**Supplementary Table S1.** Primers and probes used in the study.

|  |  |  |  |
| --- | --- | --- | --- |
| Target | Primer and probe sequences (5′–3′) | | Reference |
| Major histocompatibility class II | AS\_MHCII\_F | AGAAGCCTGGAACAAAGGTCCTGA | (Ahmed, 2022) |
| AS\_MHCII\_R | AACTGTCTTGTCCAGTATGGCGCT |
| Interleukin 1 beta | AS\_IL1β\_F | AACACCGGGGTTGACATCAG |
| AS\_IL1β\_R | TTAGTTGTGGCGCTGGATGG |
| Transforming growth factor beta | AS\_Tgf β\_F | GCCATCCGTGGACAGATACT |
| AS\_Tgf β\_R | TCTCCCTCCTGGTCAATCTCT |
| Tumour necrosis factor | AS\_TNFα\_F | AGGTTGGCTATGGAGGCTGT |
| AS\_TNFα\_R | TCTGCTTCAATGTATGGTGGG |
| Interleukin 10 | AS\_IL10\_F | TCCTCTCTCCTCCTATCCGTGC |
| AS\_IL10\_R | ATAAAGGAGCAGCAACGGTCG |
| Beta-actin | AS\_ β actin\_F | CCATCCAGGCAGTGTTGT |
| AS\_ β actin\_R | CGGAGTCCATGACGATACC |
| 16S rRNA V3-4 | V3-4 [314F] | CCTACGGGNGGCWGCAG | (Huang et al., 2018; Kiruthiga et al., 2018) |
| V3-4 [805R] | GACTACHVGGGTATCTAATCC |
| V3\_V4\_TaqMan | ATTACCGCGGCTGCTGG |
| 16S rRNA V4 | 16S\_V4F | TCGTCGGCAGCGTCAGATGTGTATAAGAGACAGAYTGGGYDTAAAGNG | (Ma et al., 2017) |
| 16S\_V4R\_1 | GTCTCGTGGGCTCGGAGATGTGTATAAGAGACAGTACCRGGGTHTCTAATCC |
| 16S\_V4R\_2 | GTCTCGTGGGCTCGGAGATGTGTATAAGAGACAGTACCAGAGTATCTAATTC |
| 16S\_V4R\_3 | GTCTCGTGGGCTCGGAGATGTGTATAAGAGACAGCTACDSRGGTMTCTAATC |
| 16S\_V4R\_4 | GTCTCGTGGGCTCGGAGATGTGTATAAGAGACAGTACNVGGGTATCTAATC |
| Atlantic salmon elongation factor  (EFA) | EFA-Probe | ATCGGTGGTATTGGAAC | (Olsvik et al., 2005) |
| EFA-F | CAG AGG TTT TTC ATA CGC CAG AA |
| EFA-R | GAG GTC ACG GTG ATG ACA GAA C |
| Rainbow trout elongation factor | OMelf-F | CCC CTC CAG GAT GTC TAC AAA | (Kvåle, 2020) |
| Omelf-R | CAC ACG GCC CAC GGG TAC T |
| OMelf-probe | ATC GGC GGT ATT GGA AC |
| Halobacterium salinarum  (Hsal) | Hsal-Probe | AGG CGT CCA GCG GA | (Andersen et al., 2010) |
| Hsal-F | GGG AAA TCT GTC CGC TTA ACG |
| Hsal-R | CCG GTC CCA AGC TGA ACA |
| Infectious salmon anemia virus  (Segment 7) (ISAV) | ISAV-Probe | CAC ATG ACC CCT CGT C | (Plarre et al., 2005) |
| ISAV-F | TGG GAT CAT GTG TTT CCT GCT A |
| ISAV-R | GAA AAT CCA TGT TCT CAG ATG CAA |
| Salmon gill poxvirus  (SGPV) | SGPV-Probe | TTA TAC ACC ATC ACA TTT GTG | (Nylund et al., 2021) |
| SGPV-F | CAG AGG TTT TTC ATA CGC CAG AA |
| SGPV-R | GAG GTC ACG GTG ATG ACA GAA C |
| Salmonid alphavirus  (SAV) | SAV-Probe | CTG GCC ACC ACT TCG A | (Hodneland and Endresen, 2006) |
| SAV-F | CCG GCC CTG AAC CAG TT |
| SAV-R | GTA GCC AAG TGG GAG AAA GCT |
| Piscine orthoreovirus (PRV) | PRV-Probe | CTG GCT CAA CTC TC | (Nylund et al., 2018a) |
| PRV-F | CAA TCG CAA GGT CTG ATG CA |
| PRV-R | GGG TTC TGT GCT GGA GAT GAG |
