

# *Ecological Genetics*

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The Index contains a list of all Help topics available for the **User Guide**. For information on how to use Help, press F1.

## Running the Program

To run the *Ecological Genetics* program, simply enter data in the Parameter Entry Panel. The preferred method of navigating through the entry panel is to use the tab key. This procedure will ensure that you enter data in the order that allows the greatest accuracy of the built in checking mechanism. If you enter a value that is outside of its range, a message box will appear with information about the range. Because the ranges of many of the values depend on the other values already entered, these ranges will be different with each type of analysis.

Because it is possible to enter data out of order and bypass the built-in validation routines for each parameter, a second method is employed to prevent the use of meaningless data. When ever your choice of values results in one of the breeding parameters being less than zero or greater than one, the run button will be disabled. The present value of the breeding parameters are displayed on the right side of the button bar. If you find that you have been able to enter values without receiving a validation error, but you cannot run the program, you should follow these general guidelines:

If **Phi(m)** is out of range, then check  $b$  and  $\text{var}(b)$ , but  $p$  also has a big influence.

If **Phi(w)** is out of range, then it is almost always because  $p$  and  $\text{var}(p)$  are invalid.

If **Phi(f)** is out of range, then check  $\text{var}(k)$ . Also,  $k$  may be to large (remember, a value of 4 represents a doubling of population size every generation!).

If you think you know which parameter is the most likely offending value, simply double-click on it, then press the tab key. If the value is outside its limits, the internal validation routines will inform you of the proper values.

When you have every thing you want set like you want it, then the run button should be enabled (you will see a green check mark). Just click on it and the results will be displayed in the Results Pane to the right.

## Window Layout

The *Ecological Genetics* program has a multiple document interface (MDI) that allows the user to open several different analysis windows. The main application workspace consists of a menu and a "client" area. The client area is where the analysis window(s) and charts are displayed. An analysis window consists of a tool bar, parameter entry panel and a results pane.

Because the *Ecological Genetics* program is an MDI application, you can open multiple analysis and chart windows in the client area. This is useful if you would like to compare results from different analyses.

## **Edit Menu**

The Edit menu includes commands that enable you to move text in the results pane to and from the clipboard, to delete text, and change the appearance of the text.

For more information, select the Edit menu command name.

Cut Deletes text and moves it to the clipboard.

Copy Copies text to the clipboard.

Paste Moves text from the clipboard to the edit window.

Select All Cancels a previous operation.

Font Changes the Font

## **File Menu**

The File menu includes commands that enable you to open and save files, establish a new workspace, and to print.

For more information, select the File menu command name.

New

Open

Close

Save

Save As

Print

Print Setup

Exit

## **Chart Menu**

The Chart menu contains commands for the display of graphs of the results.

For more information, select the chart menu command name.

Gene Correlations

Fixation Indices

Effective Sizes

## Chart **Gene Correlations** Command

This command allows the user to plot the three gene correlations as a function of generations. A discussion of gene correlations is provided in the [Study Guide](#). See [Chart Buttons](#) for help on how to manipulate charts.



## Chart **Fixation Indices** Command

This command allows the user to plot the three fixation indices as a function of generations. A discussion of fixation indices is provided in the [Study Guide](#). See [Chart Buttons](#) for help on how to manipulate charts.

## Chart **Effective Sizes** Command

This command allows the user to plot the three effective sizes as a function of generations. A discussion of effective sizes is provided in the Study Guide. See Chart Buttons for help on how to manipulate charts.

## **Window Menu**

The Window menu allows you to arrange open documents and icons in the workspace.

For more information, select the Window menu command name.

Cascade

Tile

Arrange Icons

Minimize All

## Help Menu

The Help Menu allows you to obtain help on using the *Ecological Genetics* program.

For more information, select the Help menu command name.

User Guide











Study Guide

Charts

About

## Tool Bar













The tool bar provides buttons that have the same functionality as many of the menu items. The tool bar is located above the Parameter Entry panel. The buttons are

- Open a file 
- Save a file 
- Print results 
- Printer setup 
- Cut text 
- Copy text 
- Paste text 
- Change the font 
- Chart all results 
- Exit 

In addition to the buttons, the tool bar contains three display areas. These display areas provide the estimates of the breeding parameters, which are calculated every time a change is made in the Parameter entry panel. The breeding parameters are probabilities of different types of matings, and their meanings are discussed in the Study Guide. Because these parameters are probabilities, their values must be between zero and one. If you make a change in the parameter entry panel that results in one of the breeding parameters being outside this range, the Run button will be disabled.

