Craig Smith (University of Hawaii):

Whale falls, wood, or kelp: A bonanza for life in the deep sea

Most of the deep sea has a very slow supply of nutrients raining down from the surface waters. Whale carcasses that fall to the seafloor provide a sudden, concentrated food source, a bonanza for organisms in the deep sea. Different stages in the decomposition of the whale carcass support a succession of marine biological communities. Scavengers consume the soft tissue in a matter of months. Organic detritus from this stage also enriches the sediments nearby, for a year or so. The skeleton, however, supports rich communities for years to decades, both as a hard substrate for invertebrate colonization and as a source of sulfides from anaerobic decay of bone lipids. Microbes live off of the energy released from catalyzing chemical reactions, particularly oxidation of sulfide, and form the basis of chemoautotrophic ecosystems for as long as the food source lasts.

Wood and kelp falls appear to play a similar role, as islands of concentrated organic nutrients on the seafloor. In each case, locally intense decomposition of organic matter creates reducing and high-sulfide conditions.

The West Coast & Polar Regions Undersea Research Center (NURP) is supporting research by Craig Smith (University of Hawaii) and Amy Baco-Taylor (Woods Hole Oceanographic Institution), to track the progression of biological communities supported by decomposing whale falls and to compare them with wood and kelp falls. During October, 2002 these researchers used the ROV Tiburon, operated by the Monterey Bay Aquarium Research Institute, to investigate 3 whale falls, 4 wood parcels, and 6 kelp parcels off the coast of southern California.

Because one of the purposes of the study is to determine the pattern and duration of colonization on these falls, the experiment includes a range of ages for each type of fall material. One of the whale carcasses (a 35 ton grey whale) was towed into place by these researchers in 1998. They have dated the bones of the other two (natural) whale falls at 50 yrs and 80 yrs. The ROV dives showed that colonization of enriched sediment around the 1998 whale fall, including newly discovered species, is still active and is expected to last for several more years. This stage ended long ago at both of the older skeletons, but they still support sulfophilic communites and have changed little since they were discovered 15 years ago, suggesting that whale falls can act as a food source in the deep sea for a century or so, much longer than expected. Among other things, this raises questions about the impact of 18th and 19th century whaling on the biology of the deep sea.

Wood parcels were implanted on the seafloor in two groups, 3 years prior and 6 months prior to the ROV dives. These were cubes of untreated douglas fir, ~200 kg total, held in a nylon net bag and weighed down with steel ballast. The ROV dives showed abundant biological activity on the wood and in surrounding sediment, demonstrating that ecological succession at wood falls occurs over years to decades. Kelp falls were deployed 6 months and 3 months prior to the dives. The ~100 kg kelp parcels consisted of 4-5 kelp plants with their holdfasts, also in nylon net bags with steel ballast. In contrast to the whale and wood falls, the kelp were nearly gone after 6 months, by which time the main inhabitants may have been suspension feeders using the holdfasts as an anchor point.

One of the questions raised with initial discoveries of whale falls was whether they might serve as reservoirs for biological colonization of the more geographically isolated hydrothermal vents and cold seeps, another type of isolated low oxygen, high sulfide environment. Despite the common environmental characteristics of isolation, low oxygen, and high sulfide, Smith's research group found relatively little overlap between the biological communities at whale falls, wood falls, and kelp falls. Furthermore, they saw only modest species overlap between these communities and those at cold-seeps. This suggests that there may be specialized sommunities living on each type of organic enrichment, with modest exchange between them. Nonetheless, DNA-based studies on bathymodiolin mussels suggest, for example, that a small subset of the whale-kelp-wood-fall biota may colonize vents and seeps, and may contribute fundamentally to the vent-seep biota over evolutionary time.

web link: http://www.soest.hawaii.edu/hannides/galleries/Calbasins.html