MAINLAND ROCKY INTERTIDAL AERIAL SURVEY FROM POINT ARGUELLO TO POINT LOMA, CALIFORNIA

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INTRODUCTION AND METHODS

Data were collected during helicopter overflights — where not restricted by military regulations or human population densities -and supplemented by numerous ground truth observations on predominant rocky-intertidal zonal assemblages found along the Southern California mainland coastline (from 18 December 1979 through 20 December 1980 and from 16 January 1980 through 17 January 1980). The observers' ability to identify species and recognize assemblages was enhanced from detailed studies conducted at 7 sites located within the area examined (Littler, 1979), and by extensive previous experience with helicopter survey techniques (Littler and Littler, 1979). Additional observations were made by hiking from automobile over the southern portion of the study area. Photographic samples (color slides) were taken continuously at low tide and zonal communities were identified and noted on tape recorder in terms of the abundant groups of organisms determined by cluster analysis for the intensive, high-resolution study sites documented in Littler (1979, Report II-1.0, Chapters 1.1-1.22). This latter study includes voucher specimens and detailed seasonal data. Observations were made by cruising at about 40 knots, 15-30 m in altitude, with the doors of the helicopter removed to improve visibility and photography. Landings (or hovering) were done to obtain ground truth information at nearly all accessible portions of the shoreline. In addition to the major zonal assemblages, the extent of sandy beaches (light stipling), boulder beaches (circle pattern), and rocky-intertidal substrates (dark shading) was quantified in considerable detail and mapped; although biotic mapping was not done for sandy beaches (Maps 1-40). The zonal assemblage data and the aerial photographs were then used to document the major rocky-intertidal communities and the extent and distribution of rocky, boulder, and sandy beach intertidal habitats

at low tide on a series of 40 U.S.G.S., 7.5-minute quadrangle (scale 1:24,000) maps. These 40 maps and the original field notes comprise the data-base. The fact that all flights were made during low tide periods gives a considerably different assessment of substrates than indicated on the original U.S.G.S. coastal maps. During the actual mapping, black and white photographs taken by U-2 overflight at 100,000 ft altitude were used to reference the topographic features and biota in the color slides to the coarser-scale U.S.G.S. maps. The absolute and relative proportions of sand, boulder, and rock substrates were precisely determined for both the upper and lower portions of the coastline with a Minerva Plane Measurer prior to the overlaying of pattern (Table 1).

The study was designed as a general survey, so not every habitat or population was precisely denoted. The major assemblages in a given region were depicted; however, variability in vertical relief and microhabitat patchiness resulted in isolated nonconformities too detailed for inclusion.

The dominant intertidal assemblages are represented on the quadrangle maps by capital letters with a key to the predominant species in each assemblage. Although the symbols used on these maps are similar to those used by Littler (1979), they are not always identical, so care should be used when comparing the two reports. The assemblages are given in sequence according to their vertical intertidal level with the highest assemblage at the top. Actual vertical ranges may, of course, extend either higher or lower. Vertical ordering was indicated only for the main assemblage lists. The notation of species at areas that did not quite conform to the surrounding assemblage, typically where several species were unusually abundant, is not necessarily in vertical sequence.

Lines are drawn from the assemblage lists to the extreme outer rocky intertidal boundaries where these assemblages occur along the shoreline;

Table 1. The extent of sand, boulder, and rock substrates from the Mexican border to Point Arguello, California.

	Upper Intertidal				Lower Intertidal			
	Sand	Boulder	Rock	T	Sand	Boulder	Rock	T
Miles	229	26	50	305	195	20	88	303
Kilometers	369.4	41.3	80.9		314.3	32.6	142.7	
Percentage	75.1%	8.4%	16.5%		64.2%	6.7%	29.1%	

most but not all of the rocky intertidal areas between these lines contain the same assemblages. All of the taxa represented by a given assemblage list are present in the denoted area regardless of where the line from the seashore reaches the assemblage list. Also, when the abundance of an assemblage is other than "normal", the assemblage symbol is followed by words of further clarification. For example, the terms common, abundant, very abundant, and dominant represent various degrees of increasing cover; few, numerous, dense, and very dense refer to numbers of individuals; and sparse, patches, and extensive are used to describe the breadth of distribution of the various populations. The generic epithet Acmaea was used on the maps consistently, although it has recently been revised to Collisella and Notoacmaea. Grouped taxa were as follows: Gelidium turf (Gelidium pusillum or G. coulteri with tightly packed branches and containing numerous other small species), filamentous Rhodophyta (mostly species of Ceramium, Polysiphonia, Pterosiphonia, and Centroceros in various combinations), crustose Corallinaceae (Hydrolithon, Lithophyllum, and Lithothamnium species in various combinations), and Ralfsiaceae (crust forms of Phaeophyta).

