

**NPAFC**  
**Doc. 1266**  
**Rev.**

Vertical distribution of Pacific salmon in the central  
Bering Sea in summer 2007

by

Kentaro Morita

*Hokkaido National Fisheries Research Institute, Fisheries Research Agency*  
*116 Katsurakoi, Kushiro 085-0802, Japan (E-mail: [moritak@affrc.go.jp](mailto:moritak@affrc.go.jp))*

Submitted to the

North Pacific Anadromous Fish Commission

by

Japan

October 2010

THIS PAPER MAY BE CITED IN THE FOLLOWING MANNER:

Morita, K. 2010. Vertical distribution of Pacific salmon in the central Bering Sea in summer 2007. NPAFC Doc. 1266. 4 pp. (Available at [www.npafc.org](http://www.npafc.org))

# Vertical distribution of Pacific salmon in the central Bering Sea in summer 2007

**Abstract:** The vertical distribution of Pacific salmon *Oncorhynchus* spp., sampled by trawl net, in the central Bering Sea in summertime was examined. The abundance of Pacific salmon caught decreased with increasing depth and the majority of Pacific salmon were caught within the upper 50 m. The inter-specific variation in vertical distribution was relatively small.

Many previous studies have explored vertical distribution of Pacific salmon *Oncorhynchus* spp. in offshore areas (e.g., Manzer, 1964; Machidori, 1966; Ogura and Ishida, 1995; Radchenko and Glebov, 1998; Ishida *et al.*, 2001; Walker *et al.*, 2007). These studies found that the vertical distribution of Pacific salmon can vary by species, seasons, regions, thermocline and diel vertical migration. In this study, I examined the vertical distribution of Pacific salmon, sampled by trawl net, in the central Bering Sea in summertime.

Pacific salmon were collected in 31 trawls conducted in the central Bering Sea, between 54° and 59°N latitude and between 177°E and 176°W longitude from 30 June to 15 July 2007 in the first leg of the 2007 summer Japanese salmon research cruise of the R/V *Hokko maru*. Morita *et al.* (2007) have reported details of the cruise and fishing stations. The 31 trawls were towed at the speed of 5 knots for 1 h in daytime. The warp length was set at 300 m for all trawls. The height and width of the mouth of trawl was about 30 and 40 m, respectively; the trawl length was 152 m; and the cod end of the net was lined with a net of mesh size 17.5 mm.

To vary the depth of the towed trawl net, the angle of the canvas kite, the number of floats, and the weight of the ground rope were adjusted for each trawl. The resulting depth ranges of the head and ground ropes were 0–39 m and 28–68 m, respectively. For the analyses of depth-related patterns, small depth recorders (SBT-500, Murayama Denki Ltd., Tokyo) were attached to the trawl net. Median depth between the head rope and ground rope were used, because fishing efficiency is generally highest at the centre of the net.

In total, 2,738 chum salmon, 342 pink salmon, 95 chinook salmon and 91 sockeye salmon were caught during 31 trawls.

