

# ecology



Striated surgeonfish, *Ctenochaetus striatus*

Text by Ila France Porcher

**During a seven-year study of reef sharks in Tahiti, ethologist Ila France Porcher also observed the behaviours of various fish species. Here, she offers a detailed description and insights into the dynamic and mesmerising spawning events of the striated surgeonfish, which take place every year in the South Pacific.**

One evening in late December, fish were splashing in the glowing surface at the western edge of the fringe lagoon. I drifted to where they were leaping in scattered places, and the streaming water beneath my kayak became opaque with striated surgeonfish (*Ctenochaetus striatus*) while the dorsal fins of reef sharks sliced through them. Sometimes, they lunged ahead.

I anchored some distance from the leaping fish, slid underwater, and swam towards a darkness that filled the waters from sand to surface. Surgeonfish streamed in a dense cloud to the limits of visibility, while here and there, a few bunched together and

flashed to the surface to release tiny clouds into the water. They were spawning, and those striated fish had turned a pale, pearly-rose colour.

### **A close-up look**

I returned the next night to

investigate more closely and found them at 5:45 p.m. in their usual places in the coral bordering the lagoon. But they seemed restless. After looking around, I held onto a dead coral formation to watch the progression of events, and

they gathered around me. Approximately two hundred fish hovered beneath me and in the coral beside me, yet there were none anywhere else in sight. They were so skittish that if I moved, they all jumped 15cm, while an assortment of blackfin

and whitetip reef sharks patrolled through the area.

Striated surgeonfish filed continuously out of the lagoon to gather in the open, sandy area on the border where they had spawned the previous evening. It was a natural cavity on the

# The Fabulous Spawning Ritual of Striated Surgeonfish





border of the bay, approximately circular, about 30m in diameter, and three to four metres deep. A long string of big coral formations crossed it and ended where the sandy floor fell into the gloomy depths of the bay.

A staggering concentration of

fish gathered, and still they came in single file from between the corals of the lagoon. Sometimes, they streamed away from the shadows of the deep water beyond, but it was not possible to see what had spooked them. Other times, a shark passing

downcurrent caused them to pour inward. They congregated most thickly around the string of coral formations—where it ended, so did their dark cloud.

Waves of the solemn little creatures streamed rhythmically out over the sand and back again, fluid as running water. And strangely, wherever I went, they surged towards me. Yet, in spite of their continuous motion, they remained within the designated area, of which the centre was the string of coral structures. They were very specific about the place where they wanted to be.

### Changing colours

Their colours slowly turned to rose-grey as their excitement mounted during the half hour in which they accumulated, and soon they formed an opaque cloud that obscured the surroundings. Their faces looked intent as they flitted by, and all the while a sense of

