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# Canadian Highseas Salmon Surveys in 2009-2010

by

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## INTRODUCTION

The Canadian Program on High Seas Salmon has been conducting integrated epipelagic ecosystem surveys from the west coast of British Columbia to Southeast Alaska since 1998 to assess the effects of ocean conditions and climate change on the distribution, migration, growth and survival of Pacific salmon, and to forecast salmon returns to British Columbia (Beamish et al. 2007; Appendix A). These surveys are usually conducted in late spring-early summer (June-July) and in the fall (October-November). In addition, these surveys have been conducted during winter (February-March) since 2001 to assess the effects of winter conditions on the ecology, bioenergetics, and survival of juvenile salmon (Trudel et al. 2007a).

The working hypothesis of this research is that fast growth enhances the marine survival of salmon, either because fast growing fish quickly reach a size that is sufficiently large to avoid predators (Holtby et al. 1988; Pearcy 1992), or because they accumulate enough energy reserves to better survive their first winter at sea, a period generally considered to be critical in the life cycle of salmon (Beamish and Mahnken 2001). The comparative approach is used to relate changes in salmon growth and bioenergetics to ocean conditions in two contrasting ocean domains: the west coast of Vancouver Island is located at the north end of the California Current System and is affected by upwelling, whereas Southeast Alaska is located in the Alaska Coastal Current and is affected by downwelling (Ware and MacFarlane 1989). In general, sea surface temperature, phytoplankton and zooplankton biomass are higher off the west coast of Vancouver Island (Ware and Thomson 2005).

Three surveys have been planned by the Canadian Program on High Seas Salmon for 2009-2010: a summer survey on June 18 – July 6, 2009, a fall survey on October 8 – November 17, 2009, and a winter survey on February 2 – March 2, 2010. The primary objectives of these surveys will be to (1) collect biological information on Pacific salmon (Oncorhynchus spp.) and associated epipelagic fish community, (2) describe the ambient oceanographic conditions, and (3) quantify the biomass of zooplankton and describe zooplankton species community composition in coastal waters of British Columbia and Southeast Alaska.

## GENERAL SURVEY INFORMATION

The summer survey will conduct scientific operations primarily on the continental shelf off the west coast of Vancouver Island, in Queen Charlotte Sound, Hecate Strait, Dixon Entrance, Southeast Alaska, and off the west coast of the Queen Charlotte Islands (Table 1; Figure 1). The dates for this survey are currently tentative, as this survey will be conducted using a fishing vessel that will be chartered later this year. As a consequence, the number of berths available for this survey is currently unknown.

The fall and winter surveys will conduct scientific operations on the continental shelf off the west coast of Vancouver Island, in Queen Charlotte Sound, Hecate Strait, Dixon Entrance, Southeast Alaska, and off the west coast of the Queen Charlotte Islands, as well as the inlets of the west coast of Vancouver Island, central British Columbia, and straits of Southeast Alaska (Table 2-3; Figure 2). These surveys will be conducted using the *CCGS W.E. Ricker*. Additional scientists can be accommodated for these surveys, pending security clearance.

## FISHING GEAR AND FISHING OPERATION

The research vessel will tow a mid-water trawl, originally manufactured by Cantrawl Nets Ltd., Richmond, BC, and later modified to a model 240 trawl by the fishing crew, for 30 minutes. The trawl has a heavy-duty front end of hexagonal web made from 3/8 in. (9.5 mm) and 5/16 in. (7.9 mm) Tenex rope, and a tapered body made-up of 64 in. (163 cm), 32 in. (81.3 cm), 16 in. (40.6 cm), 8 in. (20.3 cm) and 4 in. (10.2 cm) polypropylene sections, an intermediate section of 3 in. (7.6 cm) polypropylene, and a codend of 1.5 in. (3.8 cm) knotted nylon lined with 0.25 in. mesh (64 mm). The trawl has three 40 m bridles of 5/8 in. (1.6 cm) wire rope per side that are attached with a single hook-up to 5 m Jet doors. Typically, 100-150 m of 1.25 in. (3.2 cm) warp was paid out to tow the trawl at the surface. The trawl is towed at the surface at 5 knots (2.6 m $s^{-1}$) in good sea conditions, and this typically achieved a mouth opening that was approximately 28 m wide by 16 m deep as measured acoustically by a Scanmar trawl eye mounted on the headrope. In rough weather, the trawl is towed at headrope depths down to 15 m.

