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Corresponding Author
Ashish Sahu
e-mail: sahu81862@gmail.com

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Whale Fall Ecosystems- An Unknown Deep Sea Ecosystem

Ashish Sahu[1,2*], Pramila Sahadevan[1] and Mahender Singh[2]

Abstract

In nature, every death brings new life. A fascinating example is the whale fall ecosystem. When a whale dies, its carcass will sink down to the seafloor where it creates a unique ecosystem for bottom-dwelling organisms. In short, a whale fall is a food boon in this typically nutrient-poor region of the ocean and use up everything they can, until the last vertebra is decompose. Four stages of ecological succession in a whale-fall include mobile-scavenger stage, enrichment-opportunist stage, self-fulfilling stage and reef stage. Whale carcasses become hotspots for ocean life, which supports more than 400 animal species. Over 120 new species have been discovered living at whale falls including, *Osedax frankpressi*, polychaete worms (zombie worm and bone-eating worm), which were first discovered living on the bones of a gray whale in 2002. Carbon sequestration through whale falls, or carcasses is substantial. More than 1,45,000 tonnes of carbon are transferred to the ocean floor by the dead bodies of whales each year. These so called whale fall also greatly enhance the diversity of the deep-sea ecosystem.

1. Introduction

When whales die and sink, their carcasses known as whale falls (Figure 1), provide a bounty of nutrients for deep-sea organisms. Occasionally, a whale carcass will sink to the seabed and can support a complex biological community for up to 50 years. Whale fall with hydrothermal and cold springs are called the "oasis" of deep-sea life, providing food for sharks, octopuses, fish, worms, crabs and more.

2. History of Whale Fall Ecosystem

Mysterious ecosystems that live off the bodies of dead whales may date back to the time of the dinosaurs. Whale falls are quite a new burning topic, even in marine science. The first direct observation of a whale fall happened in 1987. Whale-fall ecosystems were first studied in 1988 by a team of researchers at the University of Hawai, led by Craig Smith. Experts said that at present, less than 50 modern natural whale falls had been found in the world and the newly discovered whalebone has a long-term observation value for the change of the marine environment (Smith et al., 2015)

Author's Address

[1]Kerala University of Fisheries and Ocean Studies, Faculty of Fisheries, Panangad, Cochin, Kerala (682 506), India
[2]ICAR- National Bureau of Fish Genetic Resources, Lucknow, U.P. (226 002), India

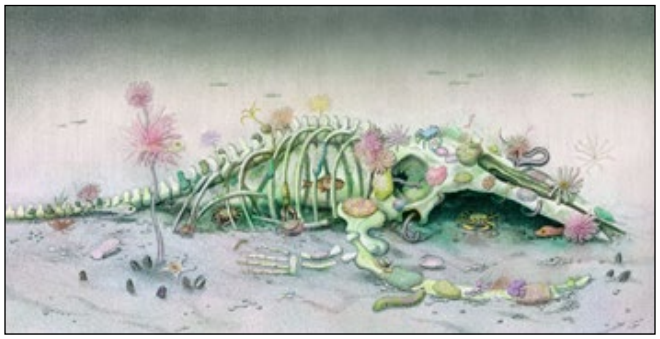

Figure 1: Strange and unique whale fall ecosystem of the ocean (Source: Marlow, 2019)

3. Stages of a Whale Fall Ecosystem

Researchers have concluded that there are distinct phases in a mysterious whale-fall ecosystem (Smith and Baco, 2003).

a) Mobile-Scavenger Stage: The first wave of organisms, scarves, hagfish, gigantic sleeper sharks, rat-tails and larger crustaceans remove whale soft tissue at high rates (40-60 kg day^{-1}). It lasts from months to one and half years.

b) Enrichment-Opportunist Stage: In this stage, molluscs, smaller organisms (such as worms and crustaceans) dig through the sediment to find bits of decomposing tissue. Animals also colonize the bones. This stage lasts from months to four and half years.

c) Self-fulfilling Stage: This is one of the longest stage, lasting between 50 to 100 years, also called *sulphophilic or 'sulphur-loving' stage* because hydrogen sulphide is produced through bacterial breakdown of organic matter, such as in this case the lipid-rich bones and the carbon-enriched sediment around the carcass, eg. Sulfur-oxidizing bacteria, like chemosynthetic clams, are known as *Vesicomyids*. This sulphide is nutrition for another microorganism community, made up of so-called chemoautotrophic bacteria. These can be free-living, mat-forming bacteria that cover the bones and sediment surfaces. They can also act as endosymbionts, living inside other organisms where they are responsible for their nutrition and survival. The genus *Osedax frankpressi*, polychaete worms (bone-eating worms), this variety of worm bores away at the bones of the whale carcass.

d) Reef Stage: It is the final stage of the whale-fall ecosystem. The fat depleted bones are fed on by suspension feeders and become the home of a diverse community of bivalves, barnacles, tunicates, sponges, as well as potentially a variety of cnidarians, such as anemones, hydrozoans and corals.

