Oregon Coastal Kelp Resources

Summer 1990

Revision 1.1
April 30, 1991

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OREGON COASTAL KELP RESOURCES

Summer 1990

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Summary of Updates/Changes

Final Report

- Methods and Results- Results included in methods section, Clarification of methods
- Discussion- New section, addresses comments from first review

Tables and Figures

-Table 1- Added "Kelp Bed Numbers"

-Table 2- Added "Kelp Bed Numbers"

-Table 3- No Changes

-Table 4- Changed "un-scaled" to proper control points

-Table 5- No Changes

-Table 6- No Changes

-Table 7- New Table- Canopy Area Statistics by "Kelp Bed Number

-Table 8- New Table- Canopy Area, Planimeter Area, Relative Density Index by "Kelp Bed Number"

-Figure 1- No Changes

-Figure 2- No Changes

-Figure 3- Chart format (non-"3D")

-Figure 4A, B- No Changes

-Figure 5A, B- No Changes

-Figure 6A, B- New Figure- Kelp Canopy Area by "Kelp Bed Number"

-Figure 7A, B- New Figure- Kelp Canopy Areas, Planimeter Area, Relative Density Index by "Kelp Bed Number"

OREGON COASTAL KELP RESOURCE MAPPING

Summer 1990

Methods and Results

Revision 1.1
April 30, 1991

This kelp mapping project was divided into four project areas for clarity: 1) Kelp canopy aerial photography and species documentation, 2) Kelp canopy mapping, 3) Kelp canopy area and density analysis, and, 4) Electronic file transfer.

1) Kelp Canopy Aerial Photography and Species Documentation

The photography of the Oregon coastal kelp canopies was accomplished from 9,500' MSL on August 26, 1990 using 70mm Kodak color infrared film. Continuous sequential vertical photographs (30%-40% overlap) were taken of all kelp canopies along the Oregon coast with the exception of the range between Redfish Rocks (map O-21) and the Oregon-California border (map O-24) due to fog. Approximately 20% shoreline was included on each slide to facilitate accurate projection onto base-line maps, except on offshore flight lines of large canopies. These slides from the offshore flight lines were "side-lapped" by 30%-40% with the onshore flight lines to facilitate the accurate location of these large canopies. The associated environmental conditions were optimum for good kelp imagery with low wind/seas, tide, and sun angle during the survey period (see flight report, figure 1). On October 7th, the area between Redfish Rocks and the Oregon-California border was photographed from 9,500' MSL using 70mm color infrared film, as in the previous survey. Selected kelp canopies along the entire coast were also recorded on October 7th, 1990 from 5,000' MSL using 35mm Kodak color infrared film (except offshore canopies). Environmental conditions associated with this second survey, although not excellent, were acceptable for good kelp imagery (see flight report, figure 2).

The slides from the survey were indexed on letter size copies of the finished kelp canopy maps for ease in location individual slides. Each indexed slide was then copied and a complete set was included with the finished project.

In addition, low altitude flights (500'MSL) were conducted along the survey range on 8/25, 10/7, and 11/2/90 and each kelp canopy was observed for species composition. This visual data was later compared with the kelp canopy slides and maps to determine the location and areal extent of each kelp canopy species.

2) Kelp Canopy Mapping

Kelp canopy mapping was accomplished in two phases: A) Base-line map preparation, and, B) Kelp canopy tracing and shading.

A) Base-line Map Preparation

Twenty-four contiguous base-line maps (24"x36", scale 1:24,000) were made of the Oregon coast using USGS 7 1/2' quadrangle maps as a reference. All standard detail from these maps was preserved, including prominent shoreline features, offshore rocks, rivers, beaches, cities, and topographic relief. Offshore bathymetric contours were intended to be included on these maps and used in a subsequent area analysis, but, were unavailable on the base-line quadrangle maps and so were not included. They will be added at a later date when the data becomes available from a suitable source. A range wide index was included showing the location of each individual map plate (see "Map Index"). In addition, the maps were indexed by map number (table 1), and map name (table 2). Individual kelp "study" canopies, as determined by Oregon Department of Fish and Wildlife (ODFW), were referenced to the appropriate map number on both indexes. Prominent geographic features were listed alphabetically in tabular form (table 3) with cross-references to the map name and number where they are found to facilitate the field use of the maps. Two control points (UTM-Zone 10) were chosen for each map (A & B) and the coordinates were listed in table 4. Control point "A" is located on the left when viewing "onshore" and point "B" is on the right.

B) Kelp Canopy Tracing and Shading

All color infrared slides were projected onto the base-line maps, and, after aligning common shoreline features from the slides and base-line maps, the kelp canopies were traced. The canopies were then shaded in black to best represent the resource in addition to allowing the most accurate image processing and subsequent area analysis. All areas that were shaded represent the actual surface kelp canopy plants and the un-shaded areas within the shaded canopy perimeter indicate that there were no visible kelp plants at the surface. Kelp canopy species composition was determined by combining both visual and photographic data and noted both on the final project maps (see "Kelp Canopy Maps: 1-24"-24"x36", 11"x17" and 8.5"x11") and in the subsequent area analysis.

The kelp canopy planimeter "growing" areas were also determined from the previous maps and are shown graphically (see "Kelp Canopy Planimeter (Growing) Areas"-Maps: 1-24"-11"x17"). The canopy planimeter area is the area of the sea surface that is occupied by the kelp canopy as a whole and is always larger than the actual kelp canopy area, which is the actual measure of kelp canopy at the surface. Planimeter area is determined by drawing a line around the canopy and including all kelp plants inside the "perimeter" that are within 100 meters of each other (each plant is given a 50 meter radius as its "growing area"). This area statistic is comparable to that obtained by using a planimeter to determine kelp canopy area, and, hence the name. Many environmental surveys, past and present, have used planimeter areas

to describe resource abundance, and, these values in this survey allow possible comparisons with earlier Oregon kelp canopy data.

3) Kelp Canopy Area and Density Analysis

The actual kelp canopy areas, planimeter "growing areas", and, kelp canopy density (relative density index) were accurately determined from the finished kelp maps using computer image processing techniques. Each map was digitized using a Microtek MS-300Z flat-bed image scanner and the actual area of surface canopy (hectares) was determined by "pixel counting" using computer image analysis software. Kelp canopy area/density statistics were tabulated by: 1) map number (0-1 to 0-24), and, 2) kelp bed number (6.1 to 24.1) to best represent the resource and to allow future comparisons. The areas, referenced by map number and species, are listed in table 5, and plotted in figures 3 (overview), and, 4A,B (showing greater detail). Kelp canopy "planimeter areas" and densities (by map number) were determined using the above methods (table 6) and plotted in figures 5 A,B. In addition, surface canopy areas by kelp bed number were also tabulated (table 7) and plotted in figures 6A and 6B. Planimeter areas, by kelp bed number, were listed in table 8 and plotted in figures 7A,B.

The "Relative Density Index" (RDI) value is a measure of how much of the planimeter "growing" area is actually covered with kelp canopy and approximates the probability of encountering kelp plants at a random point within the planimeter area. It is determined by dividing the actual kelp canopy area by the planimeter area. This value approaches "0" for very sparse canopies and "1" for very dense canopies. Kelp canopy densities (RDI), by map number, are also shown in table 6 and co-plotted in figures 5 A,B with canopy areas. Kelp canopy densities, by kelp bed number, are shown in table 8 and plotted in figures 7A,B.

4) Electronic File Transfer

In order to facilitate electronic file transfer and incorporation into the Oregon Department of Fish and Wildlife "GIS" each of the 24 kelp canopy maps, in addition to the "Planimeter Area" maps were simplified to include only the offshore kelp canopies, the shoreline, and the two UTM control points. Each map page was then digitized by scanning (as described above) into a raster (PCX) file (1600 x 2100 pixels). Raster files of this nature preserve all of the kelp canopy detail that was originally mapped. These PCX (raster) files were then "vectorized" using the "auto-trace" mode within Micrographics "Designer". Past experience with this raster-vector conversion procedure has shown the resulting vector file to be an excellent approximation of the original complex raster file and to offer virtually 100% precision between subsequent "traces" of the same map.

These "vectorized" PCX files were then converted to "Autocad" DXF (data exchange format) files by a DXF translator also within "Designer". The resulting files (named OK9001.DXF to OK90024.DXF and OK9006P.DXF to OK90024P.DXF) were converted to equivalent "DLG-3" (optional format) files by ERDAS Inc. of Atlanta Georgia. These files were distributed on 1.2M floppy disks formatted under "DOS 4.01".

All spreadsheet data from the tables were converted to standard data base files (DBF) and included on the enclosed floppy disk under names described below and in the "README2.DOC" file on the diskette.

Electronic Data Base Files - "DBase Format"

Tables

-Table 1- Map Index - By Map Number
ODFWIN1.DBF

-Table 2- Map Index - By Map Name
ODFWIN2.DBF

-Table 3- Base-Line Map Geographic Features Index

-Table 4- Map Control Points - UTM Coordinate System, Zone 10
ODFWCTR1.DBF

-Table 5- Kelp Canopy Areas - By Map Number
ODFWARE1.DBF

-Table 6- Kelp Canopy Planimeter Areas/Relative Density Index By Map Number
ODFWARE2.DBF

-Table 7- Kelp Canopy Areas - By Kelp Bed Number
ODFWARE5.DBF

-Table 8- Kelp Canopy Planimeter Areas/Relative Density Index By Kelp Bed Number
ODFWARE6.DBF

Discussion

1) Kelp Canopy Aerial Photography and Species Documentation

The selected timing, aircraft altitude, and photographic scale used to obtain imagery that best represents the Oregon coastal kelp resource is largely a function of and a balance between the following factors: 1) the seasonal timing of maximum kelp canopy development, 2) the approved contract period, 3) the selected final mapping scale/desired resolution, 4) the overall length of the survey, 5) the areal extent of the kelp canopies especially those offshore, and, 6) physical factors of the environment such as favorable tides, sun angle, wind, seas, and weather, especially coastal fog. When these factors are combined, an "optimum survey window" is created to allow photographic imagery that best represents the actual resources within the above parameters. When all of these factors are considered, this "survey window" for optimum imagery is usually very small, frequently less than five days in a given year. Commonly, one or more of the above factors become limiting and prevent the survey from occurring within this optimum time frame and less than perfect conditions have to be accepted.

This state-wide survey was intended to capture the Oregon coastal kelp canopies at the maximum level of development which generally occurs between mid-July and mid-October depending on several physical and biological factors, including: 1) severity of the storms from the previous winter, 2) late summer storms (current season), 3) habitat availability, 4) seasonal water temperatures, 5) exposure, and, 6) predation. Several conversations with ODFW researchers in addition to my own observations indicated that the Oregon kelp resources were very well developed in the summer of 1990 and may have even been "above average" in areal extent.

The aerial portion of this coastal kelp survey went well and was, for the most part, within this "survey window" that has been discussed. We did encounter three "limiting" factors that influenced the outcome of this project to varying degrees: 1) late receipt of the approved project contract, 2) persistent coastal fog from Port Orford south to the Oregon-California border, and, 3) a late summer storm that occurred between the two aerial surveys thereby reducing the kelp canopy record south of Redfish Rocks to varying degrees, as discussed in a subsequent section.

The signed contract to go ahead with the work was scheduled to arrive here by July 15th but was not received until we returned from the August 26th survey. Even though we had been given a "verbal" go-ahead in July, we were advised to wait for the "signed contract" to assure proper funding. This delay meant that several good low tide periods in July and August were missed and the "base-line" mapping got off to a late start. The end effect of this contract delay was minor, but, when combined with the persistent fog south of Redfish rocks, we just ran out of "good tides" and "calm seas" before we could photograph the south end of the range.

On future surveys, this issue needs to be addressed to allow a little more flexibility in choosing the survey dates.

The aircraft altitude and photographic scale used for this survey was selected to provide a good balance between resolution and overall coverage on the medium-resolution (1:24,000 scale) base-line maps. This altitude (9,500' MSL) has been used extensively in California, Mexico, and Washington for mapping at this scale with excellent results. The biggest factors influencing the quality and resolution of the imagery are low sun angle, low tides, low wind/seas/currents, proper exposure, and, image size. Ground truth tests from 9,500'MSL (70mm film, 70mm lens), under ideal conditions, using Macrocystis pyrifera, have indicated that the smallest "kelp dots" on the maps represent as few as 3 surface stipes from a single kelp plant. This test was conducted within a protected bay, under perfect conditions, and, does not necessarily represent the resolution on the open coast unless the conditions are similar. Infrared film has very poor water penetration properties (about one foot), and, will "miss" kelp surface kelp stipes that are pulled below the surface due to currents, winds, seas/swells, and high tides. This issue of kelp resolution, as influenced by physical factors of the environment, again re-enforces the need to conduct the photography within the "survey window".

The large but sporadic coastal kelp canopies in Oregon have provided a substantial infrared return on the imagery, and, although virtually 100% Nereocystis, were no more difficult than Macrocystis to interpret and map. The most difficult interpretation and mapping involves single plants (either Macro or Nereo) that are not associated with a distinct "canopy", especially if these plants are "low in the water" due to tides, winds, and currents, as discussed.

The normal photographic procedure, also used in this survey, to obtain maximum resolution is to do two photographic passes, one at 9,500 feet MSL for an "overview" and to aid in the location of offshore canopies, and another photographic pass at 5,000' MSL of only the kelp to ensure optimum resolution, especially of the smaller canopies. This "two pass" approach has proved effective in large surveys, such as this one, in which the "optimum survey window" is small due to persistent poor weather or less than optimum tides, as in this case. From 9,500 feet large areas can be covered within a small "tide/weather" window, making the most out of an available good survey day, and, getting the imagery "in the can" before the "window" is lost. The second pass at 5,000' MSL, then, provides slightly higher resolution for subsequent mapping and comparison.

The survey of August 26th, 1990 yielded excellent imagery from nearly ideal conditions with only "tide" being outside the "survey window" (figure 1). The survey of October 7, 1990, was conducted under less than ideal conditions, especially since it occurred after a significant late summer storm that reduced the kelp canopy to varying degrees (see "Kelp Canopy Area and Density Analysis" section). In addition, "wind" and "tide" became factors later in

the survey day (figure 2), possibly obscuring individual plants from the imagery. All things considered, future efforts should include an earlier contract "start date" more persistence in "waiting out" the coastal fog during the ideal survey periods.

2) Kelp Canopy Mapping

The systematic mapping of the Oregon coastal kelp resources went well and all visible kelp on the imagery was transferred to the base-line maps. In addition, visual data from the three low altitude overflights was combined with the canopy slides to properly locate the areal extent of each of the individual canopy species. All of the Oregon coastal kelp canopies were observed on the overflights of 8/25/90 and 10/7/90, and the canopies from Cape Arago south were observed on 11/2/90. The full coast low altitude survey of 8/25/90 was a preliminary investigation of the location of the individual kelp beds in addition to species identification work in preparation for the photographic survey of 8/26/90. This initial visual "rough location" of the kelp canopies greatly helps in planning the subsequent aerial survey, and prevents missing small "kelp patches" from the higher photographic altitudes.

In ODFW review of this mapping project, concerns have been raised by researchers regarding small kelp canopies that have been seen near the "headlands" north of Lincoln City to the Columbia River that were not mapped on this survey. Low altitude data from both of the overflights, in addition to further review of the aerial kelp slides, have not indicated the presence of additional attached kelp canopies in these areas. The only kelp seen north of Cape Lookout included three small "drift" kelp canopies (< 10m across) on 8/25/90 in the vicinity of Cascade Head, which did not appear on the survey imagery of the following day. These observations of kelp in these areas may have been: 1) from a previous year, 2) intertidal kelp species, 3) drift kelp, or, 4) taken during an extremely low tide when more plants may be visible.

3) Kelp Canopy Area and Density Analysis

Kelp canopy area and density statistics were compiled by both map number and kelp canopy number (established by ODFW). This method for determining and tabulating kelp canopy area, planimeter area, and relative density index was designed to be flexible enough to allow future kelp resource comparisons in addition to being compatible with archival data formats (planimeter area). This same methodology has also been used successfully in Washington, California, and Baja California to establish a database for future resource analysis. It allows for kelp resource comparisons between: 1) individual kelp canopies, 2) areal extent of individual species, 3) geographic areas, and, 4) seasonal maximums.

The summer 1990 Oregon coastal kelp canopies were well developed, and this was reflected both on the maps and in the tabulated area statistics. As previously stated, the kelp canopy imagery from "Redfish Rocks" to the Oregon-California border was obtained under less than "ideal conditions" (10/7/90) and when mapped appeared to show varying amounts of canopy reduction due to the occurrence of a substantial late summer storm in addition to less than "optimum" wind and tides on the survey day. The effect of significant late summer storms on the areal extent of the kelp canopy can vary from "no effect" to 100% removal depending on: 1) the timing/duration of the storm, 2) the sea/swell direction/height, 3) the health of the canopy (water temperature/nutrient dependant), 3) the canopy species involved, and, 4) the canopy exposure to the oncoming swell. Spot comparisons of kelp canopies north of Cape Arago indicated that a significant reduction in kelp canopy (60%) occurred as a result of the storm, except in the Cape Lookout canopy, which was largely unaffected. Since this canopy is "south facing", it indicates a significant "northern" component to the large "storm swell" and possibly explains why the near-shore canopies south of Cape Blanco appeared to be largely un-affected by the high seas. Spot comparisons between imagery of the near-shore canopies in the vicinity Cape Blanco, Port Orford, and Redfish Rocks on each of the survey dates indicate that these canopies were largely un-affected by the storm. Their location, in the "shadow" of Cape Blanco, probably protected them from significant removal. The "off-shore" canopies, however, in the vicinity of Cape Blanco, showed a significant reduction (30%) between the two surveys, probably due to exposure. In summary, it appears that the near-shore canopies south of Cape Blanco did not suffer significant reductions (< 10%) due to the winter storm, and, since most of the canopies in this range are near-shore and "shadowed" by Cape Blanco, we can hope that this storm effect was minor. The offshore canopy in the vicinity of Rogue River Reef may have had a significant reduction in its areal extent (30% or more, as noted at Cape Blanco); there is just no way of knowing. Its location, farther south along the coast, may have exposed it to "lower energy swells" than at Cape Blanco and allowed more canopy to remain. Subsequent surveys, in addition to comparisons with archival records and observations will probably be to only way to tell for sure. Other than the question about the Rogue Reef canopy, I am confident that the maps and subsequent tabular data well reflect the Oregon coastal kelp resources of "Summer 1990".

Conclusions

This mapping project was intended to break new ground regarding the state-wide systematic survey of Oregon coastal kelp resources. Although this was a first time effort, significant goals were achieved, including the establishment of: 1) a state-wide coastal base-line map system that can be used for kelp or other systematic resource surveys, 2) a benchmark kelp survey showing the location and areal extent of coastal kelp canopies conducted during an "optimum" kelp year, 3) a kelp database system designed to be compatible and comparable with archival or future survey efforts, and, 4) an electronic file transfer system compatible with the ODFW Geographic Information System (still undergoing final evaluation).

