Curaçao Help Index

This index contains all of the help topics available for Curaçao.   To select a topic, click on it with the mouse.   Topics are arranged according to the organization of the program.   Use the scroll bar to see   entries that are not currently visible in the help window.

For more information on how to use help, press F1 or choose Using Help from the Help menu.

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Introduction

The sterile insect release method (SIRM) of pest population supression consists of releasing large numbers of sterilized insects into the environment to reduce the probability that members of a natural population of the same species will successfully reproduce. The practical feasibility of this method was first demonstrated by E. F. Knipling's eradication of the screwworm, *Cochliomyia hominivorax*, from the Caribbean island of Curaçao in 1955.

Selecting **Run** from the File Menu immediately upon program startup will reproduce the simple mathematical model that Knipling (1979) presented to demonstrate that, in theory, the method can bring about the total eradication of a defined population in a small number of generations.

The following assumptions are implicit in Knipling's simple model:

1. The initial population is 1 million insects, half male and half female, in a well-defined geographic area.

2. Both the native and released sterile insects are dispersed uniformly (no spatial variability and no migration).

3. Exactly 9 sterile males are released for each native male.

4. Sterile males are equally competitive as native males for mates.

5. For every female, 5 female progeny survive to reproduce in the next generation.

6. There are no random events; the system is deterministic.

This model assumes that only sterile males are released and that females mate no more than once.   Countless variations on this basic simulation can be created by changing the structure of the model and its underlying assumptions.   Select **Options** from the File Menu to change the model structure, or select **Native**, **Release by Zone**, or **Release by Cell** from the **Insects Menu** to alter the model's assumptions.   Use the **View Menu** to change the way the results are presented on the screen.

Click on **Getting Help** for information on the available help resources and how to use them.

Getting Help

Curaçao features a context sensitive help system which provides information about all aspects of the program,   To access the help system, press **F1**.   This will take you directly to the help item most appropriate for your current situation.   If no specific help item exists you will be presented with the help index.   Selecting **Index** from the **Help Menu** will take you directly to the help index.

To get help on a menu command, pull down the menu and highlight the command using either the mouse or the arrow keys.   While the command is still highlighted (don't let up on the mouse button!), press **F1**.   The Help window will appear with the appropriate information.

To get help while in a dialog box. press **F1**.   In complex dialogs such as the **Native Insects** dialog, you will be given help on the specific item which is highlighted (e.g. **Aggregation Index**).   Simpler dialogs have only one help item.

If you need more general help with the **Microsoft Windows ®** environment, use the **Help Menu** in either the **Program Manager** or **File Manager** window.

To learn more about the help system, press **F1** while the Help window is active, or select **Using Help** from the Help window's **Help Menu**.

Run

    Once you have decided on the appropriate <u>options</u> and parameters, select **Run** from the File Menu to begin execution of the simulator.   The island of Curaçao, with its initial insect population, will be created in the main application window.   Another window will appear which shows a running <u>summary</u> as the simulation progresses.   Each time you click the **Generation** button in the main window, another generation will be simulated.

Options

Options allows you to make changes in the structure of the model.

The Options dialog box uses a rotary selection control symbolized by the chasing arrows icon.   Click on the control to cycle through the available options.   The options are:

1. <u>Spatial Resolution</u> - low, medium, high
2. <u>Order of Events</u> - timing of release relative to mating and dispersal
3. <u>Deterministic vs. stochastic simulation</u>
4. <u>Population Dynamics</u> - density-dependent or density-independent

Spatial Resolution

With low spatial resolution, a single, central cell constitutes one zone, and the six surrounding cells make up a second zone.   With medium spatial resolution, there are three zones with 7, 12, and 18 cells, respectively.   The high spatial resolution also has three zones, but with 19, 42, and 66 cells.

Order of Events

The default order of events is release:mating:dispersal.   Two other orderings are possible, release:dispersal:mating and dispersal:release:mating.

Stochastic vs. Deterministic Model

The stochastic option generates random variates in the processes that determine the numbers of:

- Wild female adults
- Females that mate
- Matings that are with fertile males
- Adults that emigrate from a cell
- Eggs carried by fertile females
- Offspring that survive to adulthood

The destinations of emigrating adults are also determined randomly with the stochastic option.

