

# Introduction for Fisheries and Aquatic Biology

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## APPENDIX

1.

Seawater density  $\rho$  can be expressed as a function of salinity  $s$  (psu), water temperature  $t$  ( $^{\circ}\text{C}$ ) and pressure  $p$  (bar) as follows.

$$\rho(s, t, p) = \frac{\rho(s, t, 0)}{1 - p/K(s, t, p)}$$

$\rho(s, t, 0)$  is a density at  $p = 0$  and expressed as follow.

$$\begin{aligned} \rho(s, t, 0) = & + 999.842\,594 & + 6.793\,952 \times 10^{-2} \times T \\ & - 9.095\,290 \times 10^{-3} \times T^2 & + 1.001\,685 \times 10^{-4} \times T^3 \\ & - 1.120\,083 \times 10^{-6} \times T^4 & + 6.536\,332 \times 10^{-9} \times T^5 \\ & + 8.244\,93 \times 10^{-1} \times S & - 4.089\,9 \times 10^{-3} \times T \times S \\ & + 7.643\,8 \times 10^{-5} \times T^2 \times S & - 8.246\,7 \times 10^{-7} \times T^3 \times S \\ & + 5.387\,5 \times 10^{-9} \times T^4 \times S & - 5.724\,66 \times 10^{-3} \times S^{3/2} \\ & + 1.022\,7 \times 10^{-4} \times T \times S^{3/2} & - 1.654\,6 \times 10^{-6} \times T^2 \times S^{3/2} \\ & + 4.831\,4 \times 10^{-4} \times S^2 & \\ K(s, t, p) = & + 19\,652.21 & \\ & + 148.420\,6 \times T & - 2.327\,105 \times T^2 \\ & + 1.360\,477 \times 10^{-2} \times T^3 & - 5.155\,288 \times 10^{-5} \times T^4 \\ & + 3.239\,908 \times p & + 1.437\,13 \times 10^{-3} \times T \times p \\ & + 1.160\,92 \times 10^{-4} \times T^2 \times p & - 5.779\,05 \times 10^{-7} \times T^3 \times p \\ & + 8.509\,35 \times 10^{-5} \times p^2 & - 6.122\,93 \times 10^{-6} \times T \times p^2 \\ & + 5.278\,7 \times 10^{-8} \times T^2 \times p^2 & \\ & + 54.674\,6 \times S & - 0.603\,459 \times T \times S \\ & + 1.099\,87 \times 10^{-2} \times T^2 \times S & - 6.167\,0 \times 10^{-5} \times T^3 \times S \\ & + 7.944 \times 10^{-2} \times S^{3/2} & + 1.648\,3 \times 10^{-2} \times T \times S^{3/2} \\ & - 5.300\,9 \times 10^{-4} \times T^2 \times S^{3/2} & + 2.283\,8 \times 10^{-3} \times p \times S \\ & - 1.098\,1 \times 10^{-5} \times T \times p \times S & - 1.607\,8 \times 10^{-6} \times T^2 \times p \times S \\ & + 1.910\,75 \times 10^{-4} \times p \times S^{3/2} & - 9.934\,8 \times 10^{-7} \times p^2 \times S \\ & + 2.081\,6 \times 10^{-8} \times T \times p^2 \times S & + 9.169\,7 \times 10^{-10} \times T^2 \times p^2 \times S \end{aligned}$$

2.

Potential water temperature  $\theta$  can be expressed as a function of salinity  $S$  (psu), water temperature  $t$  ( $^{\circ}\text{C}$ ) and pressure  $p$  (bar) as follow.

$$\begin{aligned} \theta(S, t, p) = & t - p(3.6504 \times 10^{-4} + 8.3198 \times 10^{-5}t - 5.4065 \times 10^{-7}t^2 \\ & + 4.0274 \times 10^{-9}t^3) - p(S - 35)(1.7439 \times 10^{-5} \\ & - 2.9778 \times 10^{-7}t) - p^2(8.9309 \times 10^{-7} - 3.1628 \times 10^{-8}t \\ & + 2.1987 \times 10^{-10}t^2) + 4.1057 \times 10^{-9}(S - 35)p^2 \\ & - p^3(-1.6056 \times 10^{-10} + 5.0484 \times 10^{-12}t) \end{aligned}$$