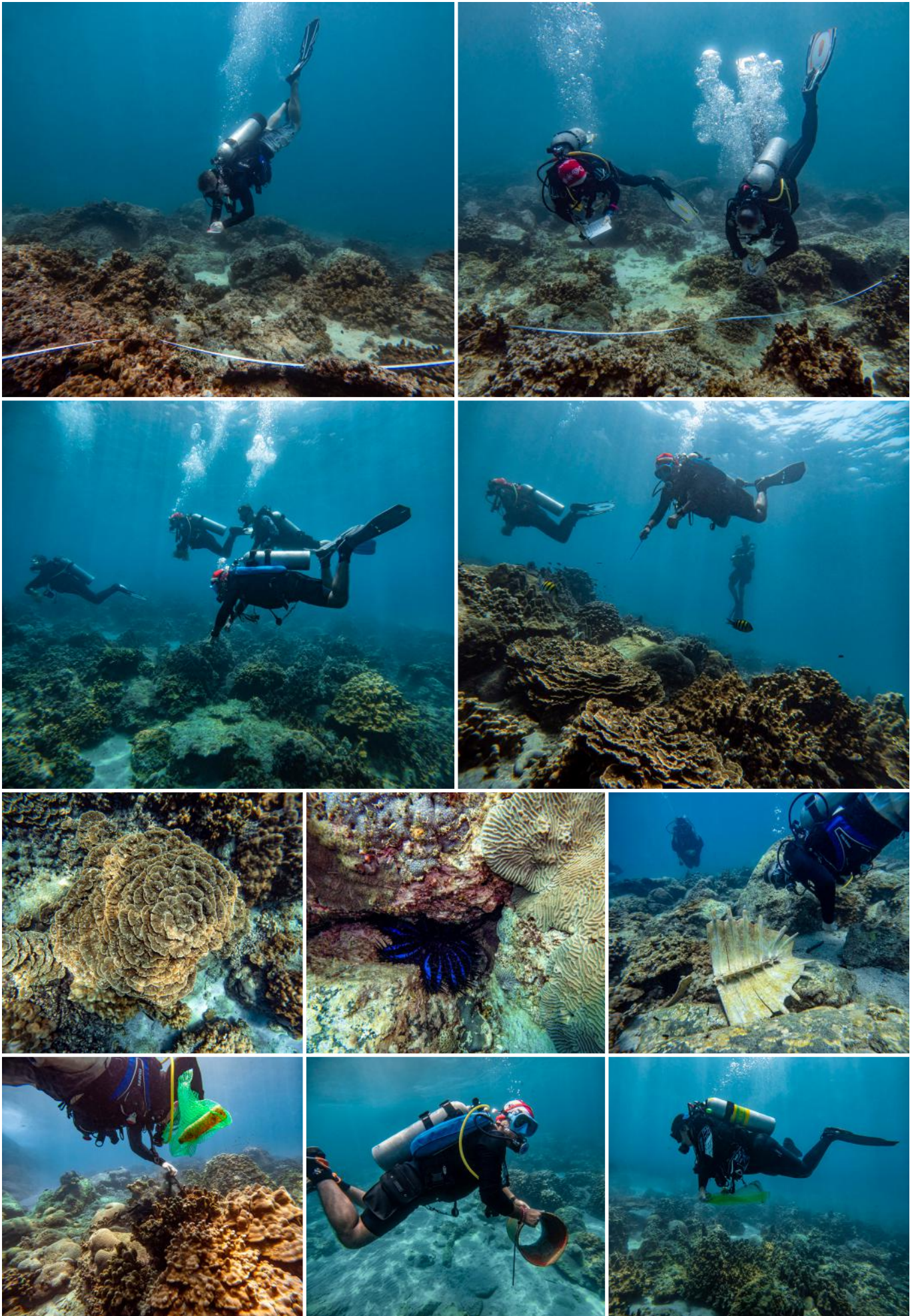
Congratulations to Om for having successfully

passed all 3 requisites for his Fish, Invertebrates and Substrates exams. He is now officially Reef Check Certified!

Our second dive was at Hole-in-the-Wall to enjoy the beautiful coral garden and do a clean-up sweep if we crossed paths with any unwanted debris. Surprisingly, we picked up a fair amount, including: an aerosol can, a 4L paint bucket, 4 beverage cans, a Tabasco bottle, 3 plastic bottles, a construction pipe, a black plastic bin liner wrapped around coral, and 2 old fishing cement weights with rope ties. We also made a note of finding 2 crown-of-thorn sea stars amongst our observations.

Our trip coincided with World Sea Turtle Day the following day, so we kept a look out for any turtle sightings. Ali and Matthew were lucky to spot one swim past, but the rest of us came upon the remains of a very large Green turtle's carapace amongst the shallows now providing nutrients for some of the smaller reef fish scavengers.

These trips of purpose remain so meaningful to our members now that they have a better understanding of our underwater world after having taken their Reef Check courses with Rania Shawki Mostafa. We are constantly learning after each and every dive!



REEF CHECK VISITS BRITISH COLUMBIA FOR KELP NODE WORKSHOP IN BAMFIELD

WORDS BY **JACKIE SELBITSCHKA**, REEF CHECK WASHINGTON REGIONAL MANAGER



Since 2022 Reef Check has been participating in the transboundary Kelp Node group based in the Pacific Northwest that brings together kelp practitioners composed of First Nations stewards, researchers, managers, policy makers, educators and citizen scientists. The aim is to advance kelp conservation, management and recovery in the shared waterways of British Columbia and Washington State. The Node is composed of six working groups spanning a range of topics related to kelp conservation: Canopy Kelp Spatial Dynamics, Subtidal Kelp & Kelp Ecosystem Services, Kelp Drivers of Change, Kelp Early Life Histories & Restoration, Participative Kelp Science, Training and Engagement and Data Integration.

Through these working groups, Reef Check was invited to participate in a kelp forest monitoring development workshop held at Bamfield Marine Science Centre (BMSC)

in Bamfield, British Columbia, Canada. Representatives from Hakai Institute, Huu-ay-aht First Nations, Kelp Rescue Initiative, and Department of Fisheries and Oceans Canada under the organisation of Markus Thompson from Thalassia Environmental came together with the goal of creating kelp monitoring protocols that could be implemented by Indigenous Guardian initiatives across British Columbia. Launched in 2017, the Indigenous Guardians have implemented programmes that support Indigenous rights and responsibilities in managing lands, waters and resources guided by science, both Indigenous and western.

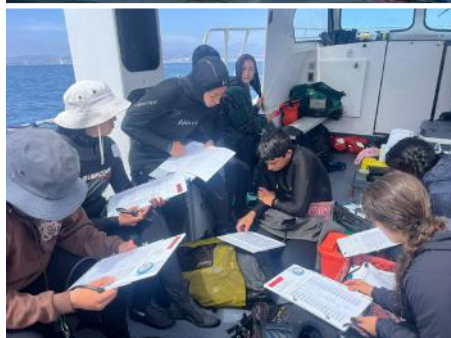
During the workshop we spent six days sharing methods and training materials from our various programmes to create a robust monitoring programme that could be implemented by any Guardian group. While there was a day focused on aerial drone

photogrammetry and ROVs, the majority of our time was spent developing subtidal monitoring protocols that could be adapted to fit the needs and interests of individual First Nations. We spent the mornings sharing and adapting protocols and used the afternoons to implement them in various kelp forests around Barkley Sound. Additionally we spent time on how to teach species ID and creating helpful training tools. What ultimately formed was a tiered monitoring programme that included the use of drones, ROVs and scuba surveys to capture the state of kelp forests. The protocols that emerged from this workshop will be implemented at a training in Calvert, British Columbia in the fall.

Thank you to all organisers and participants; we felt very welcomed by the BMSC dive programme and local residents during our time on their beautiful campus.

SECOND REEF CHECK BAJA TRAINING COURSE COMPLETED

WORDS BY **JESSICA PANTOJA**, REEF CHECK BAJA CALIFORNIA REGIONAL MANAGER



Reef Check Baja has completed its second round of kelp forest monitoring training in Ensenada, Baja California! Reef Check's staff instructors Jessica Pantoja and Dan Abbott, along with our partners from MexCal, trained 10 participants in Reef Check's kelp forest monitoring protocols. Participants came from Tijuana, Ensenada, and San Diego, forming a diverse group of recreational and professional divers, along with students from the Universidad Autónoma de Baja California (UABC), the Instituto de Investigaciones Oceanológicas (IIO), the Centro de Investigación Científica y de Educación Superior de Ensenada (CICESE), and San Diego State University (SDSU).

This training is part of our ongoing effort to build local capacity for long-term kelp forest monitoring and marine conservation in Baja California, in close collaboration with our partners at MexCal and thanks to grant support from the Binational Resilience Initiative at San Diego Foundation.

The five-day in-person course kicked off with dive safety theory and practical sessions, where participants refreshed essential scuba

and rescue skills in the open waters of Playitas. Through hands-on practice, students worked on buoyancy control, dive planning, and emergency response – laying a strong foundation for safe and effective underwater monitoring.

Following this ocean-based safety refresher, students moved on to two days of theory and hands-on training in the monitoring protocols for fish, invertebrates, algae, and the underwater visual point count (UPC). For field practice, they visited two diving sites: Playitas and San Miguel, both of which offered excellent real-world examples of what to expect during actual surveys.

To wrap up the week, participants and instructors boarded the Baja Diving Adventures dive boat and headed to Todos Santos Island for final evaluations. Surveys were conducted at two official Reef Check sites on the island, where the newly trained divers successfully applied all protocols. Clear skies and excellent visibility made for the perfect ending to a productive and inspiring week beneath the surface.

"This training gave me the tools to better understand the biodiversity associated with kelp forests. It helped me appreciate these ecosystems more deeply and inspired me to protect and study them." – Manuel Vivanco.

"The training was dense but practical and engaging. The team made everything dynamic and enjoyable – a truly enriching experience. I'm grateful to be part of this important collective effort" – Gibran Villa.

And to top it all off, the entire experience was beautifully captured through the lens of Marco Mazza – one of our favourite underwater photographers.

Special thanks to UABC for hosting us, to Baja Diving Adventures for boat support, and to Baja Seasters and Bucea Baja Norte for helping us connect with passionate local divers.

We are deeply grateful to our partners, and the participants for their enthusiasm and dedication. Reef Check Baja continues to grow and build a beautiful and big community thanks to people like you. ¡Muchas gracias!

REEF CHECK RÉUNION

DOCUMENTS MOST SEVERE BLEACHING EVER

WORDS BY **JEAN-PASCAL QUOD, REEF CHECK FRANCE**



Reef Check Réunion, a chapter of Reef Check France in the south-west Indian Ocean, is very concerned by the most severe bleaching ever encountered in Réunion during the first months of 2025. The subsequent mortality was highly enhanced on some fringing reefs by the cyclone Garance that hit the island in late February.

Reef Check Réunion was initiated in 2003 and

now comprises more than 35 sites monitored every year. All data is added to a global citizen database about coral reef health. This database is analysed through an online dashboard.

Additional activities of the Réunion team include creating awareness of marine pollution and impacts of sun creams as well as conducting field surveys on marine biodiversity to provide a diversity index for Reef Check sites.

Figure 1 below reveals that, as for many other places on our blue planet, hard coral cover has been seriously declining for three decades, with a negative trend predicted for the coming years.

Citizen Reef Check surveys in Réunion have proved to provide the same overall results as those obtained by scientists operating for the Marine Reserve.

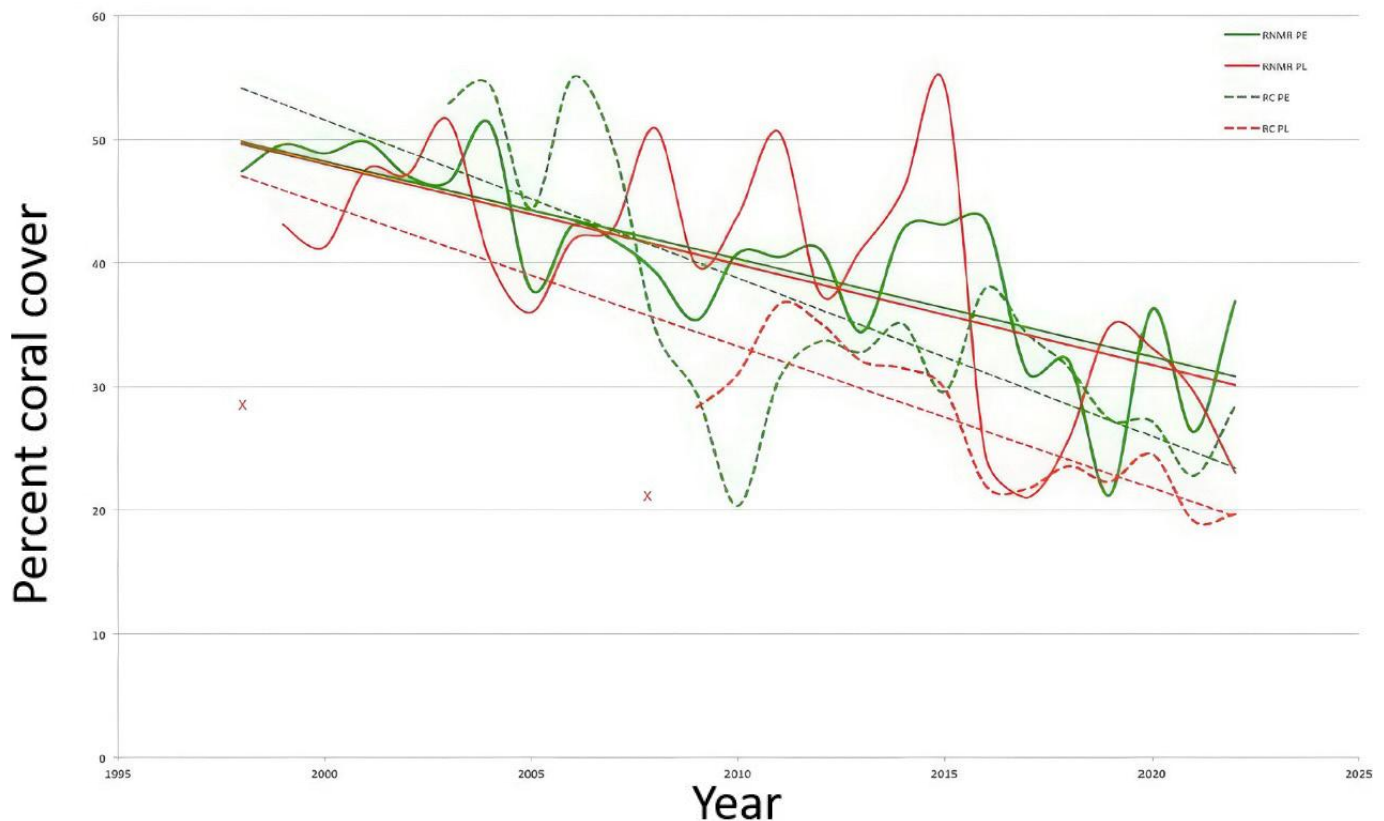


Figure 1. Trends in hard coral cover from two sites. Solid lines show data collected by the Marine Reserve programme. Dashed lines show Reef Check data. Green lines indicate data from the site "PE" and red lines indicate data from the sites "PL". While there is a lot of variability, both datasets show the same declining trend in hard coral cover.

SCIENCE MEETS ADVENTURE:

BIOSPHERE'S MALDIVES CORAL EXPEDITION RETURNS THIS OCTOBER

WORDS BY **BIOSPHERE EXPEDITIONS**



Biosphere Expeditions is heading back to the Maldives 4-10 October and 11-17 October 2025 for its twelfth annual expedition, and you're invited to be part of the action. In partnership with Reef Check, this unique expedition blends hands-on science, local collaboration, and tropical adventure.

Since its inception in 2011, the expedition has thus far trained over 100 people in Reef Check surveying, including over 30 local Maldivians in techniques on how to monitor their reefs and set up community-based monitoring. As

a direct result of this, local NGO Reef Check Maldives was formed in 2017 and is now active in community-based reef conservation work and advocacy. Some of these community surveyors are now teaching Reef Check themselves, and are employed by government agencies and private consultancies to undertake management and surveillance.

Data on reefs and whale sharks are given to local and international NGOs, government and other decision-makers, who are planning on increasing the number and area of Maldives

marine protected areas (MPAs). Reef Check data will form part of that picture when the government considers new MPAs.

Whether you're a diver, snorkeller, or nature enthusiast, this is your chance to experience the Maldives beyond the tourist trail – contributing to science, connecting with like-minded people, and making a real difference beneath the surface.

MORE INFORMATION AT
www.biosphere-expeditions.org/maldives

JOINING THE VOLUNTEERING TEAM TO FREESTYLE DIVERS' PROJECT REEFFRAME

WORDS BY **OM KISHAN MANOJ**



I first read about Freestyle Divers in a *Divers for the Environment* magazine published by the Emirates Diving Association. Buried between articles about marine life and conservation efforts, their name caught my attention, not only because of what they did, but also because of how they did it. My conviction that I had to be involved in their effort to restore the coral reefs in Fujairah grew stronger as I read more about it. So, when I saw they were looking for volunteers, I didn't hesitate. I had no idea that after a few clicks, an online course, and a few training dives, I would soon be regularly driving out to Fujairah with my gear bag in hand and prepared to work under the waves.

As usual for any diver, my journey didn't start with a plunge into the ocean, but into the world of marine conservation... on my laptop. The online course taught me about the threats encroaching coral reefs, from warming oceans, to pollution. Once I passed the online exams, it was time for the real learning: four practical training dives. The first two hovering above Dibba Rock's reefs identifying fish and corals native to Fujairah, and then my instructor trained me in choosing and collecting healthy

coral pieces for the artificial reef, which I would later learn to plant onto the artificial reef table with zip-ties! At last, I was officially a volunteer; my weekends started to look a lot more like saltwater, marine life, and the hum of a regulator.

Once I was part of the volunteer team, I would spend my dives – which usually lasted an hour because the reefs were only at 10m – on the quiet, steady work that keeps our artificial reefs healthy. We would carefully clear away sponges that crept ALL OVER the frames and corals. The tools we used were both practical and clever – paint scrapers, dental picks, even a pair of pliers split in half, which was the tool I used (mainly because there was a lot of competition over the only two scrapers). It was strangely satisfying work, almost meditative; in a way this was how I debriefed at the week's end.

There was one small damselfish who seemed to think I was trespassing on its home. Whenever I worked with one hand with my other resting idly, it would dart around and get multiple quick nibbles at my fingers.

It happened so often on multiple dives that I began talking to it in my head telling it to bugger off, but eventually I befriended him (even if it is one-sided).

Looking back, my time with Freestyle Divers has been more than just volunteering – it has been a lesson that's taught me patience and how to care. Every sponge scraped away, every coral planted, feels like a promise to the ocean that we're still trying. Project REEFframe's mission is more than merely about saving coral reefs, but bringing people together to protect something we all love and depend on.



YOUTH LEADERSHIP IN ACTION

WORDS BY **TIMIDU WEERAWARDHANA**



On Thursday the 27th of June, I proudly took part in an international underwater clean-up at Swamy Rock and Life Saving Point in Trincomalee, Sri Lanka, hosted by Clean Ocean Force Lanka.

I am a passionate 16-year-old diver from Dubai, certified as a Junior Advanced Open Water Diver and Reef Check Eco Diver. Over the years, I've been actively engaged in underwater clean-ups organised by the Emirates Diving Association (EDA) across the UAE. Beyond diving, I have developed ocean-themed virtual reality games to raise awareness among youths about marine conservation. My dedication and

creativity have made me the youngest diver to join Clean Ocean Force Lanka, where I now proudly represent the Clean Ocean Force Youth Diving Team as the Youth Ambassador for the UAE.

The clean-up team, comprised of nine divers from EarthLanka, successfully removed 73kg (wet weight) of marine debris. The collection ranged from ghost nets and single-use plastics to cans and polythene waste. Every item recovered represented one less hazard to marine life and coral reefs. Drawing on the valuable experiences I've gained through EDA clean-ups, I have played a key role in initiating

and leading this successful effort in Sri Lanka. Looking ahead, I'm eager to organise more clean-up dives across the island, bringing communities together to safeguard more marine ecosystems.

This dive was so much more than just a clean-up. It stood as a celebration of youth-driven leadership, international cooperation, and the belief that anyone, anywhere, can take action to protect our oceans. The event reinforced the powerful truth that collective action, even at an individual level contributes to global change in preserving the health of our oceans.

