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The Role of Fish Food in the Deep Sea Which Plays an Important Role for Revisiting the Fishes

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Abstract

The massive pelagic animal carcasses that descend to the ocean floor provide an abundance of food for the deep-sea benthos, although natural food-falls have only occasionally been seen. Here are reports about the first sightings of a whale shark and three mobula rays as enormous "fish-falls" on the deep sea floor. These findings are the result of commercial remotely controlled vehicle video studies of the seafloor along the continental margin of Angola. Up to 50 scavenger fish, predominantly from the family Zoarcidae, appeared to live on or around the carcasses, which supported moderate congregations of scavenger fish. We calculate that the elasmobranch carcasses served as food for travelling scavengers for extended periods of time, ranging from weeks to months, based on a global dataset of scavenging rates. With the exception of possible sulphide-oxidizing bacterial mats that surrounded one of the mobulid carcasses, no signs of whale-fall type communities were seen on or near the carcasses. We determine that the corpses described here constitute an average supply of carbon to the nearby seabed of 0.4 mg m2d1, which is equivalent to 4% of the typical particulate organic carbon flux, using the best estimations of carcass mass. The biological pump that moves carbon from the surface oceans to the deep sea operates more effectively when there is a rapid flux of high-quality labile organic carbon in fish carcasses. We hypothesise that the high surface primary productivity in the study area, coupled with a local concentration of large marine animals, is what causes these food-falls.

Keywords: Animal carcasses; Whale shark; Primary productivity; Marine animals

Introduction

The majority of deep-ocean organisms rely on debris from the surface waters as their main food source when there is no sunlight. This is primarily made up of dead plankton and faecal pellets that zooplankton create and export as tiny particles of "marine snow" to the deep bottom [1]. It is thought that Particulate Organic Carbon, which plays a significant role in organising deep-sea habitats, exports exponentially less POC to the deep sea as one descends in depth. The benthic population below can be significantly impacted by temporal variations in the quantity and quality of POC, and certain creatures seem to have evolved specifically to respond to these changes.

The remains of large plants, algae, and animals arrive as bulk packages that produce areas of significant organic enrichment, but the majority of detritus reaches the seafloor as millimetre-sized particles of marine snow [2]. The use of wood and other plant remnants in the deep water was the subject of early research into this phenomenon, and baited video traps revealed a variety of scavengers who consumed animal carcasses. Additionally, reports of accidental images of whole mammal carcasses and skeletons on the deep-sea floor sparked debate over the part that food-falls play in deep-sea food systems [3]. In particular, it was questioned if food-falls could be sufficient in frequency to support apparent specialised scavengers.

The accidental discovery of an entire whale skeleton at bathyal depths off the coast of California brought these debates to light. It's interesting to note that the skeleton supported chemoautotrophic fauna that thrived on hydrogen sulphide produced by the anaerobic breakdown of skeletal lipids, similar to that found in hydrothermal vents [4]. This result demonstrated that the greatest food-falls may serve ecological functions beyond just feeding scavengers. These ecosystems move through multiple biological stages in which various trophic guilds predominate, according to later investigations of both naturally occurring and experimentally implanted whale carcasses. The relatively high species variety at whale-fall habitats, including specialists like the bone-eating Osedax worms and bone-eating snails Rubyspira, is due to this ecological succession [5]. Thus, by expanding the breadth of ecological niche space, whale-falls may significantly contribute to conserving biodiversity throughout ecological and evolutionary time scales.

The larger size of whales, the high lipid content of their bones, and their multi-decadal persistence on the seafloor have all been linked to the increased variety associated with whale-fall habitats. However, studies on the fate of vertebrate remains at bathyal depths have only focused on either small porpoise and dolphin carcasses or large whale carcasses, such as those of the blue whale [6]. There has been much speculation about the ability of non-mammalian food-falls to host whale-fall type communities and the size required to attract and sustain whale-fall communities. Here, we describe the accidental finding of a number of sizable "fish-falls" off the coast of Angola, which included the remains of a whale shark and three mobulid rays. We go over the related fauna and how these significant food falls affect deep-sea ecosystems.