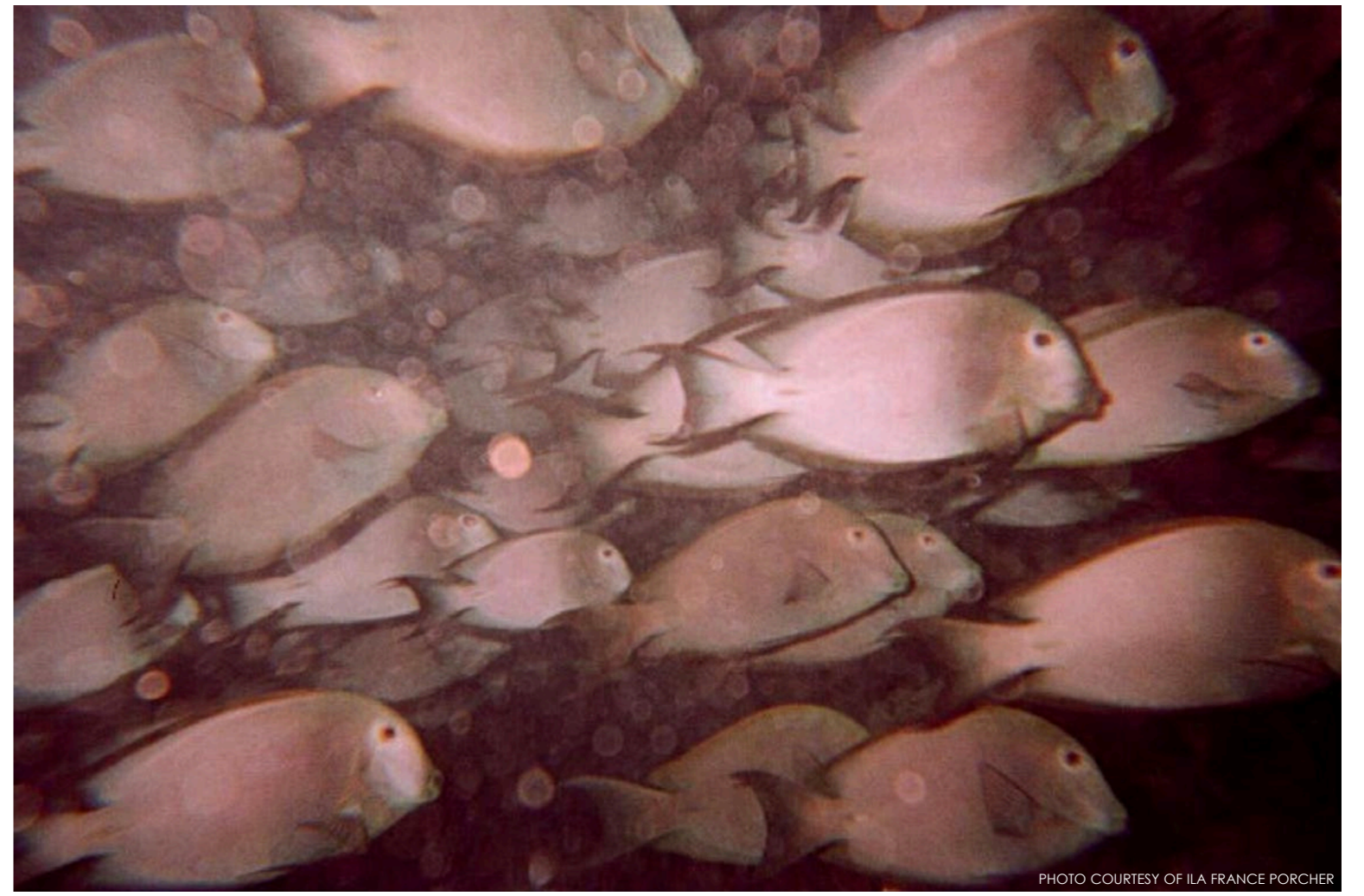


tension grew among them. Their colours brightened to an opaline violet, and by 6:10 p.m., they began to rise slowly towards the surface very gradually, and then descend again in rhythmic waves.

As the sun approached the horizon, the tension among them became a palpable force. They grew increasingly energetic, rushing upwards in twos and in larger groups, only to calm again

## Spawning

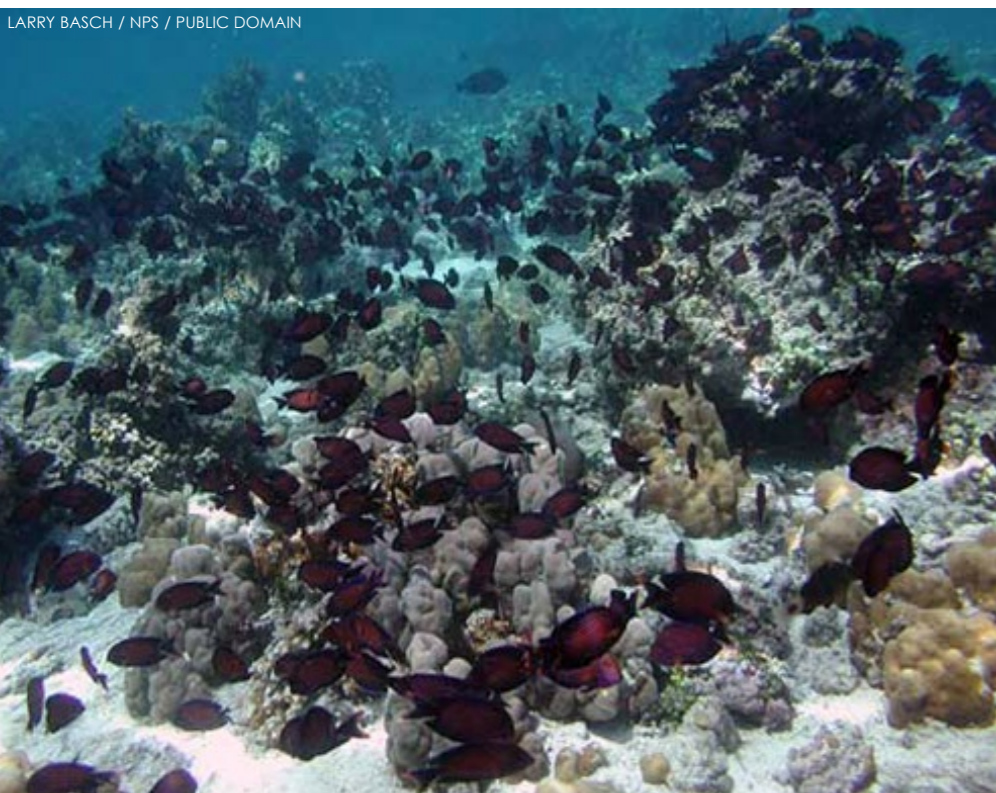
and sink in a swirling mass. Once, as they collected densely below to begin their expansion upwards, a large, pregnant blackfin sailed above them, and the flowing fish descended, presenting a dramatic sight in the mysterious light. Behind her they rose again in an enormous wave and, as if at an invisible signal, the dance began. In every direction, they shot upwards in small groups. At the moment they flicked the surface, they released tiny pale clouds of eggs and sperm. They were shining a pale, pearly rose colour with black accents. The mating ritual of the striated surgeonfish began at 6:30 p.m.