OREGON COASTAL KELP RESOURCES

Summer 1990

Revision 1.1
April 30, 1991

List of Tables and Figures

Tables

Figures

Table 1

OREGON COASTAL KELP RESOURCES

Map Index - By Map Number

Revision 1.1

MAP NUMBER	MAP NAME	KELP BED NUMBERS
O-1	Columbia River	
O-2	Tillamook Head	
O-3	Cape Falcon	
O-4	Rockaway	
O-5	Netarts Bay	
O-6	Cape Lookout	6.1, 6.2
O-7	Cascade Head	
O-8	Lincoln City	8.1, 8.2
O-9	Newport	8.2, 9.1, 9.2
O-10	Seal Rock	
O-11	Waldport	
O-12	Heceta Head	
O-13	Florence	
O-14	Tahkenitch Lake	
O-15	Winchester Bay	
O-16	Empire	
O-17	Cape Arago	17.1, 17.2, 17.3, 17.4
O-18	Bandon	
O-19	Floras Lake	19.1
O-20	Port Orford	19.1, 20.1, 20.2, 20.3, 20.4
O-21	Sister Rocks	20.4, 21.1, 21.2, 21.3
O-22	Gold Beach	22.1, 22.2
O-23	Cape Sebastian	23.1, 23.2
O-24	Brookings	23.2, 24.1

Table 2

OREGON COASTAL KELP RESOURCES

Map Index - By Map Name

Revision 1.1

MAP NUMBER	MAP NAME	KELP BED NUMBERS
O-18	Bandon	
O-24	Brookings	23.2, 24.1
O-17	Cape Arago	17.1, 17.2, 17.3, 17.4
O-3	Cape Falcon	
O-6	Cape Lookout	6.1, 6.2
O-23	Cape Sebastian	23.1, 23.2
O-7	Cascade Head	
O-1	Columbia River	
O-16	Empire	
O-19	Floras Lake	19.1
O-13	Florence	
O-22	Gold Beach	22.1, 22.2
O-12	Heceta Head	
O-8	Lincoln City	8.1, 8.2
O-5	Netarts Bay	
O-9	Newport	8.2, 9.1, 9.2
O-20	Port Orford	19.1, 20.1, 20.2, 20.3, 20.4
O-4	Rockaway	
O-10	Seal Rock	
O-21	Sister Rocks	20.4, 21.1, 21.2, 21.3
O-14	Tahkenitch Lake	
O-2	Tillamook Head	
O-11	Waldport	
O-15	Winchester Bay	

Table 2

OREGON COASTAL KELP RESOURCES
Map Index - By Map Name

MAP NUMBER	MAP NAME	KELP BED NUMBERS
O-18	Bandon	
O-24	Brookings	
O-17	Cape Arago	
O-3	Cape Falcon	
O-6	Cape Lookout	
O-23	Cape Sebastian	
O-7	Cascade Head	
O-1	Columbia River	
O-16	Empire	
O-19	Floras Lake	
O-13	Florence	
O-22	Gold Beach	
O-12	Heceta Head	
O-8	Lincoln City	
O-5	Netarts Bay	
O-9	Newport	
O-20	Port Orford	
O-4	Rockaway	
O-10	Seal Rock	
O-21	Sister Rocks	
O-14	Tahkenitch Lake	
O-2	Tillamook Head	
O-11	Waldport	
O-15	Winchester Bay	

OREGON COASTAL KELP RESOURCES - Baseline Map Geographic Features Index

INDEX	GEOGRAPHIC FEATURE	MAP NAME	MAP NUMBER
1	Agate Beach	Cape Arago	O-17
2	Agate Beach	Netarts Bay	O-5
3	Agate Beach City	Newport	O-9
4	Agate Beach Wayside	Newport	O-9
5	Alder Creek	Cape Falcon	O-3
6	Alder Lake	Florence	O-13
7	Allen Creek	Cape Lookout	O-6
8	Alsea Bay	Waldport	O-11
9	Alsea River	Waldport	O-11
10	Anderson Creek	Newport	O-9
11	Arcadia Beach	Cape Falcon	O-3
12	Arch Cape City	Cape Falcon	O-3
13	Arch Cape Creek	Cape Falcon	O-3
14	Arch Cape Pt.	Cape Falcon	O-3
15	Arch Rk.	Cape Sebastian	O-23
16	Arch Rk.	Port Orford	O-20
17	Asbury Creek	Cape Falcon	O-3
18	Austin Creek	Netarts Bay	O-5
19	Austin Pt.	Cape Falcon	O-3
20	Bagley Creek	Port Orford	O-20
21	Baker Beach	Heceta Head	O-12
22	Bald Pt.	Tillamook Head	O-2
23	Bandon	Bandon	O-18
24	Bandon State Airport	Bandon	O-18
25	Bandon State Park	Bandon	O-18
26	Barnacle Rk.	Brookings	O-24
27	Barrel Rk.	Port Orford	O-20
28	Barrett lake	Florence	O-13
29	Barview	Empire	O-16
30	Barview	Rockaway	O-4
31	Battle Rk.	Port Orford	O-20
32	Bayside Gardens	Cape Falcon	O-3
33	Beachside State Park	Waldport	O-11
34	Beal Lake	Empire	O-16
35	Bear Lake	Florence	O-13
36	Beaver Creek	Seal Rock	O-10
37	Beerman Creek	Tillamook Head	O-2
38	Berry Creek	Heceta Head	O-12
39	Best Rk.	Port Orford	O-20

OREGON COASTAL KELP RESOURCES - Baseline Map Geographic Features Index

INDEX	GEOGRAPHIC FEATURE	MAP NAME	MAP NUMBER
40	Beverly Beach City	Newport	O-9
41	Beverly Beach State Park	Newport	O-9
42	Big Creek	Cape Arago	O-17
43	Big Creek	Heceta Head	O-12
44	Big Creek	Waldport	O-11
45	Big Stump Beach	Waldport	O-11
46	Bird Pt.	Tillamook Head	O-2
47	Black Rk.	Cape Sebastian	O-23
48	Black Rk.	Cape Sebastian	O-23
49	Black Rk.	Port Orford	O-20
50	Blacklock Pt.	Floras Lake	O-19
51	Blattner Creek	Newport	O-9
52	Blodgett Peak	Waldport	O-11
53	Blowout Creek	Heceta Head	O-12
54	Bluebill Lake	Empire	O-16
55	Bob Creek	Heceta Head	O-12
56	Boiler Bay Wayside	Lincoln City	O-8
57	Bowman Creek	Brookings	O-24
58	Brey Pt.	Heceta Head	O-12
59	Brookings	Brookings	O-24
60	Brookings Airport	Brookings	O-24
61	Brush Creek	Sister Rocks	O-21
62	Brush Prarie	Floras Lake	O-19
63	Buck Lake	Florence	O-13
64	Bullards Beach State Park	Bandon	O-18
65	Burke Lake	Columbia River	O-1
66	Butte Creek	Cascade Head	O-7
67	Butte Creek	Floras Lake	O-19
68	Butterfield	Tillamook Head	O-2
69	Butterfield Lake	Empire	O-16
70	Butterfly Lake	Tahkenitch Lake	O-14
71	Camp Angell	Waldport	O-11
72	Camp Magruder Pt.	Rockaway	O-4
73	Camp Rilea	Columbia River	O-1
74	Camp Winema	Cascade Head	O-7
75	Cannery Hill	Cascade Head	O-7
76	Cannon Beach	Cape Falcon	O-3
77	Cannon Beach Junction	Tillamook Head	O-2
78	Cape Arago Pt.	Cape Arago	O-17

OREGON COASTAL KELP RESOURCES - Baseline Map Geographic Features Index

INDEX	GEOGRAPHIC FEATURE	MAP NAME	MAP NUMBER
79	Cape Blanco Pt.	Port Orford	O-20
80	Cape Blanco State Airport	Floras Lake	O-19
81	Cape Creek	Cape Lookout	O-6
82	Cape Creek	Heceta Head	O-12
83	Cape Creek	Waldport	O-11
84	Cape Falcon Pt.	Cape Falcon	O-3
85	Cape Foulweather Pt.	Newport	O-9
86	Cape Kiwanda Pt.	Cape Lookout	O-6
87	Cape Kiwanda State Park	Cape Lookout	O-6
88	Cape Lookout Pt.	Cape Lookout	O-6
89	Cape Lookout State Park	Cape Lookout	O-6
90	Cape Lookout State Park	Netarts Bay	O-5
91	Cape Meares City	Netarts Bay	O-5
92	Cape Meares Lake	Netarts Bay	O-5
93	Cape Meares Nat. Wildlife Refuge	Netarts Bay	O-5
94	Cape Meares Pt.	Netarts Bay	O-5
95	Cape Perpetua Pt.	Waldport	O-11
96	Cape Ridge	Waldport	O-11
97	Cape Sebastian Pt.	Cape Sebastian	O-23
98	Cape Sebastian State Park	Cape Sebastian	O-23
99	Cape Sebastian State Park	Gold Beach	O-22
100	Captain Cook Pt. Waldport	Waldport	O-11
101	Carnahan	Columbia River	O-1
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573	West Fork Creek	Cape Falcon	O-3
574	West Lake	Tillamook Head	O-2
575	Westlake	Tahkenitch Lake	O-14
576	Whale Cove	Newport	O-9
577	Whaleshead Creek	Brookings	O-24
578	Whaleshead Is.	Brookings	O-24
579	Whiskey Creek	Cape Sebastian	O-23
580	Whisky Run Creek	Cape Arago	O-17
581	Whisky Run beach	Cape Arago	O-17
582	White Rk.	Brookings	O-24
583	Willow Creek	Floras Lake	O-19
584	Wilson Beach City	Netarts Bay	O-5
585	Winchester Bay	Winchester Bay	O-15

Table 3

OREGON COASTAL KELP RESOURCES - Baseline Map Geographic Features Index

INDEX	GEOGRAPHIC FEATURE	MAP NAME	MAP NUMBER
586	Winchester Bay Harbor	Winchester Bay	O-15
587	Winchuck River	Brookings	O-24
588	Winterville	Bandon	O-18
589	Wm. Tugman State Park	Winchester Bay	O-15
590	Wndge Creek	Cape Sebastian	O-23
591	Woahink lake	Florence	O-13
592	Woods	Cape Lookout	O-6
593	Yachats	Waldport	O-11
594	Yachats Ocean Road Wayside	Waldport	O-11
595	Yachats River	Waldport	O-11
596	Yachats State Park	Waldport	O-11
597	Yager Creek	Netarts Bay	O-5
598	Yaquina Bay	Newport	O-9
599	Yaquina Bay State Park	Newport	O-9
600	Yaquina Head Pt.	Newport	O-9
601	Yaquina John Pt.	Waldport	O-11
602	Yaquina River	Seal Rock	O-10

Table 4

OREGON COASTAL KELP RESOURCES

Map Control Points - UTM Coordinate System, Zone 10

Revision 1.1

MAP NUMBER	MAP NAME	CONTROL POINT A UTM (m.) N/UTM (m.) E	CONTROL POINT B UTM (m.) N/UTM (m.) E
O-1	Columbia River	5,116,000/426,000	5,107,000/429,000
O-2	Tillamook Head	5,100,000/430,000	5,085,000/427,000
O-3	Cape Falcon	5,078,000/427,000	5,067,000/427,000
O-4	Rockaway	5,058,000/428,000	5,046,000/428,000
O-5	Netarts Bay	5,038,000/426,000	5,026,000/426,000
O-6	Cape Lookout	5,018,000/426,000	5,006,000/426,000
O-7	Cascade Head	4,998,000/425,000	4,986,000/422,000
O-8	Lincoln City	4,977,000/421,000	4,966,000/419,000
O-9	Newport	4,957,000/417,000	4,946,000/417,000
O-10	Seal Rock	4,937,000/417,000	4,925,000/416,000
O-11	Waldport	4,916,000/415,000	4,905,000/413,000
O-12	Heceta Head	4,896,000/413,000	4,885,000/412,000
O-13	Florence	4,875,000/411,000	4,865,000/410,000
O-14	Tahkenitch Lake	4,855,000/409,000	4,845,000/407,000
O-15	Winchester Bay	4,835,000/405,000	4,824,000/403,000
O-16	Empire	4,816,000/400,000	4,804,000/395,000
O-17	Cape Arago	4,797,000/390,000	4,784,000/388,000
O-18	Bandon	4,779,000/388,000	4,764,000/384,000
O-19	Floras Lake	4,758,000/382,000	4,749,000/378,000
O-20	Port Orford	4,742,000/376,000	4,733,000/381,000
O-21	Sister Rocks	4,725,000/385,000	4,714,000/387,000
O-22	Gold Beach	4,704,000/385,000	4,693,000/385,000
O-23	Cape Sebastian	4,684,000/386,000	4,674,000/389,000
O-24	Brookings	4,667,000/390,000	4,655,000/398,000

Table 5

OREGON COASTAL KELP RESOURCES

Kelp Canopy Areas - By Map Number

MAP NUMBER	MAP NAME	KELP CANOPY AREA (ha.) N. leutkeana	KELP CANOPY AREA (ha.) M. integrifolia	TOTAL CANOPY AREA (Ha.) Both Species
1	Columbia River	0.00	0.00	0.00
2	Tillamook Head	0.00	0.00	0.00
3	Cape Falcon	0.00	0.00	0.00
4	Rockaway	0.00	0.00	0.00
5	Netarts Bay	0.00	0.00	0.00
6	Cape Lookout	5.03	0.00	5.03
7	Cascade Head	0.00	0.00	0.00
8	Lincoln City	9.39	0.00	9.39
9	Newport	50.31	0.00	50.31
10	Seal Rock	0.00	0.00	0.00
11	Waldport	0.00	0.00	0.00
12	Heceta Head	0.00	0.00	0.00
13	Florence	0.00	0.00	0.00
14	Tahkenitch Lake	0.00	0.00	0.00
15	Winchester Bay	0.00	0.00	0.00
16	Empire	0.00	0.00	0.00
17	Cape Arago	28.35	5.80	34.15
18	Bandon	0.00	0.00	0.00
19	Floras Lake	0.29	0.00	0.29
20	Port Orford	508.79	0.00	508.79
21	Sister Rocks	48.97	0.00	48.97
22	Gold Beach	86.60	0.00	86.60
23	Cape Sebastian	60.60	0.00	60.60
24	Brookings	38.32	0.00	38.32
TOTALS		836.64	5.80	842.44

Table 6

OREGON COASTAL KELP RESOURCES

Kelp Canopy Planimeter ("Growing") Areas/Relative Density Index

MAP NUMBER	MAP NAME	KELP CANOPY AREA (ha.) Both Species	PLANIMETER AREA (ha.) Both Species	RELATIVE DENSITY INDEX RDI
O-1	Columbia River	0.00	0.00	0.00
O-2	Tillamook Head	0.00	0.00	0.00
O-3	Cape Falcon	0.00	0.00	0.00
O-4	Rockaway	0.00	0.00	0.00
O-5	Netarts Bay	0.00	0.00	0.00
O-6	Cape Lookout	5.03	17.21	0.29
O-7	Cascade Head	0.00	0.00	0.00
O-8	Lincoln City	9.40	30.41	0.31
O-9	Newport	50.31	99.50	0.51
O-10	Seal Rock	0.00	0.00	0.00
O-11	Waldport	0.00	0.00	0.00
O-12	Heceta Head	0.00	0.00	0.00
O-13	Florence	0.00	0.00	0.00
O-14	Tahkenitch Lake	0.00	0.00	0.00
O-15	Winchester Bay	0.00	0.00	0.00
O-16	Empire	0.00	0.00	0.00
O-17	Cape Arago	34.15	81.16	0.42
O-18	Bandon	0.00	0.00	0.00
O-19	Floras Lake	0.29	1.13	0.26
O-20	Port Orford	508.79	881.76	0.58
O-21	Sister Rocks	48.97	102.84	0.48
O-22	Gold Beach	86.60	220.33	0.39
O-23	Cape Sebastian	60.60	183.11	0.33
O-24	Brookings	38.32	205.40	0.19
TOTALS		842.46	1822.84	0.46

Table 7

OREGON COASTAL KELP RESOURCES

Kelp Canopy Areas - By Kelp Bed Number

Revision 1.1
Summer 1990

KELP BED NUMBER	KELP CANOPY AREA (ha.) N. leutkeana	KELP CANOPY AREA (ha.) M. integrifolia	TOTAL CANOPY AREA (Ha.) Both Species
6.1	4.65	0.00	4.65
6.2	0.43	0.00	0.43
8.1	0.26	0.00	0.26
8.2	56.38	0.00	56.38
9.1	1.85	0.00	1.85
9.2	0.69	0.00	0.69
17.1	4.83	0.00	4.83
17.2	0.84	0.00	0.84
17.3	22.01	5.75	27.76
17.4	0.97	0.00	0.97
19.1	1.77	0.00	1.77
20.1	100.90	0.00	100.90
20.2	313.47	0.00	313.47
20.3	12.24	0.00	12.24
20.4	78.43	0.00	78.43
21.1	46.63	0.00	46.63
21.2	1.93	0.00	1.93
21.3	0.94	0.00	0.94
22.1	8.08	0.00	8.08
22.2	77.74	0.00	77.74
23.1	0.50	0.00	0.50
23.2	62.41	0.00	62.41
24.1	37.23	0.00	37.23
TOTALS	835.19	5.75	840.94

Table 8

OREGON KELP RESOURCES

Kelp Canopy/Planimeter Areas and Relative Density Index - By Kelp Bed Number

Revision 1.1
Summer 1990

KELP BED NUMBER	KELP CANOPY AREA (ha.) Both Species	PLANIMETER AREA (ha.) Both Species	RELATIVE DENSITY INDEX RDI
6.1	4.65	15.47	0.30
6.2	0.43	1.85	0.23
8.1	0.26	0.53	0.49
8.2	56.38	122.51	0.46
9.1	1.85	4.51	0.41
9.2	0.69	2.26	0.31
17.1	4.83	9.15	0.53
17.2	0.84	1.61	0.52
17.3	27.76	68.63	0.40
17.4	0.97	3.07	0.32
19.1	1.77	6.11	0.29
20.1	100.90	189.72	0.53
20.2	313.47	463.51	0.68
20.3	12.24	32.18	0.38
20.4	78.43	193.30	0.41
21.1	46.63	95.07	0.49
21.2	1.93	5.03	0.38
21.3	0.94	2.07	0.45
22.1	8.08	35.17	0.23
22.2	77.74	182.87	0.43
23.1	0.50	1.57	0.32
23.2	62.41	190.57	0.33
24.1	37.23	196.91	0.19
TOTALS	840.93	1823.68	0.46

Figure 1

ECOSCAN RESOURCE DATA

AERIAL SURVEY FLIGHT REPORT

AGENCY/CONTACT:
Oregon Dept. of Fish and Wildlife
Marine Science Dr. Building #3
Newport, OR 97365

AGENCY P.O.#:
Dr. Dave Fox

FLIGHT DATE: August 26, 1990

SURVEY DELIVERY DATE: Dec 1990

AREA SURVEYED: Columbia River to Redfish Rocks

NATURE OF SURVEY:
1) Color aerial infrared photography of all coastal kelp canopies within the above range
2) Kelp canopies traced/shaded onto baseline maps
3) Canopy area and density analysis

FLIGHT DATA:

-Time: 0930-1130

-Altitude: 9500' MSL

-Lens: 70mm
35mm (selected sites)

-Film: Kodak Color Infrared
70mm

-Angle: Vertical

-Scale: 1:24,000 (maps)

ASSOCIATED ENVIRONMENTAL CONDITIONS

-Sea/Swell: < 3 feet

-Wind: < 10 knots

-Sky Cond: Clear to ovc.
Fog south

-Visibility: 25+ miles

-Tide: 1.9(+) -2.5 (+)

CREW:
-Pilot: Unsicker
-Photographer: Van Wagenen
-Observers/Data Recorders: None

RESULTS:

-Kelp Observations: Large/healthy summer canopy
Low altitude species observations taken

-Misc. Observations: Optimum survey conditions

-Survey Slides:
-Quality: Excellent - All canopies photographed within the above range

-Comments: Fog south of Redfish Rocks

Figure 2

ECOSCAN RESOURCE DATA

AERIAL SURVEY FLIGHT REPORT

AGENCY/CONTACT:
Oregon Dept. of Fish and Wildlife
Marine Science Dr. Building #3
Newport, OR 97365

