

Is the Walrus a Keystone Species Within its Marine Ecosystem?

Abstract

Over time, the definition of a keystone species has been challenged and redefined to refer to a species whose role within its community exceeds its abundance (Powers et al, 1996). Keystone species have an important ecosystem function that regulates other organisms at lower trophic levels by competing for limited resources (Davic, 2003). This controlling ability is often maintained through a process of interactions rather than by direct predation (Powers et al, 1996). If taken out of the ecosystem, a keystone species will disrupt the dynamic regime concept which states that there is stability within a space that relies on the internal attractions and relationships between species (Mayer and Rietkerk, 2004). When internal interactions are altered, the disruption attracts external forces which then trigger change within the ecosystem (Mayer and Rietkerk, 2004). Given this, is the walrus a keystone species within its marine ecosystem? I conclude that no, the walrus is not a keystone species based on historical evidence and the influence of other species interactions and influences on the ecosystem.

Defining the Keystone Species

Ecologists will agree that the most abundant species play major roles in controlling many community and ecosystem functions. Recently, experiments have shown that less abundant species also have strong effects on their communities and ecosystems. In 1969, Paine defined these species that have “high trophic status whose activities exert a disproportionate influence on the pattern of species diversity in a community” (Davic p 2, 2003) as keystone species. Today this definition is no longer accepted and a new definition has been expanded from Paine’s original thought. Keystone species is now characterized as one whose impact to the community or ecosystem is disproportionately large in comparison to its biomass or abundance (Power et al, 1996).

To apply this definition, the community importance index can be used. Community importance is the change within a community trait per unit change in abundance of a species (Power et al, 1996).

$$CI = [d(\text{trait})/dp] [1/(\text{trait})]$$

where p is the proportional biomass

If the absolute value of CI is much greater than 1, then the species undergoing this equation is a keystone (Power et al, 1996). Under this definition, keystone species are believed to occur within all the major ecosystems, are not always found in the highest trophic status, and can yield effects through consumption, competition, mutualism, dispersal, pollination, disease, and modification of habitats (Power et al, 1996).

Evidence has also brought up the idea of context dependency, stating that keystone species might not always be the dominant controlling factor at all times.

Instead, their roles may be keystone under certain conditions (Power et al, 1996). One circumstance may be diversity; the more species that are functionally similar within a community, the lesser degree a single species' role, thus suggesting that the loss of species diversity will place greater importance upon remaining species (Power et al, 1996). Another circumstance of context dependency is trophic position where the line between dominant species and keystone species is defined. Although keystone species may be found at all trophic levels, it is suggested that lower trophic level species have a greater biomass, consequently resulting in a lower importance per abundance whereas higher level trophic species are more dominant (Power et al, 1996). Time is another context dependence consequence. This goes to say that species co-existing in an ecosystem have different histories and interaction between each other. Recently introduced species may be more likely to play keystone roles because their interactions are typically stronger (Power et al, 1996).

Dynamic Regime Concept

Defining a keystone species is an important conservational step as pointed out by the dynamic regime concept. This concept states that ecosystems are maintained within a regime by internal variables (Mayer and Rietkerk, 2004). Such variables include the interaction between species populations coexisting within an ecosystem. When these internal relations are altered, the dynamics of the regime are shifted and then react with large scale external forces eventually leading up to an entirely new ecosystem (Mayer and Rietkerk, 2004).

To take the dynamic regime concept and place it into respect of a keystone species, the disappearance of such a population will result in changes between species interactions. Since the keystone species has a major role within its environment, the reduction of population size will shift the interior variables and cause a major disruption and alteration of the entire ecosystem. In order to maintain natural ecosystems, defining the keystone species and protecting them will allow for the conservation of that particular ecosystem. For example, when it was discovered that Sea Otters were keystone species and the hunting of them caused an ecosystem alteration (loss of kelp diversity and increase of sea urchin population) the sea otter was placed under protection and its ecosystem was conserved (Arens, 2005).

The Walrus

To determine whether or not the walrus is a keystone species, basic information about it should be known. Walruses are a species of marine mammals classified as pinnipeds. Pinnipeds are “fin-footed”, torpedo-shaped marine mammals consisting of 34 species that must return to ice or land for mating and giving birth (Behler, 1994). Most pinniped species form large colonies in which the males fight for both land and mating rights (Behler, 1994).

There is only one species of walrus but scientists recognize and accept two different sub-species; the Atlantic Walrus (*Odobenus rosmarus*) and the Pacific Walrus (*Odobenus rosmarus divergens*) (Vlessides, 2000). The genus *Odobenus* comes from the Greek meaning “one who walks on his teeth” which refers to the unique characteristic of the walrus: its tusks (Busch, 1999). The Pacific Walrus is larger, darker, more migratory,

and more numerous than the Atlantic Walrus (Busch, 1999). There is a total population of 150,000 to 200,000 Pacific walruses and an estimated 15,000 Atlantic walruses in the wild today (Busch, 1999).

Despite the two different sub-species, both the Atlantic Walrus and the Pacific Walrus graze for food along the ocean bottom using their sensitive bristles around their muzzle to find mussels, clams, and other small slowly moving animals (Wildlife Conservation, 1997). On average a walrus will consume 6,000 individual organisms, or about 120 pounds of food in a single feeding (Vlessides, 2000).

Connecting the Walrus to Keystone

Given this description, at a quick glance the walrus could be a likely candidate for a keystone species within its marine ecosystem. Both subspecies of walrus appear to have a relatively low biomass and can arguably have a large impact on their environment based on the amount of food they consume. Despite these characteristics, I conclude that the walrus is not a keystone species.

Evidence to support these conclusions is as follows. The walrus has a low biomass relative to the combined populations of other species within its environment. I combine the populations of other species (i.e. the variety of seals, penguins, whales, and larger fish) because they all contribute to an even bigger impact on mollusk populations than the walrus alone does. Although one walrus can consume a lot in one feeding, 6,000 individual organisms or 120 pounds as stated above, an even bigger variable effecting mollusk populations is the biomass of plankton available for consumptions (Seibel, 2003). Whales and small fish are the major predators of plankton (Seibel, 2003). Then

when you factor in the larger fish, penguins, polar bears, and seals that feed on these smaller fish and compare it to their effect on mollusk abundance, the walrus' huge appetite no longer appears to have as large an impact. It is this process of interactions rather than the direct predation of mollusks by walruses that has the ultimate effect on the ecosystem and points the walrus away from the keystone role.

In addition, a further study of this marine ecosystem history also proves the walrus to not be considered a keystone species. In the mid-1800's roughly 50,000 walruses were being hunted and killed every year because of their rich source of oil, leather, meat, and ivory (Busch, 1999). As their biomass was being worn-out, the ecosystem was not altered as an effect. When applied to the community importance index, as the abundance of the walrus species rapidly decreased, no records show that any characteristics or community traits of this environment were changed. This proves that there is another factor that balanced and stabilized the ecosystem when the walruses were being removed.

Conclusion

After further research of the keystone species definition, I have concluded that the walrus does not fit. To be a keystone species, influence must be disproportionately larger than biomass. Walruses have low biomass but their total control within the maritime ecosystem does not outweigh abundance. Other organisms have greater controlling effects on mollusks; it is not the large consumption from feeding walruses. History also shows that when a decrease and almost total extinction of walrus populations in certain areas occurred, the ecosystem did not witness any alterations.

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