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CHANGES IN INTERTIDAL ALGAE AT PALOS VERDES

The marine flora of the Palos Verdes peninsula has been the subject of scientific study since before the turn of the century. Originally conspicuous because of the easy access to abundant intertidal seaweeds and later because of environmental changes induced by an adjacent sewage outfall, the shores of Palos Verdes have received a great deal of public attention. Published accounts have reported continually decreasing or depauperate algal populations since the initiation of sewage discharge in 1937. In the last few years, however, our observations suggest a substantial improvement in species numbers which has not been previously reported. We felt it was important to document the current status of Palos Verdes' algal populations because of the significance of any change in the quality of marine life in an area subject to domestic and industrial sewage discharge and intensive foot traffic.

As part of a larger survey in 1956-59, E. Yale Dawson, of the Herbarium of the Allan Hancock Foundation (HAHF), studied the intertidal algae at five Palos Verdes sites (Figure 1)--Flat Rock Point (FRP), Lunada Bay (LB), Portuguese Point (PP), Whites Point (WP), and Point Fermin (PF) (Dawson 1959, 1965). From historical data he concluded that the flora at Whites Point had included not less than 60 conspicuous species per station visit--a reduction of 70 percent over historical reports. (While both the pre-1913 and the 1957 figures give only a minimum representation of the existing floras, and the collecting methods used are not comparable, they do reflect the status of the algal community for each time period.) Dwarfed or physically distorted plants existed at Whites Point and at Portuguese Point, a similarly impacted area. Later studies by Widdowson (1971), Murray and Littler (1978), and Thom (1976) have shown the entire Palos Verdes area to be one of low species diversity and continuing stress. Results of recent work done by the Coastal Water Research Project are in strong contrast to those from previous studies; now we find higher numbers of species and increasing population

abundances. Further, the work of Mearns et al., 1977; Wilson and Mearns, this volume; and Grigg 1979; details the return of giant kelp and the substantial increase of several large brown algae.

In light of these changes and the continuing interest in the marine life off Palos Verdes, we decided to resurvey Dawson's five stations. By comparing our data to his and that of more recent investigators, we hope to document the extent of the species changes, as well as produce comprehensive species lists for the peninsula.

Winter sampling has been completed, allowing us to do preliminary qualitative work-ups. At four of the five stations we found increases in species to numbers equal to those of pre-discharge measurements. Some species not recorded in certain areas since the turn of the century have been encountered. Large brown algae, once rare, are now

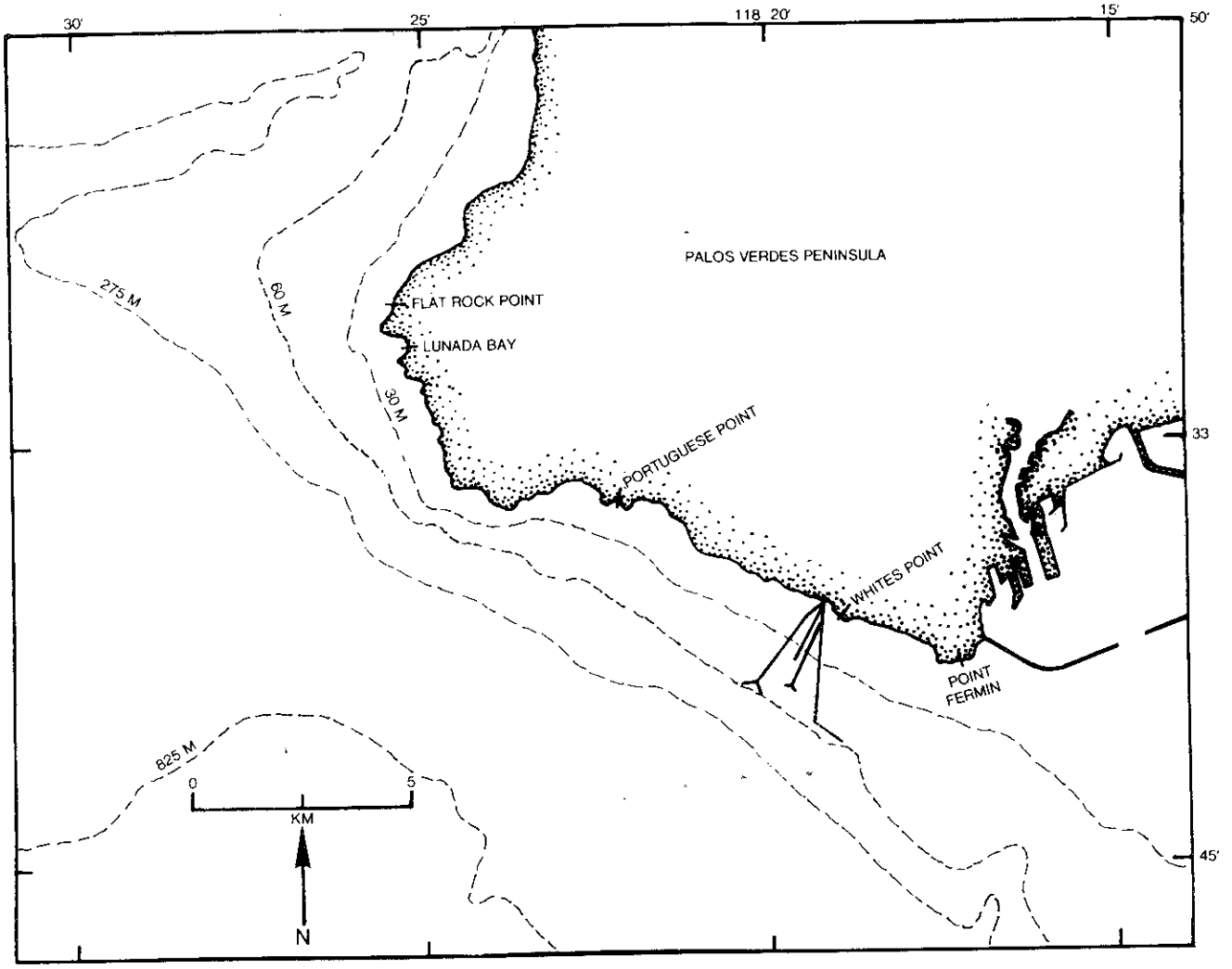


Figure 1. Location of sampling sites.

generally abundant in the intertidal zone, and the membranous or leafy reds have increased.

HISTORICAL BACKGROUND

The Palos Verdes peninsula has been a favorite collecting area for phycologists for nearly 100 years, particularly at Whites Point where records exist back to 1880 (Dawson 1959, 1965). W.A. Setchell of the University of California at Berkeley collected around the San Pedro area from December 1895 to January 1896. From 1908 to 1912, N.L. Gardner, also from Berkeley, collected algae at Whites Point and Point Fermin during the fall and winter. From their unpublished field notes Dawson was able to compile species lists with which to compare his data (Dawson 1959, 1965). In 1915, E.B. Couch (USC) wrote his master's thesis on the marine algae of Point Fermin (Couch 1915). The species collected during a 2 1/2 year period were identified with literature largely written for other areas of the world, such as W.G. Farlow's work on algae of New England (Farlow 1881). His voucher specimens were filed in the USC herbarium (now Hancock's) but unfortunately they appear to have been lost. Another USC student, J.S. Goodman, finished his master's thesis on marine algae near Flat Rock Point in 1935. He studied 6 localities, 2 of which--Flat Rock Point and Lunada Bay--correspond with those later surveyed by Dawson. At the time of Goodman's study major monographs on Pacific coast marine algae had been published, and he was able to use these for the identification of the intertidal and subtidal algae he collected over 2 to 3 years. His specimens were filed in the Hancock Herbarium and also appear to be lost. Goodman's work is the last study we have seen that was done before the beginning of discharge at Whites Point in 1937. At that time, his 6 sites averaged 74 species each.

Starting in 1956, the Allan Hancock Foundation, under the auspices of the State Water Pollution Control Board of California (later changed to the State Water Quality Control Board), conducted a major oceanographic survey of the southern California bight. Included in this was a survey of benthic intertidal algae at 42 mainland sites by Dawson.

Dawson had been concerned for several years about modifications in the coastal marine flora that he attributed to sewage discharge or development. He found a strong correlation between areas of large decreases in numbers and abundance of species and their proximity to sewage discharges. At some stations adjacent to sewage discharge, almost pure stands of articulated corallines occurred. Beyond the corallines grew sparse and stunted plants of *Prionitis* spp. and *Gigartina* spp. Virtually all of the membranous red algae and most of the medium-to-large size

brown algae had disappeared at these stations, to be replaced by the corallines and small turf-forming algae. Dawson felt these changes could be directly attributed to the introduction of sewage and other activities of man. The discharge produced high levels of turbidity which cut down on light needed for photosynthesis or reproduction; it also contained chemicals that may have had a deleterious effect on the plants. Other effects Dawson noted were caused by beachfront development and jetty construction.

From 1968 to 1970, T. Widdowson (California State University, Long Beach) resurveyed 15 of Dawson's stations between Dana Point and Point Dume. He concluded that there had been a further widespread reduction in algal diversity since 1956-1959. He agreed with Dawson (1959, 1965) that sewage discharge had been the primary factor responsible for the decline in the number of species between 1937 and 1959. Widdowson believed that since 1959 the primary factors were, in order of impact, human beach usage, aerial fallout of pollutants, and sewage (water) pollution. Unfortunately he did not publish the species lists from his station visits so we are unable to include his work in this comparison of data.

R. Thom (1976, Thom and Widdowson 1978), a graduate student of Widdowson, followed Dawson's suggestion that the latter's 1956-59 stations be resurveyed in 15 years to assess any further changes. From 1973-74 he sampled the 42 mainland stations and added 30 more.

In the Los Angeles area Thom saw a slight increase but agreed with Widdowson that there had been no substantial change in the area since Dawson's finding. He stated that the area had reached a "state of equilibrium (disclimax) with existing polluted (and trampled) conditions", producing a stable, albeit reduced situation. He also agreed with Widdowson's hypothesis that trampling of the intertidal was the most important factor in the decline of seaweed populations, followed by aerial pollution (especially in the high intertidal) and then sewage pollution.

Murray and Littler (1978) investigated one Palos Verdes station 600 m northwest of Dawson's Whites Point station. In 4 visits over a year's time, they found a total of 56 species, an average of 41 per station visit. This was a 20 percent increase over the number of species found in any previous study since 1912. However, they agreed that the Whites Point area was depauperate and represented a stressed environment. Certain parallels existed between the conditions at Whites Point and those at sewage perturbed communities on San Clemente Island (Littler and Murray 1974, 1975). Surrounding the San Clemente outfall is a community dominated by turf-forming species that have rapid growth rates and high productivity. Large brown algae and surf grasses are reduced or absent. In additon to sewage or

trampling, the presence of large urchin populations at Whites Point, maintained by high levels of sewage-produced organics, was thought to be another possible factor responsible for the low cover of foliose algae in the intertidal (Murray and Littler, 1978).

METHODS

In this study we made every attempt to relocate Dawson's exact sampling sites. For each station he recorded the permanent landmarks, magnetic bearings and fixed shore base points that he used for repeated sampling. Further, he took color photographs of each station to permit future comparative studies. When we started sampling in 1979, some of the permanent points had been destroyed by erosion or by coastal development, however, those used for Palos Verdes were largely in place. Where the original shore base point was missing we selected another, keeping as close as possible to what we thought was the original base point.

We sampled in the same months as Dawson to minimize seasonal species changes in flora. A transect line with markings every meter was stretched from the designated shore base point to just past the low water tide point. Specimens for identification and vouchers were taken from within one meter to either side of the line. A tape recorder was used to simplify making observations in the field. Photographs were taken of the general area and the substrate along the line at intervals of every two meters. These will be used for quantitative assessments of cover by species; they have not yet been studied in detail.

At the laboratory the collected material was sorted, scanned for cryptic species and epiphytes, and identified. Most identifications were confirmed by Robert Setzer of the Herbarium of the Allan Hancock Foundation (HAHF). Voucher specimens of all species encountered at each station were prepared, in duplicate when possible. Most of the material was processed into standard herbarium mounts, but small, delicate or questionable specimens were made into permanent slides or bottled in 5 percent formalin. The voucher collection will be archived at HAHF, where the vouchers of Dawson's survey are housed, making both sets available for comparison by future investigators.

RESULTS - THE STUDY AREAS

Lunada Bay

Dawson's transect area was easy to find even though the hillside rock he designated as the permanent shore base point has been lost through erosion. The area from which

samples were taken is a series of sandstone ridges, tide pools and large rocks situated about 100 meters from the south side of Lunada Bay. Unlike the south side which seems to remain free of heavy sand deposits, the transect area is subject to constant sand movement and build-up, heaviest during fall and winter storms.

In October 1979 we found a total of 22 species of marine plants. Much of the substrate from the high to mid-intertidal regions was occupied by almost pure stands of *Corallina vancouveriensis* turf; the few *Corallina*-free spots were covered by another turf-forming species, *Gelidium pusillum*. *Gigartina canaliculata* also covered large areas slightly lower in the intertidal zone. The overall appearance of this area was of sparse and stunted vegetation. Further down in the intertidal zone, the surf grass *Phyllospadix* sp. was abundant, as were *Prionitis cornea*, *Pterocladia capillacea*, and *Bossiella* spp. Although growth here was dense, it consisted of only a few species. When Dawson sampled in October 1959, he recorded a low of 19 conspicuous species, down from his spring and summer records of 27 and 31 species.

The low number of species recorded in October, 1957 and 1979, may be a function of sand scour since the unaffected south side appears to have a consistently rich year-round flora. There may be other reasons for the paucity of species however, because *Pelvetia fastigiata*, a brown alga that normally lives high enough on rocks to escape sand scour, is almost gone from the study area. Photographs taken in 1957 show a heavy growth of *P. fastigiata* covering many square meters but only a few scattered plants were found in 1979. Its decline was possibly part of the general decrease in brown algae of the last few decades, and conditions in the sampling area are still unfavorable for its growth. The species could also be preferentially taken by marine botany students, since Lunada Bay is a favorite collecting spot.

Portuguese Point

In his 1965 report, Dawson described the general flora off Portuguese Point as "extemely monotonous, and all around the headland it is much like that at Whites Point where evidence of pollution is strong in the complete dominance of *Corallina* and the virtual absence of membranous red algae. Only stunted *Prionitis*, *Halidrys*, *Eisenia* and the *Calliarthron* sp., all as at Whites Point, are present."

In his report Dawson recorded 12 species of marine plants: 1 angiosperm, 7 brown algae and 4 red algae on his visit in November, 1957. In November, 1973 Thom identified 25, a 50 percent+ increase in species (or 30 percent- using

Dawson's herbarium material, Thom concluded that Dawson recorded 18 species from Portuguese Point)*. In July and November of 1979 we found 57 and 56 species respectively.

Gigartina canaliculata, *G. leptorhynchos* and *Rhodoglossum affine* are most conspicuous in the high to midintertidal regions. Dense, sand-holding turfs of *Gelidium pusillum* cover much of the remaining substrate. Encrusting and articulated corallines are present in low densities. Beyond this area is an extensive *Egregia* cover and the broad expanses of a *Corallina vancouveriensis/Lithothrix aspergillum* compact turf. While this articulated coralline turf covers much of the midintertidal it serves as a substrate for *Gigartina* spp., *Colpomenia sinuosa*, *Laurencia pacifica* and *Chondria californica*. Several meters seaward is a gently sloping siltstone pavement bare of any algae except a circular encrusting coralline and clumps of *Bossiella* sp. and *Calliarthron* sp. Sea urchins are extremely abundant here. Large algae such as *Laurencia*, *Prionitis*, *Gelidium* and *Dictyopteris undulata* grow thickly on boulders atop the siltstone bottom. Southeast of the transect line is a large tidepool filled with *Cystoseira osmundacea*, *Sargassum muticum*, and *Gigartina spinosa*. Young *Macrocystis pyrifera* plants were seen in the pool in July but not in November. The *Egregia* beds continued subtidally, eventually grading into *Macrocystis* kelp beds with increasing water depth.

The flora looked healthy, exhibiting none of the stunted plants seen by Dawson in 1965. Since 1957, the number of species has increased nearly five times; in the six years from 1973 to 1979 alone, it has more than doubled (110). Thom and Widdowson (1978) felt that the increase in 1973 "indicated some degree of recovery," caused by the beach being "little used due to the difficulties in access" (Thom and Widdowson 1978). The increase in species number is certainly a recovery but it is not due to lack of use, since the area enclosed by Portuguese Point and Inspiration Point is very popular with sunbathers.

