## Sergio Villamaring assignment 3

### A few notes before I start solving the problem

Recall the the original formulation of the problem resulted in the similar equation without harvest by normalizing the population by the max carrying capacity (this is the reason of the factor. Since we are now working with the parameter , then I will decide on appropriate values for this parameter based on this normalization, that is if we pick then it means we are harvesting half of the total carrying capacity. This means that if we were to pick values bigger than 1 there will probably be issues as the rate of harvest would exceed the maximum sustainable population. This will come up later in the calculations. Additionally negative numbers would instead add to the population, and since this is a “harvest” equation, those would be meaningless for the purpose of this study. We therefore will consider and will explore a single value of the parameter unless there’s something in the calculations that suggest there would be a different behaviour.

### Osmotic potential

Using van’ Hoff equation of osmotic potential given

And since all the quantities provided are already per unit of cubic centimeter, i.e. then the formula resolves to

Finally, considering that and plugging and approximate of the molar gas constant we get the potential

### Soil resistance

Before I break up into each case I will consider the general situation a bit to avoid repetition. The value for specific water (at 20C) . Additionally, the hydraulic conductivity function for loamy sand for a given saturation can be expressed using the provided empirical coefficients as

In particular we care about the following 2 scenarios: full saturation , and 30% saturation , so

The difference in scale of the hydraulic conductivity already hints that the difference between these two scenarios is massive.

Lastly, we will use the notation from Manzoni 2013 for the characteristic length of water to travel from the soil to the inside of the roots, and we will assume (couldn’t find the Porporato 2022 ref) that we can use in the equation

(This is probably either a 75% percentile of the root lengths which may be a good representative value for the root depth horizon?) and substituted the root diameter

#### sclerophyll, shrubs and trees

In this scenario the characteristic length of water

Now soil conductance is

And so each scenario for we get

And finally for the corresponding soil resistances we get

#### tropical evergreen forest

In this scenario the characteristic length of water

Soil conductance is again

And so each scenario for we get

And finally for the corresponding soil resistances we get

### Water potential of air