

appropriate references in the text of this preamble will be completed as soon as funding allows.

The following counties are excluded from this rule under Section 4(b)(2): Butte, Madera, Merced, Solano, and Sacramento. We find that the benefits of excluding these areas from critical habitat outweigh the benefits of including them. See further discussion under the Section 4(B)(2) analysis subheading below.

Vernal pool crustaceans and plants live in vernal pools (shallow depressions that hold water seasonally), swales (shallow drainages that carry water seasonally), and ephemeral (short-lived) freshwater habitats. None are known to occur in riverine waters, marine waters, or other permanent bodies of water. The vernal pool habitats of the 4 vernal pool crustaceans and 11 plants addressed in this final rule have a discontinuous distribution west of the Sierra Nevada that extends from southern Oregon through California into northern Baja California, Mexico (Holland and Jain 1978, 1988; Eriksen and Belk 1999).

Vernal pools are a unique kind of wetland ecosystem. Central to their distinctive ecology is that they are vernal or ephemeral, occurring temporarily—typically during the spring following fall and winter rains—and then disappearing until the next year. They are wet long enough to be different in character and species composition from the surrounding upland habitats, and yet their prolonged annual dry phase prevents the establishment of species typical of more permanent wetlands. In California, where extensive areas of vernal pool habitat developed over long periods of time, unique suites of species specially adapted to the unusual conditions of vernal pools have evolved. Fish and other predators are among the species excluded by vernal pools' annual drying, so vernal pool communities have developed and flourished in the absence of many predators. California vernal pools are also renowned for their showy displays of wildflowers, blooming in concentric rings about the pools in spring.

Many areas in California and portions of southern Oregon have the combination of environmental conditions that favor the development of vernal pools (Keeley and Zedler 1998). The climate is of a type classified as Mediterranean, with a wet season when rainfall exceeds evaporation, filling the pools, and a dry season when evaporation is greater, drying the pools. Rainfall is relatively meager even in most wet seasons, so erosion by overflowing waters does not dissect the

topographic irregularities that form vernal pool basins. Temperatures during the fall and winter wet season are mild, so plants and animals can grow, mature, and reproduce.

A second major factor in the development of vernal pools is soil. Vernal pools form where there is a soil layer below or at the surface that is impermeable or nearly impermeable to water (Smith and Verrill 1998). Precipitation and surface runoff become trapped or "perched" above this layer. In California, the restrictive soil layers underlying vernal pools are of four main types: hardpans, claypans, volcanic flows, and non-volcanic rock. Hardpans are formed by leaching, redeposition, and cementing of silica minerals from high in the soil profile to a lower ("B") horizon (Hobson and Dahlgren 1998; Smith and Verrill 1998). Claypans are formed by another redeposition process—fine clay particles are transported to the B horizon and accumulate there. Claypans may also be augmented by redeposition of saline or alkaline compounds. Hardpans and claypans both develop gradually over thousands of years, and can be a yard (meter) or more thick. Smith and Verrill (1998) list many of the soil series associated with vernal pools in the Central Valley. Volcanic flows include basaltic lavas and cemented mudflows, and are most common along the lower western slope of the Sierra Nevada. The soil parent material underlying vernal pools greatly influences species composition and hydrologic functioning of the vernal pool (Hanes and Stromberg 1998; Smith and Verrill 1998). Soils beneath vernal pools are extremely variable and may not be the same as soils mapped by soil surveys (Holland and Dain 1990).

A third factor, related to soil and climate, is topography or relief. Vernal pools typically occur in landscapes that, on a broad scale, are shallowly sloping or nearly level, but on a fine scale may be quite bumpy. Complex microrelief results in shallow, undrained depressions that form vernal pools. Some vernal pool landscapes are dotted with numerous rounded soil mounds known as mima mounds (Scheffer 1947). From the air, vernal pool landscapes often show characteristic patterning, produced by plant responses to mound and trough microrelief. This patterning has allowed mapping of vernal pool habitats throughout California's Central Valley and adjacent coastal foothill areas to a scale between 10 and 40 acre units (Holland 1998, 2003).

Vernal pools come in a variety of shapes and sizes, from less than a

square yard (1 meter) to 2.5 ac (1 ha) or more. Some larger vernal wetlands, such as the 90 ac (36 ha) Olcott Lake in the Jepson Prairie Preserve in Solano County, are also referred to as playa pools or lakes. Playa pools with high alkalinity are termed alkali sinks. These larger wetlands contain many of the same animals and plants of smaller vernal pools, including many rare, threatened, and endangered species.

Since appropriate combinations of climate, soil, and topography often occur over continuous areas rather than in isolated spots, vernal pools in California, particularly in the Central Valley, tend to occur in clusters called "complexes." A landscape that supports a vernal pool complex is typically a grassland, with areas of obstructed drainage that form the pools. Vernal pools can also be found in a variety of other habitats, including woodland, desert, chaparral, or pine forest. The pools may be fed or connected by low drainage pathways called "swales." Swales are often themselves seasonal wetlands that remain saturated for much of the wet season, but may not be inundated long enough to develop strong vernal pool characteristics. Swales, due to their connection to adjacent pools, are considered part of the vernal pool complex.

Vernal pools begin to fill with the fall and winter rains. Before ponding occurs, there is a period during which the soil is wetted and the local water table may rise. Some pools have a substantial watershed that contributes to their water inputs; others may fill almost entirely from rain falling directly into the pool (Hanes and Stromberg 1998). Although exceptions are not uncommon, the watershed generally contributes more to the filling of larger or deeper pools, especially playa pools. Even in pools filled primarily by direct precipitation, Hanes and Stromberg (1998) report that subsurface inflows from surrounding soils can help dampen water level fluctuations during late winter and early spring. Vernal pools exhibit four major phases: (1) The wetting phase, when vernal pool soils become saturated; (2) the aquatic phase, when a perched water table develops and the vernal pool contains water; (3) a water-logged drying phase, when the vernal pool begins losing water as a result of evaporation and loss to the surrounding soils but soil moisture remains high; and (4) the dry phase, when the vernal pool and underlying soils are completely dry (Keeley and Zedler 1998). Upland areas associated with vernal pools are also an important source of nutrients to vernal pool organisms (Wetzel 1975). Vernal pool