AGENCY P.O.#: Dr. Dave Fox

FLIGHT DATE: October 7, 1990

SURVEY DELIVERY DATE: Dec 1990

AREA SURVEYED: Columbia River to Oregon/California border

NATURE OF SURVEY:
1) Color aerial infrared photography of all coastal kelp canopies within the above range
2) Kelp canopies traced/shaded onto baseline maps
3) Canopy area and density analysis

FLIGHT DATA:

-Time: 0830-1030

-Altitude: 9500' MSL

-Lens: 50mm and 35mm
35mm (selected sites)

-Film: Kodak Color Infrared
70mm and 35mm

-Angle: Vertical

-Scale: 1:24,000 (maps)

ASSOCIATED ENVIRONMENTAL CONDITIONS

-Sea/Swell: 3-5 feet

-Wind: 10-15 knots

-Sky Cond: Clear

-Visibility: 25+ miles

-Tide: 1.8(+) -2.5 (+)

CREW:
-Pilot: Unsicker
-Photographer: Van Wagenen
-Observers/Data Recorders: None

RESULTS:

-Kelp Observations: Large/healthy summer canopy
Low altitude species observations taken
Offshore canopies showed approx. 10% reduction due to high seas the previous week-nearshore canopies appeared unaffected

-Misc. Observations: Good survey conditions
11/2-Canopy species observations-Cape Arago to the Oregon/California border

-Survey Slides:
-Quality: Excellent - All canopies photographed within the above range

-Comments:

Figure 3
Revision 1.1
Summer 1990

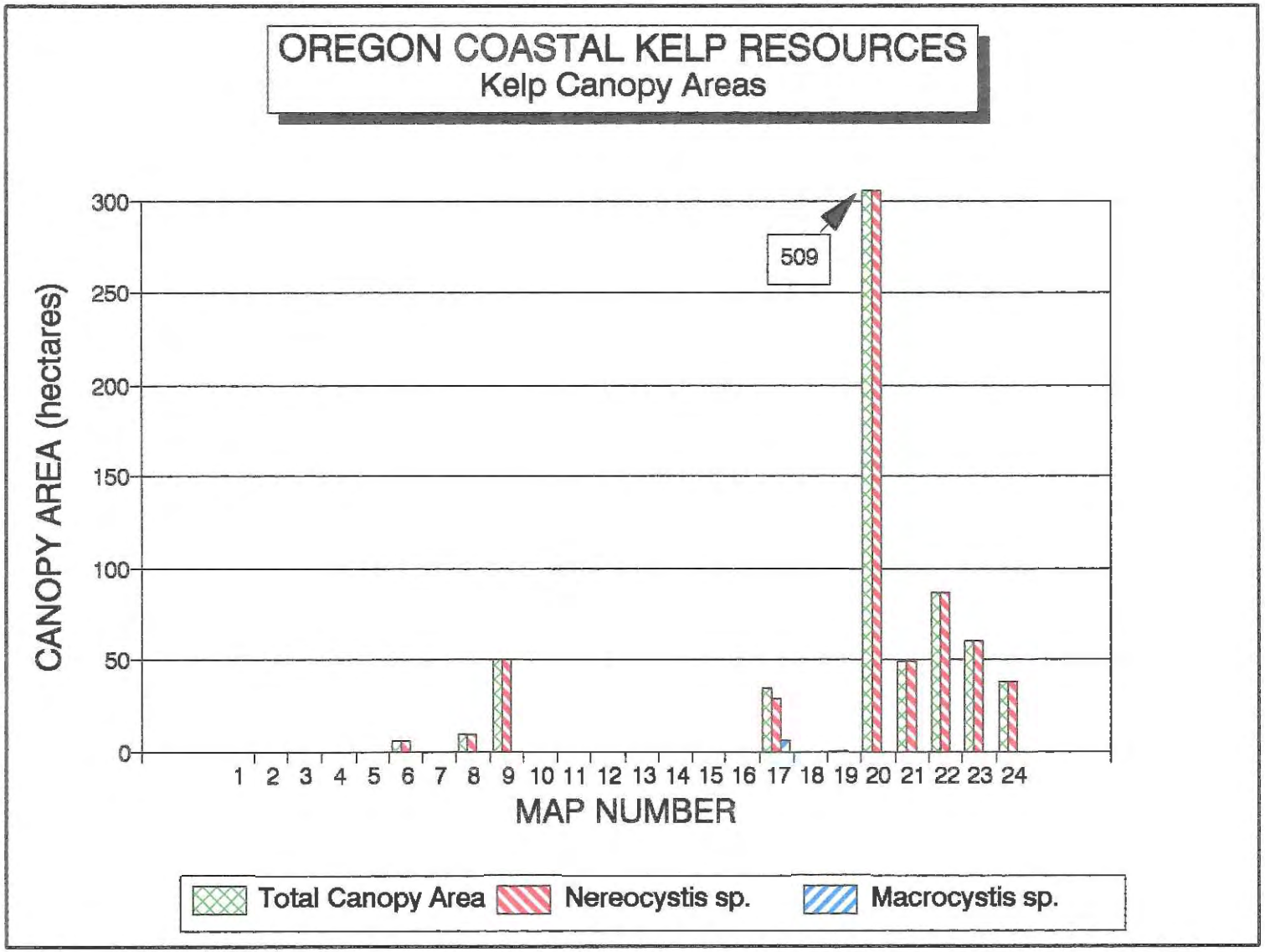


Figure 4A
Revision 1.1
Summer 1990

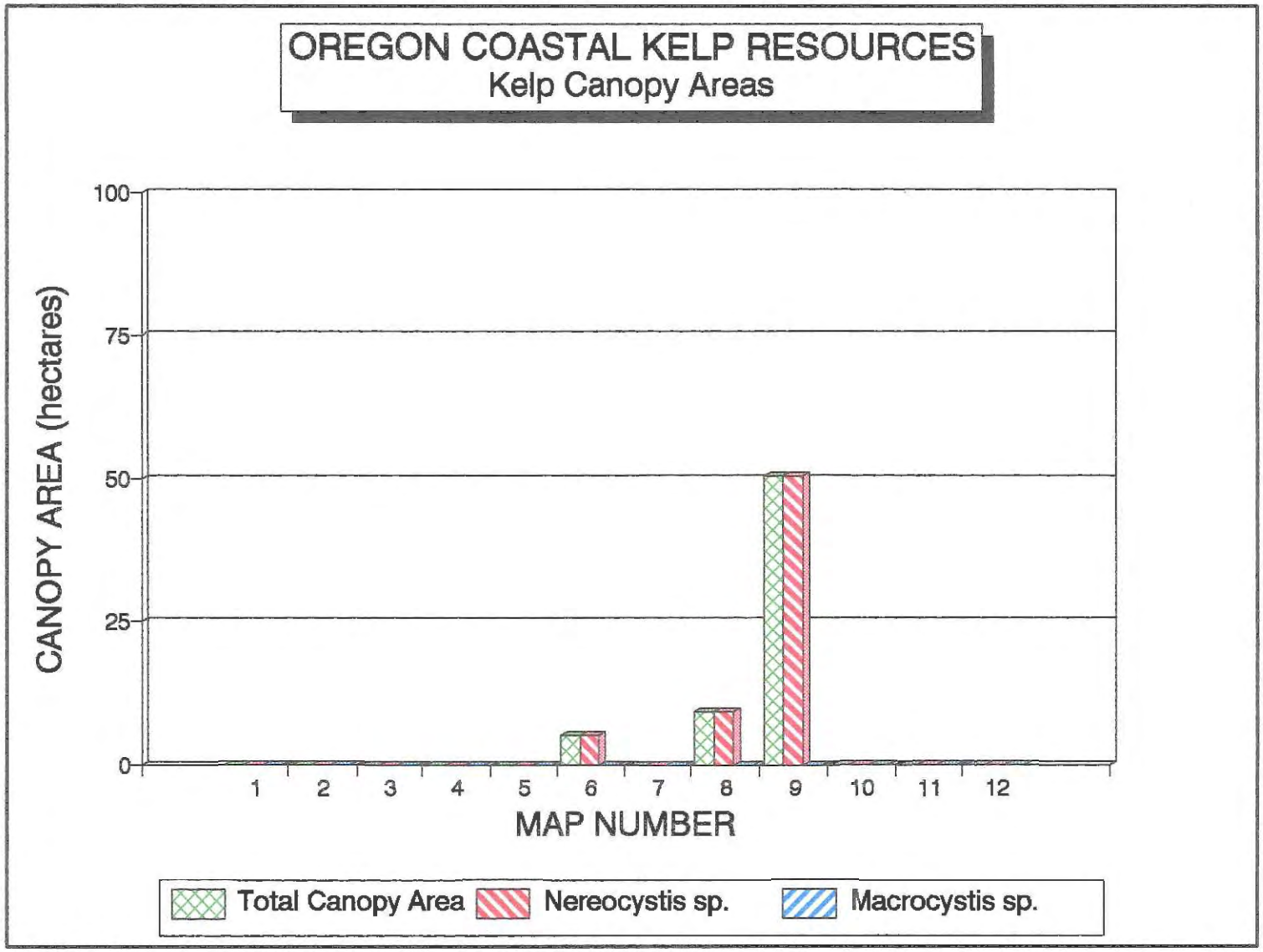


Figure 4B
Revision 1.1
Summer 1990

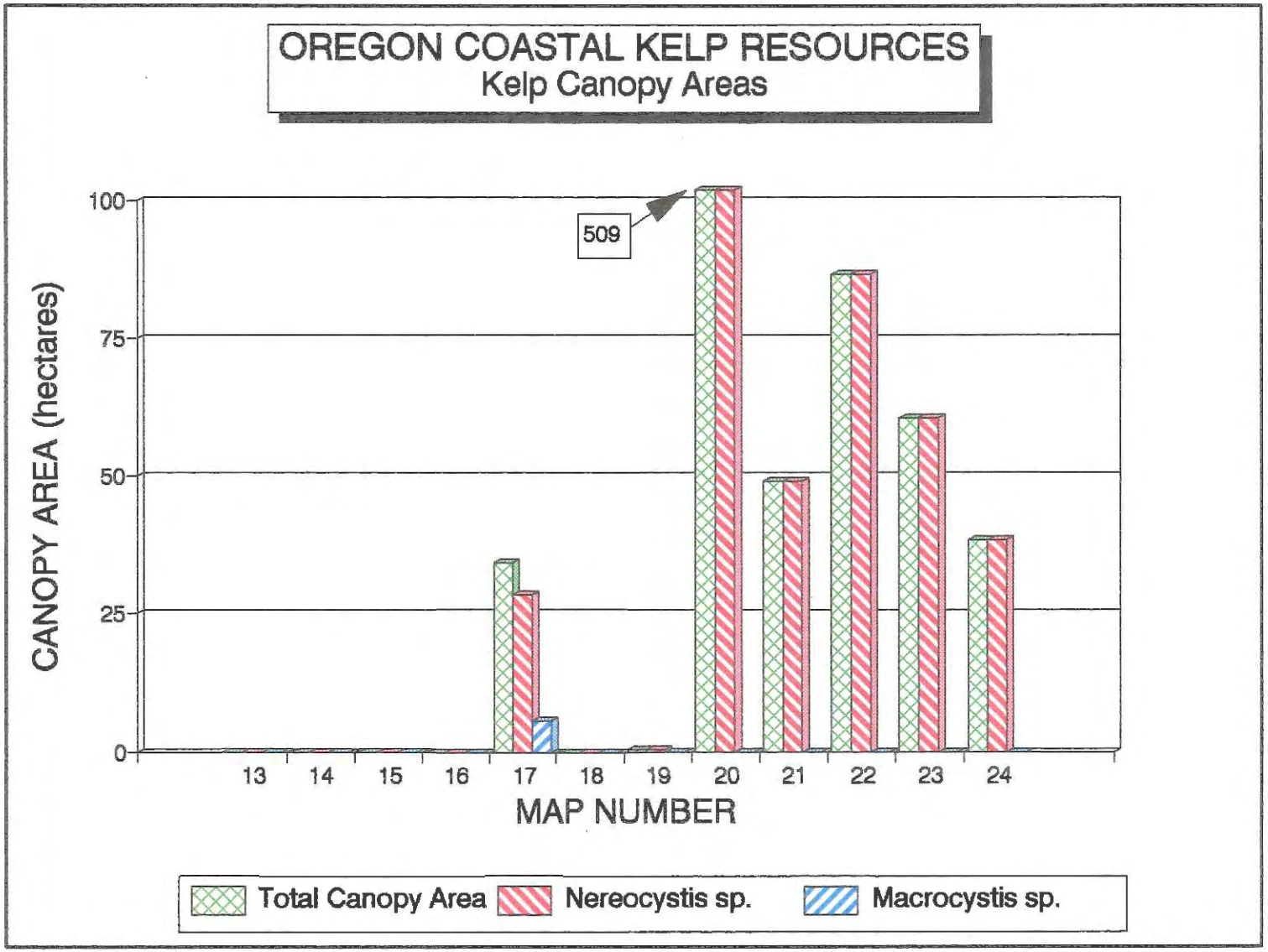
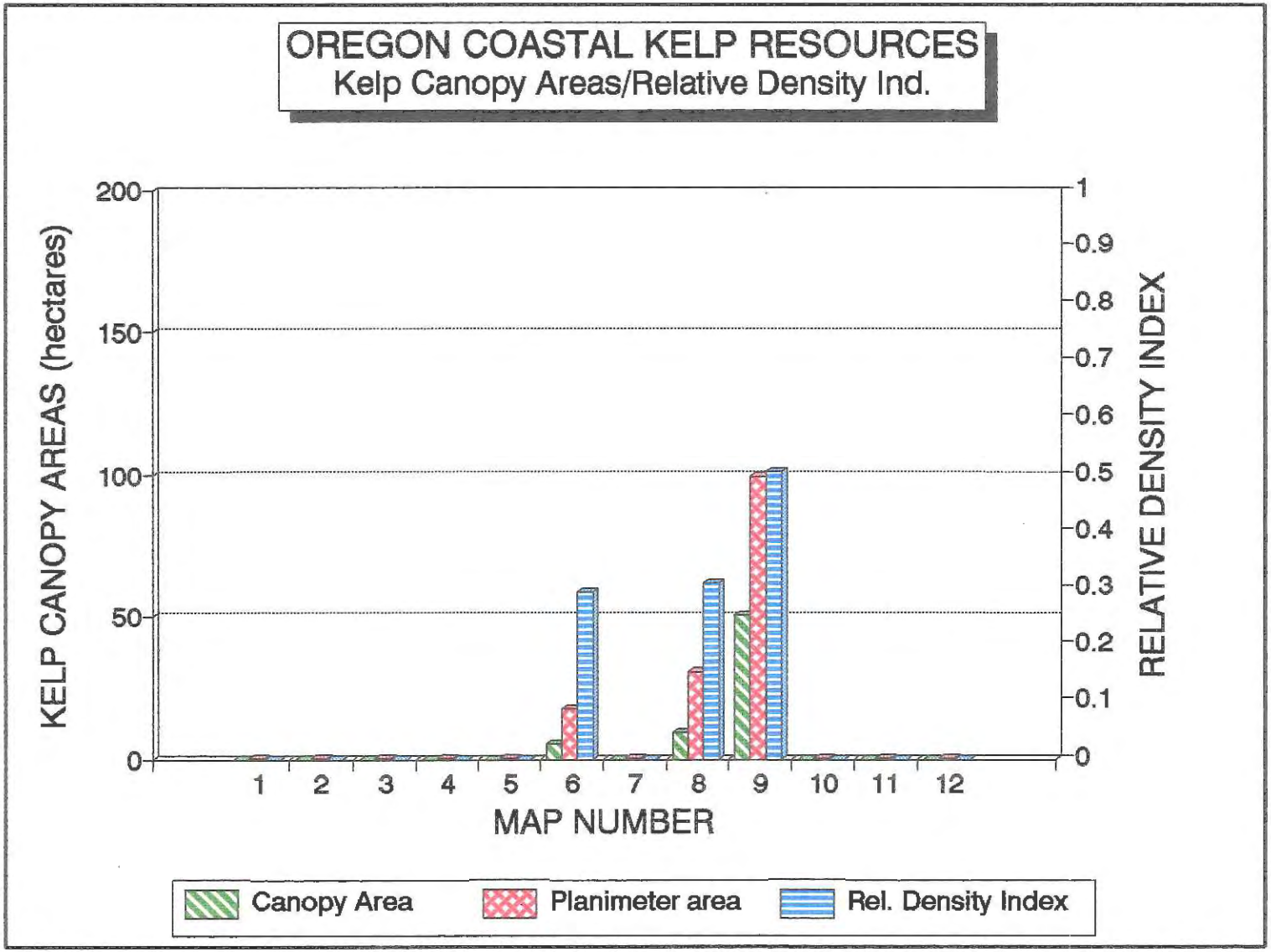


