

processes (e.g., sulfide and methane production) (Feldman et al., 1998; Braby et al., 2007; Goffredi et al., 2008; Smith et al., 2015). However, the majority of species at Monterey whale falls are background deep-sea taxa, with bone and seep specialists contributing less to overall richness than in some other regions (Lundsten et al., 2010; Smith et al., 2015). The site provides evidence that whale falls can serve as evolutionary stepping stones for vent and seep fauna, supporting the hypothesis of faunal connectivity among deep-sea chemosynthetic habitats (Feldman et al., 1998; Braby et al., 2007; Smith et al., 2015).

The Monterey Canyon whale fall case study highlights the ecological richness, successional dynamics, and evolutionary significance of whale falls as deep-sea oases and their role in connecting chemosynthetic ecosystems.

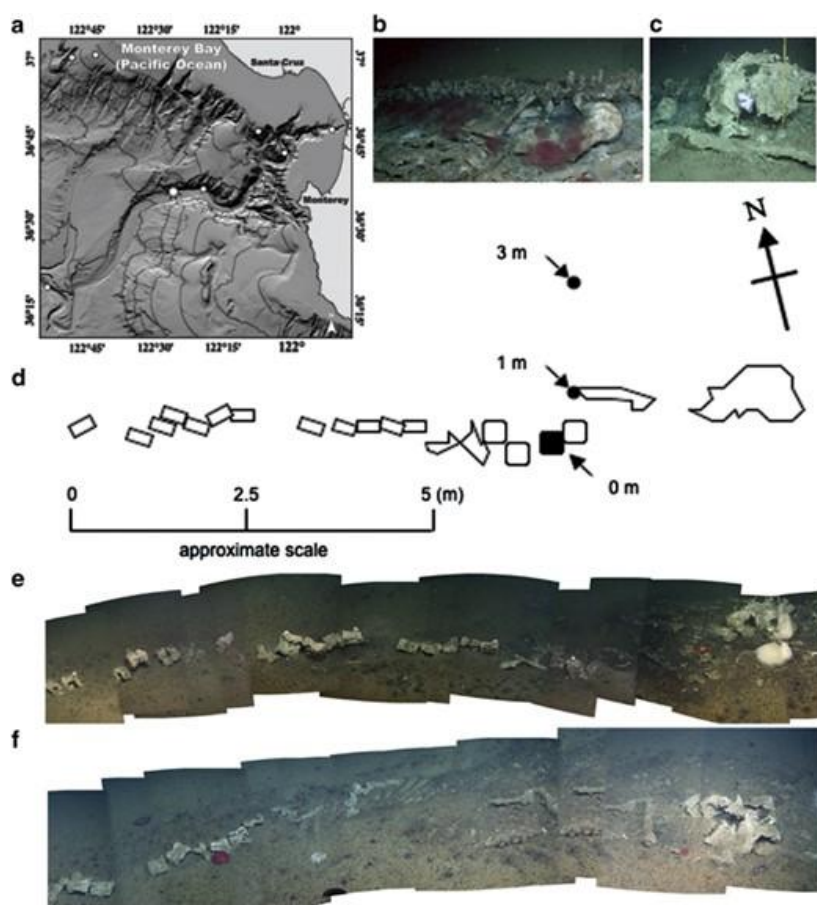


Figure 1(a) Shaded relief map of the continental margin off Monterey Bay showing the whale-fall location at 2891 m depth (large white star). Modified from Goffredi et al., 2004. (b, c, e, f) Photo mosaics of digital still images. (d) Schematic of the whale skeleton at 2893 m showing areas of sediment collections and sampling strategy. (b, c) At 33 months (dive no. T769, November 2004), (e) 45 months (dive no. T917, November 2005) and (f) 51 months (dive no. T991, May 2006) (Adopted from Goffredi et al., 2008)

8 Future Directions in Whale Fall Research

8.1 Gaps in current knowledge

Major gaps remain in the detailed understanding of microbial succession at whale falls. While the broad stages of faunal succession are established, the temporal and spatial dynamics of microbial communities—especially the interplay between sulfate-reducing, methanogenic, and sulfur-oxidizing microbes—are still poorly characterized, partly due to technical challenges in deep-sea sampling and monitoring (Smith et al., 2015; Moriya et al., 2016; Amendola et al., 2021). Additionally, the connectivity between whale falls and other chemosynthetic habitats (e.g., vents, seeps) is not fully resolved. While molecular and faunal evidence suggests whale falls act as evolutionary stepping stones and dispersal corridors for specialized taxa, the extent and mechanisms of this connectivity, particularly for meiofauna and microbes, require further study (Smith et al., 2014; Smith et al., 2015; Avila et al., 2023).