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Opinion Article

Coastal Dunes: Geomorphology and Classification of Coastal Dunes and its Threats

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DESCRIPTION

Coastal dunes, also known as sand dunes, grow where there is a plentiful supply of sand-sized debris and are found in the supratidal zone, landward of the beach. The size and shape of dunes in coastal environments are governed by the size and extent of sediment, the duration, velocity, and direction of winds in the coastal zone, as well as the size and spread of vegetation. The beach is where dunes develop and build when the wind is blowing onshore. When the wind blows offshore, the dunes convey silt back onto the beach or offshore into Open Ocean, where it may be brought back to the beach by waves.

When the wind carrying the sand hits a barrier, the sand gathers to form a dune system. Driftwood, debris, or masses of seaweed can all act as an obstruction, causing the wind's velocity to drop temporarily, halting the transfer of the sand and depositing it. Most of the time, salt-water resistant vegetation, either beach grasses or shrubs and trees, depending on the climate of the region, is the barrier that prevents enormous continuous sand dunes from forming. As a result of roots, vegetation increases sand deposition and serves to stabilize the dune system. When a beach is in balance with the prevailing conditions, the base of the dunes is not influenced by wave energy since the waves dissipate on the beach face during fair weather conditions.

Dunes of varied sizes and morphologies are generated depending on the features and availability of the sediment supply, dominating wind velocity and direction, moisture and vegetation present, and the geomorphology of the near shore and beach face. Sand deposition, accretion, and erosion in the coastal environment result in a variety of dune morphologies; however, they can be divided into primary and secondary dunes. Primary dunes are made up of sand blown directly from the beach face (active beach), whereas secondary dunes develop after primary dunes have been modified.

Fore dunes are shore-parallel, convex, and symmetrical to asymmetrical dune ridges that form at the back of the backshore habitats (landward of the active beach). Fore dunes come in a variety of shapes and sizes, but they can be divided into three categories: incipient fore dunes, established fore dunes, and relict fore dunes. Incipient fore dunes are the first dunes to grow above the high spring tide mark, and they form when a roughness feature at the back of the beach significantly limits wind flow velocities, causing sediment buildup. Although driftwood can serve as a focal point for the initial deposition of dune sand, vegetation is the most common roughness factor in the creation of incipient dunes.

Secondary dunes form as a result of aeolian processes continuing to modify the "primary dune," and are often found further inland, away from near shore processes. Blowouts, parabolic dunes, and transgressive dune fields are the most common secondary dunes. However, parabolic and transgressive dune field dune types can also form directly from the beach, and they are considered primary dunes.

The growth of parabolic dunes is frequently caused by the continued transport of sand through blowouts. An actively advancing snout and depositional lobe, as well as two trailing arms that encircle a deflation basin, make up these structures. This results in a dune with a distinctive U-shape (i.e., parabolic) or V-shape. Their long axis orientation is closely aligned with that of the primary wind direction as they evolve through time. Where there is a larger range of wind directions, shorter and wider parabolic dunes occur.

The downwind and alongshore migration of sand across vegetated to semi-vegetated terrain forms transgressive sand sheets and dune fields, which are relatively large-scale aeolian sand deposits. Transgressive sheets (like bed sheets) are generally flat to undulating, largely dune-free sheets, whereas transgressive dune fields are composed of diverse sorts of dunes on the surface. Mobile dunes, sand drifts, and migratory dunes are all terms used to describe transgressive dune fields. The destruction of a dune can be caused by a variety of factors. Natural vents, for example, which are eroded by storms, over wash, and sea flooding occurrences. The vulnerability of coastal dunes to flooding is determined by the dune system's characteristics, such

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as height, width, and conservation status. It also depends on the event's qualities.

Higher dunes are more flood resistant but may be more prone to erosion, whilst lower dunes may be more sensitive to floods. Climate change will result in a rise in mean sea level, more intense and frequent storms, and a more contrasting distribution of drought and precipitation between winter and summer. Coastal erosion and sea flooding threats will be altered as a result of these alterations. Dune dynamics are influenced by natural disturbances, which can be both common and unintentional. However, when these disturbances become more intense or frequent, or when they become less frequent, significant changes in community dynamics can ensue. Dunes are considered fragile because even minor disturbances might result in change and long-term gradual alteration of their ecological diversity can be easily exploited.