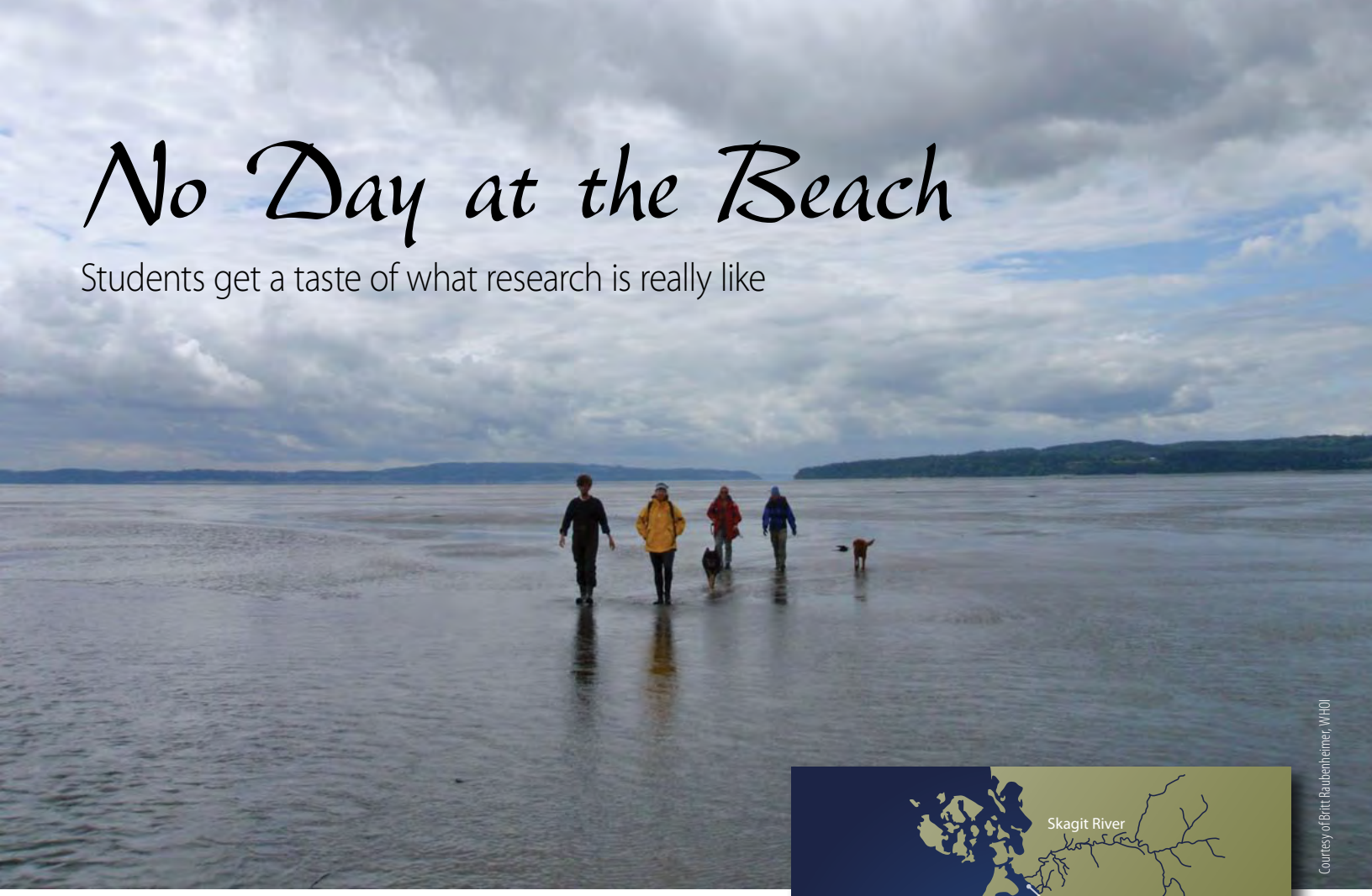
# No Day at the Beach

## Students get a taste of what research is really like



Courtesy of Britt Raubenheimer, WHOI


WHOI researchers trek across the Skagit tidal flats at low tide. Their study area north of Seattle spanned almost the entire distance to the islands in the background. At high tide, the flats are covered by up to 5 meters of water.

Field research in oceanography is no day at the beach—even when it's *at* the beach. Just ask the students who spent the summer of 2009 doing research on a swash zone near Seattle.

The swash zone, the area between the high and low tide marks, is more than a great place to find seashells. It's also a very challenging place to work, which was one of the main reasons Britt Raubenheimer, a physical oceanographer at Woods Hole Oceanographic Institution (WHOI), took students there. In 2003, she launched a fellowship program to give undergraduates and recent college graduates a full-immersion research experience. During their six-month tenure, her students would be involved in every step of a research project.