## Chart Buttons

The Chart tool bar provides buttons that allow the user to change the appearance of, save, and print the charts. The tool bar is located above the Chart. The function of the buttons are

- Open a file 
- Save a file 
- Copy Bitmap 
- Copy Data 
- Print Chart 
- Change Legend 
- Vertical Grid 
- Horizontal Grid 
- Edit Titles 
- Change Font 
- Chart Tools 
- Chart Options 

You can see a description of the function of each tool bar button by pressing the right mouse button while the cursor is over the button.

## **Status Bar**

The status bar is found at the bottom of the main window. This bar provides information about the various components of the window when the mouse cursor passes over them. This feature is particularly useful when entering data in the parameter panel, because it provides a brief explanation of each parameter.

## **Glossary**

clipboard

Effective Size

Fixation Index

Gene Correlation

Ideal Population



## Copying Text

Choosing this command copies text from the Results pane to the clipboard. After the text is placed in the clipboard, it can be pasted back into the window or into another application.

A keyboard shortcut for this command is highlight the text, hold down the **Ctrl** key, and press **Insert**.

## Pasting Text

Choose this command to paste text that was previously copied to the clipboard into the Results pane.

A keyboard shortcut for this command is highlight the text, hold down the **Shift** key, and press **Insert**.

## Deleting Text

To delete text, simply highlight the text and press either the **Delete** or **Backspace key**.

Text that has been deleted is not available for pasting because it is not copied to the clipboard. To make the text available for pasting into another document, it must be deleted using the cut command.

## Cutting Text

Cutting text removes it from the Results Pane and places it in the clipboard. To cut text, simply highlight the text and press choose the cut command from the edit menu. Text that has been cut is available for pasting.

A keyboard shortcut for this command is to highlight the text, hold down the **Shift** key, and press **Delete**.

## Exiting

Choose this command to exit the *Ecological Genetics* program. If you have open window that have changed, or if you have performed calculations with the Run button, you will be reminded that these have not been saved.

## **Edit Copy Command**

Choosing this command copies text from the Results pane to the clipboard. After the text is placed in the clipboard, it can be pasted back into the window or into another application.

A keyboard shortcut for this command is highlight the text, hold down the **Ctrl** key, and press **Insert**.

## Edit **Cut** Command

Cutting text removes it from the Results Pane and places it in the clipboard. To cut text, simply highlight the text and choose the cut command from the edit menu.

Text that has been cut is available for pasting.

A keyboard shortcut for this command is highlight the text, hold down the **Shift** key, and press **Delete**.

## Edit **Paste** Command

Choose this command to paste text that was copied to the clipboard into the Results pane.

A keyboard shortcut for this command is highlight the text, hold down the **Shift** key, and press **Insert**.



## **Edit Select All Command**

This command allows you to select all the text in the Results pane. This command is useful using the clipboard to transfer data to a spreadsheet for further analysis.

## **Edit **Font** Command**

This command allows the user to change the font in the Results pane. Changing the font affects all the text in the Results pane, not just the highlighted text.

## File **Exit** Command

Choose this command to exit the *Ecological Genetics* program. If you have open window that have changed, or if you have performed calculations with the Run button, you will be reminded that these have not been saved.

## File **New** Command

This command allows you to open a new analysis window. Each analysis window in *Ecological Genetics* consists of two parts: the Parameter Entry panel and the Results pane.

## **File Open Command**

This command allows you to open an existing file. A dialog box will open to allow you to enter the file name or find the file on a disk drive. There are four types of files that you can open and in the ***Ecological Genetics*** program. These are:

Tables (\*.TAB) - The data in the Results pane.

Base Values (\*.BAS) - The values entered in the Parameter Entry panel.

All Values (\*.ECO) - Both parameters and results.

Charts (\*.CHF) - Charts of the results

## File **Print** Command

This command allows you to print the data in the Results pane. This command will not print the parameters in the Parameter Entry panel or the charts. There are separate commands of opening, saving, and printing charts.

## **File Print Setup Command**

This command allows you to change the setup of the currently selected printer, or choose another printer.