Striated surgeonfish (top left) turn a rose pink as they gather for the spawning event (above); Then their colours brighten to an opaline violet (top right); Surgeonfish shoot upwards in small groups to release pale clouds of eggs and sperm (left)



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Striated surgeonfish turn a bright violet colour during spawning events (above and top right); Schooling surgeonfish (top left and centre)

and, within ten minutes, began to wane in excitement. At 6:38 p.m., the sun sank beneath the horizon and, as darkness gathered, they began to disperse. By 6:48 p.m., only scattered groups were still half-heartedly rushing together to flash to the surface, without their former zeal. The rest streamed away into the lagoon and disappeared among the corals. Finally, bang on 6:50 p.m., the event was over, and the last of them, now brown-black again with purple tinges, hurried away into the lagoon in a loose line.

The surgeonfish left an enormous cloud of thick spawn, which I circumnavigated night after night during my observations of this remarkable natural phenomenon. The cloud tended to stay in place, instead of dispersing with the current.

### A remarkable location

The event took place, year after year, in the middle of the wet season, when heavy oceanic waves pouring into the lagoon always produced high turbulence, but the conditions at the spawning site were unique. It appeared that



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the fish had chosen the one location on the border where not only was the water fairly deep, slowing the current, but the surge from the bay counteracted the outflow from the lagoon, holding the spawn right there in position, caught by the opposing forces of the sea!

Along the border in the direction of the ocean, strong current poured over shallow reef flats, and beyond that were breaking waves on a coral wall, which extended to the place where the barrier reef began at the mouth of the bay. In the direction of the shore, a high patch reef formed a wall between the shallow lagoon and the bay's depths. Nowhere else did the striated surgeonfish congregate.

During the period in which they were spawning, the striated surgeonfish passed my shark study site inside the lagoon for more than

## Spawning

Colour change in spawning striated surgeonfish may be mediated by the pineal hormone, melatonin, in concert with a complex arrangement of light-reflecting cells (M. Goda and R. Fujii).

half an hour, for as far as I could see through the coral formations, heading towards their spawning site. And as night gathered, they returned, always in single file in their many lines, following fairly straight paths back through the mazes of coral.

### The extent of the event

Year after year, I went to see the spawning event when I was not with the sharks. My husband, a mathematician, accompanied me one time and calculated that between 10,000 to 15,000 fish had assembled. Each time, they began to cluster at the site just before 6:00 p.m. The spawning took place between 6:30 and 6:50 p.m., and sunset came at 6:40 p.m.

The event began in the last days of December and continued into January. After about a week, the fish seemed to start to lose interest. Many of them gathered into lines and moved towards the spawning site, then clustered, turned colour, spawned briefly over a coral, and returned the way they had come. For several days, there were no fish filing through the lagoon, and only a very few in the spawning area turning rose, clustering, twirling together, and occasionally darting to the surface to emit a spurt of eggs and sperm. But no cloud formed, so the main event had ended with a few individuals still spawning, while the majority had lost interest.

