OCEANOGRAPHICAL STATION LIST

VOLUME 76

INVESTIGATIONS BY F.V. ESTELLE STAR IN SOUTH AND WESTERN AUSTRALIAN WATERS IN 1966

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION

AUSTRALIA

MELBOURNE, 1968

CONTENTS

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CSIRO Aust. Oceanogr. Stn List 76.

OCEANOGRAPHICAL STATION LIST

VOLUME 76

Investigations by F.V. Estelle Star
in South and Western Australian Waters in 1966

I. INTRODUCTION

This report lists the hydrological data collected during three cruises of F.V. Estelle Star during 1966 (ES1/66-ES3/66). The first two of these cruises were on the South Australian tuna fishing grounds during March and April, and in May-June the vessel spent a month on charter in Western Australian waters tagging juvenile southern bluefin tuna. Track charts and station positions are shown in Figures 1 and 2.

II. WORK ACCOMPLISHED

Table 1 gives details of cruise dates, number of stations worked, nature of work, and staff on each cruise. On the third cruise, 634 juvenile southern bluefin tuna were tagged in the Albany area.

TABLE 1

DETAILS OF CRUISES AND WORK DONE

Cruise	Dates	Staff	Number of Stations Occupied	Hydrology 1	Hydrology 2	BT
ES1/66	Mar. 30-Apr. 2	R. Bradley	10	10	2	9
ES2/66	Apr. 5-6	R. Bradley	8	8	1	8
ES3/66	May 19-June 24	O.M. Moore	76	76	0	0

BT Bathythermographs

Hydrology 1 Number of stations at which surface samples were collected
2 Number of stations at which subsurface samples were collected

III. METHOD OF COLLECTION AND ANALYSIS OF SAMPLES

1. Physics

Temperature.—Surface temperatures were measured using a surface sampler fitted with a thermometer graduated to 0.1 degC and

accurate to ± 0.2 degC. Subsurface temperatures were obtained from the bathythermograph and are considered accurate to about ± 0.3 degC.

Bathythermograph.—A small electric-hydraulic winch was fitted to Estelle Star so that BT lowerings could be made conveniently. Nansen water-bottles were occasionally used at the same time as the BT was lowered, but only to collect water samples. A 900-ft bathythermograph was used, and slides were digitized on board according to the method of the U.S. National Oceanographic Data Center (1964). The results were transferred to punched cards and computer listings produced. The listings are held at Cronulla.

Sigma-t.—Sigma-t values were computed from temperature and salinity values, using the equations of Knudsen (La Fond 1951).

2. Chemistry

Salinity.—Samples were analysed at either Port Lincoln or Cronulla using a chlorinity-temperature meter of the conductivity type (Hamon 1956). Chlorinity was converted to salinity by the relation -

$$\text{Salinity} = 0.03 + 1.805 \times \text{Chlorinity}$$

Salinities are considered accurate to ± 0.05‰.

REFERENCES

HAMON, B.V. (1956).—A portable temperature-chlorinity bridge for estuarine investigations and seawater analysis. J. scient. Instrum. 33, 329-33.

LA FOND, E.C. (1951).—Processing oceanographic data. U.S. Navy Hydrogr. Off. Publ. No. 614.

U.S. NATIONAL OCEANOGRAPHIC DATA CENTER (1964).—Manual for processing bathythermograph data. Part 1 Instructions for manually digitizing bathythermograph data. Publ. M-3. (U.S. Naval Oceanographic Office : Washington, D.C.)

U.S. NAVY HYDROGRAPHIC OFFICE (1955).—Instruction manual for oceanographic observations. Publ. No. 607.

