

Creating Forage Growth Curves Using GPFARM-Range

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GPFARM-Range History

GPFARM-Range is a systems model that simulates forage growth, soil water balance, carbon cycling, and livestock production.

GPFARM-Range was originally created in 1990 with components from SPUR.

During the past 20 years it has been improved significantly. Some of the changes include improved water stress, use of growing degree days, carbon – nitrogen cycling and others.

The forage growth curve generator takes the volumes of GPFARM-Range output and reduces it down to simple growth curves and percent production by month.

GPFARM-Range Interface

Old

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
R1														
R2														
R3														
R4														
R5														
R6														
R7														
R8														
R9														
R10														
R11														
R12														
R13														
R14														
R15														
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R39														
R40														
R41														
R42														
R43														
R44														
R45														
R46														
R47														
R48														
R49														
R50														

We have replaced GPFARM-Range's data intensive interface with a simpler version.

New

State

Location

Elevation Feet

Percent Cool Season Grasses %

Percent Warm Season Grasses %

Percent Forbs %

Percent Legumes %

Percent Shrubs %

Total of All Functional Groups %

*Total Must Equal 100

Run GPFARM-Range

Update Output

Access Plant Parameters

Access Soil Parameters

Create Climate for Location

Interface Output Input Weather Events water0_out soil0_out plant0_out livestock0_out herdOut Parameters Defaults Sheet1

The new version only asks for easily obtainable data.

GPFARM-Range Interface

The screenshot shows a spreadsheet interface with the following data and controls:

Field	Value
State	Utah
Location	Fish Springs Refuge
Elevation	4350 Feet
Percent Cool Season Grasses	35 %
Percent Warm Season Grasses	65 %
Percent Forbs	0 %
Percent Legumes	0 %
Percent Shrubs	0 %
Total of All Functional Groups	100

*Total Must Equal 100

Buttons: Run GPFARM-Range, Update Output, Access Plant Parameters, Access Soil Parameters, Create Climate for Location

Information in yellow is automatically generated by GPFARM-Range.

GPFARM-Range Interface

The screenshot shows a spreadsheet interface for GPFARM-Range. The background is light green. The interface includes the following elements:

- State:** Input field with "Utah" selected.
- Location:** Input field with "Brian Head" selected.
- Elevation:** Input field with "9770 Feet" selected.
- Percent Cool Season Grasses:** Input field with "20" selected, followed by a "%" sign.
- Percent Warm Season Grasses:** Input field with "50" selected, followed by a "%" sign.
- Percent Forbs:** Input field with "15" selected, followed by a "%" sign.
- Percent Legumes:** Input field with an empty white box, followed by a "%" sign.
- Percent Shrubs:** Input field with "15" selected, followed by a "%" sign.
- Total of All Functional Groups:** Input field with "100" selected, followed by a "%" sign.
- *Total Must Equal 100** (text label)
- Buttons:** "Run GPFARM-Range", "Update Output", "Access Plant Parameters", "Access Soil Parameters", and "Create Climate for Location".

The spreadsheet grid shows columns A through P and rows 1 through 47. The bottom tab bar includes: Interface, Output, Input, Weather, Events, water0_out, soil0_out, plant0_out, livestock0_out, herdOut, Parameters, Defaults, Sheet1.

Cells in white require percent forage composition by functional group.

GPFARM-Range Interface

The screenshot displays the GPFARM-Range interface within a spreadsheet application. The interface is set against a light green background and includes the following elements:

- State:** A dropdown menu with "Utah" selected.
- Location:** A text input field containing "Brian Head".
- Elevation:** A text input field containing "9770" followed by a "Feet" label.
- Percent Cool Season Grasses:** A slider or input field set to "20 %".
- Percent Warm Season Grasses:** A slider or input field set to "50 %".
- Percent Forbs:** A slider or input field set to "15 %".
- Percent Legumes:** An empty input field.
- Percent Shrubs:** A slider or input field set to "15 %".
- Total of All Functional Groups:** A text input field set to "100 %".

Below the input fields, a note states: "*Total Must Equal 100".

