

1971

Camel Version I

U.S. International Biological Program

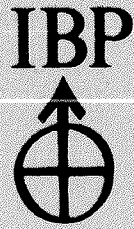
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DESERT BIOME
US/IBP ANALYSIS OF ECOSYSTEMS

MODELS

CAMEL

VERSION I

MODELLING REPORT SERIES NUMBER 10

CAMEL

VERSION 1

DESERT BIOME
UTAH STATE UNIVERSITY
LOGAN, UTAH 84321
MAY 1971

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DESERT BIOME PROGRAM, UNDER GRANT # GB 15886 FROM THE NATIONAL SCIENCE
FOUNDATION.

I N T R O D U C T I O N

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.

1
2

```
/* CAMEL: A MODEL TO SIMULATE GRAZING BY COMPETING HERBIVORES */
/*
CAMEL: PROC OPTIONS (MAIN);
DCL INTPOL ENTRY (FLOAT DEC, (*) FLOAT DEC, (*) FLOAT DEC)
    RETURNS (FLOAT DEC);
/*
/*****
/*
/* CAMEL HAS BEEN BUILT TO INVESTIGATE QUESTION AL2102:
/* "WHAT COMPOSITION OF DOMESTIC UNGULATES (CATTLE),
/* NATIVE UNGULATES (PRONGHORN), AND EXOTIC UNGULATES
/* (CAMELS) WILL MAXIMIZE SECONDARY PRODUCTION IN A
/* GIVEN DESERT AREA?"
/*
/*
/*
/* THE DESCRIPTIVE NAMES (CAMEL, CATTLE, AND PRONGHORN)
/* ARE ARBITRARY AND WERE USED TO SIMPLIFY READING THE
/* MODEL. ANY COMBINATION OF THREE UNGULATE SPECIES
/* DESIREABLE FOR A GIVEN AREA CAN BE USED BY MODIFYING
/* THE APPROPRIATE PARAMETERS.
/*
/*
/* THE MODEL AT THIS STAGE DOES NOT INCLUDE UNGULATE
/* REPRODUCTION OR WEATHER SIMULATION.
/*
/*
/*
/* THE MODEL USES FIVE PLANT GROUPS - ANNUAL GRASSES,
/* PERENNIAL GRASSES, FORBES, AND TWO SHRUBS. THESE ARE
/* ALSO ARBITRARY AND VALUES CAN BE GIVEN FOR THE DESIRED
/* SPECIES OF ANY AREA.
/*
/*
/*****
/*
```

3

```

/*
/*****
/*
/*      DECLARE AND INITIALIZE PARAMETERS
/*
/*
/*****
/*
DECLARE
    ABOVE_GROUND_BIOMASS(5) INIT (150,200,50,500,300),
    AVAILABILITY(5),
    BODY_WT_AXIS_CAMEL(4) INIT (40,200,500,800),
    BODY_WT_AXIS_CATTLE(4) INIT (40,200,400,500),
    BODY_WT_AXIS_PRONGHORN(4) INIT (10,25,50,75),
    CALORIE_INTAKE_OF_CAMELS(6) INIT (0,1E2,1E3,1E4,5E4,1E5),
    CALORIE_INTAKE_OF_CATTLE(6) INIT (0,1E2,1E3,1E4,5E4,1E5),
    CALORIE_INTAKE_OF_PRONGHORN(6) INIT (0,8E1,1E2,3E3,8E3,5E4),
    CALORIFIC_EQUIVALENT(5) INIT (6000,5000,5000,3500,3000),
    CAMEL_AGE_AXIS(6) INIT (0,3,4,5,8,14),
    CAMEL_AGE_EFFECT(6) INIT (1,1,.5,.2,.1,0),
    CAMEL_DENSITY(12) INIT ((12).1),
    CAMEL_DIET_AXIS(3) INIT (0,.3,1),
    CAMEL_DIET_QUALITY_EFFECT(3) INIT (.5,.75,.95),
    CAMEL_PREFERENCE(5) INIT (1,1,2,2,2),
    CAMEL_RESP_EFFECT(4) INIT (10,150,350,450),
    CARRYING_CAPACITY(12) INIT ((12)3000),
    CATTLE_AGE_AXIS(6) INIT (0,3,4,5,8,14),
    CATTLE_AGE_EFFECT(6) INIT (1,1,.5,.2,.1,0),
    CATTLE_DENSITY(12) INIT ((12).1),
    CATTLE_DIET_AXIS(3) INIT (0,.3,1),
    CATTLE_DIET_QUALITY_EFFECT(3) INIT (.5,.75,.95),
    CATTLE_PREFERENCE(5) INIT (8,8,6,2,1),
    CATTLE_RESP_EFFECT(4) INIT (10,150,250,300),
    DEMAND_WITH_BODY_WEIGHT_CAMEL(4) INIT (1,3E4,8E4,1E5),
    DEMAND_WITH_BODY_WEIGHT_CATTLE(4) INIT (1,3E4,8E4,1E5),
    DEMAND_WITH_BODY_WT_PRONGHORN(4) INIT (1,8E3,3E4,5E4),
    EMERGENCE_THRESHOLD(5) FIXED BIN INIT (3,3,4,4,5),
    GROWTH_PATE(5) INIT (1,.9,.7,.5,.4),
    LIVE_GREEN_FRACTION(5,12) FLOAT DEC,
    NON_GREEN_AVAILABILITY(5) FLOAT DEC INIT (.95,.95,.95,.5,.5),
    PRONGHORN_AGE_AXIS(6) INIT (0,2,3,5,8,14),
    PRONGHORN_AGE_EFFECT(6) INIT (1,1,.5,.2,.1,0),
    PRONGHORN_DENSITY(12) INIT ((12).1),
    PRONGHORN_DIET_AXIS(3) INIT (0,.3,1),
    PRONGHORN_DIET_QUALITY_EFFECT(3) INIT (.5,.75,.95),
    PRONGHORN_PREFERENCE(5) INIT (3,3,3,10,1),
    PRONGHORN_RESP_EFFECT(4) INIT (5,75,125,175),
    QUIESCENCE_THRESHOLD(5) FIXED BIN INIT (6,9,8,10,9),
    WT_GAIN_PER_CALORIE_CAMELS(6) INIT
        (0,150,250,350,500,600),
    WT_GAIN_PER_CALORIE_CATTLE(6) INIT
        (0,125,200,250,300,350),
    WT_GAIN_PER_CALORIE_PRONGHORN(6) INIT
        (0,75,120,150,175,200),
    (PLANT, YEAR) FIXED BIN;

```

```

/*
/*****
/*
/*      INITIALIZATION SECTION
/*
/*****
/*
4      *_RUNS = 10;                      /* YEARS */
5      CAMEL_AGE = 1;                   /* YEARS */
6      CATTLE_AGE = 1;                  /* YEARS */
7      PRONGHORN_AGE = 1;               /* YEARS */
8      CAMEL_WEIGHT = 50;               /* KILOGRAMS */
9      CATTLE_WEIGHT = 40;              /* KILOGRAMS */
10     PRONGHORN_WEIGHT = 5;            /* KILOGRAMS */
11     TOTAL_CAMEL_WT_GAIN = 0;          /* KILOGRAMS */
12     TOTAL_CATTLE_WT_GAIN = 0;         /* KILOGRAMS */
13     TOTAL_PRONGHORN_WT_GAIN = 0;      /* KILOGRAMS */
/*
/*****
/*
/*      DATA READ IN
/*
/*****
/*
14     GET LIST (LIVE_GREEN_FRACTION);
15     GET DATA;