IV. TRACK CHART

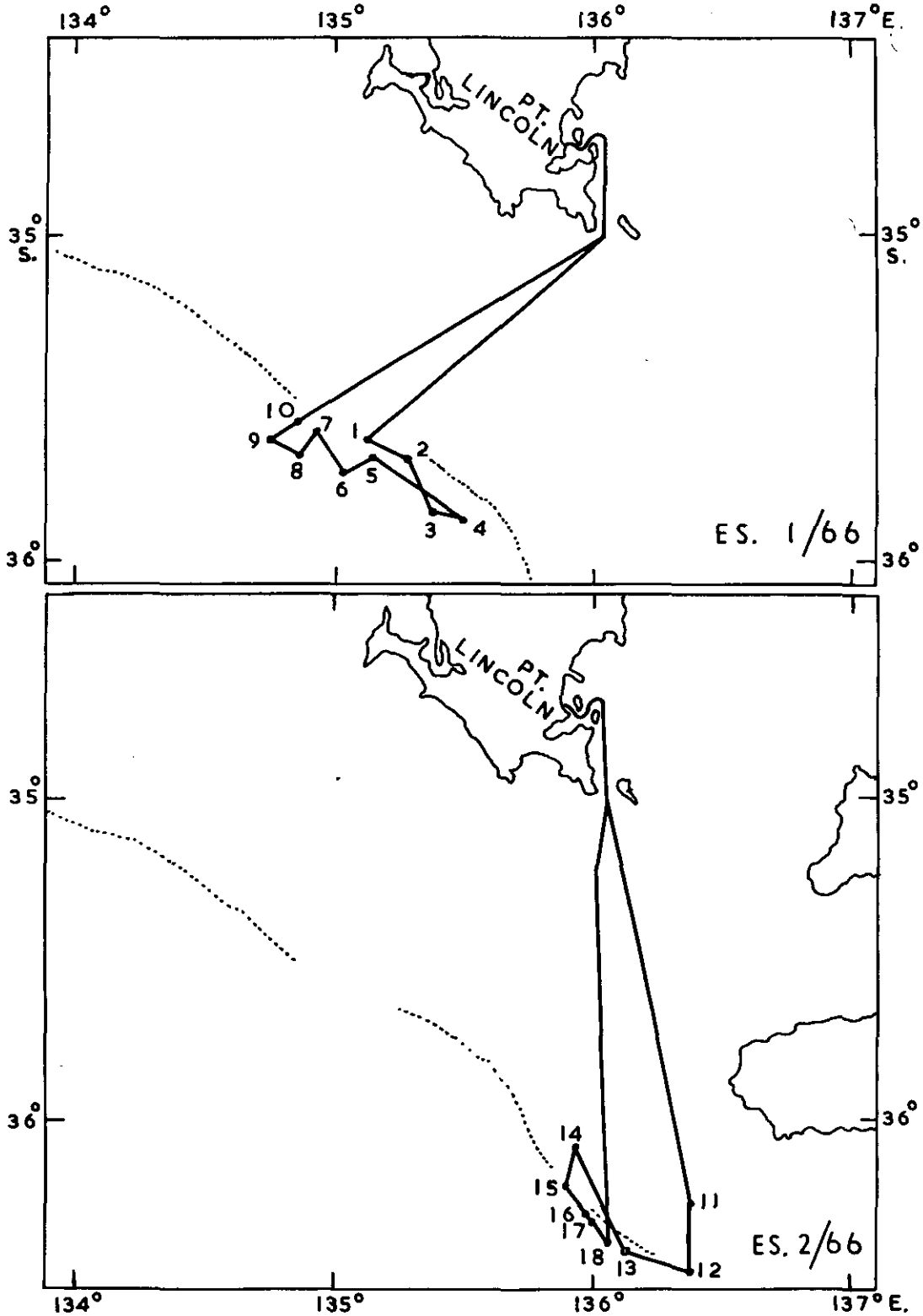

Fig. 1.– Track chart Cruises ES 1/66 e E 2/66

