Hello Jean-Noel,
I am not sure that I understand every detail of your reasoning. Here is what I get.

$$R(x) = \frac{1}{1+e^{b(x-c)}} \quad \text{and} \quad \int_{t_0}^{t^*} R(x(t))\,dt = F.$$

These are our equations.

Now consider the case that temperature is constant: $x(t) \equiv x$

$$\int_{t_0}^{t^*} R(x(t))\,dt = R(x)\cdot(t^* - t_0)$$

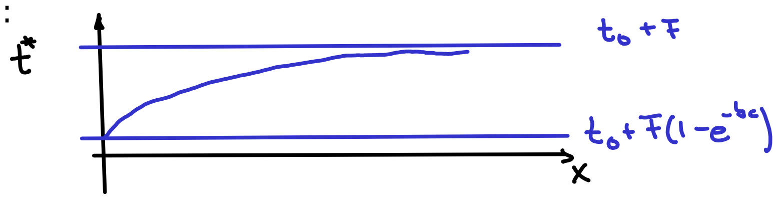
Then the defining equation for t^* becomes

$$R(x)(t^* - t_0) = F \quad \text{or} \quad t^* = t_0 + \frac{F}{R(x)} = t_0 + F(1+e^{b(x-c)})$$

Hence, we have an explicit expression of the final time

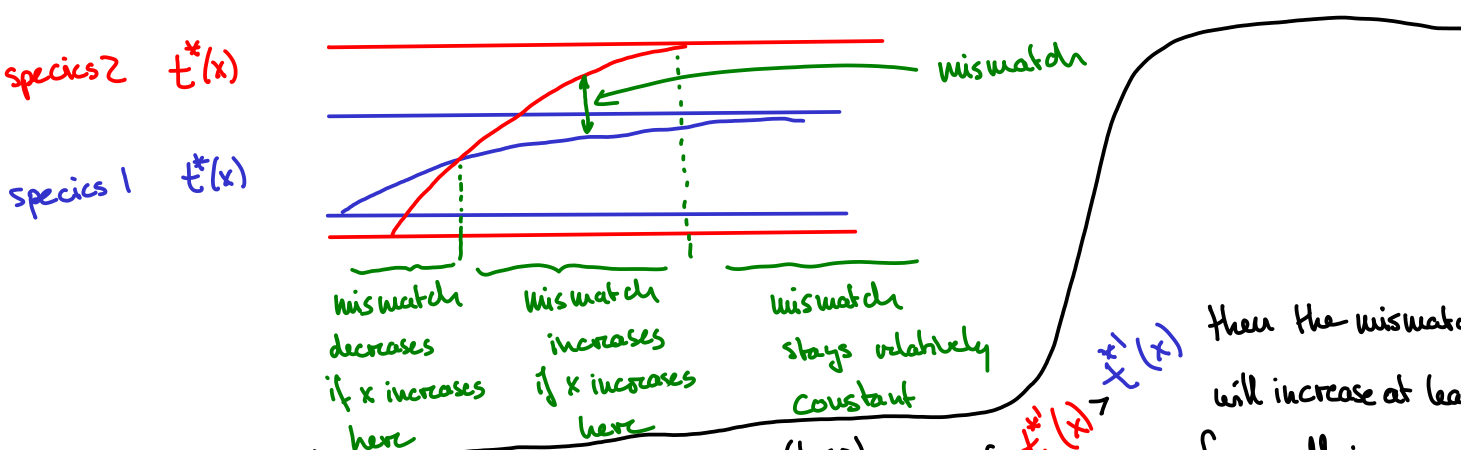
$$t^*(x) = t_0 + F(1+e^{b(x-c)}) \quad \text{with } b<0.$$

This function has a simple graph:



So, we see that the rate of change of t^* decreases as x increases.
This confirms some of the statements that you make if I understand them correctly.

However, if you consider the mismatch between two species, you have a graph of this kind for each species. Then you could have the following situation.



The slope of t^* is $t^{*\prime}(x) = -bFe^{b(x-c)} > 0$ $(b<0)$

so, if $t^{*\prime}(x) > x^{*\prime}(x)$ then the mismatch will increase at least for small increases of x.