User's guide to B:RUN, a decision support system and teaching tool for managing the coastal resources of Brunei Darussalam

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The software, **B:RUN**, was developed by the International Center for Living Aquatic Resources Management (ICLARM) in close cooperation with the Department of Fisheries, Ministry of Primary Industry and Resources, Brunei Darussalam to assist in the formulation of management option for managing the coastal zone, and especially the coastal fisheries of Brunei Darussalam.

Although greatest care was taken in the preparation of the software and this manual, the package is supplied without warranty against malfunctioning. ICLARM does not claim as to the accuracy and completeness of the programs nor does it assume any responsibility for the consequences of its use.

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ABSTRACT

This manual describes, with emphasis on its use as a teaching tool, the structure and operations of **B:RUN**, a small DOS software implementing a low-level GIS originally designed to help formulate options for the analysis of Brunei Darussalam's coastal fisheries, under various economical and ecological constraints. Program outputs are in graphical form and require at least a graphic-capable monitor. The background for the stock production models, and the economic and oil spill simulations included in **B:RUN** may be found in the reprints distributed with the software.

TABLE OF CONTENTS

INTRODUCTION

The application of low-level GIS (Geographic Information System) is a line of research and methods development strategy which ICLARM (International Center for Living Aquatic Resources Management) have initiated in early 1990. This interest was based on the observation that crucial information that are spatially–distributed (e.g., spatial distribution of catches, catch-per-effort) is lost when presented as a single number (e.g., total biomass) or in the form of a time series.

B:RUN, a low-level GIS originally designed to help formulate alternative management options for the coast of Brunei Darussalam consists of three basic routines for:

(i) generating high-resolution plot or low resolution plots of tabular data arranged in cells (=grid-squares) representing areas of 5 by 5 nautical miles;

(ii) performing cost–return analysis of trawl fishing using catch-per-unit of effort (C/f) information stored on disk and other parameters that are user-defined; and

(iii) simulating the trajectory of oil spills emerging from various oil fields.

B:RUN does not contain a data management routine. Data required to draw the map and the high resolution overlays are taken directly from a series of text files. These files can be edited using any commercially available text editor. Cell–specific data are taken from a LOTUS 1-2-3 spreadsheet file (WK1) and may be edited using commercially available spreadsheet programs such as LOTUS 1-2-3 and Microsoft Excel. In essence, **B:RUN** is only the user-interface for a host of spreadsheet data.

HARDWARE REQUIREMENTS

B:RUN was developed and designed for use with IBM PC microcomputers (or its compatibles) having the following minimum configuration:

- 512 Kbytes of memory;
- 1.5 Mbytes of free disk space (i.e. a hard disk is required);
- At least an EGA or compatible graphic adapter.

Some **B:RUN** routines extensively read and writes to the disk. To accelerate execution speed, it is recommended to install **B:RUN** to a virtual disk Please refer to the DOS manual for more information on the creation of a virtual disk.

The software was designed to display a variety of colors. However, it does not automatically translate the colors to gray scale for monochrome graphic displays. Thus, showing **B:RUN** output through monochrome screens will completely obliterate visual impact of the software.

INSTALLATION AND STARTING

A SETUP routine is available in the distribution disk to install the package to a hard disk or other storage media with the required space (1.5Mbytes). However, before installing the package (and before using **B:RUN**), read the notes on the READ.ME file. This may contain update information regarding the software not covered by this manual. To read the file, do the following:

1. Insert disk into available disk drive (e.g. A:);
2. Change current directory to the source drive; [Example: If the current drive is C: and the disk is in floppy drive A:, from DOS prompt, enter **A:.** Note that the word 'enter' here means typing the specified command through the keyboard and followed by pressing the <ENTER> key to submit the command for processing];.
3. From DOS prompt, enter **TYPE READ.ME**.

Other DOS text editors or word processors that can read text files (e.g., Microsoft Word, WordPerfect, WordStar) may also be used to read the file.

To install the package, do the following:

1. Insert disk into available disk drive (e.g., A:);
2. Change current directory to the source drive (see example above),
3. From DOS prompt, enter **SETUP**.

