A Report of Drift-Bottle Surveys off Kamchatka, USSR in 1940 and 1941

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OBJECT

For more than ten years before the war Japanese salmon gill-net boats worked very actively on the open seas off both east and west coasts of Kamchatka, USSR (mainly on the east coast), in connection with the factory-ships which canned and salted the fish. The salmon caught by these ships were hatched originally in the streams of Kamchatka but they fed and matured in some unknown area in the north Pacific Ocean, finally appearing around the Komandorskie Islands.

Eventually the fishermen decided it was mainly the currents that drove the schools of salmon on their migration-route amid the vastness of the ocean. It was also observed that any change in the manner of current flow whether on a large scale or otherwise must have affected the hydrographic conditions and that the change was reflected in the commercial catch.

With such a hypothesis in mind and with the objective of making clear the systematic distribution of the currents in question, Taiheiyo Gyogyo K.K. ("Pacific Fisheries Co., Ltd.", later amalgamated into Nichiro Fisheries Co., Ltd., by wartime measure) performed a series of drift-bottle surveys on a large scale during the fishing seasons of 1940 and 1941.

METHOD

All the fishing fleet participated in the surveys, including a few research boats and some two hundred gillnetters; the author supervised the entire operation from one of the research boats.

Because current bottles usually are not picked up unless and until they have come ashore, we employed ones that would be picked up on the ocean. Moreover, the bottles thus recovered would provide us with more accurate and opportune data than those that would have drifted ashore and remained some time before being recovered.

We employed ordinary cider bottles of about 500 cc., to each of which a cotton line about 3 feet long was attached. At the end of the line a small iron anchor 15 cm x 10 cm, was affixed so that it would become entangled in the driftnet of a fishing boat on the open seas. The device proved highly successful.

OBSERVATIONS

A. Observation in 1940

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In 1940, 1,458 bottles were thrown overboard, of which 307 were recovered, the effective rate of recovery being 21%. The release of bottles took place off both east and west coasts of the Kamchatka peninsula and the results obtained enabled us to draw up a general map of the sea-water currents existing in these areas as shown in Fig. 1.

A detailed description by area is as follows:

1. **Off East Coast (Pacific Ocean)**

   Off the east coast 1311 bottles were liberated at locations near the Komandorskie Islands, around the Gulf of Kamchatskii, Cape Kronotskii, Cape Kozlova, Cape Shipunskii and Utashud Island (Lat. 51°30' N, Long. 157°42' E) during the entire period commencing 14 May and ending 11 August. Two hundred fifty-seven bottles were recovered, an effective rate of 19.6%, and the location of recovery ranged from off the estuary of the Kamchatka River (Gulf of Kamchatskii) on down south to the adjacent waters of the North Kurile Islands.

   The data are tabulated by season as follows:

   **a. From May to the first part of June, 1940 (Earlier fishing season)**

<table>
<thead>
<tr>
<th>Location</th>
<th>No. of Bottles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off Komandorskie Islands</td>
<td>439</td>
</tr>
<tr>
<td>Inside Gulf of Kamchatskii</td>
<td>223</td>
</tr>
<tr>
<td>Off Cape Kozlova</td>
<td>67</td>
</tr>
<tr>
<td>Off Cape Shipunskii</td>
<td>22</td>
</tr>
<tr>
<td>Total</td>
<td>751</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location</th>
<th>No. of Bottles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inside Gulf of Kamchatskii and off Cape Kozlova</td>
<td>152</td>
</tr>
<tr>
<td>Off Cape Shipunskii</td>
<td>6</td>
</tr>
<tr>
<td>Off Utashud Island</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>159</td>
</tr>
</tbody>
</table>

   These surveys resulted in formation of the general drifting route shown in Fig. 2. From these drift patterns the followings may be inferred.