Point Fermin

Dawson's station at Point Fermin was the easiest of the five to locate. When compared with his field notes (Dawson 1965: p. 382-3) the sampling area seemed little changed from 1957. The same algal species appear in the same tidal areas as before. The occurrence of four large browns has changed: *Pelvetia fastigiata*, *Halidrys dioica* and *Laminaria farlowii* were not found in 1979 and *Sargassum muticum*, a recently introduced seaweed (Setzer and Link, 1971) is now common in high intertidal pools. Dawson collected a total of 45 species in January 1956 and October 1957; in January 1980 we

* See Appendix

found 58. Of the 34 taxa seen only in 1980, half were small epiphytes probably overlooked by Dawson, or species that vary from Dawson's only because of differences in taxonomic concepts. An example of the latter category is *Rhodymenia pacifica* Kylin which I identified, compared to Dawson's record of *Rhodymenia rhizoides* Dawson. *R. rhizoides* is rare and poorly known, so specimens may be commonly mistaken for *R. pacifica*. If these are combined into one taxon, and similar pairs of species from 1957 and 1979-80 are combined and added to those taxa in common, and the epiphytes from 1980 are disregarded, then 30 species occur in both lists and only 19 additional species were seen in 1980. Of the 19, and also for the 15 recorded in 1957, many are common plants that may not have been in the immediate sampling area during the surveys.

Given these qualifications, the Point Fermin area has changed remarkably little since 1957. Judging by Dawson's intepretation of earlier records, the species composition is very similar to the flora found at the turn of the century. He considered this area to be relatively free from the deleterious factors affecting Whites Point and Portuguese Point. Any stress on Point Fermin would be far more likely to be coming from the Long Beach-Los Angeles Harbors, and Dawson thought that "a general but moderate pollution condition prevails" (Dawson 1965; p. 383) and probably had since the start of shipping in San Pedro Bay. This would help account for the moderate number of 58 species in November, moderate when compared with the 88 recorded at Flat Rock.

Flat Rock

In 1935 Goodman recorded approximately 72 species of intertidal plants; by 1956 the number had decreased to 31. Dawson's field notes and photographs indicated that the majority of the sampling area was dominated by four species: *Pelvetia fastigiata*, *Corallina vancouveriensis*, *Gigartina canaliculata*, and *Gigartina leptorhynchos*. *Egregia menziesii* and *Phyllospadix* sp. were not abundant until the lower intertidal. During Thom's sampling, the pattern of abundance for the differnt species changed on each visit, but *Egregia* and *Phyllospadix* sp. were usually among the highest in density. In June of 1973, there did not appear to be any dominant species. By November of the same year, *Egregia* and *Phyllospadix* were the most abundant, followed by *C. vancouveriensis* and *G. leptorhynchos* (visual estimates). From July to November 1979, I found the dominant plants to be the same as during Dawson's survey, with the exception of *Pelvetia*. In Dawson's photographs *Pelvetia* largely covered the high intertidal area, now it appears in a few small patches.

The sampling area consists of small to medium-size boulders on a sandy substrate. The 1979 flora at Flat Rock appeared limited because the extensive amount of cover by only 5 or 6 species. There were, however, many understory seaweeds, epiphytes, and a very rich turf assemblage. Although past data has not indicated noticeable sand movement, there was a moderate sand cover in November. This movement was probably recent since the buried algae (plants up to 10 cm long) showed no signs of deterioration. The site appears to have remained relatively unchanged.

RESULTS

Preliminary analysis shows a total of 149 taxa collected and identified during October and November, 1979 (Table 1). This figure represents 54 percent of the 273 taxa reported in previous Palos Verdes studies from 1895 to 1976 (Tables 2 and 3). Four of the five stations (FRP, PP, WP, PF) showed large increases in species richness over most earlier work. At three of the four stations for which I have pre-1937 data (FRP, WP, PF), the current number of species is equal to or greater than the early counts. Algal diversity declined only at Lunada Bay. If all five stations are considered, the average number of species is 62.4 for our eight visits to Palos Verdes. This represents an apparent increase of 38.8 species above Dawson's average of 23.6 (for ten visits). The actual increase is somewhat less since Dawson concentrated on conspicuous members of the flora or those dominant in biomass. Thom, however, identified each alga including cryptic and epiphytic species and found a mean of only 30.0 species over 14 visits. I hypothesize that the majority of the rise in species numbers has taken place over the last six years (see Figure 2).

The most conspicuous change was the increase of large brown algae. The giant kelp, *Macrocystis pyrifera*, is not only in beds offshore from most of the stations but young plants (up to 3 m) were found in tide pools adjacent to the transects at Whites Point and Portuguese Point. Frondose red algae appear to be increasing. Turf algae and articulated corallines are being overgrown by other species in some areas, although not necessarily replaced on the substrate.

TABLE 1: # SPECIES (BY DIVISION) COLLECTED AT PALOS VERDES, WINTER 1979

	FRP	LB	PP	WP	PF	CUMULATIVE
Spermatophyta	1	1	0	0	1	1
Chlorophyta	8	2	3	10	3	16
Phaeophyta	12	6	10	12	7	20
Rhodophyta	68	13	40	55	47	112
Total # species	89	22	53	77	58	149

Changes in abundance are hard to estimate. Only one truly quantitative work has been done, that of Murray and Littler (1978). They established permanent quadrants of which photographs were assessed for species percent cover by using a grid system. They also sampled impermanent quadrants for species biomass data, and from which photographs were also taken for assessment. Earlier workers in the Palos Verdes area assigned numerical values to abundance (frequency) categories of "rare to scant", "occasional to frequent", and "common to abundant", all of which can vary from observer to observer.

Some changes in algal abundance patterns have been observed. The large browns, *Egregia* and *Eisenia*, have apparently increased, as have smaller brown algae such as *Pachydictyon coriaceum*, *Dictyopteris undulata* and *Dictyota flabellata*. At Whites Point most of the increase has occurred in surge channels from the midintertidal water level and lower. The decrease in species numbers at Lunada Bay seems to be matched by a decrease in abundance along the transect line. Photographs taken in March, 1957 by Dawson show a heavy cover of *Pelvetia fastigiata* at Lunada Bay while our 1979 surveys found only a few scattered plants.

TABLE 2: SURVEYS AT PALOS VERDES

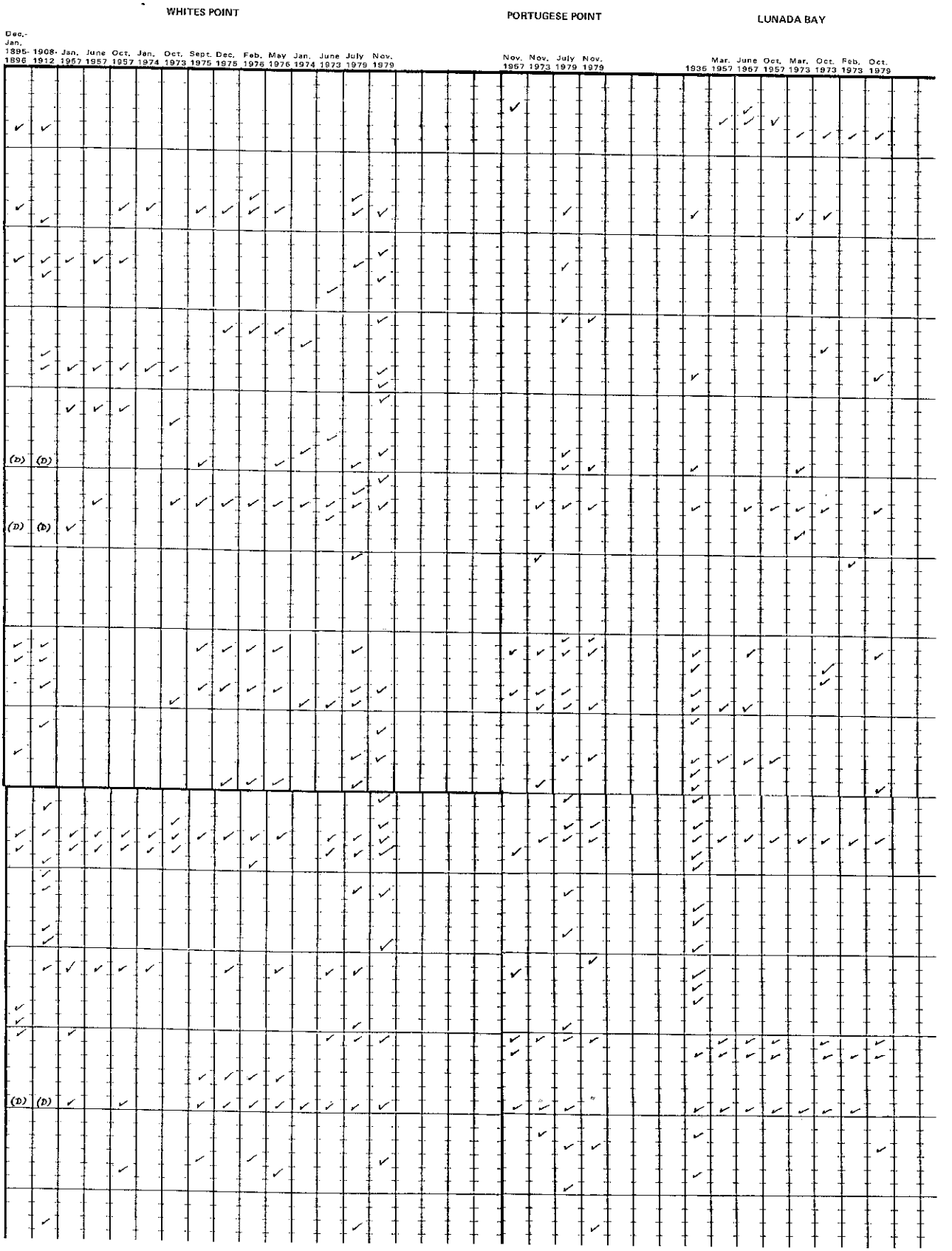
DATE	LOCATION	GENERAL SURVEY (G) TRANSECT SURVEY (T)	COLLECTOR
1895-96	Whites Point area, Point Fermin	G	W. A. Setchell (UCB)
1908	Point Fermin	G	N. L. Gardner (UCB)
1908-12	Whites Point	G	N. L. Gardner
1915	Point Fermin	G	E. B. Couch (USC)
1935	Lunada Bay, Malaga Cove, Flat Rock Point, Bluff Cove, Rocky Point, Resort Point	G	J. S. Goodman (USC)
1956-59	Whites Point, Point Fermin, Lunada Bay, Flat Rock Point, Portuguese Point	T	E. Y. Dawson (AHF)
1968-70	Whites Point, Point Fermin, Lunada Bay, Flat Rock Bay Portuguese Point (Data not available)	T	T. B. Widdowson (CSULB)
1973-74	Whites Point, Point Fermin, Lunada Bay, Flat Rock Point, Portuguese Point	T	R. M. Thom (CSULB)
1975-76	Royal Palms (Whites Point)	T	S. Murray & M. Littler (SAI-BLM)
1979-80	Whites Point, Point Fermin, Lunada Bay, Flat Rock Point, Portuguese Point	T	L. H. Harris (SCCWRP)

DISCUSSION

In both the SCCWRP survey done for the Los Angeles County Sanitation District in July 1979 and one done in late 1979, there was a dramatic increase in species number at four stations since 1956-1959. Large brown and red algae definitely increased. There were no definite reasons for the improvement along Palos Verdes. One hypothesis is better water clarity and quality which resulted from a more efficient system of sewage solids removal started by the Los Angeles County Sanitation Districts in 1977. The rise in intertidal seaweeds and in *Macrocystis pyrifera* coincided with the decrease in suspended solids and the onset of increasing visibility (Figure 3, also see Wilson and Mearns, this publication). Unlike other areas of southern California, where human activity and aerial pollution probably have been more important than sewage pollution in altering floral conditions since 1959 (Widdowson 1971; Thom and Widdowson 1978), sewage pollution is likely to have remained the major cause of environmental stress along Palos Verdes since 1937. Another reason for the increase could be the switch to deep water outfalls and the disappearance of the effects of the earlier shallow water outfalls. Trampling and collecting may be reduced because of the establishment of marine parks and reserves, the enactment of stricter laws on casual collecting, and better public awareness of the need to protect California's marine resources.

Lunada Bay was the one station that did not share in the general increase. Recorded species numbers have been fairly consistent except during October 1957 when Dawson recorded 18 species and during October 1979, when the Project found 20. This decrease might be explainable as a seasonal decline, but Thom found 30 species during October 1973. Dawson's transect is a sloping ridge at the south side of the bay which is subject to rapid and heavy sand movement. Comparison of weather records for the years 1957, 1973, and 1979 may reveal a pattern of storm occurrence that will correlate with changes in species numbers.

Other reasons for the changes in species numbers and abundance are seasonal or shorter phenomena. Sand movement, especially during winter storms, can extensively scour the substrate or cover algae beyond their tolerance of burial. Dawson (1959, 1965), Foster, Neushul and Zingmark (1971), Nicholson and Cimberg (1971), and Cimberg, Mann and Straughan (1973) all concur on the importance of sand scour in structuring a community. Dawson pointed out that the stations with the greatest amount of sand movement also had the greatest variation in the number of algae. Certain species can dominate an area until they mature and then senesce, allowing other species to settle. Severe physical


WHITES POINT
PORTUGESE POINT
LUNADA BAY
Dec.-Jan. 1895-1896
1908-1912
Jan. 1957
June 1957
Oct. 1957
Jan. 1974
Oct. 1973
Sept. 1975
Dec. 1975
Feb. 1976
May 1976
Jan. 1974
June 1973
July 1979
Nov. 1979
Nov. 1957
Nov. 1973
July 1979
Nov. 1979
Mar. 1935
June 1957
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(b)
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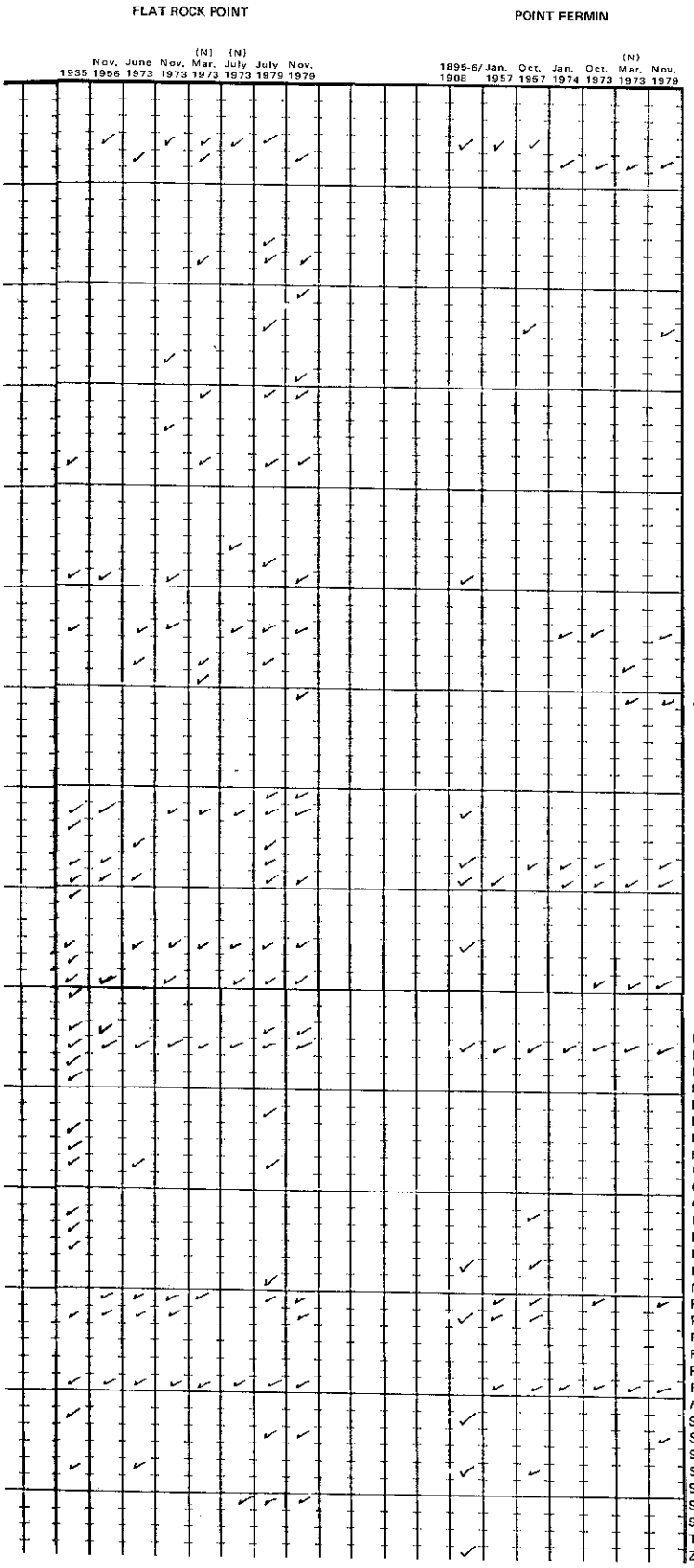


