From:	Endries, Mark
To:	Reid, Rebekah N; Marshall, Michael E; Stephanie DeMay; Becker, Drew N
Subject:	Maxent model results for Hexastylis Naniflora
Date:	Friday, February 9, 2018 12:01:43 PM
Attachments:	Maxent model for Hexastylis_naniflora_RandomPts in Polys.pdf
Importance:	High

Hi All,

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To summarize, the model performed well. By a wide margin SSURGO soils was the biggest contributor to the model results, but 8 other variables contributed a significant portion as well.

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Thanks!

Mark

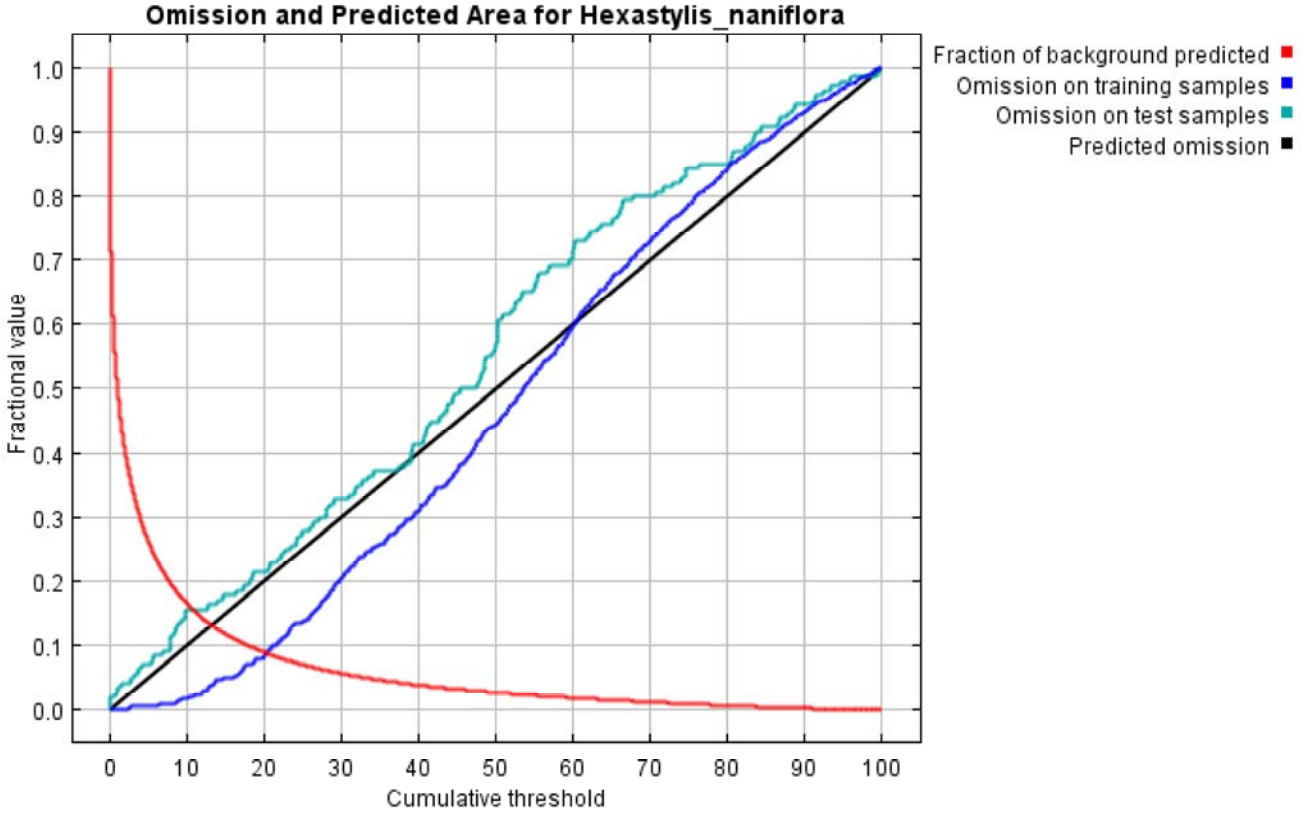
Mark Endries
USFWS
160 Zillicoa St
Asheville, NC 28801
Office: 828.258.3939 ext. 231
Mobile: 828.215.1740

Maxent model for Hexastylis_naniflora

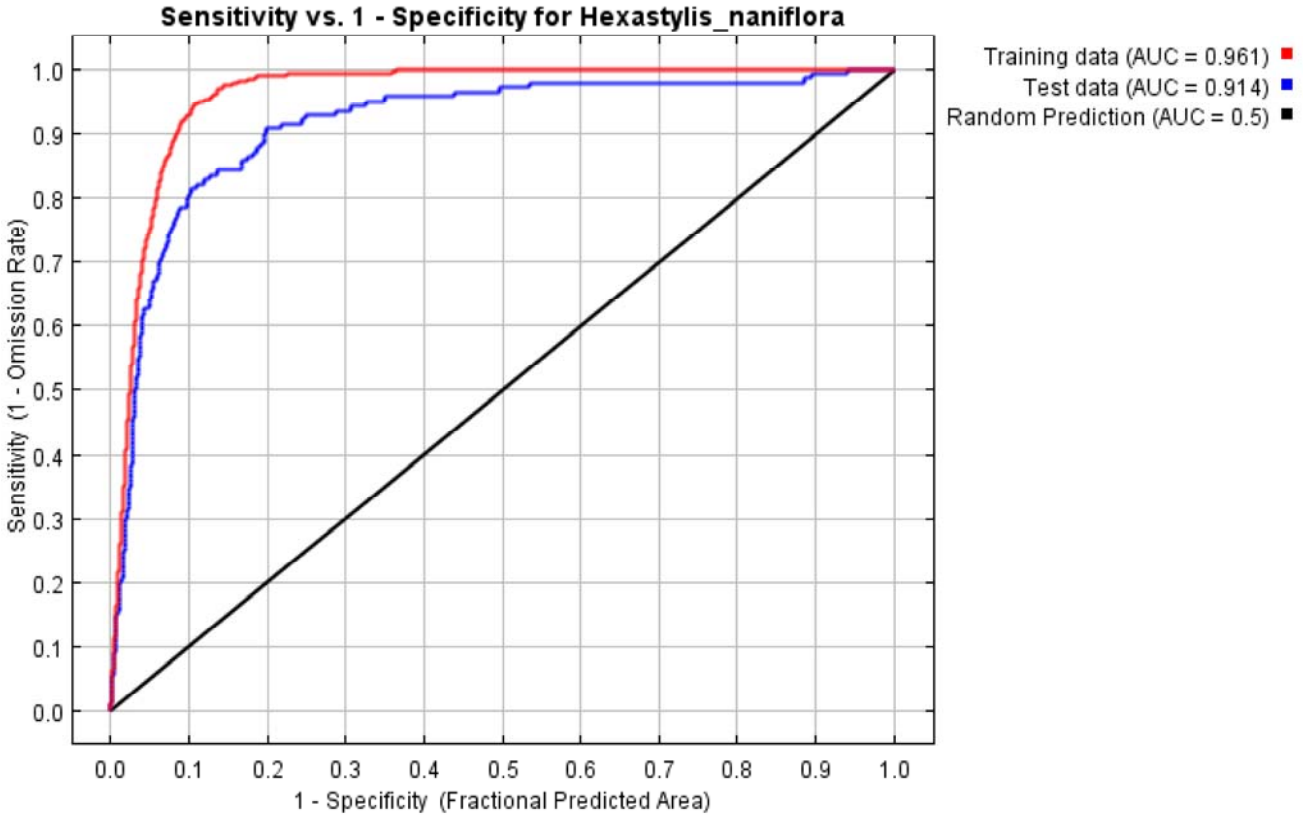
This page contains some analysis of the Maxent model for Hexastylis_naniflora, created Fri Feb 09 11:25:53 EST 2018 using Maxent version 3.4.1. If you would like to do further analyses, the raw data used here is linked to at the end of this page.

Analysis of omission/commission

The following picture shows the omission rate and predicted area as a function of the cumulative threshold. The omission rate is is calculated both on the training presence records, and (if test data are used) on the test records. The omission rate should be close to the predicted omission, because of the definition of the cumulative threshold.



The next picture is the receiver operating characteristic (ROC) curve for the same data. Note that the specificity is defined using predicted area, rather than true commission (see the paper by Phillips, Anderson and Schapire cited on the help page for discussion of what this means). This implies that the maximum achievable AUC is less than 1. If test data is drawn from the Maxent distribution itself, then the maximum possible test AUC would be 0.936 rather than 1; in practice the test AUC may exceed this bound.