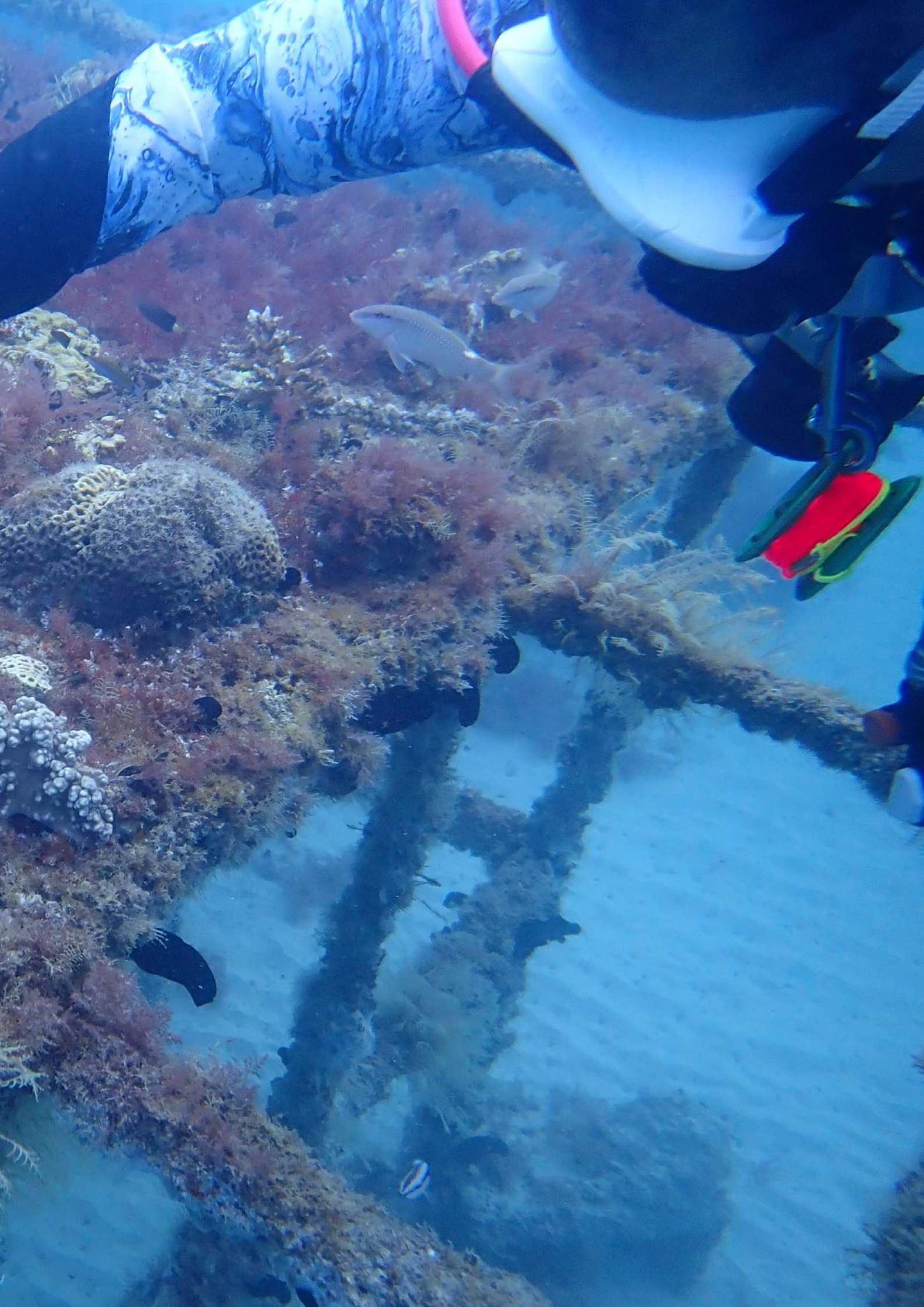
An underwater photograph showing a coral reef. In the foreground, a diver's hand wearing a black glove with a grey wristband is visible, holding a long, thin metal tool. The hand is positioned near a patch of coral. Several small, silvery fish are swimming in the water. The background is filled with various types of coral and seaweed, creating a vibrant and textured scene.

SOLVING THE UNSOLVABLE

A MUSSEL-INSPIRED REVOLUTION IN CORAL RESTORATION

COMPILED BY **AHMED NABIL, IUCN – SSC MEMBER, CORALS GROUP**

The future of reef restoration is here, stronger, safer, and more sustainable. Thanks to the humble mussel, Wilker of Purdue University, and Mussel Polymers, we've finally solved the unsolvable.



Adhesion in wet environments is a fundamental challenge. When it comes to underwater work, few things are more frustrating than trying to make something stick. Coral restoration divers know this all too well.

The traditional adhesives often fail in the harsh marine environment, compromised by saltwater, pressure, and the constant movement of waves. Surprisingly nature has already solved this problem!

Meet the mussel, a humble shellfish with a superpower:

Shellfish refers to a diverse group of aquatic invertebrate animals that have a shell or shell-like exoskeleton. They are broadly classified into two main groups: crustaceans (such as crabs, shrimp, and lobsters) and molluscs (such as clams, oysters, and mussels). While the term "shellfish" isn't a strict scientific classification, it's commonly used in culinary and fisheries context. Mussels can anchor themselves to wet, rough, and slippery rocks in pounding surf, never letting go. Now, inspired by this biological marvel, scientists and innovators have developed a game-changing adhesive that brings that natural power to coral restoration.

Welcome to the age of PCS: Poly catechol-styrene, the revolutionary biomimetic of the mussel protein responsible for underwater adhesion.

From Mussels to Marine Missions, the core of this innovation is groundbreaking research by Professor Jon Wilker of Purdue University, supported by the Office of Naval Research. By studying how mussels use proteins containing catechol molecules to stick to virtually any underwater surface, Wilker and his team developed PCS, a synthetic polymer that mimics mussel glue with astonishing precision.

This technology is now brought to life through Mussel Polymers Inc. It is already making waves in coral conservation.

THE JOURNEY

In an effort to identify rate limiting efforts for coral reef restoration, The National Ocean and Atmospheric Association (NOAA) got together with the defence contractor Draper and conducted a large study of restoration activities throughout the world. One of the key findings of this study was that a major rate limiting step was the adhesive used in reef restoration activities, which are usually cyanoacrylate or epoxy based glues. A diver could only plant 6 to 10 coral heads in a dive before they ran out of air. If someone could come out with a sticky and tacky underwater adhesive, they could have a meaningful impact on the rate of outplanting for reef restoration.

"While it may seem like a simple issue, finding a more effective adhesive has the potential

to result in a three times efficiency increase for coral outplanting overnight. While there are other challenges to scaling up, this one will have the most immediate effect," says Tom Moore, NOAA Coral Reef Restoration Programme Manager.

Mussel Polymers obtained a Government grant and worked with NOAA to develop a super sticky and tacky underwater adhesive based upon the metrics learned from this collaborative large study.

In conclusion of this grant, Mussel Polymers had a prototype product that could be utilised for reef restoration activities. This was originally designed as a two part system using PCS and a urethane prepolymer that was highly loaded with calcium carbonate. With the need to come to market and some of the challenges of biomimetic polymer synthesis at scale, Mussel Polymers created a one part system – inspired by PCS, but not PCS – that was super sticky and tacky in underwater situations, squirt – stick – and go, and could be deployed utilising traditional caulk guns and equipment. This one-part SeaTak® covered most of the key performance indicators necessary. SeaTak® was launched in March of 2023 and is being utilised all over the world by various groups including commercial, academic and not-for-profit. SeaTak® is intentionally designed as a slow set adhesive with a 30-40 minute working time, a 2-4 hour set time, and an overnight cure.

Key benefits include:

- Works in fully submerged conditions.
- Strong bonding to a wide range of materials: from limestone and cement to plastics, metals, and marine composites.
- Eco-friendly and reef-safe, no leaching, harmful residues, or coral tissue irritation.
- Long-lasting under dynamic marine pressures.
- Field-Tested in Harsh Conditions.

When compared to the next best alternatives of cyanoacrylate and epoxy, SeaTak® out performs.

At Our own corals restorations projects, we

tested SeaTak® glue across coral restoration projects in the Arabian Sea and Western Indian Ocean. These are one of the world's most extreme marine environments. Here, where summer temperatures soar and water conditions can be unpredictable, we needed an adhesive that could hold fast and not compromise coral health.

We compared SeaTak® with cyanoacrylate glue (superglue) and marine cement, and the difference was clear:

- Adhesion: SeaTak® showed superior bonding even on wet, porous, & irregular reef surfaces.
- Speed: Divers cut fixing time by nearly 50%.
- Outcomes: Coral fragment survival and health increased significantly, with minimal bleaching or dislodgement.

Mussel Polymers continues to develop SeaTak® with its SeaTak Pro™ which is a two part system that uses PCS and is mixed with a static mixer at time of use. The main benefit of SeaTak Pro is the speed of full cure which can be as little as 15 minutes.

A New Tool for Reef Heroes whether you're a marine biologist, dive team, citizen scientist, or conservation group, PCS is your new best friend underwater. It is not just glue, it is a next-gen restoration tool inspired by millions of years of natural evolution. Mussel Polymers Inc. is rapidly expanding its product line, leveraging its patented catechol chemistry platform to develop adhesives for everything from dental surgery to underwater construction.

The future of reef restoration is here, stronger, safer, and more sustainable. Thanks to the humble mussel, Wilker of Purdue University, and Mussel Polymers, we've finally solved the unsolvable.

Get Involved and Try It Yourself, Want to see how SeaTak® performs in your reef restoration efforts? Contact us for training kits, trial samples, and technical support for NGOs, universities, and dive groups working on coral regeneration.

Email: info@alphaconsultancy24.com

Learn more: www.musselpolymers.com

Performance Comparison

	MPI Coral Adhesive	Cyanoacrylate	Epoxy
Initial tack underwater	●	●	●
'Grab' of live rock, frag plug	●	●	●
Structural Support	●	●	●
Ease of Dispensing	●	●	●
Release of material into water	●	●	●
Toxicity	●	●	●



= Strong performance



= Adequate performance



= Poor performance



MUSSEL
POLYMERS
INC.





CONVOY COWBOYS

MAPPING MARITIME MEMORIES

WORDS AND PHOTOGRAPHY BY **JESPER KJØLLER**

Beneath the serene surface of the Mediterranean Sea off the coast of Tunisia lies a largely forgotten chapter of history – an undersea landscape marked by the remnants of World War II convoy battles.

These shipwrecks are silent witnesses to a vital yet often overlooked naval conflict that shaped the outcome of the North African campaign.

COVER PHOTO: As the tanks deteriorate, millions of gallons of fuel trapped in these wrecks will eventually leak, creating a significant ecological threat.





ABOVE: The footage will feed the insatiable appetite of the photogrammetry model, slowly reconstructing the SS Beatrice in the digital realm.

Beneath the serene surface of the Mediterranean Sea off the coast of Tunisia lies a largely forgotten chapter of history – an undersea landscape marked by the remnants of World War II convoy battles. These shipwrecks are silent witnesses to a vital yet often overlooked naval conflict that shaped the outcome of the North African campaign. Quest editor-in-chief Jesper Kjølner chronicles the meticulous efforts to document and preserve these submerged sites, revealing their historical significance and honouring the men who risked everything to sustain the war effort. Through advanced underwater technology and dedicated research, ongoing projects uncover the enduring legacy of the Mediterranean convoys and the crucial role they played in the broader theatre of war.

The lovely deep blue colour enveloping us as we descend is a hue found only in the heart of the Mediterranean. It's almost midday, and the ocean above us is completely flat, a perfect mirror reflecting nothing but sky. We have "bonaccia," the Italian term for dead calm.

We follow the thin, white shot line with the attached ribbons every 3m/10ft to make it more visible. By the time we reach 30m/110ft, the shadow of the massive SS Beatrice begins to reveal itself beneath us. She rests on her

port side, remarkably intact despite the years.

Stefano, Faisal, and Thomas, who slipped beneath the surface 15 minutes before Rami and I, are already deeply immersed in their photogrammetry missions. Bright video lights fixed to their scooters pierce the twilight, casting glowing halos across the towering flanks of the sunken giant. The divers cruise alongside the wreck at staggered depths, maintaining precise distances as they methodically capture thousands upon thousands of high-resolution images – each frame a small piece of the puzzle. The footage will feed the insatiable appetite of the photogrammetry model, slowly reconstructing the SS Beatrice in the digital realm.

Below us, the seabed at 75m/250ft is a quiet chaos of debris and scattered cargo – mute evidence of the moment SS Beatrice was claimed by the sea after an air raid in 1941.

Rami spots an intriguing cargo hold and steers his scooter toward the large, square opening – like a giant barn door hanging open to the sea. I follow him inside, and we begin exploring the vast interior, scattered with rusting fuel drums.

After 35 minutes on the bottom, we reluctantly begin our ascent after scooting the entire

137m/450ft from the bow to the stern. The long decompression ahead offers ample opportunity for my thoughts to drift back in time to the desert war that claimed this ship and the hundreds of others now lying silent in these waters.

THE DESERT FOX

The North African campaign of World War II, famously marked by the rivalry between Field Marshal Erwin Rommel and General Bernard Montgomery, was one of the most demanding and strategically complex theatres of the war. Fought between 1940 and 1943 across the deserts of Libya and Egypt, the "Desert War" was a test of endurance, mechanized warfare, and above all, logistics.

The extreme environment made every movement equipment-intensive. With open, featureless terrain, blistering heat, and fine sand that wreaked havoc on machinery, even basic operations became monumental tasks. Tanks, trucks, and artillery broke down regularly. There were no local resources to draw on – fuel, water, ammunition, and spare parts had to be shipped in from across dangerous waters.

For Rommel's Axis forces, that meant relying on convoys sailing from Italy across the Mediterranean. But these convoys were



ABOVE: Inside Ingo, a German freighter at 56m/184ft. The holds contain an extraordinary cache of WWII military equipment.

relentlessly hunted by Allied forces based on the island of Malta. Submarines, bombers, and fast-attack craft decimated Axis shipping, causing chronic shortages. Rommel, AKA the "Desert Fox" frequently pushed ahead of his supply chain, leading to daring manoeuvres that dazzled but often stalled due to a lack of fuel and ammunition.

The Allies, by contrast, had more stable supply routes via the Suez Canal and the port of Alexandria. Though not without challenges, their lines were longer-lasting and better protected. Montgomery's leadership, beginning in 1942, brought a more methodical approach: no offensive began without a solid logistics base. This strategy paid off at the Second Battle of El Alamein, where Allied preparation and supply overwhelmed Rommel's weakened Afrika Korps. It marked a turning point in the campaign.

UNDER-REPORTED NAVAL WAR

Desert warfare, in many ways, resembled naval combat on land. Vast distances, minimal cover, and reliance on radio and reconnaissance gave battles a fluid, expansive character. Success depended on manoeuvre, coordination, and massing firepower at critical points – hallmarks of Montgomery's patient yet powerful strategy. Yet while tanks clashed in the desert, equally

fierce battles raged at sea. Control of the Mediterranean was essential – whoever ruled the sea controlled the lifelines that kept desert armies alive.

Axis convoys sailed from Italian ports such as Naples and Taranto to North African destinations such as Tripoli and Benghazi. Their mission was critical but perilous. Allied submarines and aircraft, operating from Malta, made the Central Mediterranean a deadly corridor. Fuel tankers and cargo ships were lost in alarming numbers – each sinking reducing the Afrika Korps' chances of survival.

To defend their supply lines, the Axis powers deployed warships and armed escorts. The Allies responded with daring naval engagements, surprise attacks, and stealth missions. Every ship that reached North Africa gave Rommel another chance; every loss brought him closer to collapse.

These fierce engagements left behind a haunting legacy beneath the waves. Shipwrecks litter the seabed from Libya to Malta – silent remnants of a brutal, under-reported naval war.

Control of the sea wasn't a backdrop to the Desert War – it was its foundation. Without ships, there were no tanks, no food, no bullets.

The desert victories depended on what happened at sea. And the wrecks that remain today – still bearing the scars of war – remind us that behind every land battle, there was a supply chain, a convoy, and a crew who risked everything to keep the war machine running.

While the majority of war supplies did reach the armies on land, both sides suffered significant losses in the process. The eventual success of the Allied forces in North Africa was due in large part to their vastly superior industrial capacity – especially that of the United States – which ensured a steady flow of men, equipment, and ammunition. This logistical advantage proved decisive. Furthermore, the German high command prioritised the Eastern Front, limiting the support available to Rommel's Afrika Korps. This strategic decision, combined with overstretched supply lines and Allied control of the sea and air, contributed significantly to Rommel's eventual defeat.

A GAME OF TETRIS

We're diving from Granma 2, a 13m/42ft cabin cruiser just large enough to support six divers, so the team is handpicked with that limit in mind. Six is an ideal number: flexible enough to split into two teams of three or three teams of two, depending on the day's objective. The seventh member of the team is the heart of



Scattered cargo makes it clear these wrecks were once laden with supplies bound for the desert war.

the operation – our skipper, cook, deckhand, and an exceptionally skilled CCR diver in his own right: Rocco Canella. His experience and calm presence are as essential as any piece of gear on board.

The boat is not initially designed for diving but with a few clever modifications, it does the job admirably. And compared to the assortment of fishing vessels used earlier in the project, it's a clear upgrade. Still, with the sheer volume of equipment needed to support six CCR divers – cameras, scooters, bailout tanks, drysuits, undergarments, and all the knickknacks of technical diving – it's a constant game of Tetris to keep everything in order. We keep the chaos under control and the boat is remarkably comfortable. And what it lacks in space, it makes up for in flavour: Rocco and Stefano, unfazed by the cramped galley and limited provisions, spoil us daily with simple, delicious Italian meals. Their dishes – humble yet deeply satisfying – are a welcome comfort after long hours beneath the ocean.

The expedition follows an established template: wait for a favourable two-day weather window, then depart at night so the 100-nautical-mile

journey from Lampedusa to the wreck sites off the Tunisian coast can be completed while we sleep. Once on site, we typically complete two dives per day before returning to shore to refill tanks, resupply, and prepare for the next two-day run.

GAS MANAGEMENT

Since we don't have the capacity to refill tanks at sea, a slightly different protocol has been developed over the years. The twin manifolded diluent tanks on the GUE-configured JJ-CCR units remain untouched during the dives. Instead, we feed the rebreather diluent from side-slung S40s routed through a switch block. In the event of a failure or if the drive gas runs low, it's easy to switch to the onboard diluent, which is also accessible through the open-circuit regulators connected to the back-mounted tanks.

To preserve drive gas, we also use what's commonly referred to as a "fourth bottle." This is mounted opposite the oxygen tank and contains air for inflating both wing and drysuit. In a standard configuration, the wing is inflated via the right post of the back gas, and the suit from a separate inflation bottle, thus providing

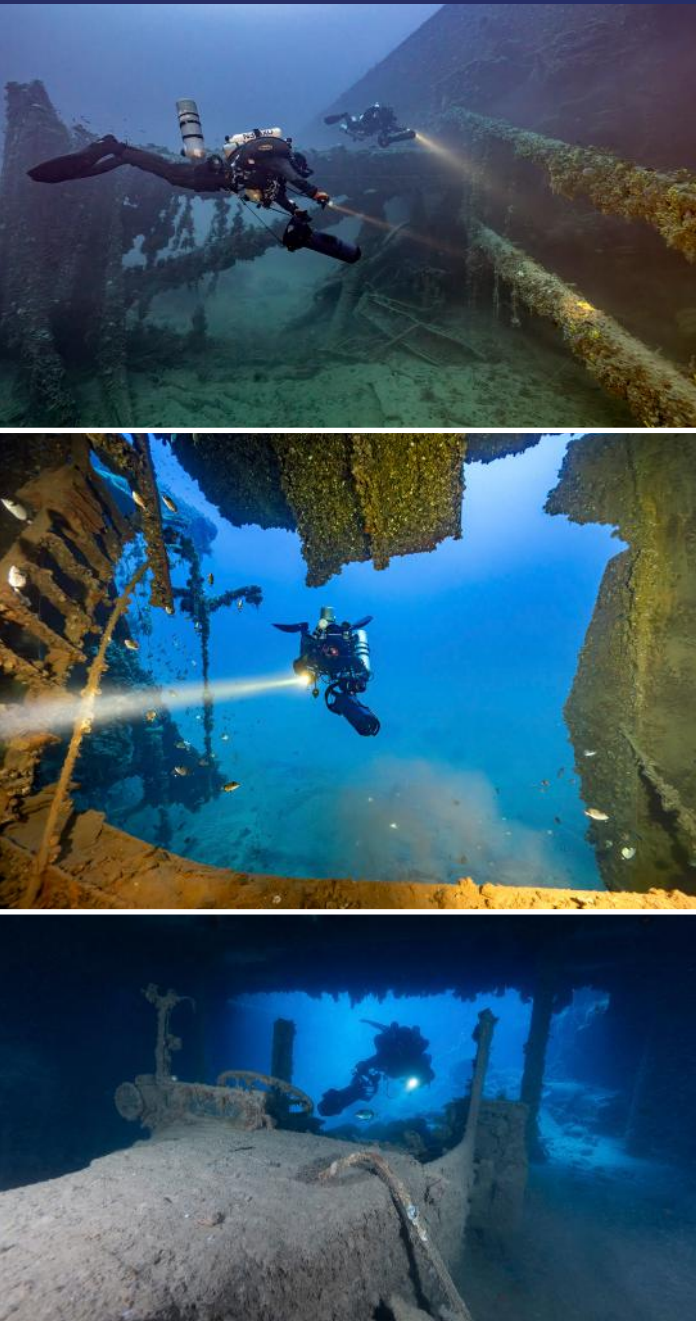
redundant buoyancy. However, inflating wings with precious trimix is a waste. But using the fourth bottle as the sole gas source for both inflation systems carries a significant risk – if that supply fails, the capacity to adjust buoyancy is completely lost. To mitigate this, we keep a backup inflation hose on the right post as a safeguard. But in an emergency, replacing the inflator hose under stress can be challenging. To address this, a dedicated switch block has been developed to simplify the process and enhance safety.

THE PROJECT

Launched by SDSS (Società per la Documentazione di Siti Sommersi or the Society for the Documentation of Submerged Sites) in the early 2000s, this ongoing project documents aircraft and naval wrecks linked to the WWII Battle of the Mediterranean Convoys. Its mission is to use the intrigue of these underwater sites to tell the human stories behind them – reviving a lesser-known chapter of history and honouring the tens of thousands from many nations who fought, suffered, and died.

These remote wrecks are extraordinary





The expedition follows an established template: wait for a favourable two-day weather window, then depart at night so the 100-nautical-mile journey from Lampedusa to the wreck sites off the Tunisian coast can be completed while we sleep.

pieces of historical heritage. SDSS sees documentation as a crucial first step toward protection, ensuring natural decay isn't worsened by human activity. In Sicily and its surrounding islands, this work is carried out with the support of the Sicilian Region's Superintendence of the Sea and the Museum of the Sea in Palermo.

Local fishermen from Lampedusa, Sicily, and Tunisia have been vital partners. While often unaware of the wrecks' identities, their knowledge of the seafloor – where fishing nets snag or marine life gathers – has been key in locating the wreck sites.

GUE Instructor Mario Arena is one of the driving forces behind the project. He is a passionate underwater explorer and historian whose knowledge of the region, tireless curiosity, and deep respect for maritime history have helped transform scattered wrecks into

compelling historical narratives. Through his leadership – and in collaboration with public institutions – the project has become far more than a research initiative. It now generates exhibitions, educational programmes, digital archives, and immersive experiences that bring history to life.

