Canadian Oceanographic Research in the eastern Subarctic Pacific Region during 1963

by A.J. Dodimead

October, 1963.
Canadian Oceanographic Research in the eastern Subarctic Pacific Region during 1963

by A.J. Dodimead

The data income and output, and the research projects during the past year consisted of:

1. Comprehensive oceanographic observations at Ocean Station "P" (Lat. 50°N; Long. 145°W) and en route to and from the Station (Line "P") during alternate six-week periods (15 Jan. - 4 March; 9 April - 27 May; 25 June - 5 Aug.; 10 Sept. - 28 Oct., 3 Dec. - 14 Jan.). Bathythermograph observations were maintained aboard C.G.G.S. "Stonetown" during the interim periods. These observations provide a monitor of oceanographic conditions (temperature, salinity, transport and productivity) in the eastern Central Subarctic Domain (Fig. 1).

2. Publication of charts of sea surface temperature, depth to top of seasonal thermocline (potential layer depth) magnitude (ΔT) of, and depth of the bottom of the seasonal thermocline weekly by the Canadian Oceanographic Information Service, Esquimalt, B.C. These charts provide an immediate picture of the temperature structure and its distribution in the eastern Subarctic.

3. Preparation of mean monthly OCEAN charts (with Scripps Institution of Oceanography). Bathythermograms collected in the eastern North Pacific since 1945 have been grouped by months and 1° squares and analysed according to the OCEAN system of assessment (Pacific Oceanographic Group, MS Report 105). From these analyses, charts are now being prepared showing the monthly mean values, occurrence of transient thermoclines, depth to top and bottom of thermocline. These will provide the necessary reference charts upon which further studies and comparisons can be made with the weekly charts from the Canadian Oceanographic Information Service.

4. An assessment of coastal structure off Vancouver Island. Previous research has defined the structure models and their relation to wind stress, heating and cooling and runoff (summarized in Appendix II, "Review of Oceanography of the Subarctic Pacific Region", INPFC Bulletin 13). These models have been applied to the accumulated data to determine the relation of the oceanographic situations to the daily weather and daily coastal seawater observations.

5. Oceanographic data taken by the Marine Salmon Investigation, Biological Station, Nanaimo during their high seas tagging program. The bathythermograph data have been included in the Information Service charts.

6. Daily seawater observations at 15 stations to monitor oceanographic conditions in the Coastal Domain (Fig 1). A graphical catalogue of the 7-day running averages and the statistical classification of monthly mean values is being prepared for publication.
Oceanographic conditions during 1963

No major synoptic oceanographic surveys were undertaken as in past years. However, it is possible to define the oceanographic features for the eastern Subarctic from the data outlined in the previous section. In particular, the data at Ocean Station "P" and along Line "P" (Fig. 1) are reviewed for this purpose. Comparison of conditions existing in 1963 to those in other years, and to average conditions, in the eastern Central Subarctic Domain can be made from these data, particularly when the anomalies at Ocean Station "P" are relatively large. Anomalies in the Coastal Domain are apparent in the daily seawater observations.

1. January through March.

The temperature and salinity distributions along Line "P" (Jan. 16-20) and Line A (outbound, Jan. 19-28; inbound, Jan. 28-Feb. 3) are shown in Fig. 2 and 3 respectively. The data along the latter line were taken in conjunction with the high seas exploratory fishing and tagging operations.

The characteristic features of structure in the eastern Subarctic during this period occur in these sections. The upper or seasonal zone was isothermal and isohaline to depths between 75 metres near the Canadian coast and Alaskan Gyre and to 100 metres in the vicinity of Ocean Station "P". Near the coast, the seasonal waters were relatively warm and fresh, with temperature decreasing and salinity increasing to seaward. The bottom of the halocline, defined by salinity = 33.8%, occurred at depths between 150 and 225 metres.

The temperature and salinity distributions at Ocean Station "P" from Jan. 20 to Feb. 25 are shown in Fig. 4. During this period the temperature of the water in the upper zone decreased about 0.3°C; the salinity remained constant (32.5%). Little or no change occurred in the deeper waters.

During March the sea surface temperature, and hence upper zone temperatures, averaged 6.1°C. Thus, there was little change in the temperature and salinity conditions at Ocean Station "P" during the first three months of 1963. It is reasonable to assume that over the eastern Central Subarctic Domain, temperature and salinity conditions were similarly stable.

How the temperature and salinity conditions in the upper zone compare to those in other years at Ocean Station "P" for this period are summarized in Table I. The years that the data indicate similar temperature conditions are 1958, 1960, 1962, and 1963. However, salinity conditions were similar only during 1958 and 1960. The lowest salinities were observed in 1963.

The daily seawater observations suggest that temperatures in the Coastal Domain were slightly above average for this period.