SPERMATOPHYTA

Phyllospadix scouleri *Hooker*
Phyllospadix torreyi *Watson*
Phyllospadix *sp.*

CHLOROPHYTA

Bryopsis corticulans *Setch.*
Chaetomorpha linum *(Müll.) Kütz.*
Chaetomorpha spiralis *Okam.*
Chaetomorpha *sp.*
Cladophora albida *(Huds.) Kütz.*
Cladophora columbiana *Coll.*
Cladophora graminea *Coll.*
Cladophora microcladioides *Coll.*
Cladophora stimpsonii *Harv.*
Cladophora *sp.*
Cladophoropsis fasciculatus *(Kjellm.) Okam.*
Cladophoropsis *sp.*
Codium cuneatum *S. & G.*
Codium fragile *(Sur.) Har.*
Derbesia marina *(Lyngb.) Sol.*
Enteromorpha clathrata *var.* clathrata *(Roth) Grev.*
Enteromorpha compressa *(L.) Grev.*
Enteromorpha flexuosa *(Roth) J. Ag.*
Enteromorpha intestinalis *var.* cylindracea *J. Ag.*
Enteromorpha intestinalis *var.* intestinalis *(L.) Link*
Enteromorpha *sp.*
Entocladia cingens *S. & G.*
Ulothrix *sp.*
Ulva californica *Wille*
Ulva lactuca *L.*
Ulva *sp.*
Urospora mirabilis *Aresch.*
Green alga, unidentified

PHAEOPHYTA

Coilodesme californica *(Rupr.) Kjellm.*
Colpomenia peregrina *(Sauv.) Hamel*
Colpomenia sinuosa *(Roth) Derb. & Sol.*
Colpomenia tuberculata *Saund.*
Colpomenia *sp.*
Cylindrocarpus rugosus *Okam.*
Cystoseira osmundacea *(Turn.) C. Ag.*
Cystoseira setchellii *Gardn.*
Cystoseira *sp.*
Desmarestia ligulata *(Lightf.) Lamour.*
Dictyopteris undulata *Holmes*
Dictyota binghamiae *J. Ag.*
Dictyota flabellata *(Coll.) S. & G.*
Ectocarpus parvus *(Saund.) Hollenb.*
Ectocarpus tomentosus
Ectocarpus *sp.*
Egregia menziesii *(Turn.) Aresch.*
Eisenia arborea *Aresch.*
Endarachne binghamiae *J. Ag.*
Feldmannia acuminata *(Saund.) Hollenb. & Abb.*
Feldmannia cylindrica *(Saund.) Hollenb. & Abb.*
Feldmannia hemispherica *(Saund.) Hollenb.*
Feldmannia irregularis *(Kütz.) Hamel*
Giffordia granulosa *(J.E. Smith) Hamel*
Giffordia mitchelliae *(Harv.) Hamel*
Giffordia *sp.*
Halidrys dioica *Gardn.*
Hapterophycus canaliculata *S. & G.*
Hesperophycus harveyanus *(Decne.) S. & G.*
Laminaria farlowii *Setch.*
Macrocystis pyrifera *(L.) C. Ag.*
Pachydictyon coriaceum *(Holmes) Okam.*
Pelvetia fastigiata *(J. Ag.) DeToni*
Petalonia fascia *(Müll.) Kuntze*
Pseudolithoderma nigra *Hollenb.*
Pylaiella *sp.*
Ralfsia *sp.*
Ralfsiaceae, UI
Sargassum agardhianum *J. Ag.*
Sargassum muticum *(Yendo) Fensh.*
Scytosiphon dotyii *Wynne*
Scytosiphon lomentaria *(Lyngb.) J. Ag.*
Sphacelaria californica *(Sauv.) S. & G.*
Sphacelaria *sp.*
Streblonema anomalum *S. & G.*
Taonia lennebackeriae *J. Ag.*
Zonaria farlowii *S. & G.*

Table 3. Marine plants recorded from the Palos Verdes peninsula, 1895-1979, in the vicinity of E. Yale Dawson's collecting stations. [(D) = historical presence assumed by Dawson (1959, 1965).]

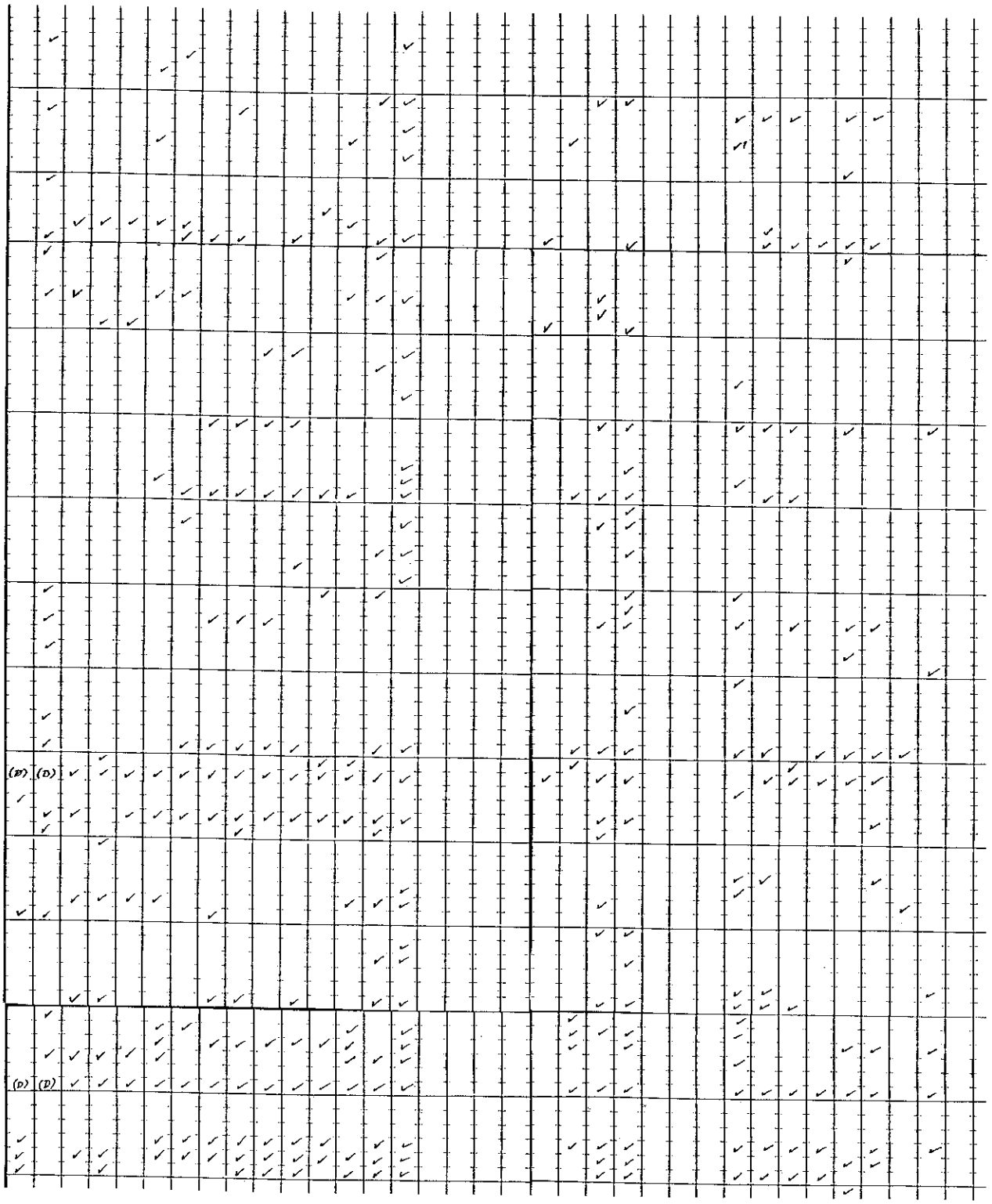
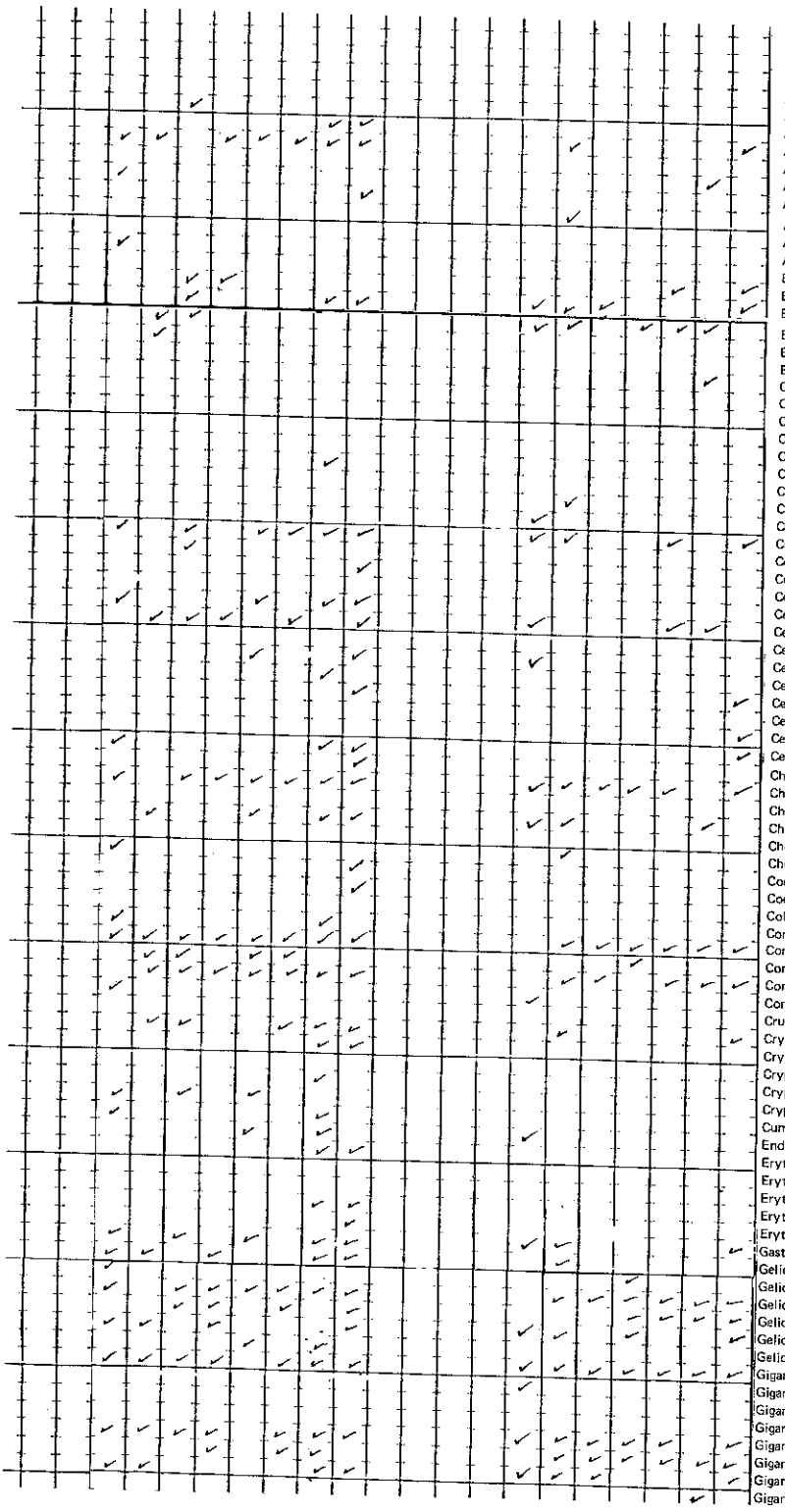


TABLE 3



RHODOPHYTA

Acrochaetium daviesii *(Dillw.) Nag.*
Acrochaetium microscopicum *(Kütz.) Nag.*
Acrochaetium pacificum *Kylin*
Acrochaetium rhizoideum *(Drew) Jao*
Acrochaetium *sp.*
Acrosorium uncinatum *(Turn.) Kylin*
Aglaothamnion endovagum *(S. & G.) Abb.*
Amphiroa zonata *Yendo*
Anisocladella pacifica *Kylin*
Antithamnion defectum *Kylin*
Antithamnion plumulum *(Ell. & Sol.) Thur.*
Arthrocladia *sp.*
Bangia fusco-purpurea *(Dillw.) Lyngb.*
Bossiella chiloensis *(Decne.) Johans.*
Bossiella orbigniana *ssp.* dichotoma *(Manza) Johans.*
Bossiella orbigniana *ssp.* orbigniana *(Decne.) Silva*
Bossiella plumosa *(Manza) Silva*
Botryoglossum ruprechtiana *(J. Ag.) DeToni*
Calliarthron cheilosporioides *Manza*
Calliarthron tuberculosum *(P. & R.) Daws.*
Calliarthron *sp.*
Callithamnion pikeanum *Harv.*
Callithamnion rupicolum *Anders.*
Callithamnion *sp.*
Callophyllis obtusifolia *J. Ag.*
Callophyllis violacea *J. Ag.*
Callophyllis *sp.*
Centroceras clavulatum *(C. Ag.) Mont.*
Ceramium californicum *J. Ag.*
Ceramium camouii *Daws.*
Ceramium caudatum *S. & G.*
Ceramium codicola *J. Ag.*
Ceramium eatonianum *(Farl.) DeToni*
Ceramium gracillimum *var.* byssoideum *(Harv.) Maz.*
Ceramium pacificum *(Coll.) Kylin*
Ceramium procumbens *S. & G.*
Ceramium sinicola *S. & G.*
Ceramium viscainoense *Daws.*
Ceramium zacae *S. & G.*
Ceramium *spp.*
Chondria arcuata *Hollenb.*
Chondria californica *(Coll.) Kylin*
Chondria decipiens *Kylin*
Chondria nidifica *Harv.*
Chondria oppositiclada *Daws.*
Chondria *sp.*
Coeloseira parva *Hollenb.*
Coeloseira *sp.*
Colacodasya *sp.*
Corallina frondescens *P. & R.*
Corallina officinalis *var.* chilensis *(Decne.) Kütz.*
Corallina pinnatifolia *(Manza) Daws.*
Corallina vancouveriensis *Yendo*
Corallina *sp.*
Cruoriopsis *sp.*
Cryptopleura corallinara *(Nott) Gardn.*
Cryptopleura crispa *Kylin*
Cryptopleura lobulifera *(J. Ag.) Kylin*
Cryptopleura violacea *(J. Ag.) Kylin*
Cryptopleura *sp.*
Cumagloia andersonii *(Farl.) S. & G.*
Endocladia muricata *(P. & R.) J. Ag.*
Erythrocystis saccata *(J. Ag.) Silva*
Erythrotrichia carnea *(Dillw.) J. Ag.*
Erythrotrichia porphyroides *Gardn.*
Erythrotrichia tetraseriata *Gardn.*
Erythrotrichia welwitschii *(Rupr.) Batt.*
Gastroclonium coulteri *(Harv.) Kylin*
Gelidium coulteri *Harv.*
Gelidium nudifrons *Gardn.*
Gelidium purpurascens *Gardn.*
Gelidium pusillum *(Stackh.) Le Jol.*
Gelidium robustum *(Gardn.) Hollenb. & Abb.*
Gelidium *sp.*
Gigartina canaliculata *Harv.*
Gigartina corymbifera *(Kütz.) J. Ag.*
Gigartina exasperata *Harv. & Bail.*
Gigartina harveyana *(Kütz.) S. & G.*
Gigartina leptorhynchos *J. Ag.*
Gigartina papillata *(C. Ag.) J. Ag.*
Gigartina spinosa *(Kütz.) Harv.*
Gigartina *sp.*