Results and Discussion

The carcasses of three mobulid rays and a whale shark were accidentally discovered on the bottom at bathyal depths on the Angola continental margin during normal seabed surveys that were place over the course of two years [7]. Natural food-falls are extremely uncommon;

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in five decades of deep-sea investigation and photography, only nine vertebrate carcasses have ever been recorded. It is unusual to discover four in such close proximity, which suggests that massive food-falls are frequent in the area. The creatures included here have unclear causes of death, and the majority of their carcasses look as though they arrived at the seafloor whole [8]. Ship strikes and unintentional entanglement are frequent causes of anthropogenic mortality for whale sharks and mobulid rays off the coast of Angola, yet there is no focused fishery for these species. Shark and killer whale opportunistic attacks are typically the cause of natural demise.

Whale shark carcass

Whale sharks have only lately been discovered in the ocean waters around Angola, and they seem to frequent areas with water depths of more than 1,000 m. Due to their preference for deep waters, deep-sea scavengers in this region may frequently encounter whale shark carcasses as a source of food [9, 10]. A whale shark's remains were discovered dorsal-side up on the seafloor at a depth of 1210 metres. Only the front of the body, which included the fleshy head, pectoral fins, pectoral girdle, and a section of the spine trailing behind, was still visible.

We can only guess at the corpse' real size in the absence of a precise scale. Eight of the ten whale shark sightings off the coast of Angola that Weir recorded were thought to be between 5-7 metres long. One animal was measured to be about 15 metres long after being monitored for a long time swimming adjacent to an oil platform [11]. The stranding records of individuals measuring 11.5 m and 15.9 m in length provide additional evidence of huge whale-sharks off the coast of Angola. We may calculate that the cadaver filmed here would be roughly 7.3 m long, equal to about 3,600 kg of body mass, if the mean length of the seen sharks reported by Weir is accepted as indicative [12]. Using the video footage as a guide, the following anatomical measurements of an 8.75 m long specimen can give some context for the magnitude of the structures seen here: Its mouth measured 1.7 metres in width, and 2 metres separated the nose from the beginning of the pectoral fin. The pectoral fin was 0.67 m wide at its base and 1.47 m long along its outer margin.

18 zoarcids (eelpouts) cf. Pachycara crassiceps, which have also been seen at baited video traps in this location, flocked around the cadaver. Most of the fish stayed still on or close to the carcass, and no active feeding on it was seen [13, 14]. These Pachycara species, which spend a lot of time at the bait, are known for their characteristic "roosting" habit. Although certain zoarcids may take bait directly, their primary food is benthic fauna, especially small crustaceans like amphipods. Previous observations of Pachycara sp have shown them scavenging an elasmobranch carcass and making "long, deep groves" in the flesh as they consume amphipods that had dug into the flesh. These grooves are visible in the head region of the carcass, proving that the fish had aggressively consumed it [15, 16]. The absence of the posterior portion of the carcass may be explained by Witte's observation that all scavengers mostly consumed the dorsal portion of the elasmobranch carcass. Although no other animals were seen on or around the carcass, the camera was unable to pick up any possible low-density macro fauna.

Conclusions

Contrary to what was previously believed, food-falls of huge animal carcasses can occur often in some regions of the deep sea. This was demonstrated by the discovery of four enormous elasmobranch carcasses over a 1.48 km^2 area along the continental coast of Angola. Unlike bigger marine mammal carcasses, which tend to host a distinctive "whale-fall" fauna, these carcasses appear to support scavenger populations on the deep seafloor for weeks to months at a time. However, they are primarily important for mobile scavengers. Where oceanic circumstances produce zones of high productivity and draw planktivorous mega fauna, large food-falls may occur more frequently. Our findings imply that huge food-falls in such regions can be responsible for a sizeable amount of carbon export to the deep sea, roughly ten times greater than earlier estimates for a single taxon. A larger community of deep-sea scavengers will be supported by this increased export since a relatively high proportion of local surface primary production will reach the deep seafloor.

Acknowledgement

None

Conflict of Interest

None

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