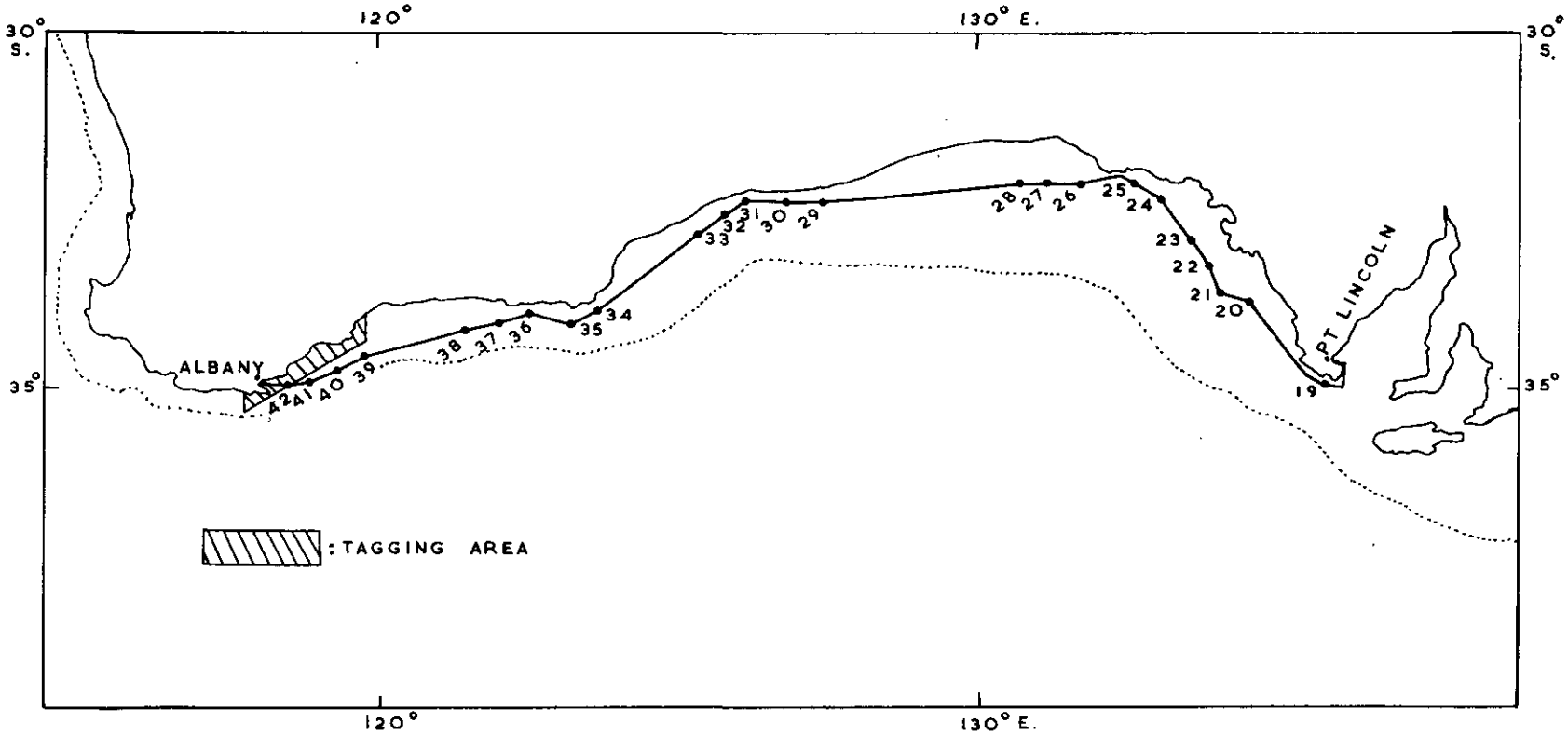

Fig. 2.– Track chart Cruise ES 3/66

V. DATA

The data were processed in a C.D.C. 3600 Computer.