```

```

/*
/*****
/*
/*      OUTPUT GRAPHS
/*
/*****
/*
16      CALL PUT_CURVE
        ('FIG 1 - CAMEL WEIGHT ON CALORIE DEMAND',
         BODY_WT_AXIS_CAMEL, DEMAND_WITH_BODY_WEIGHT_CAMEL);
17      CALL PUT_CURVE
        ('FIG 2 - CAMEL CALORIE INTAKE ON WT GAIN',
         CALORIE_INTAKE_OF_CAMELS, WT_GAIN_PER_CALORIE_CAMELS);
18      PUT PAGE;
19      CALL PUT_CURVE
        ('FIG 3 - CAMEL AGE ON WT GAIN',
         CAMEL_AGE_AXIS, CAMEL_AGE_EFFECT);
20      CALL PUT_CURVE
        ('FIG 4 - CAMEL DIET QUALITY ON WT GAIN',
         CAMEL_DIET_AXIS, CAMEL_DIET_QUALITY_EFFECT);
21      PUT PAGE;
22      CALL PUT_CURVE
        ('FIG 5 - CATTLE WEIGHT ON CALORIE DEMAND',
         BODY_WT_AXIS_CATTLE, DEMAND_WITH_BODY_WEIGHT_CATTLE);
23      CALL PUT_CURVE
        ('FIG 6 - CATTLE CALORIE INTAKE ON WT GAIN',
         CALORIE_INTAKE_OF_CATTLE, WT_GAIN_PER_CALORIE_CATTLE);
24      PUT PAGE;
25      CALL PUT_CURVE
        ('FIG 7 - CATTLE AGE ON WT GAIN',
         CATTLE_AGE_AXIS, CATTLE_AGE_EFFECT);
26      CALL PUT_CURVE
        ('FIG 8 - CATTLE DIET QUALITY ON WT GAIN',
         CATTLE_DIET_AXIS, CATTLE_DIET_QUALITY_EFFECT);
27      PUT PAGE;
28      CALL PUT_CURVE
        ('FIG 9 - PRONGHORN WEIGHT ON CALORIE DEMAND',
         BODY_WT_AXIS_PRONGHORN, DEMAND_WITH_BODY_WT_PRONGHORN);
29      CALL PUT_CURVE
        ('FIG 10 - PRONGHORN CALORIE INTAKE ON WT GAIN',
         CALORIE_INTAKE_OF_PRONGHORN, WT_GAIN_PER_CALORIE_PRONGHORN);
30      PUT PAGE;
31      CALL PUT_CURVE
        ('FIG 11 - PRONGHORN AGE ON WT GAIN',
         PRONGHORN_AGE_AXIS, PRONGHORN_AGE_EFFECT);
32      CALL PUT_CURVE
        ('FIG 12 - PRONGHORN DIET QUALITY ON WT GAIN',
         PRONGHORN_DIET_AXIS, PRONGHORN_DIET_QUALITY_EFFECT);
33      PUT PAGE;
34      CALL PUT_CURVE
        ('FIG 13 - CAMEL WT ON RESPIRATION',
         BODY_WT_AXIS_CAMEL, CAMEL_RESP_EFFECT);
35      CALL PUT_CURVE
        ('FIG 14 - CATTLE WT ON RESPIRATION',
         BODY_WT_AXIS_CATTLE, CATTLE_RESP_EFFECT);

```

```
36      PUT PAGE;  
37      CALL PUT_CURVE  
      ('FIG 15 - PRONGHORN WT ON RESPIRATION',  
       BODY_WT_AXIS_PRONGHORN, PRONGHORN_RESP_EFFECT);  
38      PUT PAGE;
```

```
/*
/*****
/*
/*      YEAR CYCLE
/*
/*****
/*
39      YEARS: DO YEAR = 1 TO #_RUNS;
/*
/*****
/*
/*      REINITIALIZE ANNUAL WT GAIN, WEIGHTS, AND STOCKING AGE.
/*
/*
/*****
/*
40      CAMEL_AGE = 1;          /* YEARS */
41      CATTLE_AGE = 1;        /* YEARS */
42      PRONGHORN_AGE = 1;     /* YEARS */
43      CAMEL_WEIGHT = 50;     /* KILOGRAMS */
44      CATTLE_WEIGHT = 40;    /* KILOGRAMS */
45      PRONGHORN_WEIGHT = 5;   /* KILOGRAMS */
46      TOTAL_CAMEL_WT_GAIN = 0; /* KILOGRAMS */
47      TOTAL_CATTLE_WT_GAIN = 0; /* KILOGRAMS */
48      TOTAL_PRONGHORN_WT_GAIN = 0; /* KILOGRAMS */
/*
/*****
/*
/*      MONTH CYCLE
/*
/*
/*****
/*
49      MONTHS: DO MONTH = 1 TO 12;
```

```
/*
/*****
/*
/*      COMPUTE PLANT GROWTH BY SPECIES
/*
/*****
/*

50      FORAGE = SUM(ABOVE_GROUND_BIOMASS);
51      DO PLANT = 1 TO 5;
52      IF MONTH >= EMERGENCE_THRESHOLD(PLANT)
53          & MONTH <= QUIESCENCE_THRESHOLD(PLANT)
54          THEN DO;
55              ABOVE_GROUND_BIOMASS(PLANT) =
56              ABOVE_GROUND_BIOMASS(PLANT) *
57              EXP(GROWTH_RATE(PLANT) *
58              (CARRYING_CAPACITY(MONTH) - FORAGE)
59              / CARRYING_CAPACITY(MONTH));
60          END;
61      END;
```

```

/*
/*****
/*
/*      COMPUTE CAMEL FOOD DEMAND - WEATHER IS NOT CONSIDERED
/*
/*****
/*
57      CAMEL_GRAZE:
58      IF CAMEL_DENSITY(MONTH) = 0 THEN GO TO PRONGHORN_GRAZE;
/*
/*      SEE FIG 1 FOR THE FOLLOWING FUNCTIONAL RELATIONSHIP
/*
59      CAMEL_CALORIE_DEMAND = INTPOL (CAMEL_WEIGHT,
      BODY_WT_AXIS_CAMEL, DEMAND_WITH_BODY_WEIGHT_CAMEL);
/*
/*****
/*      CALL STATEMENT TO FEED CAMEL DENSITY, CALORIE DEMAND,
/*      AND PLANT PREFERENCE TO THE GRAZING SUBROUTINE.
/*
/*      DIET QUALITY AND TOTAL CALORIE INTAKE ARE RETURNED.
/*
/*****
60      CALL GRAZE (CAMEL_DENSITY, CAMEL_CALORIE_DEMAND,
      CAMEL_PREFERENCE, CAMEL_CALORIE_INTAKE);
/*
/*****
/*      DIET QUALITY VARIES BETWEEN .5 AND 1, DEPENDING ON
/*      THE LIVE GREEN FRACTION IN THE DIET.
/*
/*****
61      CAMEL_DIET_QUALITY = (DIET_QUALITY / 2) + .5;
/*
/*      SEE FIG 2 FOR THE FOLLOWING FUNCTIONAL RELATIONSHIP
/*
62      X = INTPOL (CAMEL_CALORIE_INTAKE,
      CALORIE_INTAKE_OF_CAMELS,
      WT_GAIN_PER_CALORIE_CAMELS);
/*
/*      SEE FIG 3 FOR THE FOLLOWING FUNCTIONAL RELATIONSHIP
/*
63      Y = INTPOL (CAMEL_AGE, CAMEL_AGE_AXIS,
      CAMEL_AGE_EFFECT);
/*
/*      SEE FIG 4 FOR THE FOLLOWING FUNCTIONAL RELATIONSHIP
/*
64      Z = INTPOL (CAMEL_DIET_QUALITY, CAMEL_DIET_AXIS,
      CAMEL_DIET_QUALITY_EFFECT);

```

```

/*
/*****
/*
/*      POTENTIAL WEIGHT GAIN IS INFLUENCED BY CALORIE INTAKE,
/*      DIET QUALITY, AND AGE.
/*
/*****
/*
65      POT_CAMEL_WT_GAIN = X * Y * Z;
/*
/*      SEE FIG 13 FOR THE FOLLOWING FUNCTIONAL RELATIONSHIP
/*
66      CAMEL_RESP_DEMAND = INTPOL (CAMEL_WEIGHT,
          BODY_WT_AXIS_CAMEL, CAMEL_RESP_EFFECT);
/*
/*****
/*      WEATHER IS NOT CONSIDERED WHEN COMPUTING RESPIRATION
/*      DEMAND.
/*
/*****
/*
67      CAMEL_RESPIRATION = CAMEL_RESP_DEMAND * CAMEL_DENSITY(MONTH);
68      CAMEL_WT_GAIN = POT_CAMEL_WT_GAIN - CAMEL_RESPIRATION;
69      CAMEL_WEIGHT = CAMEL_WEIGHT + CAMEL_WT_GAIN;
70      TOTAL_CAMEL_WT_GAIN = TOTAL_CAMEL_WT_GAIN + CAMEL_WT_GAIN;
71      CAMEL_AGE = CAMEL_AGE + .08333;
72      IF CAMEL_WEIGHT < 40 THEN DO;
/*      IN THIS UNLIKELY SITUATION THE RANGE MANAGER WOULD FIND
/*      GREENER PASTURES FOR HIS CAMELS.
74      CAMEL_DENSITY(*) = 0;
75      PUT SKIP LIST ('CAMELS GO HUNGRY IN MONTH ', MONTH);
76      END;