Density Dependence

Four factors in the model can be made density-dependent:

- Probability of a female mating
- Fecundity
- Survival
- Emigration rate

Log to Disk

Log to Disk allows you to keep a running log of your simulations in a text file on disk. This is especially useful for preparing printed reports.   If you choose **Log to Disk** after a number of generations have been simulated, all generations back to the first will be included in the log.

New

New allows you to begin a new simulation.   You may repeat the same problem or change parameters and/or <u>options</u> before running the new simulation.   Any parameters or options not changed will be the same as in the last simulation.

Repeating the same simulation is especially useful when running the <u>stochastic</u> model. In this case, the same options and parameters can give different results simply by random chance.

Open

Open allows you to open a disk file in which you have stored the options, parameters, and initial values for a particular simulation or the state of the program at the moment you executed the **<u>Save As</u>** command in a previous run.

Save As

Save As creates a Curaçao document on disk using the name and extension you provide.   Use of the .SIR extension is strongly recommended to distinguish Curaçao documents from other types of files.   If you add a line for the .SIR extension to the [extensions] section of your WIN.INI file, you will be able to start Curaçao simply by double clicking a document.

A Curaçao document contains the complete state of the simulation at the time it was saved.   If you save a document named STARTUP.SIR, Curaçao will load it automatically when you start the program.   In this way, you can override the default settings provided for the various parameters and options.

Exit

This selection terminates Curaçao.   The same thing may be accomplished by double clicking the close box in the upper left corner of the Curaçao window.

Native Insects

   Native... allows you to set the **initial populations** of native insects in each of 3 zones and to set the native population parameters, including the **aggregation index**, the **probability of emigration**, the **proportion female**, the **eggs per female**, and the **survival to adult**.

Initial Population

The island is divided into three concentric zones (only two zones with the low spatial resolution option).   You can set the initial population of native insects in each zone by entering the desired number in the appropriate box.

Aggregation Index

Knipling's original model assumed uniform dispersion of the native insects. In Curaçao you can create spatial variability and adjust the degree of aggregation by assigning a nonzero value to the aggregation index. This parameter is actually the coefficient of variation (standard deviation/mean). A value of 0.0 gives a uniform dispersion, while a value of 1.0 gives a severely clumped dispersion.

Probability of Emigration

This parameter sets the proportion of the population in each cell that will leave that cell during the dispersal phase of each generation.   Individuals leaving a cell have an equal probability of moving to each of the six neighboring cells.   If a cell is on the boundary of the outermost zone, dispersing individuals leave the modelled area and disappear into the sea!

Proportion Female

This parameter sets the proportion of the native insect population that is female.

Eggs per Female

This parameter sets the number of eggs produced per female.   This parameter along with the **<u>Survival to Adult</u>** determines the normal trend of the population.

Survival to Adult

This parameter sets the proportion of eggs that survive to the adult stage.   This parameter along with **<u>Eggs per Female</u>** determines the normal trend of the population.

Release by Zone/Cell

Sterile males may be released either by Zone or by Cell.   **Release by Zone...** allows you to set the initial release ratios (sterile:fertile) or initial release numbers in each of 3 zones. **Release by Cell...** allows you to set the initial release ratios or initial release numbers cell by cell.

The release of sterile males in each zone or cell can be by numbers of males or by the ratio of sterile males to fertile males.   The sterile:fertile ratio can be determined by exact knowledge of the native population, or by an estimate of the native population that varies randomly according to a normal distribution with a standard error equal to 40% of the mean population.

If sterile males are being released by cell, they can be released in **all cells** (in which case the release ratios are determined cell-by-cell, according to the initial populations of native males in each cell), or specific cells can be marked for release of sterile males.   If the **marked cells only** option is turned on, the cells can be marked only after clicking OK in the Release by Cell dialog box, initiating execution by selecting **Run** from the **File Menu**, and then selecting **Mark Cells** from the **Insects Menu**.

The **competitiveness** of the released, sterile males relative to the native, fertile males for mating success can be set to 1.0 (sterile and fertile males equally competitive) or a value less than 1.0.

Marking Cells for Release

   Mark Cells allows you to mark the cells in which you would like to release sterile insects.   This command is available only when **Release by Cell** has been selected and the button for **Marked Cells Only** is checked in the **Release by Cell** dialog box.   If this is the case, you will be reminded by a dialog box when you choose **Run** to start the simulation.   Cells can only be marked once the simulation has been started and the island has been created.