The fish samples are sorted by species, enumerated, and measured onboard the ship to characterize the nekton community in epipelagic waters of British Columbia and Southeast Alaska (Brodeur et al. 2006; Orsi et al. 2007). All the juvenile coho and Chinook salmon are systematically scanned for coded-wire tags, irrespective if their adipose fin has been clipped or not, as not all the tagged fish are clipped (Morris et al. 2005). For juvenile salmon, we will also take a skin sample from the operculum using a hole-punch and preserved in 70% ethanol to determine their stock of origin using microsatellite DNA (Beacham et al. 2001, 2005, 2006) and remove calcified-structures (i.e. scales and otoliths) for age determination. Stomach contents of juvenile salmon will also be removed, weighted individually, and pooled by species and tow for dietary analyses (Brodeur et al. 2007). A subsample of the catch is preserved frozen individually at –20ºC for various chemical and calorimetric analyses such as stable isotopes, and to examine their stomach contents.

Biological data collected for each salmon will include species common name, fork length, total length, and observed fin clip. It will also include, when available, whole body weight (g wet), sex, stomach content weight (g wet), % water that is based on the ratio of dry to wet whole body weight, coded wire tag number, and pit tag number. Age separation is generally determined based on examination of fork length distributions, that showed non-overlapping size modes for chum, coho, pink, and sockeye salmon (Trudel et al. 2007b). For Chinook salmon, we used a combination of coded-wire tag recoveries of known-age fish and DNA analyses to establish size-classes to separate juveniles from adults, and life history types (Fisher et al. 2007; Trudel et al. 2007c), as there is considerable overlap among size modes that represent the multiple age groups.

## OCEANOGRAPHIC SAMPLING

At oceanographic stations, the scientific crew will (1) conduct CTD (conductivity-temperature-depth) casts, (2) collect seawater samples at 10 m from the surface with a Niskin bottle for nitrate, phosphate, silicate, and salinity, and (3) filter surface seawater on GF/F glass fibre filter disks for chlorophyll a. Nitrate, phosphate, and silicate samples will be collected in acid-washed glass test tubes, whereas the glass fiber disks will be

folded and placed in polypropylene scintillation vials. All these samples will be stored frozen. CTD casts will be conducted to 250 m or within 5 m of the bottom with a Seabird SBE 911+ probe. Several calibration samples from selected CTD casts will be collected over the course of the survey with Niskin bottles at depths where the salinities are stable.

The oceanographic data collected in these surveys will be stored on a database maintained at the Institute of Ocean Sciences (Sidney, British Columbia). The contact procedure to obtain the CTD files is available at:

http://www-sci.pac.dfo-mpo.gc.ca/osap/data/default_e.htm

## ZOOPLANKTON SAMPLING

Vertical bongo tows to approximately 150 m or within 10 m of the bottom will be conducted with two 57 cm diameter, 253 μm Nitex nets. One of the nets is equipped with a flowmeter. Zooplankton collected from the flowmeter side will be preserved in 10% formalin and sent to the zooplankton laboratory at the Institute of Ocean Sciences, Fisheries and Oceans Canada (Sidney, BC) for species classification and enumeration. Zooplankton taken from the net without flowmeter will be sorted into four size fractions by successively sieving through 8.0, 1.7, 1.0, and 0.25 mm screens. Each size fraction will then be weighed wet, dried at 60oC for 48 hours, re-weighed, and stored in plastic bags for future stable isotope, bomb calorimetry, and proximate analyses.

The zooplankton data collected in these surveys will be stored on a database maintained at the Institute of Ocean Sciences (Sidney, British Columbia). The contact procedure to obtain detail species records from selected plankton sampling stations is available at:

http://www.pac.dfo-mpo.gc.ca/sci/osap/projects/plankton/zooplanktondatabase_e.htm

## REFERENCES

Beacham, T.D., J.R. Candy, B. McIntosh, C. MacConnachie, A. Tabata, K. Kaukinen, L. Deng, K.M. Miller, R.E. Whitler, and N. Varnavskaya. 2005. Estimation of stock composition and individual identification of sockeye salmon across the Pacific Rim using microsatellite and major histocompatibility complex variation. Trans. Am. Fish. Soc. 134: 1124-1146.

