Host intro: Sometimes a little bit of protection can mean the difference between everything and nothing. We head now to the middle of the Pacific Ocean, where the consequences of just such a difference are unfolding in a way no one expected. Reporter Ari Daniel sniffed out this story.

Ari intro: This is Small Matters – the audio series where we sweat the little things. I'm Ari Daniel.

Ari: Go snorkeling off the coast of Fiji, and a gorgeous coral reef swims into view, full of color, sound and texture. <sneak up video sound> This video of the reef shows big boulder-y corals, branching spiky corals, and fish darting around every bend.

Dixson: There's a lot of space for things to hide in. And there's a huge amount of biodiversity there.

Ari: Danielle Dixson is an ecologist at Georgia Tech, and she studies coral reef communities.

<fade up next part of video sound>

Now, here's another patch of beach, but this time you don't hear any of the pops and crackles from before. It's eerily quiet. A field of sand and coral rubble is broken up by an occasional brown seaweed – which is a type of algae – waving in the current.

These two places – the bustling coral ecosystem and the algae expanse – aren't miles apart. They're right next to each other, two halves of the same stretch of beach experiencing the same waves and the same weather. The only difference is that on one side it's a marine protected area where fishing is banned. And on the other side, fishing's allowed.

Sadly, around the world, coral reefs are disappearing and looking more and more like that field of rubble. Mark Hay is also an ecologist at Georgia Tech.

Hay: Everything that's going on – global warming, overfishing, pollution – means there's less coral, more algae, and more contact between corals and algae. Our question was, what do present day seaweeds do to corals?

Ari: And the answer for some algae, it turns out, is something akin to waging war.

Hay: We started by putting the coral and the seaweed together. Some seaweeds, within two days, those corals, they start bleaching and tissues start dying where they're in contact. And then on a couple of those corals, that bleaching just spreads around the rest of the coral.

Ari: So in some cases, a mere algal touch can deal a deadly blow to the coral.

Hay: Almost all, if not all of the reaction we were seeing to the various seaweeds was due to chemistry alone.

Kubanek: The chemicals are from a family called turpenes.

Ari: Julia Kubanek is a chemist and biologist, also based at Georgia Tech.

Kubanek: These species on a coral reef – they're not all living there together in some kind of kumbaya-happy cooperation. They're fighting and killing each other day by day in order to survive and reproduce.

Ari: Now, it's not entirely an everyone-for-themselves, fight-to-the-death bloodbath either. Conflict leads to alliances. Here's Danielle Dixson again.

Dixson: In coral reefs, there are these small little fish called gobies. They're actually really beautiful – they're aqua with red spots and stripes. And they spend their whole lives in one coral head – they live in it, they mate in it.

Ari tape: So they're loyal.

Dixson: Yeah, they're loyal little fish. So if this algae has the potential to kill the coral, it's in the fish's best interest to do whatever it can to protect its home. So what these little gobies do is they eat the algae so that it's no longer in brushing contact with the coral and effectively save their home.

Ari: Dixson discovered it's not visual cues that bring the gobies out. Rather, it's a molecular distress call.

Dixson: The coral releases some kind of chemical that the goby responds to within about 5 minutes.

Ari: These chemicals – both the algal ones that hurt the corals and the coral ones that fetch the gobies – are potent, and they have to act fast before they're washed out to sea.

The story of chemistry on these reefs goes one step further. Some reef fish grow up in the open ocean and have to find corals to settle on as adults. And Dixson has found that they do so using smell.

Dixson: When you're in the open ocean, there's actually very little to orient yourself to – it's just vast blue water. So you would expect a coral reef to smell like coral, you'd expect mangroves to smell like mangroves. And if coral reef fish are able to find the smell of coral in the ocean, they follow that home like a yellow brick road.

Ari: Dixson determined that these fish sniff out healthy reefs over degraded reefs, and can even use smell to locate particular coral species within the reef.

So you can see that chemistry is how life tends to converse, even across species lines, and Julia Kubanek and Mark Hay love trying to decode that conversation.

Kubanek: I see chemistry as a language that organisms use to communicate critical messages to other organisms in their world.

Hay: Most organisms don't have eyes, don't have ears, and so they decide whether to eat something next to them or run from it or mate with it based totally on chemistry alone. And that's a world that we're pretty much blind to.

Ari: But we're not blind to its effects. Which brings us back to those neighboring stretches of beach in Fiji I told you about at the start.

When you see them, the difference between the healthy reef and the ravaged reef is immediately obvious.

And it's the chemistry that's giving us clues – that's using its language to tell us how this fragile ecosystem works, in ways both large and little.

<fade up music>

Our series, Small Matters, is produced by the Center for Chemical Evolution, and sponsored by the National Science Foundation, with additional support from NASA. I'm Ari Daniel.