Mario is especially passionate about three long-term goals. The first is increasing public awareness in Italy, particularly by integrating this largely underexposed piece of history into schools and educational curricula. The second is facilitating the development of a sustainable dive tourism industry in Tunisia, where many of the wrecks lie within reach and could form the foundation of a culturally rich and economically valuable heritage tourism sector.

The third goal focuses on creating awareness of a looming environmental threat beneath the waves – millions of gallons of fuel trapped in

these wrecks will eventually leak as their tanks deteriorate, posing a serious ecological risk.

KEEPING THE STORIES ALIVE

Being part of this project has been both a meaningful experience and a rare opportunity to connect with the history hidden beneath the waves and to honour the lives entwined with these wrecks. I'm grateful to contribute to the preservation of this maritime legacy and look forward to returning to continue this important work alongside others equally committed to the cause.

Sharing these stories with a wider audience is not only a privilege but a responsibility – to keep the legacy alive and to inspire others to value and protect this extraordinary underwater heritage. Through exploration and storytelling, we help ensure that the sacrifices of the convoy crews and the lessons of the past are never forgotten.

FACT FILE: LAMPEDUSA

Lampedusa is the largest of the Pelagie Islands, located in the Mediterranean Sea roughly midway between Sicily and the North African coast. It is part of Italy's Sicily region but lies much closer to Tunisia than to mainland Italy. This strategic position has shaped Lampedusa's history, culture, and modern significance.



The island covers about 20km²/7.7mi² and hosts a population of approximately 6,000 residents. The community is small but diverse, consisting largely of locals whose livelihoods have historically depended on fishing and agriculture. Over time, the economy has shifted significantly towards tourism, which now plays a central role. The Island is primarily frequented by Italian tourists, with very few international visitors.

The island's population experiences seasonal fluctuations, with numbers swelling in the summer months when guests arrive.

Historically, Lampedusa's location made it a strategic military point, especially during World War II. The island was occupied by Allied forces in 1943 as part of the campaign to control Mediterranean Sea routes and the southern approaches to Italy. Before and during the war, Lampedusa's proximity to North Africa meant it was a key observation and staging post for naval and air operations. Though the island itself saw limited combat, it served as a vital link in the logistics chain and as a refuge for ships and aircraft.

Today, remnants of wartime infrastructure such as bunkers and observation posts remain scattered across the island, offering tangible reminders of its strategic role during that global conflict.

In recent decades, Lampedusa has also become known as a major landing point for migrants crossing from North Africa to Europe, highlighting its ongoing geopolitical importance and humanitarian challenges.

Ferries from mainland Italy or Sicily operate daily, as do domestic flights from Palermo.

**RESOURCES**

www.sdss.blue
www.underwaterhistory.org

SPECIAL THANKS

Pelagos 2.0 Diving Centre Lampedusa – www.pelagoslampedusa.it

JESPER KJØLLER

Jesper began his professional life as a musician but discovered his passion for diving over 30 years ago. He changed careers, becoming a diving instructor in 1994 and a PADI Course Director in 1999 – the same year he took on the role of editor for the Scandinavian diving magazine, DYK. He became a GUE instructor in 2011, and in 2015, relocated to Dubai to bring his talent for underwater storytelling and imagery to Deep Dive Dubai as the facility's Marketing Manager. From his base in Dubai, Jesper travels the globe to teach, contribute to international dive publications, and take part in exploration projects such as the Mars field studies in the Baltic Sea, deep wreck exploration in the UAE and Egypt, or the Battle of the Convoys project in the Southern Mediterranean. In 2021, he became Editor-in-Chief of Quest, GUE's member journal.

THE TEAM (L-R)

Jesper Kjølter, Denmark/UAE
 Thomas Solberg, Norway
 Rami Shakarchi, Switzerland/UAE
 Stefano Gualtieri, Italy
 Rocco Canella, Italy
 Faisal Khalaf, Lebanon/Egypt
 Mario Arena, Italy (not pictured)





TURNING YACHTS INTO SCIENCE LABS:

HOW SEAKEEPERS IS HELPING TO SAVE OUR OCEANS

WORDS BY **VICKY NEILD, LILLIAN ENGELHARD, ROSEMARIE MOORE, AND IVONNE GAMBOA**
PHOTOS BY **AUBRI KEITH, SEAKEEPERS, THE GOLDINGS, TONY GILBERT, AND VICKY NEILD**

OUR MOTTO IS TO: "Research. Educate. Protect. Restore."





The International SeaKeepers Society (SeaKeepers) is where luxury meets purpose – uniting yacht owners, boaters, divers, and ocean lovers to make a real difference for our seas. SeaKeepers is a non-profit organisation dedicated to advancing oceanographic research, conservation, and education through direct involvement with the boating and yachting community. Headquartered in Miami, Florida, with chapters in the United Kingdom, Asia, and the South Pacific, we empower the boating community to leverage their unique access to the sea to advance marine science and raise awareness about global ocean issues.

Since 1998, our mission has been simple yet powerful: use the unique access that private vessels have to the open sea to advance ocean research, inspire public awareness, and protect marine life. Our flagship DISCOVERY Programme transforms yachts into platforms for research and education, enabling hands-on projects in four key areas: scientist-led expeditions, citizen science, educational outreach, and community engagement. To date, over 200 vessels have opened their decks to science, eliminating research vessel costs and freeing up funds that can be allocated elsewhere to maximise research potential and

enable groundbreaking discoveries.

OUR MOTTO IS TO: “Research. Educate. Protect. Restore.”

BECOME A CITIZEN SCIENTIST

You don't need a lab coat to help save the ocean. Whether you're sailing the open sea, diving beneath the waves, or simply exploring your local shoreline, you can become a SeaKeepers Citizen Scientist. By following simple, field-tested protocols and collecting data that researchers can use to test and refine their hypotheses, you'll be directly contributing to large-scale marine research and helping drive the policy changes our oceans desperately need. From mapping uncharted seafloor with Seabed 2030, to tracking whales and dolphins with ORCA, to collecting water samples containing eDNA to track white sharks – there is a project for every ocean enthusiast. Two of our most popular projects are CoralWatch and Shark Sightings.

CoralWatch invites boaters and divers in the Red Sea and beyond to help monitor coral bleaching – a stress response caused by rising ocean temperatures. Using the easy-to-carry Coral Health Chart developed by the

University of Queensland, you can record your observations and contribute to one of the largest coral reef health databases in the world. Your notes could help scientists protect fragile ecosystems before it's too late.

Shark Sightings gives you the chance to document encounters with sharks, rays, and skates year-round. By contributing your sightings, you can help The Shark Trust to create a clearer picture of global species distribution and provide critical information for protecting these apex predators from overfishing and habitat loss. Your report could shape conservation policy and raise awareness for one of the ocean's most misunderstood and essential creatures.

Citizen scientists are game-changers. They make data collection possible on a scale that professional researchers alone could never achieve, spanning oceans, seasons, and species worldwide. By joining, you're not just learning about the ocean – you're actively shaping its future.

HANDS-ON OCEAN CONSERVATION: MARINE DEBRIS REMOVAL

Protecting the ocean starts with action – on



the shore and beneath the waves. Through the SeaKeepers' community engagement programme, volunteers work both above and below the surface to keep coastlines clean.

SeaKeepers equips volunteers with the Marine Debris Tracker app, enabling them to contribute valuable data to an open-access database that aims to inform research and policy, monitor marine debris trends and identify pollution hotspots. By empowering global communities to become ocean stewards for their local marine environment, SeaKeepers aims to mobilise community action to feed into global efforts to protect and restore the ocean. It's global action made personal, and it starts with one clean-up.

Across the globe, SeaKeepers partners with dedicated dive shops and local communities to host regular underwater clean-ups, turning divers' passion into tangible conservation action. In South Florida, for example, our long-time partner Sea Experience hosts monthly underwater clean-ups, giving divers a chance to turn their love for the ocean into direct conservation impact. Since 2019, Sea Experience, a PADI Green Star Dive Centre Award winner, has worked alongside

SeaKeepers to remove harmful debris such as cargo straps, glass bottles, aluminium cans, and tyre litter; often encrusted with marine life after years of being underwater. These dives are challenging, rewarding, and critical for protecting Florida's marine habitats.

In Singapore and across Southeast Asia, SeaKeepers Asia also partners with local researchers, citizen scientists, and community volunteers to protect coral reefs, remove marine debris, and safeguard endangered species. Our work has included clean-up dives and reef monitoring efforts in Malaysia and Singapore, as well as coral relocation efforts on Redang Island in partnership with Laguna Redang Island resort and Universiti Malaysia Terengganu (UMT). This project successfully moved 200 coral nubbins from a nursery to a sheltered area within Redang Island Marine Park, supporting a multi-year rehabilitation programme to restore degraded reefs. SeaKeepers dive clean-ups combine hands-on conservation and education, giving both seasoned divers and first-time participants the skills to protect marine ecosystems long after the dive is over.

"Our clean-up dives are driven by a deep

love and respect for the ocean," says Suzanna Sharkey, Sea Experience Eco Events Coordinator. "For six years, we've partnered with SeaKeepers and a passionate dive community who care deeply about preserving our incredible underwater world. It's not about obligation – it's about protecting what we cherish. Seeing divers surface with big smiles proves that giving back to the ocean brings people together in a truly powerful way. There's something magical about giving back to a place that's given us so much."

READY TO BECOME A SEAKEEPER?

Wherever you are in the world, the ocean needs allies – and you can be one of them. Whether you are a diver, sailor, beachgoer, or simply someone who loves the sea, there's a way to connect your passion to real-world impact. Join SeaKeepers in sharing your skills, learning from experts, and be part of the movement that's proving individuals can make a global difference.

Discover more and start your journey at www.seakeepers.org



An underwater photograph showing a diver in the distance, swimming towards the left. The water is deep blue with some light rays filtering through. In the foreground, there is a large, dark, textured object, possibly a piece of coral or a rock, with some yellowish-brown growth on it. A long, thin, brown object, possibly a piece of driftwood or a branch, extends from the top left towards the center.

PART 1

THE HISTORY OF DIVING

WORDS BY **PATRICK VAN HOESERLANDE**

History is a story. Although the content must be based on historical facts, the story itself depends on the narrator. My approach is that of our diving equipment. I focus on the “firsts”, the countless small first steps in the development of our contemporary diving equipment, and less on its successive improvements.

COVER PHOTO: Illustration of a Greek freediver in 3,000 BC created using Generative AI by Midjourney – Ivo Madder.

This is certainly not the first text written about the history of diving. Every self-respecting author of a book about diving starts with a brief history of the sport. So why this series? It started with the following question asked during an editorial meeting, "Why not write an article about the origins of our diving equipment, such as the snorkel?" After a little research, I concluded that it was difficult to write about the snorkel without mentioning dive masks, for example. Dive masks are inextricably linked to the first divers who used a tuba. After all, our diving equipment was not developed in isolation, but through a combination of different needs and inventions. Only a complete story does justice to this evolution. An article about the development of one piece of equipment therefore evolved into this new series on the history of diving.

History is a story. Although the content must be based on historical facts, the story itself depends on the narrator. My approach is that of our diving equipment. I focus on the "firsts", the countless small first steps in the development of our contemporary diving equipment, and less on its successive improvements. This does not mean that I am against continuous improvement, but as a subject, it is slightly less interesting to write about. During my research, I came across some anecdotes and facts that I will share with you. Before we begin, I would like to mention that if, despite my many hours of research, you discover an error, you are always welcome to contact me. The history of diving is not set in stone.

At the beginning of this series, I advise you to forget everything you know about diving. To better understand history, it is best to start with a blank slate. After all, you will encounter several ideas that, based on your current knowledge, will make you think, 'What a stupid idea!' When you consider that what you know still had to be invented or discovered, you will appreciate the historical context better. So, just forget everything for a moment and rebuild your knowledge as you read on.

THE FIRST DIVER

No one knows how it started. I begin my story with a scantily clad and hairy ancestor scraping mussels off a rock. He accidentally drops his prehistoric knife into the water. The precious object sinks to the bottom. If he were to jump into the water, he would avoid hours of grinding to get a new stone into the right shape. And so, he dived into the water. At that moment, he, and all of humanity with him, entered a new world and a new era, that of homo aquatica. Whether it was for fishing valuable objects, hunting, gathering food or repairing ships, from that moment on, the desire to dive proved impossible to suppress. Humans wanted to go deeper and longer underwater. This wet pursuit led to the long history of diving that we all know today.

Mesopotamia, the land between the Euphrates

and Tigris rivers bordered by the Aegean Sea and the Persian Gulf in an east-westerly direction, is considered the cradle of civilization. Five thousand years ago, the country was in a region that is now part of modern-day Iraq. The history of diving also begins in this cradle. This is where the story of Oannes, the fish god, comes from. Oannes is an amphibian, half human and half fish. At sunrise, Oannes rose from the Persian Gulf to bring people wisdom, science and art, to teach them to write, count, build cities, make laws and much more. At sunset, Oannes returned to the sea to come ashore again the next day.

When people assign a specific function to a god, that function plays an important role in the existence of those people. Archaeological finds from what was once Mesopotamia have shown that free divers collected sponges. In addition, algae were fished for food and pearls, mother-of-pearl and corals were fished for use as currency. The diving equipment was very simple and probably consisted of a heavy stone, sometimes tied to a rope for reuse, to descend quickly and effortlessly, and a basket to collect the harvest.

Historical data shows the practice of free diving in various earlier cultures, such as the sponge divers of Greece, the pearl divers of the Caribbean and the Yahgan Indians of Tierra del Fuego. However, none of these divers appear to have used eye protection. Although successful, these divers paid a price in the form of bloodshot eyes and impaired vision above water.

Homer wrote about Greek sponge fishermen and their technique, the Skandalopetra. In this technique, the diver descends to almost 30 metres to the seabed while attached to a heavy stone, or skandalopetra, along a long rope. The diver uses the skandalopetra to guide the descent. Of course, they knew nothing about the anatomy of equalisation. To compensate somewhat for the increasing pressure on the ears, a diver poured olive oil into his ear canal and took a mouthful of it before the descent. Once at the bottom, he spat out the oil and cut as many sponges from the bottom as his limited lung capacity allowed. The diver pulled on the rope to signal to the surface that he was ready to be pulled up. It was a gruelling and painful way to earn a living.

THE FIRST BREATHING TUBE

The earliest signs of people breathing underwater can be found in this region, namely amongst sponge farmers on the Greek island of Crete. These farmer-divers used a hollow reed as a snorkel when tending and harvesting their sponges.

THE FIRST BELLOW

We may be familiar with bellows from the blacksmith's forge, but this object is important in the development of diving as a precursor to the compressor. Around 1800 BC, Babylonian and



Hittite metalworkers used a pot bellow to smelt copper. In ruins in the Levant, archaeologists have found primitive pot bellows, consisting of a ceramic pot with a loose leather skin attached to the top. The air flow was ensured by moving this flexible top up and down.

Around 400 BC, the Chinese used bellows made from ox hide. In the early Han dynasty, around 200 BC, they used the more efficient double-acting piston bellows, in which a piston is enclosed in a rectangular box with a handle coming out of one side. These bellows blow air with every movement and are more efficient than pot and single stroke bellows which only blow during the downward movement. Around 1100 AD, blacksmiths in medieval Europe used bellows made from whole sheep skins, carefully removed in one piece without tearing it, so that it held air like a balloon.

FIRST MILITARY DIVERS

The two epics, the Iliad and the Odyssey, attributed to Homer and believed to have been written around the 7th century BC, describing, amongst other things, the Trojan War (1194-1284 BC). According to the stories, freedivers were used to sabotage enemy warships. Whether the Trojan War was a mythological war or actually happened is still undecided, but the fact that Homer wrote about these divers proves that they were used during conflicts. We can therefore assume that the use of military divers against ships was a common tactic.

THE OLDEST IMAGE FOUND OF COMBAT SWIMMERS

To protect their unfavourable country, the



ABOVE: A stone carving of Assyrian enemy archers attacking freedivers. **BELOW:** Bellows operated by a camshaft, driven by a water wheel (1540).

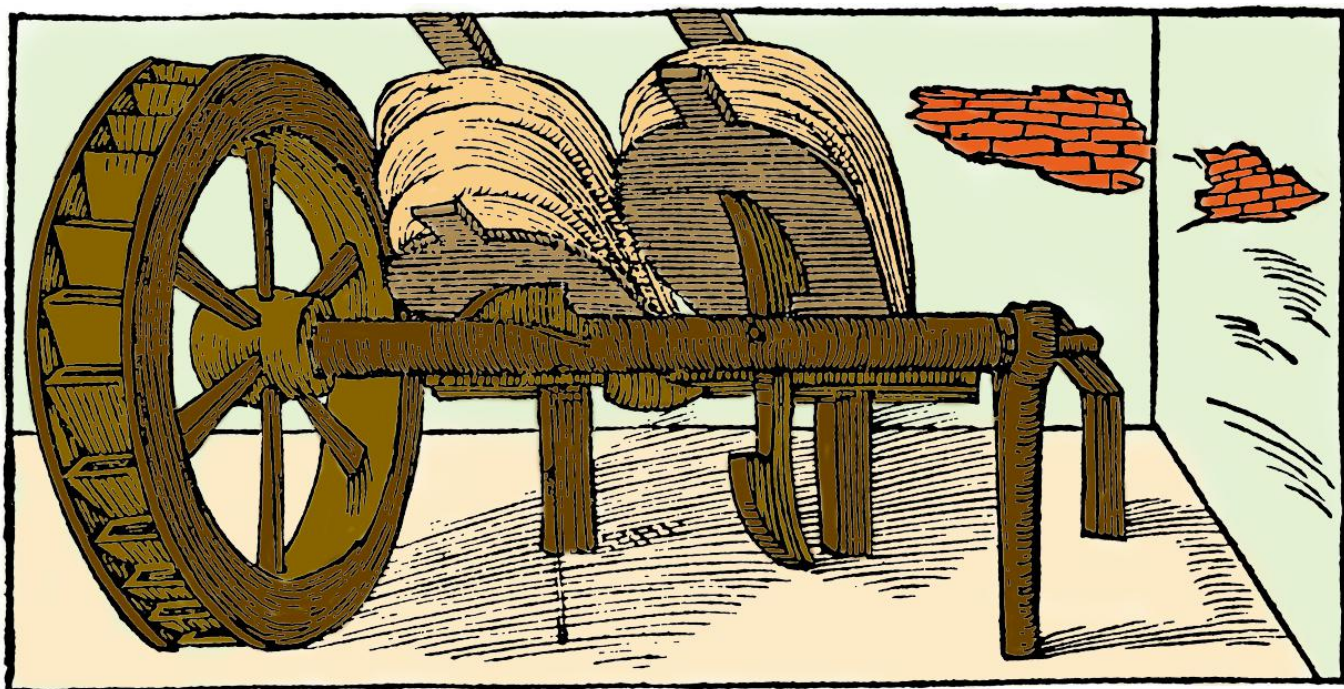
Assyrians built up a large army, equipped with modern and superior iron weapons. Under King Sargon II (722-705 BC), this army conquered neighbouring countries, using combat swimmers to attack fortified cities. An Assyrian woodcut depicts these soldiers on an air-filled animal skin. Was this bag an air supply or a means of floatation? If was used as an air supply, it was probably exhaled into the water. Blowing the air back into the animal skin would have led to headaches, which the early divers would have quickly experienced. This is unfortunate, because otherwise we

would have discovered the first application of a "Closed Circuit Rebreather" (CCR). Assuming that the bag was an air supply, the diver's buoyancy would decrease the longer he remained underwater. We can therefore assume that this air bag served as buoyancy to compensate for the weight of the weaponry.

THE FIRST FAMOUS MALE AND FEMALE DIVERS

Herodotus (484-425 BC) wrote about the most famous diver of antiquity: the Greek Scyllias of Scione. However, he was not alone,

as his daughter Hydna (also known as Hydne or Cyana) was also a diver. Around 460 BC, the Persian King Xerxes commissioned them to recover treasures during one of the many wars between the Persians and the Greeks. Xerxes did not want to lose this valued diving duo and refused to let them return home after their mission was completed. Disagreeing with this decision, they slipped into the water in the dark of the night and escaped, using reeds as breathing tubes to avoid detection. Years later, they destroyed one of Xerxes' fleets by diving into a stormy sea and cutting the mooring ropes





ABOVE: Illustration of a breath-hold diver from Mesopotamia 5,000 years ago created using Generative AI by Midjourney – Ivo Madder.

of the anchored ships. For their bravery, statues of Scyllias and Cyana were erected in the Greek city of Delphi. A writer of that time wrote that Cyana's diving experience proved that "young women can dive into the sea without fear of losing their virginity". Until then, it was believed that the water pressure that could so easily rupture eardrums, would similarly compromise the virtue of young virgins.

Although heroic tales take liberties with reality, there is evidence that Greeks used hollow reeds to remain incognito underwater and avoid detection by their enemies. One Greek soldier was even able to swim between the Persian fleet and cut their moorings to prevent an attack. This ancient snorkeller then swam more than 14km underwater to rejoin the Greek army near Artemisium.

THE FATHER OF PNEUMATICS

Ktesibios, or Ctesibius in Latin, (285-222 BC) was a Greek scientist, technician, inventor, and mathematician in Alexandria, Egypt. He wrote the first treatise on the science of compressed air, pneumatics, and is considered the discoverer of the elasticity of air. He invented various devices that use compressed air, including power pumps and an air catapult. However, his most famous invention was an improvement on the clepsydra or water clock, in which water dripping at a constant rate lifted a float that held a pointer to indicate the passing of the hours. Another important idea of his was the piston pump, which could be used to pump water. This invention was widely used by the early Greeks and Romans, among others, employing a device called the Ctesibius pump

to create a water flow. Its description can be found in the reports of Vitruvius and Heron, and the pump is therefore also known as Heron's pump. The ingenuity of the invention is evident from the fact that it was not only used in Antiquity and the Middle Ages, but fire pumps continued to work on the same principle until the 19th century. Moreover, piston pumps and compressors are still in use today. Ironically, the idea was lost in the burning of Alexandria. As a result, none of his written work has survived.

