

# Vulnerabilidad socio ecológica de la salmonicultura frente al cambio climático

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- Bueno, P. & Soto, D. 2017. Adaptation strategies of the aquaculture sector to the impacts of climate change. FAO Fisheries and Aquaculture Circular No. 1142. FAO, Rome.
- Garreaud, R. 2018. Record-breaking climate anomalies lead to severe drought and environmental disruption in Western Patagonia in 2016. *Climate Research*, 74: 217-229.
- Handisyde, N., Telfer, T. & Ross, L. 2017. Vulnerability of aquaculture-related livelihoods to changing climate at the global scale. *Fish and Fisheries*, 18: 466-488.
- León-Muñoz, J., Urbina, M., Iriarte, J. & Garreaud, R. 2018. Hydroclimatic conditions trigger record harmful algal bloom in western Patagonia (summer 2016). *Scientific Reports*, 8: 1-10
- Soto, D., León-Muñoz, J., Dresdner, J., Luengo, C., Tapia, F. & Garreaud, R. 2019. Salmon farming vulnerability to climate change in southern Chile: understanding the biophysical - socioeconomic and governance links. *Reviews in Aquaculture*, 11: 354-374.
- Soto, D. 2022. Policy Brief N°11. Propuesta para establecer un sistema que regule la máxima producción posible de salmonídeos en ecosistemas marinos atendiendo a su capacidad de carga. [<https://centroincarc.cl/wp-content/uploads/2022/07/PolicyBrief11Incar.pdf>].
- Vargas, D.; Vallejos-Vidal, E.; Reyes-Cerpa, S.; Oyarzun-Arrau, A.; Acuna-Castillo, C.; Imarai, M.; Reyes-López, F.; Sandino, A. The Analysis of Live-Attenuated *Piscirickettsia salmonis* Vaccine Reveals the Short-Term Upregulation of Innate and Adaptive Immune Genes in Atlantic Salmon (*Salmo salar*): An In Situ Open-Sea Cages Study. *Microorganisms* 2021, 9, 703.
- Karatas, S.; Mikalsen, J.; Steinum, T.M.; Taksdal, T.; Bordevik, M.; Colquhoun, D.J. Real time PCR detection of *Piscirickettsia salmonis* from formalin-fixed paraffin-embedded tissues. *J. Fish Dis.* 2008, 31, 747-753.
- Delphino, M.; Mardones, F.O.; Neumann Heise, J.; Gallardo, A.; Jimenez, D.; Pena, A.; Rozas-Serri, M.; Gardner, I.A. Cost-effectiveness of longitudinal surveillance for *Piscirickettsia salmonis* using qPCR in Atlantic salmon farms (*Salmo salar*) in Chile. *J. Fish Dis.* 2021, 44, 315-326.
- Laurin, E.; Gardner, I.A.; Pena, A.; Rozas-Serri, M.; Gayosa, J.; Neumann Heise, J.; Mardones, F.O. Bayesian estimation of diagnostic sensitivity and specificity of a qPCR and a bacteriological culture method for *Piscirickettsia salmonis* in farmed Atlantic salmon (*Salmo salar* L.) in Chile. *J. Fish Dis.* 2020, 43, 1167-1175. Gaete-Carrasco, A.; Rosenfeld, C.; Gallardo, A. Análisis epidemiológico del programa de vigilancia activa de *Piscirickettsia salmonis* del Servicio Nacional de Pesca y Acuicultura de Chile. *Rev. Sci. Tech.* 2019, 38, 823-849.
- Rees, E.E.; Ibarra, R.; Medina, M.; Sanchez, J.; Jakob, E.; Vanderstichel, R.; St-Hilaire, S. Transmission of *Piscirickettsia salmonis* among saltwater salmonid farms in Chile. *Aquaculture* 2014, 428-429, 189-194.
- Happold, J.; Meyer, A.; Sadler, R.; Cowled, B.; Mackenzie, C.; Stevenson, M.; Ward, M.P.; Lagno, A.L.G.; Cameron, A. Effectiveness of antimicrobial treatment of salmonid rickettsial septicaemia in commercial salmon and trout farms in Chile. *Aquaculture* 2020, 525, 735323.
- Rise, M.L.; Jones, S.R.; Brown, G.D.; von Schalburg, K.R.; Davidson, W.S.; Koop, B.F. Microarray analyses identify molecular biomarkers of Atlantic salmon macrophage and hematopoietic kidney response to *Piscirickettsia salmonis* infection. *Physiol. Genom.* 2004, 20, 21-35.
- Rozas-Serri, M. Why Does *Piscirickettsia salmonis* Break the Immunological Paradigm in Farmed Salmon? Biological Context to Understand the Relative Control of *Piscirickettsiosis*. *Front. Immunol.* 2022, 13, 856896.
- Tacchi, L.; Bron, J.E.; Taggart, J.B.; Secombes, C.J.; Bickerdike, R.; Adler, M.A.; Takle, H.; Martin, S.A.M. Multiple tissue transcriptomic responses to *Piscirickettsia salmonis* in Atlantic salmon (*Salmo salar*). *Physiol. Genomic.* 2011, 43, 1241-1254.
- Gaete-Carrasco, A.; Rosenfeld, C.; Gallardo, A. Análisis epidemiológico del programa de vigilancia activa de *Piscirickettsia salmonis* del Servicio Nacional de Pesca y Acuicultura de Chile. *Rev. Sci. Tech.* 2019, 38, 823-849.
- Rees, E.E.; Ibarra, R.; Medina, M.; Sanchez, J.; Jakob, E.; Vanderstichel, R.; St-Hilaire, S. Transmission of *Piscirickettsia salmonis* among salt water salmonid farms in Chile. *Aquaculture* 2014, 428-429, 189-194.
- Happold, J.; Meyer, A.; Sadler, R.; Cowled, B.; Mackenzie, C.; Stevenson, M.; Ward, M.P.; Lagno, A.L.G.; Cameron, A. Effectiveness of antimicrobial treatment of salmonid rickettsial septicaemia in commercial salmon and trout farms in Chile. *Aquaculture* 2020, 525, 735323.
- Rise, M.L.; Jones, S.R.; Brown, G.D.; von Schalburg, K.R.; Davidson, W.S.; Koop, B.F. Microarray analyses identify molecular biomarkers of Atlantic salmon macrophage and hematopoietic kidney response to *Piscirickettsia salmonis* infection. *Physiol. Genom.* 2004, 20, 21-35.
- Rozas-Serri, M. Why Does *Piscirickettsia salmonis* Break the Immunological Paradigm in Farmed Salmon? Biological Context to Understand the Relative Control of *Piscirickettsiosis*. *Front. Immunol.* 2022, 13, 856896.
- Tacchi, L.; Bron, J.E.; Taggart, J.B.; Secombes, C.J.; Bickerdike, R.; Adler, M.A.; Takle, H.; Martin, S.A.M. Multiple tissue transcriptomic responses to *Piscirickettsia salmonis* in Atlantic salmon (*Salmo salar*). *Physiol. Genomic.* 2011, 43, 1241-1254