EXPLANATION OF HEADINGS

Parts 1 and 2	Hydrology
STATION	Gives the station identification. For example, ES1/5/66 signifies the 5th station worked by Estelle Star in 1966 on her 1st cruise for that year
DATE	Given as day/month/year
TIME	Given as Zone Time. Zone Time is given in Central Australian Time, GMT $+9\frac{1}{2}$ hr, Code J
LATITUDE LONGITUDE	Given in degrees and minutes
SONIC DEPTH	Given in metres, measured at standard sound velocity of 800 fm (1463 m) per second
AIR TEMP. WET DRY	Air temperatures recorded from wet and dry bulb thermometers in °C
WIND DIR. SP.	Wind direction and speed are coded using Tables 8 and 9 in U.S. Navy Hydrogr. Office (1955)
ANEM. HEIGHT	Average height of the anemometer above sea level, given in feet
CLOUD TYPE AMT.	Cloud type and amount are coded using Tables 2 and 3 in U.S. Navy Hydrogr. Office (1955)
VIS.	Visibility is coded using Table 4 in U.S. Navy Hydrogr. Office (1955)
SEA DIR. AMT.	Sea direction and amount are coded using Tables 5 and 8 in U.S. Navy Hydrogr. Office (1955)
SWELL DIR. AMT.	Sea swell direction and amount are coded using Tables 6 and 8 in U.S. Navy Hydrogr. Office (1955)

BAROM. or ATMOS. PRESSURE	Atmospheric pressure given in millibars
WIRE ANGLES CAST 1 CAST 2 CAST 3	Wire angles are measured at the surface and expressed in degrees for each cast
CAST	Gives the cast number
DEPTH	Sampling depth given in metres
TEMP.	Sea temperatures recorded in °C
SALINITY	Given in parts per thousand
SIGMA-T	Sigma-t to 2 decimal places

*, ***, or a blank indicates no data available

DATA

PART 1

HYDROLOGY

SURFACE SAMPLES

VESSEL	CRUISE	STATION NUMBER	YR.	MTH.	DAY	TIME	LATITUDE	LONGITUDE	TEMP.	SALINITY	WIND DN.	WIND AMT.	SEA DN.	SEA AMT.	SWELL DN.	SWELL AMT.	WEA.	VIS.	BAROM.
17	1	1	66	3	31	0800	J 35 37	S 135 07	E 19.0	35.93	27	3	27	1	19	1		7	1016.9
17	1	2	66	3	31	0918	J 35 40	S 135 17	E 18.8	35.71	27	3	27	1	19	1		7	1017.3
17	1	3	66	3	31	1200	J 35 51	S 135 23	E 19.2	35.62	27	3	27	1	19	1		7	1017.3
17	1	4	66	3	31	1514	J 35 52	S 135 30	E 18.9	35.62	24	2	99	1	19	1		7	1016.3
17	1	5	66	3	31	1904	J 35 41	S 135 08	E 19.0	35.64	99	1	99	1	19	1		7	1016.3
17	1	6	66	4	1	0700	J 35 43	S 135 02	E 18.7	35.62	04	4	04	2	99	1		7	1014.6
17	1	7	66	4	1	0915	J 35 36	S 134 56	E 19.1	35.66	04	5	04	3	99	1		7	1013.9
17	1	8	66	4	1	1223	J 35 40	S 134 52	E 19.5	35.82	03	3	04	3	99	1		7	1012.2
17	1	9	66	4	1	1540	J 35 37	S 134 46	E 19.9	35.82	03	2	03	2	99	1		7	1010.2
17	1	10	66	4	1	1825	J 35 35	S 134 52	E 19.2	35.68	03	3	03	2	99	1		7	1009.1
17	2	11	66	4	5	0614	J 36 15	S 136 23	E 19.1	35.81	27	3	27	1	99	1		7	1017.3
17	2	12	66	4	5	0910	J 36 28	S 136 23	E 19.0	35.86	28	3	28	2	99	1		7	1018.6
17	2	13	66	4	5	1203	J 36 24	S 136 07	E 19.0	35.88	28	5	28	3	99	1		7	1016.6
17	2	14	66	4	5	1820	J 36 05	S 135 56	E 19.1	35.93	23	4	23	3	23	6		7	1017.3
17	2	15	66	4	6	0707	J 36 12	S 135 54	E 19.1	35.81	15	2	15	1	23	4		7	1018.3
17	2	16	66	4	6	0911	J 36 17	S 135 59	E 19.0	35.81	15	2	15	1	23	4		7	1018.3
17	2	17	66	4	6	1225	J 36 17	S 136 00	E 19.2	35.88	99	1	99	1	23	4		7	1017.9
17	2	18	66	4	6	1500	J 36 22	S 136 04	E 19.3	35.81	27	3	27	1	23	4		7	1015.9
17	3	19	66	5	19	0900	J 34 57	S 135 57	E 17.1	35.95									
17	3	20	66	5	20	0900	J 33 45	S 134 33	E 17.3	35.93									
17	3	21	66	5	20	1000	J 33 33	S 134 33	E 16.8										
17	3	22	66	5	20	1100	J 33 45	S 134 09	E 17.1										
17	3	23	66	5	20	1200	J 33 39	S 134 03	E 17.3	35.88									
17	3	24	66	5	20	1300	J 33 33	S 134 03	E 17.5										
17	3	25	66	5	20	1400	J 33 27	S 133 57	E 17.5										
17	3	26	66	5	20	1500	J 33 15	S 133 51	E 17.5	35.90									
17	3	27	66	5	20	1600	J 33 03	S 133 45	E 17.5										
17	3	28	66	5	20	1700	J 32 57	S 133 39	E 17.5										
17	3	29	66	5	20	1800	J 32 51	S 133 33	E 17.6	35.90									
17	3	30	66	5	20	1900	J 32 39	S 133 27	E 17.6										
17	3	31	66	5	20	2000	J 32 27	S 133 21	E 17.5										
17	3	32	66	5	20	2100	J 32 21	S 133 09	E 17.5	35.91									
17	3	33	66	5	21	0300	J 31 57	S 132 27	E 17.4	36.00									
17	3	34	66	5	21	0900	J 32 09	S 131 45	E 16.3	36.08									
17	3	35	66	5	21	1000	J 32 09	S 131 33	E 18.6										
17	3	36	66	5	21	1100	J 32 09	S 131 21	E 18.4										
17	3	37	66	5	21	1200	J 32 09	S 131 15	E 18.6	36.15									
17	3	38	66	5	21	1300	J 32 09	S 131 03	E 18.9										
17	3	39	66	5	21	1400	J 32 09	S 130 51	E 18.9										
17	3	40	66	5	21	1500	J 32 09	S 130 39	E 18.9	36.33									