TABLE 3

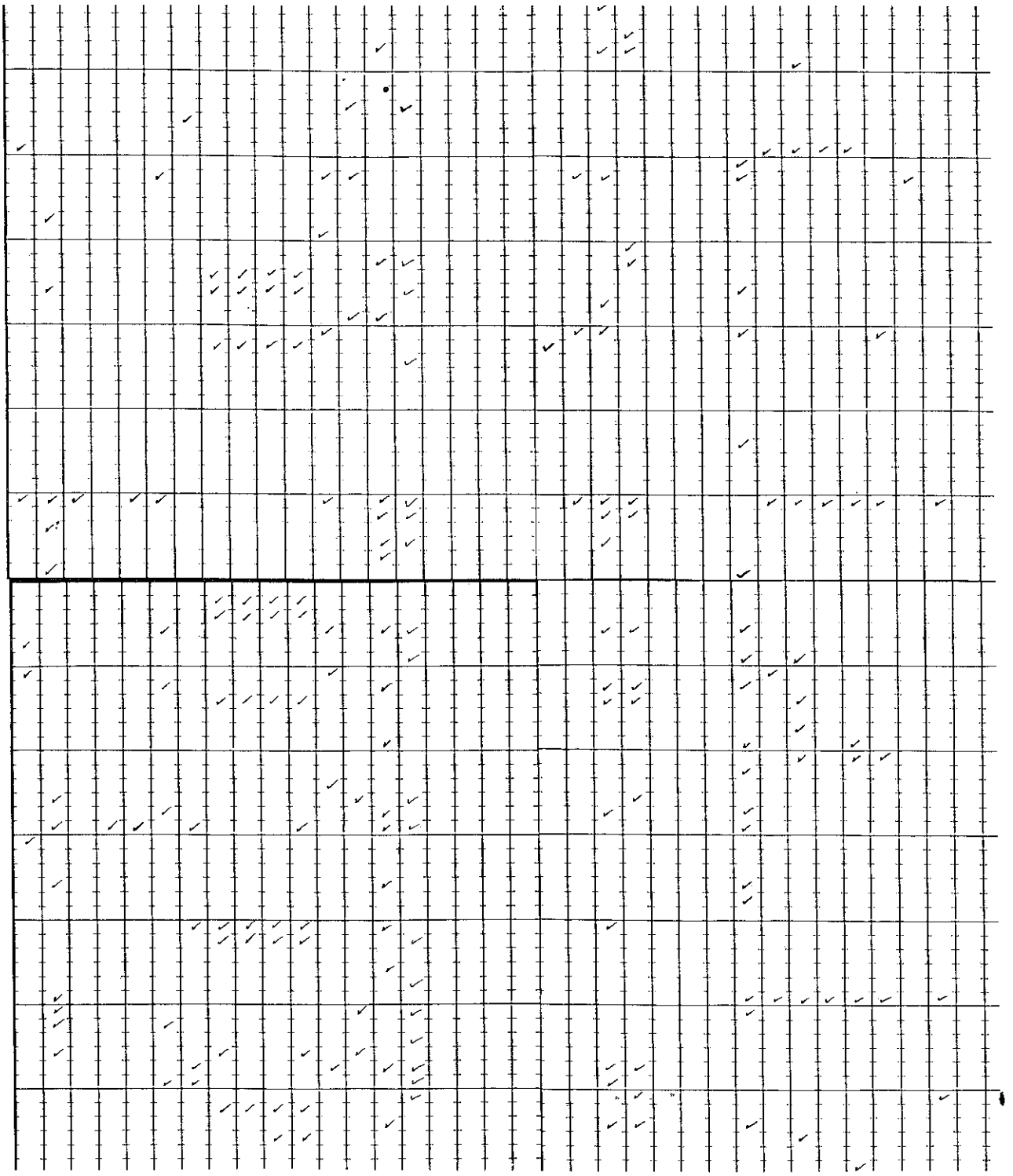
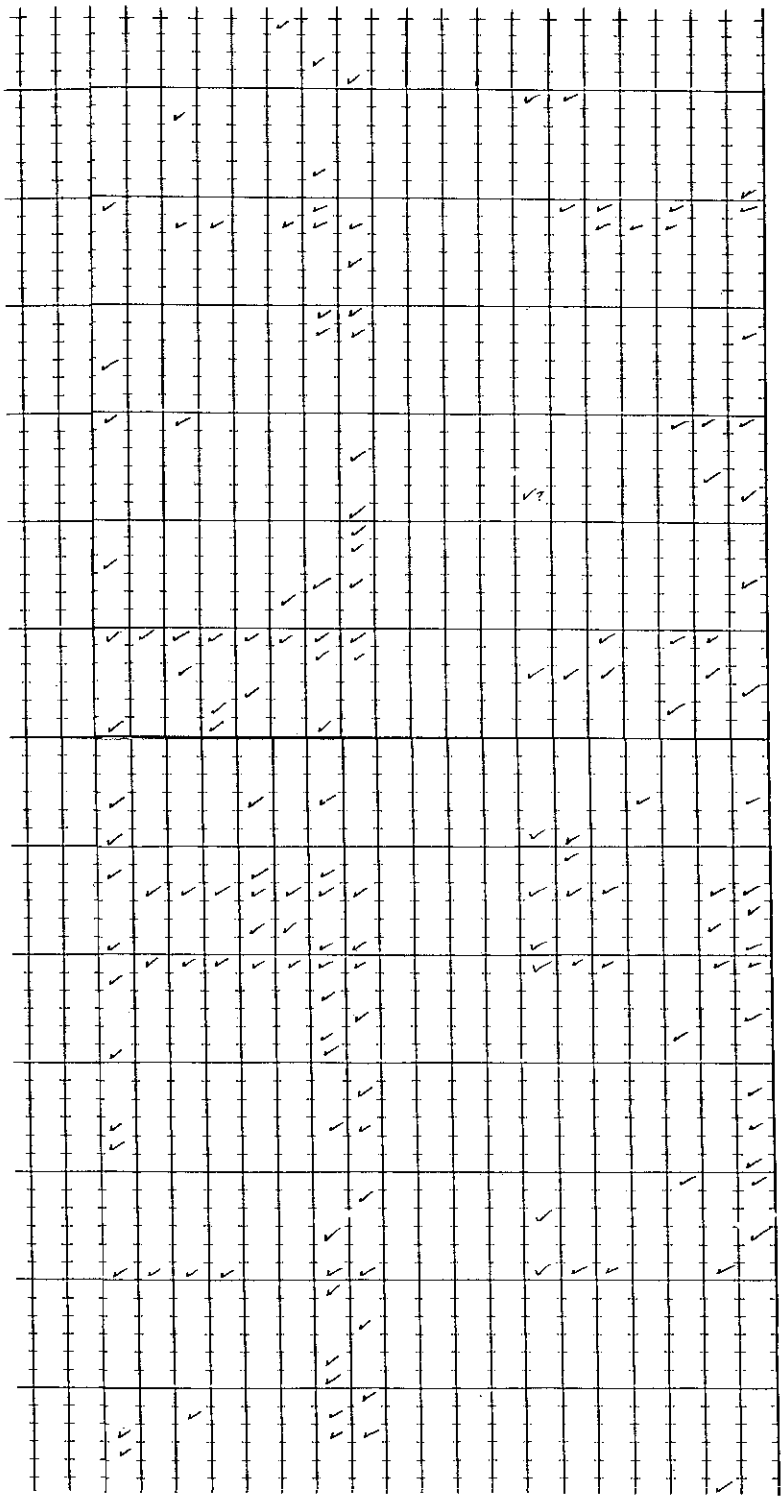


TABLE 3



Gloiopeltis furcata *(P. & R.) J. Ag.*
Gloiosiphonia capillaris *(Huds.) Berk.*
Goniotrichum alsidii *(Zanard.) Howe*
Goniotrichum cornu-cervi *(Reinsch) Hauck*
Gracilaria andersonii *(Grun.) Kylin*
Gracilaria textorii *var.* cunninghamii *(Farl.) Daws.*
Gracilaria *sp.*
Grateloupia doryphora *(Mont.) Howe*
Grateloupia prolongata *J. Ag.*
Gymnogongrus crustiformis *Daws.*
Gymnogongrus leptophyllus *J. Ag.*
Gymnogongrus platyphylius *Gardn.*
Haliptylon gracilis *(Lamour.) Johans.*
Halosaccion glandiforme *(Gmel.) Rupr.*
Halymenia *sp.*
Herposiphonia erecta
Herposiphonia hollenbergii *Daws.*
Herposiphonia littoralis *Hollenb.*
Herposiphonia plumula *(J. Ag.) Hollenb.*
Herposiphonia tenella *f.* secunda *(C. Ag.) Hollenb.*
Herposiphonia verticillata *(Harv.) Kylin*
Herposiphonia *sp.*
Heteroderma nicholsii *Setch. & Mason*
Hildenbrandia *sp.*
Hydrolithon decipiens *(Fosl.) Adey*
Hypnea *sp.*
Iridaea *sp.*
Janczewskia gardneri *Setch. & Guerns.*
Janczewskia lappacea *Setch.*
Jania crassa *Lamour.*
Jania tenella *(Kütz.) Grun.*
Jania *sp.*
Jantinella verrucaeformis *(Setch. & McFadd.) Kylin*
Laurencia lajollae *Daws.*
Laurencia masonii *S. & G.*
Laurencia pacifica *Kylin*
Laurencia sinicola *S. & G.*
Laurencia spectabilis *var.* diegoensis *(Daws.) Daws.*
Laurencia spectabilis *var.* spectabilis *P. & R.*
Laurencia splendens *Hollenb.*
Laurencia subopposita *(J. Ag.) Setch.*

Laurencia *sp.*
Lithophyllum proboscideum *(Fosl.) Fosl.*
Lithophyllum *sp.*
Lithothamnium aculeiferum *Mason*
Lithothamnium californicum *Fosl.*
Lithothamnium crassiusculum *(Fosl.) Mason*
Lithothamnium *sp.*
Lithothrix aspergillum *J. E. Gray*
Lomentaria *sp.*
Lophosiphonia reptabunda *(Suhr) Kylin*
Melobesia marginata *Setch. & Fosl.*
Melobesia mediocris *(Fosl.) Setch. & Mason*
Melobesia *sp.*
Mesophyllum *sp.*
Microcladia coulteri *Harv.*
Microcladia *sp.*
Nemalion helminthoides *(Vell.) Batt.*
Neogoniolithon setchellii *(Fosl.) Adey*
Neopolyporolithon reclinatum *(Fosl.) Adey & Johans.*
Neoptilota densa *(C. Ag.) Kylin*
Nienburgia andersoniana *(J. Ag.) Kylin*
Nitophyllum *sp.*
Opuntiella californica *(Farl.) Kylin*
Petrocelis franciscana *S. & G.*
Peyssonnelia *sp.*
Platysiphonia clevelandii *(Farl.) Papenf.*
Pleonosporium squarrulosum *(Harv.) Abb.*
Plocamiocolax pulvinata *Setch.*
Plocamium cartilagineum *(L.) Dixon*
Plocamium violaceum *Farl.*
Polysiphonia acuminata *Gardn.*
Polysiphonia bajacali *Hollenb.*
Polysiphonia hendryi *var.* gardnerii *(Kylin) Hollenb.*
Polysiphonia hendryi *var.* hendryii *Gardn.*
Polysiphonia pacifica *var.* delicatula *Hollenb.*
Polysiphonia savatierii *Hariot*
Polysiphonia scopulorum *var.* villum *(J. Ag.) Hollenb.*
Polysiphonia *sp.*
Porphyra perforata *J. Ag.*
Porphyra thuretii *Daws.*
Porphyra *sp.*

TABLE 3

disturbance of an area can open up the substrate to settlement by new species. The periods of growth and abundance for each species is correlated with temperature and illumination so that warm-water years, unusual long periods of overcast skies or turbid water can alter a community. This hypothesis is extremely hard to document. The scant information on this subject usually comes from laboratory research on the effect of one factor rather than the interaction of the many environmental factors that shape natural communites. Looking at past data and weather records, we have been unable to find any relationship between number of species and water temperature. Goodman collected an average of 74 species of seaweed during 1933-34's cold water; Dawson collected an average of 24 from cold water in 1956 (the end of a long period of cold water) and in warm water in 1957-59 (the start of a long warm water episode); Thom collected an average 30 species in cold water years, while the water in 1979 was warm when we found 63.

Desiccation and deterioration leading to death is produced by exposure of high and midintertidal species to Santa Ana winds, and extreme heat or cold during low tides. Storms that create heavy freshwater run-off detrimental to many seaweeds also bring heavy loads of pollutants washed from normally dry streets or stream beds into the intertidal.

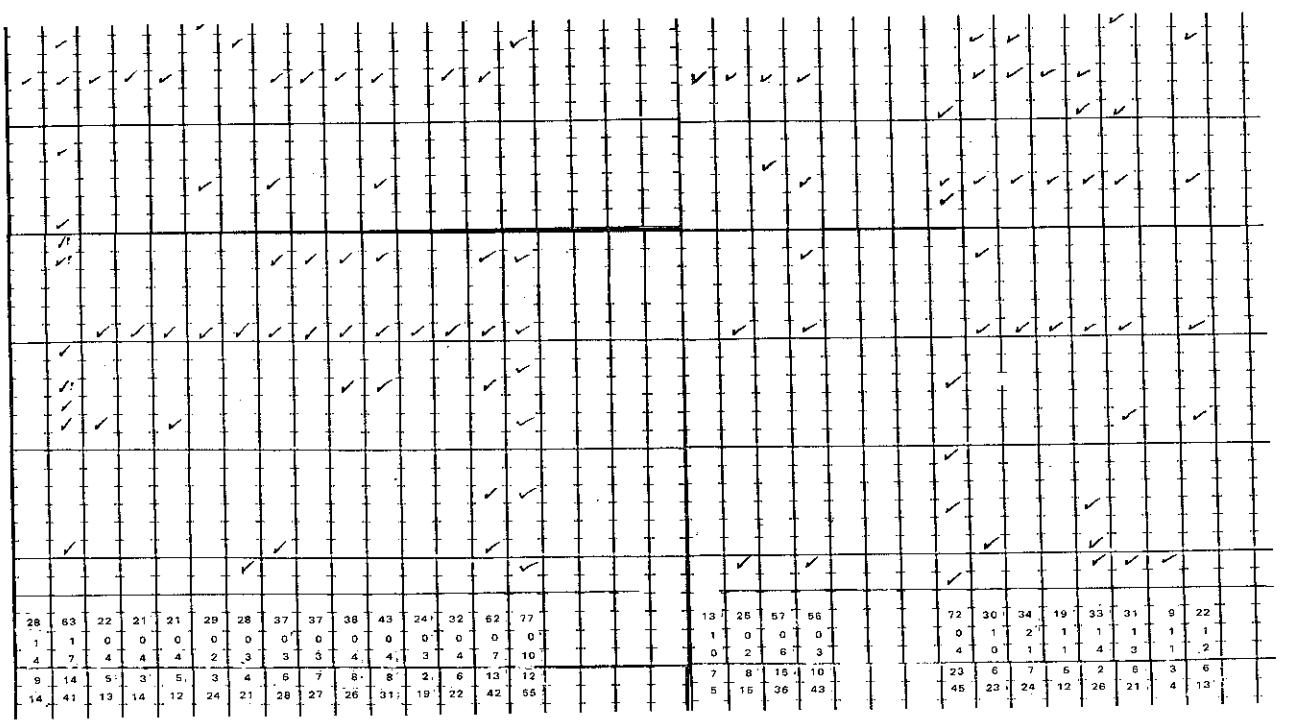


TABLE 3

A problem inherent in a study of this kind is whether it reasonably can be compared to previous works. Different workers may utilize different collection methods, have varying levels of taxonomic expertise, or concentrate on different groups of plants. Fortunately, since Dawson, all of the intertidal workers at Palos Verdes have used transect lines to sample their stations. Thom, Widdowson, and the Project attempted to follow Dawson's methods and find his locations precisely in order to compare results. The level of taxonomic expertise varied, but the surveys either had been done by professional phycologists or had the identified material confirmed by specalists (e.g. Dr. I.A. Abbott, Stanford; Robert Setzer, HAFH). Voucher specimens exist for most of the surveys and can easily be checked for verification.

Dawson concentrated on conspicuous or dominant forms and ignored many of the cryptic or epiphytic species. Thom, Murray and Littler, and the Project made an effort to identify all species found, including endoparasites. These latter studies are comparable in this sense, and to Dawson's results if the smaller species omitted by Dawson are removed from the comparison. Using only Dawson's 1965 list of species for comparison, the 1979-1980 collections still show significant increases in species diversity (Table 4). The earlier studies of Setchell and Gardner, although using random collecting methods, show a fairly representative

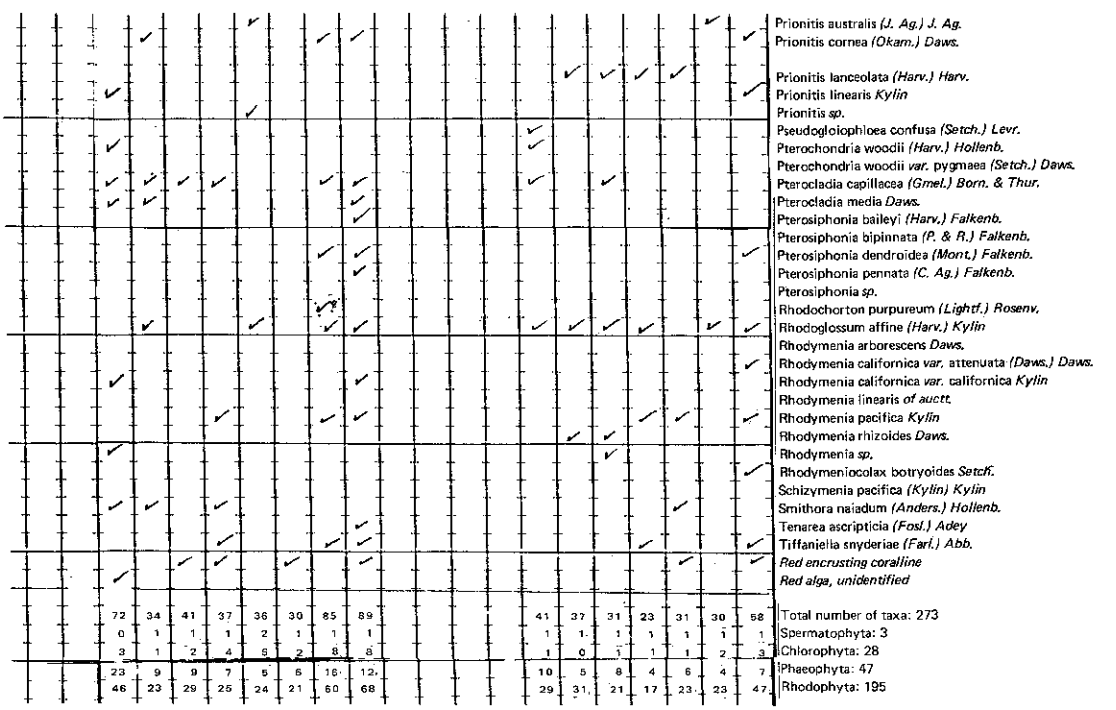


TABLE 3

picture of the area's flora. Their fall and winter collections can be compared to similar seasonal data from the later surveys. The work of Goodman (1935) was done over a 2-3 year period; again, it gives a reasonably complete picture of what species inhabited the area and is a good basis for comparison.