Figure 5A
Revision 1.1
Summer 1990



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Revision 1.1
Summer 1990

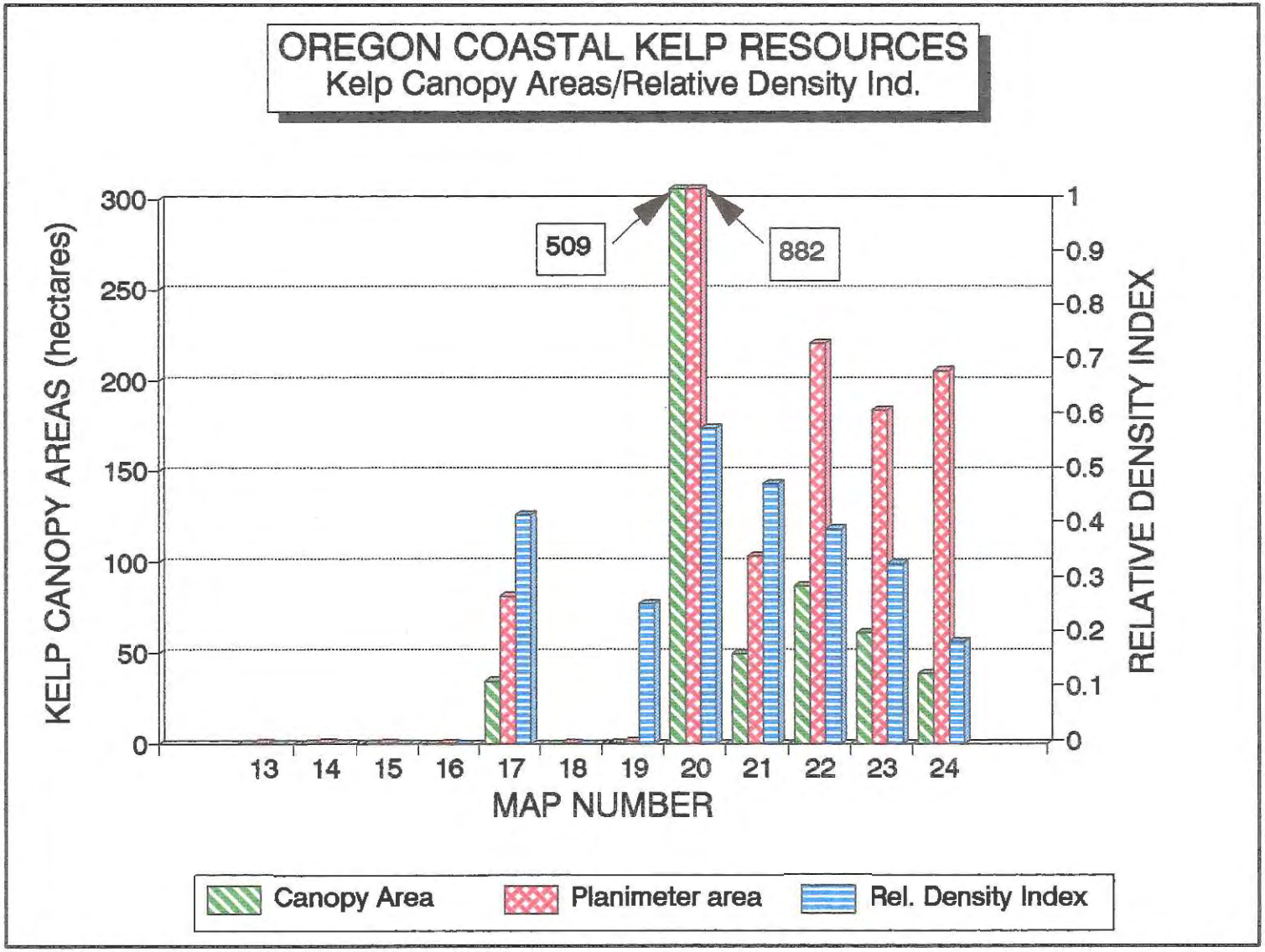


Figure 6A
Revision 1.1
Summer 1990

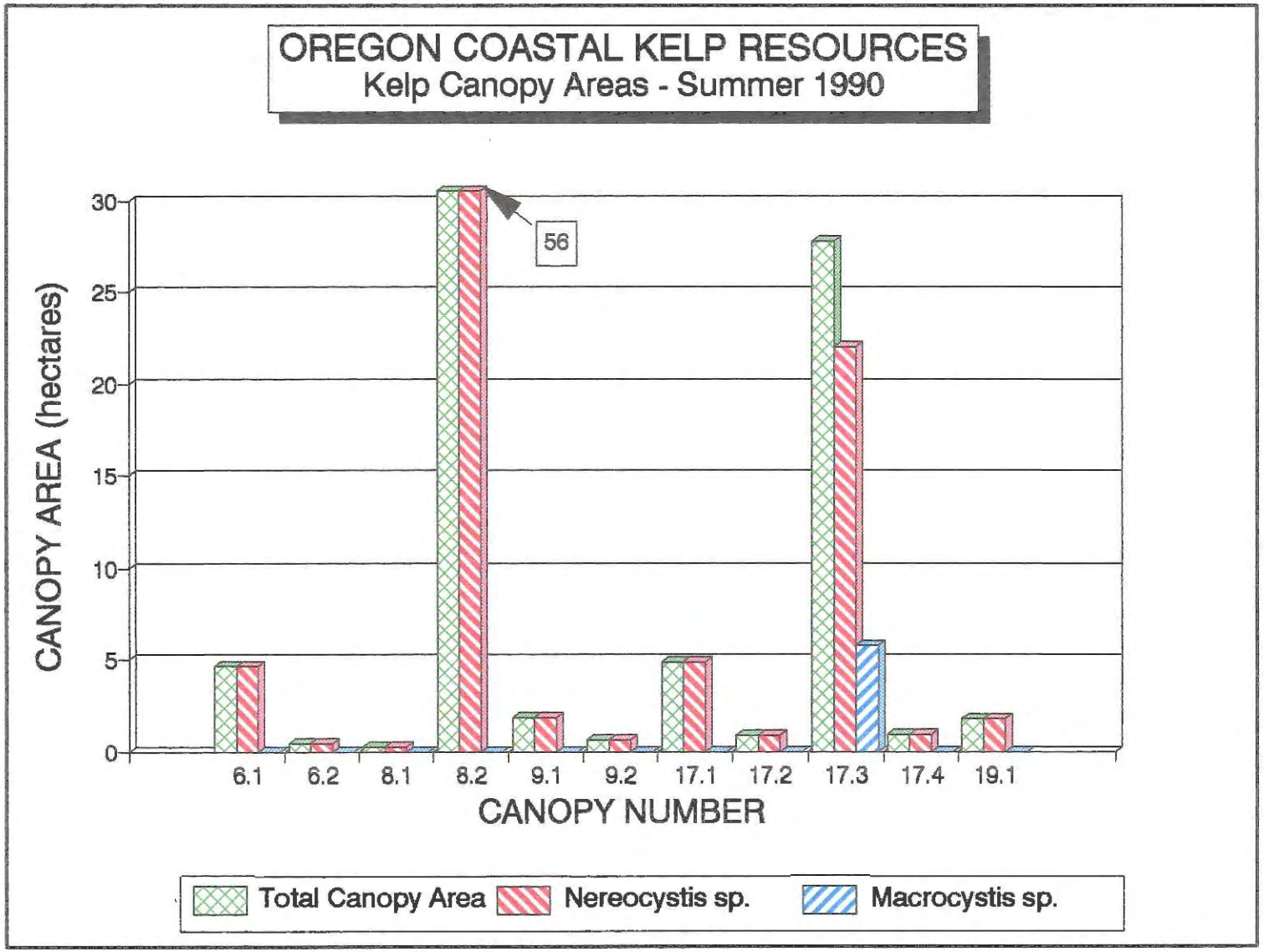


Figure 6B
Revision 1.1
Summer 1990

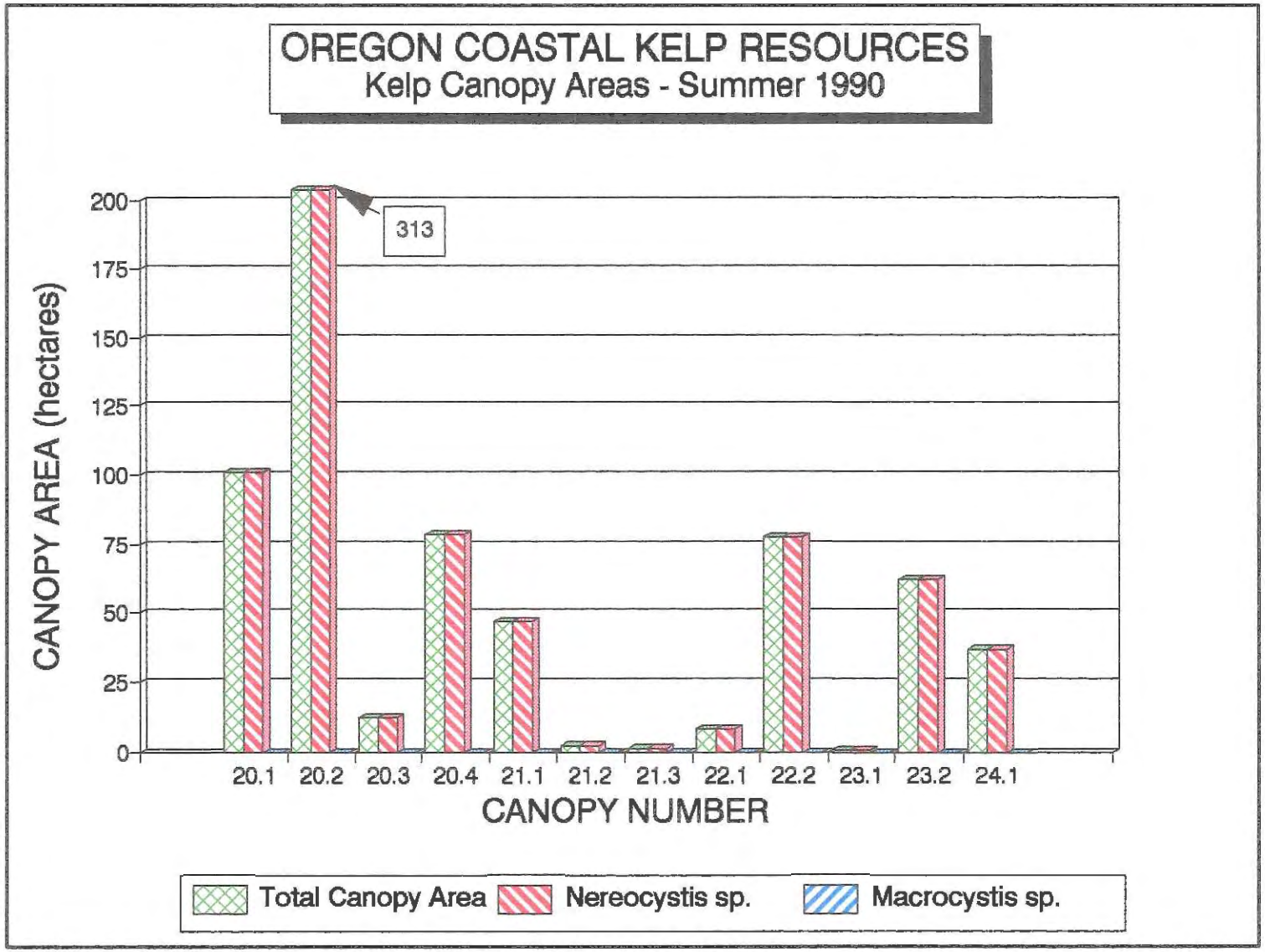
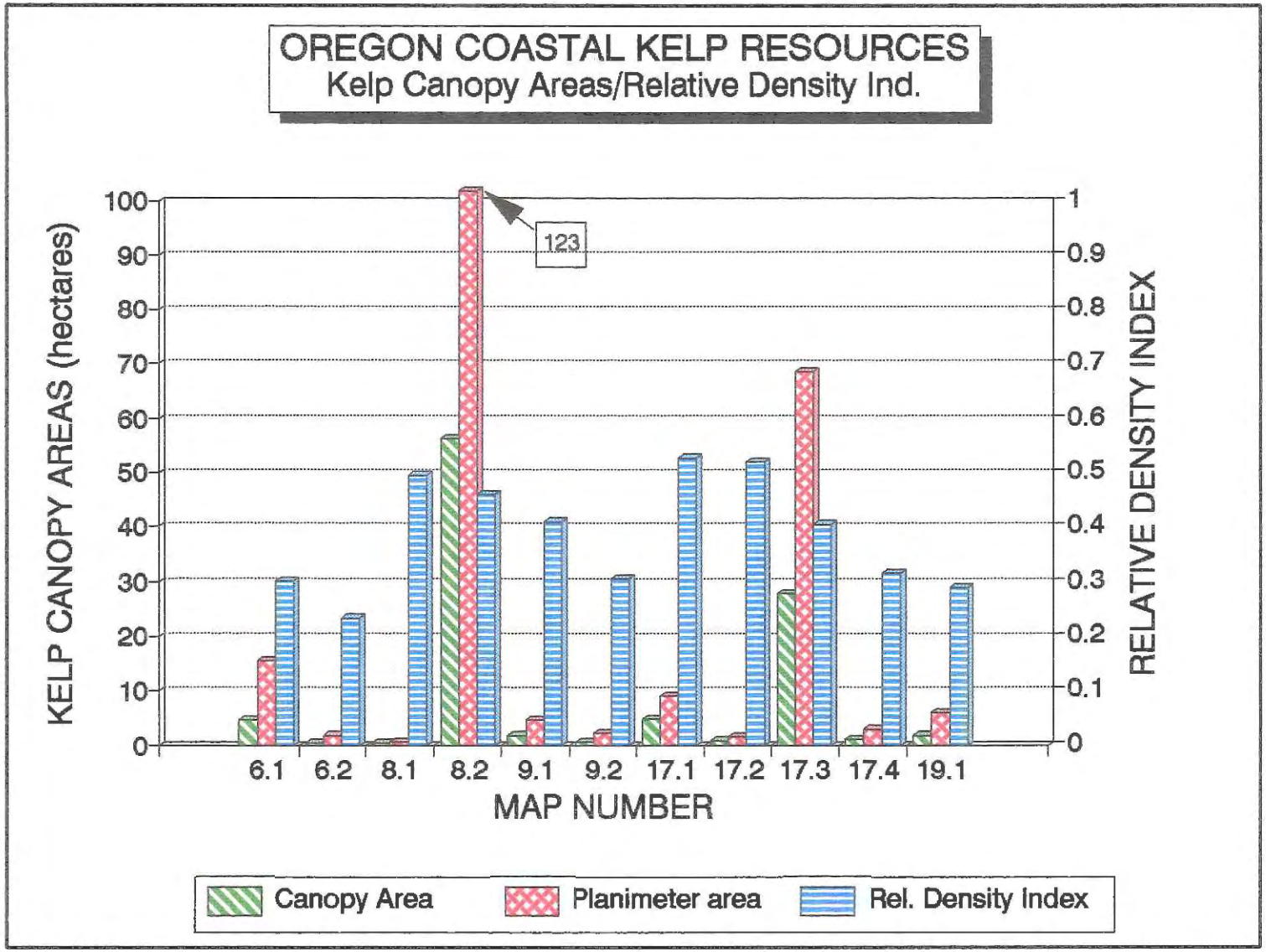


Figure 7A
Revision 1.1
Summer 1990



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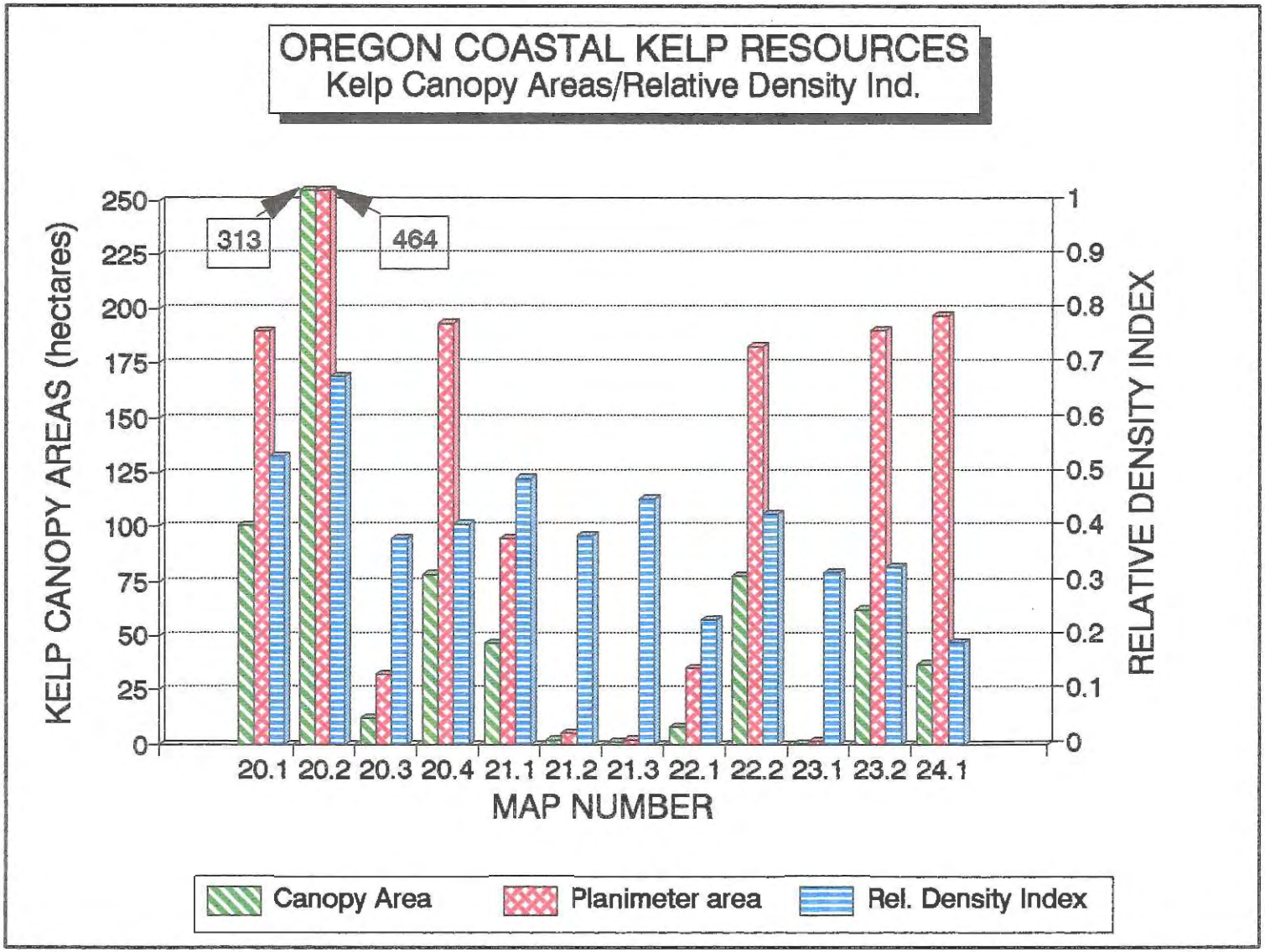
Revision 1.1
Summer 1990



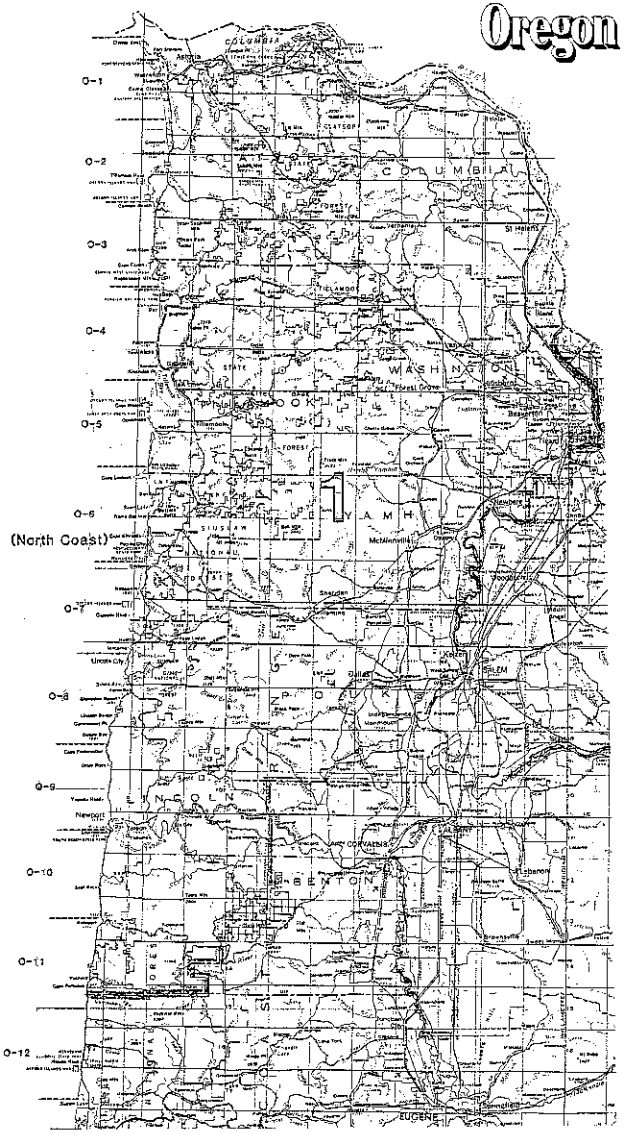
Oregon Coastal Kelp Resources

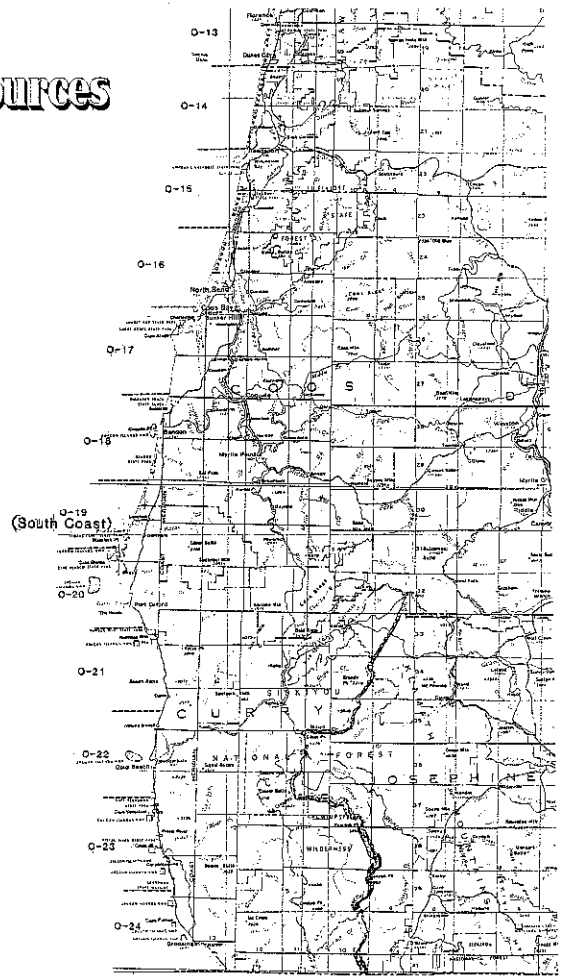
Summer 1990

Prepared By:
Ecoscan Resource Data
P.O. Box 1046
Freedom, CA 95019
(408) 728-3285