"It's rare for undergraduates to have much opportunity to get involved in extensive fieldwork," said Raubenheimer. As a result, many students arrive at grad school not knowing whether they want to work in a lab or the field—or even whether they enjoy doing research at all. "When I was a grad student, the main reason for students leaving was that they discovered they didn't like it."

### On the flats

Understanding how water and sediment move in the swash zone is crucial for homeowners worried about beach erosion, military strategists considering amphibious landings, and officials assessing the risk of offshore spills washing up on beaches. The swash zone is also a critical ecosystem for a variety of marine life.

Raubenheimer, her dog Whit, and her husband Steve Elgar, also a WHOI physical oceanographer, have worked with students at swash zones in far-flung places, each with different contours and currents. At Duck, N.C., the sandy beach is constantly reconfigured by the water. At La Jolla, Calif., an offshore canyon generates towering waves.

The 2009 students studied yet another kind of swash zone at the Skagit (rhymes with "badge-it") tidal flats in the northern reaches of Puget Sound in Washington state. Tidal flats are aptly named—they are vast stretches of sand and mud with the barest hint of a slope.

"It's way flatter than the crown of a football field," said Elgar of the Skagit site. Big ocean waves don't play much of a role there; instead, the movement of sediment is dominated by tides. The spring tide runs to nearly 5 meters deep; at low tide, the flats are dry for hours.

Formed where the Skagit River empties into a large bay of the same name, the Skagit swash zone is especially important for wildlife. The bay, the flats, and the neighboring marsh provide crucial habitat for species both in and above the water. The area hosts the largest congregations of migratory waterfowl on the West Coast; and five species of salmon and two species of trout pass through the area as juveniles on their way to the sea and again as adults, when they return to their natal streams to spawn.

"Preserving the habitat requires that you know things like where the sediments are going," said Elgar. "Will they be swept offshore? How might the flats change if we put in a new dike or take one out?"

The answers to such questions depend on the slope and structure of the ground; the size of the sediment particles; the strength and direction of the waves, currents, tides, and winds; and the frequency and ferocity of storms. "The physics get very complicated," said Raubenheimer. Getting the basic measurements needed to figure out the physics was no simple matter, either.

## Digging in

Raubenheimer developed her swash zone fellowship program as part of a National Science Foundation grant proposal that required applicants to come up with an educational project that went beyond what their institution already did. In addition to giving students a full research experience, she hoped her program would attract students majoring in fields such as math, physics, and engineering who might not have realized that oceanography was a career option for them.

The 2009 students included recent graduates Dana Giffen, with a degree in environmental studies from the University of Washington, and Seth Zippel, with a degree in physics from Whitman College in Walla Walla, Wash.; Sean Kilgallin, who after the fellowship had one semester to finish as a marine science major at the University of South Carolina; and Regina Yopak, who had a degree in physics from Simmons College and was working as a physics instructor at MIT.

The students discovered that real research is a bit more strenuous than a field trip, when their first task upon arriving at the site was to take pickaxes to a gravel parking lot. They needed to dig trenches for the cables that would carry electric power and Internet connections to their temporary office, set up in three shipping containers.

That chore was a little hard to explain to family members eager to hear about the students' first day on the job as working

Courtesy of Britt Raubenheimer, WHOI

So this is how you do science! Students Dana Giffen (left) and Seth Zippel and WHOI scientist Britt Raubenheimer take a break from digging a ditch.

At left, tripods bearing current meters and other instruments were anchored to the flats at low tide. When the tide came in (center), researchers had to dive to check and clean the instruments. At right, the instruments had to be cleared of massive gobs of algae every day. "It was back-breaking work," said oceanographer Britt Raubenheimer.

scientists. “My grandpa was like, ‘Oh, you need a college education for that?’ ” laughed Giffen.

The strenuous labor continued throughout the 14-week project. To gather data on water temperature, salinity, depth, and currents, the team set up sensors on sturdy tripod frames anchored to the ground throughout the swash zone. The Skagit flats are so vast—about 5 kilometers by 5 kilometers (3.1 miles by 3.1 miles)—that most of the sensors were too far from shore to run electrical lines out to them. They had to be powered by batteries.

Courtesy of Britt Raubenheimer, WHOI

Student Regina Yopak zips across the flats at high tide.

That was fine, except that batteries need to be changed; in this case, about once every two weeks. Because of the distance between sensor stations, even working from dawn to dusk the team could only service eight to 10 stations a day. Over the course of the season, the team changed more than 500 batteries. “It was like painting the Golden Gate Bridge,” said Elgar. By the time they finished replacing all the batteries, it was time to start all over again.

Another challenge was that massive gobs of algae draped the sensor frames. A fresh crop washed in and got caught on them every day, interfering with the sensors.