The command in Step 3 will load the disk installation routine that will properly install the package to the desired destination drive. The only information that the routine

will require is the destination drive address. This implies that the SETUP program will not test if the hardware requirements are met. You must do this before installing **B:RUN**.

Starting **B:RUN** is as easy as entering the command START from the specified subdirectory (i.e., \BRUN). This command will load the software and the introductory screen will be displayed.

Note that **B:RUN** was developed to run only on DOS environment, but may also be installed on a computer with Microsoft Windows as its environment. However, running **B:RUN** in an environment other that DOS may cause problems which are not predictable.

THE MAIN MENU

The MAIN menu of **B:RUN** (see Fig. 1 of Appendix I) has five options. To select an option (and the same is true in selecting options from other menus), move the pointer (a pointing hand) to the desired option using the arrow keys (<↑>,<↓>) and press the <ENTER>.

Selections are always presented in the lower-left corner of the screen while legends and miscellaneous information are displayed on the lower–right corner. **B:RUN** has four reserved keys which are active while selecting an option in a menu, viz.:

(i) <ESC> to return to a previous menu,
(ii) function key [F2] to clear the screen,
(iii) function key [F4] to show the fishing areas, and
(iv) function key [F1] to switch briefly to a help window describing the options.

The following are the options available in the MAIN menu;

(i) Display low-resolution maps,
(ii) Overlay high-resolution data points,
(iii) Cost-return analysis,
(iv) Oil spill simulation, and
(v) Quit to DOS.

At the level of the MAIN menu, the <ESC> key has the same function as the last option, i.e. it terminates **B:RUN** and returns control to DOS.

THE LOW-RESOLUTION MAPS

A plot of the low-resolution map is the first option of the MAIN menu. These maps, the key feature of **B:RUN**, provide quantitative information by grid square (5 by 5 nM; 1 nautical mile = 1.84 Km) in color coded form. When this option is accessed from the MAIN menu, a list of available maps is displayed. Selecting a map is the same as selecting an option from the MAIN menu, i.e. move pointer to desired option and press <ENTER> (see reprints for examples of low-resolution maps).

Basic features

Plotting of the low-resolution map is done in four steps:

1. Depending on the option selected from the submenu, this routine will read a text file (see section on creating new files) and stores its grid-specific value in memory;
2. Using the biggest and smallest value, a scale is created by dividing the range of values into seven classes (except for the data on red tide occurrences; see Table 1). Colors will be assigned to each grid: blue refers to the smallest set of values and the red the highest range of values. Note that grid squares without values remain black.
3. Using the coordinates of the grid squares (also stored on disk), each will be given its assigned color, and displayed on screen.

Table 1. Summary of low-resolution maps (tables) in **B:RUN**.

Titles	Remarks	Source
Distance from Muara (nM)	sailing distance in nautical-miles (nM) from the port of Muara	Navigational map
Distance from K. Belait (nM)	sailing distance in nautical-miles (nM) from the port of Kuala Belait	Navigational map
Average depth (m)	average depth measured in meters	Geographic map
Surface : % water	the percent of the grid square covered by sea water.	Geographic map
Bottom substrate : % Trawlable	the area of the grid square where trawling is possible considering the limits set by the government of Brunei Darussalam for trawling.	Navigation map
Bottom substrate : % corals	the bottom substrate of coral, in percent of grid square area	DOTCP 1986
Bottom substrate : % coral sands	the bottom substrate of coral sands, in percent of grid square area	DOTCP 1986
Bottom substrate : % fine sands	the bottom substrate of fine sands, in percent of grid square area	DOTCP 1986
Bottom substrate : % silt	the bottom substrate of silt, in percent of grid square area	DOTCP 1986
Bottom substrate : % silt clay	the bottom substrate of silt clay, in percent of grid square area	DOTCP 1986
Bottom substrate : % clay	the bottom substrate of clay, in percent of grid square area	DOTCP 1986
Mean C/f '55 (kg/hr)	catch per unit of effort (C/F) of demersal fish, recorded during the 1955 trawl survey	Ommanney (1962)
Mean C/f '68 (kg/hr)	catch per unit of effort (C/F) of demersal fish, recorded during the 1968 trawl surveys	DOF (1968)
Mean C/f '72 (kg/hr)	catch per unit of effort (C/F) of demersal fish, recorded during the 1972 trawl surveys	Mohammad Shaari et al. (1976)
Mean C/f '79-80 (kg/hr)	catch per unit of effort (C/F) of demersal fish, recorded during the 1979-80 trawl surveys	Beales (1984)
Mean C/f '89-90 (kg/hr)	catch per unit of effort (C/F) of demersal fish, recorded during the 1989-90 trawl surveys	Silvestre and Matdanan (1992)
Red tide occurrences	data are plotted using only three colors to indicate the year of occurrence (i.e., yellow for 1980, orange for 1990 and red if the red tide occurred on the same grid for the two years)	Matdanan et al. (1989)
Biomass: All pelagic fish	estimated through acoustic surveys	DOF (1989)
Biomass: *Carangoides* spp.		
Biomass: *Decapterus* spp.		
Biomass: *Selar crumenopthalmus*		
Biomass: *Uraspis uraspis*		
Biomass: *Ariomma indica*		
Biomass: *Rachycentron canadum*		
Biomass: *Rastrelliger* spp.		
Biomass: *Sardinella* spp.		
Biomass: *Dussumieria* spp.		