CONCLUSIONS

Our single set of data indicates a recovery in species numbers to levels comparable to those that existed in the early part of the century. We believe these high species counts will continue throughout the rest of our 1980-1981 sampling. This recovery does not signify the existence of a balanced indigenous intertidal flora (if there is even such a well-defined assemblage). Abundances of the seaweeds are probably very different from those of 1895-1935, as are patterns of distribution. The possibility for further recovery in terms of abundance seems good, but more investigation is needed. There is a need for continued observation and sampling of the intertidal of Palos Verdes, for work to determine the dominant source of stress on algal communities--whether sewage or human traffic--and to determine patterns of repopulation.

ACKNOWLEDGEMENTS

I want to thank all of my SCCWRP associates, particularly Willard Bascom, Alan Mearns, Jack Word, and Gary Kleppel, for their support, encouragement, and discussions. Special thanks go to Pete Striplin for his invaluable help in the field . The continual generosity of Dr. Robert Setzer (Assistant Curator, Herbarium of the Allan Hancock Foundation) in providing advice and taxonomic expertise, proved to be essential to this project. The support of Dr. David Young (Curator, Herbarium of the Allan Hancock Foundation), and his kindness in allowing me full access to the Herbarium's resources is greatly appreciated. My gratitude also goes to Janice Thompson, Dr. Joan Stewart, Dr. Paul Dayton (Scripps Institution of Oceanography) and Dr. Craig Barilotti (Kelco Co.) for their stimulating discussions and criticisms.

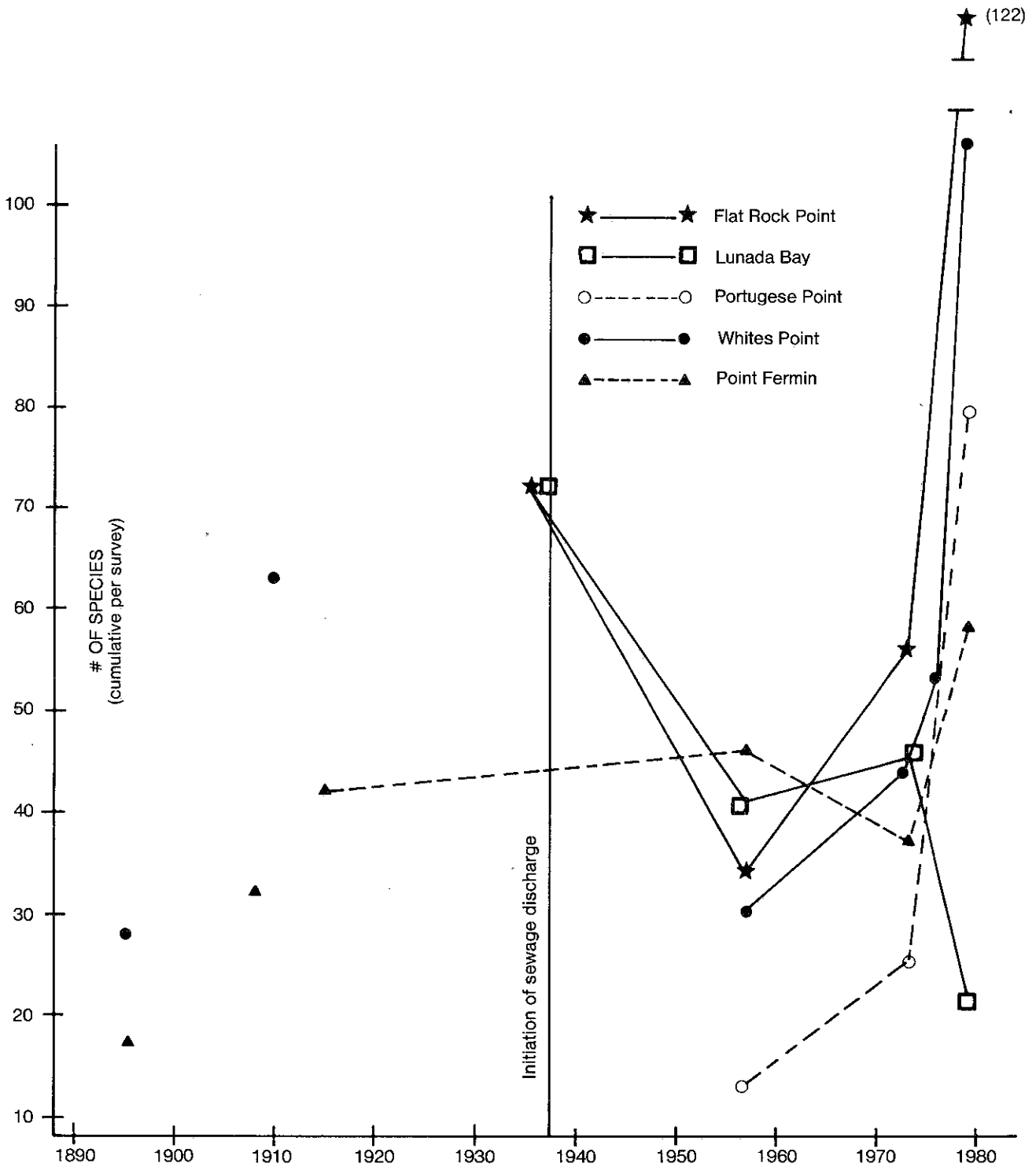


Figure 2. Number of intertidal seaweeds at each station through time. Only data points after 1915 have been connected; no effort was made to collect representative floras before then.

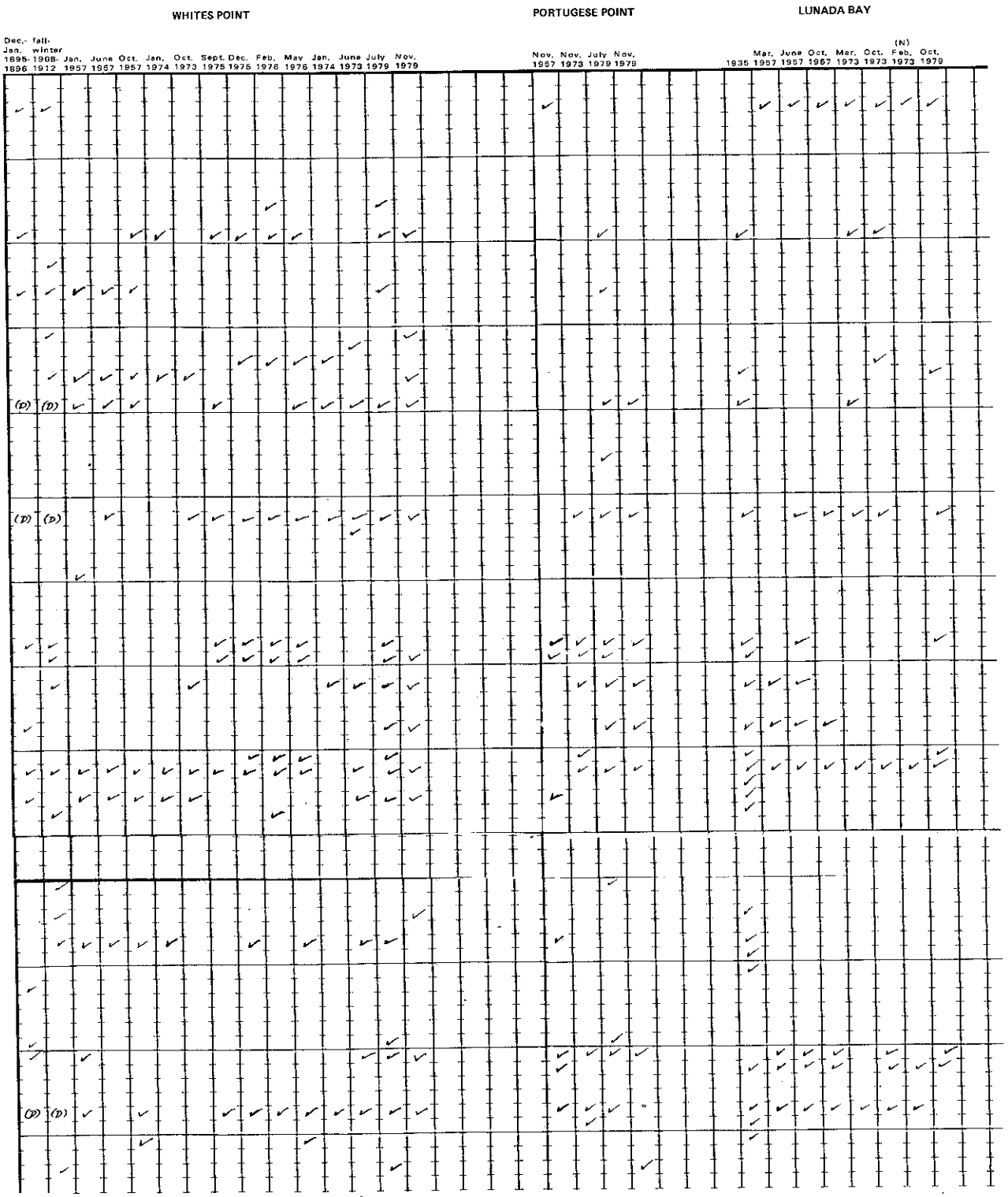
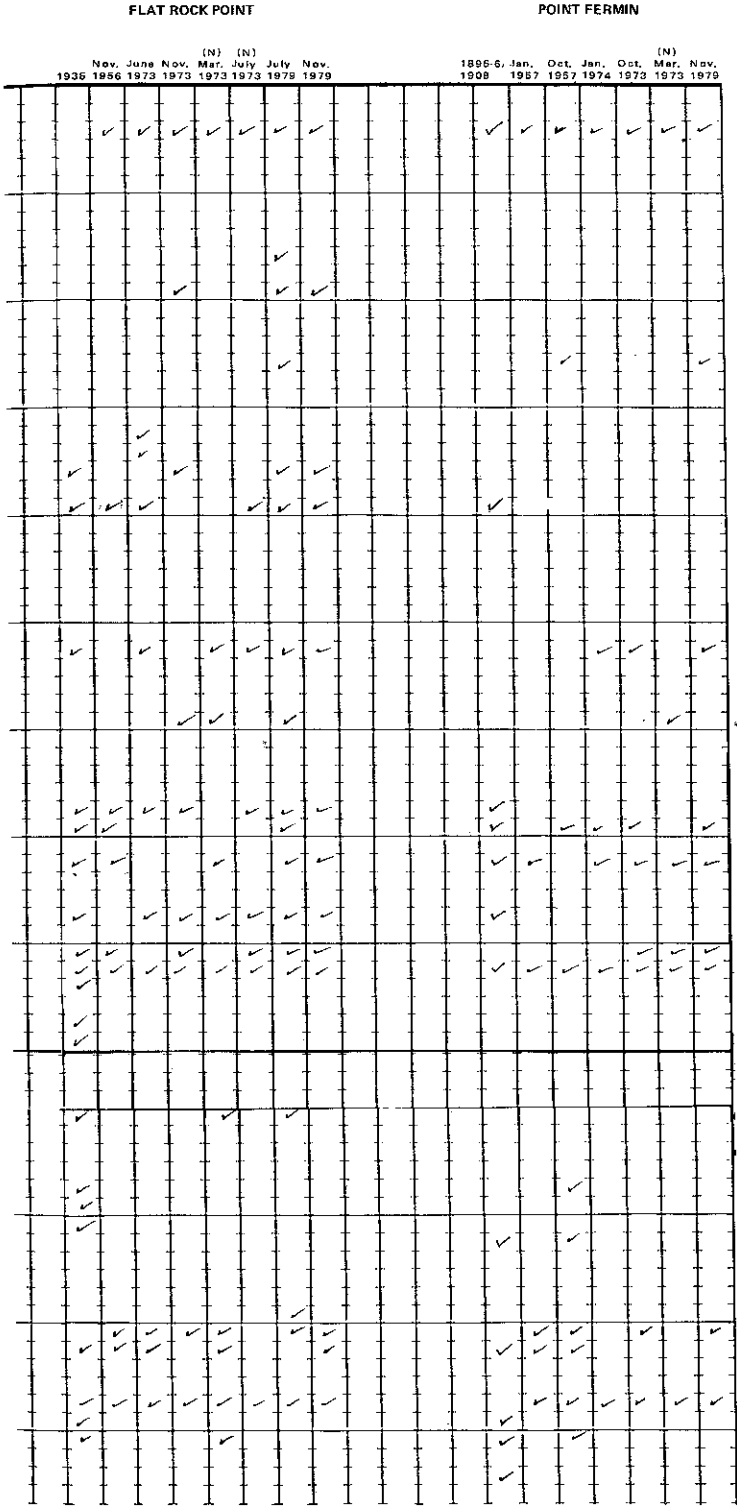


Table 4. Comparison of all data to Dawson's 1965 species list. Dawson's list has been used in order to eliminate the smaller or ephemeral species recorded by later surveys and provide a better basis for comparison of species diversity. The species list has been changed



SPERMATOPHYTA

Phyllospadix torreyi *Watson*
or Phyllospadix scouleri *Hooker*

CHLOROPHYTA

Blidingia minima *(Kütz.) Kylin*
=*Enteromorpha minima *Kütz.*
*Bryopsis corticulans *Setch.*
*Bryopsis hypnoides *Lamour.*
Chaetomorpha linum *(Müll.) Kütz.*
=*Chaetomorpha aerea *(Dillw.) Kütz.*
Chaetomorpha spiralis *Okam.*
=*Chaetomorpha torta *(Coll.) Yendo*
Cladophora columbiana *Coll.*
=*Cladophora hemisphaerica *Gardn.*
=*Cladophora trichotoma *auctt.*
*Cladophora graminea *Coll.*
*Cladophora microcladioides *Coll.*
*Cladophoropsis fasciculatus *(Kjellm.) Okam.*
*Codium fragile *(Sur.) Hariot*
*Codium setchellii *Gardn.*
Enteromorpha *spp.*
*Enteromorpha compressa *(L.) Grev.*
Entermorpha clathrata *var.* crinita *(Roth) Hauck*
*Enteromorpha crinita *(Roth) J. Ag.*
*Enteromorpha intestinalis *(L.) Link*
Enteromorpha linza *(L.) J. Ag.*
*Ulva linza *L.*
*Ulva augusta *S. & G. or* U. taeniata *(Setch.) S. & G.*
*Ulva californica *Wille*
*Ulva lactuca *L.*
*Ulva lobata *(Kütz.) S. & G.*
*Ulva rigida *C. Ag.*
*Ulva *spp.*

PHAEOPHYTA

*Collodesme rigida *S. & G.*
*Colpomenia sinuosa *(Roth) Derb. & Sol.*
Cylindrocarpus rugosus *Okam.*
=*Petrospongium rugosum *(Okam.) S. & G.*
*Cystoseira osmundacea *(Turn.) C. Ag.*
Desmarestia ligulata *(Lightf.) Lamour.*
=*Desmarestia herbacea *(Turn.) Lamour.*
Dictyopteris undulata *Holmes*
=*Dictyopteris zonarioides *Farl.*
*Dictyota flabellata *(Coll.) S. & G.*
Egregia menziesii *(Turn.) Aresch.*
=*Egregia laevigata *Setch.*
*Eisenia arborea *Aresch.*
*Endarachne binghamiae *J. Ag.*
Feldmannia irregularis *(Kütz.) Hamel*
=*Ectocarpus mucronatus *Saund.*
Fucus distichus *spp.* edentatus *(de la Pyl.) Pow.*
=*Fucus furcatus *auctt.*
Giffordia granulosa *(J.E. Smith) Hamel*
=*Ectopcarpus granulosus *(J. E. Smith) C. Ag.*
Giffordia mitchelliae *(Harv.) Hamel*
=*Ectocarpus mitchelliae *Harv.*
*Halidrys dioica *Gardn.*
*Hapterophycus canaliculatus *S. & G.*
*Hesperophycus harveyanus *(Decne.) S. & G.*
*Laminaria farlowii *Setch.*
*Laminaria sinclairii *(Harv.) Farl., Anders. & Eaton*
*Leathesia difformis *(L.) C. Ag.*
*Leathesia nana *S. & G.*
*Macrocystis pyrifera *(L.) C. Ag.*
*Pachydictyon coriaceum *(Holmes) Okam.*
*Pelvetia fastigiata *(J. Ag.) DeToni*
Phaeostrophion irregulare *S. & G.*
=*Phaeostrophion australe *Daws.*
*Ralfsia *spp.*
*Sargassum agardhianum *J. Ag.*
*Scytosiphon lomentaria *(Lyngb.) J. Ag.*
*Soranthera ulvoidea *P. & R.*
*Taonia lennebackeriae *J. Ag.*
*Zonaria farlowii *S. & G.*

to reflect current nomenclature as set out in Abbott and Hollenberg, 1976. Asterisks denote names which were originally used by Dawson. All species of *Enteromorpha* have been combined as a single taxa. [(D) = historical presence assumed by Dawson.]

