

## Research on Fraser River adult sockeye salmon migrations

### Peer-reviewed papers in scientific journals

Links to PDF versions of the following papers can be found at:

<http://faculty.forestry.ubc.ca/hinch/Salmon%20mig%20and%20repro%20pubs.html>

- Farrell, A.P., S.G. Hinch, S.J. Cooke, D.A. Patterson, G.T. Crossin, M. Lapointe, and M.T. Mathes. 2008. Pacific salmon in hot water: applying aerobic scope models and biotelemetry to predict the success of spawning migrations. *Physiological and Biochemical Zoology*. 82: In press.
- Hanson, K.C., S.J. Cooke, S.G. Hinch, G.T. Crossin, D.A. Patterson, K.K. English, M.R. Donaldson, J.M. Shrimpton, G. Van Der Kraak, and A.P. Farrell. 2008. Individual variation in migration speed of upriver migrating sockeye salmon in the Fraser River in relation to their physiological and energetic status at marine approach. *Physiological and Biochemical Zoology*. 82: In press
- Cooke, S.J., Hinch, S.G., Crossin, G.T., Patterson, D.A., English, K.K., Healey, M.C., Macdonald, J.S., Shrimpton, J.M., Young, J.L., Lister, A., Van Der Kraak, G., and Farrell, A.P. 2008. Physiological correlates of coastal arrival and river entry timing in Late Summer Fraser River sockeye salmon (*Oncorhynchus nerka*). *Behavioural Ecology*. In press.
- Crossin, G.T., Hinch, S.G., Cooke, S.J., Welch, D.W., Lotto, A.G., Patterson, D.A., Jones, S.R.M., Leggatt, R.A., Mathes, M.T., Shrimpton, J.M., Van Der Kraak, G., and Farrell A.P. 2008. Exposure to high temperature influences the behaviour, physiology, and survival of sockeye salmon during spawning migrations. *Canadian Journal of Zoology* 86: 127-140.
- Crossin, G.T., S.G. Hinch, S.J. Cooke, D.W. Welch, S.D. Batten, D.A. Patterson, G. Van Der Kraak, J.M. Shrimpton, and A.P. Farrell. 2007. Behaviour and physiology of sockeye salmon homing through coastal waters to a natal river. *Marine Biology* 152:905-918.
- Young, J.L., Bornik, Z.B., Marcotte, M.L., Charlie, K.N., Wagner, G.N., Hinch, S.G. and Cooke, S.J. 2006. Integrating physiology and life history to improve marine fisheries management and conservation. *Fish and Fisheries*. 7:262-283.
- Rand, P.S., S.G. Hinch, J. Morrison, M.G.G. Foreman, M.J. MacNutt, J.S. Macdonald, M.C. Healey, A.P. Farrell, and D.A. Higgs. 2006. Effects of changes to river discharge, temperature, and future climates on energetics and mortality of adult migrating Fraser River sockeye salmon. *Transactions of the American Fisheries Society*. 135:655-667.