“When it’s covering the sensors, you get bad data,” said Zippel. “You get points saying the water’s traveling at 100 meters per second or something else that’s obviously not true.”

“We had to clean every instrument every day,” Raubenheimer said. “It was back-breaking work.”

Some members of the group would ride a boat to the more distant stations, while others hiked across the flats to stations nearer to shore, often leaving before dawn to get the job done while the tide was out.

“It’s just a part of the job that someone has to do in order to get this data,” Raubenheimer said. “And it’s one of the reasons that our field data isn’t perfect—it’s really hard to collect.”

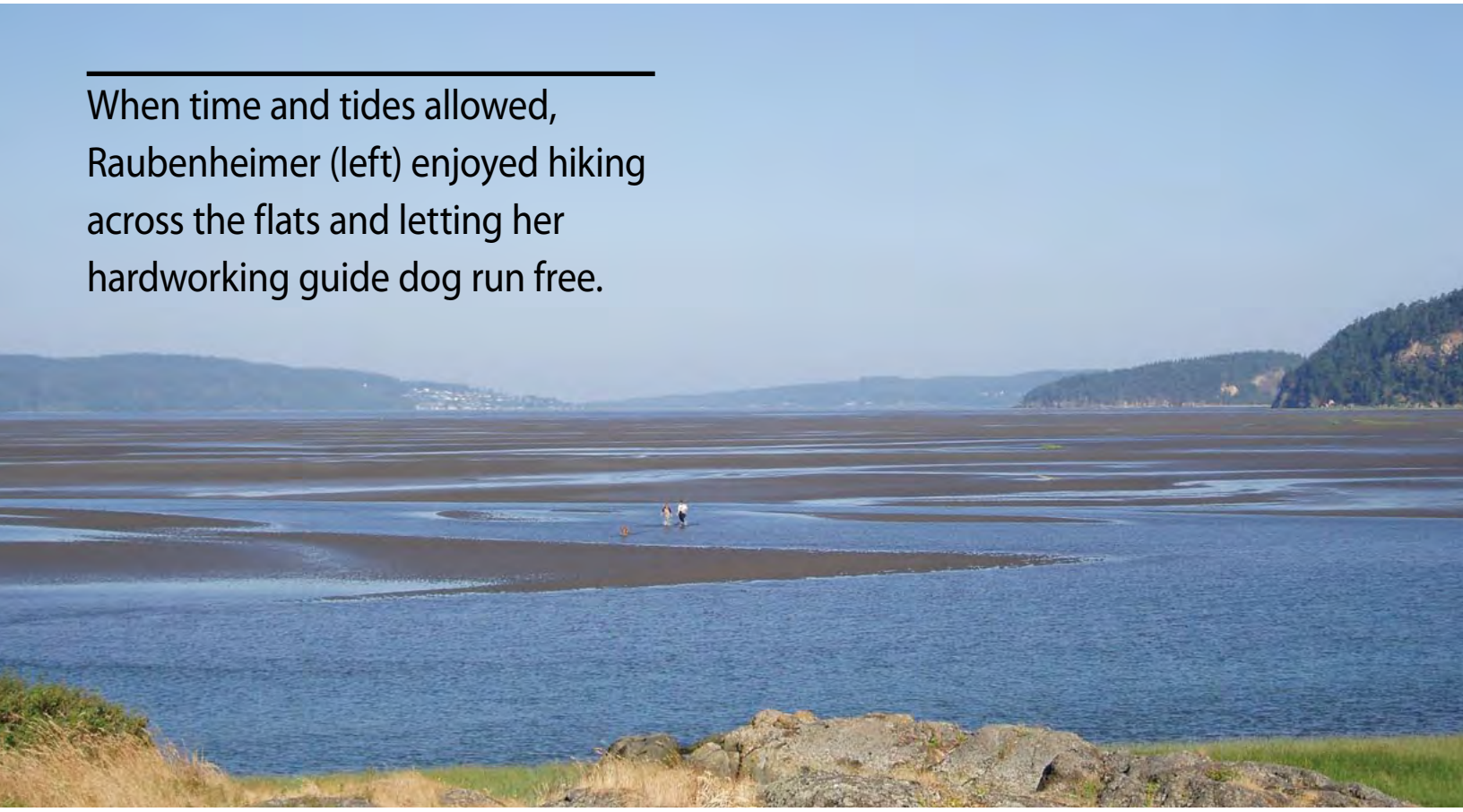
### Seeing it through

Working on the flats had an upside for Raubenheimer in particular: It gave Whit, a Labrador-golden retriever mix, a chance to run and play. Whit may be the hardest-working member of the hard-working team. He was with Raubenheimer every step of the way, all day, every day, except when she went in the water to check an instrument. Then he watched intently from a boat, relaxing again only when she surfaced.