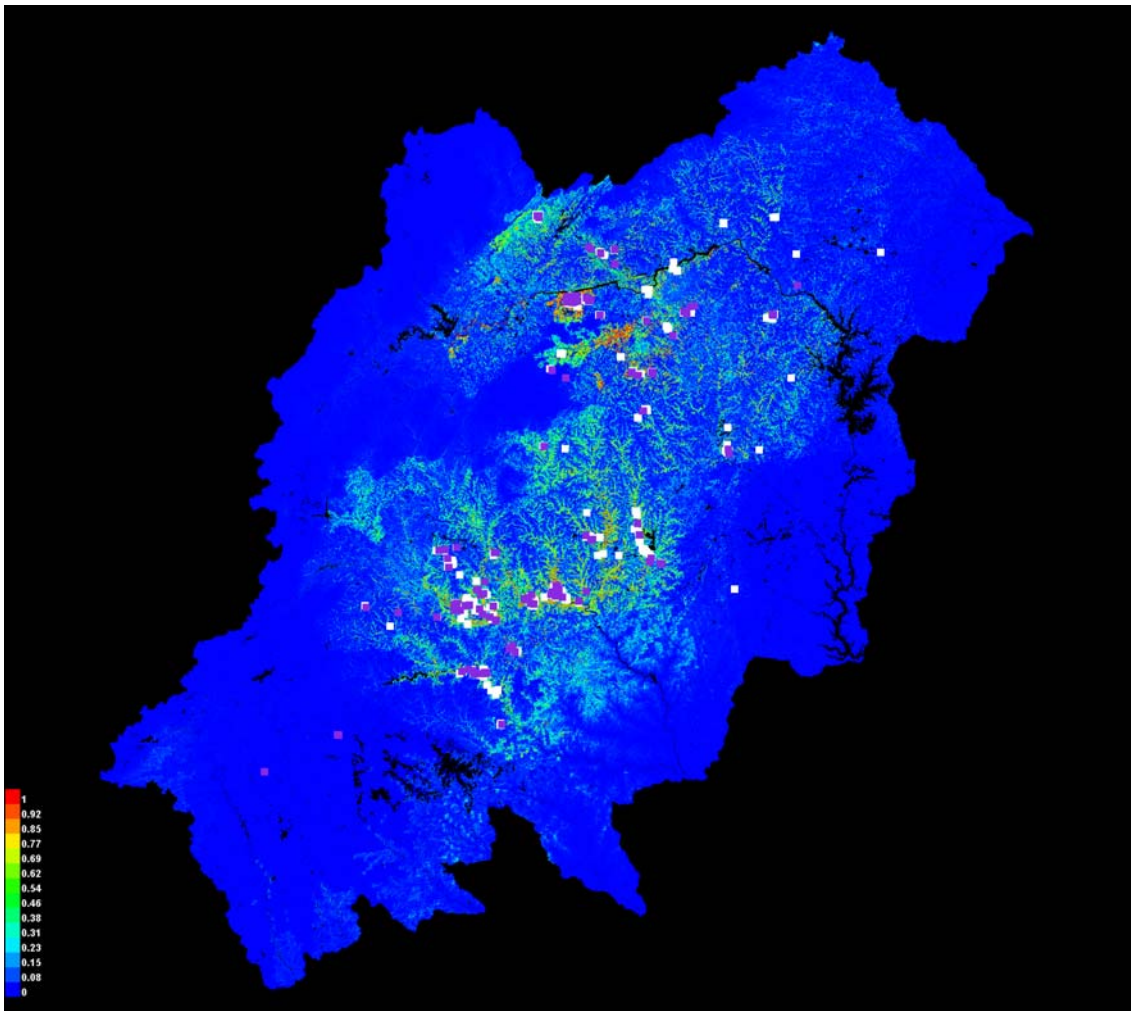
Some common thresholds and corresponding omission rates are as follows. If test data are available, binomial probabilities are calculated exactly if the number of test samples is at most 25, otherwise using a normal approximation to the binomial. These are 1-sided p-values for the null hypothesis that test points are predicted no better than by a random prediction with the same fractional predicted area. The "Balance" threshold minimizes 6 * training omission rate + .04 * cumulative threshold + 1.6 * fractional predicted area.

Cumulative threshold	Cloglog threshold	Description	Fractional predicted area	Training omission rate	Test omission rate	P-value
1.000	0.011	Fixed cumulative value 1	0.495	0.002	0.036	5.524E-29
5.000	0.049	Fixed cumulative value 5	0.262	0.007	0.071	0E0
10.000	0.114	Fixed cumulative value 10	0.165	0.019	0.157	0E0
0.528	0.007	Minimum training presence	0.573	0.000	0.021	1.533E-22
21.572	0.313	10 percentile training presence	0.083	0.099	0.229	0E0
20.339	0.294	Equal training sensitivity and specificity	0.088	0.087	0.214	0E0

16.557	0.226	Maximum training sensitivity plus specificity	0.108	0.054	0.186	0E0
10.659	0.123	Equal test sensitivity and specificity	0.157	0.021	0.157	0E0
16.228	0.219	Maximum test sensitivity plus specificity	0.110	0.054	0.179	0E0
5.878	0.059	Balance training omission, predicted area and threshold value	0.238	0.007	0.086	0E0
11.101	0.130	Equate entropy of thresholded and original distributions	0.152	0.024	0.157	0E0

Pictures of the model

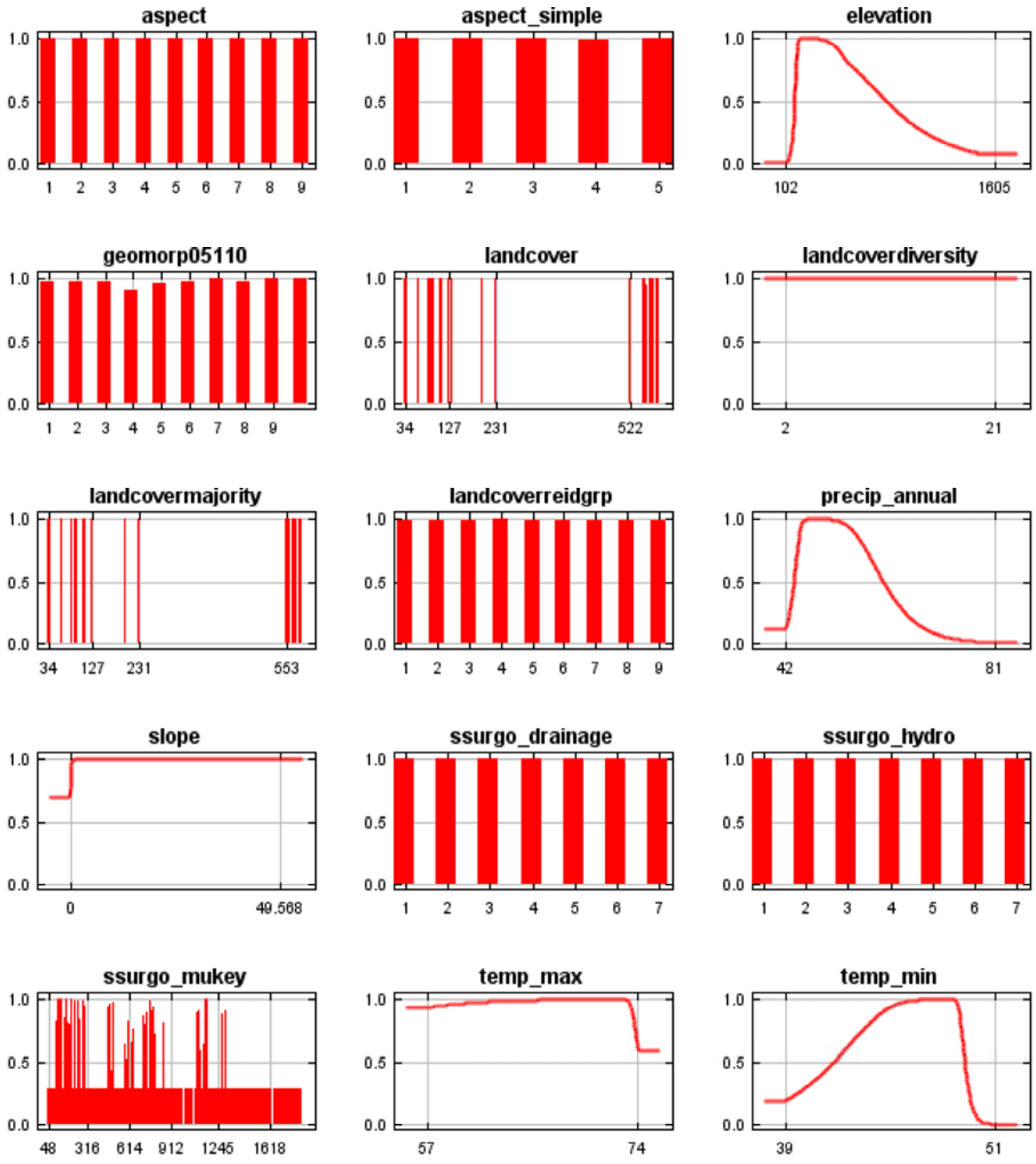
This is a representation of the Maxent model for Hexastylis_naniflora. Warmer colors show areas with better predicted conditions. White dots show the presence locations used for training, while violet dots show test locations. Click on the image for a full-size version.