Beacham, T.D., J.R. Candy, K.L. Jonsen, K.J. Supernault, M. Wetklo, L. Dend, K.M. Miller, R.E. Whitler, and N. Varnavskaya. 2006. Estimation of stock composition and individual identification of Chinook salmon across the Pacific Rim by use of microsatellite variation. Trans. Am. Fish. Soc. 135: 861-888.

Beacham, T.D., Candy, J.R., Supernault, K.J., Ming, T., Deagle, B., Schulze, A., Tuck, D., Kaukinen, K.H., Irvine, J.R., Miller, K.M., and Withler, R.W. 2001. Evaluation and application of microsatellites and major histocompatibility complex variation for stock identification of coho salmon in British Columbia. Trans. Am. Fish. Soc. 130: 1116-1149.

Beamish, R.J., and Mahnken, C. 2001. A critical size and period hypothesis to explain natural regulation of salmon abundance and the linkage to climate and climate change. Prog. Oceanogr. 49: 423–437.

Beamish, R.J., Trudel, M., and Sweeting, R. 2007. Canadian coastal and high seas juvenile Pacific salmon studies. North Pacific Anadromous Fish Commission Technical Report 7: 1-4.

Brodeur, R.D., Daly, E.A., Studervant, M.V., Miller, T.W., Moss, J.H., Thiess, M., Trudel, M., Weitkamp, L.A., Armstrong, J., and Norton, E.C. 2007. Regional comparisons of juvenile salmon feeding in coastal marine waters off the West Coast of North America. Am. Fish. Soc. Symp. Ser. 57: 183-203.

Brodeur, R.D., S. Ralston, R.L. Emmett, M. Trudel, T.D. Auth, and A.J. Phillips 2006. Recent trends and anomalies in pelagic nekton abundance, distribution, and apparent recruitment in the Northeast Pacific Ocean. Geophys. Res. Let. Doi:10.1029/2006GL026614.

Fisher, J., Trudel, M., Ammann, A., Orsi, J., Piccolo, J., Bucher, C., Harding, J., Casillas, E., MacFarlane, B., Brodeur, R., Morris, J., and Welch, D. 2007. Regional comparisons of distribution and abundance of juvenile salmon along the West Coast of North America. Am. Fish. Soc. Symp. Ser. 57: 31-80

Holtby, L.B., B.C. Anderson, and R.K. Kadowaki. 1988. Importance of smolt size and early ocean growth to interannual variability in marine survival of coho salmon (*Oncorhynchus kisutch*). Can. J. Fish. Aquat. Sci. 47: 2181-2194.

Morris, J.F.T., M. Trudel, D.W. Welch, M.E. Thiess, and T.B. Zubkowski. 2004. Canadian Highseas Salmon surveys: CWT recoveries from juvenile Chinook and coho salmon on the continental shelf of British Columbia and southeast Alaska from 1998 to 2003. North Pacific Anadromous Fish Commission Document No. 823.

Orsi, J.A., Harding, J.A., Pool. S.S., Brodeur, R.D., Haldorson, L.J., Murphy, J.M., Moss, J.H., Farley, E.V., Jr., Sweeting, R.M., Morris, J.F.T., Trudel, M., Beamish, R.J., Emmett, R.L., and Fergusson, E.A. 2007. Epipelagic fish assemblages associated with juvenile Pacific salmon in neritic waters of the California Current and Alaska Current. Am. Fish. Soc. Symp. Ser. 57: 105-155.

Pearcy, W. G. 1992. Ocean ecology of North Pacific salmonids. University of Washington Press, Seattle, WA .

Trudel, M., Thiess, M.E., Morris, J.F.T., Candy, J.R., Beacham, T.D., Higgs, D.A., and Welch, D.W. 2007a. Overwinter mortality and energy depletion in juvenile Pacific salmon off the west coast of British Columbia and Alaska. North Pacific Anadromous Fish Commission Technical Report 7: 61-63.

