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After the Debris Flow

The catastrophic debris flow that affected Montecito, Calif., in early January, 2018 was the result of a rare confluence of severe events. The Thomas Fire had been raging for weeks in Ventura and Santa Barbara counties, and an unusually strong winter storm dumped half an inch of rain in five minutes on the newly-charred hills above the suburban enclave. With the tough vegetation that holds the hillsides in place burned off by the fire, tons of water, silt, burnt plant matter and rocks roared down the slopes and engulfed the community below, causing massive damage and the death of 23 residents.

As the community dug itself out of the mud in the aftermath of the disaster, Santa Barbara County's flood control officials were faced with a major problem: what to do with the slurry of silt and other debris that had flooded creeks, clogged catchments and buried homes. One solution: Take it to Goleta Beach for disposal, which they did later that month over the course of several weeks.

"They were trying to work alongside Mother Nature to get the debris material dispersed," recalled Heili Lowman, at the time a graduate student researcher affiliated with the Santa Barbara Coastal Long Term Ecological Research program, under the guidance of UC Santa Barbara ecologist John Melack. Wintertime into spring is the period of the most precipitation in the area, she explained, with waves and storms battering the coast and rains filling creeks that run into the sea, which could enhance dispersal of the material offshore.

For Lowman and her colleagues — who could see the county's progress on Goleta Beach from the Marine Science Institute on campus — the situation lent itself to a study exploring how far the debris from the emergency disposal would actually travel. Would it wash up somewhere else along the coast or would it move out into the open ocean? Would it accumulate in a marine habitat where it might cause ecological impacts? They conducted a study in collaboration with scientists from the University of Florida and the Université du Québec à Montréal, and supported by the Coastal Fund and the National Science Foundation (via the SBC LTER). The results of their study appear in the journal Science of the Total Environment.

Tracking Terrestrial Debris

"The high biodiversity of the Santa Barbara coast is due to the rich and productive mosaic of nearshore marine habitats that includes kelp forests, sandy beaches, surf zones, rocky reefs, surf and eelgrass beds and soft benthos, all closely associated in space," said UCSB coastal marine ecologist Jenifer Dugan. "This means that even in a small area of the coast, the impacts of debris disposal could potentially affect multiple marine habitats and their biodiversity. In light of this, increasing our understanding of the fate of this type of material and its disposal is a very important step in conserving these marine habitats and their biodiversity as we respond to climate change and the likelihood of future severe events here and elsewhere."

To get a sense of where the detritus from the debris flow had gone after it was dumped on Goleta Beach, the researchers collected samples from the beach and from Goleta Bay. They also sampled the sea floor in the nearshore zone south of Goleta Slough and along a transect extending westward. In order to determine whether the sediment was from a terrestrial source, such as the debris flow, they looked in particular for charcoal and compounds that indicate burned material and terrestrial plant matter. Using samples collected near the slough, which drains creeks that were not affected by the Thomas Fire, the scientists were able to compare sediments for a clear "charcoal signal" that was the definite sign of the material burned in the fire.

"The good news is that we did find that the debris material appeared to be largely removed from the beach," said Lowman, who is now completing postdoctoral work at the University of Nevada, Reno. "And we really didn't pick it up in the other intertidal sites that we sampled through time.

“Although the debris material was not detected in the shallow core samples on Goleta beach, it may have been buried by the large amounts of sand that moves from west to east along the beaches of the region,” Dugan added.

In the nearshore cores, however, the charcoal signal was strong, a sign that the debris hadn’t traveled very far from the beach.

“We can say with a high degree of certainty that the charcoal was basically sticking around in the marine sediment,” Lowman said. The nearshore zones in the Santa Barbara Channel are also home to diverse kelp forest communities that host fish, crustaceans and the occasional marine mammal and bird. The debris detected in shallower waters showed a fair amount of degradation, thanks to wave action, but some of the material in deeper waters were somewhat fresher. This is what scientists would expect from organic debris that had not been acted upon by microbes and degraded by the normal downstream travel, but rather transported rapidly from the mountains, then scooped up and placed directly into the ocean.

“This implies that a huge influx of organic matter from the terrestrial environment into the marine environment occurred in one big pulse,” Lowman said. “We saw evidence of fresh terrestrial material at water depths of around 20 meters.”

They did not assess the effects this debris may have had on the nearshore marine environment, Lowman added; this study was mainly to see if and how far the debris traveled.

“Goleta Bay supports eelgrass beds that are highly sensitive to sedimentation and an abundant community of subtidal benthic infauna,” Dugan said. “Some of the sandy beaches lining the bay are among the richest known in the world and surfgrass beds can thrive in the rocky parts of the shoreline.” The bay historically supported a large kelp forest that stretched from Campus Point to past the Goleta pier. That kelp forest had an unusual growth form that allowed it to flourish on the sandy benthos of the bay, Dugan added.

Given the increasing likelihood of severe weather events — the Thomas Fire was then the largest in California’s history, but has been dwarfed by seven wildfires since — it may not be the last time burned organic material from the mountains is transported to the ocean. Knowing the impacts these pulses of organic matter have on the nearshore community is important, according to the researchers.

“This study was to explore whether or not the debris material stuck around, and to motivate additional studies on the impact of this influx of material from the terrestrial environment into the marine environment,” Lowman said. “Now that we actually know that it’s here, we need to better study its impacts because it’s not being dispersed as far as we thought it might be.”

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