4. When all grid squares have been shaded and displayed, the scale used for shading and the corresponding cut-off values are displayed in the lower right corner of the screen.

Available files

The distribution disk contains 28 files to choose from. However, these files may change whenever another file (i.e. table) is added or the inputs are altered (see next section). Table 1 is a summary of the files available in the distribution disk.

Creating/modifying files

As stated in the earlier section, existing files may be altered and/or files added to those in Table 1. To edit or append a file, the following is the procedure if one uses a LOTUS 1-2-3 (ver. 2.01) software:

1. Load the BRUNEI.WK1 that is distributed with **B:RUN**;
2. Editing of files may be done using LOTUS environment. However, care must be taken when editing the cells: the spreadsheet is arranged such that the column represents map specific information, while the rows refer to the grid location;.
3. Print the column to a file excluding the title row but including the dummy row (with zero value) provided in the spreadsheet. Note that to produce the proper text file, the following should be considered:

   (a) print the file using the 'Unformatted' option;
   (b) do not sort or rearrange the rows; and

   (c) use a proper filename for the print file, i.e. using the format TABLE1xx.DAT, where 'xx' refers to the entry number from Table 1. Example, the file with the sailing distance from the port of Muara is TABLE12.DAT, the second in the list describing the sailing distance from the port of Kuala Belait is TABLE13.DAT, etc., If a new file is to be added to the list, the new filename should therefore be TABLE130.DAT, and correspondingly TABLE131.DAT for a file that follows, etc.

4. FILE1.DAT is a text file containing a title heading (of up to 32 characters) of the tables. These titles are arrange such that the first title refers to the contents for TABLE12.DAT, the next for TABLE13.DAT and so on. These titles are used by **B:RUN** to display the titles on a menu. If a new table is created, it will be accessible to the user only after FILE1.DAT has been appended using any text editor. Please note that if a wordprocessor is used to update FILE1.DAT, save the file unformatted.

Few other notes that should be considered when editing files for use with **B:RUN**:

- In is not advisable to alter the values in column 17 of the BRUNEI.WK1 which refers to the catch–per–unit data used for the economic simulation of the trawl fishery—unless obviously to replace it by data from a more recent survey.
- It is also not advisable to edit (though it is possible) the data directly from the text file generated from the procedure outlined above because the data statements are sorted in a manner that may not be readily identifiable when using the text file.

- Other electronic spreadsheets that can read and edit LOTUS 1-2-3 (ver. 2.01) spreadsheets may also be used to generate the required files. However, please refer to the software's manual for more information on how to generate unformatted text files.

THE HIGH-RESOLUTION OVERLAYS

The second option in the MAIN menu is the overlay of fixed structures. The word "overlay" means here that the existing display are not erased prior to plotting the new data points (see reprints).