2. April through August.

The temperature and salinity distributions from April 10 to May 21 and July 1 to 31 at Ocean Station "P" are shown in Fig. 5 and 6 respectively. It is apparent in Fig. 5 that warming of the surface water occurred towards the end of April. This seasonal warming occurred about two to three weeks later than usual. Upper zone salinities increased slightly (about 0.1%) in this period.
Table I. Average temperature and salinity values for the upper zone at Ocean Station "P"

<table>
<thead>
<tr>
<th>Year</th>
<th>Upper Zone</th>
<th>January 15-31</th>
<th>February 1-15</th>
<th>February 16-28</th>
<th>March 1-15</th>
</tr>
</thead>
<tbody>
<tr>
<td>1956</td>
<td>Temp. (°C)</td>
<td>5.5</td>
<td>6.1</td>
<td>5.5</td>
<td>4.9</td>
</tr>
<tr>
<td></td>
<td>Sal. (%)</td>
<td></td>
<td></td>
<td>no data</td>
<td></td>
</tr>
<tr>
<td>1957</td>
<td>Temp. (°C)</td>
<td>5.6</td>
<td>5.6</td>
<td>5.5</td>
<td>5.9</td>
</tr>
<tr>
<td></td>
<td>Sal. (%)</td>
<td></td>
<td></td>
<td>32.65</td>
<td></td>
</tr>
<tr>
<td>1958</td>
<td>Temp. (°C)</td>
<td>6.7</td>
<td>6.3</td>
<td>6.3</td>
<td>6.3</td>
</tr>
<tr>
<td></td>
<td>Sal. (%)</td>
<td></td>
<td></td>
<td>32.70</td>
<td></td>
</tr>
<tr>
<td>1959</td>
<td>Temp. (°C)</td>
<td>5.8</td>
<td>5.6</td>
<td>5.3</td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td>Sal. (%)</td>
<td></td>
<td></td>
<td>32.83</td>
<td></td>
</tr>
<tr>
<td>1960</td>
<td>Temp. (°C)</td>
<td>6.6</td>
<td>6.0</td>
<td>6.1</td>
<td>6.3</td>
</tr>
<tr>
<td></td>
<td>Sal. (%)</td>
<td></td>
<td></td>
<td>32.71</td>
<td></td>
</tr>
<tr>
<td>1961</td>
<td>Temp. (°C)</td>
<td>5.3</td>
<td>5.0</td>
<td>5.0</td>
<td>4.7</td>
</tr>
<tr>
<td></td>
<td>Sal. (%)</td>
<td></td>
<td></td>
<td>32.82</td>
<td></td>
</tr>
<tr>
<td>1962</td>
<td>Temp. (°C)</td>
<td>5.9</td>
<td>6.0</td>
<td>6.1</td>
<td>6.0</td>
</tr>
<tr>
<td></td>
<td>Sal. (%)</td>
<td></td>
<td></td>
<td>32.61</td>
<td></td>
</tr>
<tr>
<td>1963</td>
<td>Temp. (°C)</td>
<td>6.4</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
</tr>
<tr>
<td></td>
<td>Sal. (%)</td>
<td></td>
<td></td>
<td>32.50</td>
<td></td>
</tr>
</tbody>
</table>

--- = average values for whole period
By July, the seasonal thermocline was well developed (Fig. 6). Surface salinities were again as low (32.5%) as observed early in the year.

The average monthly sea surface temperatures at Ocean Station "P" show that considerable warming of the surface waters occurred in August (Fig. 7). Water temperatures were about 1°C higher than the 10-year mean. This is the highest monthly mean temperature that has occurred since 1955.

Seawater temperatures at the coastal lightstations also increased markedly during August. The values were from 1 to 2°C higher than average.

The sea surface temperature anomalies published by the Bureau of Commercial Fisheries, Biological Laboratory, San Diego show that these unusually high temperatures occurred over the eastern Subarctic, and were between 1 and 2°C higher than average.

**SUMMARY**

Surface temperatures between the Canadian coast and Ocean Station "P" were well above average, at least until September of 1963. The largest anomaly was noted in August. Charts of sea surface temperatures and anomalies for this month show these unusually warm conditions existed over the eastern Subarctic Region.

Surface salinities were lower than usual between the Canadian coast and Ocean Station "P" during the same period. It is postulated that surface salinities were relatively low in the Central Subarctic Domain.
Figure 1.

NORTH PACIFIC OCEAN
DOMAINS IN THE UPPER (SEASONAL) ZONE
OF THE SUBARCTIC PACIFIC REGION
(Dodimead, Favorite and Hirano)
Figure 2. Temperature and salinity along Line "P" (Jan. 16-20, 1963)
Figure 3. Temperature and salinity along Line A (outbound, Jan. 19-28; inbound, Jan. 28-Feb. 3, 1963).
Figure 4. Temperature and salinity at Ocean Station "P" (January 20 - February 25, 1963).
Figure 5. Temperature and salinity at Ocean Station "P"
Figure 6. Temperature and salinity at Ocean Station "P" (July 1 - 31, 1963).
MONTHLY MEAN SURFACE
SEA TEMPERATURE (°C)
AT STATION "P"
(Lat. 50°N. Long. 145°W)

Figure 7.