It was not until the 18th century that the principle behind the Ctesibius pump was rediscovered, and hand-operated fire engines began to appear. Until then, city dwellers had relied on the bucket brigade: two rows of people connecting the water source and the



ABOVE: Illustration of Cyana and Scyllias in 480 BC.

fire, with one passing on full buckets and the other returning empty ones. Wet blankets protected endangered buildings.

THE FIRST STRUCTURAL DEPLOYMENT OF COMBAT SWIMMERS

The Greek general Thucydides (450-400 BC) is considered the father of "scientific history" because he was the first to apply strict standards of impartiality, evidence gathering, and cause-and-effect analysis, without reference to divine intervention. His "History of the Peloponnesian War" recounts the conflict between Sparta and Athens in the 5th century BC. Until then, divers had been deployed individually to sabotage ships, but during this conflict they were deployed more systematically, and in groups. Thucydides wrote about Greek divers who, during the siege

of Syracuse, swam underwater to remove underwater obstacles from the harbour and thus ensure the safety of the ships.

THE FIRST STUDY OF A SNORKEL AND A DIVING BELL

The Greek philosopher Aristotle (384-322 BC) was the first to study snorkelling, although the word was not yet known at that time. He observed how an elephant swims underwater and uses its trunk to breathe. This story cannot be confirmed, but it is one of the first written accounts in history to explore the concept of snorkelling. In his "Problemata physica" (Aristotle's Problems – 415 questions about melancholy, wine, music, love...), Aristotle mentions the use of a kind of diving bell with an air supply: "... to provide these sponge fishermen with a means of breathing, a kettle is

lowered, filled not with water but with air; near the submerged man; the kettle is deliberately kept upright during the descent to prevent the air from escaping and the water from flowing in...". Divers in the Aegean Sea used these diving bells to reach deeper waters where the sponges were of better quality and to stay underwater longer.

Some claim that Aristotle himself tried diving with both reed tubes and diving bells. Later, he must have taught Alexander the Great how to use a diving bell. Something the latter used, among other things, during the siege of Tyros. The second part of this series will begin in this city.

To be continued...



WHALE SHARK RESIDENCY AND SMALL-SCALE MOVEMENTS AROUND OIL AND GAS PLATFORMS IN QATAR

WORDS BY **STEFFEN S. BACH¹**, **DAVID P. ROBINSON^{2,3}**, **MOHAMMED Y. AL JAIDAH¹**,
SIMON J. PIERCE^{4,5}, **PRASAD THOPPIL⁶**, **CHRISTOPH A. ROHNER⁴**
PHOTOGRAPHY BY **DAVID P. ROBINSON**

Whale sharks are Endangered, having suffered severe population decline over the past three generations. They face a variety of potential threats in the Gulf region, likely making this one of the more at-risk populations for the species.



- ¹ Qatar Whale Shark Project, Qatar Ministry of Municipality and Environment, Research Department, Doha, Qatar
- ² Sharkwatch Arabia, Research Department, Dubai, UAE
- ³ Sundive Research, Research Department, Byron Bay, NSW, Australia
- ⁴ Marine Megafauna Foundation, Research Department, West Palm Beach, FL, United States
- ⁵ University of the Sunshine Coast, School of Science, Technology and Engineering, Sippy Downs, QLD, Australia
- ⁶ Ocean Sciences Division, US Naval Research Laboratory, Stennis Space Center, Hancock County, MS, United States

ORIGINAL SOURCE:

<https://www.frontiersin.org/journals/marine-science/articles/10.3389/fmars.2025.1568607/full#supplementary-material>

Whale sharks seasonally aggregate near oil and gas platforms in Qatar to feed on fish spawn, creating one of the world's largest aggregations of the species. We used passive acoustic telemetry to examine their fine-scale movements, residency, and seasonality and investigate whether the platforms influence their space use in this area. Tags had a mean retention of 161 ± 186 days (standard deviation, SD) and 32 of the 117 tags were recorded in multiple years in the acoustic array (21 stations). Most detections were recorded from May to September, confirming that this whale shark aggregation is seasonal. Whale sharks stayed up to 77 consecutive days in the array (mean = 16 ± 12.51 days) and had a mean residency index $R_{\max}$ of 0.31. Although most detections (65%) were made at a single receiver located near a platform, here designated P1, an 'open water' receiver near this location also had a high proportion of total detections (8.5%). Receivers at other platforms, located away from this specific site, had relatively few detections. The distance from P1, identified as the centre of the aggregation, was the main explanatory variable in a GAM. Whale shark aggregations were routinely observed feeding on tuna spawn at the surface at this location, with the eggs (and hence whale sharks) moving with the current through the day, and moving through the array as they did so. Whale sharks then swam against the current in the late afternoon and at night to relocate back to near the presumed tuna spawning site, close to P1, again in the early morning. Rather than being generally associated with platforms, whale sharks were clearly associated with a specific feeding location close to P1. Our results highlight the importance of this small feeding area for whale sharks, which face a high threat level in the region.

INTRODUCTION

Marine pelagic species live in a vast environment that, despite seeming homogenous, is characterised by spatiotemporal variation in

biological, chemical, and physical parameters (Sims et al., 2008). These heterogeneous conditions result in a patchy resource landscape, with biological diversity and productivity concentrated in relatively small areas, such as in fronts, near seamounts and oceanic islands, or even around anthropogenic structures (Acha et al., 2015; Rowden et al., 2010; Snodgrass et al., 2020). These productive areas influence the distribution of pelagic animals and can be preferred aggregation sites (Morato et al., 2010). These aggregation sites are commonly important to the ecology and social behaviours of marine species (Genin, 2004; Magurran, 1990; Ritz et al., 2011; Sims et al., 2000). Such aggregations may, however, also increase a species vulnerability to human-induced threats (Tobin et al., 2013), and targeted fishing of aggregations can result in severe population declines (Rose and Kulka, 1999; Srinivasan et al., 2012). Fish aggregating devices (FADs) exploit the same principle and target commercially important species, such as tuna (Fonteneau et al., 2000). Managing the exploitation of aggregation sites, and ensuring their persistence, is therefore an important consideration in the conservation of threatened pelagic species.

Whale sharks *Rhincodon typus* aggregate in ~30 currently known hotspots, termed 'constellations', in tropical and subtropical waters around the world (Norman et al., 2017b; Rohner et al., 2022). Aggregation sites are important to whale sharks that are otherwise solitary and wide-ranging, and these sites are thus often focal areas for conservation management of this Endangered species (IUCN Red List of Threatened Species; Pierce and Norman, 2016). Many constellations are seasonal and are driven by high prey availability (Nelson and Eckert, 2007; Rohner et al., 2015). Prey taxa vary among sites and include small fishes, sergestids, euphausiids, mysids, copepods, crab larvae, chaetognaths, and fish eggs, among others (Rohner et al., 2022). Feeding in high-density, but ephemeral, prey patches is likely to be crucial to whale shark nutrition, as they may undergo long periods of fasting between productive feeding bouts (Wyatt et al., 2019). Examining their residency and small-scale movements within an aggregation site can thus improve our understanding of the importance of these sites and aid in their protection.

Although whale sharks are often seasonally sighted at the surface in constellations, passive acoustic telemetry has revealed that some whale sharks may be present, but not sighted, at other times (Cagua et al., 2015), emphasising the importance of sightings-independent methods to examine seasonality and habitat use. The percentage of sharks that remained in the constellation areas throughout the year varied among different study sites, highlighting the need for site-specific investigations (Cagua et al., 2015; Cochran et al., 2019; Norman et al., 2017a). Satellite-tagged whale sharks

may move 1,000's of kilometres away from aggregation sites (Robinson et al., 2017; Hearn et al., 2022), though many individuals return to constellations in subsequent seasons (Norman et al., 2017b; Robinson et al., 2016). Their fine-scale movements and temporal shifts in space use within constellations are less understood. Off Mafia Island in Tanzania, the whale shark core habitat shifted over the year, from feeding areas close to shore during the main sighting season, to a few kilometres offshore between seasons (Rohner et al., 2020). Elsewhere, studies have typically focused on seasonality and residency rather than fine-scale movements.

Segregation by sex and size is a ubiquitous characteristic among whale shark constellations. There is a substantial bias towards male sharks at most locations, and small (0.6–3m total length TL) or large (>8m TL) individuals are rarely seen at most sites (Araujo et al., 2022; Rohner et al., 2022). One exception to the sexual segregation has been documented in the Red Sea, where juvenile females and males occur in an even ratio. Passive acoustic telemetry and satellite tagging showed no differences in residency or wider-scale movements between the juveniles of both sexes (Cochran et al., 2019). Another exception is the offshore island of St Helena in the mid-Atlantic, where mostly large, mature whale sharks are sighted (Acuña-Marrero et al., 2014; Perry et al., 2020). At present, it is unclear whether these large sharks display temporal changes to their habitat use within constellations, or how their small-scale movements compare to those of smaller individuals.

One of the largest whale shark constellations in the world has been documented in oil and gas fields off the coast of Qatar in the Arabian Gulf. Whale sharks seasonally gather here from May-Sep and primarily feed on freshly-spawned fish eggs from mackerel tuna (*Euthynnus affinis*) (Robinson et al., 2013). Densities of up to 100 sharks in a 1km² area have been reported (Robinson et al., 2013). More males (69%) than females are seen off Qatar, and there is an unusually large proportion of mature males (63% of males) and even some large females, unlike the juvenile bias in other regional hotspots (Norman et al., 2017b), making it possible to examine small-scale habitat use and residency across a broad size range of sharks in a population for the first time.

The whale shark constellation in Qatar occurs in an area of active oil and gas extraction known as the Al Shaheen field and the North field. The first reports of this constellation were made by workers on oil and gas platforms, and it is unknown whether whale sharks aggregated in this area before the establishment of platforms (Robinson et al., 2013). Platforms elsewhere have also reported the presence of whale sharks (McKinney et al., 2012; Thomson et al., 2021; D'Antonio et al., 2025) and more

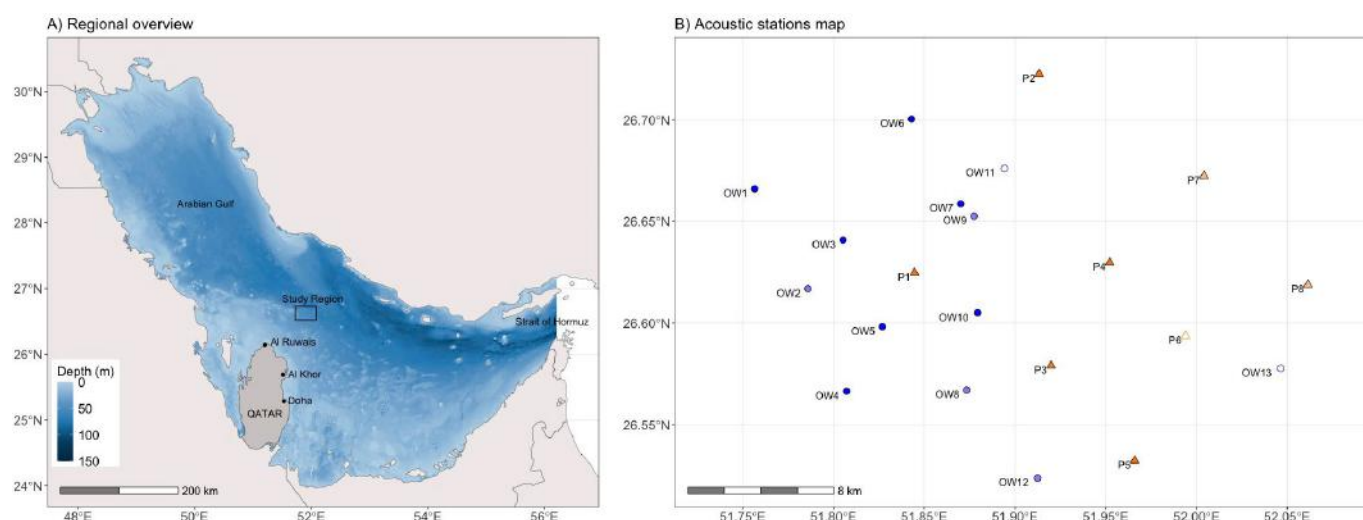


FIGURE 1. (A) Regional overview map. (B) The acoustic receiver array off Qatar with platform-associated stations (P1-P8, orange triangles) and open water stations (OW1-OW13, blue circles). Empty symbols indicate stations that were lost before the first data download, and the light colours represent stations that were only used in the first season (2012/13).

generally attract migratory animals, such as tuna, billfish, and sharks (Snodgrass et al., 2020). To test whether it is the platforms specifically that attract the sharks, or whether the platforms are simply in the general area in which fish eggs are available, or attract spawning tuna that are protected from fishing here, observations at and around several platforms are needed.

To that end, we used passive acoustic telemetry to examine whale shark movements within their aggregation site in Qatar. Receivers were placed both near platforms and away from platforms, in open water, to test for an association between whale sharks and these structures. We also investigated whale shark residency and the seasonality of this constellation, and examined the core habitat and the timing of their movements between stations in the receiver array.

METHODS

STUDY AREA

The Arabian Gulf, 'the Gulf' hereafter, is an almost enclosed sea that is connected to the Gulf of Oman and the Indian Ocean by the narrow Strait of Hormuz in the east (Figure 1A). Located in the arid sub-tropics and surrounded by deserts, the Gulf is one of the warmest and most saline waters on earth (Reynolds, 1993; Sheppard et al., 2010). Surface water temperatures fluctuate strongly across seasons, from 20°C in winter to up to 35°C in summer in the deeper, central areas, where whale sharks have been sighted around oil and gas platforms (Robinson et al., 2013, 2017). Platforms in the study area are located ~80km north-east off the coast of Qatar, where water depth ranges from 50-70m (Figure 1A). The first fixed platforms related to the Al Shaheen oil field were established in 1996, while the latest was put in place in 2009. There are 34 structures in total, with some interconnected through gangways, resulting in 9 separate platform locations. The subsurface section of the platform structures occupies on average an area of 2,500m². Whale sharks

have mostly been sighted in this area between May-September, here termed the "season" (Robinson et al., 2013).

ACOUSTIC ARRAY

Acoustic monitoring equipment was deployed, and whale sharks were tagged during 49 boat-based surveys between 2012-2016. The point of departure was the port of Al Khor or Al Ruwais on the north coast of Qatar (Figure 1A). Permissions for fieldwork and data collection on whale sharks were given by the Qatar Ministry of Municipality and Environment. Analyses were conducted in R version 4.3.1 (R Core Team, 2022).

Acoustic receivers (Innovasea, VR2W) were deployed at 21 stations (Figure 1B). To test whether whale sharks had an affinity for underwater structures, 8 receivers were deployed ~200m off platforms (here named P1-P8, east to west) and 13 receivers were located at a minimum of 4km away from platforms in open water (OW1-OW13). Receivers in open water were placed around the area where most whale sharks were seen surface feeding in previous surveys (Robinson et al., 2013). In the first season (2012), the array comprised 12 stations at seven platforms and five open water locations. The array was then adjusted from the second season onwards (2013-2016) to remove stations with few detections in the east of Al Shaheen, and add stations around P1, as P1 recorded the most detections (74%) in the first season, to examine the sharks' finer-scale space use in that area. There were 12 stations at five platforms and seven open water locations from 2013 onwards.

Stations were in deep water (40-60m) and required acoustic releases to retrieve receivers. We attached receivers to a cement anchor (>20kg) with an acoustic release (SubSeaSonic AR-60-E Acoustic Release Unit) and four trawl floats with a total buoyancy of 18.8kg (600 metres working depth and 30kg m⁻¹ impact strength). Receivers were thus

located ~4m above the sandy seafloor. To retrieve receivers, the acoustic releases were activated with a transducer (SubSeaSonic Acoustic Release Interrogator Model ARI-60), thereby detaching from the anchor and floating to the surface by the attached floats. Receivers were regularly downloaded and redeployed, but some gaps in the coverage exist due to operational constraints (Supplementary Figure S1). We focused receiver deployments on the tuna spawning season from May-Sep, when whale sharks formed aggregations (Robinson et al., 2013), but also had some receivers active in other months to test if whale sharks were present in the non-spawning season (Supplementary Figure S1). Receivers at three stations (P6, OW11, and OW13) were lost before any data could be downloaded and were excluded from the analyses. Considering the homogenous and flat underwater topography of the area, we assumed that all receivers had a similar detection radius. An informal range test was performed using a high-frequency sentinel tag deployed for 5 min in ~5m depth at a distance of up to 2km away from the receiver in 200m increments. This test was repeated at several stations and indicated a ~1,000m detection radius, including at platform stations, suggesting that platform noise (low frequency) or benthic marine life associated with pipelines (that connect all platforms along the seafloor) did not significantly influence detection capability for pelagic whale sharks. It is possible that there was an occlusion zone at the platform itself, which we could not test, as boats are not allowed within 200m of the platform. It is also possible that noise from support and supply vessels, which irregularly use the area, influenced detections.

WHALE SHARK TAGGING

Whale sharks were encountered and tagged with acoustic tags (Innovasea V16-4L, 69 kHz, transmission power: 152-158 dB re 1 uPa @1m) at the surface during their feeding aggregations. We were unable to photo-ID some (23 of 125) of the tagged individuals,

Metric	Tags	Whale shark length (m)	Deployed	Retention (d)	Detected (d)	$R_{\max}$	$R_{\min}$	Max days	Total detections
Mean $\pm$ SD		6.56 $\pm$ 1.21		161 $\pm$ 186	50.5 $\pm$ 43.3	0.56 $\pm$ 0.31	0.11 $\pm$ 0.15	16 $\pm$ 12.5	901 $\pm$ 1,701.1
Median		6.5		75	40	0.61	0.04	13	525
Min		4	27/5/2012	1	1	0.01	0	0	5
Max		9	29/6/2016	859	221	1	0.7	77	17,547
Total	117			18,802	5,904	0.31	0.06		105,420

The end of the tag period for $R_{\max}$ was the date of last detection and for $R_{\min}$ it was 19 Oct 2016 when the study ended. Max days refers to the maximum number of consecutive days a shark was detected in the array.

TABLE 1. Summary of whale sharks tracked in this study (43 females; 57 males; 17 unknown sex).

and it is therefore possible that some of these individuals were tagged more than once over the course of the study, after they lost their initial tag. We visually determined the sex and estimated the total length (TL) of most (82%) tagged sharks (Supplementary Table S1). Tags were connected with a 10-15cm long dyneema tether to a titanium dart, which was inserted into the skin below the 1st dorsal fin of the shark. In 2012 and 2013 we used a pole spear to attach tags ($n = 43$), and in 2014-2016 we used a pneumatic spear gun to deploy the tags ($n = 82$) in an attempt to improve tag retention and to effectively tag larger individuals. Tags had an expected battery life of 2,516 days but often fell out of the shark prematurely (Table 1). Tag #72 fell off the shark next to station P1 on 18 Aug 2015 (continuous detections from then on) so we removed all detections thereafter before analysing the data. Tag retention was defined as the number of days between tag deployment and its last detection in the array. Therefore, retention is a minimum estimate, as whale sharks likely migrated away from the array with their tags attached and did not return, or lost their tags elsewhere before returning.

RESIDENCY

To investigate the importance of the feeding aggregation area to tagged whale sharks, we calculated two commonly-used residency indices, $R_{\max}$ and $R_{\min}$ (Cochran et al., 2019; Rohner et al., 2020). $R_{\max}$ was the proportion of days a shark was detected in the array over the number of days between tag deployment and its last detection. Indices were calculated for each shark individually and for all sharks combined (not the mean of the individual scores) based on the sum of detection and deployment days. The advantage of $R_{\max}$ is that it considers premature tag detachment, which occurs frequently with external tags on whale sharks (Rohner et al., 2020). A potential disadvantage is that it may overestimate residency for individuals that lose their tags quickly. To test this potential bias on the combined residency estimate, we also calculated $R_{\max5}$ only for individuals with >30 day between the first and last detection ($n = 90$), thus excluding those with early tag loss ($n = 27$). As the result was similar (0.30) to the overall $R_{\max}$ (0.31) we continued with $R_{\max}$. $R_{\min}$ was the proportion of days a shark was

detected over the number of days between tag deployment and the end of the study, 19 Oct 2016, when the last receiver was recovered. This index ignores premature tag detachment and is thus likely to be an underestimate of residency overall. Due to tag loss, individuals tagged nearer to the end of the study will have a higher $R_{\min}$ than those tagged at the start of the study. We also calculated the number of consecutive days sharks were detected in the array. The number of seasons in which each shark was detected was a longer-term measure of site fidelity, although it was biased by the relatively short tag retention. Although these metrics are termed 'residency' in acoustic telemetry studies, they are measuring seasonal site fidelity in our study, as evidenced by the strong seasonal pattern in whale shark presence.

SPACE USE

We first investigated the overall daily space use for all whale sharks combined. We used centres of activity (COA), calculated as one location per 24h, using the V-Track package (Campbell et al., 2012). These COA are position estimates based on weighted means of the number of detections at stations over a time period. They can thus be spread across the array, estimating the location of animal activity at a continuous spatial scale, rather than being restricted to receiver locations only (Simpfendorfer et al., 2002). We then calculated their core (50%; "core habitat") and extent (95%; "extent home range") kernel utilisation distributions (KUD) based on the COA locations using the adehabitat package (Calenge, 2006).

ASSOCIATION WITH PLATFORMS

To test whether platform location influenced where whale sharks aggregate, we constructed generalised additive models (GAM) in the mgcv package (Wood, 2011), with the relative number of detections per day per station as the response variable, ie the number of detections at a station divided by the number of active tags. Tags are defined as active on a day if the day is between tag deployment and the last detection, as per $R_{\max}$ to account for tag loss over the course of the study. Predictors included station type (platform or open water) as a categorical variable, and distance from station P1 and day of year as

continuous variables. The distance from P1 was used because the space use analysis showed that it is the centre of the aggregation (Figure 1B). Day of year was used to account for the seasonal effect and was modelled with a cyclic cubic regression spline to wrap around at the boundary from the last to the first day of the year. Current direction was not included because it had little variation (see "temporal patterns" below). We constructed seven models (all combinations of predictors) and compared their performance with AIC to select the best model. We highlight that the large detection radius means that whale sharks detected at a platform receiver may not have been in very close proximity to the platform structure (up to 1.2km away), but were closer to platforms than at open water receivers, which were at least 4km away from platforms.