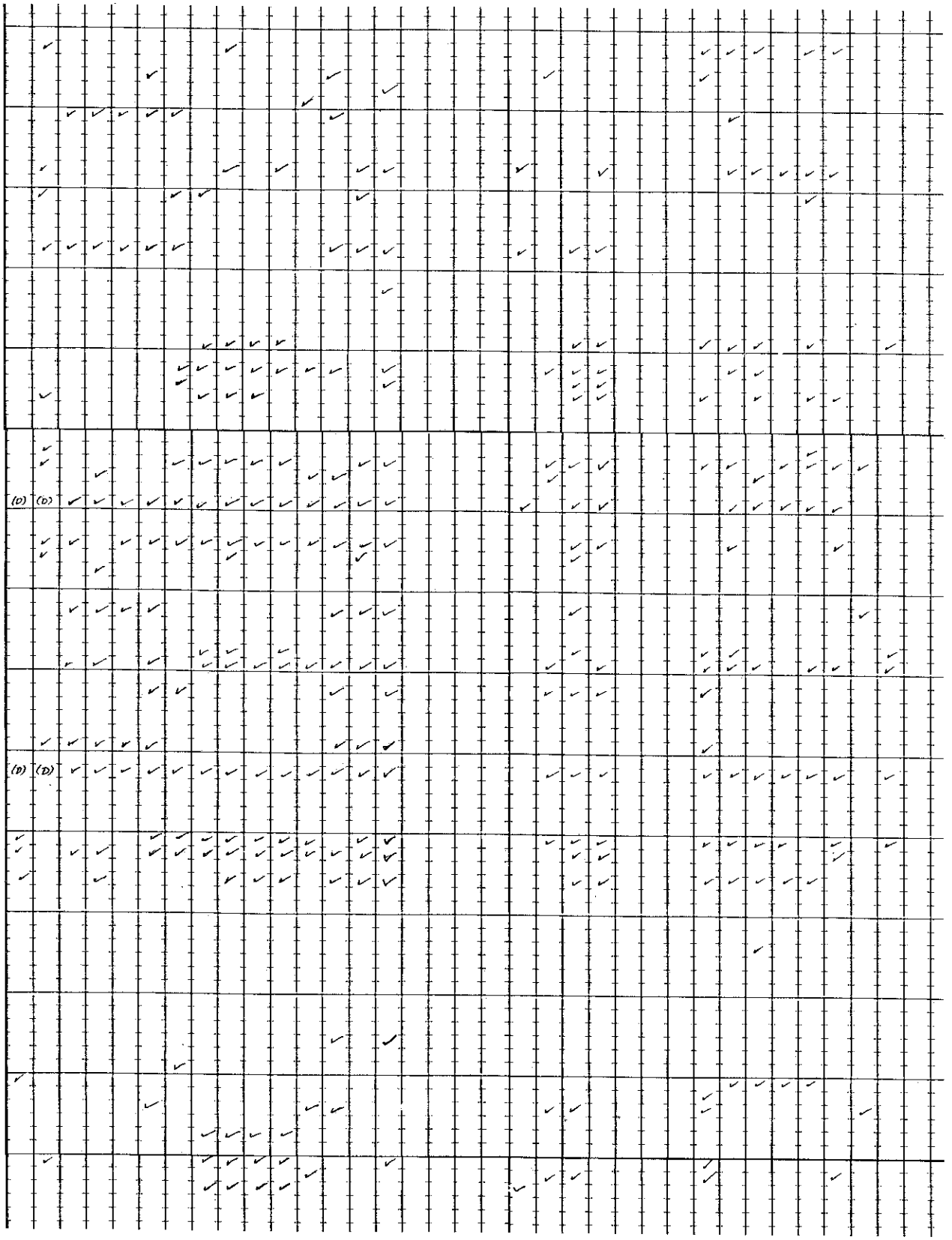
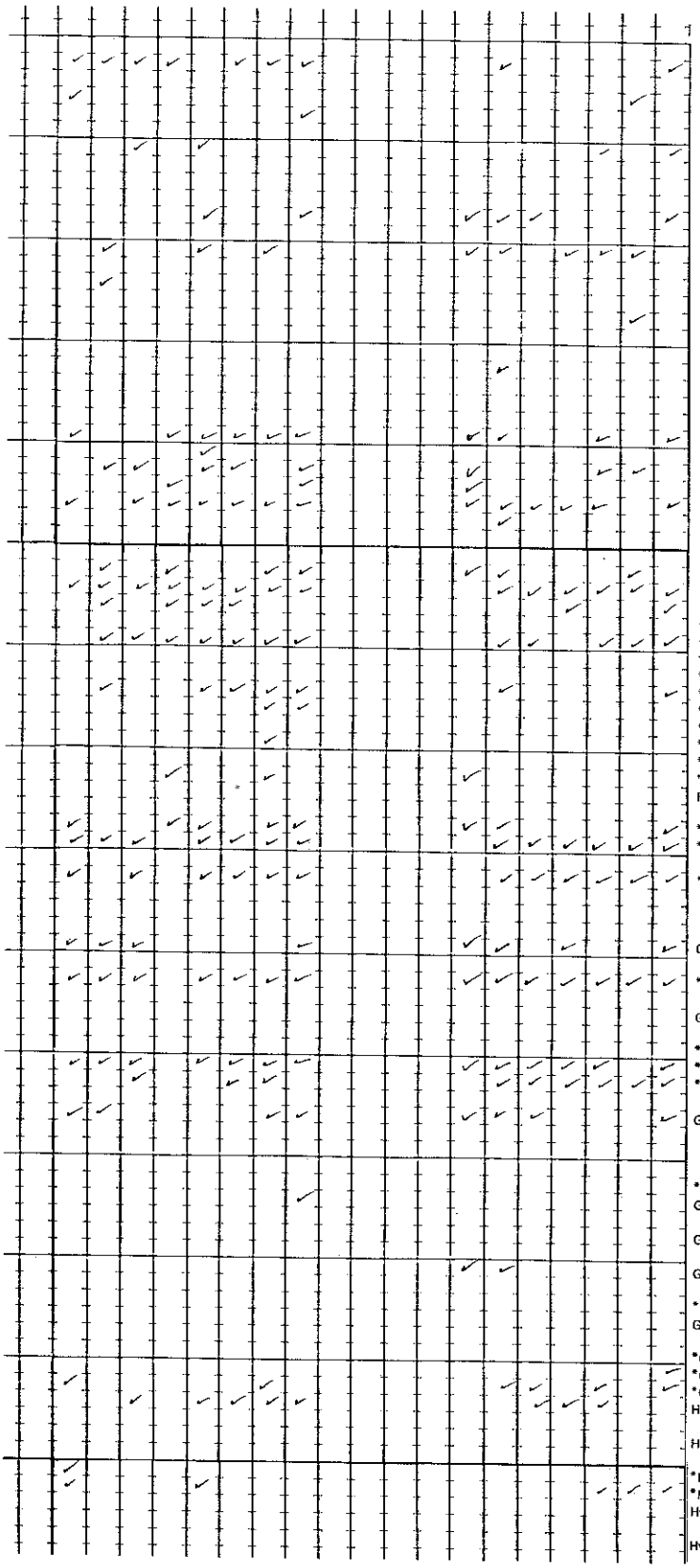


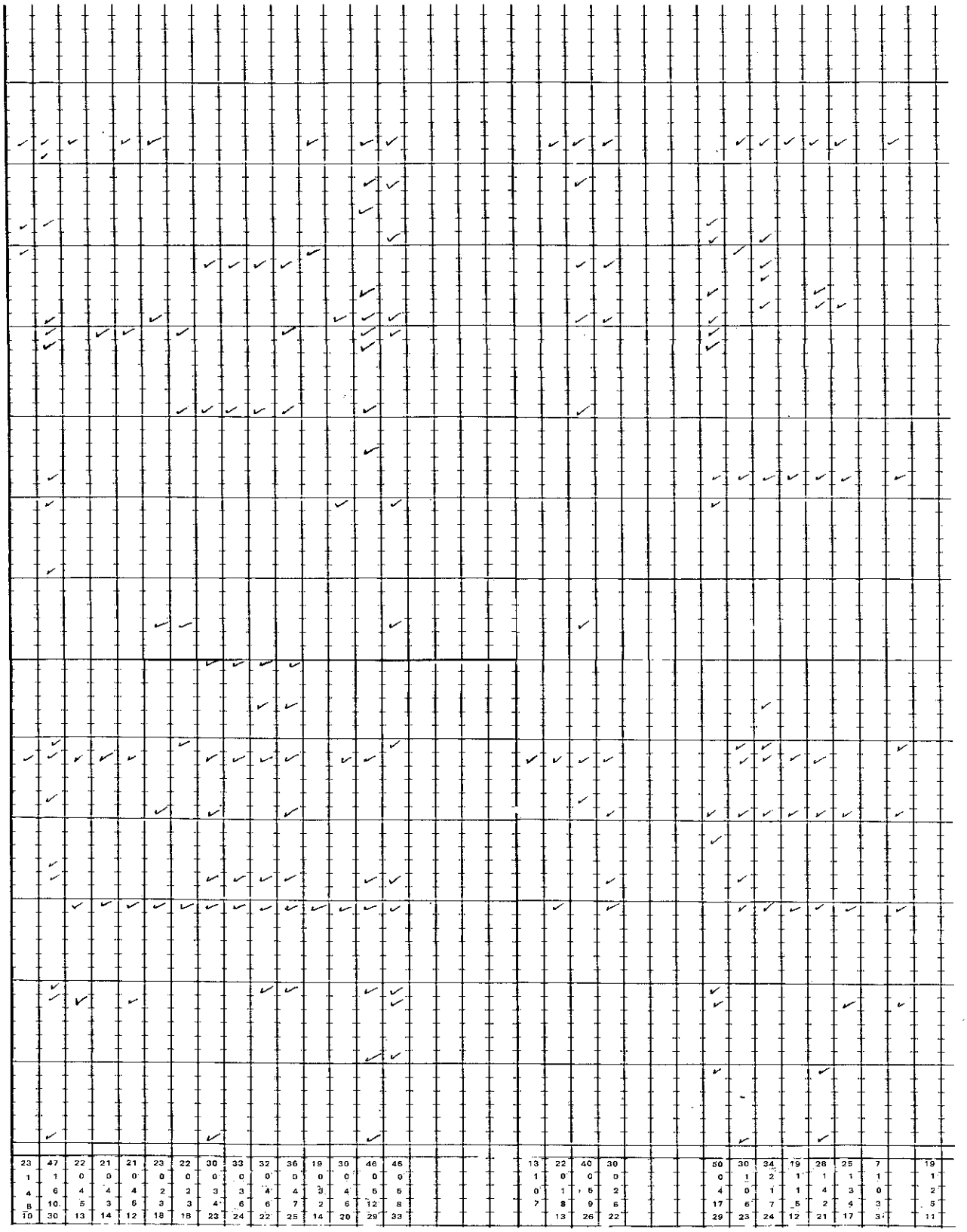
TABLE 4



RHODOPHYTA

*Acrosorium uncinatum *(Turn.) Kylin*
*Ahnfeltia plicata *(Huds.) Fries*
*Amphiroa zonata *Yendo*
*Anisocladella pacifica *Kylin*
*Bangia fusco-purpurea *(Dillw.) Lyngb.*
Bossiella chiloensis *(Decne.) Johans.*
=*Bossiella insularis *Daws. & Silva*
=*Bossiella ligulata *Daws.*
=*Bossiella sagitta *Daws. & Silva*
Bossiella orbigniana *ssp.* dichotoma *(Manza) Johans.*
=*Bossiella dichotoma *Manza* –gardneri *Manza complex*
Bossiella orbigniana *ssp.* orbigniana *(Decne.) Silva*
=*Bossiella orbigniana *(Decne.) Silva*
*Bossiella plumosa *(Manza) Silva*
*Botryoglossum farlowianum *(J. Ag.) DeToni*
*Calliarthron *sp.*
*Callithamnion pikeanum *Harv.*
*Callophyllis obtusifolia *J. Ag.*
*Callophyllis violacea *J. Ag.*
=*Callophyllis plumosa *Setch. & Swezy*
Carpopeltis bushiae *(Farl.) Kylin*
=*Polyopes bushiae *Farl.*
*Centroceras clavulatum *(C. Ag.) Mont.*
*Ceramium californicum *J. Ag.*
*Ceramium eatonianum *(Farl.) DeToni*
*Ceramium pacificum *(Coll.) Kylin*
*Chondria californica *(Coll.) Kylin*
Chondria dasyphylla *(Woodw.) C. Ag.*
=*Chondria pacifica *S. & G.*
*Chondria decipiens *Kylin*
*Chondria nidifica *Harv.*
*Corallina officinalis *var.* chilensis *(Decne.) Kütz.*
*Corallina pinnatifolia *(Manza) Daws.*
*Corallina polysticha *Daws.*
*Corallina vancouveriensis *Yendo*
*Cruoriella dubyi *(Crouan & Crouan) Schmitz*
*Cryptonemia obovata *J. Ag.*
*Cryptopleura corallinara *(Nott) Gardn.*
*Cryptopleura crispa *Kylin*
*Cryptopleura lobulifera *(J. Ag.) Kylin*
*Cryptopleura violacea *(J. Ag.) Kylin*
*Cryptosiphonia woodii *(J. Ag.) J. Ag.*
*Endocladia muricata *(P. & R.) J. Ag.*
Farlowia mollis *(Harv. & Bail.) Farl. & Setch.*
=*Farlowia crassa *J. Ag.*
*Gastroclonium coulteri *(Harv.) Kylin*
*Gelidium coulteri *Harv.*
[includes Gelidium pusillum *(Stackh.) Le Jol.]*
*Gelidium purpurascens *Gardn.*
=*Gelidium densum *Gardn.*
=*Gelidium pulchrum *Gardn.*
=*Gelidium ramuliferum *Gardn.*
Gelidium robustum *(Gardn.) Hollenb. & Abb.*
=*Gelidium cartilagineum *var.* robustum *Gardn.*
*Gigartina canaliculata *Harv.*
=*Gigartina serrata *Gardn.*
Gigartina exasperata *Harv. & Bail.*
=*Gigartina californica *J. Ag.*
*Gigartina harveyana *(Kütz.) S. & G.*
*Gigartina leptorhynchos *J. Ag.*
*Gigartina papillata *(C. Ag.) J. Ag.*
=*Gigartina cristata *(Setch.) S. & G.*
Gigartina spinosa *(Kütz.) Harv.*
=*Gigartina asperifolia *J. Ag.*
=*Gigartina eatoniana *J. Ag.*
=*Gigartina spinosa *(Kütz.) Harv.* –armata *J. Ag. complex*
*Gigartina volans *(C. Ag.) J. Ag.* =*Rhodoglossum lingulata *Daws.*
Gracilaria andersonii *(Grun.) Kylin*
=*Gracilariopsis andersonii *(Grun.) Daws.*
Gracilaria sjoestedtii *Kylin*
=*Gracilariopsis sjoestedtii *(Kylin) Daws.*
Gracilaria textorii *var.* cunninghamii *(Farl.) Daws.*
=*Gracilaria cunninghamii *Farl.*
*Gracilaria verrucosa *(Huds.) Papenf.*
Grateloupia doryphora *(Mont.) Howe*
=*Grateloupia abbreviata *Kylin*
*Grateloupia prolongata *J. Ag. or* schizophylla *Kütz.*
*Gymnogongrus leptophyllus *J. Ag.*
*Gymnogongrus platyphyllus *Gardn.*
Haliptylon gracilis *(Lamour.) Johans.*
=*Corallina gracilis *Lamour., and vars.*
Herposiphonia tenella *forma* secunda *(C. Ag.) Hollenb.*
=*Herposiphonia secunda *(C. Ag.) Ambronn*
*Herposiphonia verticillata *(Harv.) Kylin*
*Hildenbrandia prototypus *Nardo*
Hydrolithon decipiens *(Fosl.) Adey*
=*Lithophyllum decipiens *(Fosl.) Fosl.*
Hypnea valentiae *var.* valentiae *(Turn.) Mont.*
=*Hypnea californica *Kylin or* Hypnea adunca *J. Ag.*

