**2023 HiMCM**

Problem A - Dandelions: Friend? Foe? Both? Neither?

**Team: 14229**

**Summary**

先写入侵物种的定义 曹成伟

再写本文的研究目的 我和曹成伟

我来写研究方法

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   1. **Harmfulness of Invasive Species**
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   3. **Significance of the Model in this Research**

In the first question, it mentions "predict the spread of dandelions", which is a very broad question that can be approached from various angles. The term "spread" can be predicted in multiple aspects. Considering this, the first question can be divided into two aspects: predicting the population and predicting the distribution location; It is essential to elaborate on the relevant characteristics of dandelions. Below, we will explain the dissemination methods of dandelions and their interaction with ecosystems.

* + 1. **Dissemination Methods of Dandelions**

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* + 1. **Dandelions in the Ecosystems**

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* 1. **Part 1: Population Prediction Model**
     1. **Basic Assumptions**

In the context of this revised question, it is assumed that dandelions exist within a complete ecosystem, and they interact with the ecosystem to varying degrees. This assumption allows the model to better simulate the spread of dandelions in reality. To align with this concept, the following basic assumptions were used in constructing the population prediction section of the model:

Initially, there is only one dandelion, and it is in the stage of "dandelion puff"; it is located at the center of the one-hectare open land.

ach dandelion produces a fixed quantity of seeds every month, and these seeds have a certain germination rate.

There are no human activities or interventions within the predicted time frame of the model.

Dandelion seed dispersion and growth are influenced by macro climate conditions.

Dandelion growth is affected by seasonal factors, with the growth rate varying monthly due to seasonal changes.

Dandelion seed dispersion and growth are influenced by humidity.

Dandelion seed dispersion and growth are affected by other animals and plants within the ecosystem.

The one-hectare land considered in the model has a certain environmental carrying capacity.

After establishing the aforementioned basic assumptions, we have defined the following variable table.

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* + 1. **Variable Table**

|  |  |
| --- | --- |
| Variable | Description |
|  | Current month's dandelion population |
|  | Intrinsic growth rate |
|  | Environmental carrying capacity |
|  | Seeds produced per dandelion per month |
|  | Germination rate of seeds |
|  | Impact of plant competition |
|  | Impact of animal competition |
|  | Constant positive impact of animals |
|  | Climate factor |
|  | Seasonal factors |
|  | Humidity factor |
|  | Competition factor |

* + 1. **Model Construction**

After breaking down the problem, we are prepared to address it by using the population growth models. Our initial consideration is to establish the model based on the exponential growth model below, which represents , the population of dandelions at time .

In this scenario, resources were assumed to be infinite. However, the simulated situation should take place within an ecosystem with limited resources and space. Therefore, we have incorporated the concept of environmental carrying capacity.

The addition of the model allows for a reduction in the growth rate of dandelions as they approach the upper limit of the carrying capacity. In the reality, the carrying capacity may not have a significant impact on the growth rate of dandelions because they do not occupy resources and space in the same way animals do (which the carrying capacity is often used for). Nevertheless, the inclusion of the environmental carrying capacity variable still serves the purpose of preventing over-prediction and indirectly simulating competition pressure among dandelions in later stages.