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Panic Version I

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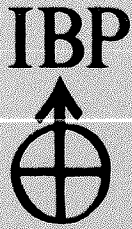Follow this and additional works at: https://digitalcommons.usu.edu/dbiome_model

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IBP

DESERT BIOME
US/IBP ANALYSIS OF ECOSYSTEMS

MODELS

PANIC

VERSION I

MODELLING REPORT SERIES NUMBER 8

PANIC

VERSION 1

DESERT BIOME
UTAH STATE UNIVERSITY
LOGAN, UTAH   84321
MAY 1971

INTRODUCTION

Reports in this series are intended for internal use by Desert Biome collaborators. They are not to be quoted or referred to in formal publications. These reports have been produced by the Desert Biome Modelling Group, with the assistance of participants in the Desert Biome and other researchers.

The main function of the models, at this stage of their development, is to provide guidance in the research efforts of the Biome. Therefore, it will be noted that most of the information which they contain is fragmentary evidence, best available estimates, arbitrary assumptions or non-Biome supported research. The collection and incorporation of more accurate data will come after these models have been prepared in this form. Validation of the models will also come later.

Any use of the models must recognize the limitations imposed by their development at this early stage of research.

(1) Biological interpretations must be performed with extreme caution. Output, for example, should be viewed in relation to system behavior (stability, general time relationships, relative magnitude of the variables, general responses to parameter modifications, etc.). These properties should be related to the processes incorporated in the model structure. No particular significance should be attached to the specific numbers given as output.

(2) Data included in these models must not be used without explicit approval of the investigators who have supplied them to us. Please contact the Desert Biome Central Office for details.

(3) The material contained in the models does not constitute publication. It is subject to revision. The modeling group requests that this material not be cited without their expressed permission.

As particular models are revised we will be re-issuing them in new versions. The versions will be numbered according to the general scheme:

Version 1. Models which have been developed by the modeling group in isolation from subject area specialists who have provided the question which has been modeled.

Version 2. Models revised to incorporate subject-areas specialist's criticisms.

Version 3. Models revised to incorporate finds of biome-sponsored research.

PANIC was written to model the question BA0104:

"What is the effect of different freeze dates and filling regimes of the Jornada Playa on the growth of the Panicum on the playa floor?"