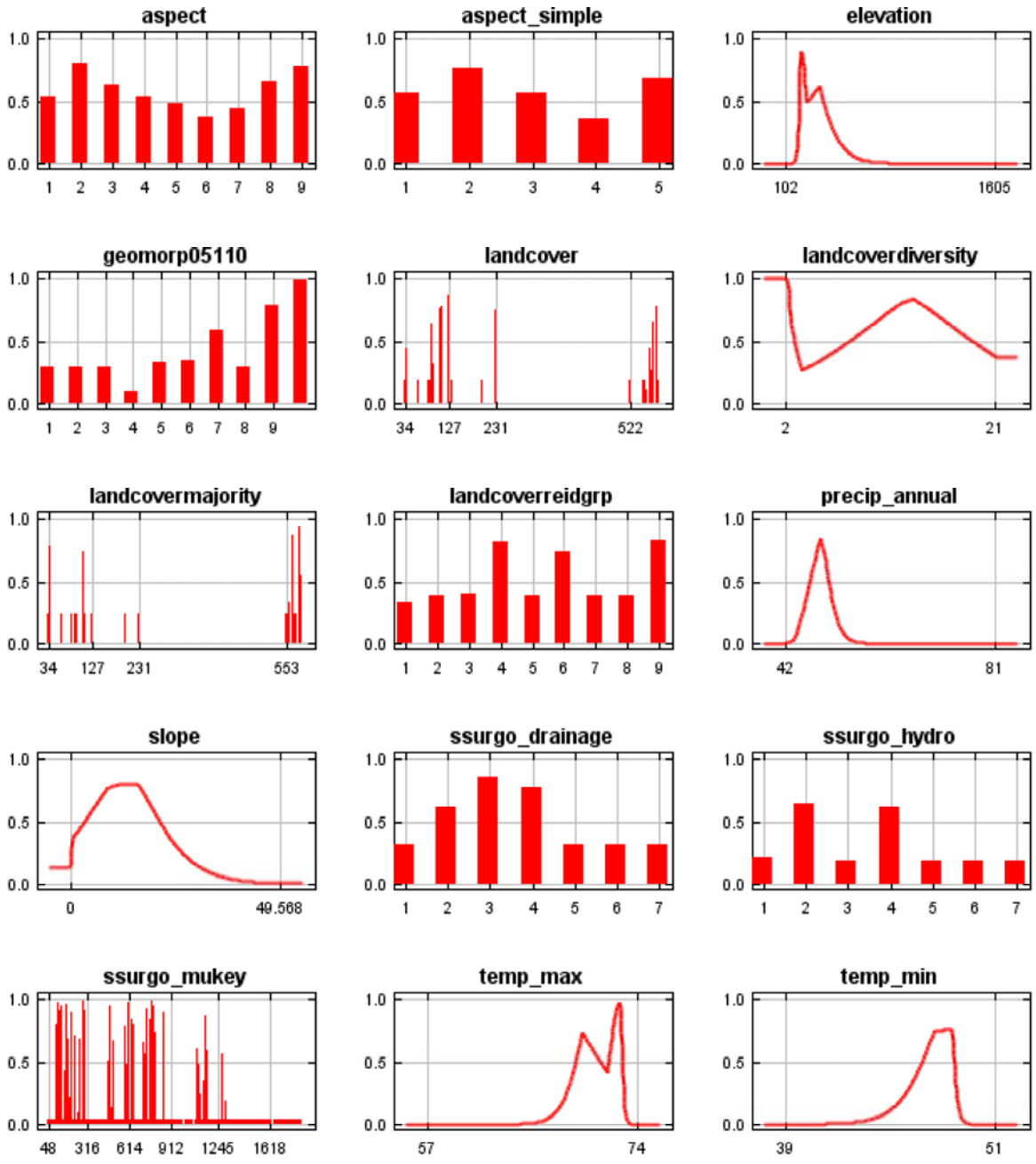
(A link to the Explain tool was not made for this model. The model uses product features, while the Explain tool can only be used for additive models.)

Response curves

These curves show how each environmental variable affects the Maxent prediction. The curves show how the predicted probability of presence changes as each environmental variable is varied, keeping all other environmental variables at their average sample value. Click on a response curve to see a larger version. Note that the curves can be hard to interpret if you have strongly correlated variables, as the model may depend on the correlations in ways that are not evident in the curves. In other words, the curves show the marginal effect of changing exactly one variable, whereas the model may take advantage of sets of variables changing together.



In contrast to the above marginal response curves, each of the following curves represents a different model, namely, a Maxent model created using only the corresponding variable. These plots reflect the dependence of predicted suitability both on the selected variable and on dependencies induced by correlations between the selected variable and other variables. They may be easier to interpret if there are strong correlations between variables.



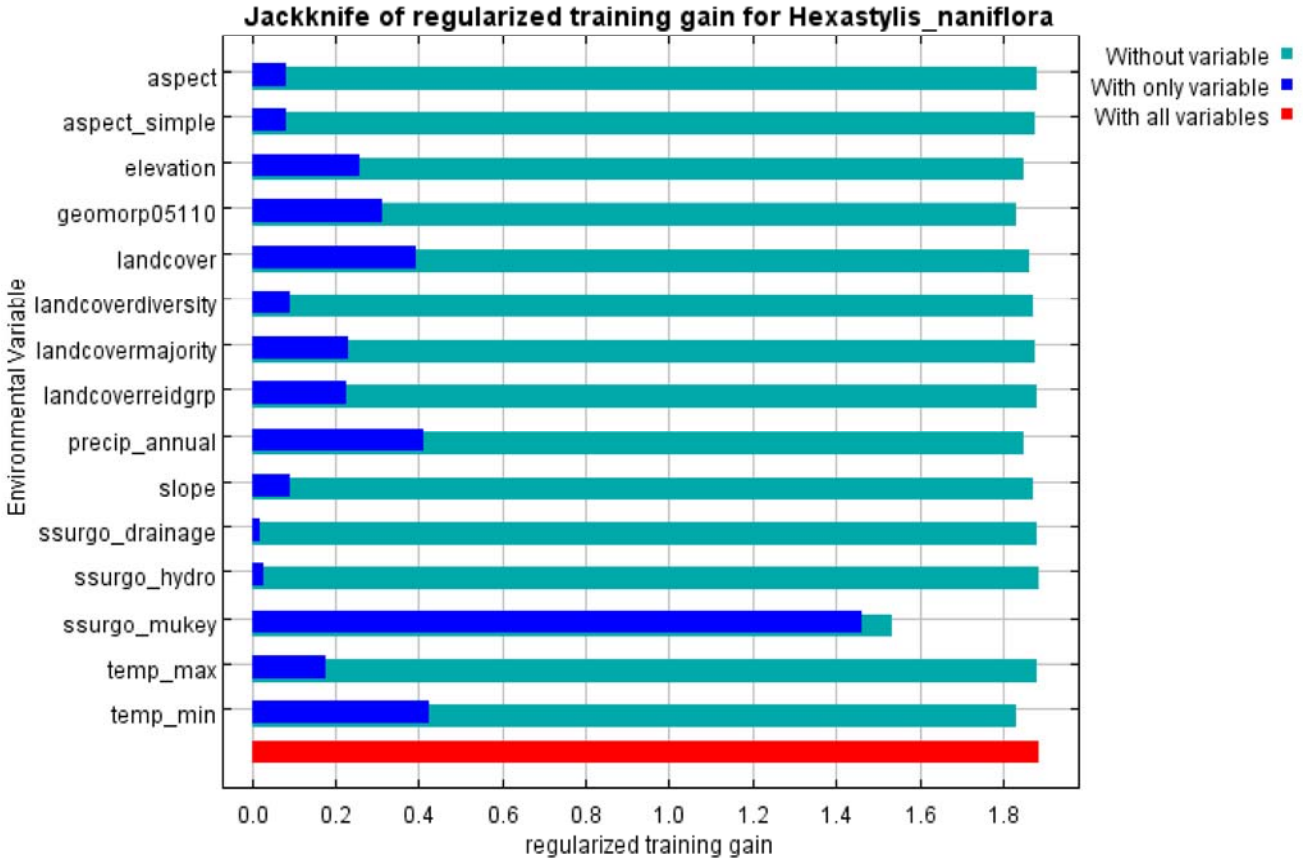
Analysis of variable contributions

The following table gives estimates of relative contributions of the environmental variables to the Maxent model. To determine the first estimate, in each iteration of the training algorithm, the increase in regularized gain is added to the contribution of the corresponding variable, or subtracted from it if the change to the absolute value of lambda is negative. For the second estimate, for each environmental variable in turn, the values of that variable on training presence and background data are randomly permuted. The model is reevaluated on the permuted data, and the resulting drop in training AUC is shown in the table, normalized to percentages. As with the variable jackknife, variable contributions should be interpreted with caution