VESSEL	CRUISE	STATION NUMBER	YR.	MTH.	DAY	TIME	LATITUDE	LONGITUDE	TEMP.	SALINITY	WIND DN.	WIND AMT.	SEA DN.	SEA AMT.	SWELL DN.	SWELL AMT.	WEA.	VIS.	BAROM.
17	3	41	66	5	21	1600	J 32 15 S	130 27 E	18.9										
17	3	42	66	5	21	1700	J 32 15 S	130 21 E	18.9										
17	3	43	66	5	21	1800	J 32 15 S	130 09 E	18.9	36,44									
17	3	44	66	5	21	1900	J 32 15 S	129 57 E	18.9										
17	3	45	66	5	21	2000	J 32 15 S	129 45 E	18.9										
17	3	46	66	5	21	2100	J 32 15 S	129 33 E	18.9	36,62									
17	3	47	66	5	22	0900	J 32 21 S	127 21 E	17.3	36,96									
17	3	48	66	5	22	1000	J 32 21 S	127 09 E	18.1										
17	3	49	66	5	22	1100	J 32 21 S	126 57 E	18.2										
17	3	50	66	5	22	1200	J 32 21 S	126 45 E	17.6	36,91									
17	3	51	66	5	22	1300	J 32 21 S	126 21 E	18.3										
17	3	52	66	5	22	1400	J 32 21 S	126 09 E	18.6										
17	3	53	66	5	22	1500	J 32 21 S	126 03 E	18.5	36,78									
17	3	54	66	5	22	1600	J 32 21 S	125 57 E	18.5										
17	3	55	66	5	22	1700	J 32 27 S	125 51 E	18.3										
17	3	56	66	5	22	1800	J 32 27 S	125 45 E	18.1	36,65									
17	3	57	66	5	22	1900	J 32 33 S	125 39 E	18.3										
17	3	58	66	5	22	2000	J 32 39 S	125 27 E	18.3										
17	3	59	66	5	22	2100	J 32 45 S	125 15 E	18.2	36,60									
17	3	60	66	5	23	0700	J 33 57 S	123 51 E	17.7										
17	3	61	66	5	23	0800	J 33 57 S	123 45 E	17.8										
17	3	62	66	5	23	0900	J 33 57 S	123 33 E	17.8	36,09									
17	3	63	66	5	23	1000	J 33 57 S	123 27 E	17.8										
17	3	64	66	5	23	1100	J 34 03 S	123 15 E	17.8										
17	3	65	66	5	23	1200	J 34 03 S	123 03 E	18.1	36,09									
17	3	66	66	5	23	1300	J 33 57 S	122 51 E	18.3										
17	3	67	66	5	23	1400	J 33 57 S	122 45 E	18.1										
17	3	68	66	5	23	1500	J 33 57 S	122 27 E	17.9	36,09									
17	3	69	66	5	23	1600	J 34 03 S	122 15 E	17.9										
17	3	70	66	5	23	1700	J 34 03 S	122 09 E	18.1										
17	3	71	66	5	23	1800	J 34 03 S	121 57 E	18.4	36,02									
17	3	72	66	5	23	1900	J 34 03 S	121 45 E	18.9										
17	3	73	66	5	23	2000	J 34 09 S	121 33 E	18.9										
17	3	74	66	5	23	2100	J 34 09 S	121 21 E	18.9										
17	3	75	66	5	24	0600	J 34 33 S	119 45 E	19.7	35,90									
17	3	76	66	5	24	0900	J 34 45 S	119 15 E	19.9	35,91									
17	3	77	66	5	24	1000	J 34 45 S	119 03 E	19.6										
17	3	78	66	5	24	1100	J 34 51 S	118 51 E	19.4										
17	3	79	66	5	24	1200	J 34 51 S	118 45 E	19.7	35,90									
17	3	80	66	5	24	1300	J 34 51 S	118 39 E	19.6										