This small model is primitive description of the actual processes involved in determining the growth of the panicum.

```
1                 PANIC: PROC OPTIONS (MAIN);
            /*                                                          */
            /*                                                          */
            /**********************************************************************/
            /*                                                          */
            /*      VERSION 3.0                                         */
            /*                                                          */
            /*                                                          */
            /*                                                          */
            /*                                                          */
            /**********************************************************************/
            /*                                                          */
2                 DCL DRY_GROWTH_RATE (10) FLOAT;
3                 DCL EVENT CHAR (20) VAR;
4                 DCL MORTALITY_OF_SUBMERGED_CROWNS (10) FLOAT INIT
                        (0,0,.05,.10,.20,.40);
5                 DCL WET_GROWTH_RATE (10) FLOAT INIT (3,6,9,9);
            /*                                                          */
            /**********************************************************************/
            /*                                                          */
            /*      ESTABLISH DEFAULT WEATHER PATTERN                   */
            /*                                                          */
            /**********************************************************************/
            /*                                                          */
6                 WEEK_OF_LAST_FREEZE = 44;
7                 WEEK_OF_NEXT_FREEZE = 44;
8                 WEEK_OF_NEXT_FILL = 28;
9                 WEEKS_FILLED = 3;
10                WEEKS_SOIL_WET = 3;
11                WEEK_OF_REFILL = 0;
12                WEEKS_REFILLED = 3;
13                WEEKS_FILLED = 3;
14                #_YEARS_TO_RUN = 1;
            /*                                                          */
            /**********************************************************************/
            /*                                                          */
            /*      IT IS ASSUMED THAT NO GROWTH OCCURS AFTER THE SOIL DRIES OUT */
            /*                                                          */
            /**********************************************************************/
            /*                                                          */
15                DRY_GROWTH_RATE = 0;
            /*                                                          */
            /**********************************************************************/
            /*                                                          */
            /*      GET #_YEARS_TO_RUN, TOTAL_ROOT_BIOMASS, STANDING_DEAD, */
            /*      LITTER, ROOT_CROWN_BIOMASS                          */
            /*                                                          */
            /**********************************************************************/
            /*                                                          */
16                GET DATA;
            /*                                                          */
            /**********************************************************************/
            /*                                                          */
            /*      PRINT COLUMN HEADINGS FOR OUTPUT                    */
            /*                                                          */
```

```
          /*****************************************************************/
          /*                                                             */
17        PUT EDIT ('WEEKS','BIOMASS')(SKIP,COL(14),A,COL(20),A);
18        PUT EDIT ('EVENTS','YEAR','WET','DRY','AB GRND','ROOT',
                    'CROWN','ST DEAD','LITTER')
               (SKIP,COL(1),A,COL(11),A,COL(14),A,COL(17),A,COL(20),A,
                  COL(27),A,COL(34),A,COL(41),A,COL(48),A);
          /*                                                             */
          /*****************************************************************/
          /*                                                             */
          /*      BEGIN YEAR LOOP                                        */
          /*                                                             */
          /*****************************************************************/
          /*                                                             */
19        DO CURRENT_YEAR = 1 TO #_YEARS_TO_RUN;
          /*                                                             */
          /*****************************************************************/
          /*                                                             */
          /*      RESET YEAR ACCUMULATORS TO ZERO                        */
          /*****************************************************************/
          /*                                                             */
20        TOTAL_WEEKS_FILLED = 0;
21        TOTAL_WEEKS_OF_WET_GROWTH = 0;
22        TOTAL_WEEKS_OF_DRY_GROWTH = 0;
          /*                                                             */
          /*****************************************************************/
          /*                                                             */
          /*      GET WEATHER INFORMATION FOR CURRENT YEAR               */
          /*                                                             */
          /*****************************************************************/
          /*                                                             */
23        GET DATA;
          /*                                                             */
          /*****************************************************************/
          /*                                                             */
          /*      MAKE SURE WEEK_OF_REFILL IS GREATER THAN               */
          /*      WEEK_OF_NEXT_FREEZE IF THERE IS ONLY ONE FILLING IN THE*/
          /*      YEAR                                                   */
          /*                                                             */
          /*****************************************************************/