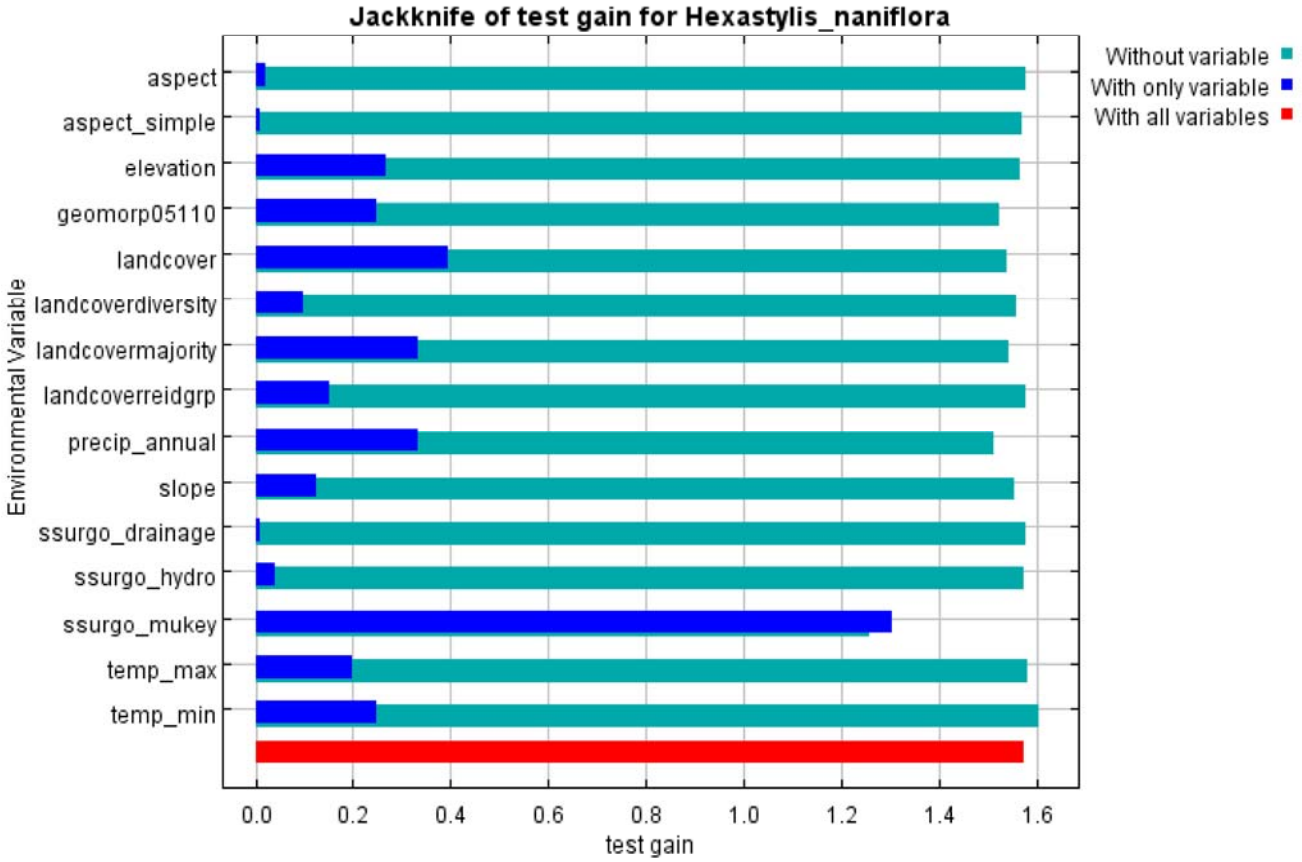
when the predictor variables are correlated.

Variable	Percent contribution	Permutation importance
ssurgo_mukey	37.2	30.4
temp_min	14.6	35.7
precip_annual	9.4	11.9
geomorp05110	8.5	3.3
landcoverreidgrp	7.9	0.9
landcover	7.8	3.9
elevation	5.2	8.8
landcovermajority	4.9	1
aspect_simple	2.6	1.1
landcoverdiversity	0.8	0.6
temp_max	0.4	0.8
slope	0.3	0.6
aspect	0.2	0.4
ssurgo_drainage	0.1	0.8
ssurgo_hydro	0	0

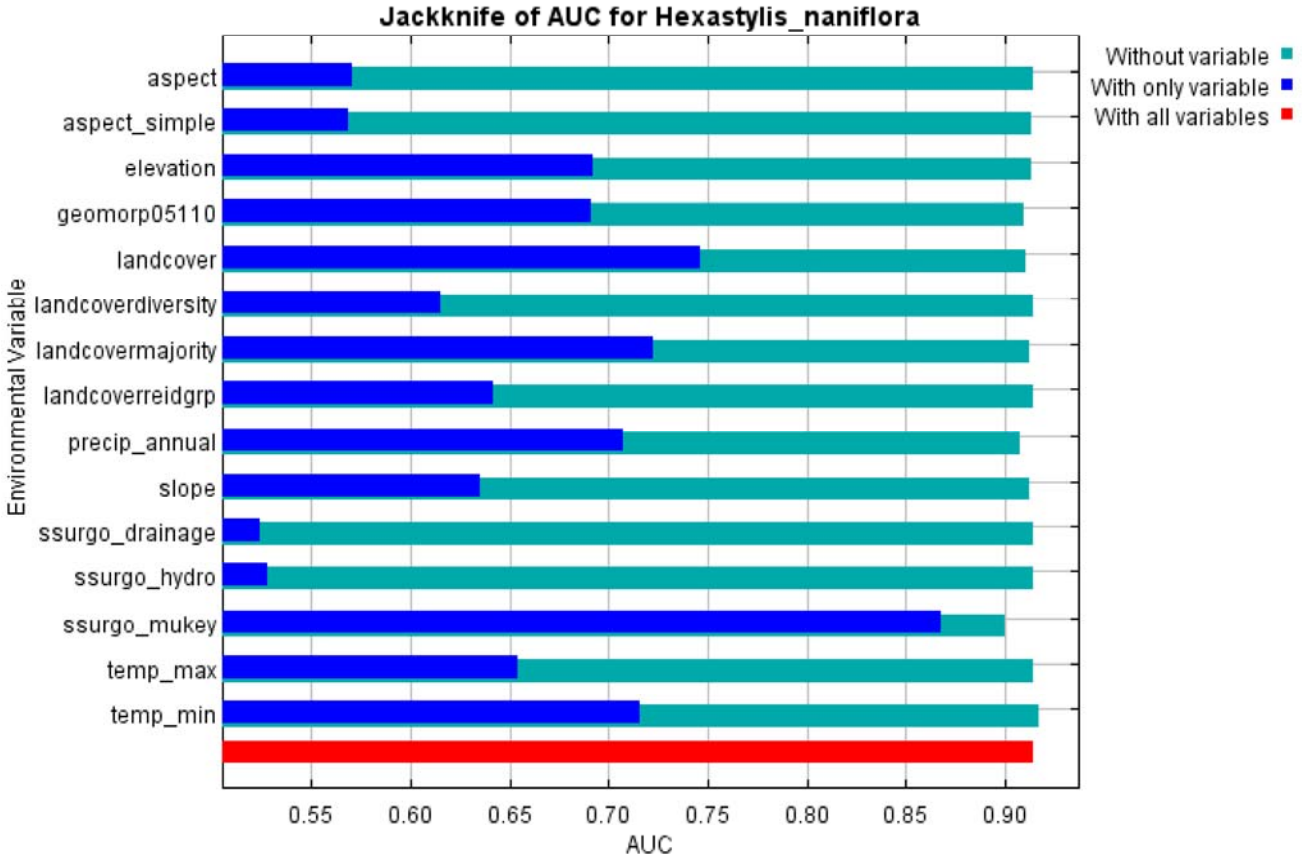
The following picture shows the results of the jackknife test of variable importance. The environmental variable with highest gain when used in isolation is ssurgo_mukey, which therefore appears to have the most useful information by itself. The environmental variable that decreases the gain the most when it is omitted is ssurgo_mukey, which therefore appears to have the most information that isn't present in the other variables.



The next picture shows the same jackknife test, using test gain instead of training gain. Note that conclusions about which variables are most important can change, now that we're looking at test data.



Lastly, we have the same jackknife test, using AUC on test data.



Raw data outputs and control parameters

The data used in the above analysis is contained in the next links. Please see the Help button for more information on these.
The model applied to the training environmental layers
The coefficients of the model
The omission and predicted area for varying cumulative and raw thresholds
The prediction strength at the training and (optionally) test presence sites
Results for all species modeled in the same Maxent run, with summary statistics and (optionally) jackknife results

Regularized training gain is 1.885, training AUC is 0.961, unregularized training gain is 2.197.
Unregularized test gain is 1.575.
Test AUC is 0.914, standard deviation is 0.013 (calculated as in DeLong, DeLong & Clarke-Pearson 1988, equation 2).
Algorithm converged after 1740 iterations (31 seconds).

The follow settings were used during the run:
423 presence records used for training, 140 for testing.
10423 points used to determine the Maxent distribution (background points and presence points).
Environmental layers used: aspect(categorical) aspect_simple(categorical) elevation geomorp05110

(categorical) landcover(categorical) landcoverdiversity landcovermajority(categorical) landcoverreidgrp (categorical) precip_annual slope ssurgo_drainage(categorical) ssurgo_hydro(categorical) ssurgo_mukey (categorical) temp_max temp_min
Regularization values: linear/quadratic/product: 0.050, categorical: 0.250, threshold: 1.000, hinge: 0.500
Feature types used: hinge product linear quadratic
responsecurves: true
jackknife: true
outputdirectory: D:\Users\mendries\DataRequests\ReidR\HENA\Maxent\Output\Random2
samplesfile: D:\Users\mendries\DataRequests\ReidR\HENA\Maxent\EOData\RandomAll.csv
environmentallayers: D:\Users\mendries\DataRequests\ReidR\HENA\Maxent\EnvironmentalLayers
randomtestpoints: 25
maximumiterations: 5000
Command line used:

Command line to repeat this species model: java density.MaxEnt nowarnings noprefixes -E "" -E Hexastylis_naniflora responsecurves jackknife outputdirectory=D:\Users\mendries\DataRequests\ReidR\HENA\Maxent\Output\Random2 samplesfile=D:\Users\mendries\DataRequests\ReidR\HENA\Maxent\EOData\RandomAll.csv environmentallayers=D:\Users\mendries\DataRequests\ReidR\HENA\Maxent\EnvironmentalLayers randomtestpoints=25 maximumiterations=5000 -t aspect -t aspect_simple -t geomorp05110 -t landcover -t landcovermajority -t landcoverreidgrp -t ssurgo_drainage -t ssurgo_hydro -t ssurgo_mukey

From: Marshall, Michael E
To: Endries, Mark
Cc: Reid, Rebekah N; Stephanie DeMay; Becker, Drew N
Subject: Re: Maxent model results for Hexastylis Naniflora
Date: Friday, February 9, 2018 3:24:57 PM
Importance: High

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Thanks,

Mike

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Mike Marshall
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From: Reid, Rebekah N
To: Marshall, Michael E
Cc: Endries, Mark; Stephanie DeMay; Becker, Drew N
Subject: Re: Maxent model results for Hexastylis Naniflora
Date: Friday, February 9, 2018 4:48:15 PM
Importance: High

I'm free all day on Monday.

