DISCUSSION OF RELATIONSHIPS IN PINUS

Dr. Daniel I. Axelrod: I have been involved with the closed-cone pines for the last six months and have visited a good number of sites. Unfortunately, I have not been to the islands. My observations on the nearby mainland differ from those that Mr. Linhart suggests. I have been to Pine Canyon on Burton Mesa. Typical *Pinus remorata* and typical *P. muricata* are there; and I assure you that they are growing on different rock types within 15 feet of one another and that in the transition from one to the other you can find what I would consider to be the typical hybrids.

Mr. Yan B. Linhart: With reference to finding possible evidence of a distinct *Pinus remorata*, it is true that it has been found in the fossil deposits of both Santa Cruz and Carpinteria; however, it should be noted that only the cones were found and nothing else. Therefore, we feel that even if at one time there was a population or variety which we could call *P. remorata*, it could be separated from *P. muricata* only on the basis of cone type and so may not have been a distinct biological species.

Dr. Axelrod: That is a good possibility, but there is another new collection, which you possibly have not heard about, in the Santa Monica Mountains. It is early Pleistocene in age. There are about 10 cones, and every one of them is typical of *Pinus remorata.* They are well preserved, and there is not a suggestion of *P. muricata* in their morphology. Along with them are a couple of typical *P. radiata* cones.

Dr. Donald W. Weaver: The three populations which Linhart refers to are really on four distinct rock and soil types, and there is very little chance of there being contamination or pockets of other soil types.

Dr. Robert F. Hoover: One mainland pine population came to my attention within the last year or so. In the sandy country south of Morro Bay there is a small isolated grove of pines in which there are probably not more than 20 full grown trees, and in that small grove you can find a complete range from one extreme to the other – from *Pinus muricata* with sharply recurved cones and sharp spurs on the outer side, to the *P. remorata* type. What is particularly interesting to me is that, if a person really wants to pick his cones, he can find a wide range of variation on a single tree.

Dr. William J. Libby: I would like to add my comments to give a little more perspective for those who are not as checked out on pine fights as we are. *Pinus* is a big, well-defined genus; it has somewhere between 80 and 110 species or species complexes, and in general they behave very well. By this I mean that shape and other morphological characteristics of cones, for instance, are relatively uniform, although they do vary in size, heaviness, etc. The California closed-cone pines are an outstanding exception to this rule of relative uniformity; and this is one reason why the island pines on Santa Cruz, Santa Rosa, Guadalupe, and Cedros are of such interest. We have a greater variation in cone type here within single populations on Santa Cruz Island than within some subsections of the genus in other parts of the world.

This is further complicated by the recent work of Mirov and Forde, which has shown that Bishop pine is by no means a simple thing. What was considered to be a relatively good species appears to be at least three quite distinct, genetically separated populations. In our current view, based largely on the work of Linhart, Burr, and Conkle, it appears that *Pinus remorata* may be no more distinct from Bishop pine than the three internal groups are from each other.

Dr. J. R. Haller: The species of the genus *Pinus* may not be so well behaved as Dr. Libby has implied. I have had some first-hand experience with another group of pines, the *P. ponderosa* - *P. washoensis* complex, in which the cone variability within some populations, scattered from Mount Rose, Nevada, to British Columbia, may be of the same order of magnitude as that of the closed-cone pines on Santa Cruz Island. If the *P. ponderosa* - *P. washoensis* complex is considered as a whole, it is probably more variable than the *P. muricata* - *P. remorata* complex; this would be expected from its great geographic range.

Then too, if one considers the Mexican pines, which include a sizeable fraction of the total number of species in the genus, one certainly does not get the impression of uniform, stable taxa. Among the yellow pines, the *Pinus ponderosa* complex, the *P. montezumae* complex, and the *P. pseudostrobus* complex are all highly variable and include a dozen or more smaller units that have been treated by taxonomists as species, varieties, or often ignored because of the continuous variability from one "taxon" to the next. Furthermore, these large complexes are not completely distinct from one another. Among the white pines, *P. flexilis*, *P. monticola*, and *P. strobus*, which are very distinct and relatively stable in the United States, are all morphologically linked together in Mexico through *P. strobiformis*, *P. strobus* var. *chiapensis*, and the highly variable *P. ayacahuite*.

INTRODUCTION TO INSULAR ZOOLOGY

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The classification of islands for biogeographical purposes was first attempted by Alfred Russell Wallace, who in his "Island Life" (1880) categorized them as Oceanic, Ancient Continental, or Recent Continental. *Oceanic Islands* are of volcanic or coralline formation; they are remote from continents and are separated from them by deep seas; they contain no indigenous land mammals or amphibians, but an abundance of birds and insects, and usually some reptiles. Examples of oceanic islands are the Galapagos and Hawaii. *Continental Islands* are more varied in formation; they contain both ancient and recent stratified rocks; they are rarely remote from continents; they always contain mammals and amphibians; they may be divided into two groups:

Ancient Continental Islands are separated from the continent by 1,000 fathoms or over; they resemble the continent in geological structure; their plants and animals are highly "peculiar" (individualistic); the fauna is fragmentary, with many families and orders not represented; they are sufficiently removed from the continent so that they always contain some plants and animals not allied to it, but to remote parts of the world (in this sense they resemble oceanic islands). Examples of ancient continental islands are Madagascar and New Zealand.

Recent Continental Islands are rarely separated from the continent by over 100 fathoms; they also resemble the continent in geological structure; their plants and animals are almost identical with those of the continent. Examples of recent continental islands are the British Isles and Japan. It is evident that the California Islands belong in this category, although the deep basins separating them from the mainland and from each other provide more than customary isolation for islands of this type.

From the standpoint of endemism, islands present a graded series as well. Only in the Oceanic Islands are endemic families found, as with the Drepanididae and Achatinellidae of Hawaii and the Geospizidae of Galapagos (considered a family by the