| Piscine myocarditis virus  (PMCV) | PMCV-Probe | TGG TGG AGC GTT CAA | (Nylund et al., 2018a) |
| PMCV-F | AGG GAA CAG GAG GAA GCA GAA |
| PMCV-R | CGT AAT CCG ACA TCA TTT TGT GA |
| Infectious pancreatic necrosis virus  (IPNV) | IPNV-Probe | TCT TGG CCC CGT TCA TT | (Watanabe et al., 2006) |
| IPNV-F | ACC CCA GGG TCT CCA GTC |
| IPNV-R | GGA TGG GAG GTC GAT CTC GTA |
| Tenacibaculum maritimum  (Tmar) | Tmar-Probe | TGA ATC AAA TGC GAT CTT | (Frisch et al., 2018) |
| Tmar-F | GCC AAT AGC AAC GGG ATA CC |
| Tmar-R | TCG TGC GAC CAT CTT TGG T |
| Tenacibaculum sp. (TB-tuf) | TB-tuf- Probe | TTT CAA TAC ATA CAC CTC AGC | (Småge et al., 2017) |
| TB-tuf-F | AGT GTG ACG TCC ACC TT |
| TB-tuf-R | CTG TAA GCC AGG TTC TGT |
| Candidatus Clavichlamydia salmonicola (Ach) | Ach-Probe | CGT GAC AGC GAT AGA G | (Steigen et al., 2013) |
| Ach-F | AGA ACC TTA CCC AGA TTT GAC ATG T |
| Ach-R | CCT GTC CTT TCG GAA GAC GAT |
| Candidatus Branchiomonas cysticola (Epit) | Epit-Probe | ACT TAG CGA AAG TTA AGC | (Nylund et al., 2018a) |
| Epit-F | GAG TAA TAC ATC GGA ACG TGTCTA GTG |
| Epit-R | CTT TCC TCT CCC AAG CTT ATG C |
| Candidatus  Piscichlamydia  salmonis (Pch) | Pch-Probe | CAA AAC TGC TAG ACT AGA GT | (Nylund et al., 2008) |
| Pch-F | TCA CCC CCA GGC TGC TT |
| Pch-R | GAA TTC CAT TTC CCC CTC TTG |
| Candidatus Syngnamydia salmonis (Sch) | Sch-Probe | TCC TTC GGG ACC TTA C | (Nylund et al., 2015) |
| Sch-F | GGG TAG CCC GAT ATC TTC AAA GT |
| Sch-R | CCC ATG AGC CGC TCT CTC T |
| Yersinia ruckeri | Yersinia-Probe | TAA TAG CAC TGA ACA TTG AC | (Kvåle, 2020) |
| Yersinia-F | GCG AGG AGG AAG GGT TAA GTG |
| Yersinia-R | CGG TGC TTC TTC TGC GAG TAA |
| Ichthyobodo sp. (Costia) | Costia-Probe | TCC ACG ACT GCA AAC GAT GAC G | (Isaksen et al., 2012) |
| Costia-F | ACG AAC TTA TGC GAA GGC A |
| Costia-R | TGA GTA TTC ACT YCC GAT CCA T |
| Paranucleospora theridion  (Nuc) | Nuc-Probe | TTG GCG AAG AAT GAA A | (Nylund et al., 2010) |
| Nuc-F | CGG ACA GGG AGC ATG GTA TAG |
| Nuc-R | GGT CCA GGT TGG GTC TTG AG |
| Paramoeba perurans  (Pperu) | Pperu-Probe | CTG GTT CTT TCG RGA GC | (Nylund et al., 2018b) |
| Pperu-F | GAT AAC CGT GGT AAA TCT AGA GCT AAT A |
| Pperu-R | TGG CAT TGG CTT TTG AAT CT |
| Parvicapsula  pseudobranchicola (Parvi) | Parvi-Probe | CCG TAT TGC TGT CTT TGA | (Nylund et al., 2011) |
| Parvi-F | TCG TAG TCG GAT GAC AAG AAC GT |
| Parvi-R | AAA CAC CCC GCA CTG CAT |
| Tetracapsuloides  salmoniarum (PKD) | Probe | Probe: TGT TGT TAG GAT ATT TTC C | (Kvåle, 2020) |
| Forward | Forward: CAA GAT CGC GCC CTA TCA AT |
| Revers | Revers: CGT CAC CCG TTA CAA CCT TGT |