Thanks!

Rebekah Reid

US Fish and Wildlife Service
Asheville Ecological Services Field Office
160 Zillicoa St.
Asheville, NC 28801
phone: 828-258-3939 x238
cell: 828-782-0090

On Fri, Feb 9, 2018 at 3:24 PM, Marshall, Michael <michael_marshall@fws.gov> wrote:

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To: Reid, Rebekah N
Cc: Marshall, Michael E; Stephanie DeMay; Becker, Drew N
Subject: Re: Maxent model results for Hexastylis Naniflora
Date: Monday, February 12, 2018 6:33:57 AM
Importance: High

Does 10 am today work for everyone?

Mark

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Cc: Reid, Rebekah N; Stephanie DeMay; Becker, Drew N
Subject: Re: Maxent model results for Hexastylis Naniflora
Date: Monday, February 12, 2018 7:37:44 AM
Importance: High

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Mike

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Cc: Reid, Rebekah N; Stephanie DeMay; Becker, Drew N
Subject: Re: Maxent model results for Hexastylis Naniflora
Date: Tuesday, February 13, 2018 12:31:03 PM
Attachments: Maxent model for Hexastylis_naniflora - Centerpoint.pdf
Importance: High

Hi All,

Model results from using a cell centerpoint. Mike, Rebekah, and I discussed this yesterday.

Thanks!

Mark

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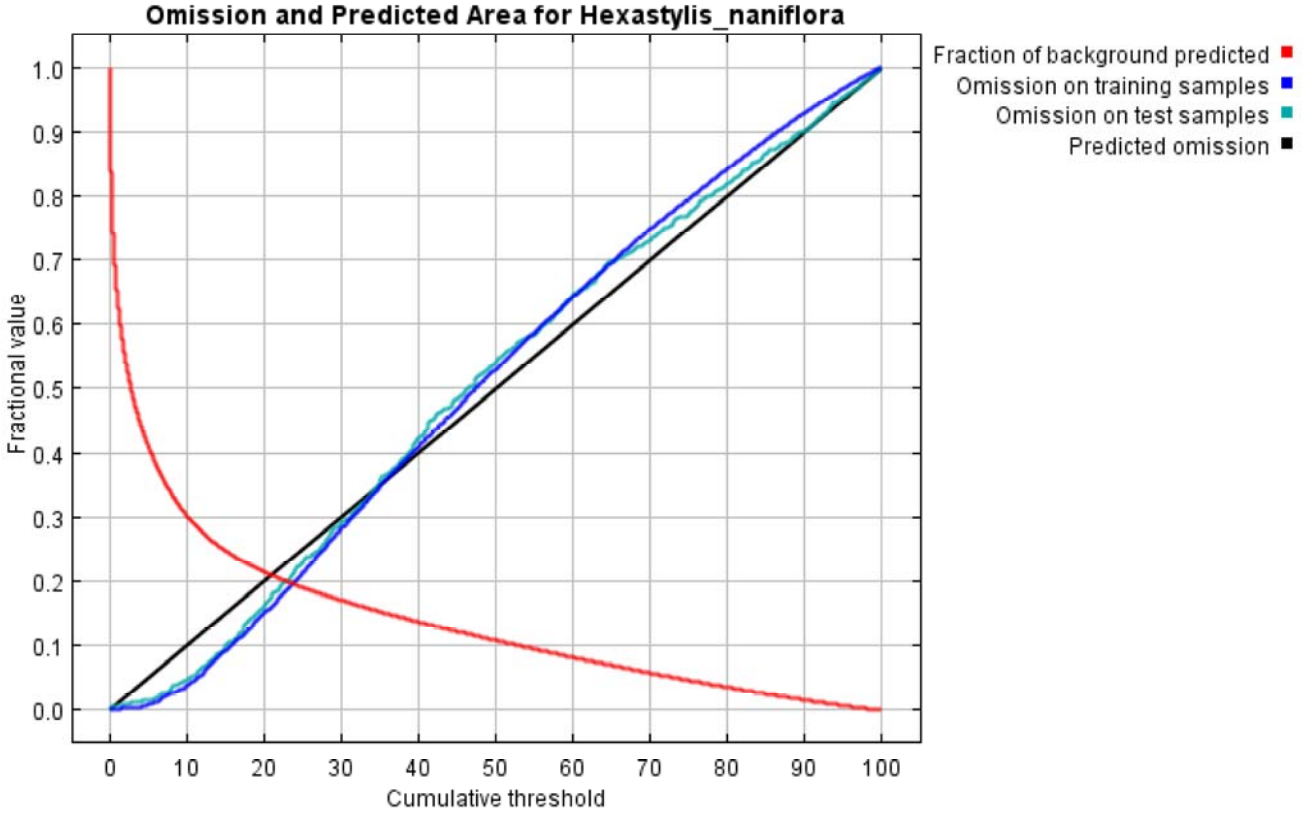
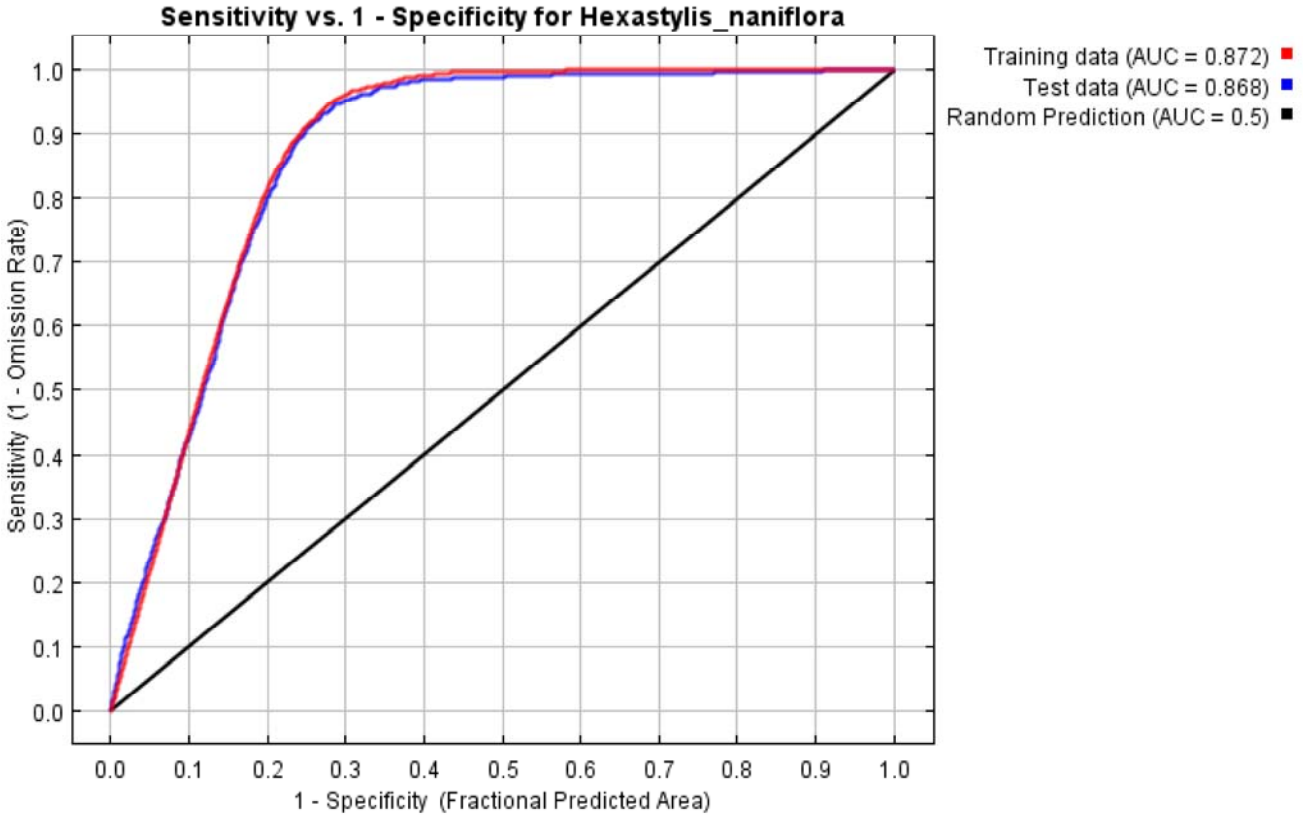
This page contains some analysis of the Maxent model for Hexastylis_naniflora, created Mon Feb 12 14:16:51 EST 2018 using Maxent version 3.4.1. If you would like to do further analyses, the raw data used here is linked to at the end of this page.