```

```

/*
/*****
/*
/*      COMPUTE PRONGHORN FOOD DEMAND - WEATHER IS NOT CONSIDERED
/*
/*****
/*
77      PRONGHORN_GRAZE:
78      IF PRONGHORN_DENSITY(MONTH) = 0 THEN GO TO CATTLE_GRAZE;
/*
/*      SEE FIG 9 FOR THE FOLLOWING FUNCTIONAL RELATIONSHIP
/*
79      PRONGHORN_CALORIE_DEMAND = INTPOL (PRONGHORN_WEIGHT,
      BODY_WT_AXIS_PRONGHORN,
      DEMAND_WITH_BODY_WT_PRONGHORN);
/*
/*****
/*
/*      CALL STATEMENT TO FEED PRONGHORN DENSITY, CALORIE DEMAND,
/*      AND PLANT PREFERENCE TO THE GRAZING SUBROUTINE.
/*
/*
/*      DIET QUALITY AND TOTAL CALORIE INTAKE ARE RETURNED.
/*
/*****
/*
80      CALL GRAZE (PRONGHORN_DENSITY, PRONGHORN_CALORIE_DEMAND,
      PRONGHORN_PREFERENCE, PRONGHORN_CALORIE_INTAKE);
/*
/*****
/*
/*      DIET QUALITY VARIES BETWEEN .5 AND 1, DEPENDING ON
/*      THE LIVE GREEN FRACTION IN THE DIET.
/*
/*****
/*
81      PRONGHORN_DIET_QUALITY = (DIET_QUALITY / 2) + .5;
/*
/*      SEE FIG 10 FOR THE FOLLOWING FUNCTIONAL RELATIONSHIP
/*
82      X = INTPOL (PRONGHORN_CALORIE_INTAKE,
      CALORIE_INTAKE_OF_PRONGHORN,
      WT_GAIN_PER_CALORIE_PRONGHORN);
/*
/*      SEE FIG 11 FOR THE FOLLOWING FUNCTIONAL RELATIONSHIP
/*
83      Y = INTPOL (PRONGHORN_AGE,
      PRONGHORN_AGE_AXIS,
      PRONGHORN_AGE_EFFECT);
/*
/*      SEE FIG 12 FOR THE FOLLOWING FUNCTIONAL RELATIONSHIP
/*
84      Z = INTPOL (PRONGHORN_DIET_QUALITY,
      PRONGHORN_DIET_AXIS,
      PRONGHORN_DIET_QUALITY_EFFECT);

```

```

/*
/*****
/*
/*      POTENTIAL WEIGHT GAIN IS INFLUENCED BY CALORIE INTAKE,
/*      DIET QUALITY, AND AGE.
/*
/*****
/*
85      POT_PRONGHORN_WT_GAIN = X * Y * Z;
/*
/*      SEE FIG 15 FOR THE FOLLOWING FUNCTIONAL RELATIONSHIP
/*
86      PRONGHORN_RESP_DEMAND = INTPOL (PRONGHORN_WEIGHT,
/*      BODY_WT_AXIS_PRONGHORN, PRONGHORN_RESP_EFFECT);
/*
/*****
/*
/*      WEATHER IS NOT CONSIDERED WHEN COMPUTING RESPIRATION
/*      DEMAND.
/*
/*****
/*
87      PRONGHORN_RESPIRATION = PRONGHORN_RESP_DEMAND *
/*      PRONGHORN_DENSITY(MONTH);
88      PRONGHORN_WT_GAIN = POT_PRONGHORN_WT_GAIN -
/*      PRONGHORN_RESPIRATION;
89      PRONGHORN_WEIGHT = PRONGHORN_WEIGHT + PRONGHORN_WT_GAIN;
90      TOTAL_PRONGHORN_WT_GAIN = TOTAL_PRONGHORN_WT_GAIN +
/*      PRONGHORN_WT_GAIN;
91      PRONGHORN_AGE = PRONGHORN_AGE + .08333;
92      IF PRONGHORN_WEIGHT < 4 THEN DO;
/*      PRONGHORN HAVE STARVED TO DEATH
/*
94      PRONGHORN_DENSITY(*) = 0;
95      PUT SKIP LIST ('PRONGHORN GO HUNGRY IN MONTH ', MONTH);
96      END;

```

```

/*
/*****
/*
/*      COMPUTE CATTLE FOOD DEMAND - WEATHER IS NOT CONSIDERED
/*
/*****
/*
97      CATTLE_GRAZE:
98      IF CATTLE_DENSITY(MONTH) = 0 THEN GO TO END_CATTLE_GRAZE;
/*
/*      SEE FIG 5 FOR THE FOLLOWING FUNCTIONAL RELATIONSHIP
/*
99      CATTLE_CALORIE_DEMAND = INTPOL (CATTLE_WEIGHT,
          BODY_WT_AXIS_CATTLE, DEMAND_WITH_BODY_WEIGHT_CATTLE);
/*
/*****
/*
/*      CALL STATEMENT TO FEED CATTLE DENSITY, CALORIE DEMAND,
/*      AND PLANT PREFERENCE TO THE GRAZING SUBROUTINE.
/*
/*
/*      DIET QUALITY AND TOTAL CALORIE INTAKE ARE RETURNED.
/*
/*****
/*
100     CALL GRAZE (CATTLE_DENSITY, CATTLE_CALORIE_DEMAND,
          CATTLE_PREFERENCE, CATTLE_CALORIE_INTAKE);
/*
/*****
/*
/*      DIET QUALITY VARIES BETWEEN .5 AND 1, DEPENDING ON
/*      THE LIVE GREEN FRACTION IN THE DIET.
/*
/*****
/*
101     CATTLE_DIET_QUALITY = (DIET_QUALITY / 2) + .5;
/*
/*      SEE FIG 6 FOR THE FOLLOWING FUNCTIONAL RELATIONSHIP
/*
102     X = INTPOL (CATTLE_CALORIE_INTAKE,
          CALORIE_INTAKE_OF_CATTLE,
          WT_GAIN_PER_CALORIE_CATTLE);
/*
/*      SEE FIG 7 FOR THE FOLLOWING FUNCTIONAL RELATIONSHIP
/*
103     Y = INTPOL (CATTLE_AGE, CATTLE_AGE_AXIS,
          CATTLE_AGE_EFFECT);
/*
/*      SEE FIG 8 FOR THE FOLLOWING FUNCTIONAL RELATIONSHIP
/*
104     Z = INTPOL (CATTLE_DIET_QUALITY,
          CATTLE_DIET_AXIS,
          CATTLE_DIET_QUALITY_EFFECT);

```

```

/*
/*****
/*
/*          POTENTIAL WEIGHT GAIN IS INFLUENCED BY CALORIE INTAKE,
/*          DIET QUALITY, AND AGF.
/*
/*****
/*
105          POT_CATTLE_WT_GAIN = X * Y * Z;
/*
/*          SEE FIG 14 FOR THE FOLLOWING FUNCTIONAL RELATIONSHIP
/*
106          CATTLE_RESP_DEMAND = INTPOL (CATTLE_WEIGHT,
          BODY_WT_AXIS_CATTLE, CATTLE_RESP_EFFECT);
/*
/*****
/*
/*          WEATHER IS NOT CONSIDERED WHEN COMPUTING RESPIRATION
/*          DEMAND.
/*
/*
/*****
/*
107          CATTLE_RESPIRATION = CATTLE_RESP_DEMAND *
          CATTLE_DENSITY(MONTH);
108          CATTLE_WT_GAIN = POT_CATTLE_WT_GAIN - CATTLE_RESPIRATION;
109          CATTLE_WEIGHT = CATTLE_WEIGHT + CATTLE_WT_GAIN;
110          TOTAL_CATTLE_WT_GAIN = TOTAL_CATTLE_WT_GAIN +
          CATTLE_WT_GAIN;
111          CATTLE_AGE = CATTLE_AGE + .08333;
112          IF CATTLE_WEIGHT < 32 THEN DO;
/*          IN THIS UNLIKELY SITUATION THE RANGE MANAGER WOULD FIND
/*          GREENER PASTURES FOR HIS CATTLE.
/*
114          CATTLE_DENSITY(*) = 0;
115          PUT SKIP LIST ('CATTLE GO HUNGRY IN MONTH ', MONTH);
116          END;
117          END_CATTLE_GRAZE:

```

```

/*
/*****
/*
      END MONTHS;
/*
/*****
/*
      OUTPUT
/*
/*****
/*
      PUT DATA;
      END YEARS;

