

Intervention by instinct

AUGMENTING HOPE FOR RAJA
AMPAT'S LEOPARD SHARKS



In a nursery in Raja Ampat, a team of researchers are pioneering new methods to reverse the current declines in marine biodiversity across the Indo-Pacific, taking bold new steps through an artificial insemination programme developed to support a genetically diverse and self-sustaining breeding population of Endangered leopard sharks. Because in Raja Ampat, eggs mark the spots.

Words by Graeme Green
Photography by Dr Mark Erdmann



The language barrier between sharks and humans means the big fish don't always appreciate that the scientists and researchers poking, prodding and conducting tests or procedures on them in the water are actually trying to help save their species. That was the case in December 2024 for Dr Mark Erdmann, as he tried to manoeuvre a male Indo-Pacific leopard shark in a state of 'tonic immobility' up to the ocean surface in Australia to attach an acoustic tag.

"One of the bigger males struggled significantly, so I had to use my body to push it into the sling on the side of the boat," says Erdmann, senior scientist at Conservation International and Executive Director of ReShark. "Consequently, I was pinned under the shark during the whole surgical procedure - the big issue was maintaining my breathing through my snorkel as waves broke over my head. The procedure was finished in about 10 minutes and we started to lower the sling to release the shark, at which point it promptly turned over and bit my calf. It was exceptionally painful, like someone had tightened a vice around the meat of my calf muscle and was trying to rip it off. The vets managed to pry the jaws open and release me (and the shark), but it was painful to walk for the next two weeks."

A little gratitude from the shark wouldn't have gone amiss. Erdmann was one of 15 international scientists, conservationists, and vets who took part in what was named the Great Australian Stegostoma Semen Expedition (GASSE), which set out to achieve a 'world first' in conservation: collecting semen from wild sharks.

From December 7-14, 2024, the team used innovative techniques to collect semen from Indo-Pacific leopard shark males (also known as zebra sharks) aggregating off North Stradbroke Island off Brisbane, Australia, with the intention of using it for artificial inseminations of female leopard sharks in aquariums across Australia and in Singapore, subsequently helping restore populations in the wild, including in Raja Ampat, Indonesia, where ReShark primarily operates.

The procedure for collecting semen from leopard sharks underwater was pioneered by Dr Paolo Martelli, Director of Veterinary Services at Ocean Park Hong Kong. "Leopard sharks have an interesting response to having their tail grasped, which puts them into a 'tonic immobility,'" explains Martelli, GASSE's primary vet. "They use this to subdue females when mating but it also works on males, so we gently grasp the very end of the tail and roll them over onto their backs. We can keep them in this position for tens of minutes, which enables the procedure to be undertaken."

Once immobilised, an Fr5 or Fr8 feeding tube, measuring 40 centimetres, is inserted (typically around 7-15 centimetres) into the shark's seminal papillae to draw semen into a syringe barrel. The technique had only ever been used previously in an aquarium setting, usually taking around 10-15 minutes. But working with sexually mature adult leopard sharks in the wild is a different kettle of fish. "The biggest concern is always the weather and environmental conditions," says Dr Christine Dudgeon, Senior Research Fellow at University of Queensland and Biopixel Oceans Foundation, who led the GASSE expedition. "If it's too rough, or there are strong currents, cold upwellings or dirty water after rain, the animals will often move away from the aggregation site. We were very lucky as the weather held out for us."

"The first shark is always the most exciting because this is truly the very first time this has been done," Dudgeon adds. "Watching the process of the sperm collection and blood collection using scuba was amazing. I was holding the tail for that, so I had an excellent view."

The team had two methods for collecting the semen. In most cases, the male sharks were put into 'tonic immobility' on the ocean bottom, in around 12 metres of water, and the semen extraction was conducted underwater. But they also wanted to acoustically tag several males, which involves surgery. "For this, one of us would spot a male leopard laying on the bottom while we were snorkelling, then we'd free dive down to the shark,



ABOVE: Wayag Lagoon in Raja Ampat.