          /*                                                             */
24        IF WEEK_OF_REFILL = 0 THEN WEEK_OF_REFILL = 53;
          /*                                                             */
          /*****************************************************************/
          /*                                                             */
          /*      UPDATE ROOT BIOMASS COMPARTMENTS;                      */
          /*      THERE IS NO GROWTH DURING PREFILL_DURATION             */
          /*                                                             */
          /*****************************************************************/
          /*                                                             */
26        ROOT_INCREMENT = TOTAL_ROOT_BIOMASS
                          - ROOT_CROWN_BIOMASS;
27        NEW_ROOT_CROWNS = ROOT_INCREMENT / 10;
28        ROOT_CROWN_BIOMASS = ROOT_CROWN_BIOMASS
                          + NEW_ROOT_CROWNS;
```

```
        /*                                                              */
        /****************************************************************/
        /*                                                              */
        /*      ASSUME THAT ROOTS DIE BACK TO THE ROOT CROWNS OVERWINTER */
        /*                                                              */
        /****************************************************************/
        /*                                                              */
29              TOTAL_ROOT_BIOMASS = ROOT_CROWN_BIOMASS;
        /*                                                              */
        /****************************************************************/
        /*                                                              */
        /*      CURRENT_WEEK IS THE WEEK OF THE CURRENT 'EVENT'          */
        /*                                                              */
        /****************************************************************/
        /*                                                              */
30              CURRENT_WEEK = WEEK_OF_NEXT_FILL;
31              PREFILL_DURATION = 52 - WEEK_OF_LAST_FREEZE
                                    + WEEK_OF_NEXT_FILL;
        /*                                                              */
        /****************************************************************/
        /*                                                              */
        /*      FILL THE PLAYA                                          */
        /*                                                              */
        /****************************************************************/
        /*                                                              */
32       FILL:
                EVENT = 'FILLED';
33              PUT EDIT (EVENT)(SKIP,A);
34              TOTAL_WEEKS_FILLED = TOTAL_WEEKS_FILLED
                                    + WEEKS_FILLED;
        /*                                                              */
        /****************************************************************/
        /*                                                              */
        /*      ALL STANDING DEAD IS MADE LITTER                        */
        /*                                                              */
        /****************************************************************/
        /*                                                              */
35              LITTER = LITTER + STANDING_DEAD;
36              STANDING_DEAD = 0;
37              AMOUNT_OF_LITTER_DECOMPOSED = (.1 * LITTER) * WEEKS_FILLED;
38              LITTER = LITTER
                        - AMOUNT_OF_LITTER_DECOMPOSED;
        /*                                                              */
        /****************************************************************/
        /*      LITTER DECOMPOSITION IS INDEPENDENT OF TEMPERATURE      */
        /*                                                              */
        /****************************************************************/
        /*                                                              */
        /*                                                              */
        /****************************************************************/
        /*                                                              */
        /*      COMPUTE ROOT LOSS DUE TO THE FILLING;                   */
        /*      ROOT MORTALITY IS A FUNCTION OF THE FILL_DURATION ONLY  */
        /*                                                              */
        /****************************************************************/
```

```
        /*                                                              */
39              ROOT_CROWN_MORTALITY = ROOT_CROWN_BIOMASS
                                    * MORTALITY_OF_SUBMERGED_CROWNS
                                      (WEEKS_FILLED);
40              ROOT_CROWN_BIOMASS = ROOT_CROWN_BIOMASS
                                    - ROOT_CROWN_MORTALITY;
        /*                                                              */
        /****************************************************************/
        /*                                                              */
        /*      UPDATE WEEK COUNTER FOR FILLED PERIOD                    */
        /*                                                              */
        /****************************************************************/
        /*                                                              */
41      WET_SOIL_ENTRY:
                EVENT = 'WET SOIL';
42              PUT EDIT (EVENT)(SKIP,A);
43              CURRENT_WEEK = CURRENT_WEEK + WEEKS_FILLED;
44              WEEK_SOIL_WILL_GO_DRY = CURRENT_WEEK + WEEKS_SOIL_WET;
45              WEEK_OF_NEXT_EVENT = MIN (WEEK_OF_REFILL,
                                        WEEK_OF_NEXT_FREEZE,
                                        WEEK_SOIL_WILL_GO_DRY);
46              WEEKS_FOR_WET_GROWTH = WEEK_OF_NEXT_EVENT - CURRENT_WEEK;
47              TOTAL_WEEKS_OF_WET_GROWTH = TOTAL_WEEKS_OF_WET_GROWTH
                                        + WEEKS_FOR_WET_GROWTH;
48              MAX_ABOVEGROUND_BIOMASS_INCR = TOTAL_ROOT_BIOMASS
                                        * WET_GROWTH_RATE
                                          (WEEKS_FOR_WET_GROWTH);
        /*                                                              */
        /****************************************************************/