1) The presence of a current coming from the southern offings of the Komandorskie Islands toward the head of Cape Kronotskii was heretofore only identified by the horizontal distribution of warm water masses. The existence of this current has been verified first by the fact that a bottle thrown off the Komandorskie Islands on 4 June was recovered close to Cape Chajima (Gulf of Kamchatskii) after 20 days (7.5 miles per day). Secondly, another one thrown at the same spot and date was also found...
off Cape Kozlova after 30 days. This main stream, running westward at a daily speed of about 9 miles apparently heading for Cape Kronotskii, was found to divide at a location 30 or 40 miles east of Cape Kronotskii. One stream flows into the Gulf of Kamchatskii and the other turns to the southwest for Cape Kozlova and farther.

2) A counter-clockwise flow in the whole southern half of the Gulf of Kamchatskii was formed by the most northerly of the above-mentioned branch streams, which covered an area beginning at the northern offing of Cape Kronotskii and that of Cape Chajima, its velocity estimated at 10—20 miles a day. This current pattern was confirmed by the fact that most of the bottles released far in the offing (30—40 miles) of Cape Chajima drifted northwest to be recovered near cape Shuberta, and the that, on the contrary, those bottles released near Cape Shuberta were recovered near Cape Kozlova or Cape Kronotskii.

3) It seemed very probable that there existed a clockwise circular current in the northern half of the Gulf of Kamchatskii since some bottles released near Cape Shuberta drifted to the north and were recovered near the mouth of the Kamchatka River.

4) The current passing southwesterly off Cape Kronotskii, which evidently causes the division of the main current as described in 1) above, flowed at an average velocity, of 15 miles a day, or a maximum of 35 miles a day when accelerated by tidal currents.

5) Near the southern offing of Cape Kozlova a clockwise circular flow was apparent (Fig. 3) but is not yet fully confirmed.

b. From middle of June to the first part of August, 1940 (The center of the fishing activity moves southward during this period.)

### Release

<table>
<thead>
<tr>
<th>Location</th>
<th>No. of Bottles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Komandorskie Islands</td>
<td>73</td>
</tr>
<tr>
<td>Gulf of Kamchatskii</td>
<td>45</td>
</tr>
<tr>
<td>Cape Kozlova</td>
<td>177</td>
</tr>
<tr>
<td>Cape Shipunskii</td>
<td>38</td>
</tr>
<tr>
<td>Utashud Island</td>
<td>52</td>
</tr>
<tr>
<td>Other areas</td>
<td>51</td>
</tr>
<tr>
<td>Total</td>
<td>436</td>
</tr>
</tbody>
</table>

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Fig. 2. Principal drifting course of Current-Bottles during the end of May to middle of June. Arrows denote the drifting course of bottles. Figures denote drifting days. Circle; thrown point, arrow; point of recovery.

Fig. 3. Principal drifting course of bottles during end of June to middle of July.
From the above releases 51 bottles or 11.7% were recovered, and after studying the data the following inferences were gained:

1) The stream running from the Kamchatka River district (in Gulf of Kamchatskii) down to Cape Kozlova showed an average velocity of 12 miles a day (Fig. 3).

2) The presence of a circular flow south of Cape Kozlova was verified and its velocity estimated at about 10 miles a day (Fig. 3, Fig. 8).

3) The stream flowing southerly from about the center of the Gulf of Kronotskii down to Cape Shipunskii showed a speed of 6—10 miles a day (Fig. 3).

4) Further, the southerly stream, as surveyed off the small island of Utashud, showed a speed of 15—20 miles a day, but closer to the island a northerly slow, small stream of about 2 miles a day was also observed. (Fig. 4)

2. Off West Coast (Sea of Okhotsk)

On the west side of Kamchatka Peninsula, 147 bottles were released during the red salmon season from 20 July to 9 August between latitudes 51°N and 53°N, with an effective recovery of 50 bottles or 34%.

In these effings (51°N—53°N) there was a northerly stream close to the shoreline. Between the northerly stream and the land, there was a current flowing southward. The northerly current was comparatively strong with a daily speed of 2—20 miles. The southerly current was rather weak with a daily speed of 1—15 miles, as shown in Figs. 4 and 5.