LEFT: "Candling" leopard shark eggs to show the developing embryo and yolk inside. Photo by Kyra Wicaksono.

PREVIOUS PAGE: Adult leopard sharks at Julian Rocks aggregation site, Byron Bay Australia.

grab it by the tail, which puts it into 'tonic immobility', and swim it to the surface," Erdmann explains. "A second swimmer would help restrain the animal and we'd 'wrestle' it into a special sling lowered from the side of the boat. The veterinarians would then make a small incision in the gut cavity, insert the acoustic tag, then suture the wound, and then the semen would be extracted before the animal was released."

Erdmann's leg-to-mouth encounter wasn't the only difficulty. "There were some dramatic moments underwater when the current at the dive site picked up significantly and dropped visibility, while also making it very hard to swim against the current or maintain position, such that when we came across a shark the whole team struggled," he tells me. "We were blowing through air quickly, and once we had the shark turned over and three of us restraining it, the current would push all of us - shark, and three divers, plus Paolo and his vet nurse - along the bottom as we tried to extract the semen. We sometimes ended up 10 metres from where we started the operation."

The GASSE team initially hoped to collect semen from at least nine wild males, enough to inseminate six sharks in Australia and three in Singapore. "The expedition was successful beyond expectations," says Martelli. "The sharks were sexually mature and had semen of high quality", with samples collected from a total of 19 males. Six females have since been artificially inseminated in total; two in Sea World Gold Coast, two in Sea Life Sydney Aquarium, and two in SEAA Aquarium Singapore. Alongside insemination, the team were able to acoustically tag seven sharks for critical movement ecology studies.

One year on and by October 2025, ReShark could count six pups from Sea World Gold Coast now occupying its sea pens, each of them the potential product of this artificial insemination, and a further six from Sea Life Sydney. Since arriving in Raja Ampat, the pups have been homed at ReShark's nursery to aid the organisation's StAR (Stegostoma tigrinum Augmentation and Recovery) project, which was launched in 2020 to re-establish a healthy, genetically diverse breeding population of Indo-Pacific leopard sharks in the Raja Ampat archipelago of Indonesia. It's here the species was almost extirpated in the late 1990s and early 2000s due to overfishing and shark finning for the shark fin trade. By late 2025, three of the six Sydney pups became ReShark's 49th, 50th, and 51st successful releases back into the wild.

At the time of going to print, a second GASSE expedition had just got underway in Byron Bay. It will be ReShark's chance to build off the lessons learned from the first run as they aim to harvest semen from at least 25 wild males for use in artificial insemination on females in four large aquariums (returning to the original three with the addition of Irukandji in Newcastle, Australia). "We're of course hoping to see fertilised eggs from all four facilities, and this go around we have the genetic technique refined to be able to say with certainty whether



ReShark scientists from Georgia Aquarium and University of Queensland conduct a cloacal swab on a wild leopard shark at North Stradbroke Island off Brisbane to examine its recent diet.

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TOP ROW: Two leopard shark eggs from Sea Life Sydney Aquarium incubating in ReShark nursery. Photo by L. Vaime | Leopard shark pup in its tank two months after hatching.

MIDDLE ROW: Three pups being released simultaneously in Misool Resort lagoon. | Pup (James) being released in Papua Diving Sorido lagoon.

BOTTOM ROW: Shark nannies feeding pups in sea pen and taking notes on growth. | Adult leopard shark at Julian Rocks aggregation site, Byron Bay Australia.

“Success means that in 20 years, we have grown the leopard shark population from 20 to at least 300 adults.”

“Many species, including the leopard sharks and whale sharks, are unique evolutionary lineages: the sole species within their ‘family’. The fossil record shows there was a sister species or at least another genus within the family if you go back many millions of years but for now these are the last of this lineage. You get rid of them and there is nothing to replace them.”