Analysis of omission/commission

The following picture shows the omission rate and predicted area as a function of the cumulative threshold. The omission rate is is calculated both on the training presence records, and (if test data are used) on the test records. The omission rate should be close to the predicted omission, because of the definition of the cumulative threshold.



The next picture is the receiver operating characteristic (ROC) curve for the same data. Note that the specificity is defined using predicted area, rather than true commission (see the paper by Phillips, Anderson and Schapire cited on the help page for discussion of what this means). This implies that the maximum achievable AUC is less than 1. If test data is drawn from the Maxent distribution itself, then the maximum possible test AUC would be 0.859 rather than 1; in practice the test AUC may exceed this bound.



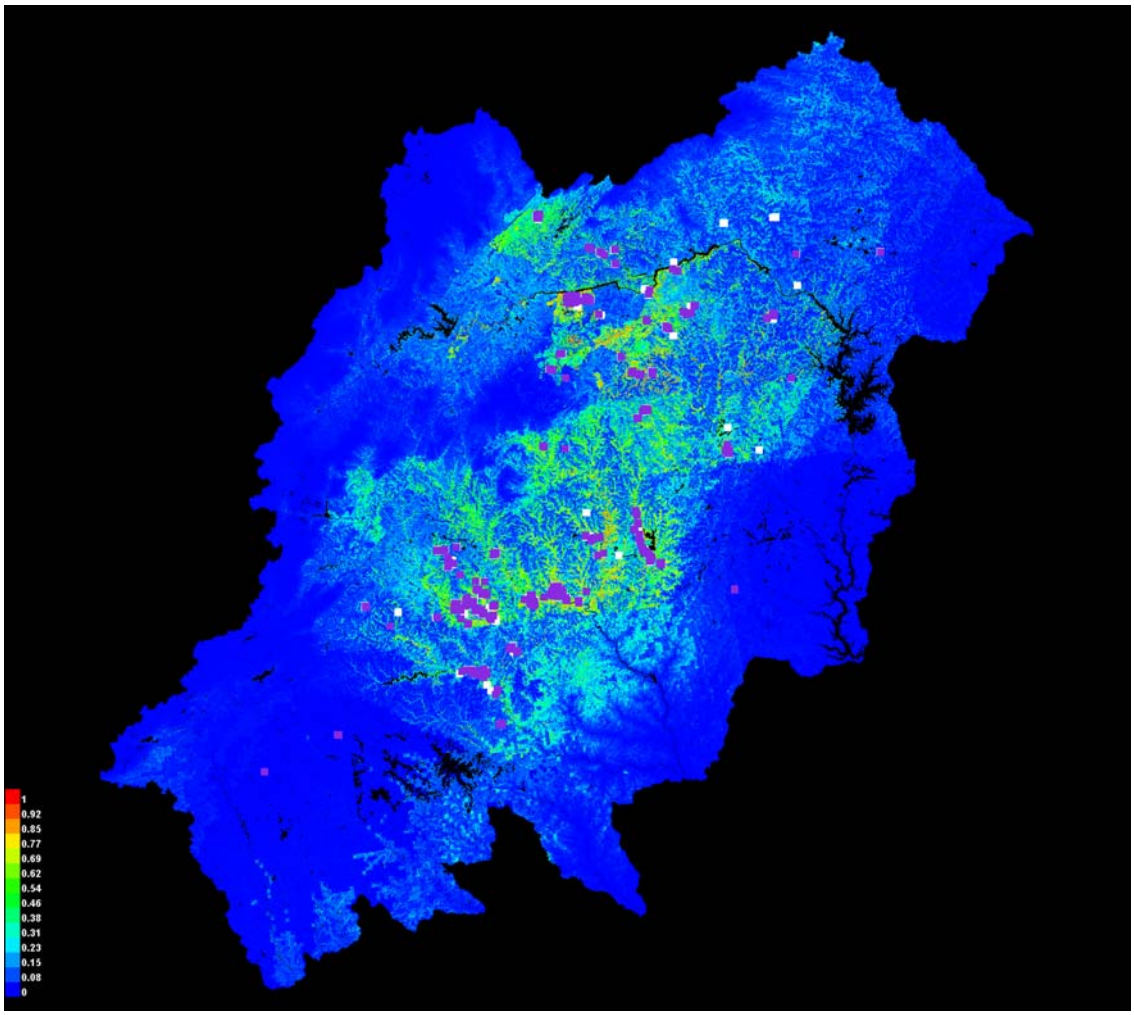
Some common thresholds and corresponding omission rates are as follows. If test data are available, binomial probabilities are calculated exactly if the number of test samples is at most 25, otherwise using a normal approximation to the binomial. These are 1-sided p-values for the null hypothesis that test points are predicted no better than by a random prediction with the same fractional predicted area. The "Balance" threshold minimizes 6 * training omission rate + .04 * cumulative threshold + 1.6 * fractional predicted area.

Cumulative threshold	Cloglog threshold	Description	Fractional predicted area	Training omission rate	Test omission rate	P-value
1.000	0.031	Fixed cumulative value 1	0.635	0.002	0.008	0E0
5.000	0.115	Fixed cumulative value 5	0.409	0.010	0.015	0E0
10.000	0.226	Fixed cumulative value 10	0.302	0.040	0.049	0E0
0.261	0.011	Minimum training presence	0.774	0.000	0.005	1.297E-59
15.573	0.392	10 percentile training presence	0.243	0.100	0.106	0E0
23.665	0.568	Equal training sensitivity and specificity	0.196	0.196	0.210	0E0

11.850	0.282	Maximum training sensitivity plus specificity	0.278	0.055	0.067	0E0
22.903	0.556	Equal test sensitivity and specificity	0.200	0.187	0.200	0E0
13.534	0.333	Maximum test sensitivity plus specificity	0.260	0.078	0.080	0E0
4.074	0.097	Balance training omission, predicted area and threshold value	0.441	0.005	0.014	0E0
6.084	0.137	Equate entropy of thresholded and original distributions	0.379	0.013	0.021	0E0

Pictures of the model

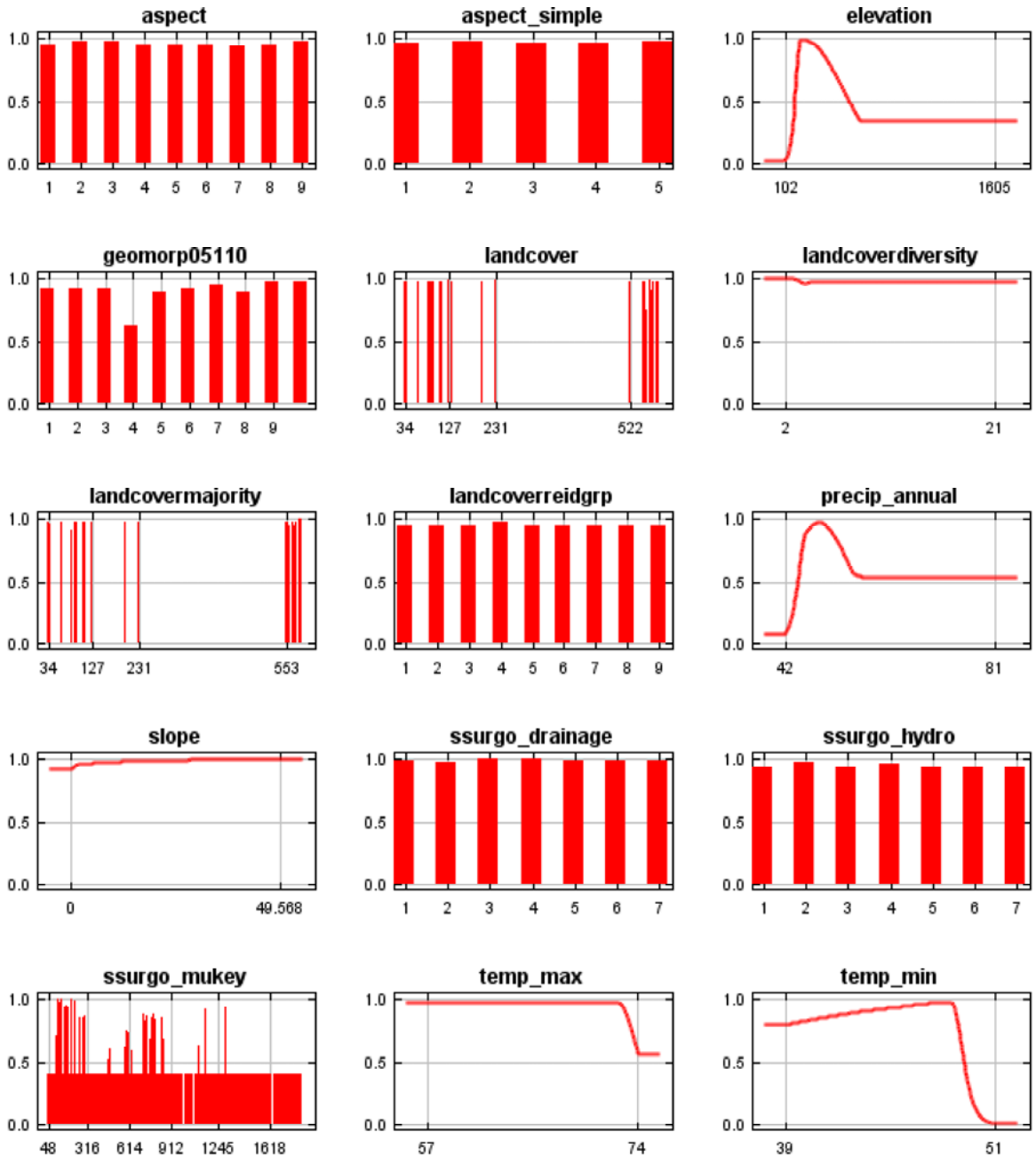
This is a representation of the Maxent model for Hexastylis_naniflora. Warmer colors show areas with better predicted conditions. White dots show the presence locations used for training, while violet dots show test locations. Click on the image for a full-size version.