        /*                                                              */
        /*      GRAZE REMOVAL                                            */
        /*                                                              */
        /****************************************************************/
        /*                                                              */
49              GRAZE_REMOVED = 10;
50              ABOVEGROUND_BIOMASS = ABOVEGROUND_BIOMASS
                                    + MAX_ABOVEGROUND_BIOMASS_INCR
                                    - GRAZE_REMOVED;
        /*                                                              */
        /****************************************************************/
        /*                                                              */
        /*      ASSUME 1:10  ROOT:SHOOT RATIO                            */
        /*                                                              */
        /****************************************************************/
        /*                                                              */
51              ROOT_BIOMASS = ABOVEGROUND_BIOMASS / 10;
        /*                                                              */
        /****************************************************************/
        /*                                                              */
        /*      UPDATE WEEK COUNTER FOR WET GROWTH PERIOD               */
        /*                                                              */
        /****************************************************************/
        /*                                                              */
52              CURRENT_WEEK = CURRENT_WEEK + WEEKS_FOR_WET_GROWTH;
53      FREEZE_ENTRY:
```

```
54                            IF CURRENT_WEEK = WEEK_OF_NEXT_FREEZE THEN DO;
55                                    EVENT = 'FREEZE';
56                          PUT EDIT (EVENT)(SKIP,A);
57                                    GO TO END_YEAR;
58                                    END;
59          DRY_SOIL_ENTRY:
60                  IF CURRENT_WEEK = WEEK_SOIL_WILL_GO_DRY THEN DO;
61                                    EVENT = 'DRY SOIL';
62                          PUT EDIT (EVENT)(SKIP,A);
63                                    WEEK_OF_NEXT_EVENT = MIN (WEEK_OF_REFILL,
                                                              WEEK_OF_NEXT_FREEZE);
64                                    WEEKS_FOR_DRY_GROWTH = WEEK_OF_NEXT_EVENT
                                                            - CURRENT_WEEK;
65                                    TOTAL_WEEKS_OF_DRY_GROWTH = TOTAL_WEEKS_OF_DRY_GROWTH
                                                                 + WEEKS_FOR_DRY_GROWTH;
66                                    MAX_ABOVEGROUND_BIOMASS_INCR = TOTAL_ROOT_BIOMASS
                                                                    * DRY_GROWTH_RATE
                                                                    (WEEKS_FOR_DRY_GROWTH);
            /*                                                                      */
            /*******************************************************************/
            /*                                                                      */
            /*       GRAZE REMOVAL                                                   */
            /*                                                                      */
            /*******************************************************************/
            /*                                                                      */
67                                    GRAZE_REMOVED = 10;
68                                    ABOVEGROUND_BIOMASS = ABOVEGROUND_BIOMASS
                                                            + MAX_ABOVEGROUND_BIOMASS_INCR
                                                            - GRAZE_REMOVED;
            /*                                                                      */
            /*******************************************************************/
            /*                                                                      */
            /*       ASSUME 1:10   ROOT:SHOOT RATIO                                  */
            /*                                                                      */
            /*******************************************************************/
            /*                                                                      */
69                                    ROOT_BIOMASS = ABOVEGROUND_BIOMASS / 10;
            /*                                                                      */
            /*******************************************************************/
            /*                                                                      */
            /*       UPDATE WEEK COUNTER FOR DRY GROWTH PERIOD                       */
            /*                                                                      */
            /*******************************************************************/
            /*                                                                      */
70                                    CURRENT_WEEK = CURRENT_WEEK + WEEKS_FOR_DRY_GROWTH;
71                                    IF CURRENT_WEEK = WEEK_OF_NEXT_FREEZE
72                                            THEN GO TO FREEZE_ENTRY;
73                                            ELSE GO TO REFILL_ENTRY;
74                            END;
75          REFILL_ENTRY:
                    WEEK_OF_NEXT_FILL = CURRENT_WEEK;
76                  WEEKS_FILLED = WEEKS_REFILLED;
77                  GO TO FILL;
78          END_YEAR:
                    WEEK_OF_LAST_FREEZE = WEEK_OF_NEXT_FREEZE;
```

```
79                      STANDING_DEAD = ABOVEGROUND_BIOMASS * .8;
80                      LITTER = ABOVEGROUND_BIOMASS * .2;
81                      ABOVEGROUND_BIOMASS = 0;
82                      PUT EDIT (CURRENT_YEAR,
                                  TOTAL_WEEKS_OF_WET_GROWTH,
                                  TOTAL_WEEKS_OF_DRY_GROWTH,
                                  ABOVEGROUND_BIOMASS,
                                  TOTAL_ROOT_BIOMASS,
                                  ROOT_CROWN_BIOMASS,
                                  STANDING_DEAD,
                                  LITTER)
                        (SKIP,COL(11),F(2),COL(14),F(2),COL(17),F(2),COL(20),F(5),
                            COL(27),F(5),COL(34),F(5),COL(41),F(5),COL(48),F(5));
83                      END;
84              END PANIC;
```

