

BYERS

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COAST REDWOODS AND FOG DRIP

Fog drip as an important means of supplying moisture to coast redwoods (*Sequoia sempervirens* (D. Don.) Endl.) during the virtually rainless summer of their region has been imputed either directly or indirectly by many ecologists. For example, Daubenmire (1947) categorically states it; Kittredge (1948), in the opening paragraph of his chapter on fog drip gives the coast redwood as an example of a fog-belt tree, but makes no further reference to it in this sense. A number of writers relate the tree to the fog belt but leave the implications to the reader, without coming to grips with the problem. (See, for example, Jepson 1910).

These ideas perhaps are traceable to W. A. Cannon's 1901 article "Relation of Redwoods and Fog." A later study by Cooper (1917) demonstrated the problem in a more modest way, implying that fog drip is only an added factor in certain locations. But the more striking situations appear to have attracted most writers.

Those who have spent a great deal of time in these forests find it difficult to recall examples of fog drip in the better stands of redwood during the summer dry season. Since the best growths are in the coastal valleys or river flats, this is entirely in agreement with meteorological data. The California summer coastal fog has a confusing name, since in the strictest sense it usually is not a fog at all, but a stratus cloud layer. A fog is a cloud on the ground, and since Californians live in a hilly or mountainous region which takes them in and out of the cloud layer as they go up or down, they experience it as fog and give it that name—or "high fog."

The fog or stratus has been described in the meteorological literature by Blake (1928), Byers (1930, 1931, 1944), Neiburger (1944),

Petterssen (1936), Vernon (1936), and others. The data show that the cloud layer is generally not below 300 feet, more commonly with the base at 800 to 1,200 feet in the coastal valleys. The top usually is between 1,000 and 3,000 feet, with an average at about 1,500 feet. At the ocean or cliffs, the cloud may be somewhat lower and fogs sometimes occur immediately on the ocean surface. At some localities these surface fogs seem to form when the coast valleys, where the redwoods grow, are mostly clear. Around Monterey Bay they often reach such trees as the Monterey cypress (*Cupressus macrocarpa* Gord.) and Monterey pine (*Pinus radiata* Don.) but seldom reach the major redwood groves. Redwoods, or at least healthy specimens of them, do not grow in such exposed places.

The effect of the so-called fog belt is to be found in factors other than fog drip. They are those associated with reduced evapotranspiration, namely, 1) reduction of the number of hours of sunshine and 2) reduction of daytime temperature. In the coastal valleys the stratus, in a typical situation, dissipates at about 10 A.M., standard time, during the summer days and forms or moves in after sunset. In the sunny afternoons the sea breeze increases as the ocean-land temperature contrast reaches its maximum, thus providing an automatic air-conditioning action. The quantity of water vapor in the air remains constant, corresponding to a dew-point temperature of about 50 to 55° F., so the relative humidity varies inversely with the dry-bulb temperature, and runs from near 100 per cent in the early morning to about 60 per cent in midafternoon. On nights when the stratus does not reach into the valleys, dew is likely to condense out of the moist air to the radiation-cooled earth. Although apparently very small in amount, this dew is

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more important than fog drip in valley locations in summer.

In regions such as the Santa Cruz mountains where some of the finest redwood groves are found in the valleys, the slopes have Douglas fir trees or, in drier locations, grasses, chaparral and live oaks. Fog drip reaches the Douglas firs and other slope trees, but the redwoods grow below. Only a few redwoods find a suitable footing in the elevated swales where summer "fog" may reach them. Professor C. E. Olmsted has suggested to the author that the relative distribution of the Douglas fir and redwoods is the same as that found farther north between Douglas fir and arborvitae, western hemlock, Sitka spruce.

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ANTAGONISM BETWEEN DIFFERENT SPECIES OF HYDROIDS ON THE SAME SHELL.

On July 6, 1952, while seasonally employed at the Prince Edward Island Biological Station of the Fisheries Research Board of Canada, the writer obtained a living hermit crab, *Pagurus* sp., in a shell of *Polinices heros* from about six feet of water at the mouth of Malpeque Bay, P. E. I. The exterior of the shell was nearly covered by two colonies of hydroids of different species; one of these was *Hydractinia cchinata*, and the other probably *Podocoryne carnea*. The identification of the latter species is slightly uncertain because of improper preservation of the specimen.

Immediately after collection, both types of hydroids readily expanded when placed in a small container of sea water. Here it was noticed that the colonies were separated by a bare strip of shell, roughly eight to twelve mm. wide, which extended from the lip of the shell across the upper part of the body whorl, passed near the apex of the shell and continued beneath the spire until it merged with the abraded area on which the shell rested. Thus a few millimetres of "no-man's land" always lay between the two colonies.

Several possible explanations of this unoccupied strip occurred to the writer but none would bear examination.

1. Environmental conditions may have differed on different parts of the shell. However, conditions must have differed more along the length than across the width of the bare strip and the two colonies were almost symmetrically arranged.

2. The bare strip may have corresponded with some structural feature of the shell. Examination of other crab-inhabited shells of *Polinices* failed to confirm this and hermit crab shells covered by *Hydractinia* alone showed no bare areas matching this one.

3. Before its occupation by the crab, the shell may have been buried to the level of the strip, being occupied by one species of hydroid in that period and by the other after its exposure. However, the shell had been exposed long enough for a limpet, *Crepidula plana*, to grow to a length of more than an inch inside its mouth.

4. Some predator, such as a snail, may have cleared this strip of its encrusting growths. It seems unlikely, though, that such an animal would eat its way across a large shell without deviating from the irregular boundary between two colonies of hydroids.

5. Both colonies may have been young and