Oregon Coastal Kelp Resources

Map Index





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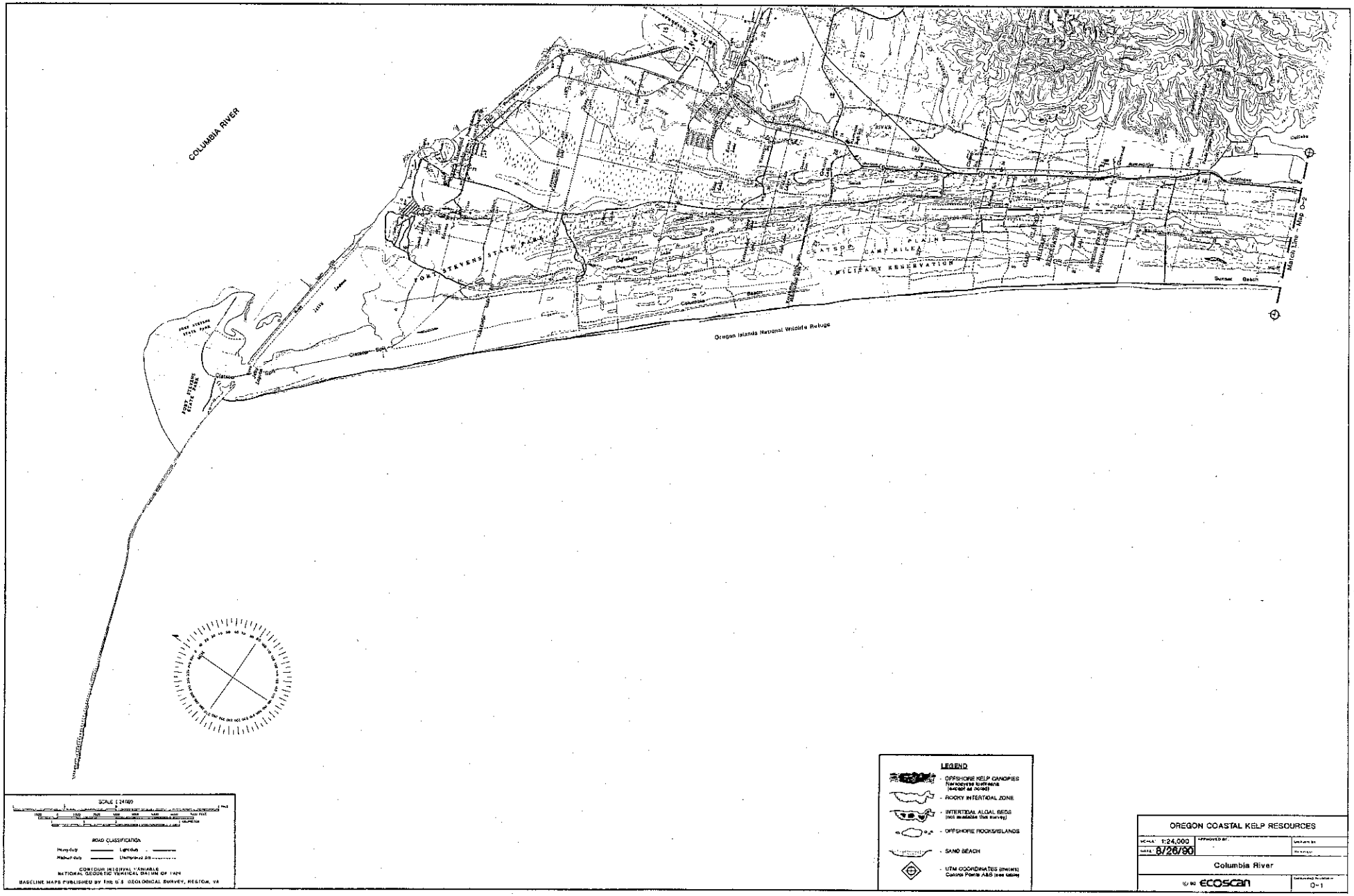
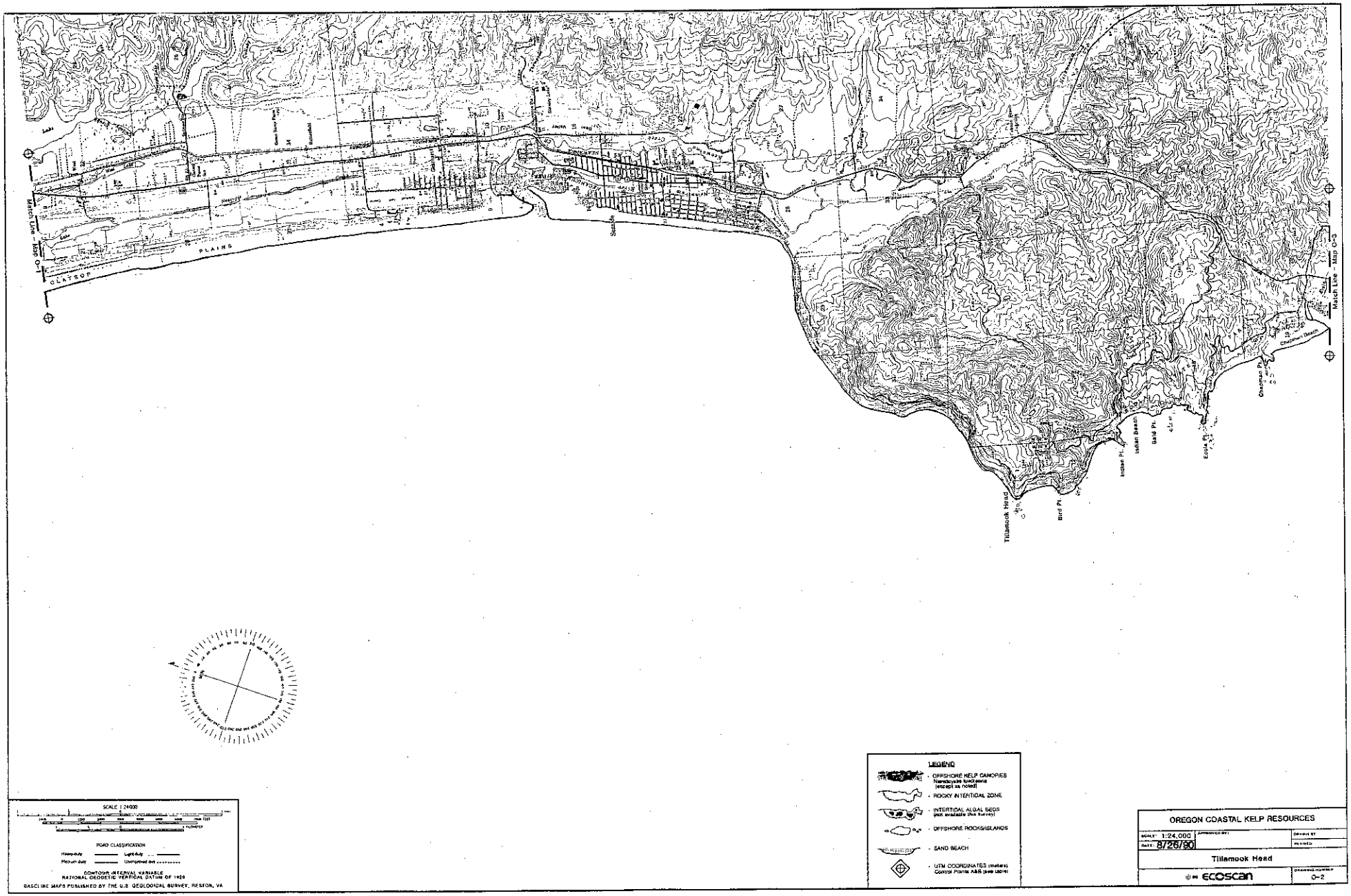
SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
MAP INDEX		
© 90 ECOSCAN		DRAWING NUMBER

11 X 17 PRINTED ON NO. 1000H CLEARPRINT ®


COLUMBIA RIVER
FORT STEVENS STATE PARK
Oregon Islands National Wildlife Refuge
Sunset Beach
SCALE 1:24000
ROAD CLASSIFICATION
CONTOUR INTERVAL VARIABLE
NATIONAL GEODETIC VERTICAL DATUM OF 1929
BASELINE MAPS PUBLISHED BY THE U.S. GEOLOGICAL SURVEY, RESTON, VA
LEGEND
OFFSHORE KELP CANOPIES
ROCKY INTERTIDAL ZONE
INTERTIDAL ALGAL BEDS
OFFSHORE ROCKS/ISLANDS
SAND BEACH
UTM COORDINATES (meters)
OREGON COASTAL KELP RESOURCES
SCALE 1:24,000
DATE 8/26/90
Columbia River
ecoscan
0-1



SCALE 1:24000

ROAD CLASSIFICATION

Heavy-duty ——— Light-duty ...

Medium-duty ——— Unimproved dirt ----------

CONTOUR INTERVAL VARIABLE
NATIONAL GEODETIC VERTICAL DATUM OF 1929
BASE LINE MAPS PUBLISHED BY THE U.S. GEOLOGICAL SURVEY, RESTON, VA

LEGEND

- OFFSHORE KELP CANOPIES *Nereocystis luetkeana* (except as noted)
- ROCKY INTERTIDAL ZONE
- INTERTIDAL ALGAL BEDS (not available this survey)
- OFFSHORE ROCKS/ISLANDS
- SAND BEACH
- UTM COORDINATES (meters) Control Points A&B (see table)

OREGON COASTAL KELP RESOURCES

SCALE: 1:24,000 | APPROVED BY: | DRAWN BY:

DATE: 8/26/90 | REVISED:

Tillamook Head

ecoscan | DRAWING NUMBER: O-2

SCALE 1:24000

ROAD CLASSIFICATION

Heavy-duty ——— Light-duty ———
Medium duty ——— Unimproved dirt - - - - -

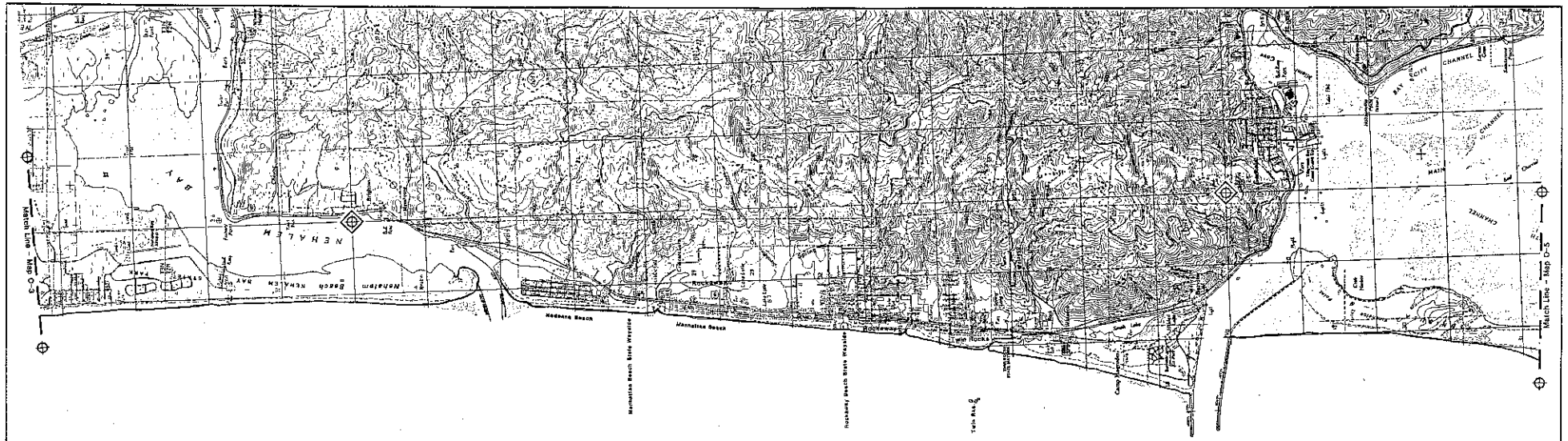
CONTOUR INTERVAL VARIABLE
NATIONAL GEODETIC VERTICAL DATUM OF 1929

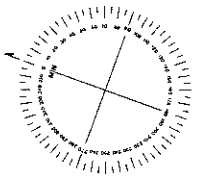
BASELINE MAPS PUBLISHED BY THE U.S. GEOLOGICAL SURVEY, RESTON, VA

LEGEND

- OFFSHORE KELP CANOPIES *Nereocystis luetkeana* (except as noted)
- ROCKY INTERTIDAL ZONE
- INTERTIDAL ALGAL BEDS (not available this survey)
- OFFSHORE ROCKS/ISLANDS
- SAND BEACH
- UTM COORDINATES (meters) Control Points A&B (see table)

OREGON COASTAL KELP RESOURCES		
SCALE: 1:24,000	APPROVED BY:	DRAWN BY
DATE 8/26/90		REVISED
Cape Falcon		
© 90 ECOSCAN		DRAWING NUMBER O-3





SCALE 1:24 000

ROAD CLASSIFICATION

CONTOUR INTERVAL VARIABLE
NATIONAL GEODETIC VERTICAL DATUM OF 1929
BASELINE MAPS PUBLISHED BY THE U.S. GEOLOGICAL SURVEY, RESTON, VA

LEGEND

- OFFSHORE KELP CANOPIES *Nereocystis luetkeana* (except as noted)
- ROCKY INTERTIDAL ZONE
- INTERTIDAL ALGAL BEDS (not available this survey)
- OFFSHORE ROCKS/ISLANDS
- SAND BEACH
- UTM COORDINATES (meters) Control Points A&S (see table)

OREGON COASTAL KELP RESOURCES

SCALE: 1:24,000	APPROVED BY:	DRAWN BY
DATE: 8/28/90		REVISED

Rockaway

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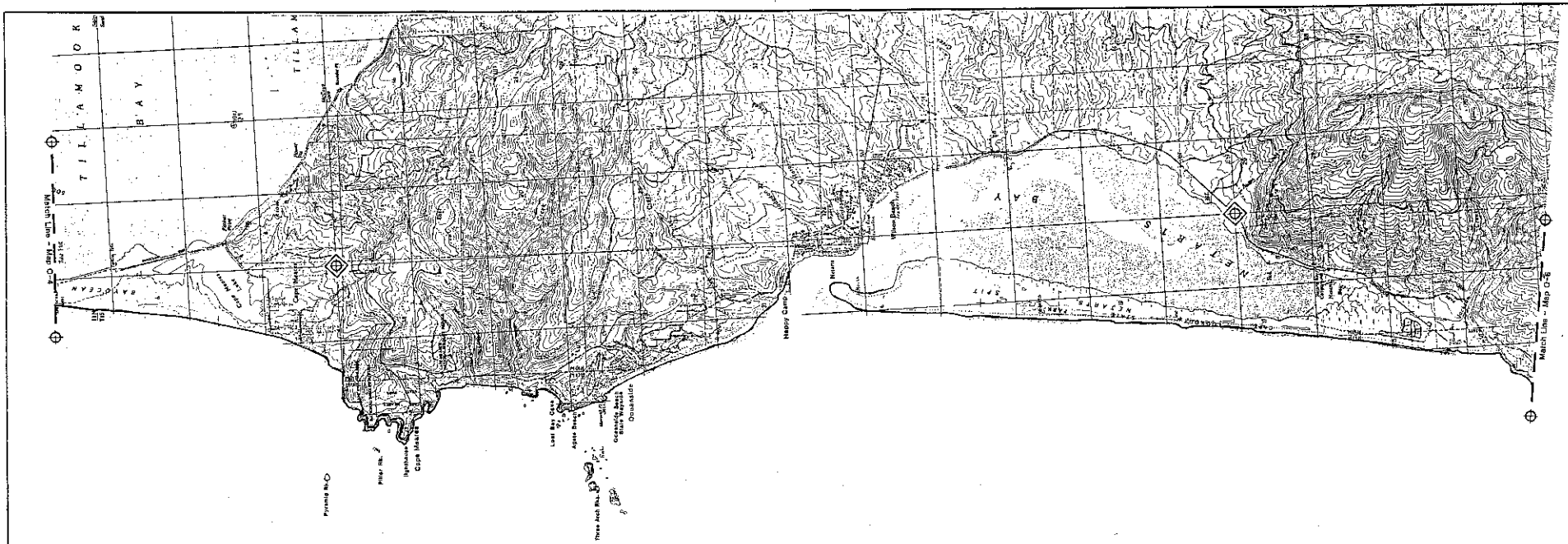
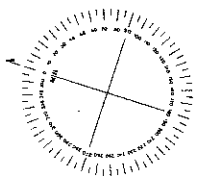
DRAWING NUMBER 0-4





SCALE 1:24000

ROAD CLASSIFICATION

Primary ——— Light-duty - - - -

Secondary ——— Unimproved dirt ·····

CONTOUR INTERVAL VARIABLE
NATIONAL GEODETIC VERTICAL DATUM OF 1929

BASELINE MAPS PUBLISHED BY THE U.S. GEOLOGICAL SURVEY, RESTON, VA

LEGEND

- OFFSHORE KELP CANOPIES (*Nereocystis luetkeana* (reached at mean))
- ROCKY INTERTIDAL ZONE
- INTERTIDAL ALGAL BEDS (not available this survey)
- OFFSHORE ROCKS/ISLANDS
- SAND BEACH
- UTM COORDINATES (Meters) Control Points A&S (see table)

OREGON COASTAL KELP RESOURCES

SCALE: 1:24,000 | APPROVED BY: | DRAWN BY:

DATE: 5/26/90 | REVISED:

Netarts Bay

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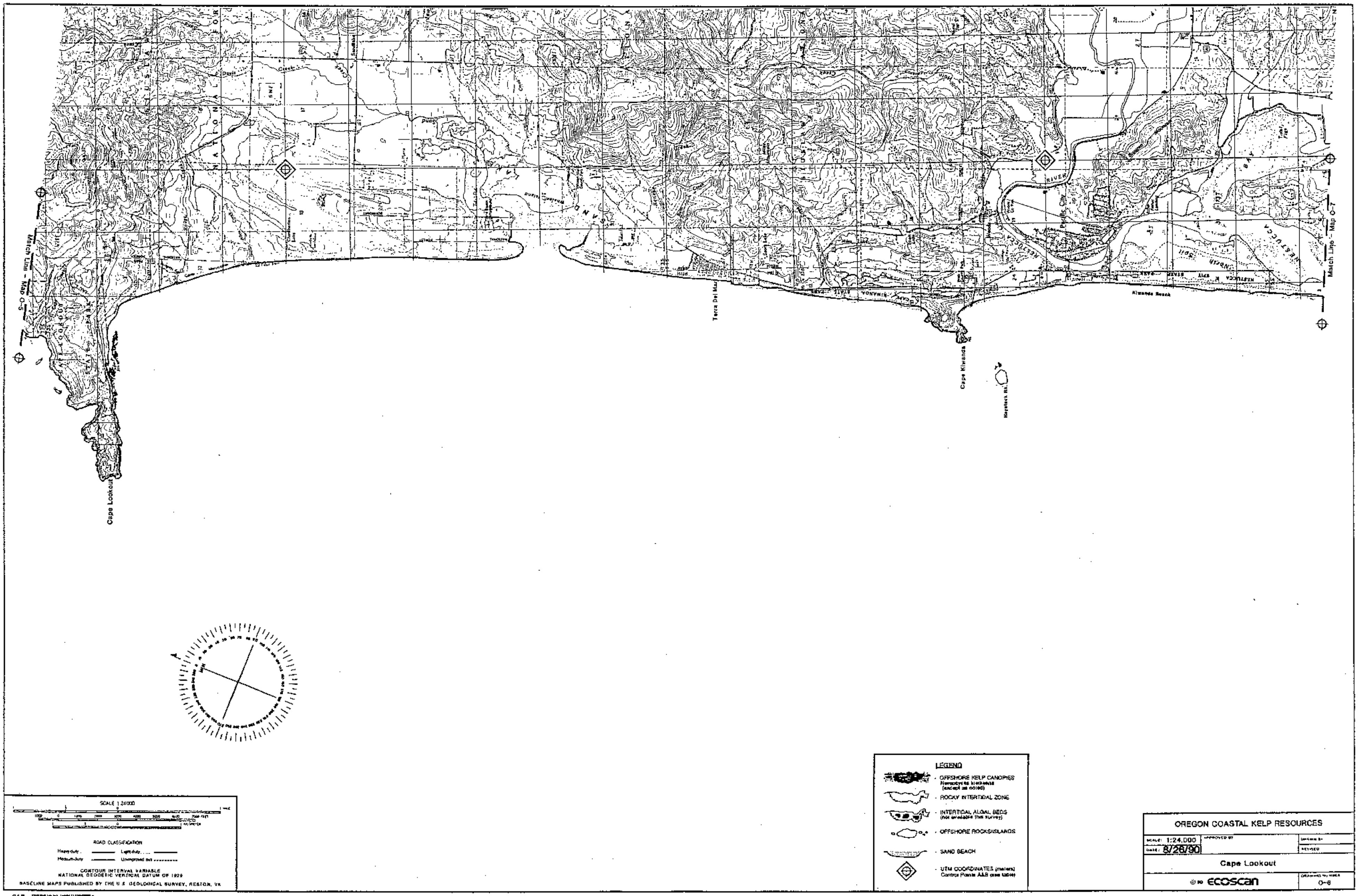
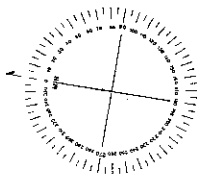

Match Line – Map O-5
Cape Lookout
Terra Del Mar
Cape Kiwanda
Haystack Rk.
Pacific City
Kiwanda Beach
Match Line – Map O-7
SCALE 1:24000
ROAD CLASSIFICATION
Heavy-duty
Light-duty
Medium-duty
Unimproved dirt
CONTOUR INTERVAL VARIABLE
NATIONAL GEODETIC VERTICAL DATUM OF 1929
BASELINE MAPS PUBLISHED BY THE U.S. GEOLOGICAL SURVEY, RESTON, VA
LEGEND
OFFSHORE KELP CANOPIES
ROCKY INTERTIDAL ZONE
INTERTIDAL ALGAL BEDS
OFFSHORE ROCKS/ISLANDS
SAND BEACH
UTM COORDINATES (meters)
Control Points A&B (see table)
OREGON COASTAL KELP RESOURCES
SCALE: 1:24,000
DATE: 8/26/90
Cape Lookout
ECOSCAN
O-6



LEGEND

- OFFSHORE KELP CANOPIES (low intertidal to subtidal (except as noted))
- ROCKY INTERTIDAL ZONE
- INTERTIDAL ALGAL BEDS (not available this survey)
- OFFSHORE ROCKS/ISLANDS
- SAND BEACH
- UTM COORDINATES (meters) Control Points A&B (see table)

SCALE 1:24000

ROAD CLASSIFICATION

Heavy-duty ——— Light-duty — — —

Medium-duty ——— Unimproved dirt .....

CONTOUR INTERVAL VARIABLE
NATIONAL GEODETIC VERTICAL DATUM OF 1929
BASELINE MAPS PUBLISHED BY THE U.S. GEOLOGICAL SURVEY, RESTON, VA

OREGON COASTAL KELP RESOURCES

SCALE 1:24,000 | APPROVED BY | DRAWN BY

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Cascade Head

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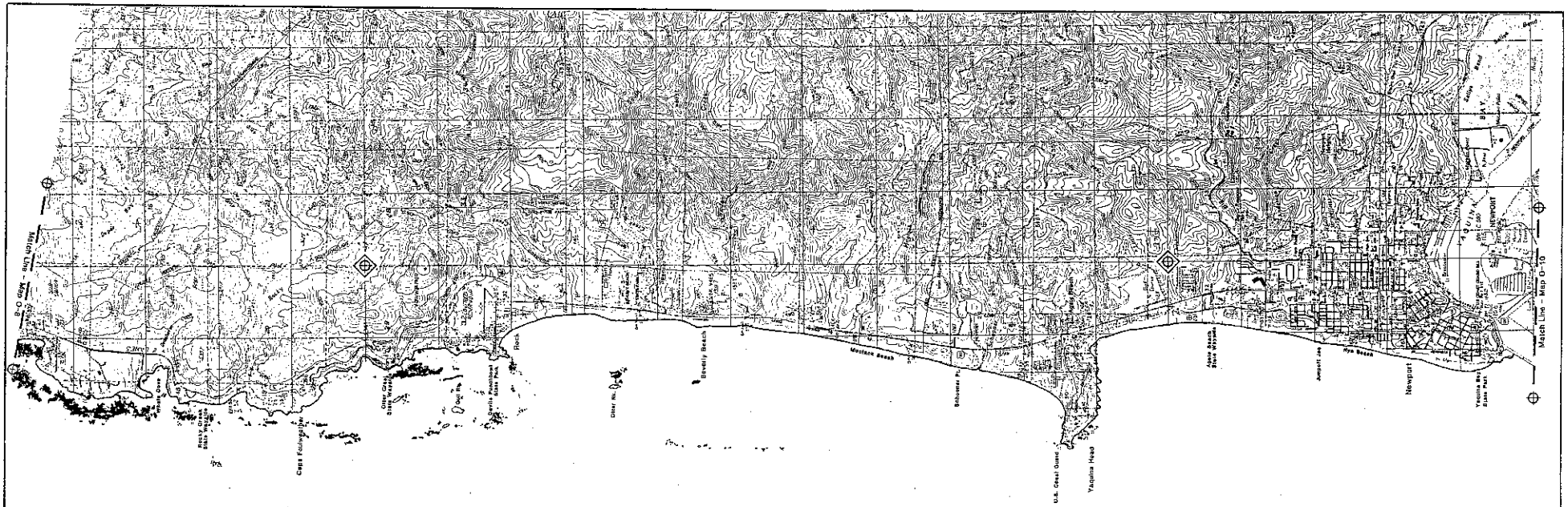
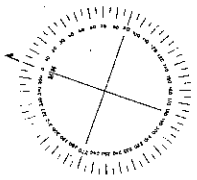
Match Line - Map O-7
Match Line - Map O-8
Lincoln City
Salishan Spit
Gleneden Beach
Lincoln Beach
Government Pt.
Depoe Bay
SCALE 1:24 000
ROAD CLASSIFICATION
CONTOUR INTERVAL VARIABLE
NATIONAL GEODETIC VERTICAL DATUM OF 1929
BASELINE MAPS PUBLISHED BY THE U.S. GEOLOGICAL SURVEY, RESTON, VA
LEGEND
OFFSHORE KELP CANOPIES
(except as noted)
ROCKY INTERTIDAL ZONE
INTERTIDAL ALGAL BEDS
OFFSHORE ROCKS/ISLANDS
SAND BEACH
UTM COORDINATES (meters)
Control Points A&B (see table)
OREGON COASTAL KELP RESOURCES
SCALE: 1:24,000
DATE: 8/26/90
Lincoln City
ECOSCAN
O-8





SCALE 1:24000

ROAD CLASSIFICATION

Heavy duty ——— Light duty - - - -

Medium duty ——— Unimproved dirt - - - - - -

CONTOUR INTERVAL VARIABLE
NATIONAL GEODETIC VERTICAL DATUM OF 1929
BASELINE MAPS PUBLISHED BY THE U.S. GEOLOGICAL SURVEY, RESTON, VA

LEGEND

- OFFSHORE KELP CANOPIES (Nereocystis luetkeana) (except as noted)
- ROCKY INTERTIDAL ZONE
- INTERTIDAL ALGAL BEDS (not available this survey)
- OFFSHORE ROCKS/ISLANDS
- SAND BEACH
- UTM COORDINATES (meters) Control Points A&S (see table)

OREGON COASTAL KELP RESOURCES

SCALE: 1:24,000 | APPROVED BY: | DRAWN BY

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Newport

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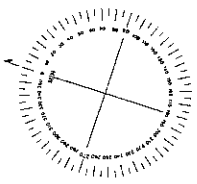

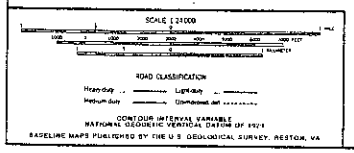

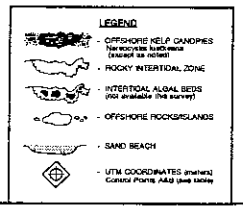

OREGON COASTAL KELP RESOURCES

SCALE: 1:24,000	APPROVED BY:	DRAWN BY
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Seal Rock

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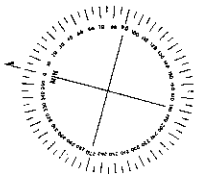
Document Number O-10


ALSEA BAY
Waldport
Match Line - Map O-10
Match Line - Map O-12
Yaquina John Pt.
Governor Patterson Mem State Park
Big Stump Beach
Wakonda Beach
Beachside State Park
Tillicum Beach
San Marine
Yachats
Yachats State Park
Cape Perpetua
Devils Churn
Cooks Chasm
Captain Cook Pt.
SCALE 1:24000
ROAD CLASSIFICATION
Heavy-duty
Light-duty
Medium-duty
Unimproved dirt
CONTOUR INTERVAL VARIABLE
NATIONAL GEODETIC VERTICAL DATUM OF 1929
BASELINE MAPS PUBLISHED BY THE U.S. GEOLOGICAL SURVEY, RESTON, VA
LEGEND
- OFFSHORE KELP CANOPIES
- ROCKY INTERTIDAL ZONE
- INTERTIDAL ALGAL BEDS (not available this survey)
- OFFSHORE ROCKS/ISLANDS
- SAND BEACH
- UTM COORDINATES (meters) Control Points A&B (see table)
OREGON COASTAL KELP RESOURCES
SCALE: 1:24,000
DATE: 8/26/90
Waldport
ECOSCAN
O-11


Match Line - Map O-11
Match Line - Map O-13
Gwynn Knoll
Searose Beach
Roosevelt Beach
CARL G. WASHBURNE MEMORIAL STATE PARK
Heceta Head
Sea Lion Pt.
Sea Lion Caves
SCALE 1:24000
ROAD CLASSIFICATION
Heavy-duty
Light duty
Medium-duty
Unimproved dirt
CONTOUR INTERVAL VARIABLE
NATIONAL GEODETIC VERTICAL DATUM OF 1929
BASELINE MAPS PUBLISHED BY THE U.S. GEOLOGICAL SURVEY, RESTON, VA
LEGEND
- OFFSHORE KELP CANOPIES
Nereocystis luetkeana
(except as noted)
- ROCKY INTERTIDAL ZONE
- INTERTIDAL ALGAL BEDS
(not available this survey)
- OFFSHORE ROCKS/ISLANDS
- SAND BEACH
- UTM COORDINATES (meters)
Control Points A&B (see table)
OREGON COASTAL KELP RESOURCES
SCALE: 1:24,000
DATE: 8/26/90
Heceta Head
ECOSCAN
O-12



SCALE 1:24000

ROAD CLASSIFICATION

Heavy-duty ——— Light-duty ———

Medium-duty ——— Unimproved dirt - - - - - -

CONTOUR INTERVAL VARIABLE
NATIONAL GEODETIC VERTICAL DATUM OF 1929

BASELINE MAPS PUBLISHED BY THE U.S. GEOLOGICAL SURVEY, RESTON, VA

LEGEND

- OFFSHORE KELP CANOPIES (*Nereocystis luetkeana* (except as noted))
- ROCKY INTERTIDAL ZONE
- INTERTIDAL ALGAL BEDS (not available this survey)
- OFFSHORE ROCKS/ISLANDS
- SAND BEACH
- UTM COORDINATES (meters) Control Points A&B (see table)

OREGON COASTAL KELP RESOURCES

SCALE: 1:24,000 | APPROVED BY: | DRAWN BY:

DATE: 5/28/90 | REVISED

Florence

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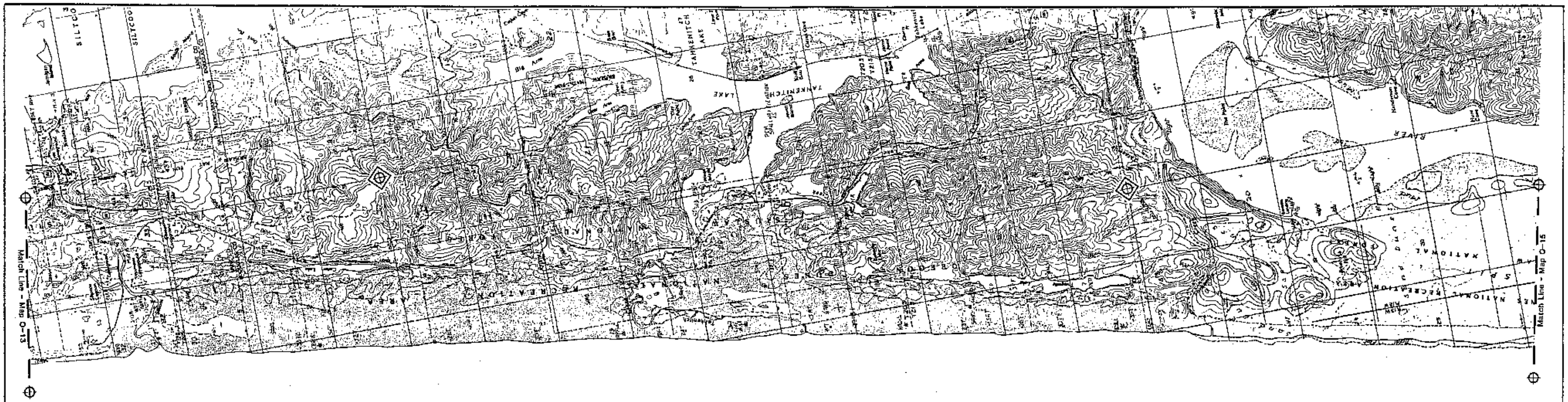

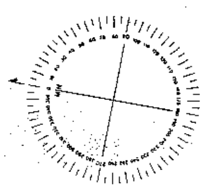

SCALE 1:24000

ROAD CLASSIFICATION

Heavy-duty — Light-duty

Medium-duty — Unimproved dirt

CONTOUR INTERVAL VARIABLE
NATIONAL GEODETIC VERTICAL DATUM OF 1929

BASELINE MAPS PUBLISHED BY THE U.S. GEOLOGICAL SURVEY, RESTON, VA

LEGEND

- OFFSHORE KELP CANOPIES (except as noted)
- ROCKY INTERTIDAL ZONE
- INTERTIDAL ALGAL BEDS (not available this survey)
- OFFSHORE ROCKS/ISLANDS
- SAND BEACH
- UTM COORDINATES (meters) Control Points A&B (see table)

OREGON COASTAL KELP RESOURCES

SCALE: 1:24,000 | APPROVED BY: | DRAWN BY

DATE: 8/26/90 | REVISED

Tahkenitch Lake

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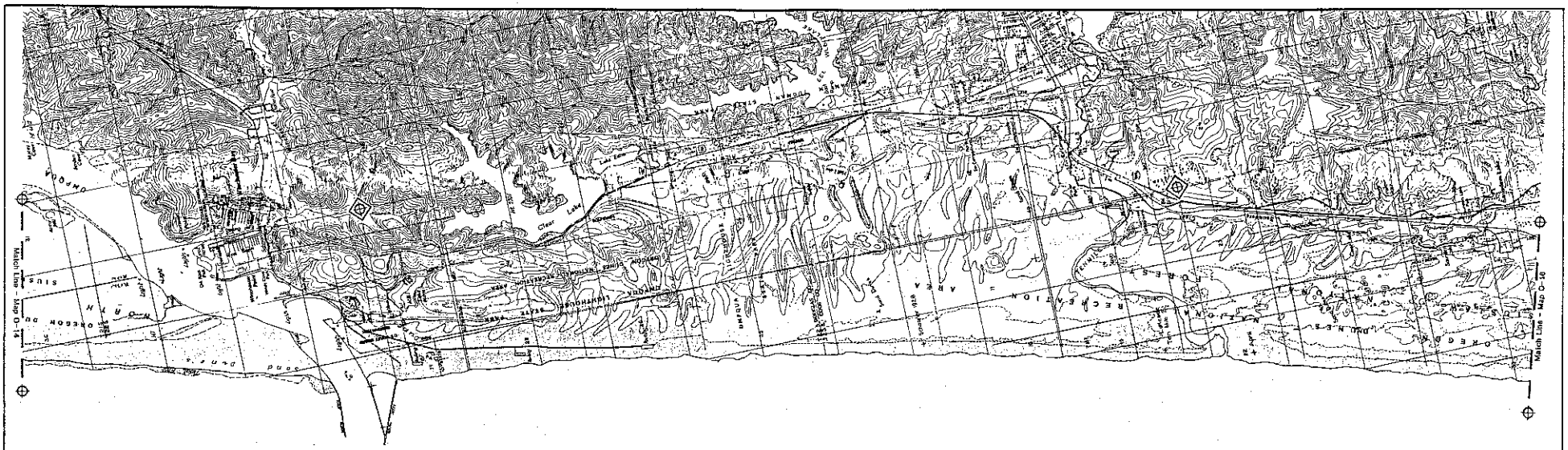
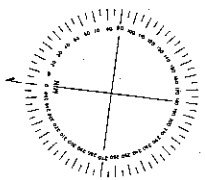




SCALE 1:24000

ROAD CLASSIFICATION

Heavy-duty ——— Light-duty ———

Medium-duty ——— Unimproved dirt - - - - - -

CONTOUR INTERVAL VARIABLE
NATIONAL GEODETIC VERTICAL DATUM OF 1929
BASELINE MAPS PUBLISHED BY THE U.S. GEOLOGICAL SURVEY, RESTON, VA

LEGEND

- OFFSHORE KELP CANOPIES (Nereocystis luetkeana) (detailed as noted)
- ROCKY INTERTIDAL ZONE
- INTERTIDAL ALGAL BEDS (not available this survey)
- OFFSHORE ROCKS/ISLANDS
- SAND BEACH
- UTM COORDINATES (meters) Control Points A&S (see table)