However, there were times in the following weeks when again large numbers of the solemn striated surgeonfish were filing to the border and returning after sunset, so apparently in some years, the event continued after a break of a few days. But it was over by 20 January.



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Adult striated surgeonfish (left) in brown livery; Juvenile striated surgeonfish (centre). Each young surgeonfish must learn the entire spawning ritual from its elders.

## Spawning

current had badly disrupted the spawning. Due to the way they seemed to consider me a provider of protection, so that I was always surrounded by the thickest gathering of the fish when I watched them, my carelessness seemed to have had a dire effect on the entire event.

The fish had been using me, instead of the coral formations, as a reference point. When I stopped finning and began drifting, all the fish spawning around me (and those around them) stayed with me. To us, all sailing along together and seeing only each other, we seemed to be in the same place, but the current in the neighbouring shallow region was very fast, so once we started, we were

turbulent conditions, I found a few tiny striated surgeonfish, which I assumed were immature juveniles, appearing to spawn in the place used by the adults, with the sun shining straight down on them. In the following days, the adults began again to spawn in the evenings.

This observation suggests a possible period of preparation for immature fish. Other researchers have found that the spawning ritual of the striated surgeonfish is a case of social learning—each individual has to learn the spawning site and the routine from the other fish. It is not instinctive. This fact raises the point that the choice of the remarkable spawning site was a deliberate decision by some fish at some time, a strong indication of consciousness.

Arthur A. Myrberg wrote a scientific paper on the spawning of a closely related species, the lavender tang (*Acanthurus nigrofuscus*), in Eilat, Israel. The geography of the region that those fish had to cover was unlike my South Pacific lagoon, so that the

area from which they came was smaller, and the place that they spawned was different. Otherwise, the event he described was very similar.

There is clearly a great deal to learn about this mysterious phenomenon. ■ *Ethologist Ila France Porcher, author of The Shark Sessions and The True Nature of Sharks, conducted a seven-year study of a four-species reef shark community in Tahiti and has studied sharks in Florida with shark-encounter pioneer Jim Abernethy. Her observations, which are the first of their kind, have yielded valuable details about sharks' reproductive cycles, social biology, population structure, daily behaviour patterns, roaming tendencies and cognitive abilities. Please visit: [ilafrenceporcher.wixsite.com/author](http://ilafrenceporcher.wixsite.com/author).*

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### A terrible mishap

One night, the current was exceptionally strong. A disturbed ocean poured over the reef and through the lagoon, picking up particles that spoiled the water's clarity. Even in the deeper pocket of the spawning site, I had to fin continuously to keep from drifting away as I watched the fervent dance of the pearl-coloured fish. It filled my view with sinuous movement in all three dimensions, without a gap to see through, and I did not notice the moment when, thrilled and almost hypnotised, I stopped finning.

A long time seemed to pass before I saw that we were all moving very fast over reef flats in shallow water. But the fish continued their dance, and I continued to watch them, despite concern that this was not in the plan. Then my visibility was suddenly zero. I could not see my hand in front of my face and looked above the surface to find that my kayak was far away. I started swimming across the current and up it, trying to find clear water. Downstream from the spawning, the water was opaque, and I had to

continue blind, checking my direction by glancing above the surface.

When I reached clear patches in which I could see, I found that the fish were swimming in a panicked column at my side, shooting ahead, pausing to normal speed, and then shooting ahead again in unison, as regular as a heartbeat. The column was about a metre wide, perfectly straight, and vanished into the murk ahead and behind. A pregnant whitetip shark shot through, and a large blue jack fish was criss-crossing the column. I swam beside the fish, most concerned about the distance we had drifted from the spawning site.

When we got there, the event was over—only scattered groups were still flowing together and flashing to the surface, while the rest filed hurriedly into the lagoon.

It was only 6:40 p.m., and by 6:45 p.m., there were no striated surgeonfish visible at all. So, it appeared that our mishap in the



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all swiftly displaced. This hypothesis was reinforced by the way their geometrically perfect column, shooting in panicked pulses back to the safety of the lagoon, had formed at my side.

The incident demonstrated the reason why the row of large coral structures crossing the region was so important to them. It provided them with the reference point they needed to stay in place while spawning.

### Social learning

One day in late December, after a series of storms had brought a month of



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Adult striated surgeonfish displaying colour change