- Cooke, S.J., S.G. Hinch, G.T. Crossin, D.A. Patterson, K.K. English, J. M. Shrimpton, G. Van Der Kraak, and A.P. Farrell. 2006. Physiology of individual late-run Fraser River sockeye salmon *Oncorhynchus nerka* sampled in the ocean correlates with fate during spawning migration. *Canadian Journal of Fisheries and Aquatic Sciences* 63: 1469-1480.
- Cooke, S.J., S.G. Hinch, G.T. Crossin, D.A. Patterson, K.K. English, M.C. Healey, J.M. Shrimpton, G. Van Der Kraak and A.P. Farrell. 2006. Mechanistic basis of individual mortality in Pacific salmon during spawning migrations. *Ecology* 87(6):1575-1586
- Young, J.L, S.G. Hinch, S.J. Cooke, G.T. Crossin, D.A. Patterson, A.P. Farrell, G. Van Der Kraak, A. Lotto, A. Lister, M.C. Healey, and K. English. 2006. Physiological and energetic correlates of en route mortality for abnormally early migrating adult sockeye salmon in the Thompson River, British Columbia. *Canadian Journal of Fisheries and Aquatic Sciences*. 63: 1469-1480.
- MacNutt, M.J, S.G. Hinch, C.G. Lee, J. R. Phibbs, A.G. Lotto, M. C. Healey, and A. P. Farrell. 2006. Temperature effects on swimming performance, energetics, and aerobic capacities of mature adult pink salmon (*Oncorhynchus gorbuscha*) compared with those of sockeye salmon (*Oncorhynchus nerka*). *Canadian Journal of Zoology* 84: 88–97.
- Wagner, G.N., Kuchel, L., Lotto, A., Patterson, D.A., Shrimpton, M., Hinch, S.G., and Farrell, A.P. 2006. Routine and active metabolic rates of migrating, adult sockeye salmon (*Oncorhynchus nerka* Walbaum) in seawater and freshwater. *Physiological and Biochemical Zoology*. 79(1):100–108.
- Shrimpton, J.M., D.A. Patterson, J.G. Richards, S.J. Cooke, P.M. Schulte, S.G. Hinch, and A.P. Farrell. 2005. Ionoregulatory changes in different populations of maturing sockeye salmon (*Oncorhynchus nerka*) from the Fraser River, British Columbia during ocean and river migration. *Journal of Experimental Biology* 208:4069-4078.
- Wagner, G.N., S.G. Hinch, L.J. Kuchel, A. Lotto, S.R.M. Jones, D.A. Patterson, J.S. Macdonald, G. Van Der Kraak, M. Shrimpton, K.K. English, S. Larsson, S.J. Cooke, M.C. Healey, and A.P. Farrell. 2005. Metabolic rates and swimming performance of adult Fraser River sockeye salmon (*Oncorhynchus nerka*) after a controlled infection with *Parvicapsula minibicornis*. *Canadian Journal of Fisheries and Aquatic Sciences*. 62: 2124–2133
- Cooke, S.J., G.T. Crossin, D. Patterson, K. English, S.G. Hinch, J.L. Young, R. Alexander, M.C. Healey, G. Van Der Kraak, and A.P. Farrell. 2005. Coupling non-invasive physiological assessments with telemetry to understand inter-individual variation in behaviour and survivorship of sockeye salmon: development and validation of a technique. *Journal of Fish Biology*. 67: 1-17.
- Crossin, G.T. and S.G. Hinch. 2005. A non-lethal method for assessing the somatic energy content of freely migrating adult Pacific salmon. *Transactions of the American Fisheries Society*. 134:184–191.

- Mehranvar, L., M.C. Healey, A.P. Farrell, and S.G. Hinch. 2004. Social versus genetic measures of reproductive success in sockeye salmon, *Oncorhynchus nerka*. *Evolutionary Ecology Research* 6:1167-1181.
- Crossin G.T., S.G. Hinch, A.P. Farrell, D.A. Higgs, and M.C. Healey. 2004. Somatic energy of sockeye salmon at the onset of upriver migration: a comparison among ocean climate regimes. *Fisheries Oceanography*. 13:345–349.
- Crossin, G.T., S.G. Hinch, A.P. Farrell, D.A. Higgs, A.G. Lotto, J.D. Oakes, and M.C. Healey. 2004. Energetics and morphology of sockeye salmon: effects of upriver migratory distance and elevation. *Journal of Fish Biology*. 65: 788–810.
- Standen, E.M., S.G. Hinch, and P.S. Rand. 2004. Influence of river currents on path selection and swimming efficiency of migrating adult sockeye salmon. *Canadian Journal of Fisheries and Aquatic Sciences*. 61:905-912.
- Patterson, D.A., J.S. Macdonald, S.G. Hinch, M.C. Healey, and A.P. Farrell. 2004. The effect of exercise and captivity on energy partitioning, reproductive maturation, and fertilization success in adult sockeye salmon. *Journal of Fish Biology* 64:1-21
- Cooke, S.J., S.G. Hinch, A.P. Farrell, M.F. Lapointe, S.R.M. Jones, J.S. Macdonald, D.A. Patterson, M.C. Healey. 2004. Abnormal migration timing and high en route mortality of sockeye salmon in the Fraser River, British Columbia. *Fisheries*. 29:22-33.
- Crossin G.T., S.G. Hinch, A.P. Farrell, M.P. Whelley, and M.C. Healey. 2003. Pink salmon (*Oncorhynchus gorbuscha*) migratory energetics: response to migratory difficulty and comparisons with sockeye (*O. nerka*). *Canadian Journal of Zoology*. 81: 1986–1995.
- Lee, C.G., A.P. Farrell, A. Lotto, M.J. MacNutt, S.G. Hinch, and M.C. Healey. 2003a. The effect of temperature on swimming performance and oxygen consumption in adult sockeye (*Oncorhynchus nerka*) and coho (*O. kisutch*) salmon stocks. *Journal of Experimental Biology*. 206: 3239-3251.
- Lee, C.G., A.P. Farrell, A. Lotto, S.G. Hinch, and M.C. Healey. 2003b. Excess post-exercise oxygen consumption in adult sockeye (*Oncorhynchus nerka*) and coho (*O. kisutch*) salmon following critical speed swimming. *Journal of Experimental Biology*. 206: 3253-3260.
- Farrell, A.P., C.G. Lee, K. Tierney, A. Hodaly, S. Clutterham, M. Healey, S.G. Hinch, and A. Lotto. 2003. Field-based measurements of oxygen uptake and swimming performance with adult Pacific salmon using a mobile respirometer swim tunnel. *Journal of Fish Biology*. 62:64-84.
- Healey, M.C., R. Lake, and S.G. Hinch. 2003. Energy expenditure during reproduction by sockeye salmon (*Oncorhynchus nerka*). *Behaviour* 140:161-182.