VESSEL	CRUISE	STATION NUMBER	YR.	MTH.	DAY	TIME	LATITUDE	LONGITUDE	TEMP.	SALINITY	WIND DN. AMT.	SEA DN. AMT.	SWELL DN. AMT.	WEA.	VIS.	BAROM.
17	3	81	66	5	24	1400	J 34 51	S 118 33	E 19.4							
17	3	82	66	5	24	1500	J 34 57	S 118 27	E 19.4	35.86						
17	3	83	66	5	27	0900	J 35 09	S 117 45	E 19.7	35.86						
17	3	84	66	5	27	1500	J 35 03	S 118 09	E 19.3	35.91						
17	3	85	66	6	6	1500	J 34 51	S 118 45	E 19.4	35.81						
17	3	86	66	6	6	1600	J 34 45	S 118 51	E 19.6							
17	3	87	66	6	6	1700	J 34 39	S 119 03	E 19.4							
17	3	88	66	6	7	0800	J 34 15	S 119 33	E 18.9							
17	3	89	66	6	7	0900	J 34 15	S 119 33	E 18.9	35.88						
17	3	90	66	6	8	0700	J 34 27	S 118 45	E 18.9							
17	3	91	66	6	8	1200	J 35 09	S 118 03	E 19.6	35.73						
17	3	92	66	6	8	1500	J 35 09	S 117 51	E 19.7	35.73						
17	3	93	66	6	9	0900	J 35 03	S 118 03	E 19.3	35.73						
17	3	94	66	6	9	1500	J 35 09	S 117 57	E 20.0	35.68						