Trudel, M., Jones, S.R.M., Thiess, M.E., Morris, J.F.T., Welch, D.W., Sweeting, R.M., Moss, J.H., Wing, B.L., Farley, E.V., Jr., Murphy, J.M., Baldwin, R.E., and Jacobson, K.C. 2007b. Infestations of motile salmon lice on Pacific salmon along the west coast of North America. Am. Fish. Soc. Symp. Ser. 57: 157-182.

Trudel, M., Thiess, M.E., Bucher, C., Farley, E.V., Jr., MacFarlane, B., Casillas, E., Morris, J.F.T., Murphy, J.M., and Welch, D.W.. 2007. Regional variation in the marine growth and energy accumulation of juvenile Chinook salmon and coho salmon along the west coast of North America. Am. Fish. Soc. Symp. Ser. 57: 205-232.

Ware, D.W., and McFarlane, G.A. 1989. Fisheries production domains in the northeast Pacific Ocean, pp. 359-379. In: Effects of ocean variability on recruitment and an evaluation of parameters used in stock assessment models. Beamish, R.J., and G.A. McFarlane (eds). Can. Spec. Publ. Fish. Aquat. Sci. 108.

Ware, D.W., and R.E. Thomson. 2005. Bottom-up ecosystem trophic dynamics determine fish production in the Northeast Pacific. Nature 308: 1280-1284.

Table 1. Tentative summer survey itinerary for the June 18 – July 6, 2009, DFO High Seas Salmon research survey.

| Date | General area of operations |
|---|---|
| June 18 | PBS Nanaimo, loading |
| June 19-25 | West coast of Vancouver Island |
| June 26 | Triangle Island |
| June 27-28 | Hecate Strait |
| June 29-30 | Dixon Entrance |
| July 1-2 | Southeast Alaska |
| July 2-3 | West coast of Queen Charlotte Islands |
| July 4-5 | Travel |
| July 6 | Nanaimo, off loading |

Table 2. Tentative fall survey itinerary for the October 8 – November 17, 2009, DFO High Seas Salmon research survey.

| Date | General area of operations |
|---|---|
| October 8 | PBS Nanaimo, loading |
| October 9-20 | West coast of Vancouver Island |
| October 21 | Triangle Island |
| October 22-23 | Hecate Strait |
| October 24 | Travel |
| October 28 | Nanaimo, off loading |
| October 25 - November 3 | Coast Guard Training Week - No sampling |
| November 4 | Prince Rupert, loading |
| November 5-6 | Dixon Entrance |
| November 7-11 | Southeast Alaska |
| November 12-14 | Central Coast of British Columbia |
| November 15-16 | Travel |
| November 17 | Nanaimo, off loading |

Table 3. Tentative winter survey itinerary for the February 2 – March 2, 2010, DFO High Seas Salmon research survey.

| Date | General area of operations |
|---|---|
| February 2 | PBS Nanaimo, loading |
| February 3 - 11 | West coast of Vancouver Island |
| February 12 | Triangle Island |
| February 13-18 | Hecate Strait & Central Coast of British Columbia |
| February 19-20 | Dixon Entrance |
| February 21-28 | Southeast Alaska |
| February 28 - March 1 | Travel |
| March 2 | Nanaimo, off loading |