TABLE 4



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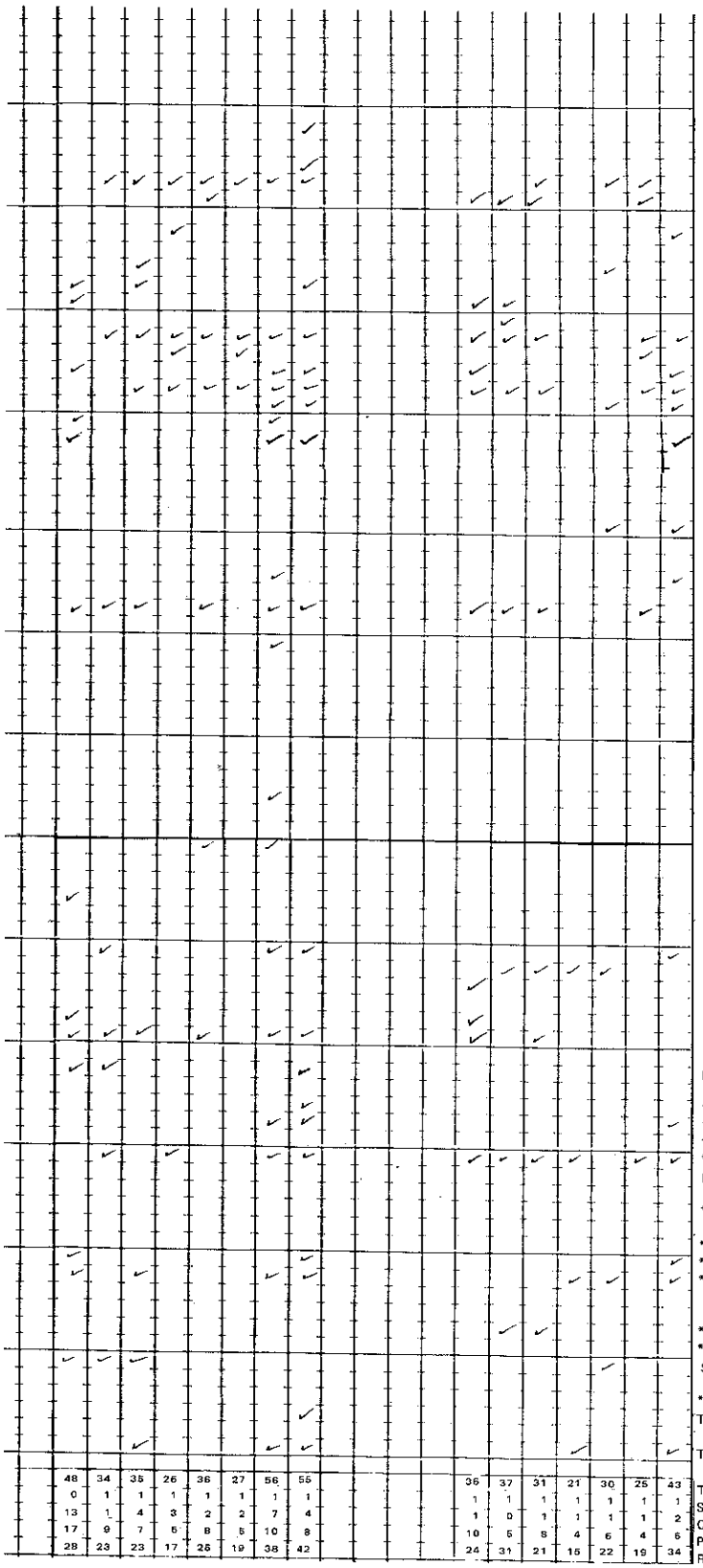

Iridaea cordata *var.* splendens *(S. & G.) Abb.*
=*Iridaea splendens *(S. & G.) Papenf.*
=*Iridaea reediae *(S. & G.) Papenf.*
=*Rhodoglossum coriaceum *Daws.*
*Iridaea flaccida *(S. & G.) Silva*
*Iridaea heterocarpa *P. & R.*
*Iridaea lineare *(S. & G.) Kylin*
Jania crassa *Lamour.*
=*Jania natalensis *Harv.*
*Jania tenella *(Kütz.) Grun.*
*Laurencia pacifica *Kylin*
Laurencia spectabilis *var.* diegoensis *(Daws.) Daws.*
=*Laurencia diegoensis *Daws.*
Laurencia spectabilis *var.* spectabilis *P. & R.*
=*Laurencia spectabilis *P. & R.*
*Laurencia splendens *Hollenb.*
*Laurencia subopposita *(J. Ag.) Setch.*
*Lithothamnium californicum *Fosl.*
*Lithothamnium crassiusculum *(Fosl.) Mason*
*Lithothrix aspergillum *J.E. Gray*
*Lophosiphonia reptabunda *(Suhr) Kylin*
*Melobesia marginata *Setch. & Fosl.*
*Melobesia mediocris *(Fosl.) Setch. & Mason*
*Microcladia coulteri *Harv.*
*Nemalion helminthoides *(Vell.) Batt.*
Nienburgia andersoniana *(J. Ag.) Kylin*
Neoagardhiella baileyi *(Kütz.) Wynne & Taylor*
=*Agardhiella coulteri *(Harv.) Setch.*
Ozophora clevelandii *(Farl.) Abb.*
=*Phyllophora californica *(J. Ag.) Kylin*
*Petrocelis franciscana *S. & G.*
*Petroglossum parvum *Hollenb.*
*Phycodrys setchellii *Skottsb.*
Pleonosporium squarrulosum *(Harv.) Abb.*
=*Pleonosporium dasyoides *(J. Ag.) DeToni*
Plocamium cartilagineum *(L.) Dixon*
=*Plocamium pacificum *Kylin*
*Plocamium violaceum *Farl.*
*Pogonophorella californica *(J. Ag.) Silva*
*Polyneura latissima *(Harv.) Kylin*
Polysiphonia confusa *Hollenb.*
=*Polysiphonia inconspicua *Hollenb.*
Polysiphonia hendryi *var.* gardneri *(Kylin) Hollenb.*
=*Polysiphonia collinsii *Hollenb.*
Polysiphonia mollis *Hook. & Harv.*
=*Polysiphonia snyderiae *Kylin*
*Polysiphonia pacifica *Hollenb.*
*Polysiphonia paniculata *Mont.*

Polysiphonia scopulorum *var.* villum *(J. Ag.) Hollenb.*
=*Lophosiphonia scopulorum *(Harv.) Wombers.*
*Polysiphonia simplex *Hollenb.*
*Porphyra perforata *J. Ag. and* P. thuretii *Daws.*
Prionitis lyallii *Harv.*
=*Prionitis andersonii *J. Ag.*
*Prionitis cornea *(Okam.) Daws.*
*Prionitis lanceolata *(Harv.) Harv.*
Pseudogloiophloea confusa *(Setch.) Levr.*
=*Gloiophloea confusa *Setch.*
*Pterochondria woodii *(Harv.) Hollenb.*
Pterocladia capillacea *(Gmel.) Born. & Thur.*
=*Pterocladia pyramidale *Gardn.*
Pterocladia media *Daws.*
=*Gelidium crinale *(Turn.) Lamour., and vars.*
*Pterosiphonia baileyi *(Harv.) Falkenb.*
*Pterosiphonia dendroidea *(Mont.) Falkenb.*
*Ptilota filicina *J. Ag.*
*Rhodoglossum affine *(Harv.) Kylin*
Rhodoglossum californicum *(J. Ag.) Abb.*
=*Rhodoglossum americanum *Kylin*
*Rhodoglossum roseum *(Kylin) Smith*

*Rhodomela larix *(Turn.) C. Ag.*
*Rhodymenia californica *Kylin*
*Rhodymenia pacifica *Kylin*
=*Rhodymenia lobulifera *Daws.*
=*Rhodymenia palmettiformis *Daws.*
*Rhodymenia rhizoides *Daws.*
*Schizymenia pacifica *(Kylin) Kylin*
Smithora naiadum *(Anders.) Hollenb.*
=*Porphyra naiadum *Anders.*
*Stenogramme interrupta *(C. Ag.) Mont.*
Tenarea ascripticia *(Fosl.) Adey*
=*Dermatolithon ascripticium *(Fosl.) Setch. & Mason*
Tiffaniella snyderiae *(Farl.) Abb.*
=*Spermothamnion snyderiae *Farl.*

48	34	35	26	36	27	56	55			36	37	31	21	30	25	43
0	1	1	1	1	1	1	1			1	1	1	1	1	1	1
13	1	4	3	2	2	7	4			1	0	1	1	1	1	2
17	9	7	5	8	5	10	8			10	5	8	4	6	4	5
28	23	23	17	25	19	38	42			24	31	21	15	22	19	34

Total number of taxa: 171
Spermatophyta: 1
Chlorophyta: 18
Phaeophyta: 31
Rhodophyta: 121

TABLE 4

APPENDIX

Dawson never published a complete listing of all seaweeds collected in the 1956-59 survey, although the 1959 publication had a species by station table for all stations through March, 1958, and in the 1965 paper his field notes were included. Both of these accounts are incomplete: the 1959 table omits species and has many species placed in wrong station columns, while the majority of citations in the field notes are only to genus and they contain identifications that were later changed. Vouchers of all algae (and Phyllospadix) collected are on file at the Hancock, but some appear to have been misplaced among the station folders. The most accurate lissting is contained in Dawson's field book in which he kept records of all plants collected and identified; however he frequently omitted large or obvious taxa such as Eisenia or Porphyra from his collections. Because of these inconsistencies, the various researchers who have used Dawson's work for comparison have ended with different numbers of species per station. Widdowson (1971) used the 1959 table and 1965 field notes in his study, Nicholson & Cimberg (1971) combined data from the field notes and vouchers, and Thom & Widdowson (1978) utilized the 1959 table plus vouchers. Nicholson & Cimberg published their compilation as an aid to future researchers.

Unfortunately, the correct number of species for each station is still uncertain. Rather than add to the confusion by simply stating another version of species numbers, I have listed the various species recorded and where they are mentioned, with annotations. Taxonomy has not been revised in these tables.

1. Dawson lists C. setchellii in the fieldbook but the identification on the voucher sheet is C. osmundacea; the material is C. osmundacea.
2. Specimens of both B. plumosa and C. pinnatifolia were identified as B. plumosa.
3. Specimens of M. mediocris are present on the Phyllospadix vouchers.
4. The "blue-greens" referred to in the field notes were later identified by Dawson as a mixture of Enteromorpha sp. and Ectocarpus sp. aff. E. chantransioides, for which vouchers exist.

The number of valid species appears to be 34.

FLAT ROCK POINT 30 Nov. 1956

Valid Species	1959 Table	1965 Station notes	Fieldbook Data	Herbarium Specimens	N & C (1971)	SPECIES
1	*	G	*	S	*	Phyllospadix torreyi
2	*	G	*	S	*	Colpomenia sinuosa
3	*	G		S		Cystoseira osmundacea[1]
4	*	*	*	S	*	Dictyota flabellata
5	*	G	*	S	*	Egregia laevigata
6	*	G	*	S	*	Pachydictyon coriaceum
7	*	*	*	S	*	Pelvetia fastigiata
8	*	*	*	S	*	Petrospongium rugosum
9	*	*	*	B	SN	Ralfsia sp.
10	*		*	S	*	Acrosorium uncinatum
11	*	G	*	S	*	Bossiella orbigniana
12	*	G	*	S	*	Bossiella plumosa[2]
13	*		*	S	*	Ceramium eatonianum
14	*	*	*	S	*	Chondria nidifica
15	*	*	*	S	*	Corallina officinalis var. chilensis
16	*	*	*	S	*	Corallina vancouveriensis
17	*	*	*	S	*	Cryptopleura corallinara
18	*	*	*	S	*	Gelidium cartilagineum var. robustum
19	*	*	*	S	*	Gelidium coulteri
20	*		*	S	*	Gelidium crinale and vars.
21	*	*	*	S	*	Gigartina canaliculata
22	*	*	*	S	*	Gigartina leptorhynchos
23	*	*	*	S	*	Gigartina spinosa - armata complex
24	*		*	S	*	Laurencia pacifica
25	*	G	*	S	*	Lithothrix aspergillum
26	*	G			SN	Melobesia mediocris[3]
27	*		*	S	*	Plocamium pacificum
28	*	*	*	S	*	Porphyra naiadum
29	*	*	*	S	*	Prionitis cornea
30	*	G	*	S	*	Pterocladia pyramidale
31	*		*	S	*	Rhodoglossum affine
			*		*	Cystoseira setchellii[1]
		*			SN	blue-greens[4]
32		G	*	B	SN	Enteromorpha[4]
33			*	B		Ectocarpus sp. aff. E. chantransioides[4]
34				S		Corallina pinnatifolia[2]

G = generic reference only
S = standard mounted specimen
B = boxed specimen (stored separately)
SN = record taken from station notes only

Valid Species	1959 Table	1965 Station notes	Fieldbook Data	Herbarium Specimens	N & C (1971)	SPECIES
1	*	G	*	S	*	Phyllospadix torreyi
2	*	G	*	S	*	Cystoseira osmundacea
3	*		*	S	*	Dictyopteris zonarioides
4	*	G	*	S	*	Egregia laevigata
5	*	G	*	S	*	Pachydictyon coriaceum
6	*	G	*	S	*	Pelvetia fastigiata
7	*	G	*	B	SN	Ralfsia sp.
8	*	G	*	S	*	Acrosorium uncinatum
9	*	G	*	S	*	Bossiella dichotoma - gardneri complex
10	*	G	*	S	*	Centroceras clavulatum
11	*		*	S	*	Ceramium eatonianum
12	*	G	*	S	*	Corallina officinalis var. chilensis
13	*	*	*	S	*	Corallina vancouveriensis
14	*		*	S	*	Gastroclonium coulteri
15	*		*	S	*	Gelidium coulteri[1]
16	*	*	*	S	*	Gigartina canaliculata
17	*		*	S	*	Gigartina leptorhynchos
18	*	G	*	S	*	Gigartina spinosa - armata complex
19	*	G	*	S	*	Gymnogongrus leptophyllus
20	*	G	*	S	*	Laurencia pacifica
21	*		*	B		Lithothamnium crassiusculum[2]
22	*	G	*	S	*	Plocamium pacificum
23	*	G	*	S	*	Prionitis cornea
24	*		*	S	*	Prionitis lanceolata
25	*	G	*	S	*	Pterocladia pyramidale
26	*		*	S	*	Pterosiphonia dendroidea
27	*	G	*	S	*	Rhodoglossum affine
28	*	G	*	S	*	Spermothamnion snyderiae
		*				Gelidium crinale?[1]
29		*			SN	Cryptopleura corallinara?[3]
30			*	*	*	Bossea sp. atypical B. insularis
					SN	turf algae

G = generic reference only
S = standard mounted specimen
B = boxed specimen (stored separately)
SN = record taken from station notes only

1. G. coulteri was probably identified in the field as G. crinale.
2. Apparently not seen by Nicholson & Cimberg.
3. Cited as Cryptopleura spp. by Nicholson & Cimberg.

The number of valid species appears to be 30, including the Cryptopleura entry.