SEASONALITY

We examined seasonal trends in whale shark visitation to compare with visual and satellite telemetry results that have shown that whale sharks frequent Al Shaheen between May-Sep (Robinson et al., 2016, 2017). We binned the total number of detections per active tag in the whole array per month and compared the May-Sep mean to the Oct-Apr mean with a test. We used this relative measure to account for the different number of tags active in the different months. We also binned the number of unique tags detected per month and the percentage of detected tags from the number of available tags in that month, with the end of tag attachment taken as the last detection, as per $R_{\max}$. To investigate fine-scale variations in space use over the season, we calculated habitat use metrics, including the 50% and 95% core KUD, for the two seasons, and also for each month within the whale shark season from May-Sep.

TEMPORAL PATTERNS

Day and night were assigned for each detection by deriving the sunset and sunrise time for each day with the StreamMetabolism package (Sefick, 2016). We wanted to assess how whale sharks move within the aggregation site over the course of the day. Previous surveys have shown that whale sharks consistently feed on fish eggs at this site (Robinson et al., 2013). Since fish eggs drift at the surface with the current, we set

out to examine whether whale sharks move with the eggs. Our field observations during surveys confirmed this and showed that the predominant current flows from northwest to southeast. We therefore optimised the receiver locations in 2013, after the initial first season, to have two transects of acoustic receivers from north-west to south-east and from north-east to south-west. We then binned detections every 30 min and calculated the proportion of detections for each 30 min bin at each station. To investigate if the peak of activity follows the drift of eggs with the current, we then created five Hierarchical Generalised Additive Models (HGAM) (Pedersen et al., 2019) with the mgcv package (Wood, 2011). The response variable was the proportion of detections per 30 min bin and the predictors were the 30 min bins nested within station with a factor-smooth interaction term to model the interaction with station and a cyclic spline to wrap around at the boundaries as the first (00:00h) and last (23:30h) bins are next to each other (Supplementary Table S3). Models varied in how they incorporated station effects: either as random effects, global smoothers with station-specific deviations, or station-specific smoothers with or without a global pattern (Supplementary Table S3). We used a normal distribution (gaussian) appropriate for a continuous response variable, and used the Restricted Maximum Likelihood (REML) method for estimating parameters in the HGAM. The best model was selected based on examination of the raw data, an AIC comparison, and inspection of model outputs (Pedersen et al., 2019) (Supplementary Table S3, Supplementary Figures S4, S5). Two models had similar results and were within 2 AIC scores: model GS with a global smoother and group-level smoothers that have the same wiggleness, and model S without a global smoother but with group-level smoothers with the same wiggleness. Since overall trends were not common to all stations (e.g. station OW10, Supplementary Figure S4) we used model S as the best model as it made sense for our data. We then predicted the fit and the standard error to plot how the proportion of detections at each station along the northwest-to-southeast transect varies over the course of the day. The proportion of detections, rather than the number of detections, allowed us to compare stations with different levels of activity. We also derived the movement segments of whale sharks among stations, and defined a move as an occurrence of an individual being detected at a subsequent station within 3h of its first detection at the original station. This time step was used because whale sharks moved slowly through the array while feeding on drifting fish eggs, and shorter time steps resulted in few movement trajectories. We then selected the first detection at each station within a move to assess at what time of day these moves occurred.

CURRENTS

To assess the likely path of floating fish eggs

after a spawning event, likely occurring near the seafloor, we mapped surface currents in the area based on a regional, high-resolution ocean model for the Gulf region for the months of May–October during 2012–2016, overlapping with the seasonal whale shark sightings in this study. The details of the model configuration are given in Thoppil and Hogan (2010a). Briefly, the numerical model is the HYbrid Coordinate Ocean Model (HYCOM) with 1-km horizontal resolution and 16 hybrid layers in the vertical axis. The model domain extends northward from 22.7°N and westward from 59.4°E and has 1,217 × 945 × 16 grid points. The eastern boundary is treated closed but relaxed towards the Generalised Digital Environmental Model version 3 (GDEM3) seasonally varying temperature and salinity climatology. The surface forcing for the model comes from the three-hourly, 0.5° atmospheric fields of winds, air temperature, humidity, precipitation and solar radiation. Surface salinity is being relaxed to the GDEM3 climatology. This configuration of the Gulf model (no tidal forcing) has previously been used for other studies (Thoppil and Hogan, 2009, 2010a, 2010b). These studies have demonstrated the model's ability to reproduce many salient features of the circulation and water masses in the Gulf, including the evolution of a series of cyclonic eddies during summer.

RESULTS

A total of 125 acoustic tags were deployed between May 2012 and June 2016. Eight tags, most deployed towards the end of the study in 2016 (Supplementary Table S1), were never recorded on the receivers, leaving 117 tags for analysis (Table 1). These were deployed on 43 females, 57 males, and 17 sharks of unknown sex (Table 1). Tracked whale sharks ranged from 4–9 m in total length, with a mean

of 6.6 m (± 1.21 m SD). Males (6.7 ± 1.2 m) were similar in size to females (6.3 ± 1.2 m; $t = 1.6965$, $df = 89.7$, $p = 0.009$). Tag retention, from deployment to the last detection, ranged from 1–859 days, with a mean of 161 ± 186 days and a median of 75 days. The entire acoustic array reported a total of 105,420 detections from 117 tags over the duration of the study, from 5 June 2012 to 8 October 2016 (Table 1).

RESIDENCY

Tagged whale sharks were routinely detected in the acoustic array, with ~105,000 detections recorded over the study duration. The highest maximum number of consecutive days a shark was detected in the array was 77 days, with a mean $\pm$ sd = 16 ± 12.51 days for all sharks. Half of all sharks were detected on at least 14 consecutive days, and 12 sharks were detected on over 30 consecutive days. The residency index $R_{\max}$, the proportion of days a shark was detected in the array between tag deployment and its last detection, ranged from 0.01 to 1, with a mean of 0.56 ± 0.31 for individual sharks (Table 1). For all sharks combined, the $R_{\max}$ was 0.31. Although tags that had a short retention generally had a higher $R_{\max}$, the 32 tags detected in multiple seasons, thus including the inter-seasonal months with no or very few detections, still had a relatively high combined $R_{\max}$ of 0.21. The more conservative $R_{\min}$ that ignores tag loss, for which tag retention was calculated as the number of days from tag deployment to the end of the study, was much lower at 0.06 for all sharks combined (Table 1).

The residency index $R_{\max}$ varied with size, with large whale sharks (≥ 8 m TL; combined $R_{\max} = 0.51$) being more resident than small (≤ 5 m; 0.25) and medium-sized (6–7 m; 0.26) individuals. However, large whale sharks

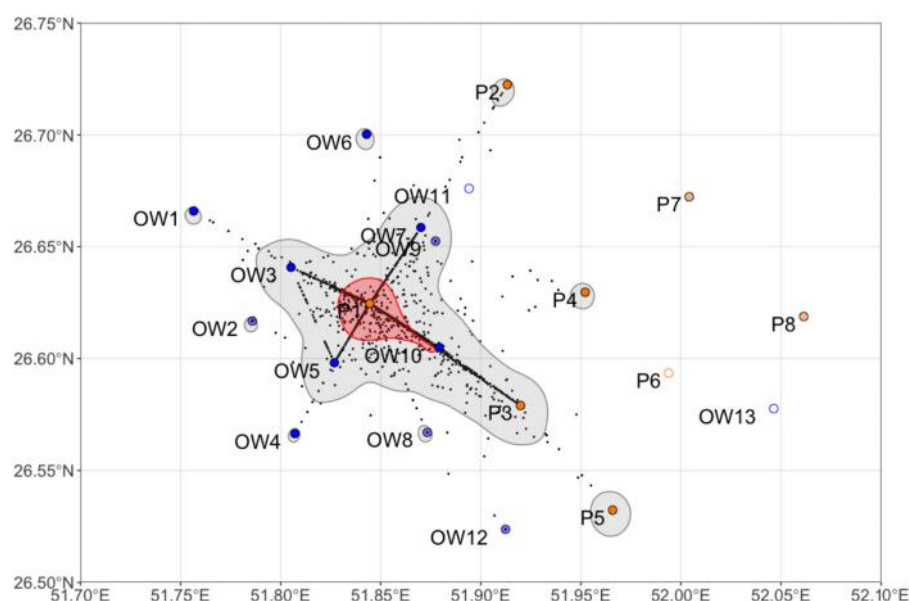


FIGURE 2. Daily space use of all whale sharks combined over the entire study period, with core (50%; red) and extent (95%; grey) kernel utilisation distributions and centres of activity per 24h period (black dots). Stations at platforms (P) and in open water (OW) are shown. Empty circles indicate stations that were lost before the first data download, and the light colours represent stations that were only used in the first season (2012/13).

also had a shorter mean tag retention (80.9 days) than small (191.4 days) and medium (214.6 days) individuals. Females (combined $R_{\text{max}} = 0.31$) had a similar residency level to males (0.27).

SPACE USE WITHIN THE AGGREGATION SITE

Whale sharks had a defined hotspot in their daily space use around station P1 (Figure 2). Station P1 recorded 65% of all detections within the array, followed by stations OW10 (8.5%) and P3 (8.1%) to the south-east of P1 (Table 2). When taking the variable effort into consideration, the same three stations had the highest number of detections per day of recording, although OW10 (16.4 detections day⁻¹) was twice as important as P3 (8.9 detections day⁻¹; Table 2). Relative numbers also showed that OW3 was more important than OW5 even though they had a similar number of total detections.

Most individual tags were detected at P1, where 114 of 117 tags were recorded (Table 2). Other stations with high numbers of detections (P3, OW3,5,7,10) also recorded many individual tags. The main exception was P5 at the southeast corner of the array which had few detections (0.9% of total) but recorded relatively many individual tags (71 of 117). Relative to the number of days of recording, OW1 stood out with 22 tags recorded in only 145 days.

The core habitat of whale sharks was concentrated around P1 and extended to OW10 to the south-east (Figure 2). The extent home range was around the core habitat, also extending to the south-east. Most stations outside of the main daily space use area also had a small, separate extent home range surrounding them, with the exception of two platforms in the north-east and OW12 in the south.

ASSOCIATION WITH PLATFORMS

The best GAM examining the number of relative detections was model 1 which explained 25.1% of the deviance and included distance from P1 ($p < 0.001$), day of year ($p < 0.001$) and station type ($p < 0.001$) as predictors (Supplementary Table S2). Most relative detections were made at station P1 with a sharp drop in detections even at relatively short $< 5\text{km}$ distances from P1, a radius including five open water stations (Figure 3). There was a clear seasonal signal, with most relative detections made from mid-April to end of September (Figure 3). There were fewer detections in open water compared to platforms (estimate = -0.31, $t = -8.8$, $p < 0.001$). Although station type was supported in model 1, model 2 with distance from P1 and day of year as predictors, excluding station type, also explained 25% of the deviance, suggesting that receiver location (close to a platform, or in open water) is less influential than the specific distance from P1,

Station	Detections (%)	Days of recording	Days with detections	Detections per day of recording	Tags recoded	Tags per 100 days of recording
P1	68,474 (65%)	1,163	825	58.9	114 (97.4%)	9.8
P2	382 (0.4%)	951	18	0.4	15 (12.8%)	1.6
P3	8,562 (8.1%)	959	357	8.9	100 (85.5%)	10.4
P4	757 (0.7%)	830	64	0.9	45 (38.5%)	5.4
P5	907 (0.9%)	961	109	0.9	71 (60.7%)	7.4
P7	2 (0%)	318	1	0	1 (0.9%)	0.3
P8	0 (0%)	318	0	0	0 (0%)	0
OW1	234 (0.2%)	145	13	1.6	22 (18.8%)	15.2
OW2	86 (0.1%)	199	12	0.4	11 (9.4%)	5.5
OW3	5,544 (5.3%)	678	301	8.2	96 (82.1%)	14.2
OW4	163 (0.2%)	301	24	0.5	22 (18.8%)	7.3
OW5	5,847 (5.5%)	938	325	6.2	109 (93.2%)	11.6
OW6	365 (0.3%)	499	34	0.7	29 (24.8%)	5.8
OW7	4,702 (4.5%)	736	245	6.4	90 (76.9%)	12.2
OW8	266 (0.3%)	199	34	1.3	12 (10.3%)	6
OW9	92 (0.1%)	234	18	0.4	8 (6.8%)	3.4
OW10	8,994 (8.5%)	548	369	16.4	79 (67.5%)	14.4
OW12	43 (0.0%)	199	9	0.2	4 (3.4%)	2
All platforms	79,084 (75%)	5,500	1,374	14.4	115 (98.3%)	2.1
All open water	26,336 (25%)	4,676	1,384	5.6	116 (99.1%)	2.5

TABLE 2. Activity metrics for all stations in the whale shark aggregation area.

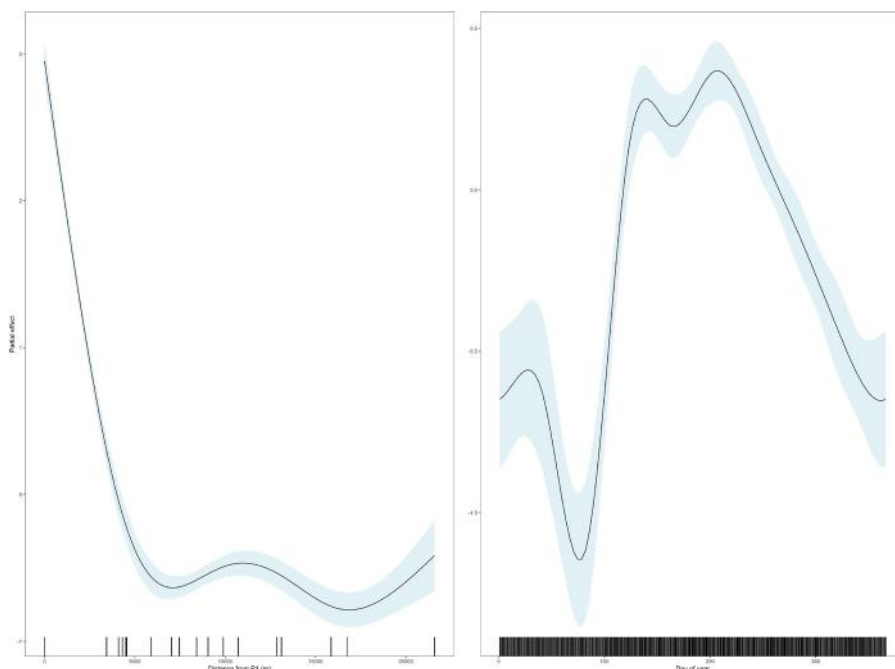


FIGURE 3. Model output from the best GAM (model 2) showing the partial effect of distance from P1 (left) and day of year (right) on the relative number of detections per day per station. The rug plot is shown in black along the x axis.

and seasonality. Raw data showed that there were more relative detections at platforms (3.7 detections per day per active tag, $n = 10,195$ station days) than in open water (1.2), but the trend was reversed when excluding detections from P1 ($n = 9,015$), with fewer relative detections at platforms (1.1).

SEASONALITY

Whale shark detections in the array were highest from May-Sep, with a peak of 28,447 detections (27% of all detections) in July. Whale sharks were detected in every month of the year; however at lower levels between Oct-Apr (8.7% of detections) than between May-Sep (91.3%; $t = 5.99$, $df = 4.46$, $p = 0.003$). Timing of tagging had little influence

on this seasonal trend, with the number of detections per active tag highest in July (265.9), although they were still relatively high in April and October (i.e. the start and end of the season), respectively (Figure 4). The number of individual tags detected in the array had a similar seasonal trend, with a maximum of 122 tags recorded in July. The highest percentage of tags detected from all active tags was in June (94%) and was $>75\%$ from April to August (Figure 4). While the overall seasonality trend was seen in all years, there was some variation among the trends for each year of the study (Supplementary Figure S2). Most detections per active tag were recorded in July 2013, 2015, and 2016, and in June 2012 and August 2014. The 2014 season extended

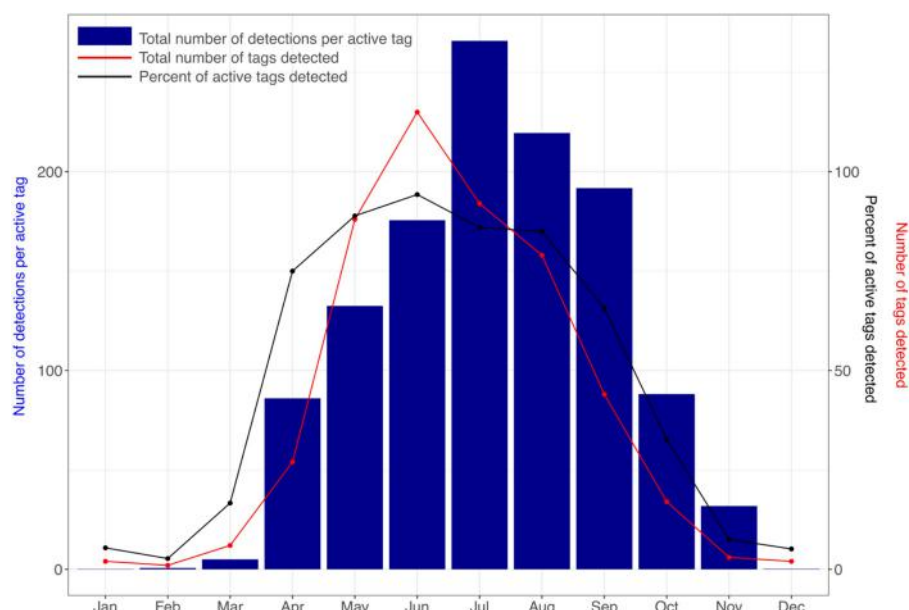


FIGURE 4. The overall number of detections per active tag (blue bars) made in the whole acoustic array by all tags combined and summed per month, with the number of tags (red) and the percentage of tags from the active tags (black) detected in the array per month.

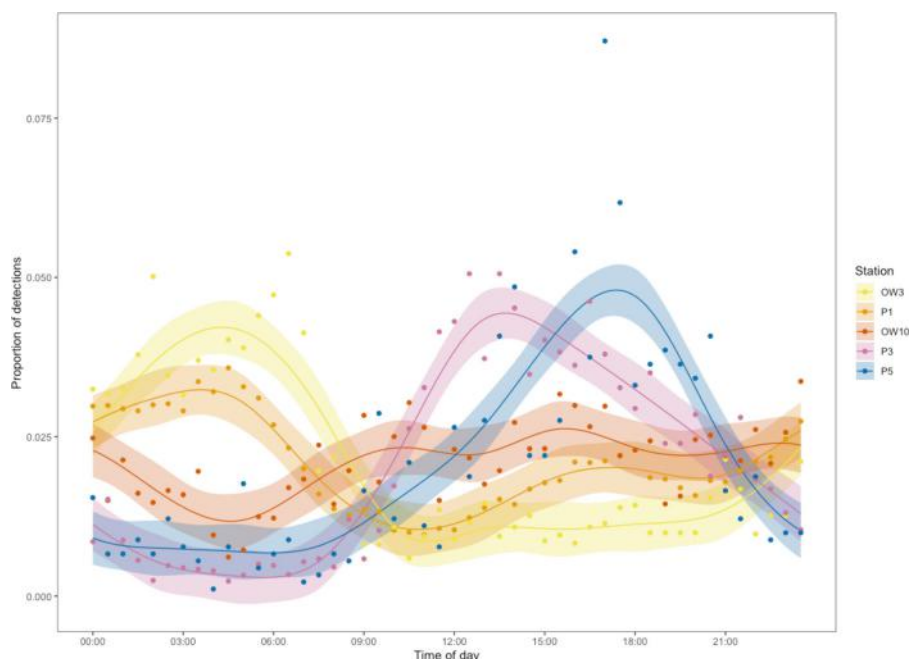


FIGURE 5. Predicted proportions of detections from a HGAM per 30-min bin for each of the five stations along the north-west to south-east transect (stations OW3, P1, OW10, P3, P5) with the standard error in the same colour. The raw 30-min binned data are also shown (dots).

longer than usual, with a relatively high number of detections per active tag in October and November (Supplementary Figure S2). Activity spaces varied between the main whale shark season (May-Sep) and the rest of the year (Oct-Apr), with a less defined space use in the latter. Within the main season there was no variation in space use among months. P1 was the centre of a small core habitat in all months from May-Sep (Supplementary Figure S3).

TEMPORAL TRENDS

Whale shark detections were made throughout the day ($n = 53,819$) and night ($n = 51,601$), with only a slight trend towards fewer detections from early morning to midday. There were some interesting spatial

differences in the temporal trends within the array. In their core habitat most detections were recorded at P1 (37%) between midnight and 6am, followed by a sharp decline to the minimum at 11:30am and a slow rise to midnight (Figure 5). Detections for five stations in a transect line from north-west to south-east (stations OW3, P1, OW10, P3 and P5) binned by 30 minutes showed that the peak of shark detections moved from north-west to south-east over the course of the day (Figure 5). Model selection (Supplementary Table S3) resulted in the S-type of the five HGAMs as the best model. The proportion of whale shark detections varied significantly with time of day in different ways across the five stations (smooth interaction term, edf

$= 27.37$, $\text{ref.df} = 44$, $F = 19.34$, $p > 0.001$). The model explained 80.6% of the deviance and 78.1% of the variance after adjusting for the number of predictors. The peaks in the proportion of whale shark detections were most pronounced for the stations at the extremities of the transect (i.e. station OW3, P3 and P5), indicating that whale sharks move the opposite way through the central stations at night (Figure 5).

Individual moves between stations were most frequent from OW10 to P1 ($n = 239$), followed by moves from OW3 to P1 ($n = 94$), OW5 to P1 ($n = 93$) and P1 to OW10 ($n = 86$; Table 3). There was again a clear pattern with the predominant north-west to south-east current direction, with sharks mostly arriving at the downstream station during the morning (P1, OW5, OW10) and the afternoon for the stations further downstream (P3, P5; Table 3). Sharks mostly swam against the predominant current during the evening and night.