```

118
119

```

/*
/*****
/*
/*      SUBROUTINE TO REMOVE UNGULATE GRAZE AS A FUNCTION OF
/*      PREFERENCE AND AVAILABILITY
/*
/*
/*      OVERGRAZING IS NOT CONSIDERED, AS STOCKING RATES
/*      ARE ASSUMED TO BE OPTIMUM.
/*
/*****
/*
120      GRAZE: PROC (DENSITY, CALORIE_DEMAND, PREFERENCE,
121                  TOT_GRAZE_REMOVAL);
122                  DCL PREFERENCE(*), DENSITY(*);
123                  SIGMA = 0;
124                  TOT_GRAZE_REMOVAL = 0;
125                  DIET_QUALITY = 0;
126                  TOTAL_DEMAND = DENSITY(MONTH) * CALORIE_DEMAND;
127                  DO PLANT = 1 TO 5;
128                      AVAILABILITY(PLANT) = ABOVE_GROUND_BIOMASS(PLANT) *
129                      (LIVE_GREEN_FRACTION(PLANT,MONTH) +
130                      ((1 - LIVE_GREEN_FRACTION(PLANT,MONTH)) *
131                      NON_GREEN_AVAILABILITY(PLANT)));
132                      SIGMA = SIGMA + PREFERENCE(PLANT) * AVAILABILITY(PLANT);
133                      END;
134                      DO PLANT = 1 TO 5;
135                      GRAZE_REMOVAL = TOTAL_DEMAND * (PREFERENCE(PLANT) *
136                      AVAILABILITY(PLANT) / SIGMA);
137                      TOT_GRAZE_REMOVAL = TOT_GRAZE_REMOVAL + GRAZE_REMOVAL;
138
/*
/*****
/*
/*      DIET QUALITY IS A FUNCTION OF THE LIVE GREEN FRACTION.
/*
/*
/*****
/*
133      GREEN_AVAIL = ABOVE_GROUND_BIOMASS(PLANT) *
134                  LIVE_GREEN_FRACTION(PLANT,MONTH);
135      GREEN_QUALITY = (PREFERENCE(PLANT) * GREEN_AVAIL) / SIGMA;
136      DIET_QUALITY = DIET_QUALITY + GREEN_QUALITY;
137      ABOVE_GROUND_BIOMASS(PLANT) = ABOVE_GROUND_BIOMASS(PLANT) -
138      (GRAZE_REMOVAL / CALORIFIC_EQUIVALENT(PLANT));
139      END;
140      END GRAZE;

```

```
139      /*
140      /******
141      /*
142      /*      A ROUTINE TO PERFORM LINEAR INTERPOLATION ON FUNCTIONS
143      /*      SUPPLIED TO THE MODEL IN GRAPHICAL (COORDINATE) FORM.
144      /*
145      /******
146      /*
147      INTPOL: PROC(X,XVAL,YVAL) RETURNS (FLCAT DEC);
148      DCL I FIXED BIN INTERNAL, X FLOAT DEC;
149      DCL XVAL(*), YVAL(*);
150      NDIM=DIM(XVAL,1);
151      IF X <= XVAL(1) THEN RETURN (YVAL(1));
152      IF X >= XVAL(NDIM) THEN RETURN (YVAL(NDIM));
153      DO I = 1 TO NDIM;
154      IF XVAL(I) > X THEN DO;
155      AM = (YVAL(I)-YVAL(I-1))/(XVAL(I)-XVAL(I-1));
156      C = YVAL(I)-AM*XVAL(I);
157      RETURN (AM*X+C);
158      END;
159      END;
160      END INTPOL;
```

```

/*
/*****
*/
/*      PUT_CURVE PROCEDURE
*/
/*****
*/
156 PUT_CURVE: PROC(H,XVAL,YVAL);
157 DCL XVAL(*), YVAL(*), H CHAR(*) , GRAPH(20,40) CHAR(1);
158 DCL (ISTORE, JSTORE) (20); /* THIS MAY BE TOO SMALL IN SOME CASES */
159 NDIM=DIM(XVAL,1);
160 IF NDIM > 20 THEN DO;
161     PUT SKIP LIST (H, ' TOO SMALL');
162     RETURN;
163     END;
164 XMIN=XVAL(1);
165 XMAX=XVAL(NDIM);
166 YMAX=YVAL(1);
167 YMIN=YVAL(1);
168 DO II=2 TO NDIM;
169     YMIN=MIN(YMIN,YVAL(II));
170     YMAX=MAX(YMAX,YVAL(II));
171     END;
172 XDIV=(XMAX-XMIN)*0.025;
173 YDIV=(YMAX-YMIN)*0.05;
174 GRAPH(*,*)=' ';
175 NPTS=1;
176 DO K = 1 TO NDIM;
177     J=CEIL ((XVAL(K)-XMIN)/XDIV-0.5);
178     IF J > 40 THEN J=40;
179     IF J < 1 THEN J=1;
180     I=CEIL ((YMAX-YVAL(K))/YDIV-0.5);
181     IF I > 20 THEN I=20;
182     IF I < 1 THEN I=1;
183     ISTORE(K)=I;
184     JSTORE(K)=J;
185     GRAPH(I,J)='*';
186     END;
187 DO N = 2 TO NDIM;
188     DO J = JSTORE(N-1)+1 TO JSTORE(N)-1;
189     GRAD=(ISTORE(N)-ISTORE(N-1))/(JSTORE(N)-JSTORE(N-1));
190     C = ISTORE(N)-(GRAD*JSTORE(N));
191     I = CEIL (GRAD*J+C);
192     GRAPH(I,J)='+';
193     END;
194     END;
195     PUT SKIP(2);
196     DO M = 1 TO 20;
197     IF M=1 THEN
198         PUT SKIP EDIT (YMAX,'+',GRAPH(1,*))
199         (COL(20),E(11,4),COL(34),A,COL(35),40 A);
200     ELSE IF M = 20 THEN
201         PUT SKIP EDIT (YMIN,'+',GRAPH(20,*))
202         (COL(20),E(11,4),COL(34),A,COL(35),40 A);
203     ELSE PUT SKIP EDIT ('|',GRAPH(M,*))
204

```


ATTRIBUTE AND CROSS-REFERENCE TABLE

DCL NO.	IDENTIFIER	ATTRIBUTES AND REFERENCES
3	ABOVE_GROUND_BIOMASS	(5)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 50,54,54,127,133,136,136
	AM	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 150,151,152
3	AVAILABILITY	(5)AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 127,128,131
3	BODY_WT_AXIS_CAMEL	(4)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 16,34,59,66
3	BODY_WT_AXIS_CATTLE	(4)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 22,35,99,106
3	BODY_WT_AXIS_PRONGHORN	(4)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 28,37,79,86
	C	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 151,152,195,196
	CALORIE_DEMAND	PARAMETER,ALIGNED,DECIMAL,FLOAT(SINGLE) 120,125
3	CALORIE_INTAKE_OF_CAMELS	(6)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 17,62
3	CALORIE_INTAKE_OF_CATTLE	(6)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 23,102
3	CALORIE_INTAKE_OF_PRONGHORN	(6)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 29,82
3	CALORIFIC_EQUIVALENT	(5)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 136
1	CAMEL	ENTRY,DECIMAL,FLOAT(SINGLE)
	CAMEL_AGE	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 5,40,63,71,71
3	CAMEL_AGE_AXIS	(6)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 19,63
3	CAMEL_AGE_EFFECT	(6)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 19,63
	CAMEL_CALORIE_DEMAND	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 59,60

DCL NO.	IDENTIFIER	ATTRIBUTES AND REFERENCES
	CAMEL_CALORIE_INTAKE	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 60,62
3	CAMEL_DENSITY	(12)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 57,60,67,74
3	CAMEL_DIET_AXIS	(3)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 20,64
	CAMEL_DIET_QUALITY	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 61,64
3	CAMEL_DIET_QUALITY_EFFECT	(3)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 20,64
57	CAMEL_GRAZE	STATEMENT LABEL CONSTANT
3	CAMEL_PREFERENCE	(5)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 60
	CAMEL_RESP_DEMAND	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 66,67
3	CAMEL_RESP_EFFECT	(4)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 34,66
	CAMEL_RESPIRATION	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 67,68
	CAMEL_WEIGHT	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 8,43,59,66,69,69,72
	CAMEL_WT_GAIN	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 68,69,70
3	CARRYING_CAPACITY	(12)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 54,54
	CATTLE_AGE	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 6,41,103,111,111
3	CATTLE_AGE_AXIS	(6)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 25,103
3	CATTLE_AGE_EFFECT	(6)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 25,103
	CATTLE_CALORIE_DEMAND	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 99,100
	CATTLE_CALORIE_INTAKE	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE)