Valid Species	1959 Table	1965 Station note	Fieldbook Data	Herbarium Specimens	N & C (1971)	SPECIES
1,2	*	G	both	S	both	Phyllospadix torreyi or scouleri
3	*	G	*	S	*	Ulva californica
4	*	G	*	S	*	Colpomenia sinuosa
5	*	G	*	S	*	Cystoseira osmundacea
6	*	G	*	S	*	Dictyopteris zonarioides
7	*	G	*	S	*	Egregia laevigata
8	*	G	*	S	*	Pachydictyon coriaceum
9	*	G	*	S	*	Pelvetia fastigiata
10	*	G	*	B	SN	Ralfsia sp.
11	*	G	*	S	*	Acrosorium uncinatum
12	*	G	*	S	*	Bossiella dichotoma - gardneri complex
13	*	*	*	S	*	Ceramium eatonianum
14		*	*	S	*	Chondria californica
15	*	G	*	S	*	Corallina pinnatifolia
16	*	*	*	S	*	Corallina vancouveriensis
17	*	*	*	S	*	Gelidium coulteri
18	*	*	*	S	*	Gigartina canaliculata
19	*	*	*	S	*	Gigartina leptorhynchos
20	*	*	*	S	*	Gigartina spinosa - armata complex
21	*		*	S	*	Gracilariopsis andersonii
22	*	*	*	S	*	Gymnogongrus leptophyllus
23	*	*	*	S	*	Laurencia pacifica
24	*		*	B		Lithothamnium californicum[1]
25	*		*	S	*	Lithothrix aspergillum
26	*		*	S	*	Lophosiphonia reptabunda[1]
27	*		*	S	*	Melobesia mediocris
28	*	G	*	S	*	Plocamium pacificum
29	*	G	*	S	*	Porphyra perforata
30	*	G	*	S	*	Prionitis cornea
31	*	G	*	S	*	Prionitis lanceolata
32	*	G	*	S	*	Pterocladia pyramidale
33	*	G	*	S	*	Rhodoglossum affine
34			*	S	*	Centroceras clavulatum
		*			*	Lithophyllum decipiens[1]
		G			*	Spermothamnion snyderiae[1]

G = generic reference only
S = standard mounted specimen
B = boxed specimen (stored separately)
SN = record taken from station notes only

1. Lithophyllum decipiens and Spermothamnion snyderiae are mentioned in the station notes but not in the table or fieldbook, and no voucher material exists; they might have been visual field identifications which Dawson later changed to Lithothamnium californicum and Lophosiphonia reptabunda.

The number of valid species appears to be 34.

Valid Species	1959 Table	1965 Station notes	Fieldbook Data	Herbarium Specimens	N & C (1971)	SPECIES
1	*	G	*	S	*	Phyllospadix torreyi
2	*	*			SN	Ulva californica
3	*		*	S	*	Dictyopteris zonarioides
4	*		*	S	*	Egregia laevigata
5	*		*	S	*	Pachydictyon coriaceum
6	*	G			SN	Pelvetia fastigiata
	*					Petrospongium rugosum[1]
7	*	G			SN	Ralfsia sp.
8	*	G	*	S	*	Bossiella dichotoma - gardneri complex
9	*	G	*	S	*	Corallina officinalis v. chilensis
10	*	*	*	S	*	Corallina vancouveriensis
11	*	*	*	S	*	Gigartina canaliculata
12	*	*	*	S	*	Gigartina leptorhynchos
13	*		*	S	*	Gigartina spinosa - armata complex
14	*	G	*	S	*	Gymnogongrus leptophyllus
15	*	*	*	S	*	Laurencia pacifica
16	*		*	S	*	Prionitis lanceolata
17	*	G	*	S	*	Pterocladia pyramidale
18	*	*			SN	Rhodoglossum affine
19			*	S	*	Plocamium pacificum

G = generic reference only
S = standard mounted specimen
B = boxed specimen (stored separately)
SN = record taken from station notes only

1. In the 1959 table, Lunada Bay (with an "extra" P. rugosum) is next to Portuguese Point ("missing" an entry for P. rugosum): almost certainly a mistake in placement. There is Melobesia mediocris on the Phyllospadix vouchers, however Dawson omitted any mention of it.

   The number of valid species appears to be 19, excluding the Melobesia.

PORTUGUESE POINT 7 Nov. 1957

Valid Species	1959 Table	1965 Station notes	Fieldbook Data	Herbarium Specimens	N & C (1971)	SPECIES
1	*	G	*	S	*	Phyllospadix scouleri
2	*	G	*	S	*	Colpomenia sinuosa
3	*	G			SN	Eisenia arborea
4	*	G			SN	Halidrys dioica
5	*	G	*	S	*	Pachydictyon coriaceum
6	*	G	*	S	*	Pelvetia fastigiata
7	*	G	*	B	SN	Ralfsia sp.
8	*	G	*	S	*	Bossiella dichotoma - gardneri complex
9	*	*	*	B	SN	Corallina vancouveriensis
	*	G				Prionitis lanceolata[1]
10	*	G			SN	Calliarthron sp.
11			*	B		Lithophyllum decipiens
12		G	*	B	SN	Petrospongium rugosum
		G				Hesperophycus harveyanus (not on transect line)
13			*	S	*	Prionitis cornea[1]
S1			*	S	*	Gelidium purpurascens (sublittoral)
S2		G	*	S	*	Dictyopteris zonarioides (sublittoral)
S3			*	S	*	Corallina officinalis v. chilensis (sublittoral)
S4			*	S	*	Gigartina spinosa (sublittoral)
S5			*	S	*	Cystoseira osmundacea (sublittoral)
S6		G	*	S	*	Zonaria farlowii (sublittoral)
S7			*	S	*	Pterocladia pyramidale (sublittoral)

G = generic reference only
S = standard mounted specimen
B = boxed specimen (stored separately)
SN = record taken from station notes only

1. P. lanceolata was a mistake in placement on the 1959 table and should be P. cornea.
2. This entry was transposed to Lunada Bay.

Dawson, 1959, lists 11 species in the table; Dawson, 1965, mentions "12 prominent species" in his discussion, and 12 intertidal species on the transect line plus 2 subtidal species in the station notes. Thom & Widdowson (1978) apparently included intertidal and some subtidal species for a total of 18 species. Nicholson & Cimberg combined both and list 19 species.

The number of valid intertidal species appears to be 13, plus 7 subtidal species which should not be considered in any comparison of intertidal work.

WHITES POINT 28 Jan. 1957

Valid Species	1959 Table	1965 Station notes	Fieldbook Data	Herbarium Specimens	N & C (1971)	SPECIES
1	*	*	*	S	*	Cladophora trichotoma
2	*	*	*	S	*	Codium fragile
3	*	G	*	S	*	Eisenia arborea
4	*	G	*	S	*	Egregia laevigata
5	*		*	S	*	Pachydictyon coriaceum
6	*	G	*	S	*	Ralfsia sp.
	*					Centroceras clavulatum[1]
7	*	G	*	S	*	Corallina vancouveriensis v. vancouveriensis
8	*	G	*	S	*	Cryptopleura corallinara
9	*	G	*	S	*	Endocladia muricata
10	*	G	*	S	*	Gigartina canaliculata
11	*	G	*	S	*	Gigartina cristata
12	*	G	*	S	*	Prionitis lanceolata
13	*	G	*	S	*	Rhodymenia palmettiformis
14	*	G	*	S	*	Rhodoglossum affine
15		G	*	S	*	Enteromorpha compressa[2]
16		*			SN	Gelidium coulteri
17		G			SN	Ulva
18		G	*	S	*	Bossea insularis[2]
19		G	*	S	*	Halidrys dioica[2]
20		*	*	B	*	Calliarthron cheilosporioides[2]
(7)		*	*	S		Corallina vancouveriensis near lycopodioides
21			*	S	*	Gelidium cartilagineum v. robustum
22			*	S	*	Laurencia pacifica
					*	Gigartina spp.[3]

G = generic reference only
S = standard mounted specimen
B = boxed specimen (stored separately)
SN = record taken from station notes only

1. In the 1959 table, Whites Point (with an "extra" C. clavulatum) is next to Point Fermin ("missing" an entry for C. clavulatum): almost certainly a mistake in placement.
2. The entries for these species were all transposed into the column for Point Fermin in the 1959 table.
3. Dawson referred Gigartina spp. to Gigartina cristata.

The number of valid species appears to be 22.

WHITES POINT 30 June 1957

Valid Species	1959 Table	1965 Station notes	Fieldbook Data	Herbarium Specimens	N & C (1971)	SPECIES
	*					Cladophora microcladioides[1]
1	*	G	*	S	*	Codium fragile
2	*	G	*	S	*	Enteromorpha compressa
3	*		*	S	*	Ulva californica
4	*	G	*	S	*	Eisenia arborea
5	*		*	S	*	Egregia laevigata
6	*	G	*	S	*	Halidrys dioica
7	*	G	*	S	*	Bossiella insularis
8	*	G	*	B	SN	Calliarthron sp.
9	*	G	*	S	*	Corallina pinnatifolia
10	*	G	*	S	*	Corallina vancouveriensis var. lycopodioides
11	*	G	*	S	*	Cryptopleura ?lobulifera
12	*	G	*	S	*	Endocladia muricata
13	*		*	S	*	Gelidium coulteri
14	*	G	*	S	*	Gigartina canaliculata
15	*	G	*	S	*	Gigartina cristata
16	*	G	*	S	*	Gigartina spinosa-armata complex
17	*	G	*	S	*	Nemalion helminthoides
18	*	G	*	S	*	Prionitis lanceolata
19	*	G	*	S	*	Rhodoglossum affine
20		*	*	S	*	Cladophora trichotoma[1]
					SN	Ulva spp.[2]
S1		G	*	S	*	Ectocarpus granulosus (subtidal)
S2			*	S	*	Pachydictyon coriaceum (subtidal)
S3			*	S	*	Taonia lennebackeriae (subtidal)
21			*	S	*	Gelidium robustum[3]
S4			*	S	*	Laurencia pacifica (subtidal)

G = generic reference only
S = standard mounted specimen
B = boxed specimen (stored separately)
SN = record taken from station notes only

1. C. microcladioides is a misplaced entry for C. trichotoma.
2. Ulva spp. is not mentioned anywhere by Dawson.
3. Dawson classed G. robustum as subtidal and didn't include it in the 1959 table; however, it was also collected intertidally and should be counted.

The number of valid intertidal species appears to be 21, plus 4 subtidal species.

Valid Species	1959 Table	1965 Station notes	Fieldbook Data	Herbarium Specimens	N & C (1971)	SPECIES
1	*	G	*	S		Chaetomorpha aerea
2	*	*				Cladophora trichotoma
3	*	G				Codium fragile
4	*	G				Enteromorpha compressa
5	*					Eisenia arborea
6	*	G				Egregia laevigata
7	*	G				Halidrys dioica
8	*					Ralfsia sp.
9	*	G	*	S		Scytosiphon lomentaria
10	*					Bossiella insularis
11	*					Calliarthron sp.
12	*	G				Corallina vancouveriensis
13	*					Cryptopleura corallinara
14	*	G				Endocladia muricata
15	*					Gelidium robustum
16	*	*				Gigartina canaliculata
17	*					Laurencia pacifica
	*					Nienburgia andersoniana[1]
18	*	G				Prionitis lanceolata
19	*		*	S		Rhodoglossum affine
20	*					Rhodymenia pacifica
21		G	*	S		Nemalion helminthoides[1]
		G				Phyllospadix (not on transect line)

G = generic reference only
S = standard mounted specimen
B = boxed specimen (stored separately)
SN = record taken from station notes only

1. N. andersoniana is a misplaced entry for N. helminthoides.
   Vouchers exist for only 4 species: heavy surf made collecting impossible. Dawson mentioned 10 other species in the station notes (one off the transect line) and 8 more are listed in the 1959 species table. Nicholson & Cimberg did not include this collection in their compilation.

   The number of documented species (with vouchers) is 4, the total number appears to be 21.

POINT FERMIN 14 Jan. 1957

Valid Species	1959 Table	1965 Station notes	Fieldbook Data	Herbarium Specimens	N & C (1971)	SPECIES
1	*	G	*	S	*	Phyllospadix torreyi
	*					Enteromorpha compressa[1]
2	*	*	*	S	*	Cystoseira osmundacea
3	*	G	*	S	*	Egregia laevigata
	*					Halidrys dioica[1]
4	*	G	*	S	*	Pachydictyon coriaceum
5	*	G	*	S	*	Pelvetia fastigiata
6	*	G	*	B	SN	Ralfia sp.
7	*	G	*	S	*	Bossiella dichotoma-gardneri complex
	*	G				Bossiella insularis[1]
8	*	G	*	S	*	Bossiella orbigniana
	*					Calliarthron sp.[1]
9	*		*			Callophyllis plumosa[2]
10	*	*	*	S	*	Chondria californica
11	*		*	S	*	Chondria nidifica
12	*		*	S	*	Chondria pacifica
13	*	G	*	S	*	Corallina officinalis var. chilensis
14	*	*	*	S	*	Corallina vancouveriensis
13	*	G	*	S	*	Cryptopleura corallinara
16	*	G	*	S	*	Gastroclonium coulteri
17	*	*	*	S	*	Gelidium coulteri
18	*	G	*	S	*	Gelidium purpurascens
19	*	*	*	S	*	Gigartina canaliculata
20	*	*	*	S	*	Gigartina cristata
21	*	*	*	S	*	Gigartina leptorhynchos
22	*	*	*	S	*	Gigartina spinosa-armata complex
23	*		*	S	*	Gracilaria cunninghamii
24	*		*	S	*	Gymnogongrus platyphyllus
25	*		*	S		Laurencia diegoensis
26	*		*	B		Lithothamnium californicum
27	*		*	B		Lithothamnium crassiusculum
28	*	G	*	S	*	Lithothrix aspergillum
29	*		*	S	*	Melobesia mediocris

(continued on next page)

G = generic reference only
S = standard mounted specimen
B = boxed specimen (stored separately)
SN = record taken from station notes only

Valid Species	1959 Table	1965 Station notes	Fieldbook Data	Herbarium Specimens	N & C (1971)	SPECIES
30	*	G	*	S	*	Plocamium pacificum
31	*	G	*	S	*	Prionitis cornea
32	*	*	*	S	*	Rhodoglossum affine
33	*		*	S	*	Rhodymenia rhizoides
34			*	S	*	Centroceras clavulatum[3]
		*	*	S		Laminaria farlowii (cast up)
35			*	S	*	Gelidium cartilagineum v. robustum
36			*	S		Antithamnion pygmaeum
					*	Gelidium pusillum[4]
					SN	Prionitis spp.[5]
37		G			SN	Acrosorium uncinatum[6]

G = generic reference only
S = standard mounted specimen
B = boxed specimen (stored separately)
SN = record taken from station notes only

1. The entries for these species were transposed from the column for Whites Point in the 1959 table.
2. The voucher for this seems to be lost.
3. The 1959 entry for C. clavulatum was placed under Whites Point.
4. Changed by Dawson to Gelidium coulteri.
5. Refers to Prionitis cornea.
6. Probably a valid species; Acrosorium is very distinctive.

The number of species appears to be 37.

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Valid Species	1959 Table	1965 Station notes	Fieldbook Data	Herbarium Specimens	N & C (1971)	SPECIES
1	*	G	*	S	*	Phyllospadix torreyi
2	*		*	S	*	Cladophora trichotoma
3	*	G	*	S	*	Egregia laevigata
4	*	G	*	S	*	Halidrys dioica
5	*	*	*	S	*	Laminaria farlowii
6	*		*	S	*	Pachydictyon coriaceum
7	*	G	*	S	*	Pelvetia fastigiata
8	*	G	*	S	*	Petrospongium rugosum
9	*	G	*	B	SN	Ralfsia sp.
10	*	*	*	S	*	Scytosiphon lomentaria
11	*	G	*	S	*	Bossiella dichotoma-gardneri complex
12	*		*	S	*	Chondria californica
13	*	G	*	S	*	Corallina gracilis & vars.
14	*	*	*	S	*	Corallina officinalis var. chilensis
15	*	*			SN	Corallina vancouveriensis
16	*		*	S	*	Gelidium pulchrum
17	*	*	*	S	*	Gigartina canaliculata
18	*	*	*	S	*	Gigartina cristata
19	*	*	*	S	*	Gigartina leptorhynchos
20	*	*	*	S	*	Gigartina spinosa - armata complex
21	*	*	*	S	SN	Gymnogongrus platyphyllus
22	*	*	*	S	*	Laurencia diegoensis
23	*		*	S	*	Laurencia pacifica
24	*	G	*	S	*	Lithothrix aspergillum
25	*		*	S	*	Melobesia mediocris
26	*	G	*	S	*	Plocamium pacificum
27	*	*	*	S	*	Prionitis lanceolata
28	*		*	S	*	Pterocladia pyramidale
29	*	*	*	S	*	Rhodoglossum affine
30	*	G	*	S	*	Rhodymenia rhizoides
31			*	S	*	Rhodymenia sp.
		*				Gelidium coulteri[1]
					SN	Endocladia muricata[2]
					*	Chondria nidifica[3]

G = generic reference only
S = standard mounted specimen
B = boxed specimen (stored separately)
SN = record taken from station notes only

1. Possibly a valid record; this is one of the taxa Dawson frequently omitted from voucher collections.
2. Not mentioned in any Dawson publication.
3. The voucher of Chondria nidifica in the Point Fermin file was misplaced and actually came from Santa Barbara Point.

The total number of valid species appears to be 31.

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