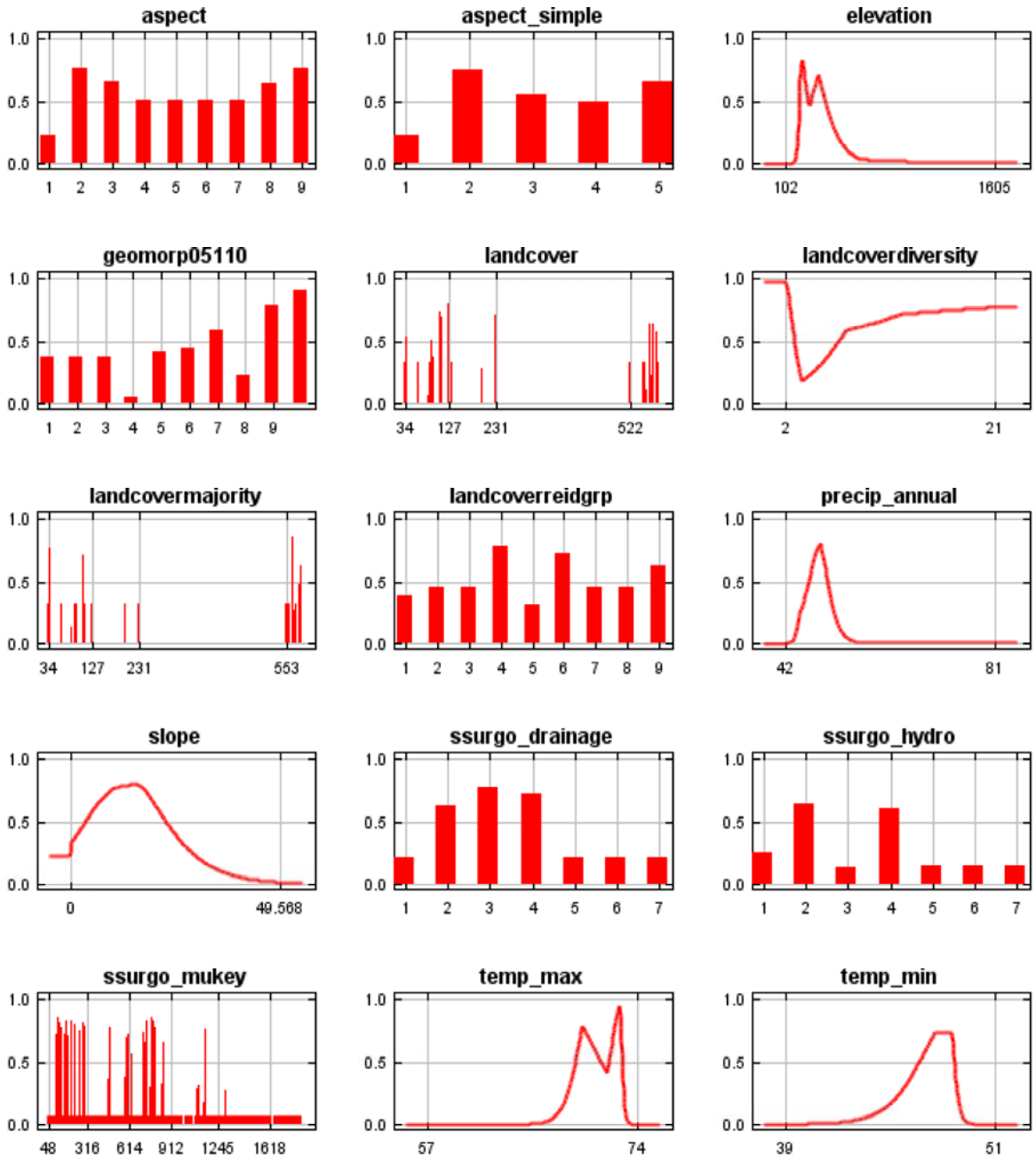
(A link to the Explain tool was not made for this model. The model uses product features, while the Explain tool can only be used for additive models.)

Response curves

These curves show how each environmental variable affects the Maxent prediction. The curves show how the predicted probability of presence changes as each environmental variable is varied, keeping all other environmental variables at their average sample value. Click on a response curve to see a larger version. Note that the curves can be hard to interpret if you have strongly correlated variables, as the model may depend on the correlations in ways that are not evident in the curves. In other words, the curves show the marginal effect of changing exactly one variable, whereas the model may take advantage of sets of variables changing together.



In contrast to the above marginal response curves, each of the following curves represents a different model, namely, a Maxent model created using only the corresponding variable. These plots reflect the dependence of predicted suitability both on the selected variable and on dependencies induced by correlations between the selected variable and other variables. They may be easier to interpret if there are strong correlations between variables.



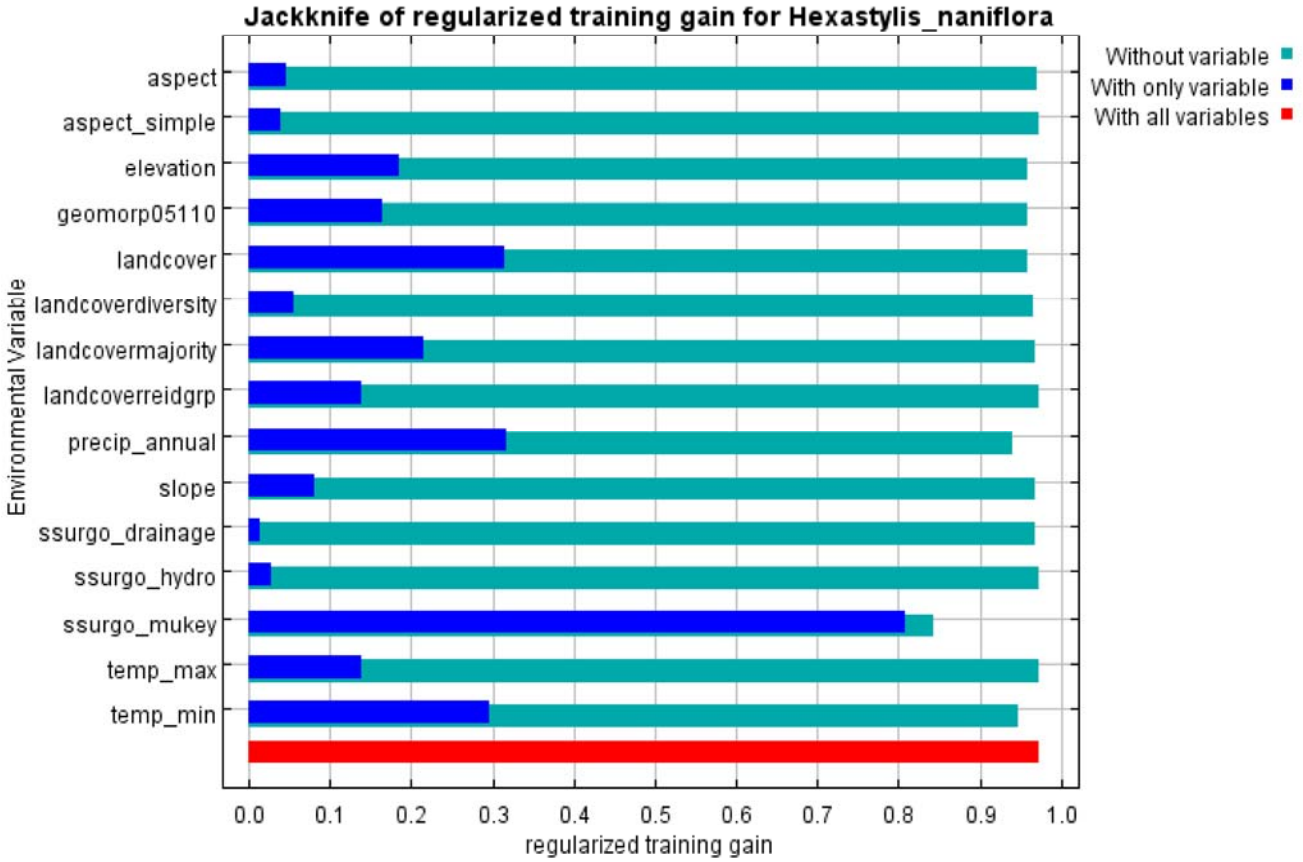
Analysis of variable contributions

The following table gives estimates of relative contributions of the environmental variables to the Maxent model. To determine the first estimate, in each iteration of the training algorithm, the increase in regularized gain is added to the contribution of the corresponding variable, or subtracted from it if the change to the absolute value of lambda is negative. For the second estimate, for each environmental variable in turn, the values of that variable on training presence and background data are randomly permuted. The model is reevaluated on the permuted data, and the resulting drop in training AUC is shown in the table, normalized to percentages. As with the variable jackknife, variable contributions should be interpreted with caution