DCL NO.	IDENTIFIER	ATTRIBUTES AND REFERENCES
		100,102
3	CATTLE_DENSITY	(12)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 97,100,107,114
3	CATTLE_DIET_AXIS	(3)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 26,104
	CATTLE_DIET_QUALITY	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 101,104
3	CATTLE_DIET_QUALITY_EFFECT	(3)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 26,104
97	CATTLE_GRAZE	STATEMENT LABEL CONSTANT 78
3	CATTLE_PREFERENCE	(5)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 100
	CATTLE_RESP_DEMAND	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 106,107
3	CATTLE_RESP_EFFECT	(4)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 35,106
	CATTLE_RESPIRATION	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 107,108
	CATTLE_WEIGHT	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 9,44,99,106,109,109,112
	CATTLE_WT_GAIN	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 108,109,110
	CEIL	GENERIC,BUILT-IN FUNCTION 178,183,196
3	DEMAND_WITH_BODY_WEIGHT_CAMEL	(4)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 16,59
3	DEMAND_WITH_BODY_WEIGHT_CATTLE	(4)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 22,99
3	DEMAND_WITH_BODY_WT_PRONGHORN	(4)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 28,79
121	DENSITY	(*)PARAMETER,ALIGNED,DECIMAL,FLOAT(SINGLE) 120,125
	DIET_QUALITY	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 61,81,101,124,135,135

DCL NO.	IDENTIFIER	ATTRIBUTES AND REFERENCES
	DIM	GENERIC,BUILT-IN FUNCTION 142,159
3	***** EMERGENCE_THRESHOLD	{5}AUTOMATIC,ALIGNED,INITIAL,BINARY,FIXED(15,0) 52
117	END_CATTLE_GRAZE	STATEMENT LABEL CONSTANT 98
	EXP	GENERIC,BUILT-IN FUNCTION 54
	FORAGE	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 50,54
	GRAD	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 194,195,196
157	GRAPH	{20,40}AUTOMATIC,UNALIGNED,STRING(1),CHARACTER 175,190,197,203,205,206
120	GRAZE	ENTRY,DECIMAL,FLOAT(SINGLE) 60,80,100
	GRAZE_REMOVAL	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 131,132,136
	GREEN_AVAIL	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 133,134
	GREEN_QUALITY	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 134,135
3	GROWTH_RATE	{5}AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 54
157	H	PARAMETER,UNALIGNED,STRING(*),CHARACTER 156,162,210
140	***** I	AUTOMATIC,ALIGNED,BINARY,FIXED(15,0) 147,148,150,150,150,150,151,151
	***** I	AUTOMATIC,ALIGNED,BINARY,FIXED(15,0) 183,184,185,186,187,188,190,196,197
	***** II	AUTOMATIC,ALIGNED,BINARY,FIXED(15,0) 169,170,171
139	INTPOL	ENTRY,DECIMAL,FLOAT(SINGLE) 59,62,63,64,66,79,82,83,84,86,99,102,103,104,106

DCL NO.	IDENTIFIER	ATTRIBUTES AND REFERENCES
158	***** ISTORE	(20)AUTOMATIC,ALIGNED,BINARY,FIXED(15,0) 188,194,194,195
	#_FUNS	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 4,39
	***** J	AUTOMATIC,ALIGNED,BINARY,FIXED(15,0) 178,179,180,181,182,189,190,193,196,197
158	***** JSTORE	(20)AUTOMATIC,ALIGNED,BINARY,FIXED(15,0) 189,193,193,194,194,195
	***** K	AUTOMATIC,ALIGNED,BINARY,FIXED(15,0) 177,178,183,188,189
3	LIVE_GREEN_FRACTION	(5,12)AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 14,127,127,133
	***** M	AUTOMATIC,ALIGNED,BINARY,FIXED(15,0) 201,202,204,206
	MAX	GENERIC,BUILT-IN FUNCTION 171
	MIN	GENERIC,BUILT-IN FUNCTION 170
	***** MONTH	AUTOMATIC,ALIGNED,BINARY,FIXED(15,0) 49,52,52,54,54,57,67,75,77,87,95,97,107,115,125,127,127,133
49	MONTHS	STATEMENT LABEL CONSTANT
	***** N	AUTOMATIC,ALIGNED,BINARY,FIXED(15,0) 192,193,193,194,194,194,194,195,195
	***** NDIM	AUTOMATIC,ALIGNED,BINARY,FIXED(15,0) 142,145,146,147,159,160,166,169,177,192
3	NON_GREEN_AVAILABILITY	(5)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 127
	***** NPTS	AUTOMATIC,ALIGNED,BINARY,FIXED(15,0) 176
3	***** PLANT	AUTOMATIC,ALIGNED,BINARY,FIXED(15,0) 51,52,52,54,54,54,126,127,127,127,127,127,128,128,130,131,131,133 133,134,136,136,136
	POT_CAMEL_WT_GAIN	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 65,68
	POT_CATTLE_WT_GAIN	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE)

DCL NO.	IDENTIFIER	ATTRIBUTES AND REFERENCES
		105,108
	POT_PRONGHORN_WT_GAIN	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 85,88
121	PREFERENCE	(*)PARAMETER,ALIGNED,DECIMAL,FLOAT(SINGLE) 120,128,131,134
	PRONGHORN_AGE	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 7,42,83,91,91
3	PRONGHORN_AGE_AXIS	(6)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 31,83
3	PRONGHORN_AGE_EFFECT	(6)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 31,83
	PRONGHORN_CALORIE_DEMAND	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 79,80
	PRONGHORN_CALORIE_INTAKE	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 30,82
3	PRONGHORN_DENSITY	(12)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 77,80,87,94
3	PRONGHORN_DIET_AXIS	(3)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 32,84
	PRONGHORN_DIET_QUALITY	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 81,84
3	PRONGHORN_DIET_QUALITY_EFFECT	(3)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 32,84
77	PRONGHORN_GRAZE	STATEMENT LABEL CONSTANT 59
3	PRONGHORN_PREFERENCE	(5)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 80
	PRONGHORN_RESP_DEMAND	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 86,87
3	PRONGHORN_RESP_EFFECT	(4)AUTOMATIC,ALIGNED,INITIAL,DECIMAL,FLOAT(SINGLE) 37,86
	PRONGHORN_RESPIRATION	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 87,88
	PRONGHORN_WEIGHT	AUTOMATIC,ALIGNED,DECIMAL,FLOAT(SINGLE) 10,45,79,86,89,89,92

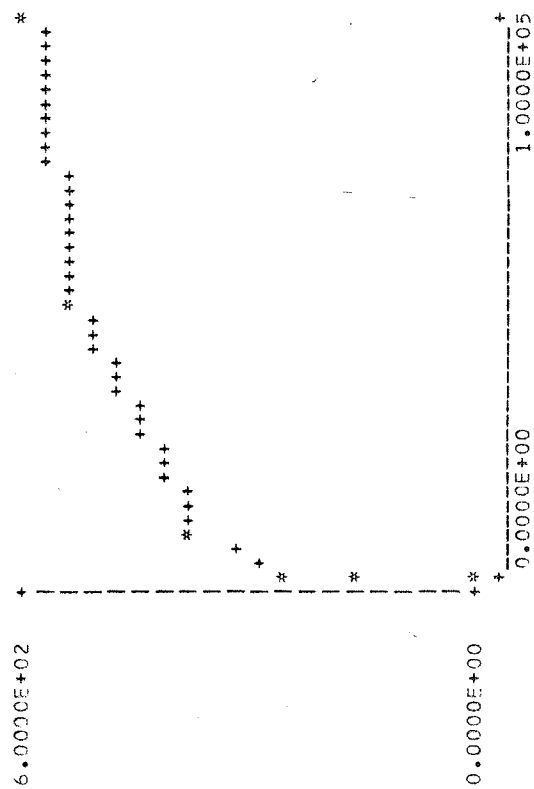
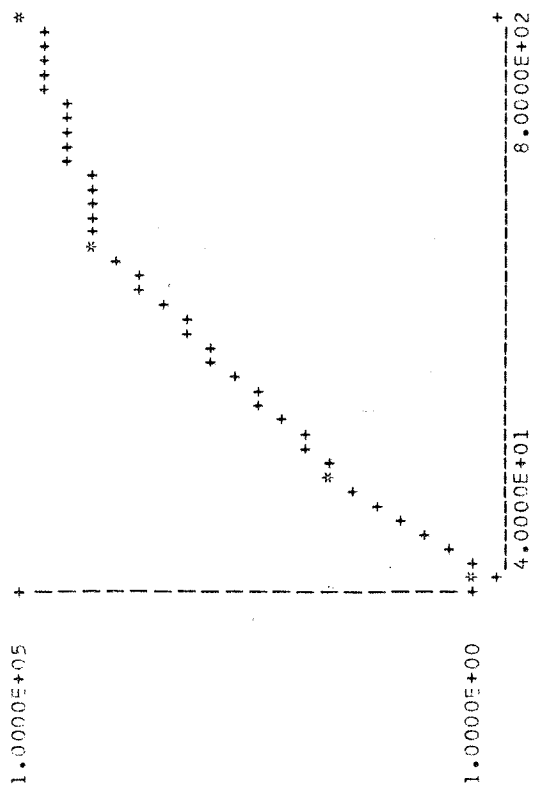
DCL NO.	IDENTIFIER	ATTRIBUTES AND REFERENCES
	PRONGHORN_WT_GAIN	AUTOMATIC, ALIGNED, DECIMAL, FLOAT(SINGLE) 88,89,90
156	PUT_CURVE	ENTRY, DECIMAL, FLOAT(SINGLE) 16,17,19,20,22,23,25,26,28,29,31,32,34,35,37
3	***** QUIESCENCE_THRESHOLD	(5)AUTOMATIC, ALIGNED, INITIAL, BINARY, FIXED(15,0) 52
	SIGMA	AUTOMATIC, ALIGNED, DECIMAL, FLOAT(SINGLE) 122,128,129,131,134
	SUM	GENERIC, BUILT-IN FUNCTION 50
	SYSIN	FILE, EXTERNAL 14,15
	/	
	SYSPRINT	FILE, EXTERNAL 18,21,24,27,30,33,36,38,75,95,115,118,162,200,203,205,206,209,209 210
	TOT_GRAZE_REMOVAL	PARAMETER, ALIGNED, DECIMAL, FLOAT(SINGLE) 120,123,132,132
	TOTAL_CAMEL_WT_GAIN	AUTOMATIC, ALIGNED, DECIMAL, FLOAT(SINGLE) 11,46,70,70
	TOTAL_CATTLE_WT_GAIN	AUTOMATIC, ALIGNED, DECIMAL, FLOAT(SINGLE) 12,47,110,110
	TOTAL_DEMAND	AUTOMATIC, ALIGNED, DECIMAL, FLOAT(SINGLE) 125,131
	TOTAL_PRONGHORN_WT_GAIN	AUTOMATIC, ALIGNED, DECIMAL, FLOAT(SINGLE) 13,48,90,90
3	WT_GAIN_PER_CALORIE_CAMELS	(6)AUTOMATIC, ALIGNED, INITIAL, DECIMAL, FLOAT(SINGLE) 17,62
3	WT_GAIN_PER_CALORIE_CATTLE	(6)AUTOMATIC, ALIGNED, INITIAL, DECIMAL, FLOAT(SINGLE) 23,102
3	WT_GAIN_PER_CALORIE_PRONGHORN	(6)AUTOMATIC, ALIGNED, INITIAL, DECIMAL, FLOAT(SINGLE) 29,82
140	X	PARAMETER, ALIGNED, DECIMAL, FLOAT(SINGLE) 139,143,145,148,152
	X	AUTOMATIC, ALIGNED, DECIMAL, FLOAT(SINGLE) 62,65,82,85,102,105