   To mark or unmark cells, you must choose **Mark Cells** from the **Insects Menu**.   When you do this, the cursor will change to a cross-hair and the **Generation** button will disappear.

   Cells are marked by double clicking when the cursor is on the desired cell.   Marked cells (those that contain circles) can be unmarked by double clicking on them.   When all the desired cells have been marked, select **Quit Marking** from the **Insects Menu**.   The cursor will then change back to the normal arrow shape, and the **Generation** button will reappear.

Show/Hide Grid

In this model, the island of Curaçao is divided into a grid of square cells.   All of the simulation calculations are performed for each individual cell in each generation.   The Show/Hide Grid command in the View Menu allows you to choose whether or not the lines separating cells are drawn on the screen.   For ease of reference, the cells are assigned coordinates as (row, column) pairs.   Holding down the mouse button while the arrow cursor is over a cell will cause that cell's coordinates to be displayed.

Population Levels

The density of the native insect population is represented on a geometric scale of 1 to 10.   Solid green represents the lowest population density; solid yellow the highest. Intermediate levels are represented by intermediate shades.   The size of the population which will be represented as **level 10** can be set in the **Population Levels** dialog box, as can the **factor** relating each level to the next.

For example, by default, level 10 represents a population of 10,000,000 insects per cell and the factor is 10.   Hence level 9 represents 1,000,000, level 8 is 100,000, and so on.

Summary Window

As you proceed with the simulation generation by generation, the **Summary Window** shows the native insect population in each zone and the number of sterile males which have been released.   The **Show/Hide Summary** command in the **View Menu** allows you to control the presence of this window.   The Summary window can also be hidden by double clicking the close box in the upper left corner of the window.   The summary can be presented as columns of numbers (**Text Summary**), or as a line graph which rescales automatically to fit the size of the window (**Graphic Summary**).

While Simulating...

When you have selected **Run** from the File Menu and the island has been created, some of the menu commands will be disabled to prevent inappropriate changes in options and parameters.   Other items will be enabled to allow you to control how the simulation results are displayed and to control the program itself.   The most important control at this point is the **Generation** button in the lower left corner of the window.   Clicking on this button will cause the simulation to progress through one more generation.   By browsing through the menu system and using the **Help** system, you can learn more about the other available options.

References

Knipling, E. F.   1955.   Possibilities of insect control or eradication through the use of sexually sterile males.   J. Econ. Entomol.   48:459-62.

Knipling, E. F.   1979.   The basic principles of insect population suppression management.   U.S.D.A. Agric. Handbook No. 512.   659 pp.

Sawyer, A. J., Z. Feng, C. W. Hoy, R. L. James, S. E. Naranjo, S. E. Webb, and C. Welty.   1987.   Instructional Simulation: Sterile Insect Release Method with Spatial and Random Effects.   Bull. Entomol. Soc. Amer. 33:182-190.

About Curaçao

Curaçao is based on the work of <u>**Sawyer *et al.*(1987)**</u>.   The simulation has been refined and adapted to the Microsoft Windows ® environment (ver. 3.0 or higher) by **Phil Arneson** and **Barr Ticknor**, Department of Plant Pathology, Cornell University.   Curaçao is copyright © 1990 Cornell University; all rights reserved.   Microsoft is a registered trademark and Windows is a trademark of Microsoft Corporation.

Permission is hereby granted for this program to be freely copied and distributed subject to the following terms and conditions:

1. All such copying and distribution must be done **free of charge**.

2. The program and all associated materials **must not be modified** in any way.

3. **All** of the following files must be distributed together :

    CURACAO.EXE   - the main program
    KEYHOOK.DLL   - the keyhook library which supports the context sensitive help
                               system.
    CURACAO.HLP   - the help file
    CURACAO.WRI   - the manual in Microsoft Windows Write format

4. **If Curaçao is used in the teaching of any academic course, registration is required.** For each course and each semester in which Curaçao is used, a copy of the course registration form from the back of the manual must be completed and sent to the address given below before the program is used.   In addition, at the end of the course, or at the end of the module in which Curaçao is used, each student must be required to complete a copy of the Student Questionaire at the back of the manual. These questionaires must be returned promptly to the address below.   These requirements are in lieu of any other payment.

Registration forms, student questionaires, and donations in any amount to support the development of other programs such as this should be sent to:

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