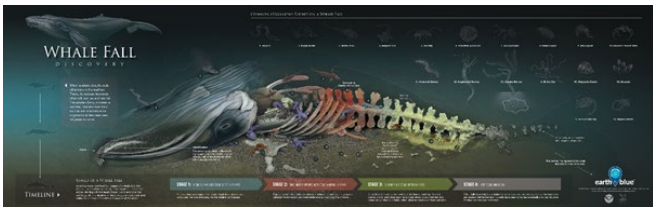

Figure 2: Whale fall stages and their communities (NOAA's Office of National Marine Sanctuaries)

4. Importance of Whale Falls Ecosystem: Their Future is Our Future

i. Provide the home and shelter for deep-sea animals

ii. Support the biodiversity of deep-sea ecosystem

iii. Provide the nutrients and food for bottom dwelling animals

iv. Help in the transfer of plankton and nutrients

v. Help in carbon storing from atmosphere (dramatically enhance carbon sequestration)

vi. Control the impact of climate change

One whale fall into the seafloor, as through blue breeze, gave life to other organisms. This is the whale's last gentle gift to the sea. Whale falls are like a jackpot for deep-sea species, providing an incredible source of nutrients for a variety of creatures, which live in deep-sea ecosystems where food is hard to come by. Deep-sea animals can feed on the body for decades afterwards.

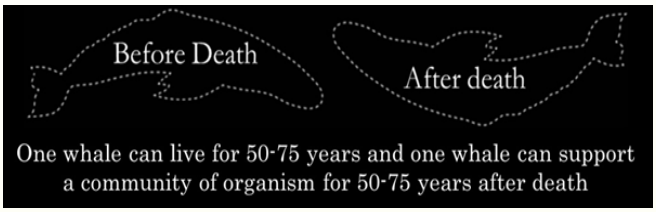

Figure 3: A supportive organism after death

More than 400 animal species maybe more depend on one whale fall. These "whale-falls" attract a diverse array of creatures from sleeper sharks to 'snow-boarding' worms and are considered important habitats for generating species diversity in the deep sea. Organisms that have been observed at deep-sea whale fall sites include giant isopods, squat lobsters, polychaetes, prawns, shrimp, lobsters, hagfish, *Osedax*, crabs, sea cucumbers and sleeper sharks. Over 120 new species have been discovered

living at whale falls including, the *bizarre Osedax* bone-eating worms. Along with whale falls, the vast amount of nutrients, and phytoplankton of the euphotic zone transfer from the surface to deep water.

Whales can play a significant role in carbon sequestration, or the removal of carbon from the atmosphere through accumulating large amounts of carbon in their bodies, which after death often sink to the sea bottom, which is primary mitigation to climate change. Approximately 2 million grams, or more than 2,000 years of background carbon flux, can result from a single 40-ton gray whale carcass fall.

A dead whale can affect the ecosystem by introducing nutrients to the seafloor. Whale falls are rare, but, generally occur worldwide along migration routes as well as in whale breeding and feeding grounds where the carcasses provide persistent and organic and sulphide-rich habitat and food for many species at the seafloor.

Figure 4: Creature of a Whale falls (Source: NOAA)

5. Conclusion

Whales that end up on the beach make headlines. But those that sink to the bottom of the ocean make new homes for sea life. When a dead whale reaches the seafloor, it brings a lot of resources to an ecosystem, which is usually limited by food availability. Whale falls can thus be considered as sources of evolutionary novelty and biodiversity in the deep sea. Research shows that whales are essential contributors to healthy marine ecosystems, healthy fish stocks and sequestering carbon to combat the increasing impacts of climate change.

6. References

Smith, C.R., Glover, A.G., Treude, T., Nicholas, D., Higgs, N.D., Amon, D.J., 2015. Whale-fall ecosystems: recent insights into ecology, paleoecology and evolution. The Annual Review of Marine Science 7, 571–596.

Smith, C.R., Baco, A.R., 2003. Ecology of whale falls at the deep-sea floor. Oceanography and Marine Biology: An Annual Review 41, 311–354.