Usually, additional subgroups shown within a larger group represent rapid changes or minor differences over short horizontal distances, whether they occur within or outside the lines used to denote a vertical sequence of assemblages. Rocky or boulder areas between two adjacent assemblage lists usually have species in common with these lists, whether isolated species are denoted or not. Although the assemblages of many of the boulder areas were indicated, the majority were not, because of lack of substrate stability or vertical extent. The seaward, horizontal, and vertical extents of the intertidal varied at different areas even though they are symbolized as the same on the maps.

RESULTS

At low tide, sandy beaches in the upper intertidal were found to total 75.1% of the shoreline with the remainder consisting of 16.5% rock and 8.4% boulder beach (Table 1). Sandy beaches in the lower intertidal comprised 64.2%, rock 29.1%, and boulders 6.7% of the southern California seashore. The coastal area having the most extensive solid rock substrate was from Point Arguello to Jalama Beach Park (maps 39 and 40); whereas, boulder beaches were most pronounced off Palos Verdes. Sand generally predominated with reduced numbers of zonal assemblages except in the Point Arguello (map 40), Point Conception (map 38), Palos Verdes (maps 17 & 18), Laguna Beach (map 13), and Point Loma (map 2) regions. Much more rock was present (mapped) during the January overflights than in December (not mapped) due to high storm waves which had swept away much of the upper intertidal sand.

In terms of the mainland biogeography there seems to be an overall gradual transition from a cold water biota toward the north to a warmer water biota toward the south. Notable exceptions to this would seem to be a cold-water pocket (indicated by abundant Laminaria, map 34) centered at El Capitan Beach Park in Santa Barbara County with a few colder-water elements appearing in the Malibu and Palos Verdes areas. The most marked break occurred at Government Point where several species (e.g., Fucus, Analipus Heterochordaria, Laminaria; map 38) that are common to central California abruptly terminated their southern distributions.

Important species were noted to be distributed as follows. Intertidal Laminaria occurs abundantly from Point Arguello to Government Point with a more southerly pocket at El Capitan State Beach (see map 34). Fucus distichus also terminates its southward distribution at Government Point where, contrastingly, only infertile specimens were observed. Cystoseira osmundaceae is abundant to

common between Point Arguello and El Capitan but seems to be largely replaced by the closely related rockweed Halidrys dioica south to Point Loma. The Endocladia/Balanus association is present from the most northerly locales sampled to Los Angeles Harbor (map 17). The southern sea palm Eisenia arborea appears intertidally from Leo Carrillo State Beach (map 24) to Point Loma with peaks in abundance off Palos Verdes and Laguna Beach. Sewage odors detected while hovering off Palos Verdes were associated with dramatic reductions in Eisenia and the surf grasses Phyllospadix torreyi and P. scouleri. These areas as well as Corona del Mar were characterized by opportunistic forms of fine filamentous algae indicating some form of environmental fluctuation or stress.

Also indicating environmental fluctuations or stress were early successional, green algal populations (e.g., Ulva, Enteromorpha) that occurred on nearly all man-made structures and on upper-intertidal sand-scoured rocks and boulders (e.g., maps 26-30). Newly emergent natural rock substrates (following sand removal by wave action) typically had extensive coverage by the persistent, long-lived coralline Hydrolithon decipiens. This crustose species appeared to be overgrown subsequently by filamentous Rhodophyta followed consistently by Gelidium nudifrons.

Unique populations of the black abalone Haliotis cracherodii were abundant just to the south of Point Arguello (map 40). These represent the only dense stocks of large intertidal abalone, that compare in size and abundance with island stocks, remaining on the mainland — there are also two small rocks north of Zuma Beach in Malibu (map 23) with abundant smaller H. cracherodii. It is our opinion that measures should be taken to preserve these unique mainland populations as isolated remnants of the intertidal ecosystem prior to overexploitation by humans, which has

been pronounced since the turn of the century (Nicholson, 1972). Also, such stocks are essential to provide new recruits that might be carried into more depauperate southern California regions by the southward flowing California Current System and its associated gyres.