CURRENTS

In the Gulf area, the currents in the upper 40m in the HYCOM model varied widely (Figure 6). This general circulation pattern was consistent with the long-term currents in this region (Thoppil and Hogan, 2009). However, within the acoustic array, the current direction was consistent during the whale shark season May-October, flowing to the southeast (Figure 6).

DISCUSSION

Whale sharks exhibited a high degree of seasonal residency to a relatively small core habitat area, adjacent to one of the platforms (P1) within the Al Shaheen field. The sharks appear to be targeting a specific spawning area for mackerel tuna located close to P1, with the tuna eggs providing a reliable and energy-dense food source. Receivers in open water near station P1 recorded more detections than other platforms in the acoustic array, highlighting that whale sharks here do not simply aggregate around structures. Individual whale sharks repeatedly returned to this spawning area each afternoon or overnight, then fed on drifting eggs at the surface between ~7am and ~12pm. Even though mean tag retention was 161 days, 27% of sharks were detected in two or more seasons, suggesting that a high proportion of whale sharks return each year; this is supported by the 41% inter-annual sighting rate of photo-identified sharks (Robinson et al., 2016) and 58% of satellite-tagged sharks that were photo-identified in subsequent years after tagging (Robinson et al., 2017) during fieldwork at Al Shaheen from 2011-14. This area is clearly an important seasonal habitat for this globally Endangered species. Al Shaheen was recently listed as an Important Shark and Ray Area (ISRA) based on the feeding criterion for whale sharks and also including other shark species (www.sharkrayareas.com/eatlas), emphasising the importance of spatial management for both whale sharks and the mackerel tuna spawning area.

Current	Direction	Moves between stations	n	% of arrivals at the last station			
				0:00-6:00	6:00-12:00	12:00-18:00	18:00-24:00
With	NW > SE	P1, OW10	86	4.7	55.8	26.7	12.8
	NW > SE	OW10, P3	36	8.3	41.7	44.4	5.6
	NW > SE	OW3, OW5	15	6.7	40	26.7	26.7
	NW > SE	P3, P5	11	0	18.2	45.5	36.4
	NW > SE	OW3, P1	94	31.9	38.3	16	13.8
Against	SE > NW	OW10, P1	239	41.8	3.4	17.6	37.2
	SE > NW	P1, OW3	61	55.7	11.5	11.5	21.3
	SE > NW	P3, OW10	39	28.2	2.6	17.9	51.3
	SE > NW	P3, OW10, P1	39	53.8	2.6	7.7	35.9
	SE > NW	P3, P1	26	69.2	7.7	3.6	19.2
	SE > NW	OW5, OW3	17	47.1		17.7	35.3

Only moves with at least 10 observations were considered, and four moves not in line with the predominant current were also excluded from the table. Highlighted in green are the time periods with the most whale sharks arriving at the last station.

TABLE 3. The number of occurrences of moves between stations within a 3h window (n), and the relative frequency of first detection times at the last station binned into night, morning, afternoon, and evening.

RESIDENCY

Whale sharks had high residency to this small site in the Gulf, with a combined $R_{\max}$ of 0.31. This residency index means that whale sharks were detected on 31% of possible days; high, considering that this is a highly mobile species that routinely swims 1,000s of km away from aggregation sites (Hearn et al., 2022). While $R_{\max}$ can overestimate residency for sharks that were only detected within a single season, it was still high (0.21) for the 32 sharks that were detected in multiple seasons. The aggregation site off Qatar is thus clearly an important interannual habitat for whale sharks in the region. Elsewhere, acoustic telemetry estimated a shorter combined $R_{\max}$ of 0.11 off St Helena (Perry et al., 2020) and 0.16 off Ningaloo Reef (Norman et al., 2017a). The constellations in Qatar and St Helena both comprise a high proportion of large, mature sharks, but St Helena sharks appear to be less resident, perhaps because feeding opportunities are rare there (Perry et al., 2020). Whale sharks in the Red Sea constellation were often feeding and had a similar $R_{\max}$ to those in Qatar (0.26; Cochran et al., 2019), which suggests that residency is higher when feeding is the main driver of the aggregation. This is further supported by the passive acoustic study from Mafia Island in Tanzania, where whale sharks feed in high-density plankton patches, which found an even higher $R_{\max}$ of 0.39 (Rohner et al., 2020, 2015). Whale sharks off Isla Contoy in Mexico aggregate in large numbers to surface-feed on little tunny (*Euthynnus alletteratus*) eggs (de la Parra Venegas et al., 2011) in a similar manner to sharks at Al Shaheen, with tuna egg biomass at Al Shaheen sometimes even higher than the former (Robinson et al., 2013). The potential daily caloric intake of sharks at Isla Contoy is estimated to greatly

exceed that needed for basal metabolic rate (Tyminski et al., 2015; Wyatt et al., 2019), or indeed the mean ration for whale sharks in aquaria (Dove et al., 2021), indicating that the tuna spawning event in Al Shaheen is a rich feeding opportunity for months at a time. The high residency and whale shark space use infers that this fish spawning event takes place on an almost daily basis throughout the May-September season in a predictable daily cycle, likely making Al Shaheen one of the most productive whale shark feeding sites on the planet. This is reflected by the high residency we observed, with half of all sharks having consecutive daily detections for at least two weeks, and 12 individuals (10.3%) having consecutive daily detections for over a month. However, there were also days during the main season with few whale sharks detected, when most were outside of the array. Some of them may have moved ~120km to a nearby location in Saudi Arabia where a secondary whale shark hotspot was identified in a satellite tagging study, with sharks also frequenting that site during the same months as in Al Shaheen (Robinson et al., 2017). To better understand why whale sharks leave the area during the season, it will be important to assess fish egg density in the area over time, as it is possible that tuna spawning fluctuates over the season. It is likely that this whale shark aggregation is almost entirely driven by the mackerel tuna spawning events (Robinson et al., 2016) so, if the mackerel tuna were to stop spawning at this location in the future, for whatever reason, that whale sharks will presumably stop aggregating in Al Shaheen.

SEXUAL AND SIZE-BASED SEGREGATION

Like many whale shark aggregations (Rohner et al., 2022), Al Shaheen is biased (~69%) toward male sharks (Prebble et al., 2018;

Robinson et al., 2016). We tried to tag a more equal mix of male to female sharks in this study – 57% of the known-sex sharks were males – to facilitate a comparison of behaviour between the sexes. Females (combined $R_{\max}$ = 0.31) had a similar residency level to males (0.27). Although male sharks have a larger mean TL (7.25m) than females (6.44m) at Al Shaheen (Robinson et al., 2016), this did not appear to influence the results observed in the present study. One of the hypotheses put forward for sexual segregation in whale sharks is a desire for females to avoid male harassment, in the form of undesired courtship or mating attempts (Rohner et al., 2022). We did not record such behaviour during our field work, which focused on feeding aggregations during the morning, but it is possible that this may occur at other times of the day when the sharks are not feeding at the surface. It is plausible that the benefits of the rich food source outweigh any drawbacks for the female sharks that do choose to frequent the site.

SPACE USE

Satellite tracking showed that the Al Shaheen area is the hotspot of whale shark activity within the Gulf (Robinson et al., 2017). Here, we expand on this by identifying the small core habitat within this area, located around station P1. This station recorded by far the most detections (65%) and almost all of the tagged sharks (97%). The location of the activity hotspot was stable, both within the season and across years. As whale sharks aggregate at Al Shaheen to feed on fish eggs (Robinson et al., 2013), this indicates that the mackerel tuna consistently spawn in the same area. It is possible that the platform structure at P1 acts as a fish aggregating device (FAD) (Robinson et al., 2013). However, the exact location and extent of the mackerel tuna spawning ground

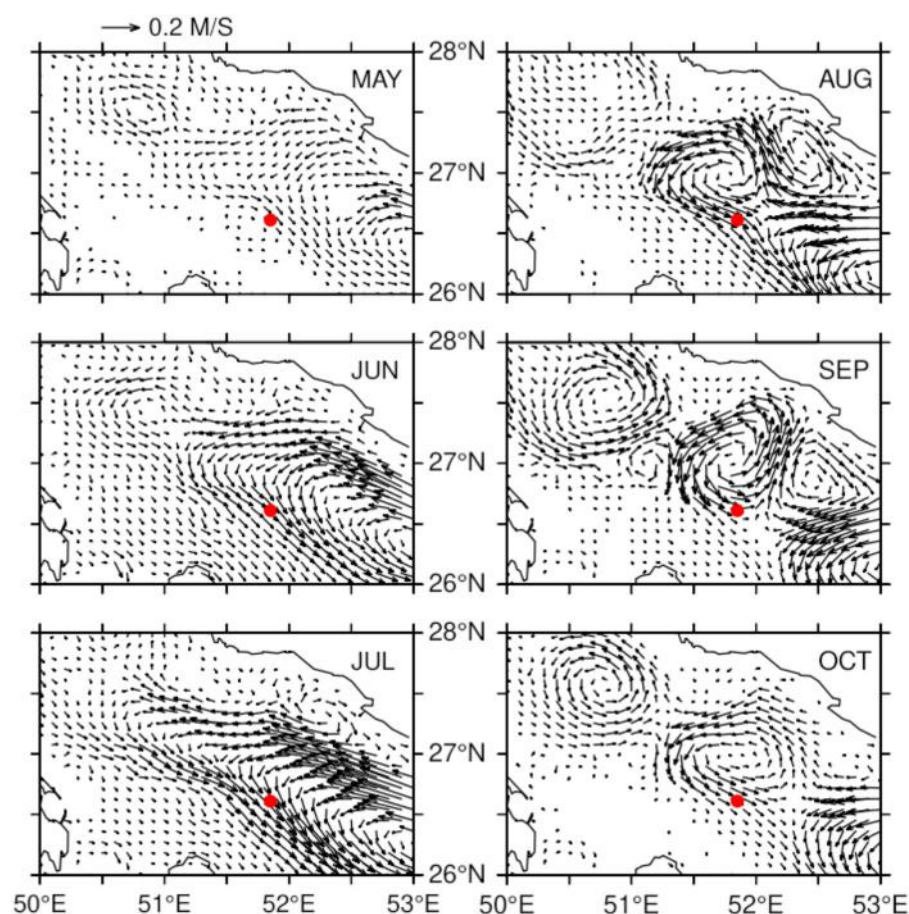


FIGURE 6. Monthly mean currents averaged in the upper 40m calculated during 2012-2016 from a 1km regional Hybrid Coordinate Ocean Model (HYCOM; Thoppil and Hogan, 2010a). The red circle indicates the location of the acoustic array.

is yet to be established. Our results indicate that it is near platform P1, where most whale sharks were detected, or slightly north-west (upcurrent) of it. The indirect protection of tuna around Al Shaheen, due to no fishing being allowed in this sensitive zone for several decades, likely plays a part in the large spawning aggregation, as evidenced by the high density of fish eggs (Robinson et al., 2013). There are also distinct hydrological characteristics in the area that could help explain the general area of the spawning ground. Hydrographic fronts in the area are formed by mesoscale cyclonic eddies carrying Indian Ocean water along the Iranian coast (Thoppil and Hogan, 2010a). At the same time, water from the northern part of the Gulf is transported along the Saudi Arabian coast to the northern tip of Qatar (Thoppil and Hogan, 2010a). It is possible that these currents are mixing in the Al Shaheen area, resulting in increased productivity and food availability for the spawning mackerel tuna.

Links between biophysical drivers of high prey densities and whale shark space use have also been identified elsewhere. At Ningaloo Reef in Australia, the whale shark core area was similar in size to the one observed in Al Shaheen and directly adjacent to a large reef passage where oceanographic frontal zones and a mesoscale eddy enhanced prey density and aggregation (D'Antonio et al., 2024). Similarly, whale sharks predictably aggregate in a small area to feed

on fish eggs off Isla Mujeres in Mexico, with the spawning ground located in an area dominated by the Loop Current (de la Parra Venegas et al., 2011). This current flows through the Yucatan Channel and creates a hydrographic front where warm water from the Caribbean Sea meets nutrient-rich water from the Gulf of Mexico, creating mesoscale eddies that influence larval fish distribution (Lindo-Atichati et al., 2012). Understanding why the spawning ground in Al Shaheen is restricted to a relatively small area, and ensuring the protection of the tuna from potential fisheries exploitation, will be important to help the tuna stock in the Gulf and protect this important feeding area for whale sharks. Even though the exact spawning area has not been delimited at this stage, the small extent of this area means that spatial management could proceed with the information available now.

ASSOCIATION WITH PLATFORMS

Whale sharks were detected on receivers at oil and gas platforms, and on receivers in open water: Station P1, located at a two-platform structure connected by a gangway, was the centre of the relatively small whale shark core habitat and had by far the most detections. Open water station OW10, ~4km southeast of P1, registered the second-most detections and was on the edge of the core habitat. OW stations 3, 5, and 7 were also located within 4km of P1 but recorded fewer detections

than P1 and OW10. The only platform with significant numbers of detections other than P1 was P3, located downstream and southeast of P1 and OW10. This underlines the importance of the currents that influence the drifting fish eggs on which the sharks feed here (Robinson et al., 2013). Although platforms can provide habitat for a variety of species, they do not appear to be a particular attraction for whale sharks in this area. The best GAM was model 1 which included distance from P1, day of year, and station type as predictors. The inclusion of station type is likely to be driven by the importance of P1, as the presumed tuna spawning area is adjacent to this platform. The high proportion of detections at P1 meant our models could not definitively disentangle platform presence from whale shark activity. However, the GAMs also showed that the best model (#1) and second-best model (#2), that excluded station type, explained the same percentage of the deviance (25.1% and 25%, respectively), indicating that station type (platform-associated or in open water) was less influential than distance from P1 and seasonality. Feeding as the main driver of whale shark presence and movement within this aggregation area is further supported by previous surveys that observed whale sharks to be feeding on fish eggs whenever aggregations are encountered (Robinson et al., 2013), and by our daily observations during field work for this study. The feeding opportunity in turn may be influenced by platforms. However, in the wider Gulf area, there are more than 800 platforms (Sheppard et al., 2010) and we are not aware of any others at which whale sharks are regularly seen, let alone to aggregate and feed near as frequently as they do around P1 in Al Shaheen. A second likely whale shark aggregation in the Gulf is ~120km to the north-west of the Al Shaheen oil field, close to the reef plateau of the Rennie Shoals in Saudi Arabia waters (Robinson et al., 2017). Here, the nearest platform is at the Abu Sa'afa field, ~10km distant.

While it is established that whale sharks aggregate at Al Shaheen to feed on fish eggs (Robinson et al., 2013), it remains unclear whether the spawning tuna aggregate here only since the platforms were constructed, or have done so before artificial structures were built. Other studies suggested that it is unlikely for tuna to alter their spawning locations in response to structures being built, but this was based partly on the assumption of their short-term association with structures (Snodgrass et al., 2020). By contrast, tuna spawn for several months at Al Shaheen. The relatively shallow bathymetry of the Gulf may not provide other typical aggregation areas for tuna, such as seamounts (Holland et al., 1999), which could further increase the importance of these human-made structures for tuna spawning here. It is thus possible that platform P1 acts like a fish aggregating device (FAD) for the tuna, which then spawn there, but it is unclear why the one platform stands out among the many

others. A more detailed analysis of the ecology and spawning behaviour of mackerel tuna at Al Shaheen is needed to better understand their relationship with structures and their influence on whale sharks. Additionally, examining how currents interact with platforms, particularly with PI in our array, and potentially influence fish egg entrainment and retention, could be a future research topic.

SEASONALITY

The results from this passive acoustic telemetry study confirm the seasonality observed for this aggregation through visual surveys and with satellite tags (Robinson et al., 2013, 2017). The main whale shark season at Al Shaheen is from May–September, with additional high activity in April and October in some individual years. During November–March, few whale sharks were detected. As such, passive acoustic telemetry confirmed the pattern seen with other methods; that this aggregation is distinctly seasonal. A similar result was seen for whale sharks at Shib Habil in the Red Sea (Cochran et al., 2019). It is plausible that, in general, whale shark aggregations driven by fish spawning are seasonal, as fish spawning is also seasonal, for example during Apr–Sep for mackerel tuna in southwestern India (Rao, 1964), particularly if no other whale shark prey are available near these locations during other times of the year. The start and duration of fish spawning may be influenced by biophysical variables, leading to years with high detections earlier or later than the main whale shark season. A better understanding of the drivers of mackerel tuna spawning at Al Shaheen will benefit the understanding of whale shark ecology at this site.

TEMPORAL TRENDS

Visual observations showed that whale sharks are feeding at the surface from ~7am to ~12pm (Robinson et al., 2013), suggesting that they may leave the Al Shaheen area until the next morning. Satellite tags also showed that they stay shallower in the morning and swim deeper during the rest of the day and night when they are at Al Shaheen, indicating that they only surface-feed during the morning (Robinson et al., 2017). Here, we found no difference in detections between the day and night, clarifying that the sharks do stay within the area covered by the acoustic stations.

We also found that the peak in relative detections moved with the predominant current over the course of the day, starting in the north-west (stations OW3, P1) during the night and early morning and ending in the south-east in the afternoon (P3, P5), before the sharks swam against the current back towards the start point. Detections increased again at OW3 and P1 from late afternoon and over the night, indicating that whale sharks return to the location in anticipation of the spawning. Movements, defined as being detected at a subsequent station within 3h of first being detected at a station, were largely

with the current during the day between 6am–6pm and against the current during the night. The HYCOM current model showed that the flow was south-easterly throughout the whale shark season months in the years of our study 2012–2016.

Due to the high sea surface water temperatures at Al Shaheen (26–35°C) during the whale shark season, the eggs likely develop and hatch quickly. Using the equation in Pauly and Pullin (1988) and an egg diameter of 0.88mm (D. Robinson unpubl. data), mackerel tuna eggs are estimated to hatch within 0.55–0.89 days (13.2–21.4h) during the whale shark season. Our assumed scenario is that (1) mackerel tuna spawn in the late hours of the night and early morning, (2) the whale sharks begin feeding on the fish eggs as they float to the surface in the early morning, (3) the sharks move with the floating eggs at the surface towards the south-east during the morning and early afternoon, and then (4) the sharks cool off at depth during the night (see Robinson et al. (2017) for vertical movement data), and return to the north-west of Al Shaheen, near P1, in anticipation of the next spawning event. As passive acoustic telemetry only records presence/absence near receiver stations, other methods, such as deployment of behavioural tags, would be useful to test this hypothesis.

NOTES ON MANAGEMENT

Whale sharks are Endangered, having suffered severe population decline over the past three generations. They face a variety of potential threats in the Gulf region (Reynolds et al., 2022), likely making this one of the more at-risk populations for the species (Pierce et al., 2021). Off Oman, whale sharks are still taken by fishers (D. Robinson unpubl. data), and the whole area – particularly the Strait of Hormuz – has intense shipping traffic which could severely impact the sharks in this region (Womersley et al., 2022). Shipping has been identified as a potentially major threat to whale sharks with high cryptic mortality rates (Womersley et al., 2022, 2024). Al Shaheen was one of the global aggregation sites with the highest overlap of ship traffic, highlighting that the core aggregation area here requires urgent management to minimise threats from ship strike (Womersley et al., 2024). The specific small-scale movement data presented here provide an opportunity for careful spatial management of vessel movements in the Al Shaheen field through the whale shark season. Additionally, it is likely that mackerel tuna spawning is the main driver of this whale shark aggregation (Robinson et al., 2016). Protecting the spawning aggregation and managing this spawning stock is essential to ensure the whale shark aggregation into the future.

ORIGINAL SOURCE:

<https://www.frontiersin.org/journals/marine-science/articles/10.3389/fmars.2025.1568607/full#supplementary-material>





PLANNING FOR THE UNKNOWN: RISK MANAGEMENT IN TECHNICAL DIVING

WORDS BY **HASSAN NK KHAYAL**

The goal of technical diving is not just to push the limits of human exploration, but to do so with a mindset that prioritises safety at all times. The risks are real, but with proper training, thorough planning, and constant vigilance, technical divers can minimise those risks and dive with confidence.







Technical diving is an exhilarating yet complex discipline. It pushes divers into environments where the risks are higher, and the conditions more challenging. Whether exploring deep wrecks, navigating intricate cave systems, or undertaking long-duration decompression dives, technical divers must be prepared for the unexpected.

Unlike recreational diving, where the risks are very often predictable and manageable, technical diving involves more variables. It requires advanced training, specialised equipment, and, most importantly, a solid risk management plan.

As a non-diving preface, it is important to delve further into some concepts in the science of risk management. Inherent risk is the risk that naturally exists in a situation before any precautions or measures are taken. It's the danger or hazard that's part of the activity itself. Control systems are the measures, or tools that you put in place to reduce or manage risks. It's the "safety net" that helps prevent problems or reduce their impact. Residual risk is the risk that remains after you've taken steps to reduce or control the inherent risk. Even with safety measures, some level of risk still exists. So even if a certain activity has high inherent risk, with an adequate system of controls, the residual risk can be greatly reduced.

With those definitions in mind, technical diving is an activity that has a high level of inherent risk and without adequate controls, the undertaking is extremely risky. All the factors that go into technical diving, such as equipment, training, and the many other things discussed below, are all control systems in order to reduce the rate of residual risk to acceptable levels.

