From The Director

For forty-four years and through nine chairs/directors, Mark Holmes has been associated in some capacity with the School of Oceanography—beginning as a graduate student in 1963, then as a staff member and affiliate faculty member during a long successful career at the USGS (United States Geological Survey), through his role as research professor after his 1995 retirement from the USGS. Since 1988, he has anchored the senior field course—the steady influence among a team of four that in this span has included twenty different faculty members. Mark’s passion for and understanding of both the art and science of sea-going oceanography will be greatly missed as he steps his workload down a notch and toward research.

Taking on the anchor role will be Rick Keil, for the past three years Associate Director for Undergraduate Education. Rick brought great energy and effectiveness in building new awareness of our undergraduate major, “the small school on the large campus”. In his tenure, undergraduate enrollment has increased more than 60% and remains on an upward trajectory. The unique publication in your hands reflects his gentle touch in bringing a group of undergraduates together each year to offer this unique perspective on what we do.

Gabrielle Rocap has agreed to take on this key administrative role when Rick steps down at the end of June. For her first five years at UW, Gabrielle was a part of the capstone team, a member that Mark Holmes described as “relentlessly motivating” to both students and her faculty colleagues. I look forward to working with Gabrielle in the coming years.

We are proud of the experiential education we offer—bringing the value of world–class research into the lives of our undergraduates. I am excited by our being very close to our fundraising goal that will establish the Richard H. Fleming Professorship, rewarding faculty excellence in working toward this core value of the school. To push us over the top, in combination Alyn and Alison Duxbury and Jed Hirota have pledged 1:1 matching of the next $30,000 of contributions toward this professorship. To see how to help, visit http://www.ocean.washington.edu

Russell E. McDuff
Director
My wife and I wish to express our appreciation on receipt of your recent issue—the Galapagos edition. We are particularly impressed by the School’s program of open sea experience, individual research, and formal presentation of results as an essential part of undergraduate education.

I know T.G. "Tommy" Thompson would be delighted to see his interest and activities in this area formalized.

I had the great good fortune to be the beneficiary of this interest. In the spring of 1935, as a sophomore in Chemical engineering, I was taking Tommy’s course in Qualitative Chemistry. At the end of a lab session, I was summoned to Dr. Thompson’s office. I had good reason to be apprehensive, fearing that one of my many peccadilloes had finally brought Cliff Barnes—currently Quant lab assistant—to report me to a higher authority. Instead, Tommy informed me that, because of an unexpected vacancy, he was able to grant my earlier request for a weekend cruise on the CATALYST.

Now, I had made no such request and my only reference to "catalyst" derived from laboratory usage. Somehow, I managed to avoid betraying my ignorance and confusion, mumbled my thanks, and stumbled out to seek enlightenment elsewhere.

Once aboard, my Scandinavian ancestry and naïve enthusiasm allowed me to pass muster with Captain Christian Larson and Cook Louie Mortenson. And even, for no reason either of us could recall or understand, with Dora Henry. By the end of the cruise, I had been designated shipboard chemist, galley slave, and full time resident caretaker while in port. No salary—Magnusson had not yet untied the federal purse strings, but free room and galley privileges were most welcome for my next two years.

In late 1938, Tommy broke tradition by inviting two undergraduate women chemists to participate in a weekend cruise on the CATALYST—Florence Ottenson and Lois Smith. By this time, I was employed by the US Fish and Wildlife, in charge of an oceanographic survey of Bristol Bay, and had laboratory space in Old Oceanography for sample analyses and data reduction. In spite of a disastrous first encounter, Florence was finally able to bring herself to accept my job offer to assist in the analyses and data reduction. It took two years before she would go out on a date with me and two more before she would accept my proposal—but she has managed to put up with me ever since.

In the meantime, Lois Smith became Mrs. Robert Paquette—Tommy was quite the matchmaker. We close with our best hopes for continued success of the Student Oceanographic Society.
Aside from the many great times in the classroom and aboard ship with our undergrads, I think that my best memories have to do with what our students do once completing the program. They come back and tell us either in person or through e-mails or letters how much the program has helped them and how much the program has meant to them after graduation. It’s always been interesting to me how a lot of the things that we teach sink in but don’t really come into play in their consciousness until they’re out in the world and into their graduate studies or consulting companies or government service. When they have to put their lessons and knowledge into practice, students realize that they learned a lot more in retrospect.