On the right side of the interface, there are two buttons:

- Run GPFARM-Range** (top button)
- Update Output** (bottom button)

At the bottom left, there is a vertical stack of three buttons:

- Access Plant Parameters**
- Access Soil Parameters**
- Create Climate for Location**

A large black arrow points from the text on the right towards the "Access Plant Parameters" button.

The spreadsheet's status bar at the bottom shows the following tabs: Interface, Output, Input, Weather, Events, water0_out, soil0_out, plant0_out, livestock0_out, herdOut, Parameters, Defaults, Sheet1.

If needed the user can access some plant and soil parameters by pushing the appropriate button.

GPFARM-Range Plant Parameters

Plant Parameters	Warm Season Grasses	Cool Season Grasses	Legumes	Shrubs	Forbs	DEFINITION	DATATYPE	UNITS
Rooting Depth (cm)	50	50	152	152	86	rooting depth	double	cm
Root to Shoot ratio	10	10	10	10	10	root to shoot ratio	double	kg/kg
Minimum temperature for starting growth	8	3	3	4	3	base/minimum temperature for growth	double	oC
Maximum temperature for growth	41	36	36	36	35	maximum temperature for growth	double	oC
Optimum temperature for growth	27	22	20	21	23	optimum temperature for growth	double	oC

Push this button if you make any changes

Push this button to reset default values

Default values are provided

Changeable plant parameters include:

- Rooting Depth
- Root to Shoot Ratio
- Minimum Growth Temp
- Maximum Growth Temp
- Optimum Growth Temp

The user doesn't need to change any parameter or can change just the ones that are known.

GPFARM-Range Soil Parameters

MUO Soil Parameters	Soil Layer Depth	Bulk Density	Percent Clay	Percent Sand	Water Content	Saturated Hydraulic Conductivity
Layer1	7	1.45	15	71.05	0.25	2.59
Layer2	15	1.45	15	71.05	0.25	2.59
Layer3	41	1.43384	24.292	54.0416	0.29	0.43
Layer4	56	1.45	22.5	53.85	0.26	0.43
Layer5	86	1.48	11.5	71.79	0.18	2.59
Layer6	116	1.48	11.5	71.79	0.18	2.59
Layer7	152	1.48	11.5	71.79	0.18	2.59
UNITS	cm	g/cm ³	%	%	m ³ /m ³	cm/h

Push this button if you make any changes

Push this button to reset default values

Default values are provided

Accommodates up to seven soil layers with parameters for each:

- Layer depth
- Bulk Density
- Percent Clay and Sand
- Water Content (ignore this one)
- Saturated Hydraulic Conductivity

The user doesn't need to change any parameter or can change just the ones that are known.

GPFARM-Range Climate Generator

The screenshot displays the GPFARM-Range Climate Generator interface within an Excel spreadsheet. The interface is set against a light green background and includes the following elements:

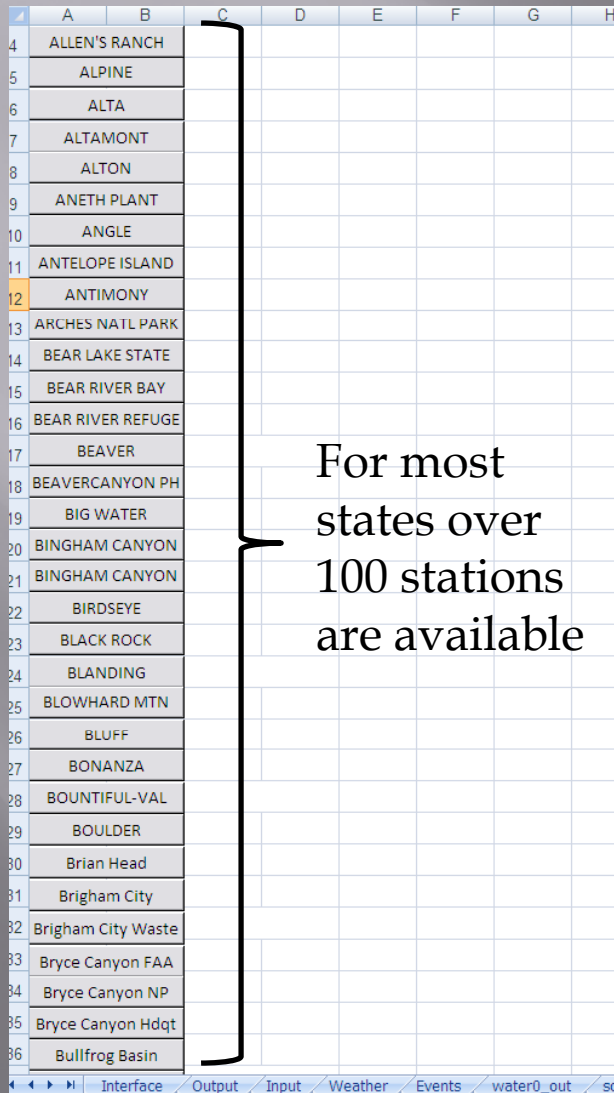
- State:** A dropdown menu with "Utah" selected.
- Location:** A text input field containing "Brian Head".
- Elevation:** A text input field containing "9770 Feet".
- Percent Cool Season Grasses:** A slider set to 20%.
- Percent Warm Season Grasses:** A slider set to 50%.
- Percent Forbs:** A slider set to 15%.
- Percent Legumes:** A slider set to 0%.
- Percent Shrubs:** A slider set to 15%.
- Total of All Functional Groups:** A slider set to 100%.
- *Total Must Equal 100**: A note below the total slider.
- Buttons:** "Run GPFARM-Range" (top right), "Update Output" (middle right), "Access Plant Parameters" (bottom left), "Access Soil Parameters" (bottom left), and "Create Climate for Location" (bottom left).

An arrow points from the text on the right to the "Create Climate for Location" button.

Excel spreadsheet tabs at the bottom include: Interface, Output, Input, Weather, Events, water0_out, soil0_out, plant0_out, livestock0_out, herdOut, Parameters, Defaults, Sheet1.

A climate file can be created for different weather stations throughout the state.

GPFARM-Range Climate Generator



	A	B	C	D	E	F	G	H
4	ALLEN'S RANCH							
5	ALPINE							
6	ALTA							
7	ALTAMONT							
8	ALTON							
9	ANETH PLANT							
10	ANGLE							
11	ANTELOPE ISLAND							
12	ANTIMONY							
13	ARCHES NATL PARK							
14	BEAR LAKE STATE							
15	BEAR RIVER BAY							
16	BEAR RIVER REFUGE							
17	BEAVER							
18	BEAVERCANYON PH							
19	BIG WATER							
20	BINGHAM CANYON							
21	BINGHAM CANYON							
22	BIRDSEYE							
23	BLACK ROCK							
24	BLANDING							
25	BLOWHARD MTN							
26	BLUFF							
27	BONANZA							
28	BOUNTIFUL-VAL							
29	BOULDER							
30	Brian Head							
31	Brigham City							
32	Brigham City Waste							
33	Bryce Canyon FAA							
34	Bryce Canyon NP							
35	Bryce Canyon Hdqt							
36	Bullfrog Basin							

For most
states over
100 stations
are available

The user needs to have internet access.

When a weather station button is pushed GPFARM-Range connects with the Western Regional Climate Center on-line and collects the long-term weather data for that weather station.

An average climate for the selected weather station is created.

