

**PhD Dissertation**  
**Department of Environmental Science and Policy**  
**George Mason University**

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Title: From teeth to baleen: morphological adaptations associated with the loss of teeth and the evolution of baleen in mysticete cetaceans

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**ABSTRACT**

Baleen whales are unique among mammals by filter feeding with baleen plates, but the origins of this innovation remain unclear. Although baleen whales have toothed ancestors, the teeth to baleen transition remains obscure because few fossils demonstrate intermediate states and because the oldest direct evidence for baleen is approximately 10– 15 million years younger than its inferred origin. This dissertation reviews existing the existing hypotheses for the teeth to baleen transition and argues that they are fundamentally decoupled, separate evolutionary events. It describes a new, stem mysticete from Washington State that informs the evolution of tooth loss. It also directly evaluates the homology of internal structures in the mandibles of modern baleen whales to those of their toothed ancestors. Finally, it presents a new stem mysticete from Oregon that demonstrates that tooth loss wholly precedes the origin of baleen in whales. In doing so, this dissertation discusses key elements pertaining to the timing, mechanism and ecological drivers that result first in the loss of teeth and subsequent origin of baleen in whales. Cumulatively, these morphological transformations represent macroevolutionary transitions akin to the land to sea transition earlier in whale evolutionary history, as well as the transition from fins to limbs in early tetrapods or scales to feathers in dinosaurs.

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