## File **Save** Command

This command allows you to save the information in the active window. The file is saved in ASCII text format. This command uses the name of the file associated with the active window. If this is a new file, you will be asked to provide a file name just as with the Save As command.

There are three types of files that can be saved with the **Ecological Genetics** program. These are:

Tables (\*.TAB) - The data in the Results pane.

Base Values (\*.BAS) - The values entered in the Parameter Entry panel.

All Values (\*.ECO) - Both parameters and results.

You may use any extension you like for saving all values because the program assume that if you are opening a file that doesn't have the .TAB, .BAS, or .CHF extensions, you are opening a file that contains both parameters and results. To save a chart, use the save button in the chart window.



## **File Save As Command**

This command allows you to save the active window with a different name than it was opened with. It is also the command that is invoked if you choose Save for a file that has no file name associated with it.

## **File **Close** Command**

This command allows the user to close the active window. If the results have changed or this is a new analysis window you will be prompted to save the file.

## Parameter Entry Panel

Each analysis window in the *Ecological Genetics* program contains a panel where you enter the parameters for the analysis. When you open a new analysis window, the portion of the panel dealing with equilibrium populations will be visible. Each of the edit fields corresponding to a parameter will contain a default number. You may change these numbers by double-clicking on the field and entering a new number. When you click on another field, or choose one of the buttons, the number will be checked to see if it is within the acceptable range of values. If an invalid number was entered, you will be prompted to re-enter the number. A description of the parameters is provided in the Study Guide.

In addition to the basic values, the parameter entry form has two check boxes that provide for additional behaviors of the model. The additional behaviors are for the incorporation of cyclic and stochastic population dynamics. Clicking on either of these check boxes will reveal an edit field for the time to carry out calculations and additional fields for necessary information. Both types of population dynamics can be employed at the same time.

Choosing either cyclic and/or stochastic population dynamics requires the entry of additional information. The default values are those for an equilibrium population. A description of the parameters, and their acceptable values, is given in the Study Guide. The check boxes corresponding to the basic parameters are used to determine which parameters will vary in the desired manner.


There are three buttons on the parameter entry panel. The Run button will perform the calculations and display the data in the Results pane. The Reset button will change all the parameters back to their default values and clear the results. The Help button will bring up the User's Guide (i.e. this help session).

## Results Pane

The results pane is not visible when you open a new analysis window. When you choose the Run button, the necessary calculations will be performed and the results displayed in tabulated form. You can copy this data to the clipboard for use in other applications that accept tab-delimited, ASCII text data.

The results consists of 10 columns. The first column is for the generation. The next three columns give the gene correlations (within individuals, within groups, and between groups). The next three columns are the fixation indices (individuals to group, individuals to total, and groups to total). The last three columns are for the effective population sizes (inbreeding, coancestral, and intergroup). A discussion of these values is provided in the Study Guide.

## Charts Commands

There are three charts available in the *Ecological Genetics* program. These correspond to the gene correlations, fixation indices, and effective population sizes. You can view the charts by choosing the chart type from the Chart Menu, or by choosing the Chart All button  on the tool bar. The Chart All button and the Chart Menu items are not available until there are results in the Results pane.

The charts rely upon the analysis window for their data, but once they are created they behave independently. Closing an analysis window will not close the charts generated from it. Additionally, printing, saving, and copying charts is done by using the tool bar associated with the chart window. To obtain the function of each button, simply press the right mouse button while the cursor is over the button. A popup dialog caption will tell you what the button does.

## **Window Cascade Command**

Choose this command to arrange the windows such that the active window is on top and the title bar of all the other open windows are visible.

This command is useful when you have several windows open and you need to switch among them frequently.

## Window **Tile** Command

Choose this command to arrange the windows as panels with part of each visible.

This command is most useful when comparing the contents of a few windows.

## **Window **Arrange Icons** Command**

Choose this command to arrange all icons of minimized windows so that they are in a neat row at the bottom of the workspace.

This command is most useful when several windows have been minimize and then moved by the user. After issuing the command, the icons should be located in a manner that will allow the user to easily find windows of interest by their file names.



## **Window **Minimize All** Command**

Choose this command to minimize all the open windows. The windows will be displayed as icons at the bottom of the client area.

This command is most useful as a means to rapidly clear the work area before starting a new project.

## Help **User's Guide** Command

Choose this command to bring up the help system for the **Ecological Genetics** program.