- Hinch S.G., E. M. Standen, M.C. Healey, A. P. Farrell. 2002. Swimming patterns and behaviour of upriver migrating adult pink (*Oncorhynchus gorbuscha*) and sockeye (*O. nerka*) salmon as assessed by EMG telemetry in the Fraser River, British Columbia, Canada. *Hydrobiologia* 483:147-160
- Standen, E.M., S.G. Hinch, M.C. Healey, A.P. Farrell. 2002. Energetic costs of migration through the Fraser River Canyon, British Columbia, in adult pink (*Oncorhynchus gorbuscha*) and sockeye (*O. nerka*) salmon as assessed by EMG telemetry. *Canadian Journal of Fisheries and Aquatic Sciences* 59:1809-1818.
- Hinch. S.G. and P.S. Rand. 2000a. Optimal swim speeds and forward assisted propulsion: energy conserving behaviours of up-river migrating salmon. *Canadian Journal of Fisheries and Aquatic Sciences*. 57:2470-2478.
- Healey, M.C., K.A. Thomson, P.H. LeBlond, L. Huato, S.G. Hinch, and C.J. Walters. 2000. Computer simulations of the effects of the Sitka Eddy on sockeye salmon returning to British Columbia. *Fisheries Oceanography* 9:271-281.
- Hinch, S.G., and J.M. Bratty. 2000. Effects of swim speed and activity pattern on success of adult sockeye salmon migration through an area of difficult passage. *Transactions of the American Fisheries Society*. 129:604-612.
- Hinch, S.G. and P.S. Rand. 1998. Swim speeds and energy use of river migrating adult sockeye salmon: role of local environment and fish characteristics. *Canadian Journal of Fisheries and Aquatic Sciences* 55:1821-1831.
- Rand, P.S. and S.G. Hinch. 1998a. Swim speeds and energy use of river migrating adult sockeye salmon: simulating metabolic power and assessing risk of energy depletion. *Canadian Journal of Fisheries and Aquatic Sciences* 55:1832-1841.
- Cox, S.P., and S.G. Hinch. 1997. Changes in size at maturity of Fraser River sockeye salmon (*Oncorhynchus nerka*) (1952-1993) and associations with temperature. *Canadian Journal of Fisheries and Aquatic Sciences* 54:1159-1165.
- Ballantyne, J.S., F. Mercure, M.F. Gerrits, G. Van Der Kraak, S. McKinley, D.W. Martens, S.G. Hinch, and R.E. Diewert. 1996. Plasma non-esterified fatty acid profiles in adult sockeye salmon (*Oncorhynchus nerka*) during the spawning migration. *Canadian Journal of Fisheries and Aquatic Sciences* 53:1418-1426.
- Hinch, S.G., R.E. Diewert, T.J. Lissimore, A.M.J. Prince, M.C. Healey, and M.A. Henderson. 1996. Use of electromyogram telemetry to assess difficult passage areas for river migrating adult sockeye salmon. *Transactions of the American Fisheries Society* 125:253-260.

Hinch, S.G., M.C. Healey, R.E. Diewert, K.A. Thomson, M.A. Henderson, R. Hourston, and F. Juanes. 1995. Potential effects of climate change on marine growth and survival of Fraser River sockeye salmon. *Canadian Journal of Fisheries and Aquatic Sciences* 52:2651-2659.