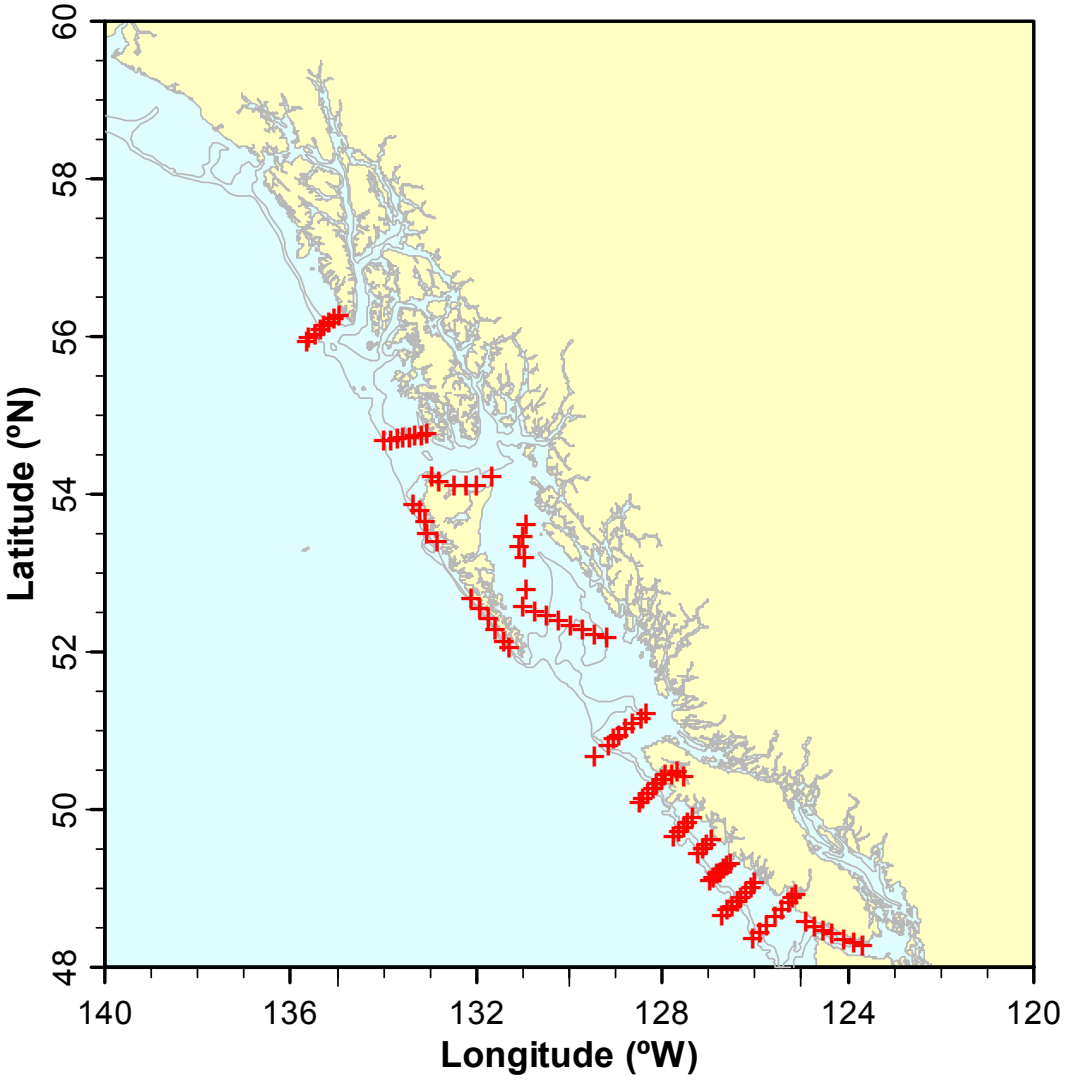


Figure 1. Tentative survey stations for the High Seas Salmon summer survey (June 18 – July 6, 2009).

