**Validation of a mathematical model of the bovine estrous cycle for cows with different estrous cycle characteristics**

H. M. T. Boer, S.T. Butler, C. Stötzel, M.F.W. te Pas, R. F. Veerkamp, H. Woelders

**Supplementary** **Table S2**

List of Hill functions1 used in the differential equations of the model (see supplementary table S1) for modeling inhibition and stimulation by other model components. A Hill function is a sigmoidal function between 0 and 1 that switches at a specified threshold from one level to the other with a specified steepness.

|  |
| --- |
| $H\_{1}^{-}(P4\&E2)∶=m\_{P4\&E2}^{GnRH,1}∙(h^{-}\left(P4\left(t\right);T\_{P4}^{GnRH,1},2\right)+h^{-}\left(E2\left(t\right),T\_{E2}^{GnRH,1},2\right)-h^{-}\left(P4\left(t\right);T\_{P4}^{GnRH,1},2\right)∙h^{-}\left(E2\left(t\right),T\_{E2}^{GnRH,1},2\right))$ |
| $H\_{2}^{-}(P4)∶=m\_{P4}^{GnRH,2}∙h^{-}(P4\left(t\right),T\_{P4}^{GnRH,2},2)$  |
| $H\_{3}^{+}(E2)∶=m\_{E2}^{GnRH,2}∙h^{+}(E2\left(t\right),T\_{E2}^{GnRH,2},5)$  |
| $H\_{4}^{-}(Inh)∶=m\_{Inh}^{FSH}∙h^{-}(Inh\left(t\right),T\_{Inh}^{FSH},5)$  |
| $H\_{5}^{+}(P4)∶=m\_{P4}^{FSH}∙h^{+}(P4\left(t\right);T\_{P4}^{FSH},2)$  |
| $H\_{6}^{-}(E2)∶=m\_{E2}^{FSH}∙h^{-}(E2\left(t\right);T\_{E2}^{FSH},2)$  |
| $H\_{7}^{+}(GnRH\_{Pit})∶=m\_{GnRH}^{FSH}∙h^{+}(GnRH\_{Pit}\left(t\right);T\_{GnRH}^{FSH},1)$  |
| $H\_{8}^{+}(E2)∶=m\_{E2}^{LH}∙h^{+}(E2\left(t\right);T\_{E2}^{LH},2)$  |
| $H\_{9}^{-}(P4)∶=m\_{P4}^{LH}∙h^{-}(P4\left(t\right);T\_{P4}^{LH},2)$  |
| $H\_{10}^{+}(GnRH\_{Pit)}∶=m\_{GnRH}^{LH}∙h^{+}(GnRH\_{Pit}\left(t\right);T\_{GnRH}^{LH},5)$  |
| $H\_{11}^{+}(FSH)∶=m\_{FSH}^{Foll}∙h^{+}(FSH\_{Blood}\left(t\right);\tilde{T}\_{FSH}^{Foll}\left(t\right),2)$  |
| $\tilde{T}\_{FSH}^{Foll}(t)∶=T\_{FSH}^{Foll}∙h^{-}(Foll\left(t\right);T\_{Foll}^{FSH},2)$  |
| $H\_{12}^{+}(P4)∶=m\_{P4}^{Foll}∙h^{+}(P4\left(t\right);T\_{P4}^{Foll},5)$  |
| $H\_{13}^{+}(LH)∶=m\_{LH}^{Ovul. Foll}∙h^{+}(LH\_{Blood}\left(t\right);T\_{LH}^{Ovul. Foll},2)$  |
| $H\_{14}^{+}(CL)∶=m\_{CL}^{CL}∙h^{+}(CL\left(t\right);T\_{CL}^{CL},2)$  |
| $H\_{15}^{+}\left(IOF\right)≔m\_{IOF}^{CL}∙h^{+}(IOF\left(t\right);T\_{IOF}^{CL},5)$  |
| $H\_{16}^{+}\left(P4\right)≔m\_{P4}^{OTR}∙h^{+}(P4\left(t\right);T\_{P4}^{OTR},5)$  |
| $H\_{17}^{+}(E2)∶=m\_{E2}^{OT}∙h^{+}(E2\left(t\right);T\_{E2}^{OT},2)$  |
| $H\_{18}^{+}\left(PGF2α\&CL\right)≔m\_{PGF2α\&CL}^{IOF}∙h^{+}(PGF2α\left(t\right);T\_{PGF2α}^{IOF},5)∙h^{+}(CL\left(t\right);T\_{CL}^{IOF},n\_{CL}^{IOF},10)$  |
| $H\_{19}^{+}\left(OTR\&OT\right)≔m\_{OTR\&OT}^{PGF2α}∙h^{+}(OTR\left(t\right);T\_{OTR}^{PGF2α},5)∙h^{+}(OT\left(t\right);T\_{OT}^{PGF2α},2)$  |

1 E2 = estradiol, P4 = progesterone, GnRH = gonadotropin releasing hormone, Inh = inhibin, OT = oxytocin, OTR = oxytocin receptor, FSH = follicle stimulating hormone, LH = luteinizing hormone, IOF = intra-ovarian factors, PGF2α = prostaglandin2α, CL = corpus luteum size. Foll = follicle size, Ovul. Foll. = ovulated follicle,  *Pit* =pituitary, , *c* = rate constant, *t* = time. *h+* = positive Hill function, *h −* = negative Hill function, *T* = threshold for change of behaviorof the Hill functions, and *m* = maximum value of the switched parameter.