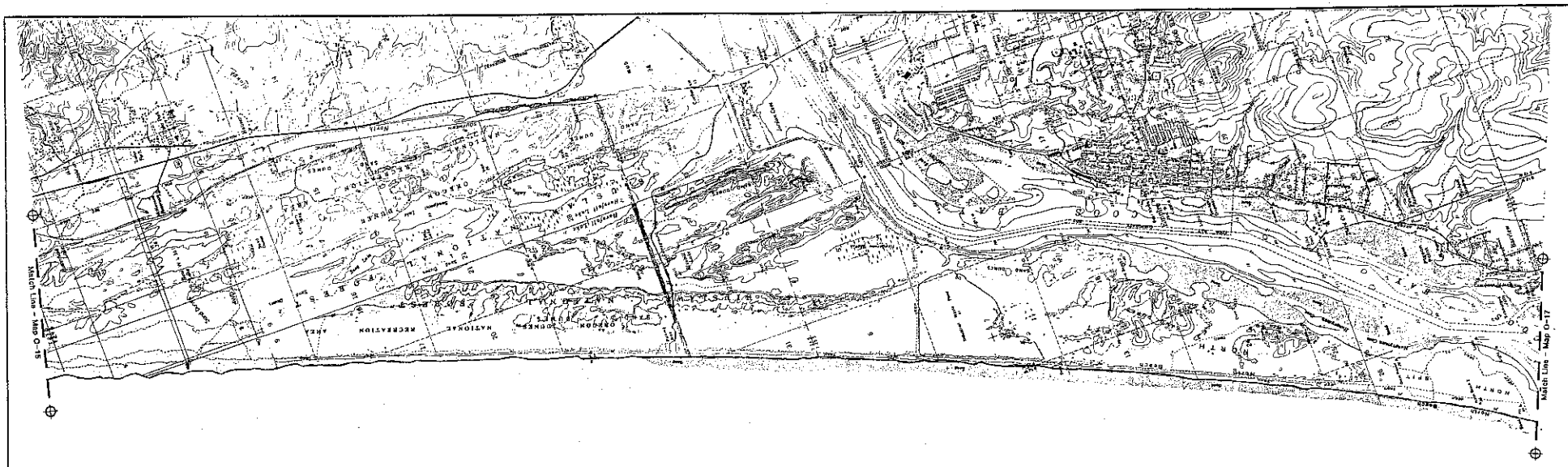
OREGON COASTAL KELP RESOURCES

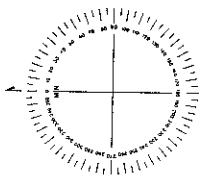
SCALE: 1:24,000	APPROVED BY:	DRAWN BY
DATE: 8/26/90		REVISED

Winchester Bay

prepared by ecoscan

DRAWING NUMBER: O-15





SCALE 1:24000

ROAD CLASSIFICATION

Heavy-duty ——— Light-duty ——

Medium-duty ——— Unimproved dirt ---------

CONTOUR INTERVAL VARIABLE
NATIONAL GEODETIC VERTICAL DATUM OF 1929

BASELINE MAPS PUBLISHED BY THE U.S. GEOLOGICAL SURVEY, RESTON, VA

LEGEND

- OFFSHORE KELP CANOPIES (No access in all areas (except as noted))
- ROCKY INTERTIDAL ZONE
- INTERTIDAL ALGAL BEDS (Not available this survey)
- OFFSHORE ROCKS/ISLANDS
- SAND BEACH
- UTM COORDINATES (meters) Control Points A&S (see table)

OREGON COASTAL KELP RESOURCES

SCALE: 1:24,000 | APPROVED BY: | DRAWN BY

DATE: 8/28/90 | REVISED

Empire

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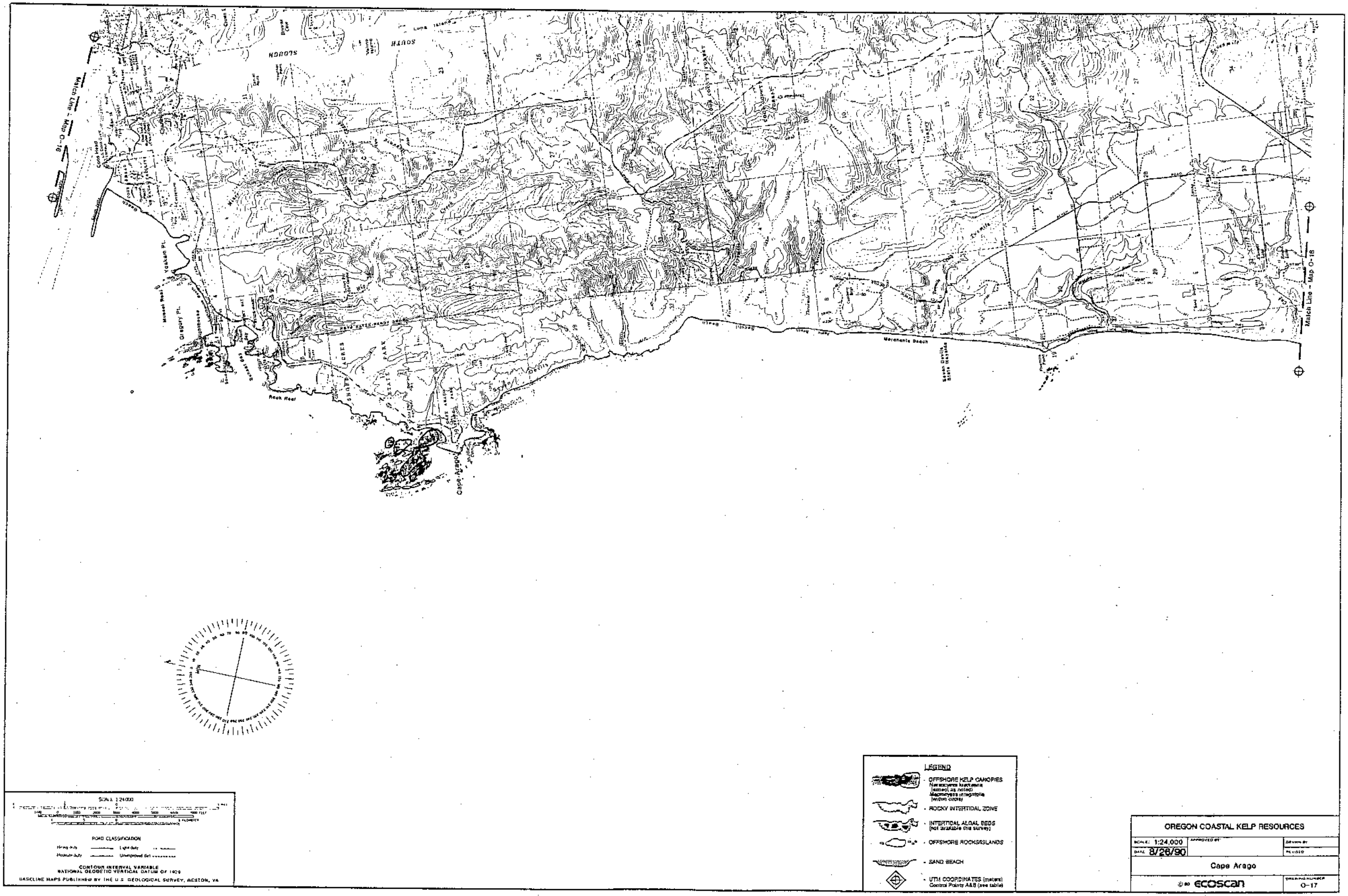
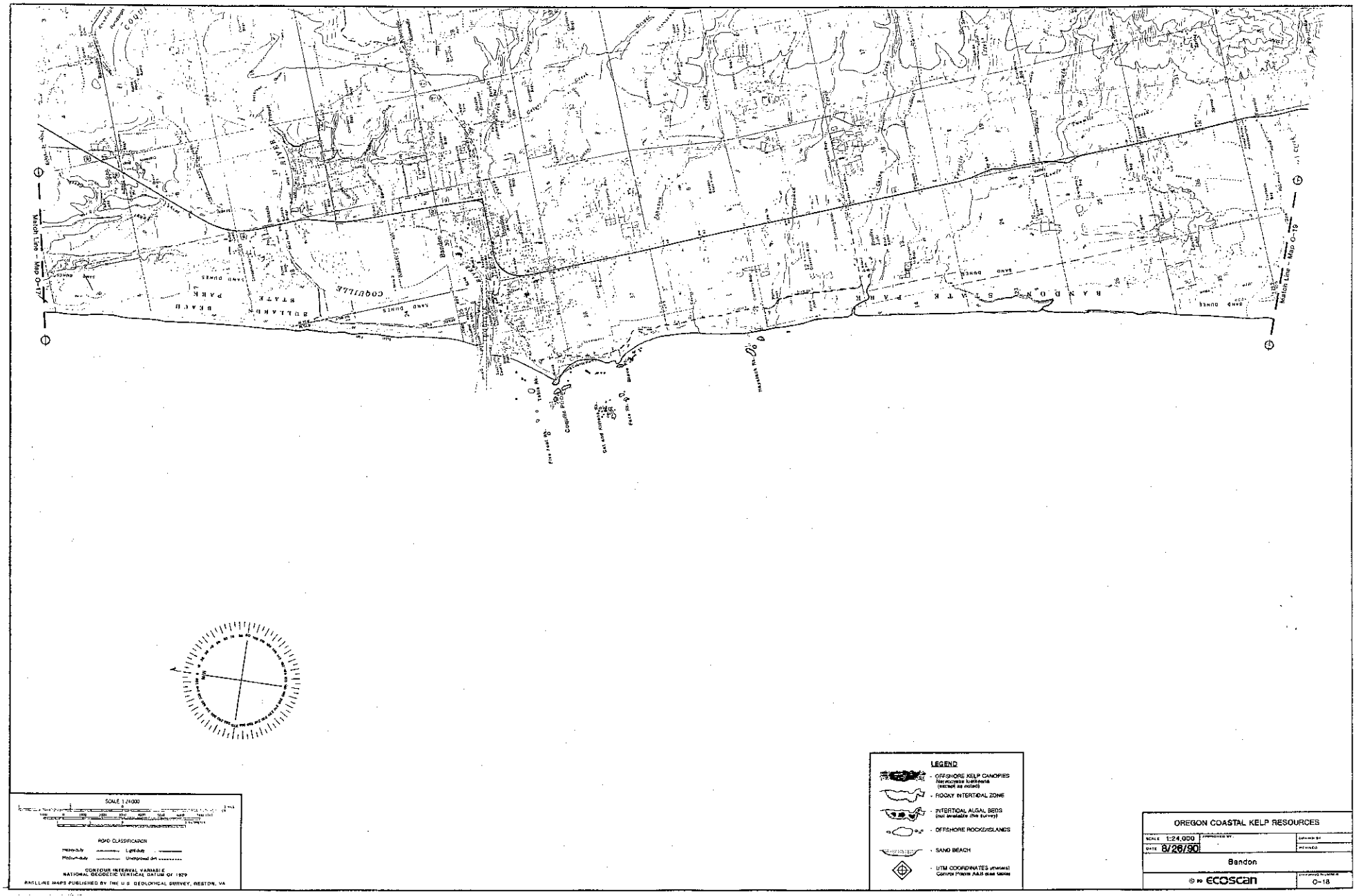

Match Line – Map O-16
Match Line – Map O-18
SOUTH SLOUGH
Yoakam Pt.
Mussel Reef
Gregory Pt.
Rock Reef
Cape Arago
Merchants Beach
SCALE 1:24000
ROAD CLASSIFICATION
Light duty
Unimproved dirt
CONTOUR INTERVAL VARIABLE
NATIONAL GEODETIC VERTICAL DATUM OF 1929
BASELINE MAPS PUBLISHED BY THE U.S. GEOLOGICAL SURVEY, RESTON, VA
LEGEND
OFFSHORE KELP CANOPIES
(except as noted)
ROCKY INTERTIDAL ZONE
INTERTIDAL ALGAL BEDS
OFFSHORE ROCKS/ISLANDS
SAND BEACH
UTM COORDINATES (meters)
Control Points A&B (see table)
OREGON COASTAL KELP RESOURCES
SCALE: 1:24,000
DATE: 8/26/90
Cape Arago
ecoscan
O-17



SCALE 1:24000

ROAD CLASSIFICATION

Heavy-duty ——— Light-duty ———

Medium-duty ——— Unimproved dirt - - - - - -

CONTOUR INTERVAL VARIABLE
NATIONAL GEODETIC VERTICAL DATUM OF 1929
BASELINE MAPS PUBLISHED BY THE U.S. GEOLOGICAL SURVEY, RESTON, VA

LEGEND

- OFFSHORE KELP CANOPIES Nereocystis bottoms (except as noted)
- ROCKY INTERTIDAL ZONE
- INTERTIDAL ALGAL BEDS (not available this survey)
- OFFSHORE ROCKS/ISLANDS
- SAND BEACH
- UTM COORDINATES (meters) Control Points AA15 (see table)

OREGON COASTAL KELP RESOURCES

SCALE 1:24,000 | APPROVED BY: | DRAWN BY:

DATE 8/26/90 | REVISED

Bandon

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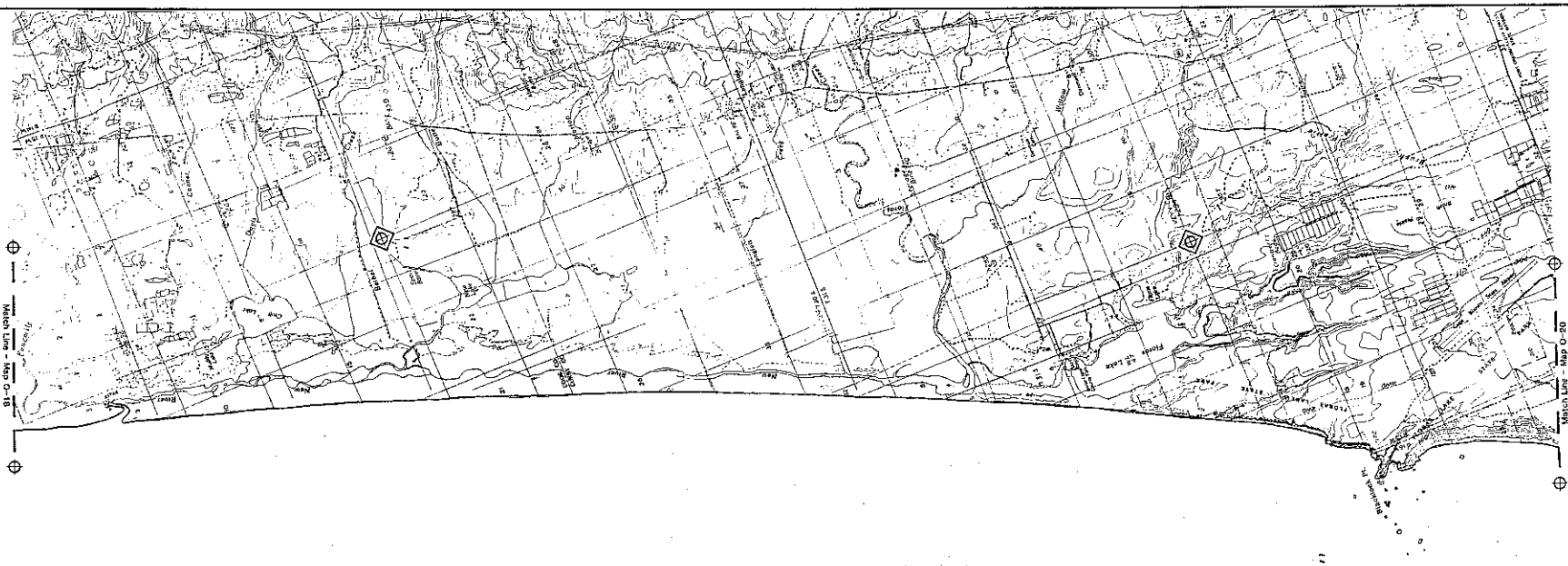
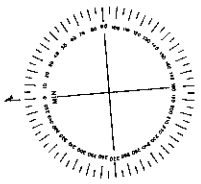




SCALE 1:24000

ROAD CLASSIFICATION

CONTOUR INTERVAL VARIABLE
NATIONAL GEODETIC VERTICAL DATUM OF 1929
BASELINE MAPS PUBLISHED BY THE U.S. GEOLOGICAL SURVEY, RESTON, VA

LEGEND

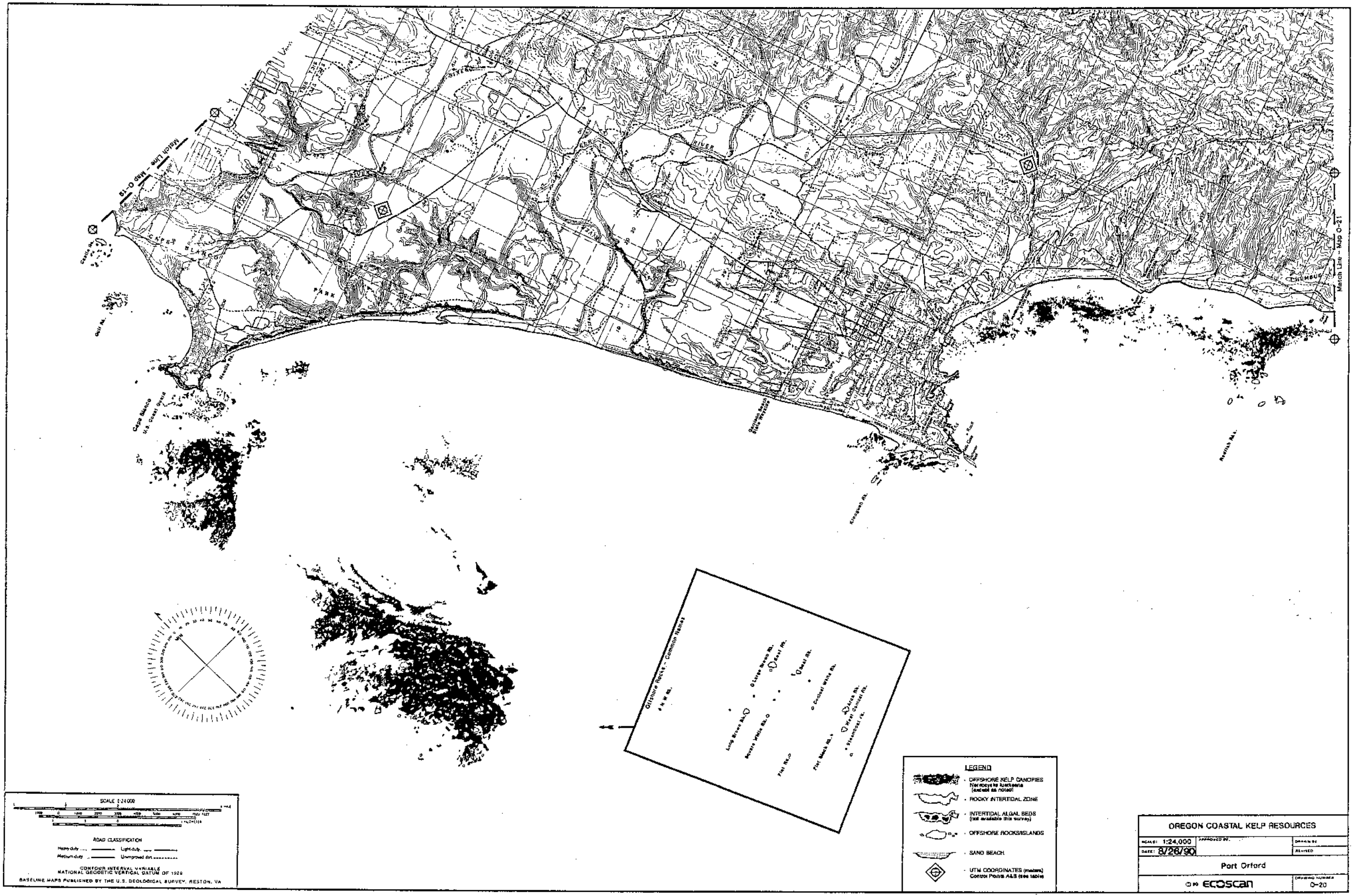
- OFFSHORE KELP CANOPIES
- RODDY INTERTIDAL ZONE
- INTERTIDAL ALGAL BEDS
- OFFSHORE ROCKS/ISLANDS
- SAND BEACH
- UTM COORDINATES (meters) Control Points AAB (see table)