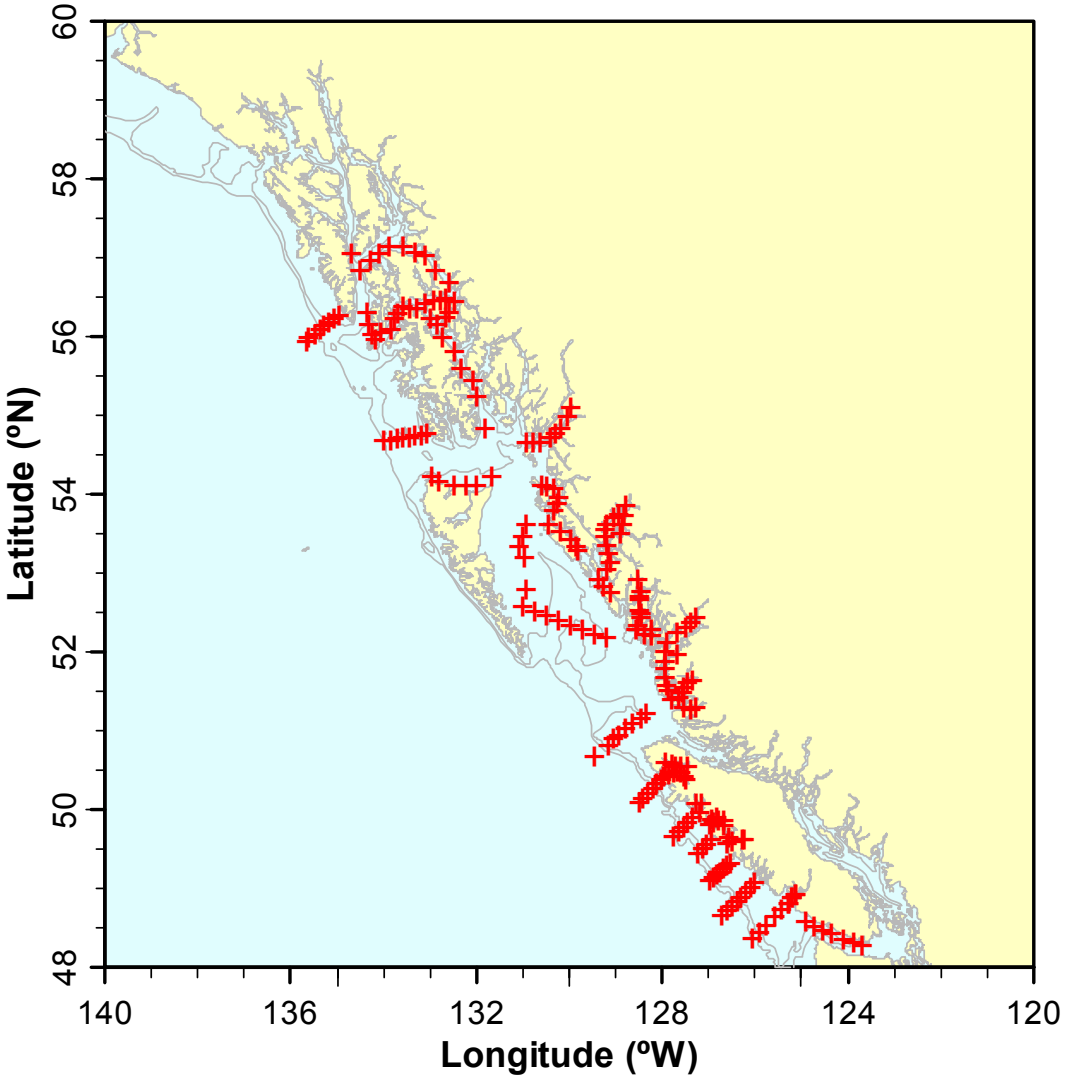


Figure 2. Tentative survey stations for the High Seas Salmon fall (October 8 – November 17, 2009) and winter surveys (February 2 – March 2, 2010).

**APPENDIX A.** Data reports produced by the Canadian Program on High Seas Salmon.

1) Welch, D. W., Morris, J. F. T., Ladouceur, A. R., Tucker, S., and Demers, E. 2002. CCGS W.E. Ricker Gulf of Alaska salmon surveys, 1998. Can. Data Rep. Fish. Aquat. Sci. 1103: 188 p.

2) Welch, D. W., Morris, J. F. T., Ladouceur, A. R., Tucker, S., and Demers, E. 2002. CCGS W.E. Ricker Gulf of Alaska salmon surveys, 1999. Can. Data Rep. Fish. Aquat. Sci. 1104: 113p.

3) Welch, D. W., Morris, J. F. T., Thiess, M. E., Trudel, M., and Anderson, D. J. 2003. CCGS W.E. Ricker Gulf of Alaska salmon survey, June 27 to July 6, 2000. Can. Data Rep. Fish. Aquat. Sci. 1125: 110 p.

4) Welch, D. W., Morris, J. F. T., Thiess, M. E., Trudel, M., Ladouceur, A. R., Jacobs, M. C., Zubkowski, T. B., Demers, E., and Zamon, J. E. 2004. CCGS W.E. Ricker Gulf of Alaska salmon survey, June 14-24, 2001. Can. Data Rep. Fish. Aquat. Sci. 1135: 86 p.