ATTRIBUTE AND CROSS-REFERENCE TABLE

DCL NO.   IDENTIFIER   ATTRIBUTES AND REFERENCES

                           ABOVEGROUND_BIOMASS   AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE)
                                                               50,50,51,68,68,69,79,80,81,82

                           AMOUNT_OF_LITTER_DECOMPOSED   AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE)
                                                               37,38

                           CURRENT_WEEK   AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE)
                                                               30,43,43,44,46,52,52,53,59,64,70,70,71,75

                           CURRENT_YEAR   AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE)
                                                               19,82

2   DRY_GROWTH_RATE   (10)AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE)
                                                               15,66

59   DRY_SOIL_ENTRY   STATEMENT LABEL CONSTANT

78   END_YEAR   STATEMENT LABEL CONSTANT
                                                               57

3   EVENT   AUTOMATIC,UNALIGNED,STRING(20),CHARACTER,VARYING
                                                               32,33,41,42,55,56,61,62

32   FILL   STATEMENT LABEL CONSTANT
                                                               77

53   FREEZE_ENTRY   STATEMENT LABEL CONSTANT
                                                               72

                           GRAZE_REMOVED   AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE)
                                                               49,50,67,68

                           #_YEARS_TO_RUN   AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE)
                                                               14,19

********* LITTER   AUTOMATIC,ALIGNED,BINARY,FIXED(15,0)
                                                               35,35,37,38,38,80,82

********* MAX_ABOVEGROUND_BIOMASS_INCR   AUTOMATIC,ALIGNED,BINARY,FIXED(15,0)
                                                               48,50,66,68

                           MIN   GENERIC,BUILT-IN FUNCTION
                                                               45,63

4   MORTALITY_OF_SUBMERGED_CROWNS   (10)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE)
                                                               39

********* NEW_ROOT_CROWNS   AUTOMATIC,ALIGNED,BINARY,FIXED(15,0)
                                                               27,28

DCL NO.	IDENTIFIER	ATTRIBUTES AND REFERENCES
1	PANIC	ENTRY,DECIMAL,FLOAT(SINGLE)
	PREFILL_DURATION	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 31
75	REFILL_ENTRY	STATEMENT LABEL CONSTANT 73
	ROOT_BIOMASS	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 51,69
	ROOT_CROWN_BIOMASS	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 26,28,28,29,39,40,40,82
	ROOT_CROWN_MORTALITY	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 39,40
	ROOT_INCREMENT	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 26,27
	STANDING_DEAD	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 35,36,79,82
	SYSIN	FILE,EXTERNAL 16,23
	SYSPRINT	FILE,EXTERNAL 17,18,33,42,56,62,82
	TOTAL_ROOT_BIOMASS	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 26,29,48,66,82
	TOTAL_WEEKS_FILLED	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 20,34,34
	TOTAL_WEEKS_OF_DRY_GROWTH	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 22,65,65,82
	TOTAL_WEEKS_OF_WET_GROWTH	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 21,47,47,82
	WEEK_OF_LAST_FREEZE	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 6,31,78
	WEEK_OF_NEXT_EVENT	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 45,46,63,64
	WEEK_OF_NEXT_FILL	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 8,30,31,75
	WEEK_OF_NEXT_FREEZE	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE)

DCL NO.	IDENTIFIER	ATTRIBUTES AND REFERENCES
		7,45,53,63,71,78
	WEEK_OF_REFILL	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE)
		11,24,25,45,63
	WEEK_SOIL_WILL_GO_DRY	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE)
		44,45,59
	WEEKS_FILLED	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE)
		9,13,34,37,39,43,76
	WEEKS_FOR_DRY_GROWTH	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE)
		64,65,66,70
	WEEKS_FOR_WET_GROWTH	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE)
		46,47,48,52
	WEEKS_REFILLED	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE)
		12,76
	WEEKS_SOIL_WET	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE)
		10,44
5	WET_GROWTH_RATE	(10)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE)
		48
41	WET_SOIL_ENTRY	STATEMENT LABEL CONSTANT