“Once we’d get out on the flats, I could just take his harness off,” she said. “He got to run around the whole time, and I got to just walk next to whoever I was with. There wasn’t much there to stumble into.”

Whit is a guide dog. Raubenheimer is almost completely blind.

Courtesy of Britt Raubenheimer, WHOI



When time and tides allowed, Raubenheimer (left) enjoyed hiking across the flats and letting her hardworking guide dog run free.

Her sight failed suddenly in 2003, soon after the swash zone fellowship program began. "I woke up one morning with the vision gone in my right eye," she recalled. Within a few months the vision in her left eye had also declined, leaving her with just a 20-degree field of view. Her optic nerves were atrophying, but her doctors didn't know why. For a while they thought she might have multiple sclerosis, a terrifying possibility that had Raubenheimer anticipating the progressive loss of muscular control as well as her vision.

"Then one day they called and said, 'You don't have MS, you're just going blind!' " That actually was good news; it meant just one thing to deal with, she said.

But the next couple of years were rough. "There was a lot to learn," she said. As her vision continued to deteriorate (now down to one degree of vision in the left eye), she found ways to do almost everything she did when sighted. With verbal guidance from Steve, she even skis.

In the office, she reads papers and views data on a computer with help from software that reads what's on the monitor. In the field, she concedes little. She excels at underwater work, in part because the poor visibility at most of their sites doesn't bother her; she's used to working by feel.

"She could do everything that we could, and sometimes much better," said Giffen. Raubenheimer even dug a trench that first day on site. "The funny thing was, Britt's ditch was so much straighter than Steve's," said Kilgallin.

**Now comes the hard part**

When the students got back from the Skagit flats in the fall, the hard physical labor gave way to intense mental work as they began analyzing their data. Their projects produced useful results about how the currents, tides, substrate, and winds influence the movement of sediment on the flats in summertime.

They also started thinking about what to do after the fellowship. Thirteen other students had participated in Raubenheimer's program before them and have gone on to do a variety of things. As of this writing, six of the 13 are in or have graduated from doctoral programs (three in oceanography and one each in mathematical biology, physics, and geology); one is a research associate at WHOI; one is still an undergraduate; and one took a quite different—and notable—path.

"She thought she wanted to do science research, and it turned out she didn't really like doing the science," said Elgar. "She was a great fellowship student, made a contribution, gave it her best, but when she was done she said, 'You know, one thing I learned was that this isn't really what I like. I really am more comfortable doing something else.' " She went to Harvard Law School and is now being interviewed to be a clerk for a Supreme Court justice.

"We don't get upset if they don't do oceanography," said Elgar. "I'm proud of Britt that her swash zone fellows are almost all doing good things. And that's the point. The point is *not* to turn them into technicians to work for us for the rest of their lives. It's for them to figure out what they want to do, and if it is something that we can help them with, to help them."

The 2009 students said their swash zone experience had persuaded them of two things: that they liked research and wanted to pursue it as a career in some form; and that they did not want to rush their choice.

Having seen firsthand how demanding research is, they wanted to explore other fields to be sure of their decision before making the commitment.

The next summer, though, found them all back in the swash zone. Elgar and Raubenheimer hired them to assist in their research on sand movement along the beaches at Duck, N.C. After the 2010 field season, Giffen took a job with an environmental consulting firm in Seattle, and Zippel, Kilgallin, and Yopak continued to work at WHOI. All four are considering their options for graduate study.

That unhurried strategy worked for Rachel Horwitz, who was Raubenheimer's first swash zone fellow back in '03. After her fellowship she worked as a data analyst with the U.S. Geological Survey for two years before taking the plunge into graduate school. She is now a doctoral student in the MIT/WHOI Joint Program, studying the coastal ocean with physical oceanographer Steven Lentz.

Horwitz credits Raubenheimer with giving her the experience to feel confident about where she was heading.

"Getting to go out in the field for that long is pretty awesome," she said. "You really see everything that goes right and goes wrong, and then you see how it all works out in the end. I definitely came into the program knowing what at least one kind of fieldwork was like.

"She got me hooked."

*—Cherie Winner*

*Elgar's and Raubenheimer's work on swash zones is supported by the Office of Naval Research and a National Security Science and Engineering Faculty Fellowship. The swash zone fellows program was supported by the National Science Foundation. Despite the program's success, the 2009–10 class of swash zone fellows will probably be the last. The NSF grant is not renewable, and neither, unfortunately, is funding for the fellowships. Raubenheimer said that she has not been able to find an agency that supports small, targeted programs like hers.*

Courtesy of Britt Raubenheimer, WHOI

Above, Raubenheimer and Whit enjoy a short hike on dry land. Below, Sean Kilgallin (left) and other team members carry equipment to a sampling station farther out on the flats.

Courtesy of Britt Raubenheimer, WHOI

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