3. Conclusions from 1941 Observations

Surveys performed with specially designed drift-bottles in the open sea have never before been attempted by Japanese or Soviet interests. The data obtained provide the following information on ocean currents influencing the distribution and migration of salmon:

a. A westerly current consisting of warm water masses from the Komandorskie Region proceeds toward the Gulf of Kamchatskii perpendicular to the general coast line of the Peninsula, while along the east coast line of Kamchatka another current of seemingly cold water masses, flows in about a southwesterly direction,

b. That tests of color, transparency and temperature of the waters thereabout correspond very accurately to the distribution of the two currents mentioned above; and

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**Fig. 4.** Principal drifting course of bottles in the west coast of Kamchatka and the Utashud Is. districts.

**Fig. 5.** Complicated drifting course in the west coast of Kamchatka.
c. That the migration course of the salmon tribe is also wholly subject to the direction and the distribution of the two currents clarified above.

4. Additional Note of Interest

In 1940 evidence was found (or seen) of the existence of a few minor circular flows along the east cost, particularly Small the Gulf of Kamchatski.

Two bottles released in the offfing of Cape Africa (56°10'N, 163°20' E) were recov-ered in the region of Cape Kozlova—one after 20 days and the other after 30 days. The mean velocity of the former was 7 miles a day while that of the latter was 4.6 miles. Driftage at a speed under 5 miles a day on an even course should be considered to be too slow—hardly explainable unless the effect of one or mere whirlpools existing on the general course of the driftage be acknowledged.

B. Observetions in 1941

In order to clarify further the insufficient points of the results obtained in the preceding year, a driftage examination with bottles was executed in the fishing season of 1941 on about the same scale; however, this time the area was confined to the more important grounds of east coast Kamchatka.

A total of 1252 bottles was released at various locations but mainly in the southern precincts of Cape Kozlova, off Cape Shipunskii and the adjacent waters. Two hundred and eighty-three bottles or 22% were recovered, providing us with data for drawing more detailed charts of the currents, as shown in Figs. 6—11, and from studies of these data together with those of the previous year we could infer the following:

1. Gulf of Kamchatskii (Fig. 6)
   a. A westerly current coming from the Komandorskii region to the east coast of Kamchatka enters the Gulf of Kamchatskii at about its center and then divides forming a circular flow to the north and to the south.

2. Cape Kronotskii (Fig. 7)
   Heretofore only a southwesterly (or somewhat southeasterly) current of a velocity of 7—15 miles per day was thought to predominate in this area. However, a westerly or even northwesterly stream of an average velocity of 7 miles per day also appears sometimes, supposedly because of a tidal current, in the same area.

3. Gulf of Kronotskii (Fig. 8)
   In the northern region of the Gulf of Kronotskii within 20 miles south of Cape Oliga a clockwise circular flow of a current is observed that requires some 11 days to complete a circle. The velocity of the flow counts 10—15 miles a day and the core of the circulation
movement is estimated to be located some 17 miles just south of Cape Oliga.

4. Cape Shipunskii (Fig. 9)

Here in the southern offings of Cape Shipunskii presence of a clockwise circular flow of about the same size and speed of the one mentioned in section 3 above was also observed.
5. **General** (Fig. 10)

From the data obtained from such bottles that had travelled a relatively great distance, it was ascertained that the usual velocity of the main southward current on the east coast of southern Kamchatka varies from 7 to 12 miles a day, or an average of approximately **9 miles a day**.

6. **Note of Interest**

As a matter of special interest for this year a bottle released on 28 May at Lat. 54°15' N, Long. 162°25' E (28 miles NE of Cape Kozlova), was recovered by a set not (or trap) on the west coast at Lat. 52°18 1/2' N, Long. 156°25' E (Bolishaya River District).

It was noteworthy that the route of the bottle had taken coincided precisely with the migration course of Pacific Salmon, and also the outstanding fact that its average velocity had been 9 miles a day made it clear that salmon travel their long migration tour by riding just on the **very superficial flow** of the ocean waters.

**Reference**

K. Taguchi, 1944,

*Report of a Current in the salmon fishing ground off Kamchatka, USSR estimated with the drifitage of gillnet, Journal of Fishery Science, Vol. 34 No. 4 (1944).*