GPFARM-Range Interface

The screenshot shows a software interface with a light green background. On the left side, there are several input fields with labels and values:

- State: Utah
- Location: Brian Head
- Elevation: 9770 Feet
- Percent Cool Season Grasses: 20 %
- Percent Warm Season Grasses: 50 %
- Percent Forbs: 15 %
- Percent Legumes: %
- Percent Shrubs: 15 %
- Total of All Functional Groups: 100 %

Below these fields, there is a note: ***Total Must Equal 100**

On the right side, there are two buttons:

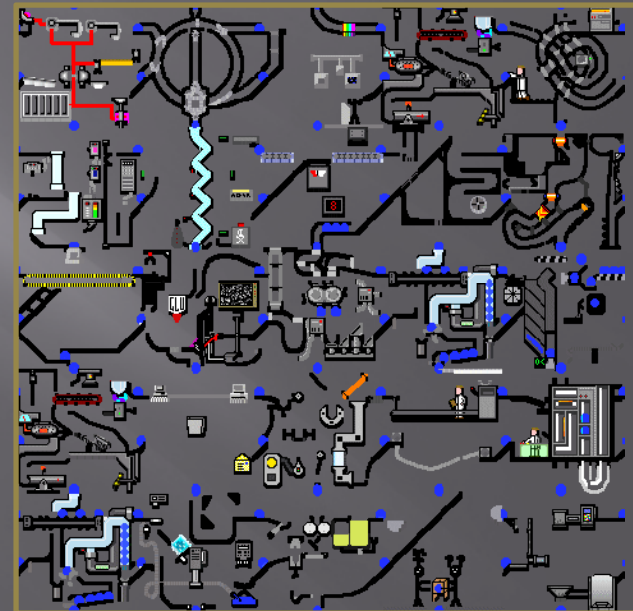
- Run GPFARM-Range
- Update Output

At the bottom left, there are three buttons in a vertical stack:

- Access Plant Parameters
- Access Soil Parameters
- Create Climate for Location

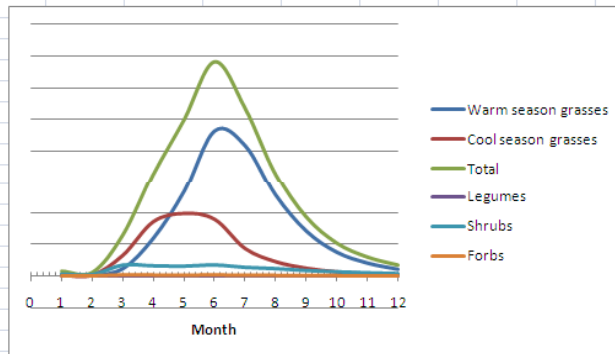
The interface is displayed within a spreadsheet window with columns A through P and rows 1 through 47. The bottom tab bar shows: Interface, Output, Input, Weather, Events, water0_out, soil0_out, plant0_out, livestock0_out, herdOut, Parameters, Defaults, Sheet1.

Once the data is entered two buttons run the program and produce the output



Growth Curve Output

	WSG % by month	CSG % by month	Legumes % by month	Shrubs % by month	Forbs % by month	Total % by month
January	0%	0%	0%	2%	2%	0%
February	0%	0%	0%	2%	1%	0%
March	1%	8%	0%	15%	16%	4%
April	7%	21%	0%	14%	14%	11%
May	15%	25%	0%	13%	13%	17%
June	25%	22%	0%	15%	15%	24%
July	23%	11%	0%	12%	12%	18%
August	14%	6%	0%	10%	9%	11%
September	8%	3%	0%	7%	6%	6%
October	4%	2%	0%	5%	5%	4%
November	2%	1%	0%	4%	3%	2%
December	1%	0%	0%	3%	3%	1%
Sum	100%	100%	0%	100%	100%	100%



Growth curve output includes:

- Forage growth percentage for each month and each functional group plus a percentage for all groups combined and,
- Graphical output.

Some things You Need to Know

- GPFARM-Range is state specific (i.e. Utah) – climate stations need to be added for each state so that the climate generator has data. We use climate stations from the Western Regional Climate Center but can use any source of climate data that is available on-line.
- The climate created by GPFARM-Range is based on long-term averages and creates an “average” year climate. It doesn’t do wet or dry years (but it could if that’s important).
- User cannot enter their own climate data – at least not yet.
- User needs to know an estimate of the percentage of each forage functional group (i.e. warm season, cool season etc.).
- Changing soil parameters is very important, especially the number and depth of soil layers.
- Changing plant parameters is not as critical but it is helpful.

Where You Can Find Me

(when I get back from Afghanistan)

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