The Point Arguello area (map 40) contains a pronounced coralline algal zone (Corallina, Calliarthron, Bossiella) which along with Laminaria and Cystoseira, overlies fairly dense populations of Strongylocentrotus purpuratus in burrows. This association is also common on pristine island sites (Littler and Littler, 1979) but is quite patchy on the mainland. However, abnormally high populational outbreaks of S. purpuratus are characteristic of much of the Palos Verdes Peninsula and these have apparently overgrazed lower-intertidal algal stocks — as demonstrated by abrupt lower limits to frondose algal forms and a dominance of crustose corallines where S. purpuratus is unusually abundant.

SUMMARY

The helicopter aerial survey technique provides a rapid, cost-effective means of documenting the status of rocky-intertidal habitats. A general overview of substrates and major zonal assemblages has been painted in "broad brush strokes" on the maps (1-40). Further detail can be obtained by perusing the tape-recorded transcripts of the field notes (Appended). The greatest resolution of data lies in the continuous photographic samples which provide a permanent historic record of mainland rocky-intertidal ecosystems. Although the present study was designed to produce qualitative information and generalized maps of the mainland rocky coastal areas, the potential quantitative information that could be obtained by assessing the aerial photographs at a later date is great. These detailed photographic records

of mainland rocky-intertidal ecosystems may prove to be invaluable in that they could be examined quantitatively by the photographimetric method (Littler, 1971) and used for comparative purposes if environmental perturbations should occur in the future.

LITERATURE CITED

Littler, M. M. 1971. Standing stock measurements of crustose coralline algae (Rhodophyta) and other saxicolous organisms. J. Exp. Mar. Biol. Ecol. 6:91-99.

Littler, M. 1979. Assessments of overall, intersite, and site specific distribution and abundance patterns of rocky intertidal organisms in the Southern California Bight. Vol. II, Report 6.0 in Southern California Intertidal Survey Year III. Prepared by Science Applications, Inc. for the Bureau of Land Management, Pacific OCS Office, Los Angeles, CA. Contract No. AA551-CT7-44.

Littler, M. M. and D. S. Littler. 1979. Rocky Intertidal Island Survey. Vol. II, Report 5.0 in Southern California Intertidal Survey Year III. Prepared by Science Applications, Inc. for the Bureau of Land Management, Pacific OCS Office, Los Angeles, CA. Contract No. AA551-CT7-44.

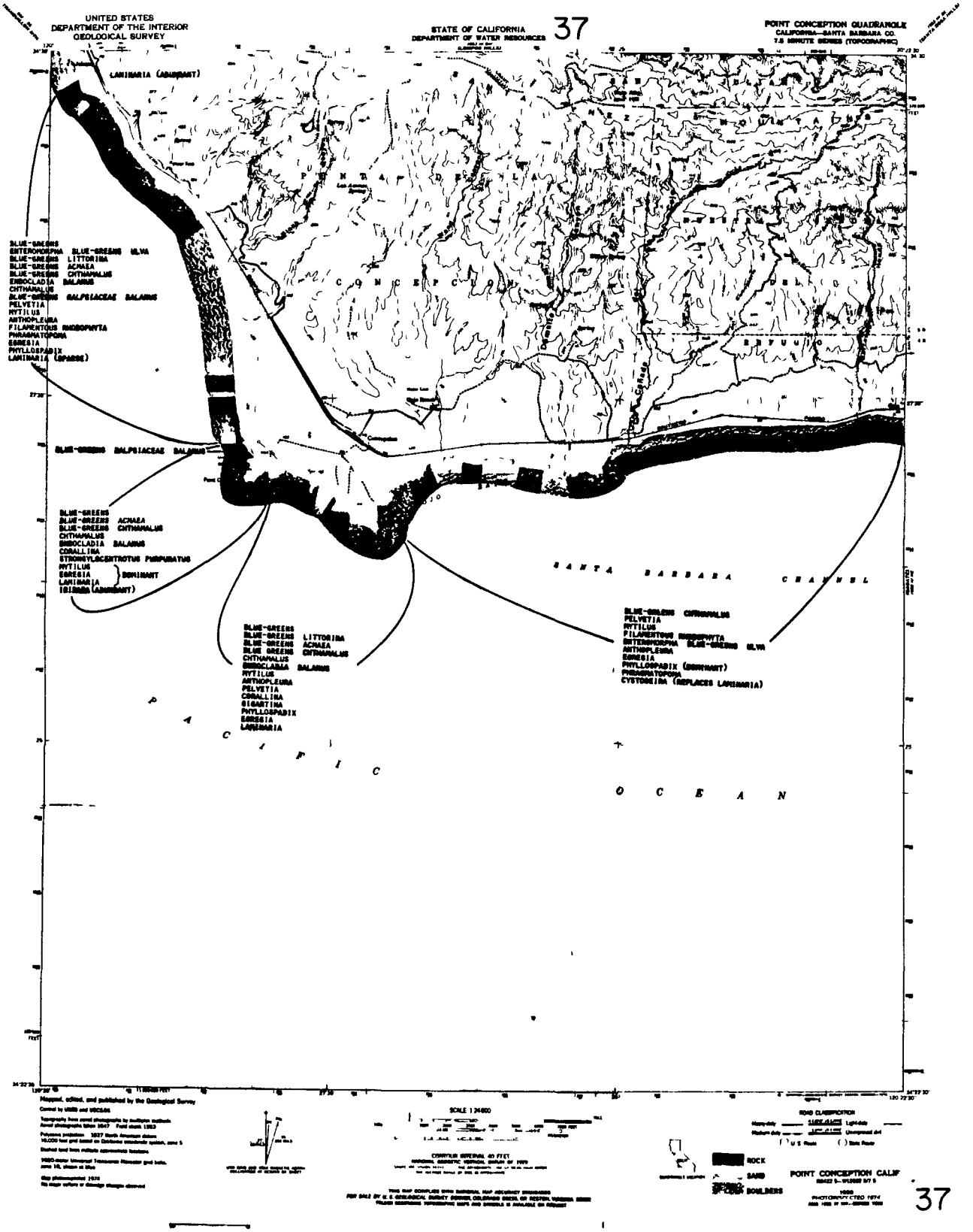
Nicholson, N. 1972. The Santa Barbara oil spills in perspective. CalCOFI Rept. 16:130-149.