Before discussing risk management strategies, it is essential to understand what makes technical diving inherently riskier, or as defined above, what are the inherent risks of technical diving. Some of the key risks include decompression illness (DCI), as technical divers often spend longer times at depth and use mixed gases, increasing the risk of nitrogen or oxygen toxicity. In addition, gas management failures are a higher risk in technical diving than in recreational diving, as divers must manage multiple tanks with different gas mixtures which increases the complexity of dive planning and the potential for mistakes. Moreover, equipment failure becomes a more significant risk in technical diving than in recreational diving with the increased complexity of technical gear such as rebreathers, dive computers, and gas switches malfunctioning. The basic laws of probability tells us that the more equipment we have, the higher the likelihood one of them will choose to fail, as well as the higher the likelihood we will make mistakes as we need to learn about and manage more things all at once. In addition, it is an unfortunate fact, but technical diving equipment is expensive, so some people might decide to try to get as good of a deal as possible, which increases the likelihood of accidents. As I like to often say, every percentage of savings usually correlates to a percentage of risk when it comes to technical diving. Of course, we also have the environmental hazards that come with the areas in which we do technical diving, such as cave systems and wrecks, which can present physical hazards such as entanglement, strong currents, or disorientation. Conditions with poor visibility or zero-visibility can make navigation challenging, particularly in confined spaces. Finally, psychological stress as the mental pressure of managing multiple dive variables, staying within time limits, and maintaining clear

communication with dive buddies can result in mental fatigue or panic, especially in stressful environments, and inversely, the reverse psychological pressure of overconfidence can also lead to many problems in technical diving.

In technical diving, the difference between a successful dive and a catastrophic one often lies in the planning. Risk management starts before you even get in the water. A detailed dive plan considers all potential risks and provides strategies for mitigating them. All these factors come together to form our control systems.

First and foremost, to build a robust risk management plan, there must be a pre-dive briefing and a thorough planning process. A comprehensive pre-dive briefing is essential for identifying risks and setting expectations for the dive. The briefing should cover the dive profile as you plan the maximum depth, bottom time, gas mixes, and decompression schedules. You should know exactly what the dive will entail and what to do in case of any emergency or deviation. Moreover, the briefing should include buddy roles and responsibilities including clear roles which should be assigned to each team member, including who oversees gas management, navigation, and emergency procedures. In addition, communication signals should be established as to what specific signals to be used underwater for gas switching, navigation, and emergency situations. These should be well understood by the team before the dive. Of course, we must not forget to plan for contingency plans in case we need to respond to, "what is the plan if things go wrong?" Have backup options for each critical element: gas shortages, equipment malfunctions, diver separation, or changes in the dive profile. Finally, time management should be agreed



upon to ensure that each dive has time limits for both bottom time and ascent times, with strict adherence to decompression stops. So, while just showing up to dive and skipping your pre-dive safety checks might be a common practice (that should be abolished) in recreational diving, it is definitely not an option for technical diving.

Second is gas management, which is the cornerstone of safety. The most critical factor during a technical dive is to know how much gas we have. In technical diving, gas management is vital. With the use of multiple gas mixtures, divers need to plan out exactly how and when to switch gases. You manage your gas by ensuring to undertake a gas analysis and making sure to always analyse the gases before the dive to ensure you are diving with the correct mix. In addition, make sure you observe gas switching protocols and clearly plan your gas switches during the dive and ensure each diver knows their role in gas management. Divers should maintain awareness of gas levels at all times. Moreover, redundancy is key. Never rely on a single gas source. Always have a backup gas (such as an additional stage tank) and a contingency plan for when that runs low or becomes unavailable. Finally, safety margins. Ensure that divers have extra gas reserves for an emergency, including a "return to surface" gas plan in case of early ascent or lost gas supplies.

Third are contingency plans and emergency procedures. Things can, and eventually always do, go wrong on technical dives. Having a strong contingency plan ensures that everyone in the team is prepared for the unexpected. A solid contingency plan includes emergency gas supplies, so make sure to know where to get your backup gas. Always have a backup plan in case your primary source fails. Also,

decompression emergencies are all but too common, so if, or more aptly, when a diver runs into problems during an ascent, such as failing to achieve decompression stops, having a clear plan for rapid ascents to a shallower depth, or managing shallow-water decompression can save lives. Funnily enough, a lost diver situation is more scary on a technical dive despite the increased experience level, and thus requires a much more elaborate protocol. Establish a system to manage situations where a diver is lost or separated from the team. This involves a decision to either continue the dive, or abort and search for the lost diver. Finally, an exit strategy is paramount. In cave diving or wreck diving, always have a defined exit strategy in case of emergencies. Knowing how to reverse your course or evacuate from a confined space could be life-saving.

Fourth is monitoring and communication during the dive, or more simply put, situational awareness. Once the dive begins, constant monitoring and communication with dive partners are critical to ensure everyone's safety. A few essential practices include regular gas checks by continuously monitoring gas supplies and checking that all divers are following the pre-agreed gas management plan. Maintaining the buddy system more closely is vital for everyone's safety. Keep track of each other's locations and air consumption throughout the dive, and have regular visual checks to confirm that everyone is safe and following the plan. Flexibility is a must so remember that while real-time adjustments are a part of life, nothing can be perfectly planned, they need to be decided upon and executed as a team. If the dive plan needs to be adjusted, due to equipment failure, weather conditions, or time constraints, ensure that the entire team is informed and agrees on the new approach. Finally, and it might sound very

basic but depth and time monitoring are more important than ever. Make sure everyone sticks to the dive profile and does not exceed depth or time limits. Dive computers can help, but the buddy system is the best way to prevent errors.

The final part of risk management does not end when the dive ends, or depending on the way your brain works, you might say that it starts as soon as the dive ends, and it is the post-dive evaluation and lessons learned from every dive that matters most. After the dive, it is critical to perform a debrief with your team. Discuss what went well, what did not, and any lessons learned. Even if the dive went as planned, there is always room for improvement. This post-dive analysis can help refine future risk management strategies and ensure that everyone on the team is continually improving their technical diving skills.

In technical diving, the best way to manage the unknown is through preparation and flexibility. While not everything can be planned for, careful risk management can mitigate many of the dangers and prepare you for a variety of potential scenarios.

The goal of technical diving is not just to push the limits of human exploration, but to do so with a mindset that prioritises safety at all times. The risks are real, but with proper training, thorough planning, and constant vigilance, technical divers can minimise those risks and dive with confidence.

Remember: The unknown is what makes technical diving so exciting, but with careful preparation, it is possible to explore those depths safely and return home to dive another day, making the residual risk levels within the acceptable and manageable ranges.

BEYOND BORDERS:

THE UNBELIEVABLE 267-YEAR ODYSSEY OF THE *HYDATINA PHYDIS* AROUND THE WORLD

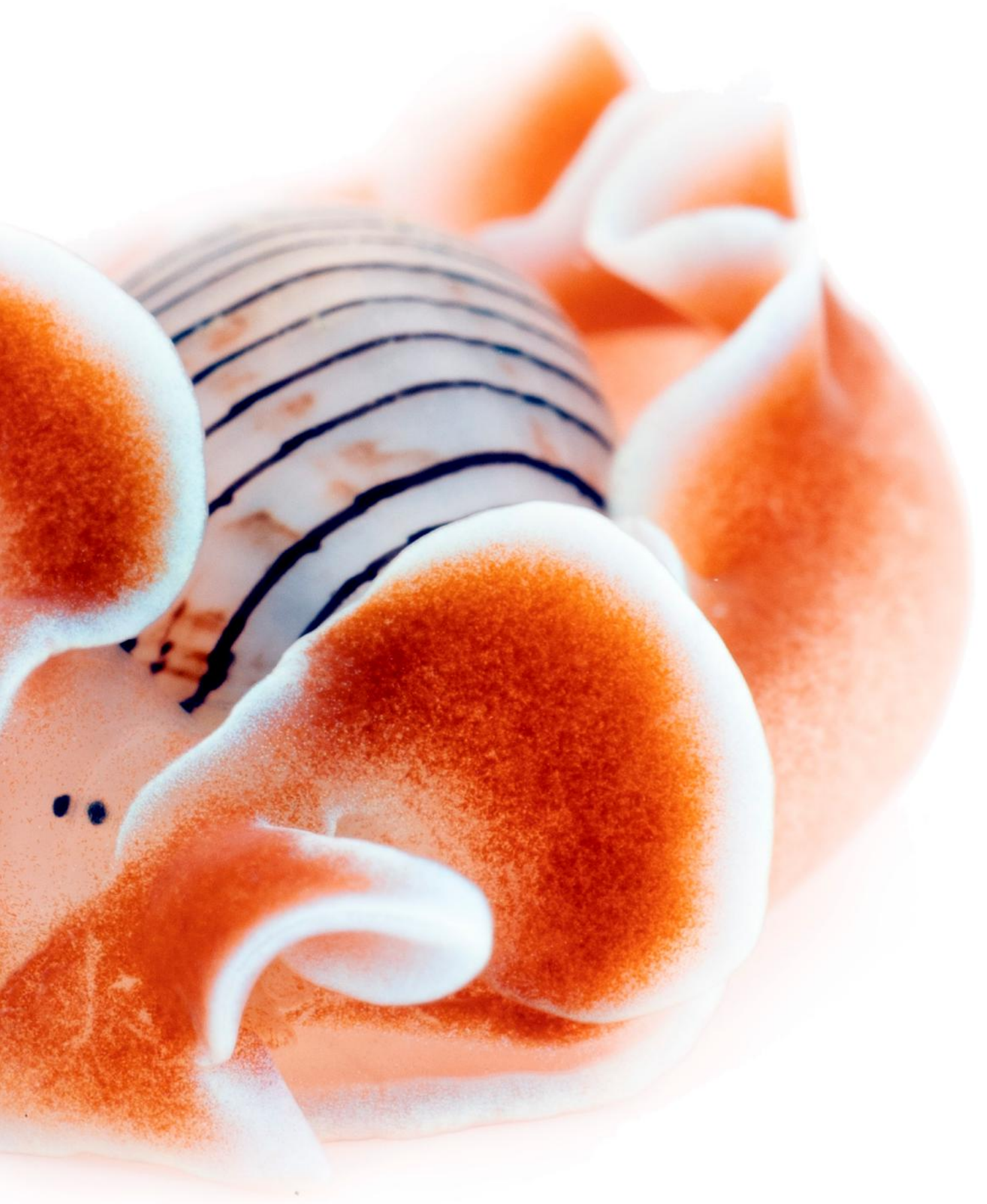
WORDS BY **ARWA MOHAMMED**

PHOTOS BY **ARWA MOHAMMED, KAITO KASAYA AND LINDA IANNIELLO**

The journey of the *Hydatina physis* is nothing short of incredible. First recorded in 1758 in Sweden, fast forward 267 years, and it has appeared again – this time in the Emirate of Fujairah, UAE, on the 1st of June 2025.

Cover photo by Kaito Kasaya







TOP & OPPOSITE PAGE PHOTOS: Arwa Mohammed Badri. **ROW BELOW:** Linda Ianniello.

The first time I encounter a new marine creature is always special. It sparks a sense of curiosity that drives hours of research, reading, and discovery. I find myself wondering when and where else in the world has this creature been seen? The elegant and mysterious *Hydatina physis* is no exception. Its shape made me question whether it's a sea snail or a sea slug.

To answer that, let's recall the key difference: a sea snail has an external shell, often coiled or conical, used for protection, and moves with a muscular foot. A sea slug, by contrast, has no shell (or a highly reduced internal one), exposing its soft, often colourful or camouflaged body – just like nudibranchs. The *Hydatina physis* is, in fact, a sea snail, as it possesses a prominent external shell.

The journey of the *Hydatina physis* is nothing short of incredible. First recorded in 1758 in Sweden, fast forward 267 years, and it has appeared again – this time in the Emirate

of Fujairah, UAE, on the 1st of June 2025. The thought that such a delicate species has survived and travelled across oceans for centuries truly shocks me.

Scientifically known as *Bulla physis* Linnaeus, this sea snail – also called the bubble snail – was first described by Carl Linnaeus in 1758. It belongs to the genus *Bulla*, recognised by its inflated, bubble-like shell: thin, lightweight, and often adorned with wavy brown or black lines. According to the World Register of Marine Species (WoRMS), the currently accepted name is *Hydatina physis*.

This is the story of one special sea snail, a Japanese scientist, and two underwater photographers from around the world. When I found my first *Hydatina* in Fujairah, it measured just 3cm, and I was surprised to learn it can grow up to 5cm in length. This sparked a journey in research that led me to a wonderful connection with scientist Kaito

Kasaya – a researcher in Japan, underwater photographer, and author of four remarkable books showcasing the beauty of Japan's macro world. His works include *Hermit Crab Exploration Guide*, *Baby of the Sea*, *Hermit Crab Gravure*, and *Marine Life Observatory* – each capturing the hidden lives of small marine creatures and making their wonders accessible to both researchers and ocean lovers.

Kaito, a graduate from Tokyo University of Marine Science and Technology, currently conducts research on the aquaculture of marine invertebrates. In a beautiful coincidence, we had both spotted the same species – but in different countries. Kaito encountered his *Hydatina* on a rocky reef in Wakayama, Japan, at a depth of 2 metres. He explained they can often be seen between spring and summer, feeding on *Cirriiformia tentaculata*, a type of polychaete worm.

As part of my research journey, I came across



The Sea Slug Forum, a site where you can ask questions and post information on sea slugs, including nudibranchs, bubble-shells, sea hares, and side-gilled slugs. There, I connected with a very passionate underwater photographer and co-author of a unique book, Linda Ianniello. She has been diving and documenting marine creatures for 30 years. She explained to me how "fascinating it is to find and photograph the animals that migrate vertically from the deep every night to feed." She has travelled around the world to document marine macro creatures, among them *Hydatina physis*, which she photographed in Indonesia, the Philippines, and Florida. Linda's book, *Blackwater Creatures: A Guide to Southeast Florida Blackwater Diving*, co-authored with Susan Mears (another amazing underwater photographer specialising in blackwater photography), not only captures beautiful underwater images but also includes identification information.

This shared discovery reminded me of the

power and importance of being a citizen scientist. When underwater photographers go the extra step to document and log their findings, identifying them and including clear photos, they become verifiable and valuable data. Scientists, conservationists, and policymakers rely on this data to track species distribution, monitor behaviour and breeding seasons, and understand climate change impacts. In some rare cases, it might even lead to the discovery of new or rare species. Most importantly, your contribution may be cited in real scientific research – your name credited in the global biodiversity record.

Making a guidebook will require a lot of time and dives, so I encourage every diver and underwater photographer to contribute and log their findings in iNaturalist at <https://www.inaturalist.org>. It's easy to use – just upload a photo with the date, location, and species name. Once your observation is verified as "Research Grade," it is automatically shared

with The Global Biodiversity Information Facility (GBIF). The GBIF is a worldwide scientific network supported by international governments, dedicated to making biodiversity data openly accessible. Your image could travel from your camera roll to a global database – helping shape scientific understanding and support future marine conservation.

Don't just be a photographer – be a sea ambassador and a bridge between scientists and the ocean.

ARWA MOHAMMED

 www.instagram.com/xphotodxb

KAITO KASAYA

 www.instagram.com/denka_hermit

LINDA IANNIELLO

 www.lindaiphotography.com



ROMBLON THE PHILIPPINES

WORDS AND PHOTOGRAPHY BY **GORDON T. SMITH**

Having visited Anilao and Puerto Galera several times in the past and looking for something new in the Philippines, I had discussed this destination with my regular SE Asian dive buddy Jen, and we both agreed that it met our criteria for a new macro destination, specifically to see and photograph two different species of nudibranchs, *Melibe colemani* and *Cyerce nigra*.

Mushroom Coral Pipefish (*Siokunichthys nigrolineatus*)



Melibe colemani



Following an article by Fakhruddin Dabhoiwala in this very magazine back in 2023, Romblon suddenly came up on my radar as a new hotspot in the Philippines for nudibranchs.

Having visited Anilao and Puerto Galera several times in the past and looking for something new in the Philippines, I had discussed this destination with my regular SE Asian dive buddy Jen, and we both agreed that it met our criteria for a new macro destination, specifically to see and photograph two different species of nudibranchs, *Melibe colemani* and *Cyerce nigra*.

GETTING THERE

Romblon is situated south east of Luzon, and about as central to the Philippines as you can get. However, our main concern was basically travel time considering it was not close to a major airport. The nearest airport is on another island, Tablas, but requires further transport by boat to Romblon, and the flights did not seem reliable enough to look at this option.

At the time of booking the trip in November 2024, we booked the last two rooms at 3P

Dive Resort, and flights to Tablas had been discontinued due to issues with the airline servicing this area.

The only other route available is by ferry, operated by a company called Starlite from Batangas which takes approximately nine to ten hours depending on the weather, to reach Romblon. With the addition of another friend, we booked a three berth VIP cabin to accommodate myself and my two buddies Jen and Arianne, giving us some comfort for the journey to and from Batangas, as well as our own private bathroom.

Jen and I had flown into Manila after ADEX in Singapore on the Sunday night, and we stayed in Manila overnight. We met up with Arianne on Monday afternoon at Batangas as she had been diving at Anilao prior to this part of the trip.

We had a bit of anxiety in Manila as our driver was over an hour late picking us up at our hotel, but we arrived at Batangas by 3pm. We already had ferry tickets, but there's a few other payments required such as port fees, porter fees etc. Pre-boarding procedures include all bags being x-rayed prior to loading onto the ferry.

We bought some snacks at the port terminal for the trip as well as other stuff for our surface intervals. Our VIP room also came with a meal on the ferry, so that wasn't too bad. On the return trip, we had an evening meal and breakfast.

The ferry left Batangas at 4pm and arrived at Romblon around 2am the following morning. From there, it was heading off to another destination, so there were disembarking passengers as well as embarking passengers – plus it was dark, and making sure our bags from the baggage area were retrieved without leaving one behind was slightly chaotic as they were buried under other bags.

A tip here would be to have some bright coloured tags on your bags for easy identification and retrieval by the porters.

Once we were off the boat and all bags accounted for, we were met by 3P's transport guy, Oscar. He organised our travel to the resort (along with five other passengers from Thailand) on trikes – basically a small motorcycle with sidecar that is common in Filipino provinces. The three of us with dive

Cyerce nigra

and camera gear were on two trikes.

The journey to 3P took about 20 minutes in the dark, and I had a rear facing seat holding on to my case containing my camera housing and strobes, gripping part of the trike structure to ensure I was not going to fall off. When we arrived at 3P I was exhausted.

All three of us crashed out in one room until the following morning. We had breakfast, assembled our camera housings etc, as well as prepare our dive gear to be taken to the dive boat/bangka.

During breakfast, we were greeted by David, who was in charge of the accommodation and kitchen. He inquired about any food allergies, likes and dislikes we had, to enable his staff to manage our meals during our 10-day stay. To his and the kitchen staff's credit, the three of us agreed that the food here was the best we have ever experienced at a Filipino Dive Resort. However, what would have been nice would have been some snacks on the boat for the morning surface interval. Only water was provided. Fortunately, we had brought some snacks with us for this purpose but we soon

used them up after sharing with the boat crew and dive guides.

When we came back from the second dive each day, a three-course lunch was devoured without thinking about it. The food was fabulous, and after two long dives we were hungry. Dinner in the evenings was also a three-course meal, generally at 7pm but delayed whenever anyone of us was doing a night dive until 8pm. The meals were served at your allocated table. Only breakfast was buffet style, and you could order eggs in whatever style you desired.

The rooms were reasonable with working space for two cameras and an extension cord for charging batteries. Both Jen and I had brought our own though to accommodate our various chargers. However, there is no dedicated camera room such as found in certain resorts in Anilao.

One point I need to make, was the constant issue of "no water" for showering in the room, as well as at the gear rinsing area. The shower at the gear rinsing area barely gave out any water at all, and in our room we had to deal

with no water at least three times a day during our entire stay.

THE DIVING

Diving is from a bangka, a typical Filipino boat with outriggers, with a crew of two. Both of the guys on our boat were excellent, and managed everything perfectly once they established how our gear was set up. Generally, all the gear is left on the boat overnight, but we opted to take our regulators off after our last dives each day for rinsing etc, and obviously, our camera gear too.

You back-roll to get off the boat, but getting back on again we had two choices. De-kit in the water and hand up the tank/BCD and fins, or hand up the fins and climb aboard a short wooden ladder with the tank on our backs. Again, the boat crew were always helpful managing us and the camera gear.

My main focus on this trip was as previously mentioned, to see and photograph the *Melibe colemani*, the "Ghost Nudi", as well as a particular *Cyerce nudibranch*, the *Cyerce nigra*. On our very first dive, late morning on our first day, the first nudi we were shown was

Cuttlefish



L-R: *Phyllodesmium* sp.; *Nembrotha kubaryana*; *Phyllodesmium koehleri*; *Stiliger* sp.; *Tenellia puti*; and *Phyllodesmium* sp3.

the *Melibe colemani*... BIG SMILEY FACE. It's difficult to describe how I felt seeing this for the first time, because the guide was trying to move it for a photo opportunity away from its natural habitat, which is something I really don't always agree with, especially as they moved it using a black plastic tie wrap. It floated in the water column looking like a piece of phlegm! It wasn't until it was moving over the substrate that I could appreciate its beauty. *Melibe* species are unusual. They feed with a large hood capturing small crustaceans and swallow them whole so that they dissolve in the digestive juices of their gut while they're still alive.

Weather conditions were pretty good, and although we rarely had flat calm surfaces, the underwater visibility was 20m+ on most of the morning dives. On some of the sites we had a slight current. Depths varied from our deepest at 25m, to 7m as our shallowest dive, with an average depth around 14-17m on most dives. All dives were on air as there is no Nitrox available.

The set-up on the small boat was okay, but it's very narrow, so the two guides that had been allocated to us sat near the stern with the boat crew in-between the three of us up front. There was no real interaction on the surface

between them and us, and we found that we had to really work at getting conversations going. There was also no dive briefing before each dive, and we had to consistently ask what we were going to be looking for, etc. After a few days, they started to provide some limited information.

On all of the dives, the two guides descended before the three of us were even in the water, and at the end of the dives, they were already back on the boat before we had surfaced! They were really good at spotting subjects, and one guide was a lot better than the other, who frequently disappeared out of sight for

Argonauta argo



L-R: Frogfish; *Hippocampus denise*; and Coconut Octopus.

extended periods of time. Help with spotting the subject after it was pointed out varied and more often than not, it was up to one of us to show the subject to each other after it had been pointed out. That said, by the end of the week they had improved a lot and were happy to assist, especially when I needed a third hand at times using the snoot, although I have become quite self-sufficient with the Backscatter optical snoot now.