First cruise
Although my first cruises were local (Puget Sound and offshore) aboard Brown Bear, my first deep water cruise was in 1964 on Burton Island, which was on a U.S. Navy icebreaker. She still had armament, and that was also in the days well before the 200-mile limit of Exclusive Economic Zones. During all of our work in the Arctic we were able to go within 12 miles of the Soviet coast perfectly legally. The main excitement occurred twice a day when Soviet bombers would come out and fly very low over us just to make sure we were minding our own business and were well outside the 12-mile limit. Our mission was to transit the Bering Strait, proceed across the East Siberian, Laptev, Kara, and Barents Seas to Bergen, coring along the way, but we suffered propeller damage in the Laptev Sea and had to turn around and limp home. In those days, it was a very different world as far as carrying out oceanographic research: no GPS, no CTD, no swath mapping systems, no satellite weather forecasts and no e-mail. You had to be an accomplished mariner as well as scientist. That’s been lost for the most part; many folks let technology isolate them, even aboard ship, from the oceanic environment.

Steering the seniors: involvement with the capstone classes
My first involvement with the capstone courses came in 1988 when I was still with the U.S. Geological Survey and had an affiliate faculty appointment with Oceanography. I was immediately addicted to the energy and enthusiasm which the undergrads brought to the program. I quickly came to regard the courses as the best teaching job on campus. I got to deal with some of the UW’s brightest students, I got to introduce them to the scientific method, and best of all, we got to play with ships together. But after 20 years, a nice round number, it’s time that I stopped having all the fun and gave someone else a chance.
Advice for students continuing in the field
I would remind them, particularly if they weren’t going on to graduate school, that these days they become part of the global workforce. When they’re looking for those first jobs, they shouldn’t limit themselves to the Seattle area but reach out and go wherever opportunity beckons. You should never hesitate to take risks. If you’re presented with an interesting and challenging opportunity, even though that opportunity might be completely unexpected and might seem a bit out of line with your expertise and field of knowledge, sort of go with the flow and take a chance. In this way you end up in a lot of very interesting and educational situations. So that would be my advice: take risks, let serendipity play a role in choosing a flexible career path and don’t try to preplan things too rigidly.

Up next: moving forward by going back
My aim is to get back into research, which has been pushed aside by my teaching responsibilities. I’m excited to be working on two proposals now. One involves earthquake hazards research in Puget Sound and another, with Paul Johnson, Susan Hautala, Marv Lilley, and USGS colleagues, involves humongous gas hydrate deposits in the deep Bering Sea basin. So I’m looking forward to starting another career, my fourth—it’s never too late. I think my retirement is still a few years off.
We had planned to use the spring quarter to finish our senior thesis projects. We were prepared to sail, to stand watch, to deploy corers, nets and CTDs. We were prepared to spend hours in the lab analyzing our samples and pondering our findings, prepared to sweat out the details of our research at all hours of the night, prepared to lose sleep and to work hard. We were not prepared to do all of these things aboard an icebreaker in the Antarctic.

When we were asked to go to Antarctica to do Kasten coring in conjunction with a glaciology project, we scrambled to rearrange our lives—and our minds—to plan for the trip. It was, simply put, the opportunity of a lifetime. We spent weeks organizing and agonizing over everything from how warm of a jacket to bring to how many coolers we’d need for sediment samples to what brand of electrical tape would work best in sub-zero temperatures.

In the end, the warm jacket, coolers, and electrical tape were small matters, and though we’d packed meticulously, we were not primed for the experience—for the adventure—that we found aboard the R/V IB (Icebreaker) Nathaniel B. Palmer.