5) Welch, D. W., Morris, J. F. T., Thiess, M. E., Trudel, M, Ladouceur, A. R., Zubkowski, T. B., MacLean, H. R., Jacobs, M. C., and Winchell, P. M. 2004. CCGS W.E. Ricker Gulf of Alaska salmon survey, October 9 to November 5, 2001. Can. Data Rep. Fish. Aquat. Sci. 1136: 145 p.

6) Welch, D. W., Morris, J. F. T., Thiess, M. E., Trudel, M., Ladouceur, A. R., Jacobs, M. C., Zubkowski, T. B., and MacLean. H. R. 2004. CCGS W.E. Ricker Gulf of Alaska salmon survey, August 15-26, 2002. Can. Data Rep. Fish. Aquat. Sci. 1137: 121 p.

7) Welch, D. W., Morris, J. F. T., Thiess, M. E., Trudel, M., Ladouceur, A. R., Zubkowski, T. B., Jacobs, M. C., Winchell, P.M., and MacLean, H. R. 2004. CCGS W.E. Ricker Gulf of Alaska salmon survey, October 17 to November 9, 2002. Can. Data Rep. Fish. Aquat. Sci. 1138: 122 p.

8) Welch, D. W., Morris, J. F. T., Thiess, M. E., Trudel, M., Ladouceur, A. R., Zubkowski, T. B., Jacobs, M. C., Winchell, P. M., and MacLean, H. R. 2004. CCGS W.E. Ricker Gulf of Alaska salmon survey, February 14-26, 2003. Can. Data Rep. Fish. Aquat. Sci. 1139: 65 p.

9) Welch, D. W., Morris, J. F. T., Thiess, M. E., Trudel, M., Zamon, J. E., Zubkowski, T. B., Ladouceur, A. R., Jacobs, M. C., Robert, M., and Wyeth, M. 2004. CCGS W.E. Ricker Gulf of Alaska salmon survey, October 4-30, 2000. Can. Data Rep. Fish. Aquat. Sci. 1141: 205 p.

10) Welch, D. W., Morris, J. F. T., Zamon, J. E., Thiess, M. E., Trudel, M., Ladouceur, A. R, Jacobs, M. C., Zubkowski, T. B., Demers, E., and Robert, M. 2004. CCGS W.E. Ricker Gulf of Alaska salmon survey, March 9-24, 2001. Can. Data Rep. Fish. Aquat. Sci. 1142: 67 p.

11) Welch, D. W., Morris, J. F. T., Thiess, M. E., Trudel, M., Ladouceur, A. R., Jacobs, M. C., Zubkowski, T. B., Winchell, P. M., and MacLean, H. R. 2004. CCGS W.E. Ricker Gulf of Alaska salmon survey, February 27 to March 17, 2002. Can. Data Rep. Fish. Aquat. Sci. 1143: 56 p.

12) Welch, D. W., Morris, J. F. T., Thiess, M. E., Trudel, M., Ladouceur, A. R., Zubkowski, T. B., Jacobs, M. C., Winchell, P. M., and MacLean, H. R. 2004. CCGS W. E. Ricker Gulf of Alaska salmon survey, June 9-11, 2003. Can. Data Rep. Fish. Aquat. Sci. 1144: 54 p.

13) Welch, D. W., Morris, J. F. T., Thiess, M. E., Trudel, M., Ladouceur, A. R., Jacobs, M. C., Zubkowski, T. B., and MacLean, H. R. 2004. CCGS W. E. Ricker Gulf of Alaska salmon survey, October 8-27, 2003. Can. Data Rep. Fish. Aquat. Sci. 1145: 116 p.

14) Welch, D. W., Morris, J. F. T., Thiess, M. E., Trudel, M., Ladouceur, A. R., Zubkowski, T. B., Jacobs, M. C., and MacLean, H. R. 2004. F.V. Ocean Selector Gulf of Alaska salmon survey, June 16-28, 2002. Can Data Rep. Fish. Aquat. Sci. 1146: 71 p.