Basic features

Unlike the previous routine where the data points are referred to a grid square, this plots high-resolution maps which are grid square-independent. Plotting is done in three (3) steps:

1. Reads a vector file in text format (see section on creating new files) and store its value in memory.
2. Assign a user-selected color for plotting (selecting a color is the same as in selecting an option from a menu; 5 colors are available; select color which contrast with map and structures to be overlaid).
3. Using the file of vector points read in Step 1 and the color defined in Step 2, the points are plotted without initializing the graphic screen.

Available files

Six overlays are available in the **B:RUN** disk (Table 2; see also Chou et al. 1987):

Table 2. High resolution files.

Titles	Remarks
Coral reefs	coral reef structure
Oil structures	oil rigs, underwater pipes and other structures
Limits from oil structures	one-mile limit from oil production related structures
Precautionary areas	government declared precautionary areas to protect structures or reserved areas for military use
Three-mile limit	three-mile inshore zone where trawling is prohibited
Excl. Econ. Zone	the Exclusive Economic Zone claimed by the Brunei government

Creating new files

It is more tedious to create a new file for a high-resolution plot than creating/editing files for low-resolution maps; note however, that no special GIS tool is necessary. The following are the simple steps to successfully create a new file for a high-resolution plot for display through **B:RUN**:

1. Draw vertical lines (or use a template) to equally divide a map of Brunei Darussalam from 113°45'E to 115°34'E into 720 sections and horizontal line from 4°30'N to 5°65'N into 348 sections (Note: it is advisable to use a large map to facilitate reading of rows and columns).
2. Label the upper left corner (i.e. at 5°65'N and 113°45'E) as coordinates 0,0 or as row 0 and column 0. The label of the subsequent rows should be going down and while those of the columns, should go up as one moves to the right such that the last row is 348 and the last column 720, at the lower right corner of the map.
3. Using the labels from Step 2, create a text file where a record (i.e. one line of input terminated by a <ENTER>) has the following format, y,x1,x2, where "y" refers to a row label (from 0 to 348) and "x1" and "x2" are column labels from 0 to 720. These labels defines a vector, i.e. where a line should start (x1) and end (x2). The values for x1 and x2 can be the same, in which case a dot will be plotted. There might be several lines of inputs where the "y" entries are the same. Examples: (i) an entry of 201,100,400 means that **B:RUN** will draw a line in row 201 from column 100 to col. 400; (ii) an entry of 201,100,100 means that a dot will be formed on the screen at row 201 and column100; (iii) the entry 201,100,730 is an example of an invalid entry since no x1 or x2 entries should exceed 720 and no y entry should exceed 348.
4. Sort all entries in ascending order using the y values as the primary sort key;.

5. At the end of the file, enter the record 0,0,0 to indicate last record.
6. Save the file in text form. As for the creation of a new file for low-resolution plots, the file FILE1.DAT should be appended to contain a brief description of its content (maximum of 32 characters). Naming of files is done in a similar fashion as in creating new files for low-resolution maps. FIXED1.DAT refers to the first structure (i.e. data to map coral reefs), FIXED2.DAT refers to a plot of the oil structures, and so on up to FIXED6.DAT. If another file is to be added, the next filename should therefore be FIXED7.DAT, etc.

THE ECONOMIC SIMULATION

The third option in the MAIN menu is a routine to perform costs and returns analyses for the demersal trawl fishery given the fishing effort and various economic parameters as defaults, but which can be changed by the user.

Tables used

The estimation of cost and returns for a given grid square requires the use of several tables summarized in Table 3:

Table 3. Files used for cost and returns analyses of the Brunei Darussalam demersal trawl fishery

Filename	Remarks
TABLE12.DAT	sailing distance in nautical-miles (nM) from the port of Muara used to estimate the total fuel and variable cost while cruising
TABLE13.DAT	same as previous but for the port at Kuala Belait
TABLE14.DAT	percent of the area of a grid that is trawlable; if percent trawlable is zero, the square will remain unfished
TABLE17.DAT	catch-per-unit of effort for production model
PRICE.DAT	weighted mean retail price per kg of the fish catch in a given grid square
SPEC%.DAT	observed species composition in a given grid square

The tables, PRICE.DAT and SPEC%.DAT can be modified using the SPECIES.WK1 LOTUS 1-2-3 file supplied with **B:RUN**. The editing procedure is the same as for editing files for low-resolution plots (see above).