This system contains an index of topics about the general use of the **Ecological Genetics** program. It also allows you to search for key words.

The help topics in this system are for general use of the **Ecological Genetics** program (such as editing, opening windows, and running the program). The detailed aspects of the analysis of gene dynamics are provided in the Study Guide.

## Help **Study Guide** Command

Choose this command to bring up the **On-line Study Guide** for the detailed description of what the *Ecological Genetics* program does and the theory behind it.

The help topics in this system are for specifics of the *Ecological Genetics* program. It provides detailed descriptions of how the various estimates are produced. It also provides some background on how the models were developed. There is also citations for relevant publications, useful equations, and example figures provided. If you would like to go to the study guide now, just click [here](#)

The general aspects of using the *Ecological Genetics* program are provided in the [Index](#).

See also:

[User's Guide](#)

## Help **About** Command

Choose this command to obtain general information about the *Ecological Genetics* program. This information includes the program name, the version number, the developers name, and the copyright date.

## **Edit Window**

The edit window in this application allows you to create, open, save, and edit text file. All of the output for the ***Ecological Genetics*** program is in ASCII text format. To view the results of you analysis, you must use an edit window.

## Order Form

This product is the shareware version of **Ecological Genetics**. You may use this version for 21 days for the purpose of evaluation, and you may distribute it to others for the same purpose, as long as you do so *free of charge*. After the evaluation period, you should either discontinue using the application, or register your copy. Registration entitles you to a free copy of the latest version of this program, and a serial number. For more information about the registered version, see the [license agreement](#).

Payments must be in US dollars drawn on a US bank, or they may be made by international postal money orders in US dollars. Send the payment and this order form to:

Wye Software  
19 Vista Dr.  
Little Rock, AR 72210-1714

You print this form by choosing Print from the file menu above (Windows 3.1), pressing the print button on the help toolbar (Windows 95), or clicking [here](#).

An alternate form of ordering is to use the Compuserve Software Registration Service. This service will charge your CIS account for the registration fee. To use this service enter GO SWREG and follow the menus. The SWREG number for this product is 9561. You may also register the software by phone if you wish to pay by [credit card](#)

### **Ecological Genetics** Registration Form

Name: \_\_\_\_\_

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Single Copy \$25.00

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Note: Although every attempt is made to ensure our software will run on most machines, we do not have the resources to deal with installation problems. If you have problems installing this software, you probably have some hardware incompatibilities. If this is the case, DO NOT register the software.

## **Credit Card Orders**

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You can order with MC, Visa, Amex or Discover from Public/software/Library  
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THE AUTHOR OF THE PROGRAM CAN'T BE REACHED AT THESE NUMBERS

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## License Agreement

When you register your copy of ***Ecological Genetics*** you receive a license to the latest version of this product for each copy you purchase. This license allows you to install the program on as many computers as you would like, however, it is your responsibility to ensure that a single licensed copy cannot be used on more than one computer at any given time. Additionally, licensing the software gives you access to Wye Software's email technical support. Licensing the software does not entitle you to distribute the release version to other people, however you may still feel free to distribute the shareware version.

THIS APPLICATION IS PRESENTED AS IS AND WITHOUT WARRANTY, EXPLICIT OR IMPLIED.



## Credits

**Ecological Genetics** was developed using Turbo Pascal and Delphi, both products of Borland International. The application contains two redistributable files that come with Delphi (b1vbx11.dll & chart2fx.vbx), and you may redistribute these only with the shareware version of the program, provided you do so free of charge and you include all of the files that came with your shareware version. ***You may not redistribute the files associated with the release version!***

Testing of the original version of this program was conducted by Drs. Ronald K. Chesser (Dept. of Genetics, Univ. of Georgia), F. Steve Dobson (Dept. of Wildlife and Zoology, Auburn Univ.), Edward J. Heske (Division of Wildlife Ecology, Illinois Natural History Survey), Robert S. Sikes (Dept. of Evolution, Ecology, and Ethology, Univ. of Minnesota), and Merrit N. Sugg (Dept. of Mathematics and Statistics, Univ. of Arkansas at Little Rock). Thanks are extended to these people and all the other beta testers.