DATA

PART 2

HYDROLOGY

SUBSURFACE SAMPLES

STATION	DATE	TIME	LATITUDE	LONGITUDE
ES 1/ 5/66	31/ 3/66	1904 J	35 41 S	135 08 E

SONIC DEPTH	AIR TEMP. WET	AIR TEMP. DRY	WIND DIR.	WIND SP.	ANEM. HEIGHT	CLOUD TYPE	CLOUD AMT.	VIS.	SEA DIR.	SEA AMT.	SWELL DIR.	SWELL AMT.	ATMOS. PRESSURE	WIRE ANGLES CAST1	CAST2	CAST3
900	***	***	99	1	*	4	3	7	99	1	19	1	1016.3	0	*	*

CAST	DEPTH	TEMP.	SALINITY	SIGMA-T	OXYGEN	OXYGEN % SAT.	INORG. P	TOTAL P	NITRATE
1	0	19.00	35.640	25.53	***	***	***	***	***
1	25	18.80	35.620	25.56	***	***	***	***	***
1	75	15.20	35.390	26.25	***	***	***	***	***
1	150	12.60	35.340	26.75	***	***	***	***	***

STATION	DATE	TIME	LATITUDE	LONGITUDE
ES 1/ 6/66	1/ 4/66	0700 J	35 43 S	135 02 E

SONIC DEPTH	AIR TEMP. WET	AIR TEMP. DRY	WIND DIR.	WIND SP.	ANEM. HEIGHT	CLOUD TYPE	CLOUD AMT.	VIS.	SEA DIR.	SEA AMT.	SWELL DIR.	SWELL AMT.	ATMOS. PRESSURE	WIRE ANGLES CAST1	CAST2	CAST3
900	***	***	04	4	*	*	*	7	04	2	99	1	1014.6	0	*	*

CAST	DEPTH	TEMP.	SALINITY	SIGMA-T	OXYGEN	OXYGEN % SAT.	INORG. P	TOTAL P	NITRATE
1	0	18.70	35.620	25.59	***	***	***	***	***
1	25	18.70	35.610	25.58	***	***	***	***	***
1	75	15.00	35.530	26.40	***	***	***	***	***
1	150	12.50	35.280	26.73	***	***	***	***	***

STATION	DATE	TIME	LATITUDE	LONGITUDE
ES 2/ 11/66	5/ 4/66	0614 J	36 15 S	136 23 E

SONIC DEPTH	AIR TEMP. WET	AIR TEMP. DRY	WIND DIR.	WIND SP.	ANEM. HEIGHT	CLOUD TYPE	CLOUD AMT.	VIS.	SEA DIR.	SEA AMT.	SWELL DIR.	SWELL AMT.	ATMOS. PRESSURE	WIRE ANGLES CAST1	CAST2	CAST3
106	16.0	18.1	27	3	20	9	7	7	27	1	99	1	1017.3	0	*	*

CAST	DEPTH	TEMP.	SALINITY	SIGMA-T	OXYGEN	OXYGEN % SAT.	INORG. P	TOTAL P	NITRATE
1	0	19.10	35.810	25.63	***	***	***	***	***
1	25	19.20	35.860	25.64	***	***	***	***	***
1	50	19.00	35.860	25.70	***	***	***	***	***
1	75	15.80	35.810	26.43	***	***	***	***	***

OCEANOGRAPHICAL STATION LISTS

1. Hydrological and planktological observations by F.R.V. *Warreen* in south-eastern Australian waters, 1938–39
2. Hydrological and planktological observations by F.R.V. *Warreen* in south-eastern Australian waters, 1940–42
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6. Estuarine hydrological investigations in eastern Australia, 1940–50. New South Wales: Middle Harbour and Port Jackson, Georges River–Botany Bay
7. Estuarine hydrological investigations in eastern Australia, 1940–50. New South Wales: Port Hacking, Lake Illawarra, Shoalhaven River, Jervis Bay, Clyde River, Moruya River, Tuross River, Wagonga Inlet; Victoria: Port Phillip; Tasmania: Tamar River, Derwent River, Huon River, D'Entrecasteaux Channel, Pittwater, Lake Dobson (freshwater), Penna Dam (freshwater)
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18. Onshore hydrological investigations in eastern and south-western Australia, 1953
19. Onshore planktological investigations in eastern Australia, 1945–54
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23. Planktological investigations made by F.R.V. *Derwent Hunter* in eastern Australian waters, 1952–54
24. Onshore hydrological investigations in eastern and south-western Australia, 1954
25. Surface sampling in the Tasman Sea, 1954
26. Estuarine hydrological investigations in eastern and south-western Australia, 1954
27. Onshore and oceanic hydrological investigations in eastern and south-western Australia, 1955
28. Surface sampling in the Tasman and Coral Seas, 1955
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30. Onshore and oceanic hydrological investigations in eastern and south-western Australia, 1956
31. Surface sampling in the Tasman and Coral Seas and the south-eastern Indian Ocean, 1956
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34. Coastal hydrological investigations at Port Hacking, New South Wales, 1957
35. Coastal hydrological investigations at Eden, New South Wales, 1957