**References**

Ahmed, A. M. K. E. (2022) *Impact of husbandry practice on the gill microbiome of Salmo salar and Oreochromis niloticus.* PhD University of Stirling

Andersen, L., Hodneland, K. & Nylund, A. (2010) No influence of oxygen levels on pathogenesis and virus shedding in Salmonid alphavirus (SAV)-challenged Atlantic salmon (Salmo salar L.). *Virology Journal,* 7(1)**,** 198. 10.1186/1743-422X-7-198.

Frisch, K., Småge, S. B., Brevik Ø, J., Duesund, H. & Nylund, A. (2018) Genotyping of Tenacibaculum maritimum isolates from farmed Atlantic salmon in Western Canada. *J Fish Dis,* 41(1)**,** 131-137. 10.1111/jfd.12687.

Hodneland, K. & Endresen, C. (2006) Sensitive and specific detection of Salmonid alphavirus using real-time PCR (TaqMan). *J Virol Methods,* 131(2)**,** 184-92. 10.1016/j.jviromet.2005.08.012.

Huang, W., Cheng, Z., Lei, S., Liu, L., Lv, X., Chen, L., Wu, M., Wang, C., Tian, B. & Song, Y. (2018) Community composition, diversity, and metabolism of intestinal microbiota in cultivated European eel (Anguilla anguilla). *Applied Microbiology and Biotechnology,* 102(9)**,** 4143-4157. 10.1007/s00253-018-8885-9.

Isaksen, T. E., Karlsbakk, E., Repstad, O. & Nylund, A. (2012) Molecular tools for the detection and identification of Ichthyobodo spp. (Kinetoplastida), important fish parasites. *Parasitology International,* 61(4)**,** 675-683. <https://doi.org/10.1016/j.parint.2012.07.006>.

Kiruthiga, R., Thanislass, J., Antony, P., Lydia, D. & Uma Maheswari, D. (2018) SSCP Analysis of V3 Region of 16S rRNA for the Characterization of Rumen Microbiome of Goat. *J Anim Sci Res,* 2(1).

Kvåle, B. L. (2020) *Effekt av termisk avlusing på gjellehelse hos laks: Hos patogenfri laks og i kommersiell produksjon på Vestlandet.* Master The University of Bergen.

Ma, L., Xie, Y., Han, Z., Giesy, J. P. & Zhang, X. (2017) Responses of earthworms and microbial communities in their guts to Triclosan. *Chemosphere,* 168**,** 1194-1202. <https://doi.org/10.1016/j.chemosphere.2016.10.079>.

Nylund, A., Hansen, H., Brevik, Ø. J., Hustoft, H., Markussen, T., Plarre, H. & Karlsbakk, E. (2018a) Infection dynamics and tissue tropism of Parvicapsula pseudobranchicola (Myxozoa: Myxosporea) in farmed Atlantic salmon (Salmo salar). *Parasites & Vectors,* 11(1)**,** 17. 10.1186/s13071-017-2583-9.