The science kept us busy during our 12-hour shifts; we were taking Kasten cores as close to the ice fronts as possible and using $^{210}$Pb analysis to calculate sedimentation rates in the fjords in front of the glaciers. We weren’t the only group aboard, though, and our time was divided between our Kastens and the other myriad of projects undertaken by the scientists aboard. There was always something to do in the labs, but there was also always something to see or experience outside of them.

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Catastrophic Calving of the Trooz Glacier

As I entered the lab one day for shift change, I was forewarned by various people that we were about to depart the fjord and that this was the last chance to take photos of the Trooz Glacier — we were extremely close to it. I decided to grab my camera and make it out to the back deck where everyone was admiring the immense structure beside us. We were all snapping pictures and laughing at the people attempting to model when the cracking sounds began and the first small pieces fell into the water. We gasped and then giggled at what we had just witnessed, watching the birds scurry away and fly rapidly away. The pieces of ice falling off of the glacier grew bigger and bigger. Twenty seconds later, a whole side of the shelf fell off and the marine technicians were racing as inside to save our lives. As we scrambled up the deck to avoid the gigantic wave approaching us at alarming speeds, the ship was also racing out of the bay to avoid as much damage as possible. Luckily, we were all safely inside when it bit and deposited an immense amount of ice and water on the back deck. If anyone had been standing outside when it struck, the freezing waves would have pulled them into the water. None of the equipment was tremendously damaged, however one of the metal cones carrying the gear for the "crumpers" was severely dented inward. Despite the danger of this event, the spirits of the crew and science party were high. The rest of the day was spent watching the few videos taken by the science party and laughing in wonderment at the memories.

The Frozen Jumbo Piston Core

The core was stuck completely and totally stuck. It was midnight, and we'd just taken an 80-foot-long jumbo piston core in the Weddell Sea. It was so cold that the sediment and plastic lining were frozen to the inside of the core barrel. The hydraulic press couldn't budge it, and the barrel of the piston core was so long that it had to be secured to the outside edge of the starboard side of the ship. Since we hadn't gotten the core out, we were left holding the barrel steady as it hung out over the water. There were six of us crowded together at the back corner of the deck, holding the frozen barrel with frozen hands and looking out at the frozen sea around us. My biceps were burning from the effort — the only warm part of me — and we stood there for three hours while the marine technicians tried to free the core with hammers, hot water, and eventually plain torches. I stood at the edge of the ship, holding the core and looking out at the sea with miles and miles of solid ice in every direction, thinking that it was beautiful, and that it was the perfect night.

Brittany Kimball is an Oceanography/Geology double major and plans to save Puget Sound from chemical contaminants.

My First Penguin Sighting

We had just finished off-loading gear for the "campers," the on-shore scenic party on King George Island, and we were enjoying the beautiful sights that surrounded us. As I was trying to capture the immaculate scenery with my digital camera, I heard someone whispering, "Hey Brittany, look what's on the beach." I turned around and saw my first Adelie Penguin. I could not contain the glee in my giggle or footsteps. The penguin looked dumbfounded at all of the people on the beach, and it swiftly turned around towards the ocean, shook its tail feathers, and rushed into the water.
The Galapagos Islands are impossible to describe due to the magnificent nature that enthralls the eyes. Giant tortoises roam the land, and iguanas of all types and sizes bask in the sun. I was lucky enough to be included in Roy Carpenter’s Ocean 240 class, which traveled to this magical place in the summer of 2006. We began our class here in Seattle learning about the processes that formed these islands. While learning about what sustains life among the islands, especially marine life, I learned about the process of upwelling. This process supports the bottom of the food chain, which in turn provides food for every marine animal that lives or migrates to the islands.

In order to study this important process, I decided to design and build a CTD (Conductivity, Temperature, and Depth) instrument to measure water properties while in Ecuador. I built a PVC frame on which to mount the instruments and then used a Nalgene bottle to house a homemade pressure sensor (stolen from a car mechanic’s shop) and a thermistor from Radio Shack. It worked perfectly until the week we were scheduled to leave when my “pressure” (the Nalgene) failed. The death of my homemade CTD necessitated a change of direction, and I reluctantly chose to investigate the dominant lobster fishery throughout the islands. When we set out from Seattle I was slightly disheartened but enthusiastic nonetheless to be traveling to a foreign country.