Erdmann and Dudgeon originally conceived of the leopard shark recovery project in Raja Ampat, using conservation translocations of genetically-appropriate eggs produced in large public aquariums, in 2015, later securing the endorsement of the West Papua and Raja Ampat governments. The StAR project was launched, with the objective of re-establishing a healthy, genetically diverse breeding population of Indo-Pacific leopard sharks in the Raja Ampat archipelago through the introduction of captive-bred juveniles sourced from genetically-appropriate adult broodstock that have been purpose-bred at participating aquariums. By 2022, the team had built two shark nurseries in Raja Ampat and received their first batch of eggs, successfully hatching and raising the initial batch of pups, which were released into the wild in January and February 2023.

The original StAR project followed two decades of intensive marine conservation efforts in Raja Ampat, which included the creation of a network of nine large-scale Marine Protected Areas (MPAs) and South-east Asia's first shark and ray sanctuary, alongside policies and regulations to manage marine tourism and regulate fisheries, and community outreach efforts. “We very specifically chose to implement StAR in Raja Ampat because it was one of only a handful of places on Earth where leopard sharks had already been largely extirpated but where sharks and rays are now protected and the reefs are recovering and actively managed, meaning that if we were to begin releasing leopard shark pups into the ocean in Raja Ampat we could feel quite certain they wouldn't be immediately caught and killed,” says Erdmann. “This is a primary prerequisite before you start a reintroduction programme - you have to make sure that whatever threats led to the population declines in the first place are now managed and no longer a problem.”

ReShark has now successfully released 50 leopard shark pups into the wild in Raja Ampat, an important milestone for the team. But just as important are the post-release monitoring methods since developed by the team, combining acoustic and satellite tagging as well as citizen science photo ID by divers. There is now quantifiable evidence of released pups surviving and thriving for at least four to six months after release.

So, what would success for Raja Ampat look like in 10 or 20 years? “My hopes are that fish stocks continue to grow and the reefs remain resilient to climate change,” says Erdmann. “With StAR, success in Raja Ampat means that in 10-20 years we will have grown the population of leopard sharks from roughly 20 to at least 300 adults.”

the AI was successful,” says Erdmann.

Being able to harvest semen from wild sharks can address many of the current challenges in aquariums’ captive-breeding programmes and help restore depleted populations of sharks around the world. “It’s expensive to move sharks and rays between facilities to promote increased genetic diversity through breeding,” says Dudgeon. “A very novel aspect of GASSE is that we’re collecting the sperm at depth using scuba gear, which provides an opportunity to obtain diverse genetics from multiple males without needing to move the animals themselves. This is potentially a game-changer, in that we can access multiple males at an aggregation site sequentially and bring that genetic diversity into the aquarium for artificial insemination.”

Extreme times call for extra measures. A 2021 study, published in *Nature*, found that the global shark and ray population crashed more than 70% in the past 50 years, with sharks often killed as by-catch in industrial fishing vessels using nets but also specifically targeted for their fins, used across Asia for shark fin soup, despite having no flavour or nutritional value. The International Union for Conservation of Nature (IUCN) classifies zebra sharks as Endangered on its Red List of Species.

“We are simply extracting way more animals than is remotely sustainable,” says Erdmann. “We really need to stop targeting sharks and rays. But, sadly, just as demand for shark fin in Asia has declined in the past decade, new markets have opened up for shark products, especially health supplements, such as liver oil or cartilage pills, in the West, as well as for use in ‘fish and chips’ and for exotic leathers. Sharks are protected in Raja Ampat, but in most parts of the world they’re exploited with little regard for sustainability.”

As apex predators, sharks are essential to the health of marine ecosystems, keeping food chains of predators and prey balanced.

“From an evolutionary and biodiversity perspective, each one of these species is like a dodo,” adds Dudgeon.