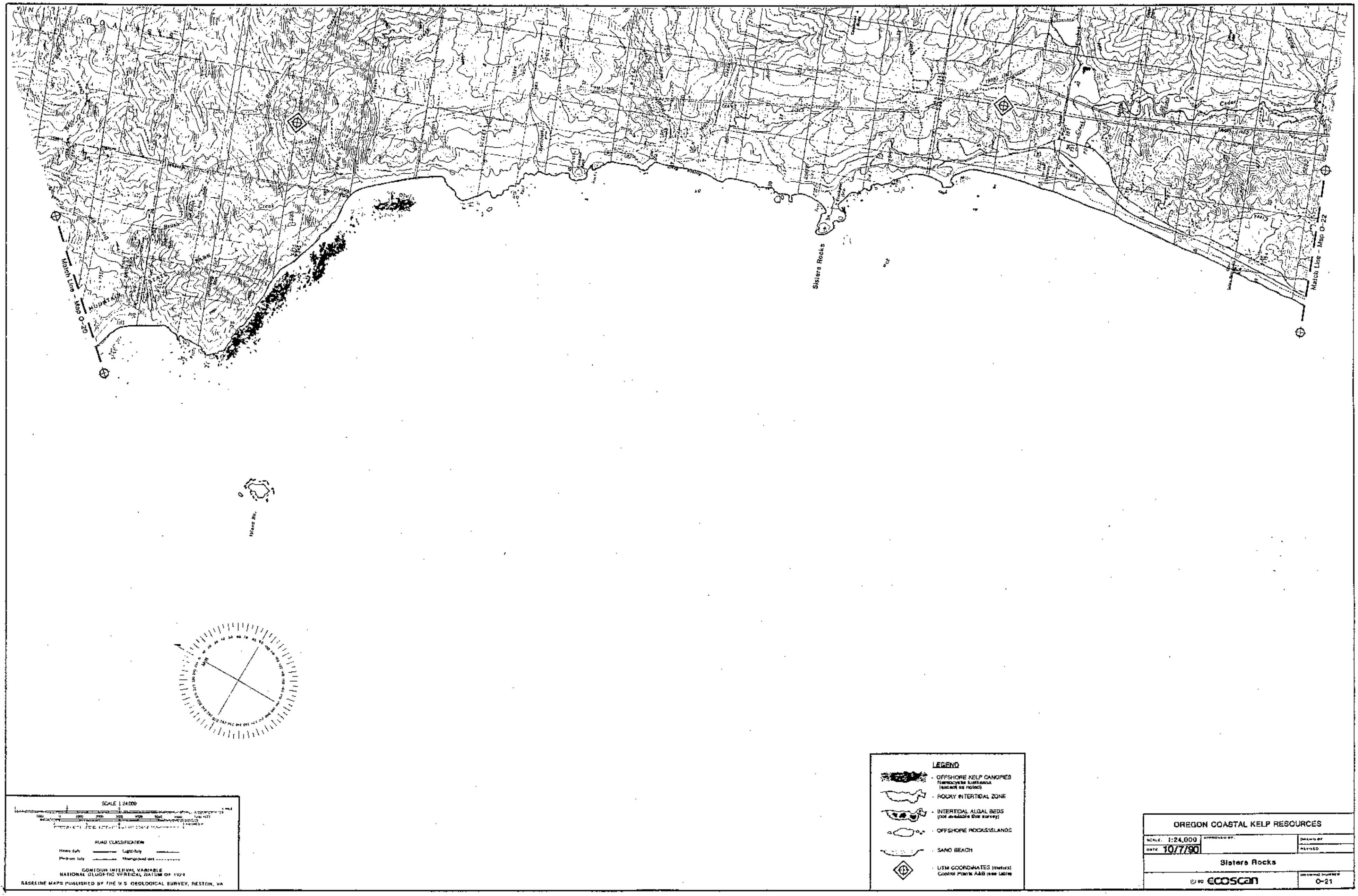
OREGON COASTAL KELP RESOURCES

SCALE: 1:24,000 | APPROVED BY: | DRAWN BY:
DATE: 8/26/90 | REVISED

Floras Lake

ECOSCAN | O-19


Match Line – Map O-19
Match Line – Map O-21
Cape Blanco
U.S. Coast Guard
Port Orford
Offshore Rocks – Common Names
LEGEND
OFFSHORE KELP CANOPIES
ROCKY INTERTIDAL ZONE
INTERTIDAL ALGAL BEDS
OFFSHORE ROCKS/ISLANDS
SAND BEACH
UTM COORDINATES
SCALE 1:24 000
ROAD CLASSIFICATION
Heavy-duty
Light-duty
Medium-duty
Unimproved dirt
CONTOUR INTERVAL VARIABLE
NATIONAL GEODETIC VERTICAL DATUM OF 1929
BASELINE MAPS PUBLISHED BY THE U.S. GEOLOGICAL SURVEY, RESTON, VA
OREGON COASTAL KELP RESOURCES
SCALE: 1:24,000
DATE: 8/26/90
Port Orford
ECOSCAN
0-20


Match Line – Map O–20
Match Line – Map O–22
Sisters Rocks
Cedar
SCALE 1:24 000
ROAD CLASSIFICATION
Heavy duty
Light duty
Medium duty
Unimproved dirt
CONTOUR INTERVAL VARIABLE
NATIONAL GEODETIC VERTICAL DATUM OF 1929
BASELINE MAPS PUBLISHED BY THE U.S. GEOLOGICAL SURVEY, RESTON, VA
LEGEND
OFFSHORE KELP CANOPIES
Nereocystis luetkeana
(except as noted)
ROCKY INTERTIDAL ZONE
INTERTIDAL ALGAL BEDS
(not available this survey)
OFFSHORE ROCKS/ISLANDS
SAND BEACH
UTM COORDINATES (meters)
Control Points A&B (see table)
OREGON COASTAL KELP RESOURCES
SCALE: 1:24,000
DATE: 10/7/90
APPROVED BY:
DRAWN BY
REVISED
Sisters Rocks
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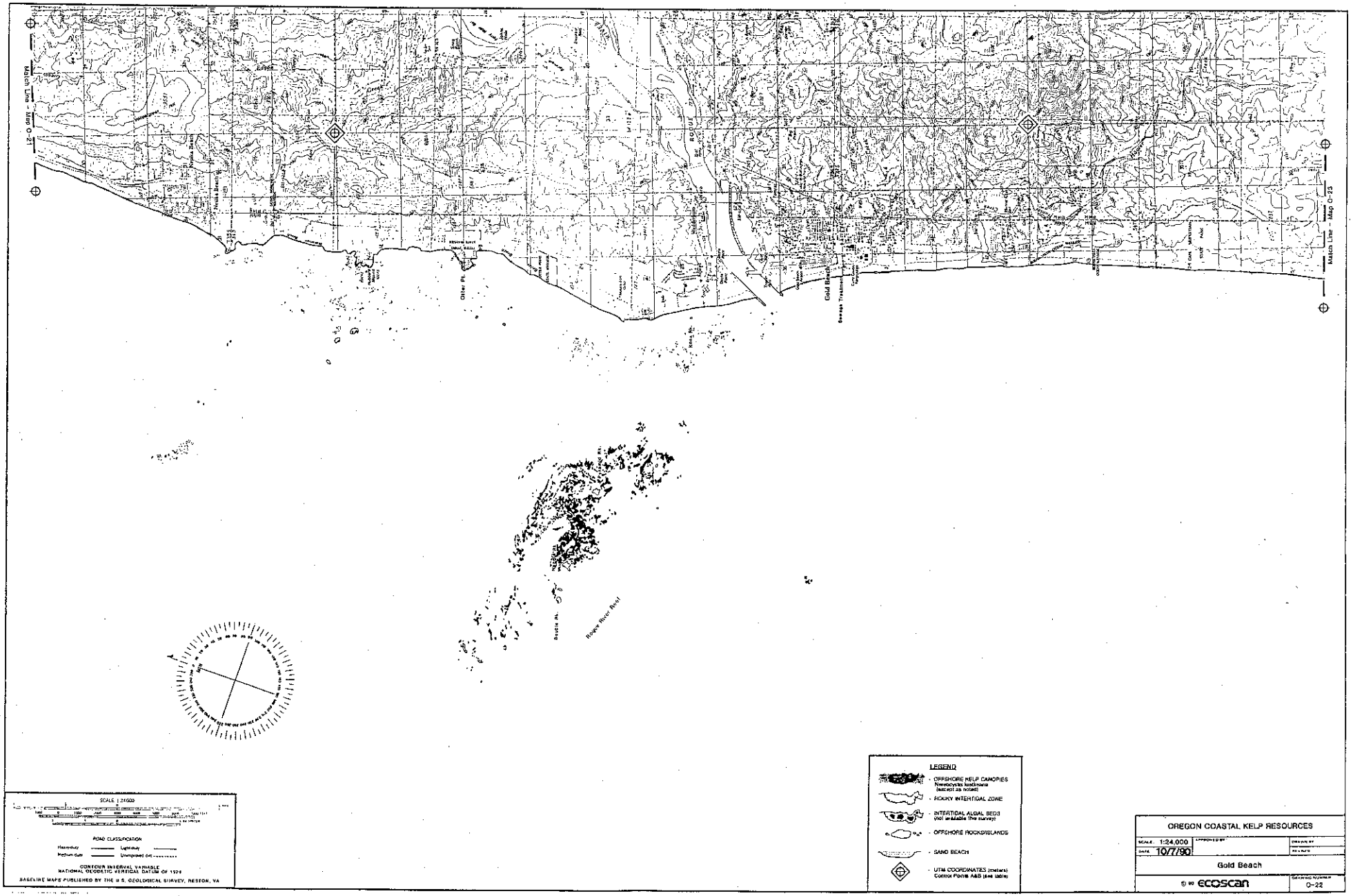
DRAWING NUMBER
O-21



OREGON COASTAL KELP RESOURCES

SCALE 1:24,000 | APPROVED BY | DRAWN BY

DATE 10/7/90 | REVISIONS

Gold Beach

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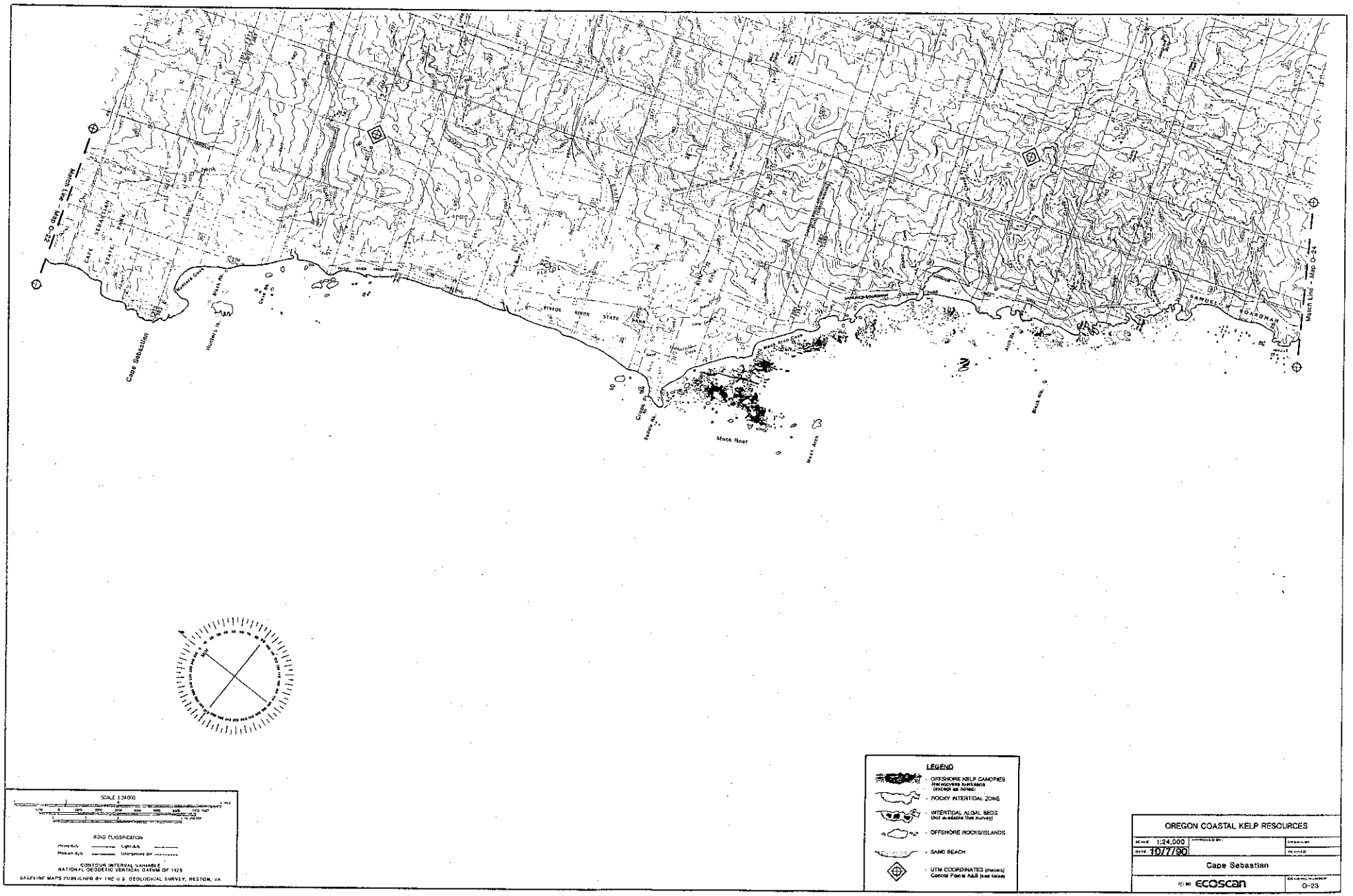

SCALE 1:24000

ROAD CLASSIFICATION

CONTOUR INTERVAL 5 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

BASELINE MAPS PUBLISHED BY THE U.S. GEOLOGICAL SURVEY, RESTON, VA

LEGEND

- OFFSHORE KELP CANOPIES (Nereocystis luetkeana) (except as noted)
- ROCKY INTERTIDAL ZONE
- INTERTIDAL ALGAL BEDS (not available this survey)
- OFFSHORE ROCKS/ISLANDS
- SAND BEACH
- UTM COORDINATES (meters) Control Points A&B (see back)

OREGON COASTAL KELP RESOURCES

SCALE 1:24,000	
DATE 10/7/90	

Cape Sebastian

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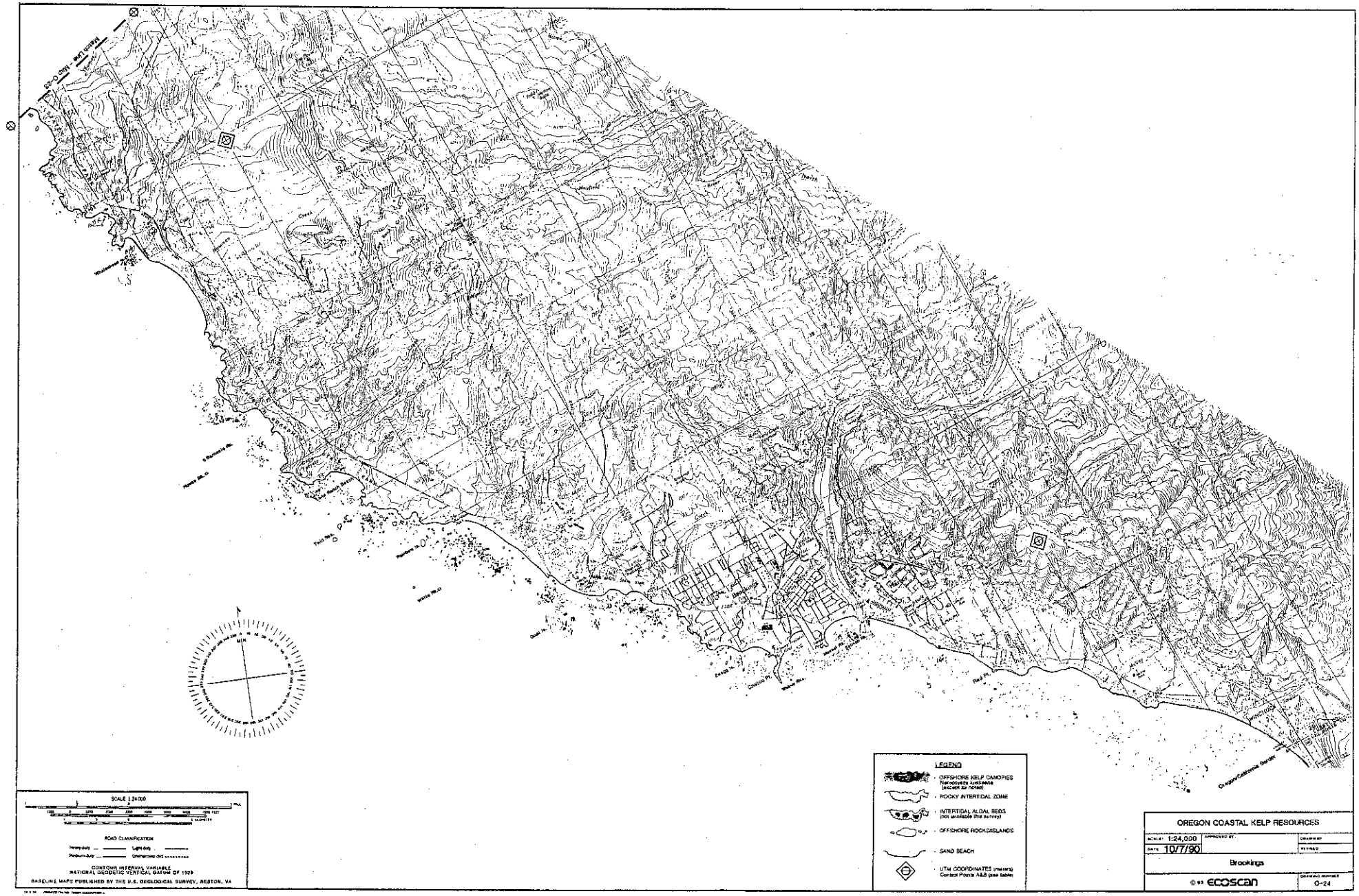
O-23


LEGEND
OFFSHORE KELP CANOPIES
Nereocystis luetkeana
(except as noted)
ROCKY INTERTIDAL ZONE
INTERTIDAL ALGAL BEDS
(not available this survey)
OFFSHORE ROCK/ISLANDS
SAND BEACH
UTM COORDINATES (meters)
Control Points A&B (see table)
SCALE 1:24,000
ROAD CLASSIFICATION
CONTOUR INTERVAL VARIABLE
NATIONAL GEODETIC VERTICAL DATUM OF 1929
BASELINE MAPS PUBLISHED BY THE U.S. GEOLOGICAL SURVEY, RESTON, VA
OREGON COASTAL KELP RESOURCES
SCALE 1:24,000
DATE 10/7/90
Brookings
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0-24