

The Ecology of Risk

(Presented at the North Atlantic Right Whale Consortium meeting, 2008)

Calanus finmarchicus, a calenoid copepod, is considered the most important food resource of North Atlantic right whales in the greater Gulf of Maine. After intensive long-term study in Cape Cod Bay, a major foraging area for right whales from late winter to mid-spring, *Pseudocalanus* spp., another group of copepods, appear to be the controlling resource during the beginning of the whales' residency in the Bay; *Calanus finmarchicus* enrichment later in the season appears essential to the eventual establishment of stable aggregations of right whales in the Bay. Data from boat-based bay-wide studies of zooplankton composition and distribution combined with bay-wide aerial right whale surveys offer a detailed representation of the zooplankton resource as the whales enter, reside in, and exit the Bay. During the winter-spring seasons reviewed (2003 to 2008), the whales enter the Bay before the *C. finmarchicus* resource had reached greater than 5% of the total zooplankton density, while *Pseudocalanus* spp concentration had already reached or exceeded 45% in four of the six seasons. Fine-scale examination of the two zooplankton genera in Cape Cod Bay reveals important differences in zooplankton behavior and depth distribution essential to predicting and managing the types of risk to which right whales may be subject. In particular, skim feeding is documented to occur when zooplankton form thick energy-rich layers at the sea-surface; hence, the whale's vulnerability to ship-strike increases when they feed upon surface layers more typical of *Calanus finmarchicus*. However, we have also observed right whales presumably feeding on dense bottom layers comprised almost entirely of *Pseudocalanus* spp. While feeding on such bottom layers right whales may be more likely to sustain mouth entanglements in ground lines used in commercial fishing. Therefore, we suggest that fine-scale observation of seasonal cycles of the influential copepod genera, and their distributional behavior will permit better forecasting of the conditions during which right whales are at increased risk of either entanglement or ship strike. We hope to continue some of this fine-scale study during the coming field season.

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