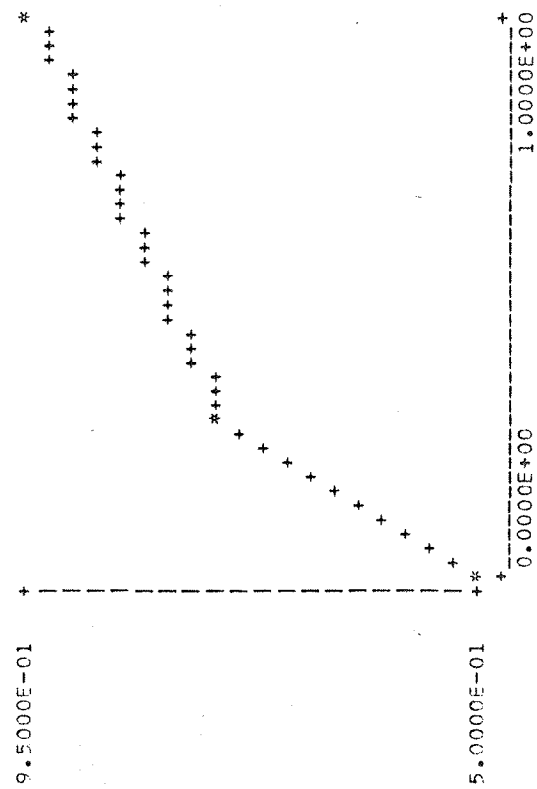
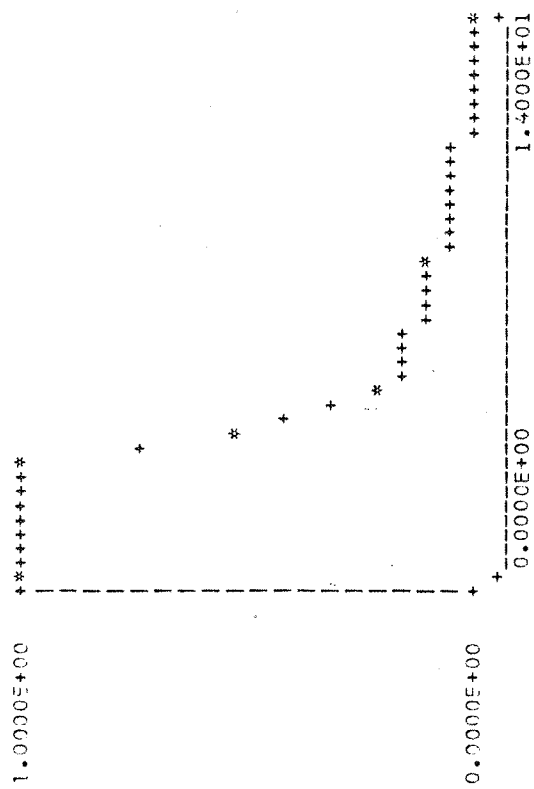
DCL NO.	IDENTIFIER	ATTRIBUTES AND REFERENCES
	XDIV	AUTOMATIC, ALIGNED, DECIMAL, FLOAT(SINGLE) 173, 178
	XMAX	AUTOMATIC, ALIGNED, DECIMAL, FLOAT(SINGLE) 166, 173, 209
	XMIN	AUTOMATIC, ALIGNED, DECIMAL, FLOAT(SINGLE) 165, 173, 178, 209
157	XVAL	(*) PARAMETER, ALIGNED, DECIMAL, FLOAT(SINGLE) 156, 159, 165, 166, 178
141	XVAL	(*) PARAMETER, ALIGNED, DECIMAL, FLOAT(SINGLE) 139, 142, 143, 145, 148, 150, 150, 151
	Y	AUTOMATIC, ALIGNED, DECIMAL, FLOAT(SINGLE) 63, 65, 83, 85, 103, 105
	YDIV	AUTOMATIC, ALIGNED, DECIMAL, FLOAT(SINGLE) 174, 183
3	***** YEAR	AUTOMATIC, ALIGNED, BINARY, FIXED(15, 0) 39
39	YEARS	STATEMENT LABEL CONSTANT
	YMAX	AUTOMATIC, ALIGNED, DECIMAL, FLOAT(SINGLE) 167, 171, 171, 174, 183, 203
	YMIN	AUTOMATIC, ALIGNED, DECIMAL, FLOAT(SINGLE) 168, 170, 170, 174, 205
157	YVAL	(*) PARAMETER, ALIGNED, DECIMAL, FLOAT(SINGLE) 156, 167, 168, 170, 171, 183
141	YVAL	(*) PARAMETER, ALIGNED, DECIMAL, FLOAT(SINGLE) 139, 144, 146, 150, 150, 151
	Z	AUTOMATIC, ALIGNED, DECIMAL, FLOAT(SINGLE) 64, 65, 84, 85, 104, 105