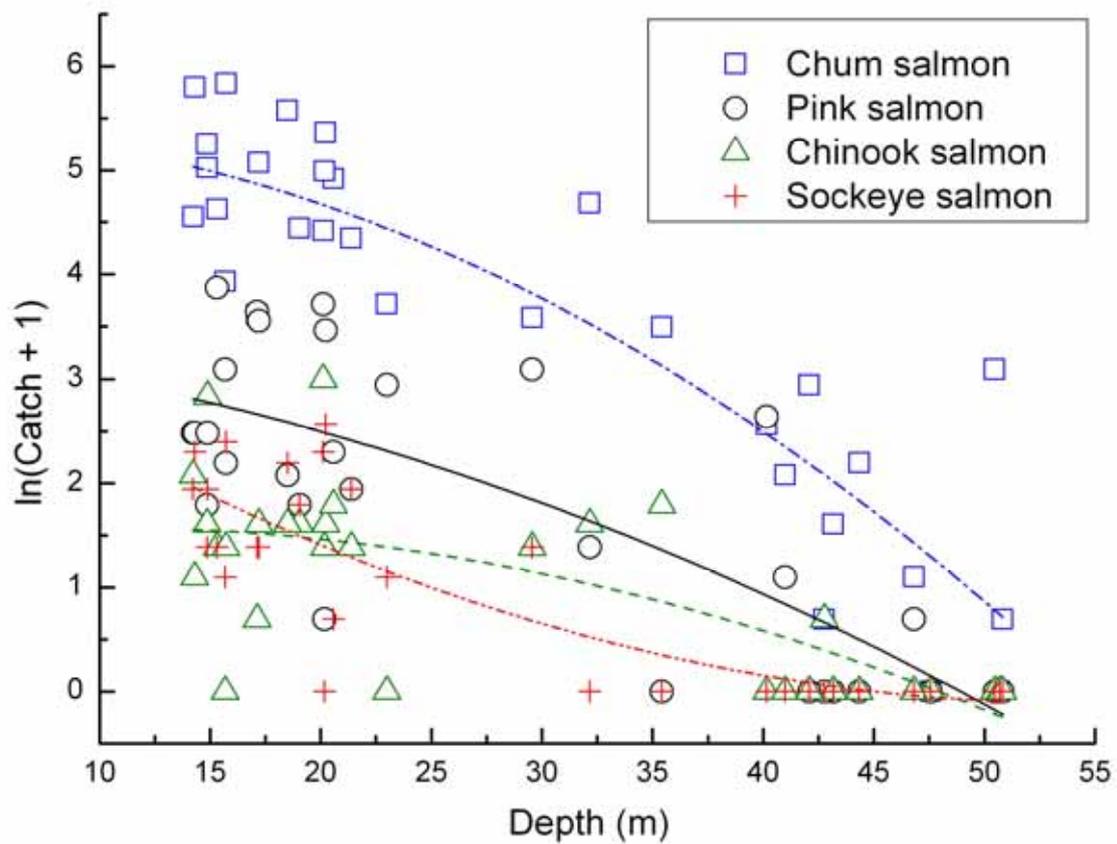
The abundance of Pacific salmon caught decreased with increasing depth and the majority of Pacific salmon were caught within the upper 50 m (Figure 1, Figure 2), although fine resolution of the vertical distribution was not possible owing to the 30 m opening of the trawl mouth. There was some inter-specific variation in vertical

distribution. First, sockeye salmon used shallow water exclusively; all sockeye salmon were caught within the upper 30 m. Second, chinook salmon tended to use deep waters compared with other species. However, the inter-specific variation in vertical distribution was relatively small. On the other hand, there was significant intra-specific variation in vertical distribution; larger chum salmon tended to inhabit deeper or colder waters than small chum salmon (Morita, submitted).