## About Wye Software

Thank you for trying our software. Wye Software is a small software development company devoted to producing teaching and analysis tools for biology and mathematics. It is hoped that the software will be useful to students as well as researchers, but the emphasis is placed on education in advanced topics. We appreciate any comments or suggestions about how to improve or extend these programs, as well as other ideas. You may contact Wye software by email or "snail" mail at the addresses below:

### Mathematical Software

Compuserve: 74471.2337  
Microsoft Net: GO wyesoft  
Internet: 74471.2337@compuserve.com  
merrit\_s@msn.com

### Biological Software

Microsoft Net: IslandFun@msn.com  
Internet: Islands@sunbelt.net

### U.S. Mail

Wye Software  
19 Vista Drive  
Little Rock, AR 72210

In the near future (c.a. 2/15/96) we will have a World Wide Web page at:

**<http://www.augusta.net/dsugg/wyesoft.htm>.**

This page will have up-to-date information about our shareware products and links to other products. Additionally, it will have links for sending email messages to the authors.

### Ombudsman

This program is produced by a member of the Association of Shareware Professionals (ASP). ASP wants to make sure the shareware principle works for you. If you are unable to resolve a shareware-related problem with an ASP member by contacting the member directly, ASP may be able to help. The ASP Ombudsman can help you resolve a dispute or problem with an ASP member, but does not provide technical support for members' products. Please write to the ASP Ombudsman at 545 Grover Road, Muskegon, MI 49442-9427 USA, FAX 616-788-2765 or send a Compuserve message via Compuserve Mail to ASP Ombudsman:70007.3536@compuserve.com



## **Windows Keys**

The keyboard topics below come from Help for Windows. You can create similar keyboard topics for your application's Help. Choose from the following list to review the keys used in Windows:

[Cursor Movement Keys](#)

[Dialog Box Keys](#)

[Editing Keys](#)

[Menu Keys](#)

[System Keys](#)

[Text Selection Keys](#)

[Window Keys](#)

## Cursor Movement Keys

<b>Key(s)</b>	<b>Function</b>
DIRECTION key	Moves the cursor left, right, up, or down in a field.
End or Ctrl+Right Arrow	Moves to the end of a field.
Home or CTRL+Left Arrow	Moves to the beginning of a field.
PAGE UP or PAGE DOWN	Moves up or down in a field, one screen at a time.

## Dialog Box Keys

<b>Key(s)</b>	<b>Function</b>
TAB	Moves from field to field (left to right and top to bottom).
SHIFT+TAB	Moves from field to field in reverse order.
ALT+letter	Moves to the option or group whose underlined letter matches the one you type.
ENTER	Executes a command button. Or, chooses the selected item in a list box and executes the command.
ESC	Closes a dialog box without completing the command. (Same as Cancel)
ALT+DOWN ARROW	Opens a drop-down list box.
ALT+UP or DOWN ARROW	Selects item in a drop-down list box.
SPACEBAR	Cancels a selection in a list box. Selects or clears a check box.
SHIFT+ DIRECTION key	Extends selection in a text box.
SHIFT+ HOME	Extends selection to first character in a text box.
SHIFT+ END	Extends selection to last character in a text box

## Editing Keys

<b>Key(s)</b>	<b>Function</b>
Backspace	Deletes the character to the left of the cursor. Or, deletes selected text.
Delete	Deletes the character to the right of the cursor. Or, deletes selected text.

## Menu Keys

<b>Key(s)</b>	<b>Function</b>
Alt	Selects the first menu on the menu bar.
Letter key	Chooses the menu, or menu item, whose underlined letter matches the one you type.
Alt+letter key	Pulls down the menu whose underlined letter matches the one you type.
LEFT or RIGHT ARROW	Moves among menus.
UP or DOWN ARROW	Moves among menu items.
Enter	Chooses the selected menu item.



## System Keys

The following keys can be used from any window, regardless of the application you are using.

<b>Key(s)</b>	<b>Function</b>
Ctrl+Esc	Switches to the Task List.
Alt+Esc	Switches to the next application window or minimized icon, including full-screen programs.
Alt+TAB	Switches to the next application window, restoring applications that are running as icons.
Alt+PrtSc	Copies the entire screen to Clipboard.
Ctrl+F4	Closes the active window.