Appendix I

Set of 40 Maps
(Enclosure I is a reduced copy of typical map)

Appendix II

Transcript of Field Notes (Table of Contents Enclosure II)


UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
37
POINT CONCEPTION QUADRANGLE
CALIFORNIA—SANTA BARBARA CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
LAMINARIA (ABUNDANT)
BLUE-GREENS
ENTEROMORPHA BLUE-GREENS ULVA
BLUE-GREENS LITTORINA
BLUE-GREENS ACMAEA
BLUE-GREENS CHTHAMALUS
ENBOCLADIA BALANUS
CHTHAMALUS
BLUE-GREENS BALPSIACEAE BALANUS
PELVETIA
MYTILUS
ARTHOPLEURA
FILAMENTOUS RHODOPHYTA
PHRAMATOPOMA
EGREGIA
PHYLLOSPADIX
LAMINARIA (SPARSE)
BLUE-GREENS BALPSIACEAE BALANUS
BLUE-GREENS
BLUE-GREENS ACMAEA
BLUE-GREENS CHTHAMALUS
CHTHAMALUS
ENBOCLADIA BALANUS
CORALLINA
STRONGYLOCENTROTUS PURPURATUS
MYTILUS
EGREGIA
LAMINARIA
IRIDAEA (ABUNDANT)
DOMINANT
BLUE-GREENS
BLUE-GREENS LITTORINA
BLUE-GREENS ACMAEA
BLUE-GREENS CHTHAMALUS
CHTHAMALUS
ENBOCLADIA BALANUS
MYTILUS
ARTHOPLEURA
PELVETIA
CORALLINA
GIGARTINA
PHYLLOSPADIX
EGREGIA
LAMINARIA
BLUE-GREENS CHTHAMALUS
PELVETIA
MYTILUS
FILAMENTOUS RHODOPHYTA
BLUE-GREENS ULVA
ARTHOPLEURA
EGREGIA
PHYLLOSPADIX (DOMINANT)
PHRAMATOPOMA
CYSTOSEIRA (REPLACES LAMINARIA)
SANTA BARBARA CHANNEL
PACIFIC OCEAN
Mapped, edited, and published by the Geological Survey
SCALE 1:24000
CONTOUR INTERVAL 40 FEET
ROAD CLASSIFICATION
ROCK
SAND
BOULDERS
POINT CONCEPTION CALIF
1950
37

Enclosure II

APPENDIX II

Mainland Rocky Intertidal Aerial Survey from Point Arguello to Point Loma, California - May 1980

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Table of Contents for Transcript of Field Notes