Each member of our class was responsible for getting him or herself to Quito, the capital of Ecuador, to meet with Roy, where we then traveled together to the island of Baltra. From there it was a short boat ride to the larger island of Santa Cruz, where we stayed for a day meeting Jaqueline de Roy. The real magic began on the islands as we met with Jaqueline and fed the finches Darwin studied. The day culminated in a visit to the Darwin Research Station where we spoke with researchers in the fields we were studying.

Finally, we embarked on a tour of all the islands, which was scheduled to last for approximately a week. Our ship, the Beagle, was privately owned by one of the residents of the islands. We traveled at night from island to island and in the mornings would see and explore each one. Later in the day we would either go snorkeling to observe the abundant sea life or, we were “routed” south from Santa Cruz all the way around the biggest island, Isabella, then north again back to Santa Cruz.

This was the defining moment of the class, the last week while we were touring the islands and learning about the endemic wildlife and the issues that surround them. We saw amazing sights—baby sea lions being defended by their mothers against the Galapagos hawk, giant tortoises traveling many miles in search of food, the list goes on and on. One thing is for sure, I will never forget the weeks I spent in the Galapagos.
In 2005, a pair of mounds were discovered in southern Hood Canal by the University of Washington research ship, the R/V Thomas G. Thompson. These mounds measured as much as 40 m tall and 350-450 m wide. Both mounds were located within one nautical mile of each other just west of Dewatto Bay. Ultimately the mounds became the focus of my undergraduate thesis project. The goal of the project was to attempt to identify what the mounds were, and to do this I drew on the experience of numerous individuals within the UW School of Oceanography such as Mark Holmes, Paul Johnson, and Tom Pratt.

At the end of winter quarter of this year, students aboard the R/V Thomas G. Thompson revisited these mounds as part of the Ocean 443/444 cruise. The ship’s EM300 multibeam system was used to gather high resolution images of the features while the 3.5 kHz sub bottom profiler was used to image the structure of the mounds. The multibeam images showed that the mounds were elliptical and ran parallel to the shoreline but were asymmetrical, with steep northern slopes and shallow southern slopes. The sub-bottom profiles taken from the 3.5 kHz system revealed that the mounds extended as much as 20–30 m below the seafloor, indicating that the mounds may be glacial in origin, perhaps from the most recent glaciation which carved out the Puget Sound basin 16,000 years ago.

Given the shape and apparent age of the features, as well as the glacial till in sediment samples taken from the mounds, it is likely that these features are drumlins. Drumlins are elongated hills that run parallel to the direction of glacial movement and are dominant features in the Puget Sound lowland. The slopes and orientation of the mounds are consistent with other similar features in the region.

The two mounds of Hood Canal are likely part of a large array of drumlins—they typically form groups of hundreds to thousands of individual features. Previous cruises of the R/V Thomas G. Thompson have collected sub-bottom profiles indicating that there may be many more similar features that are buried 20–30 m below the seafloor in Hood Canal. Perhaps future students will be able to shed more light on these mysterious mounds.
In recent years, evidence of damage to the aquatic communities of Puget Sound has been overwhelming. Anthropogenic toxins affect every level of organism in our waters. Bottom feeding fish and top predators seem to be at the greatest risk. Male English Sole have been found creating female reproductive proteins in their liver, with higher incidences occurring near sewage outfalls. King salmon here in Puget Sound are the most PCB-contaminated salmon on the West Coast. Whales, which feed on salmon and other highly contaminated aquatic animals, may be in the greatest danger and are now considered the most contaminated marine mammals in the world.

Monitoring of Seattle area watersheds by the U.S. Geological Survey has found elevated levels of numerous pesticides following storm events. In recent years, in the Seattle-area watershed of Thornton Creek, the pesticide carbaryl was measured at 0.48 ppb (parts per billion), 24 times the recommended maximum aquatic concentration suggested by the National Academy of Science. Carbaryl is an insecticide that is widely used for commercial agriculture and aquaculture, and home lawn and garden maintenance. A recent court order prohibits the ground application of three dozen pesticides within twenty yards of “salmon-supporting waters,” but these pesticides may have negative indirect effects once they feed into downstream marine waters. Copepods and other zooplankton represent a major food source for juvenile fish, including salmonids, which may be equally at risk if exposed to these pesticides.