Nylund, A., Pistone, D., Trösse, C., Blindheim, S., Andersen, L. & Plarre, H. (2018b) Genotyping of Candidatus Syngnamydia salmonis (chlamydiales; Simkaniaceae) co-cultured in Paramoeba perurans (amoebozoa; Paramoebidae). *Archives of microbiology,* 200(6)**,** 859-867. 10.1007/s00203-018-1488-0.

Nylund, A., Røed, M., Blindheim, S., Trösse, C. & Andersen, L. (2021) Experimental challenge of Atlantic salmon Salmo salar using clones of Paramoeba perurans, P. pemaquidensis and Tetramitus sp. *Dis Aquat Organ,* 145**,** 1-13. 10.3354/dao03597.

Nylund, A., Watanabe, K., Nylund, S., Karlsen, M., Sæther, P. A., Arnesen, C. E. & Karlsbakk, E. (2008) Morphogenesis of salmonid gill poxvirus associated with proliferative gill disease in farmed Atlantic salmon (Salmo salar) in Norway. *Archives of Virology,* 153(7)**,** 1299-1309. 10.1007/s00705-008-0117-7.

Nylund, S., Andersen, L., Saevareid, I., Plarre, H., Watanabe, K., Arnesen, C. E., Karlsbakk, E. & Nylund, A. (2011) Diseases of farmed Atlantic salmon Salmo salar associated with infections by the microsporidian Paranucleospora theridion. *Dis Aquat Organ,* 94(1)**,** 41-57. 10.3354/dao02313.

Nylund, S., Nylund, A. R. E., Watanabe, K., Arnesen, C. E. & Karlsbakk, E. (2010) Paranucleospora theridion n. gen., n. sp. (Microsporidia, Enterocytozoonidae) with a Life Cycle in the Salmon Louse (Lepeophtheirus salmonis, Copepoda) and Atlantic Salmon (Salmo salar). *Journal of Eukaryotic Microbiology,* 57(2)**,** 95-114. <https://doi.org/10.1111/j.1550-7408.2009.00451.x>.

Nylund, S., Steigen, A., Karlsbakk, E., Plarre, H., Andersen, L., Karlsen, M., Watanabe, K. & Nylund, A. (2015) Characterization of 'Candidatus Syngnamydia salmonis' (Chlamydiales, Simkaniaceae), a bacterium associated with epitheliocystis in Atlantic salmon (Salmo salar L.). *Archives of microbiology,* 197(1)**,** 17-25. 10.1007/s00203-014-1038-3.

Olsvik, P. A., Lie, K. K., Jordal, A.-E. O., Nilsen, T. O. & Hordvik, I. (2005) Evaluation of potential reference genes in real-time RT-PCR studies of Atlantic salmon. *BMC molecular biology,* 6**,** 21-21. 10.1186/1471-2199-6-21.

Plarre, H., Devold, M., Snow, M. & Nylund, A. (2005) Prevalence of infectious salmon anaemia virus (ISAV) in wild salmonids in western Norway. *Dis Aquat Organ,* 66(1)**,** 71-9. 10.3354/dao066071.

Småge, S. B., Brevik, Ø. J., Frisch, K., Watanabe, K., Duesund, H. & Nylund, A. (2017) Concurrent jellyfish blooms and tenacibaculosis outbreaks in Northern Norwegian Atlantic salmon (Salmo salar) farms. *PLOS ONE,* 12(11)**,** e0187476. 10.1371/journal.pone.0187476.

Steigen, A., Nylund, A., Karlsbakk, E., Akoll, P., Fiksdal, I. U., Nylund, S., Odong, R., Plarre, H., Semyalo, R., Skår, C. & Watanabe, K. (2013) ‘Cand. Actinochlamydia clariae’ gen. nov., sp. nov., a Unique Intracellular Bacterium Causing Epitheliocystis in Catfish (Clarias gariepinus) in Uganda. *PLOS ONE,* 8(6)**,** e66840. 10.1371/journal.pone.0066840.

Watanabe, K., Karlsen, M., Devold, M., Isdal, E., Litlabø, A. & Nylund, A. (2006) Virus-like particles associated with heart and skeletal muscle inflammation (HSMI). *Dis Aquat Organ,* 70(3)**,** 183-92. 10.3354/dao070183.