15) Morris, J. F. T., Welch, D. W., Thiess, M. E., Trudel, M., Ladouceur, A. R., Jacobs, M. C., and Zubkowski, T. B. 2004. The joint USA – Canada echo integration - trawl survey in 2001: a report on the catch and biological data collected for Pacific salmon from July 28 to August 18. Can Data Rep. Fish. Aquat. Sci. 1150: 110 p.

16) Morris, J. F. T., Welch, D. W., Winchell, P. M., Thiess, M. E., Trudel, M., Zubkowski, T. B., and MacLean, H.R.. 2004. The joint USA – Canada echo integration - trawl survey from June 24 to September 8, 2003: a report on the catch and biological data collected for Pacific salmon off Southeast Alaska. Can Data Rep. Fish. Aquat. Sci. 1151: 43 p.

17) Morris, J. F. T., Trudel, M.,Thiess, M. E., Zubkowski, T. B., and MacLean, H. R. 2007. CCGS W.E. Ricker Gulf of Alaska salmon survey, October 20 – November 21, 2004. Can. Data Rep. Fish. Aquat. Sci. 1184: 121 p.

18) Morris, J. F. T., Trudel, M., Thiess, M. E., Zubkowski, T. B., and MacLean, H. R. 2007. CCGS W.E. Ricker Gulf of Alaska salmon survey, March 4-25, 2005. Can. Data Rep. Fish. Aquat. Sci. 1185: 83 p.

19) Morris,J. F. T., Trudel, M., Thiess, M. E., Zubkowski, T. B., Boyle, C. A., and MacLean, H. R. 2007. CFV Frosti Gulf of Alaska salmon survey, October 27 - November 20, 2005. Can. Data Rep. Fish. Aquat. Sci. 1186: 136 p.

20) Morris, J. F. T., Trudel, M., Thiess, M. E., Zubkowski, T. B., and MacLean, H. R. 2007. CFV Frosti Gulf of Alaska salmon survey, June 28 - July 7, 2005. Can. Data Rep. Fish. Aquat. Sci. 1187: 125 p.

21) Morris, J. F. T., Trudel, M., Thiess, M. E., Zubkowski, T. B., Boyle, C. A., and MacLean, H. R. 2007. CCGS W.E. Ricker Gulf of Alaska salmon survey, February 28 - March 27, 2006. Can. Data Rep. Fish. Aquat. Sci. 1191: 73 p.

22) Morris, J. F. T., Trudel, M., Welch, D. W.,Thiess, M. E., Zubkowski, T. B., and MacLean, H. R. 2007. CCGS W.E. Ricker Gulf of Alaska salmon survey, February 13-28, 2004. Can. Data Rep. Fish. Aquat. Sci. 1193: 47 p.

23) Morris, J. F. T., Trudel, M., Thiess, M. E., Zubkowski, T. B., Boyle, C. A., and MacLean, H. R. 2008. CCGS W.E. Ricker Gulf of Alaska salmon survey, June 21-30, 2006. Can. Data Rep. Fish. Aquat. Sci. 1198: 145 p.

24) Morris, J. F. T., Trudel, M., Thiess, M. E., Boyle, C. A., Zubkowski, T. B., and MacLean, H. R. 2008. CCGS W.E. Ricker Gulf of Alaska salmon survey, November 7 – December 6, 2006. Can. Data Rep. Fish. Aquat. Sci. 1199: 144 p.

25) Morris, J.F.T., M. Trudel, D.W. Welch, M.E. Thiess, and T.B. Zubkowski. 2004. Canadian Highseas Salmon surveys: CWT recoveries from juvenile Chinook and coho salmon on the continental shelf of British Columbia and southeast Alaska from 1998 to 2003. North Pacific Anadromous Fish Commission Document No. 823.

26) Morris, J.F.T., M. Trudel, D.W. Welch, M.E. Thiess, T.B. Zubkowski, and H.R.C. MacLean. 2004. Canadian Highseas Salmon surveys in the fall of 2003 and the winter of 2004: seasonal changes in the distributions of juvenile salmon on the continental shelf off British Columbia and southeast Alaska. North Pacific Anadromous Fish Commission Document No. 780.