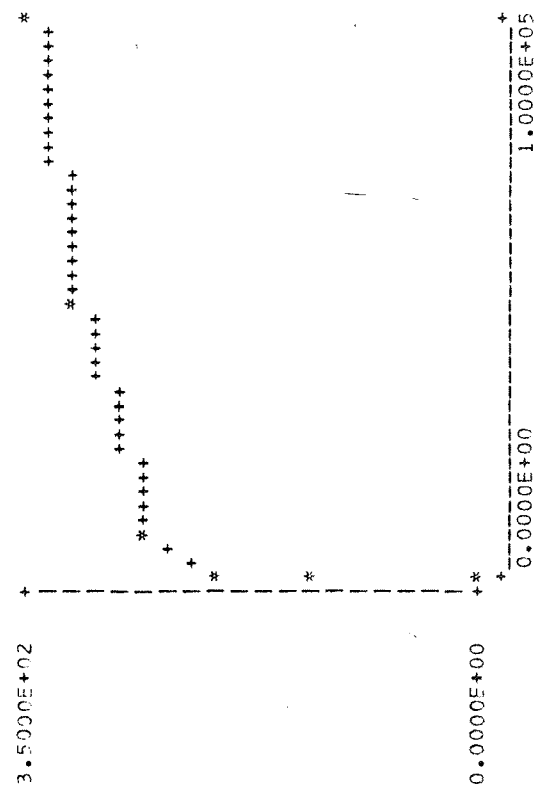
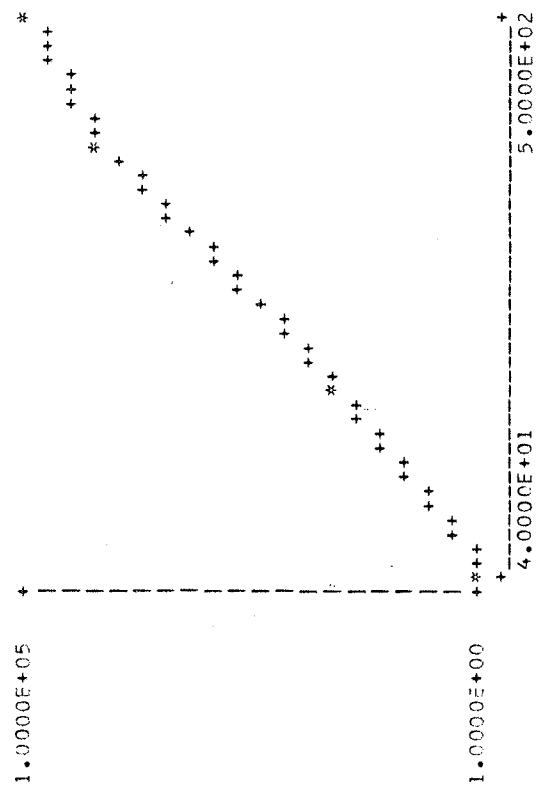
AGGREGATE LENGTH TABLE

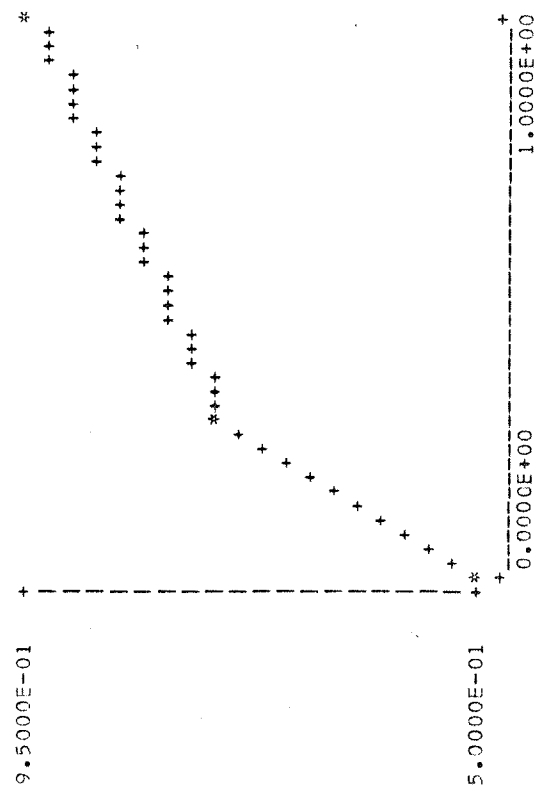
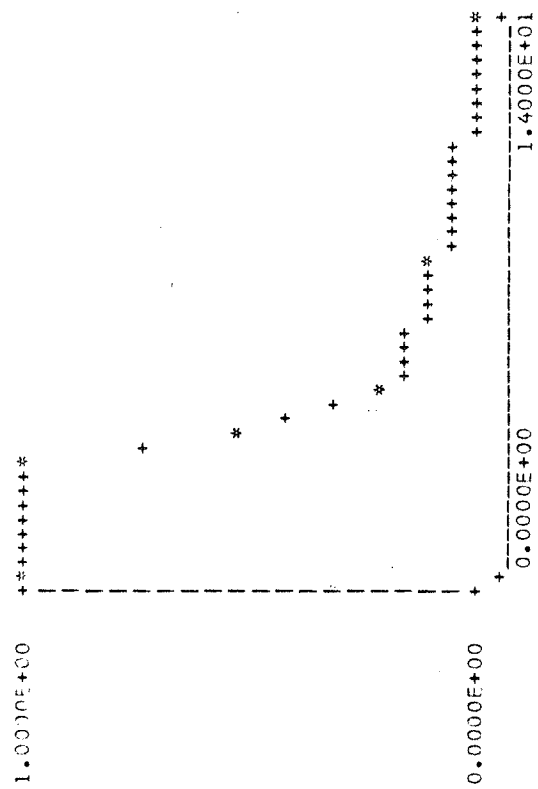
STATEMENT NO.	IDENTIFIER	LENGTH IN BYTES
3	ABOVE_GROUND_BIOMASS	20
3	AVAILABILITY	20
3	BODY_WT_AXIS_CAMEL	16
3	BODY_WT_AXIS_CATTLE	16
3	BODY_WT_AXIS_PRONGHORN	16
3	CALORIE_INTAKE_OF_CAMELS	24
3	CALORIE_INTAKE_OF_CATTLE	24
3	CALORIE_INTAKE_OF_PRONGHORN	24
3	CALORIFIC_EQUIVALENT	20
3	CAMEL_AGE_AXIS	24
3	CAMEL_AGE_EFFECT	24
3	CAMEL_DENSITY	48
3	CAMEL_DIET_AXIS	12
3	CAMEL_DIET_QUALITY_EFFECT	12
3	CAMEL_PREFERENCE	20
3	CAMEL_RESP_EFFECT	16
3	CARRYING_CAPACITY	48
3	CATTLE_AGE_AXIS	24
3	CATTLE_AGE_EFFECT	24
3	CATTLE_DENSITY	48
3	CATTLE_DIET_AXIS	12
3	CATTLE_DIET_QUALITY_EFFECT	12
3	CATTLE_PREFERENCE	20
3	CATTLE_RESP_EFFECT	16
3	DEMAND_WITH_BODY_WEIGHT_CAMEL	16

STATEMENT NO.	IDENTIFIER	LENGTH IN BYTES
3	DEMAND_WITH_BODY_WEIGHT_CATTLE	16
3	DEMAND_WITH_BODY_WT_PRONGHORN	16
3	EMERGENCE_THRESHOLD	10
157	GRAPH	800
3	GROWTH_RATE	20
158	ISTORE	40
158	JSTORE	40
3	LIVE_GREEN_FRACTION	240
3	NON_GREEN_AVAILABILITY	20
3	PRONGHORN_AGE_AXIS	24
3	PRONGHORN_AGE_EFFECT	24
3	PRONGHORN_DENSITY	48
3	PRONGHORN_DIET_AXIS	12
3	PRONGHORN_DIET_QUALITY_EFFECT	12
3	PRONGHORN_PREFERENCE	20
3	PRONGHORN_RESP_EFFECT	16
3	QUIESCENCE_THRESHOLD	10
3	WT_GAIN_PER_CALORIE_CAMELS	24
3	WT_GAIN_PER_CALORIE_CATTLE	24
3	WT_GAIN_PER_CALORIE_PRONGHORN	24