My research this spring was concerned with the influence of the pesticide carbaryl on the copepod *Euchaeta elongata*. I exposed the individual copepods, eggs and random samples of zooplankton from Hood Canal to carbaryl concentrations based on a log scale ranging from 1 to 100,000 ppb. Results for the *Euchaeta* experiment showed that short term effects are unapparent until concentrations of 100–1000 ppb, 200–2000 times greater than has been measured in Seattle area waters. The zooplankton community experiment results are less clear, but for most classes of animals short term effects were not obvious until concentrations were above 10 ppb, 20 times greater than has been measured in Seattle area waters.

While this project suggests that zooplankton, and hopefully larger aquatic species, are not directly negatively affected by short term exposure to the pesticide carbaryl, it does not explore the effects of exposure to multiple contaminants. The likelihood of aquatic animals only encountering a single chemical or toxin at a time is very slim. Today, in Puget Sound, whales and other aquatic fauna are rapidly diminishing in numbers. The human population needs to consider our effect on the environment and be mindful of what we introduce to the habitat around us before we lose animals, such as orca whales, forever.

Brianna Fox is majoring in biological oceanography. She is especially interested in how urban populations impact the marine life in coastal areas.
The School of Oceanography is proud to announce our 2007–2008 Undergraduate Scholarship recipients. Congratulations to April Bailey, our Backus award winner for outstanding senior; Evan Howard, our Johnson–Porath scholarship winner; Megan Prescott, our Ellerbeck award winner for outstanding incoming freshman; Cory Bantam is our Egedveld Scholarship winner, and special Egedveld book award winners Marie Salmi, Britta Voss and Hannah Darrin. Congratulations to these and all our outstanding undergraduates.

This coming academic year marks a new partnership for the School of Oceanography. We have a newly minted exchange program with the University of Southampton and their National Oceanographic Center in Southampton, England. With our equal exchange program, selected juniors in our school can now attend the UK’s premiere oceanographic education center (http://www.soes.soton.ac.uk) for one full academic year at UW prices and be guaranteed quality coursework that builds upon our offerings. Here at UW, we’ll be seeing UK students in their final year, and they’ll participate fully in our highly regarded senior thesis program. To learn more about how our new exchange program works, please feel free to contact me (rickkeil@u.washington.edu) or our student coordinator Michelle Townsend (mtown@u.washington.edu).

It is hard to believe that my three years as Associate Director for Undergraduate Education have come to an end. It has been a wild ride on the tailfin of our program. I learned that you can’t steer the beast very directly, but what a glorious beast our undergraduate program is. As I slide off the fin, a new rider climbs aboard. Newly minted Associate Professor Gabrielle Rocap (congratulations Gabrielle!) takes over the role of ‘visioneering’ our program. Gabrielle is wonderfully suited to the role, having recently been named the college’s outstanding undergraduate educator, and having taught in our senior thesis program for the past several years. Welcome aboard and hold on tight!

Richard Keil
Associate professor of Chemical Oceanography and a budding ukulele enthusiast.
Earth contains a vast array of diversity in the environments encompassed in the two hemispheres. From the ice-covered Weddell Sea, to the islands of the Galapagos, to the Puget Sound estuary, scientists ask questions, take samples, and dig for answers. In the pursuit of science and understanding, oceanographers cannot be restricted to studying only one of these enigmatic locales. Diversity of research as well as location is required to truly understand this planet on which we dwell, and the experience of UW undergraduates reflects this variety. From the farthest corners of the earth to our own backyard, and from the smallest phytoplankton to the biggest Antarctic glaciers, oceanography undergraduates of the University of Washington are contributing to some of the most innovative projects and helping to discover some of the planet’s most guarded secrets.