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Fluid Dynamics in an Ecological Context[1]

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Fluid dynamics has long been an invaluable tool in the study of biological mechanics, helping to explain how animals swim and fly, how blood is pumped, gases are exchanged, and propagules are dispersed. The goal of understanding how the physics of fluids has affected the evolution of individual organisms provides strong impetus for teaching and learning fluid mechanics; a viable alternative to the more traditional goals of engineering. In recent years, a third alternative has arisen. The principles of fluid dynamics can be used to specify when and where individual organisms will exceed their physical capabilities, information that can in turn be used to predict species-specific survivorship in a given environment. In other words, biological fluid dynamics can be extended beyond the study of individual organisms to play an important role in our understanding of ecological dynamics. In a world where environmental change is of increasing concern, fluid dynamic aspect of "ecomechanics" may be of considerable practical importance. Teaching fluid mechanics in ecology will be discussed in the context of wave-swept rocky shores. Various wave theories can be used to predict the maximum water velocities and accelerations impinging on specific surf-zone plants and animals. Theories of lift, drag, and accelerational forces can then be used to predict the maximum loads imposed on these organisms, loads that can be compared to the organisms' structural limits to predict the fraction of the species that will be dislodged or damaged. Taken across relevant species, this information goes far towards explaining shoreline community dynamics. .

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