User-defined parameters

Other than table values, user-defined parameters are also necessary to complete the procedure (see reprint) to simulate various scenarios and to evaluate management alternatives.

Defaults are provided for the user-defined parameters. However, when a parameter is altered, the change will be registered. To return to the default values, temporarily exit to the MAIN MENU.

The economic simulation commences immediately after all user-defined inputs have been entered and accepted. This may take, on the average, a little over two minutes on an IBM PC/AT microcomputer.

B:RUN will plot a map showing which grid squares are expected to generate profit (green) or losses (red), with two additional colors for intermediate values and yellow for the squares where trawlers will just break even. The user can then look into the details concerning a particular grid squares by pointing to a cell then pressing <ENTER>.

THE OIL SPILL SIMULATION

The fourth option of the MAIN menu is a module which simulates an oil spill from one of the oil fields off the coast of Brunei Darussalam; thus included into the package a program that has been developed independently, but whose structure and output made it highly compatible with **B:RUN**.

Tables used

The oil spill simulation routine requires the use of table values summarized in Table 4.

Table 4. Summary of files used in simulating oil spills.

Filename	Remarks
CURRENT1.DAT	Vector file to describe the water current for the months of January to March
CURRENT2.DAT	Vector file to describe the water current for the month of April
CURRENT3.DAT	Vector file to describe the water current for the months of May to November
CURRENT4.DAT	Vector file to describe the water current for the month of December
WIND1.DAT	Vector file to describe the wind direction and speed for the months of January to March
WIND2.DAT	Vector file to describe the wind speed and direction for the month of April
WIND34.DAT	Vector file to describe the wind speed and direction for the months of May to December
XYMAP.DAT	File containing the coordinates of the graphic screen

User-defined parameters

The oils spill simulation routine also requires a number of user-defined parameters, for which default values are provide. Values other than the defaults can be used to run a simulation, however, the change will not be stored, i.e. the same default values will be provided in subsequent simulations. (Table 5; see Fay 1971 for a detailed explanation of the user-defined parameters).

Table 5. Characteristics of the oil spilled and of sea water. Shown here are default values and their units of measurement.

Parameter	Default value	Unit
Oil characteristics		
Oil spill volume	10,000.00	m^3
Mass density	867.00	$kg \cdot m^{-3}$
Surface tension	0.0057	$Newton \cdot m^{-2}$
Gasoline content	30.00	%
Kerosene content	10.00	%
Heavy distillates content	25.00	%
Light distillates content	15.00	%
Residual content	20.00	%
Sea water characteristics		
Mass density	1,025.00	$kg \cdot m^{-3}$
Kinetic viscosity	0.0000012	$m^2 \cdot sec^{-1}$

Other user-defined inputs are: (i) the choice of a period of the year (January to March, April, May to November and December), each characterized by a certain wind and tidal regime; (ii) the origin of the spill, i.e. any of the nine oil rigs close to the coast of Brunei Darussalam; and (iii) wind strength, expressed through the Beaufort scale.

Modifying vector files

The vector files supplied with the B:RUN disk may be altered using any text editor. The following describes the data files in Table 4:

1. The first line is the header line describing the file, and is not used by **B:RUN**;
2. Subsequent line entries describes a current or wind vector of a sector. There are 6 sectors on the horizontal scale (from 113°45' to 115°15') and 5 entries on the vertical scale (from 4°30' to 5°45'), i.e. each sector is dimensioned into squares of 15 by 15 minutes;
3. The sectors are labeled using the format xy where x is the column number and y the row number. Sector '11' is the sector on the left lower corner and label numbers are increasing to the right and going up;
4. Entries to the file are sorted such that the first 3 line entries refers to sector '11', the second is sector '12', the third sector '13' and so on until it reaches sector '65';
5. For each group of three entries, the first line entry refers to strength or speed, the second line is the label of the sector and the third the direction in degrees (from 0° to 364°).

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