However, watching someone tear through a sea fan to find a pygmy seahorse is not something I am comfortable with. The sea fans were around at 24m, and we were all diving

on air as there is no Nitrox available. Nitrox would have been helpful, given there were three of us waiting to photograph the tiny hidden seahorse while watching our NDLs at that depth.

On our last day, we did a Black Water Dive which was pretty good. I could have done more of these to be honest, especially as the timing was not much later than the regular scheduled night dives. However, the moon phase is something that needs to be taken into consideration. I spotted and photographed Paper Nautilus', *Argonauta argo*, but we only found males.

On the whole, I got to see my bucket list nudis as well as several more that I hadn't seen before, so that was a major plus.

Would I return? Probably not given the travel time involved getting there, and my experience with the dive guides, but I would certainly recommend going there to experience this area once. There are after all, other options for diving besides 3P.

FOLLOW GORDON:

 www.instagram.com/gordon.t.smith

HOW DOES DAN EUROPE DEAL WITH DIVER ACCIDENTS?

WORDS BY **CHARLY STRINGER** PHOTO BY **CLAUDIA SCHMITT**



If you are a member of DAN Europe, or perhaps you're considering becoming one, you might have some questions about what you need to do in the event of a diving accident. We hope you'll never need us, but if you do, we would like to make it as easy as possible for you to get in touch and to get the help you need fast.

DAN has been assisting divers for over forty years, with thousands of cases of satisfied divers receiving top-level care around the world. We are always eager to learn and to improve on our procedures in order to ensure the most seamless experience for our members.

Each DAN organisation applies emergency procedures according to the territory for which it operates. For example, the Standard Operating Procedures implemented by DAN

Europe are somewhat different from those applied by DAN Americas. DAN Europe members can consult the specific info page with a Q&A section and a step-by-step guide of what to do in an emergency.

Let's move on to take a look at some of those steps in more detail.

GENERAL PROCEDURES FOR A DIVE EMERGENCY

As laid out on the emergency page, in the event of a diving emergency, even in cases of only suspected decompression sickness, do not hesitate to contact the DAN Europe emergency hotline. In case of dangerous or life-threatening situations, call the local emergency service or go to the nearest hospital first.

This can be done in many different ways:

Via regular phone call by calling the DAN Europe Hotline, through our internet-based phone system, so that if you do not have a local SIM card you can use WiFi to reach the hotline; via email by providing a local number where we can call you back or provide you instructions via email, or by sending your geo-localisation through the SOS button of DAN Europe APP (iOS, Android). Our trained operators will promptly follow up your assistance request and, if needed, will put you in contact with a Dive Medical Officer (DMO) who speaks your language to provide you with specialised medical opinion. You will then receive further instructions via email. Make sure to have your contacts up to date and check your spam folder!

Marta Marrocco is a senior Case Manager for us here at DAN Europe and she told me, "We

pride ourselves on supporting ANY diving medical emergency that reaches our Hotline. Yes, you can call us for emergency specialised medical advice even if you are not a DAN Europe member. Our dedicated team of case managers oversee all of the cases that our hotline receives, to make sure that the diver is correctly and swiftly supported. We coordinate emergencies by referring divers to the most adequate medical structure, by requesting the medical opinion of our specialists, by arranging evacuations and, finally, by gathering the information and documentation needed to evaluate financial support, in order to cover the expenses of insured divers."

She went on to explain that the multilingual team of DMOs is the real spearhead of the diving accident support process. No other organisation provides a pool of diving and hyperbaric medicine specialists ready to support a diver in need in almost any European language, 24/7.

When the DMOs have established the help needed, the case managers have gathered the necessary information or documentation to evaluate the case, DAN Europe will consider sending a Guarantee of Payment. Which leads me to this important question...

WILL YOU BE EXPECTED TO PAY THE MEDICAL EXPENSES?

For hyperbaric treatment and expensive hospitalisations, if the case falls within the insurance cover the short answer is no. As mentioned above, the DMOs provide a specialist medical opinion and recommend the best way forward to medically help the diver – for example refer him/her to a hyperbaric chamber.

Marta told me that once the help needed is established, the team then contacts the diver and the medical structure via email requesting the specific information and documentation that will allow to evaluate whether the accident falls within the cover of the insurance policy. DAN Europe DMOs will discuss the case with the doctor directly and agree on the next steps for treatment. A Guarantee of Payment is a promise to the hospital or medical practitioner that medical fees will be covered by the insurance. This means that you will not need to pay a penny out of your own pocket.

On odd occasions, a diver might decide to cover medical costs themselves without informing DAN Europe beforehand. For example, if the costs are low and they are able to pay quickly and leave with the intention of dealing with the insurance side later. In this case DAN Europe would reimburse the insured diver later on, once all the necessary forms have been filled.

This question is also addressed in the Q&A section of the Emergency Procedures page, if you'd like more information.

THE ONLINE ACCIDENT FORM

The accident form has a series of questions that helps DAN get a clear picture of the situation. It needs to be filled out by the diver or by a person aware of all the events that lead to the accident, in order for us to apply the most appropriate help.

But if a diver is in need of emergency, time-sensitive care, will help be delayed while forms are filled out? I asked Marta about this and whether the forms are something that would be needed by DAN Europe before a diver is to receive urgent care, such as Medical Evacuation (MEDEVAC) to a hyperbaric chamber. She said, "This is something we worked on at DAN Europe a few years ago. Have a look at point #3 of the Emergency info page. You will find an online accident form. We will send you that link via email immediately after you call us. It's an online procedure, quick, simple, and mobile friendly." Depending on the answers you provide, the form takes you to a different path, which keeps it relevant to your situation and as short as possible. For example, if the issue is an ear barotrauma, you will not be asked to answer questions about the amount of dives or the depths in which you dived, as these questions are not relevant to an ear injury. Whereas these questions would be relevant to a situation involving suspected Decompression Sickness. The questions stay to the point and are designed from a medical point of view to give both the Case Managers and DMOs a quick and clear summary of the problem, in order to help you as efficiently as possible.

Marta also made it clear that if the diver is in need of time-sensitive emergency help from DAN Europe, help would not be postponed while the DAN team waited for this form to be completed, "Of course we would ask for the accident form to be completed, but we would definitely not wait for the form in order to evacuate the diver. The evacuation comes first, and the forms can be completed at a later stage, and by another person if necessary".

The online accident form allows to assess your symptoms, and get you appropriate assistance, as well as cover the costs for that help.

THE IMPORTANCE OF HANDLING EMERGENCIES QUICKLY & ROBUSTLY

We understand that having a medical emergency, especially abroad, can be stressful and even quite scary. This is why we are committed to doing all the hard work for you if you ever experience a diving accident.

We spoke to Krasimira Gancheva (Amira), who was heading to Koh Phi Phi, Thailand for some New Year's celebrations and diving adventures. On the third day of her four-day trip, she experienced some worrying symptoms following a dive, "I was feeling unusual dizziness, extreme discomfort breathing, numbness in both arms and legs around the ankles, and vomiting". Amira was taken to the nearest clinic where

the doctor suspected she was experiencing Decompression Sickness. Amira called DAN straight away and told us the process was very fast. "I used the SOS button and internet call option on the DAN Europe App. The call was answered right away and a DAN doctor immediately assisted and discussed the treatment with the Thai doctor". She explained the next steps that were taken: "As I was in a small island clinic, the DAN doctor insisted that I be put on 100% oxygen and IV fluids right away, and that I should be transferred to the mainland, to a large hospital via speedboat as soon as possible to be treated in a hyperbaric chamber".

Amira told us that the medical centre requested payment upfront, before any medical care was given. She said that DAN took care of this quickly to ensure that she got the time-sensitive help she needed. "The DAN team assured the clinic that they will cover the medical expenses, and within two hours a speed boat arrived for the transfer. As soon as I arrived at the marina, an ambulance took me to the best possible hospital". It was there that Amira was diagnosed with Decompression Sickness type 2, and was immediately put into the hyperbaric chamber for nearly six hours. Meanwhile, DAN were in contact with the hospital, as well as emailing Amira to ensure all went well with the treatment.

Amira told us that this experience had been unexpected as she always stays within the diving limits, "It was my first diving-related accident. It was totally not expected, and a bit scary!" But the assistance she received from DAN really eased her mind. "DAN was not just fast, the reaction was immediate. The care was above excellent". She continued, "I don't think there is a better organisation to be insured with. I advise all my fellow divers to get a DAN membership because it makes all the difference. Once you experience it first hand, you see the difference."

It is situations like Amira's that inspire us to keep reaching for excellence for our members. Years of experience means that we are able to provide top-level care to our clients, and we strive to do so with every case. We have made the process as clear and simple as possible to make life easier for you, and to get you the help you need quickly. Check out our emergency procedures page for more information.

ABOUT THE AUTHOR

Charly is a writer who's originally from the UK but has been based in Dahab, Egypt for the past four years. She taught scuba diving for three years in Cyprus, Thailand, and Egypt before discovering her love of freediving. She still scuba dives for fun, but these days she's more focused on her freediving training. When she's not in the water, diving, she's on her laptop, writing about diving.

UNDERSTANDING DIVING ACCIDENTS: THE ANNUAL REPORT

WORDS BY **CLAUDIO DI MANAO**

DAN | AlertDiver



Photo by Marcello Di Francesco

Accidents can occur in any human activity. In an office, an improperly secured shelf may be the lone fatal hazard. In diving, potential dangers lurk in multiple areas. From equipment to diving technique, from tank filling stations to boat ladders, the areas we have to monitor for our diving safety are numerous.

The DAN Annual Diving Report was not compiled as a record of our sins, but to remind us that danger exists, and to refine the tools that help us avoid accidents as much as humanly possible.

"While there is no way to entirely eliminate risk while diving, safe practices can mitigate it greatly. And for this reason, they are essential. Part of using safe practices effectively is knowing when, where, and how to implement them."

These are the opening lines of DAN President and CEO William Ziefle's foreword to the

2020 DAN Annual Diving Report.

As divers, we know that our activity is relatively safe when compared to many others, especially those involving the use of the equipment or conducted in environments other than our normal human habitat.

We also know that zero risk is a utopian concept. What is not utopian, however, is the path toward risk mitigation. Indeed, the purpose of this survey is to identify areas that we should pay more attention to in order to direct divers toward increasingly safe practices.

This is a task that sometimes makes researchers feel as if they are looking through a planktonic fog. Not all diving incidents are reported, and data is often scattered across different archives, in different countries. In some areas, only emergency calls to DAN have been taken into account. In others, multiple channels were

sourced, ranging from Google Alerts to police and coast guard notices. Unlike civil aviation, the world of diving has no unified database that includes all accident reports.

EXPLORING THE GREY AREAS

The authors of the report identified 189 fatal cases worldwide that are directly related to diving in 2018. Of these, 100 cases occurred in recreational and technical diving*, 59 in freediving, 13 in commercial diving, 12 within public safety diving (firefighters, police, civil protection rescuers), 1 case among the military. In 4 cases, the area of activity could not be determined.

While it is relatively easy to trace the causes of non-fatal accidents, fatal accidents often lack testimonies and coroner's reports. Data is lacking for a variety of reasons, ranging from privacy issues to the length of time of forensic investigations, to local authority



regulations. Sometimes the victim is the only witness. And sometimes the testimony of the dive buddy is unreliable.

On this, I would offer a brief parenthesis aimed at the community, especially to the professionals: How many times, when talking about the circumstances of accidents with serious consequences, have we heard of disappearing dive computers, or of surviving divers telling of companions who vanished from sight in a heartbeat?

Shock certainly plays a role, but so do shame and fear of consequences. The problem of unreliable witnesses is so old that it is well documented throughout history. Although the practices of the Holy Inquisition have become a legacy of the past, the fear of consequences, whether judicial or moral, still persists.

Divers who failed to prevent a buddy's accident might even try to erase the very memory of their inaction from their consciousness. And while historians admit that many facts and aspects of life in the past are blurred, in diving, many efforts to improve diving safety are too. This should not be taken as a criticism, but rather as a recognition of bias, so that we adjust our scientific inquiry accordingly.

BUILDING A CLEARER PICTURE

Numbers, even if biased or collected following inconsistent methodologies, always end up looking alike. It happened with climate studies, too, when a Berkeley professor raised the issue of potential bias on urban heat islands and the quality of data provided by monitoring stations. A massive citizen-science effort of data collection has begun. Analysis of newly collected data confirmed that the planet is indeed warming, and that it is warming in the

ways suggested by previous studies.

Whether reliable or not, buddies' testimonies mostly concern diving procedural compliance. In other areas data is more trustworthy and numbers consistent, especially those related to age and disease. Not surprisingly, the proximate cause of death in diving is almost always drowning. The more interesting question, which the report seeks to investigate, is what ultimately caused the drowning. The leading cause is cardiac arrest, supported by clinical reports of comorbidities such as hypertension, atherosclerosis, cardiomegaly, asthma, obesity, and, though it's rarely talked about with divers – drugs or drug use. The age most at risk in diving, similar to the age for heart attack risk, seems to be the 50-59's age group. Older people are at more risk compared to divers under 30.

Here a question arises: Are older divers having more accidents, or is the population of divers simply aging? One thing is certain: Recreational diving and freediving, the areas where 84 percent of fatal accidents occur, are activities practiced mainly in countries with advanced economies where the average age is very high. This makes lack of generational turnover one possible answer.

MAPS AND ROUTES

Calls to DAN Europe from different areas of the world, reporting accidents ranging from barotrauma to decompression sickness, reflect the distribution of European divers in their respective geographic locations of activity. Overlaying DAN Europe's data with other available data, it does not appear that some diving destinations are more dangerous than others, nor does it suggest aging by itself puts divers at risk. The data instead suggests

there are age groups and destinations with more divers. Every scientific investigation while seeking the answers in its path, runs into new questions.

Does the percentage of male and female accident victims reflect the percentage among male and female divers? In what cases do women have more accidents than men, and vice versa? As the search for answers stimulates other questions, the utopian journey to zero accidents leads to solutions for greater safety. According to the report, at least among citizens in the United States and Canada, accidents have significantly decreased from the previous ten-year average.

In physics, absolute zero is a purely theoretical temperature. Nonetheless, current technology like hydrogen-based cryogenics, has come within a handful of degrees of the theoretical absolute zero. The Diving Annual Report is a map that represents one lap of the journey, a panorama, if you will. A panorama we will continue to linger on and hopefully learn from.

*Since 2023, the DAN diving reports categorise divers as: open circuit recreational, open circuit technical, cave diving and rebreather diving.

ABOUT THE AUTHOR

DAN Member since 1997, Claudio Di Manao is a PADI and IANTD diving instructor. He's the author of a series of books and novels about diving, including *Shamandura Generation*, an exhilarating portrait of Sharm el Sheikh's diving community. He collaborates with magazines, radios and newspapers, talking and writing about diving safety, marine life and travels.

MENA OCEANS SUMMIT 2025 ANNOUNCING THE 3rd EDITION



WHERE: ADNEC Centre, Abu Dhabi, UAE
WHEN: 8-11 October 2025

As part of its ongoing commitment to advancing knowledge and enabling collective action on ocean sustainability, Goumbook is delighted to share the announcement of the upcoming MENA Oceans Summit 2025.

Convened by the MENA Oceans Initiative in partnership with the International Union for the Conservation of Nature (IUCN) and strategically aligned with the IUCN World Conservation Congress (WCC) 2025, the 3rd Edition of the Summit builds on the outcomes of the Third UN Ocean Conference (UNOC3), embedding regional priorities into the global ocean agenda and translating them into contextually relevant pathways for implementation.

First convened in 2023 under the patronage of the UAE Ministry of Climate Change & Environment, the MENA Oceans Summit has since evolved into a cornerstone platform for regional collaboration. This year's expanded format reflects that progression, centring

discussions across Blue Governance, Blue Science, Blue Economy, and Blue Finance within a comprehensive framework that bridges silos and convenes diverse regional stakeholders including policymakers, industry leaders, financiers, researchers, academia, youth, and community advocates.

PROGRAMME HIGHLIGHTS

The Summit Main Plenary and the MENA Ministerial Roundtable, scheduled for the 8th of October, will spotlight the Middle East Ocean Action Agenda. This transformative blueprint identifies short and long-term priorities for ocean action and lays the foundation for closer collaboration with the North African region on shared challenges, shaping a cohesive trajectory for ocean and coastal resilience and regenerative blue economy development across one of the world's most strategically significant maritime regions.

Deep Dive Sessions from 9-11 October will invite regional experts from across sectors to exchange knowledge, share innovations, and co-design actionable road maps that support SDG14 implementation and close the science-

policy-industry loop. These sessions will cover key thematic areas including Marine Protected Areas, Regenerative Fisheries & Aquaculture, Desalination & Water Management, and Regenerative Coastal Tourism.

The MENA Oceans Summit 2025 embodies a movement toward integrated ocean stewardship that recognises both the urgency of marine and coastal challenges and the immense potential of regional partnerships. For the diving community, the health of our oceans has never been an abstract issue: it is the very foundation of the ecosystems we explore and the coastal destinations we cherish.

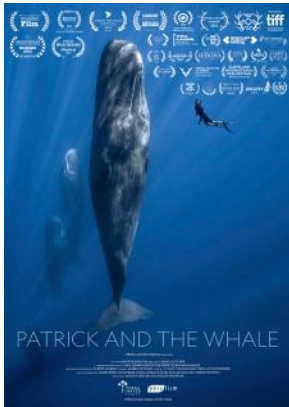
As a Knowledge Partner of the MENA Oceans Initiative, the Emirates Diving Association invites its network to engage with the frameworks and partnerships that will safeguard our coastlines, protect and restore our ecosystems, and enrich the diving experiences that connect us to the ocean. For partnership and participation inquiries, please contact menaocceans@goumbook.com.

www.goumbook.com

AN EDA MOVIE SCREENING

PATRICK AND THE WHALE

Thursday 6th November 2025 | Deep Dive Dubai | Doors Open 6:30pm | Film Starts 7pm (73 mins)



SYNOPSIS

An inspiring and engaging tale of Patrick Dykstra and a sperm whale "Dolores."

For years, Patrick Dykstra has dedicated his life to traveling the globe, following and diving with whales. Over the years, Patrick has learned how whales see and hear; how they perceive other creatures in the water and how they behave at close quarters. He has a finely tuned sense and knows how to act when within touching distance of a whale – what to do, what not to do and when. This allows him to consistently get closer than anyone else alive – a truly unique skill.

Patrick recently experienced a life-changing event. In Dominica, he had a close encounter with a female sperm whale. She seemed to be curious about him, coming within touching distance, pulsing him with her sonar. She studied him as he studied her: Patrick felt an overwhelming sense that she was genuinely trying to communicate.

We follow Patrick as he travels to Dominica again to find this special whale he named "Dolores" so she can help him show us the hidden world of her species. Using stunning underwater footage, Patrick explores the fascinating nature of the sperm whale, attempting to shine a light on its intelligence and complexity, as well as highlighting its current and past relationship with humankind. The film follows his personal journey and explores the psychology of a man who has sacrificed everything in his single-minded quest to connect with and understand one of the the biggest creatures in the ocean.

CLEANUP ARABIA EVENT 1

BENEATH THE BLUE: ABU DHABI UNDERWATER CLEAN-UP

Saturday 8th November 2025 | Taweelah (Fishermen Coop), Abu Dhabi



Calling all EDA Members to join us and support the Sustainable Future Initiative and the Authority of Social Contribution – Ma'an in attempting a World Record for the Most Divers in an Underwater Clean-up.

There are 5 different locations allocated to this event, and EDA has been designated to run the underwater clean-up at Taweelah.

Time slots and event details will be provided once we have a final number of divers taking part in this event.

OPEN FOR REGISTRATION

Please email Layla to register your spot:
projects@emiratesdiving.com
(you must be an EDA Member to take part)

CLEANUP ARABIA EVENT 2 – SAVE THE DATE

BEACH AND UNDERWATER DIVE CLEAN-UP | LOCATION TBA

Saturday 15th November 2025 | 8am



EDA Members (divers and non-divers) will be able to register to this year's main campaign event happening on the 15th of November: Save the date for now and we will share all the event details in the next few weeks to follow via email, on our website's Upcoming Events page, and on our social media platforms.

CLEANUP ARABIA EVENT 3 – SAVE THE DATE

UNDERWATER DIVE CLEAN-UP | PORT DE LA MER MARINA

Saturday 6th December 2025 | 8am



It has been 12 months since this marinas' last clean-up and we're going back to Port de la Mer to check how a year affects its underwater environment. This beautiful World-class boutique marina with panoramic views is Mediterranean-inspired, offering an unparalleled island retreat within the city. Save the date to your calendars for now and we'll share the details and let you know when registration opens. Spaces are limited and on a first come, first served basis.



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Co-Founder | Ibrahim Al Zu'bi
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Email: magazine@emiratesdiving.com, photo@emiratesdiving.com

Project Coordinator | Layla Nouliati
Email: projects@emiratesdiving.com

Reef Check Trainer | Rania Shawki Mostafa
Email: reefcheck@emiratesdiving.com

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Email: inspection@emiratesdiving.com

MISSION STATEMENT

Our mission is to conserve, protect and restore the UAE's marine resources by emphasising and promoting the underwater environment and environmental diving.

LEGISLATION

EDA is a non-profit NGO registered with the Ministry of Community Development as per the Ministerial Decree No. 149.

The Decree stipulates the following responsibilities for EDA:

- Ensure environmentally respectful diving practices in all EDA members.

- Support the diving industry within the UAE by coordinating the efforts of the diving community.
- Promote safety in the commercial and recreational diving fields through standardisation of practices.
- Preserve historical aspects of diving within the gulf region and enhance environmental education to diving and non-diving communities through EDA projects and events.

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Emirates Diving Association
P.O. Box 33220, Dubai, UAE

Office Location: Jumeirah 1, Al Hudaiba Awards Buildings, Block B, 2nd Floor, Office 214

Tel: +971 4 393 9390
Email: projects@emiratesdiving.com
Website: www.emiratesdiving.com

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EDA
جمعية الإمارات للغوص
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EDA is a non-profit NGO registered with the Ministry of Community Development and CDA, and accredited by UNEP as an International Environmental Organisation.

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