OCEANOGRAPHICAL STATION LISTS

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37. Hydrological investigations from F.R.V. *Derwent Hunter*, 1957
38. Coastal hydrological investigations in the New South Wales tuna fishing area, 1958
39. Surface sampling in the Coral and Tasman Seas, 1958
40. Coastal hydrological investigations in south-eastern Australia, 1958
41. Oceanic investigations in eastern Australian waters, F.R.V. *Derwent Hunter*, 1958
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43. Oceanic investigations in eastern Australia, H.M.A. Ships *Queenborough*, *Quickmatch*, and *Warrego*, 1958
44. Oceanic observations in Antarctic waters, M.V. *Magga Dan*, 1959
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49. Coastal hydrological sampling Rottnest Island, W.A., and Port Moresby, Papua, during the I.G.Y. (1957–58), and surface sampling in the Tasman and Coral Seas, 1959
50. Surface sampling in the Coral and Tasman Seas, 1960
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52. Coastal investigations at Port Hacking, New South Wales, 1960
53. Coastal hydrological investigations in the New South Wales tuna fishing area, 1960
54. Investigations by F.R.V. *Derwent Hunter* on the eastern Australian tuna grounds in 1961
55. Investigations by F.R.V. *Weerutta* on the South Australian tuna grounds in 1961
56. Investigations by F.R.V. *Marelda* on the eastern Australian tuna grounds in 1961
57. Investigations by F.V. *Estelle Star* in Western Australian waters in 1961
58. Temperature observations from Australian tuna fishing vessels in 1961
59. Investigations by F.R.V. *Derwent Hunter* on the eastern Australian tuna grounds in 1962
60. Investigations by F.R.V. *Investigator* on the South Australian tuna grounds in 1962
61. Investigations by F.R.V. *Marelda* on the eastern Australian tuna grounds in 1962
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65. Investigations by F.R.V. *Marelda* on the eastern Australian tuna grounds in 1963
66. Temperature and salinity observations from Australian tuna fishing vessels in 1963
67. Investigations by F.R.V. *Investigator* on the South Australian tuna grounds in 1964
68. Investigations by F.R.V. *Marelda* on the eastern Australian tuna grounds in 1964
69. Temperature and salinity observations from Australian tuna fishing vessels in 1964
70. Investigations by F.R.V. *Investigator* on the South Australian tuna grounds in 1965
71. Investigations by F.V. *Estelle Star* in South Australian and New South Wales waters in 1965
72. Investigations by F.R.V. *Marelda* on the eastern Australian tuna grounds in 1965
73. Investigations by F.V. *Degei* in Queensland waters in 1965
74. Temperature and salinity observations from Australian tuna fishing vessels in 1965
75. Investigations by F.V. *Degei* in New South Wales, South, and Western Australian waters in 1966
76. Investigations by F.V. *Estelle Star* in South and Western Australian waters in 1966
77. Temperature and salinity observations from Australian tuna fishing vessels in 1966
78. Drift bottle releases and recoveries in Bass Strait and adjacent waters, 1958–1962
79. Drift bottle releases and recoveries in Western Australia, 1956–1957
80. Investigations by F.R.V. *Lancelin* in Western Australian waters in 1963