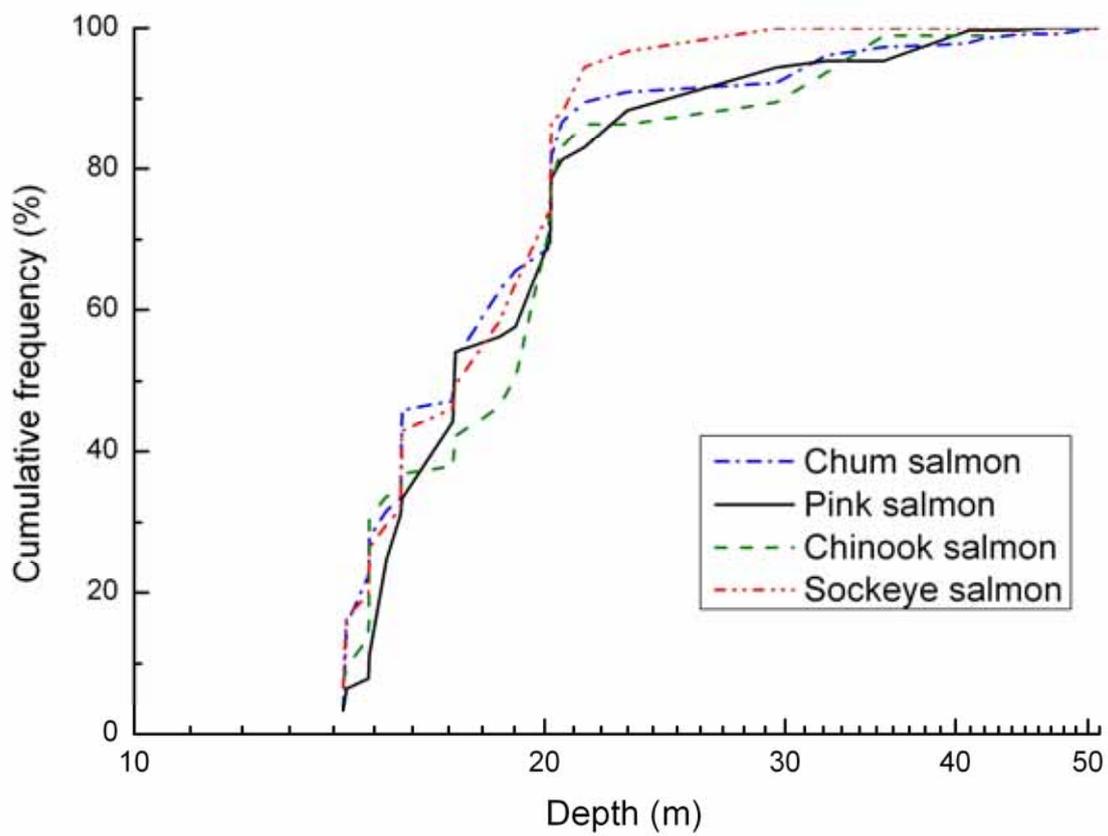
**Acknowledgements.** We thank Captain Sadaaki Danno, officers, and crew of the R/V *Hokko maru* for their cooperation in the research and collection of samples during the cruise. This work was supported by the Promotion Program for International Resources Surveys of the Fisheries Agency of Japan.

## References

- Ishida, Y., A. Yano, M. Ban, and M. Ogura. 2001. Vertical movement of a chum salmon *Oncorhynchus keta* in the western North Pacific Ocean as determined by a depth-recording archival tag. *Fish. Sci.* **67**: 1030–1035.
- Machidori, S. 1966. Vertical distribution of salmon (*genus Oncorhynchus*) in the north-western Pacific. I. *Bull. Hokkaido Reg. Fish. Res. Res. Lab.* **31**: 11–17.
- Manzer, J.I. 1964. Preliminary observations on the vertical distribution of Pacific salmon (*genus Oncorhynchus*) in the Gulf of Alaska. *J. Fish. Res. Bd. Canada* **21**: 891–903.
- Morita, K., S. Sato, M. Kagagaya, Y. Katayama, Y. Goda, T. Chiba, and K. Makino. 2007. The 2007 summer Japanese salmon research cruise of the R/V *Hokko maru*. NPAFC Doc. 1044. 8 pp.
- Morita, K. Body size-related vertical and thermal habitat use by chum salmon in the Bering Sea in summer. Submitted to *Fish. Oceanogr.*
- Ogura, M. and Y. Ishida. 1995. Homing behavior and vertical movements of four species of Pacific salmon (*Oncorhynchus* spp.) in the central Bering Sea. *Can. J. Fish. Aquat. Sci.* **52**: 532–540.
- Radchenko, V.I., and I.I. Glebov. 1998. On the vertical distribution of Pacific salmon in the Bering Sea, collected by trawling data. *J. Ichthyol.* **38**: 603–608.
- Walker, R.V., V.V. Sviridov, S. Urawa, T. Azumaya. 2007. Spatio-temporal variation in vertical distributions of Pacific salmon in the ocean. *N. Pac. Anadr. Fish Comm. Bull.* **4**: 193–201.



**Figure 1.** Relationships between depth and number of chum, pink chinook and sockeye salmon individuals caught during 31 trawls in the central Bering Sea in summer 2007. Lines indicate the fitted quadratic curves.



**Figure 2.** Cumulative frequency distributions of chum, pink chinook and sockeye salmon catch in relation to depth during 31 trawls in the central Bering Sea in summer 2007.