## Text Selection Keys

<b>Key(s)</b>	<b>Function</b>
SHIFT+LEFT or RIGHT ARROW	Selects text one character at a time to the left or right.
SHIFT+DOWN or UP	Selects one line of text up or down.
SHIFT+END	Selects text to the end of the line.
SHIFT+HOME	Selects text to the beginning of the line.
SHIFT+PAGE DOWN	Selects text down one window. Or, cancels the selection if the next window is already selected.
SHIFT+PAGE UP	Selects text up one window. Or, cancels the selection if the previous window is already selected.
CTRL+SHIFT+LEFT or RIGHT ARROW	Selects text to the next or previous word.
CTRL+SHIFT+UP or DOWN ARROW	Selects text to the beginning (UP ARROW) or end (DOWN ARROW) of the paragraph.
CTRL+SHIFT+END	Selects text to the end of the document.
CTRL+SHIFT+HOME	Selects text to the beginning of the document.

## Window Keys

<b>Key(s)</b>	<b>Function</b>
ALT+SPACEBAR	Opens the Control menu for an application window.
ALT+Hyphen	Opens the Control menu for a document window.
Alt+F4	Closes a window.
Alt+Esc	Switches to the next application window or minimized icon, including full-screen programs.
Alt+TAB	Switches to the next application window, restoring applications that are running as icons.
Alt+ENTER	Switches a non-Windows application between running in a window and running full screen.
DIRECTION key	Moves a window when you have chosen Move from the Control menu. Or, changes the size of a window when you have chosen Size from the Control menu.



## Clipboard

The Windows® clipboard is a temporary repository of information that has been copied or cut. This information is available for pasting in other Windows® application, provided they understand the format of the information.

The *Gene Dynamics* program used ASCII text format. This format is recognized by most other Windows® applications.

## Effective Size

Effective population size is often termed the size of an ideal population that loses genetic variation at the same rate as the population under study.

Effective population sizes are actually a measure of the rate at which a population loses genetic variation, and they should not necessarily be described in terms of real individuals.

For example, if a population is gaining genetic variation, instead of losing it, the effective population size will be negative.

The **Gene Dynamics** program calculates effective population sizes from the rate of change in the gene correlations. The gene correlations can be calculated at any hierarchical level of population structure. This program only deals with the levels of individuals, breeding groups, and subpopulations or colonies, and an effective size is calculated for each.

More information on the theory of effective population sizes and the methods used in this program are given in the Study Guide.

## Fixation Indices

The fixation indices partition the variation in a population into various components that tell a researcher about levels of inbreeding and differentiation.

The **Gene Dynamics** program calculates three fixation indices. The first is the level of inbreeding relative to members of the breeding groups. The second is inbreeding relative to members of the entire subpopulation or colony. The final index is for the differentiation of breeding groups within the subpopulation or colony.

The fixation indices are calculated from the gene correlations.

More information on the theory of inbreeding, differentiation and the methods used in this program are given in the Study Guide.

## Gene Correlations

Gene correlations are a measure of genetic variation. As an individual becomes more and more inbred, its genes become more correlated in the sense they are more likely to have come from the same common ancestor. This is also true for the correlation of genes between different individuals in the same breeding group and subpopulations or colonies if they share common ancestors. The more correlated the genes, the less genetic variation there is.

The **Gene Dynamics** program calculates the gene correlations within individuals, between different individuals from the same breeding group, and between different individuals from different breeding groups.

The gene correlations are used to calculate the fixation indices and effective population sizes.

More information on the theory of gene correlations, genetic variance, and the methods used in this program are given in the Study Guide.



## Ideal Population

An ideal population is a theoretical construct that population geneticists use to understand how, and the rate at which, natural populations lose genetic variation.

An ideal population is one that consists of dioecious, diploid, randomly mating individuals with equal numbers of each sex. Furthermore, the population can not be under selection, there can be no immigration or emigration, and mutation is absent.

Ideal populations lose genetic variation because they are of finite size. The random loss of genes (genetic drift) and chance matings of related individuals (inbreeding) are all a function of the size of the population.

Obviously, no natural populations meet all of the conditions of an ideal population. They may lose genetic variation more or less rapidly than an ideal population of the same size.

The effective population size of a natural population is often said to be the size of an ideal population that loses genetic variation at the same rate as the study population. There are some problems with this interpretation that are discussed in the Study Guide.

The **Gene Dynamics** program calculates the loss of genetic variation and from this can determine the effective population size.

More information on the theory of population genetics and the methods used in this program are given in the Study Guide.