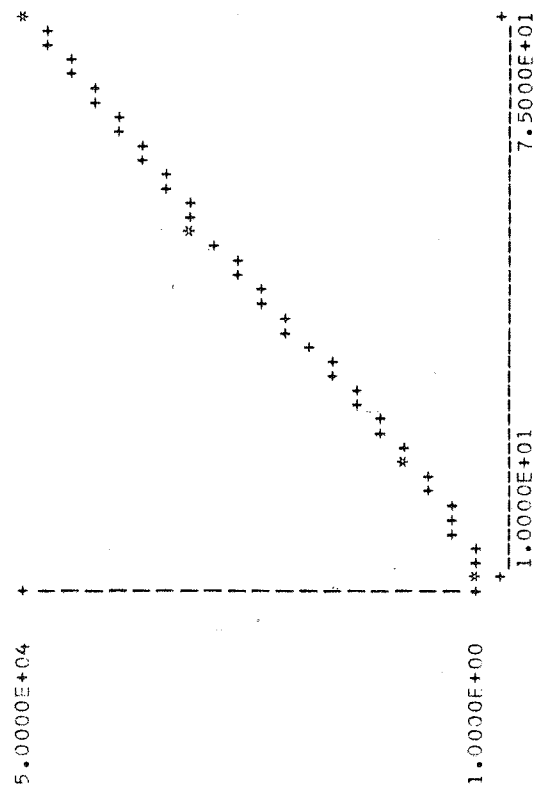


FIG 9 - PRONGHORN WEIGHT ON CALORIE DEMAND

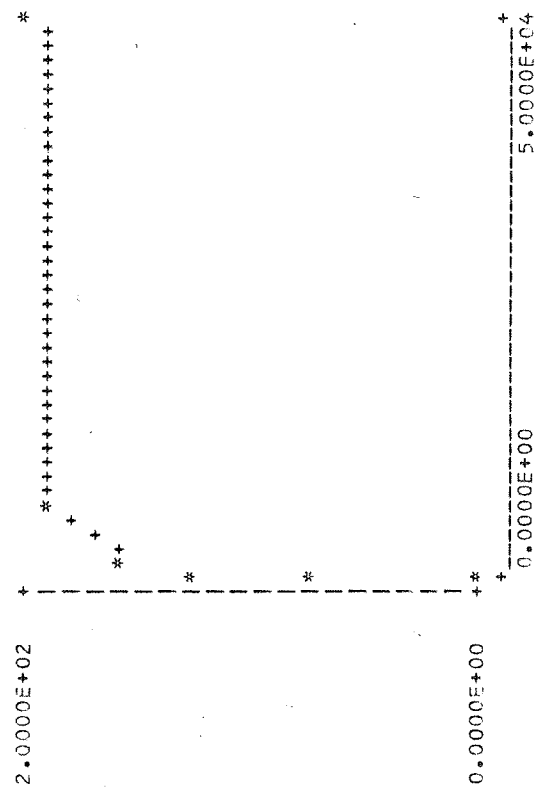
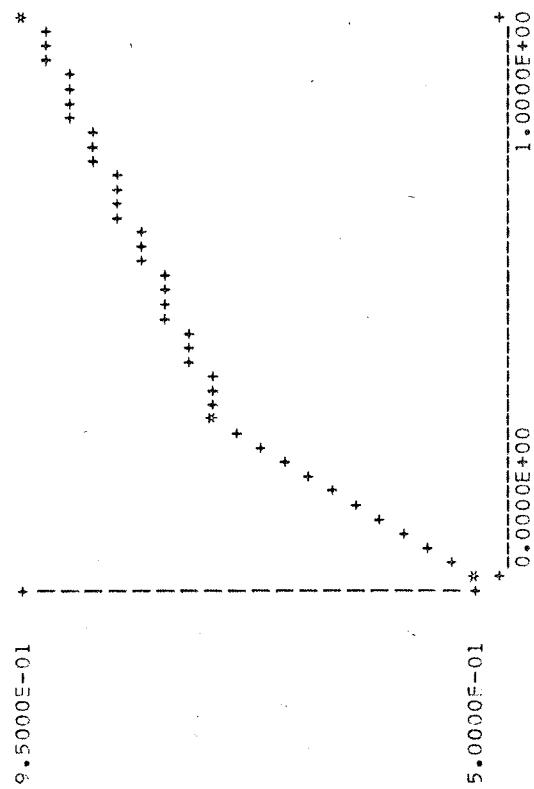
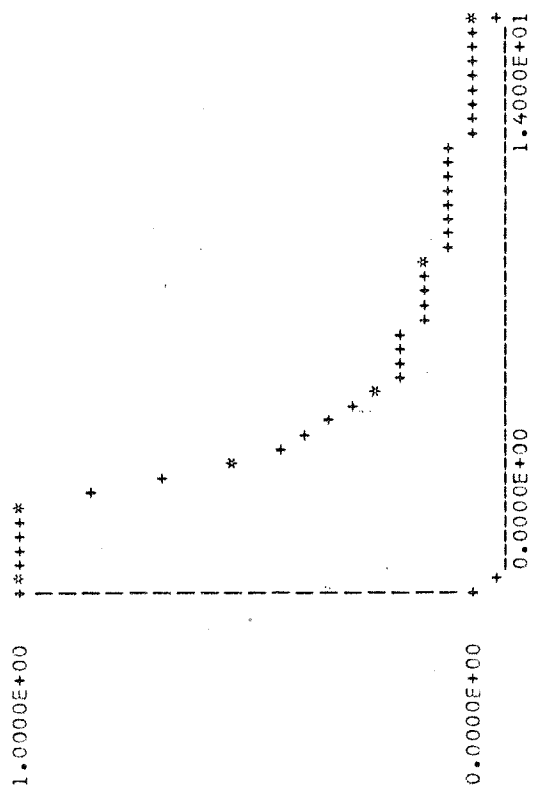


FIG 10 - PRONGHORN CALORIE INTAKE ON WT GAIN



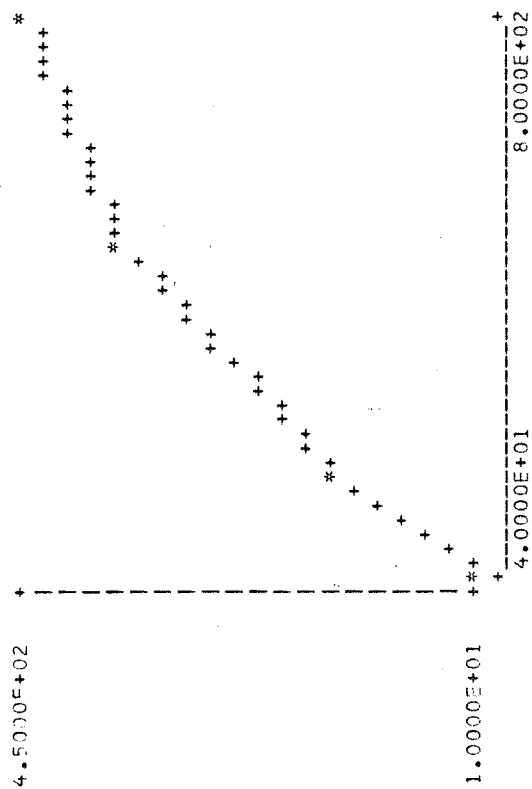


FIG 13 - CAMEL WT ON RESPIRATION

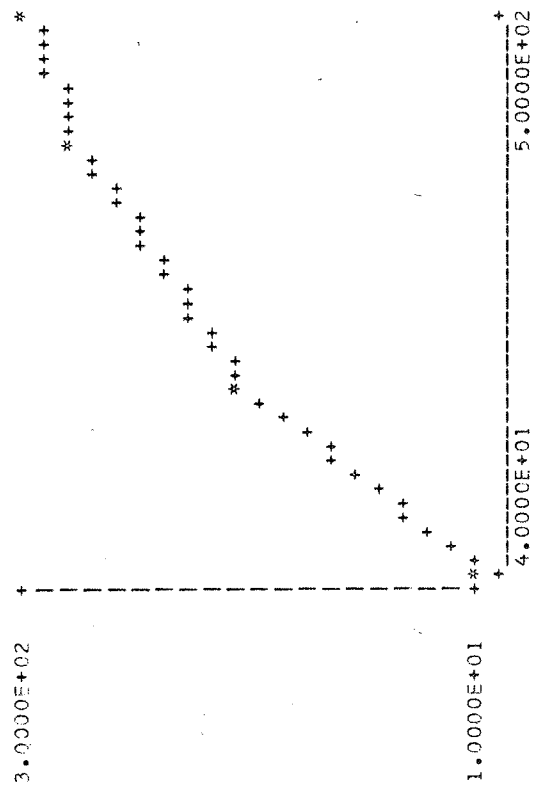


FIG 14 - CATTLE WT ON RESPIRATION

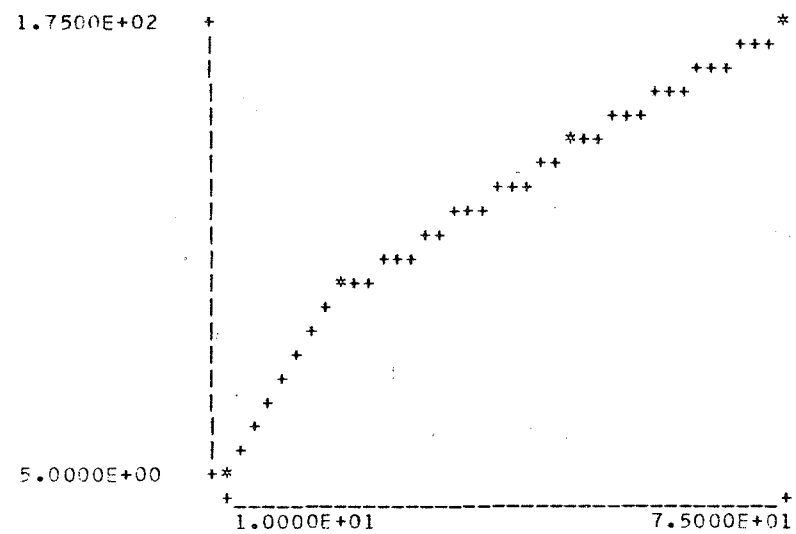


FIG 15 - PCNGHORN WT CN RESPIRATION