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F2.3 Seasonal Freshwater Lakes

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Vernal pool, Mather field, Sacramento Valley, California, USA.
Source: Jamie Kneitel

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BIOME: F2 LAKES
REALM: FRESHWATER

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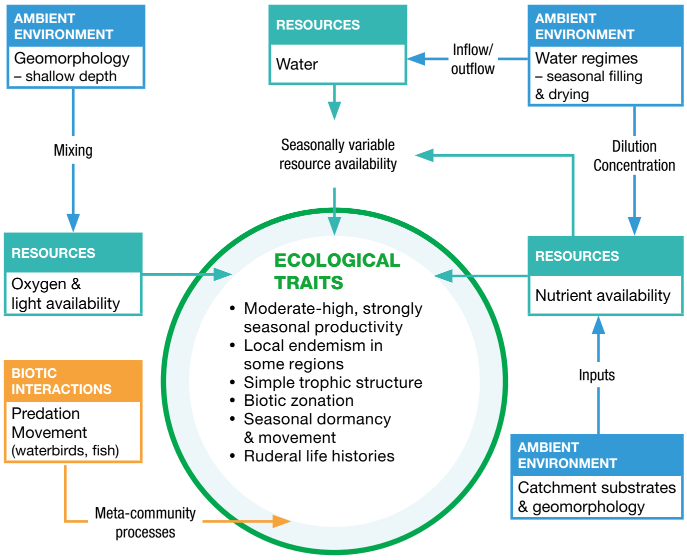
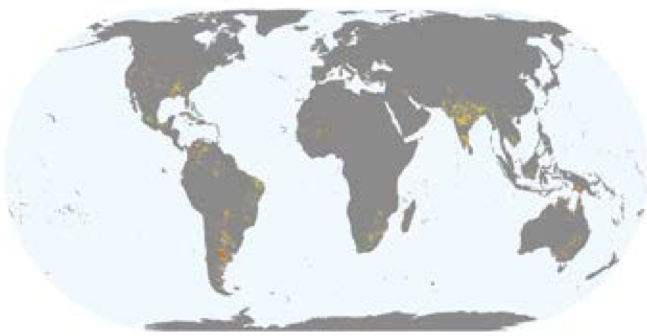


ECOLOGICAL TRAITS: These small (mostly <5 km^2 in area) and shallow (<2 m deep) seasonal freshwater lakes, vernal pools, turloughs, or gnammas (panholes, rock pools), are characterised by a seasonal aquatic biota. Local endemism may be high in lakes where hydrological isolation promotes biotic insularity, which occurs in some Mediterranean climate regions. Autochthonous energy sources are supplemented by limited allochthonous inputs from small catchments and groundwater. Seasonal variation in biota and productivity outweighs inter-annual variation, unlike in ephemeral lakes (F2.5 and F2.7). Filling induces microbial activity, the germination of seeds and algal spores, hatching and emergence of invertebrates, and growth and reproduction by specialists and opportunistic colonists. Wind-induced mixing oxygenates the water, but eutrophic or unmixed waters may become anoxic and dominated by air-breathers as peak productivity and biomass fuel high biological oxygen demand. Anoxia may be abated diurnally by photosynthetic activity. Resident biota persists through seasonal drying on lake margins or in sediments as desiccation-resistant dormant or quiescent life stages, for example, crayfish may retreat to burrows that extend to the water table, turtles may aestivate in sediments or fringing vegetation, amphibious perennial plants may persist on lake margins or in seedbanks. Trophic networks and niche diversity are driven by bottom-up processes, especially submerged and emergent macrophytes, and depend on productivity and lake size. Cyanobacteria, algae and macrophytes are the major primary producers, while annual grasses may colonise dry lake beds. The most diverse lakes exhibit zonation and support phytoplankton, zooplankton, macrophytes, macroinvertebrate consumers and seasonally resident amphibians (especially juvenile aquatic phases), waterbirds and mammals. Rock pools have simple trophic structure, based primarily on epilithic algae or macrophytes, and invertebrates, but no fish. Invertebrates and amphibians may reach high diversity and abundance in the absence of fish.

KEY ECOLOGICAL DRIVERS: Annual filling and drying are driven by seasonal rainfall, surface flows, groundwater fluctuation and seasonally high evapotranspiration. These lakes are polymicitc, mixing continuously when filled. Impermeable substrates (e.g. clay or bedrock) impede infiltration in some lakes; in others groundwater percolates up through sand, peat or fissures in karstic limestone (turloughs). Small catchments, low-relief terrain, high area-to-volume ratios and hydrological isolation promote seasonal fluctuation. Most lakes are hydrologically isolated, but some become connected seasonally by sheet flows or drainage lines. These hydrogeomorphic features also limit nutrient supply, in turn limiting pH buffering. High rates of organic decomposition, denitrification, and sediment retention are driven by water fluctuations. High alkalinity reflects high anaerobic respiration. Groundwater flows may ameliorate hydrological isolation. Seasonal filling and drying induce spatio-temporal variability in temperature, depth, pH, dissolved oxygen, salinity and nutrients, resulting in zonation within lakes and high variability among them.

DISTRIBUTION: Mainly subhumid temperate and wet-dry tropical regions in monsoonal and Mediterranean-type climates but usually not semi-arid or arid regions.



References:
Pettit, N., Jardine, T. , Hamilton, S ., Sinnamon, V., Valdez, D., Davies, P., Douglas, M., Bunn, S. (2012). 'Seasonal changes in water quality and macrophytes and the impact of cattle on tropical floodplain waterholes'. *Marine and Freshwater Research* 63(9): 788–800.
Rains, M.C., Fogg, G.E., Harter, T., Dahlgren, R.A., Williamson, R.J. (2006). 'The role of perched aquifers in hydrological connectivity and biogeochemical processes in vernal pool landscapes, Central Valley, California'. *Hydrological Processes* 20(5): 1157–1175.