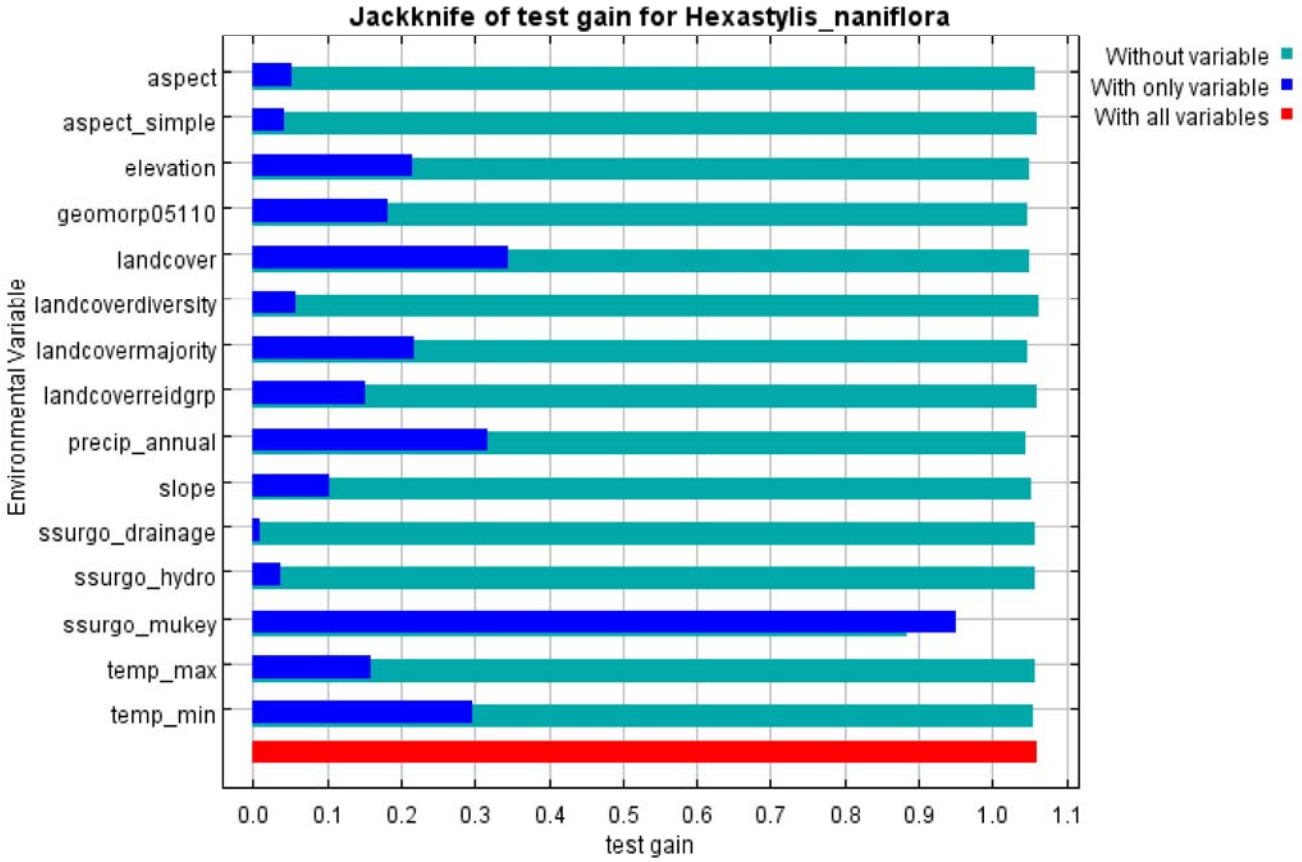
when the predictor variables are correlated.

Variable	Percent contribution	Permutation importance
ssurgo_mukey	21.3	34.7
temp_min	18.9	20.8
precip_annual	15.5	17.7
landcover	11.4	4.2
landcovermajority	9.9	0.9
geomorp05110	7.6	2.2
landcoverreidgrp	6.2	0.4
elevation	5	13.2
aspect_simple	1.3	0.2
ssurgo_drainage	0.9	3.1
landcoverdiversity	0.8	0.9
slope	0.5	1
aspect	0.4	0.5
temp_max	0.1	0.3
ssurgo_hydro	0	0.1

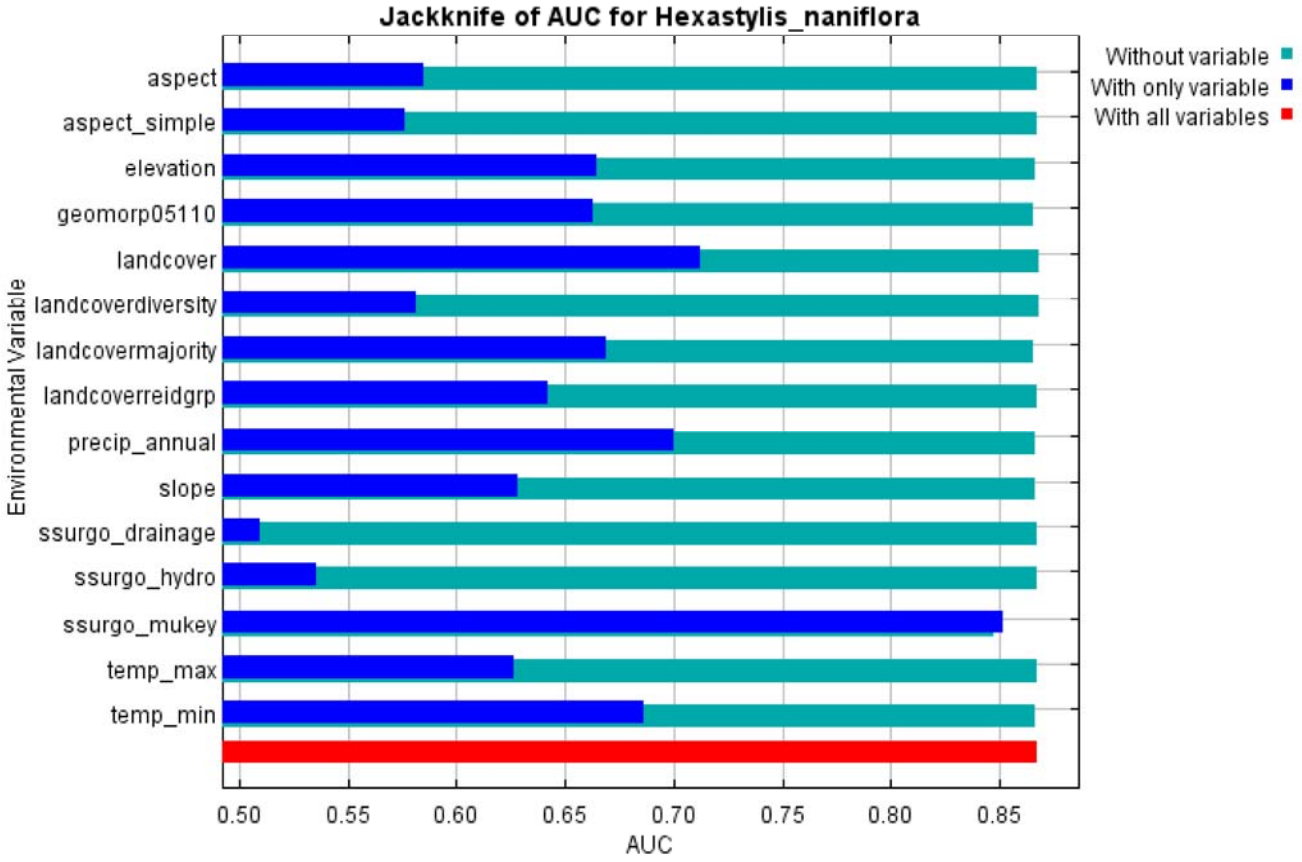
The following picture shows the results of the jackknife test of variable importance. The environmental variable with highest gain when used in isolation is ssurgo_mukey, which therefore appears to have the most useful information by itself. The environmental variable that decreases the gain the most when it is omitted is ssurgo_mukey, which therefore appears to have the most information that isn't present in the other variables.



The next picture shows the same jackknife test, using test gain instead of training gain. Note that conclusions about which variables are most important can change, now that we're looking at test data.



Lastly, we have the same jackknife test, using AUC on test data.



Raw data outputs and control parameters

The data used in the above analysis is contained in the next links. Please see the Help button for more information on these.
The model applied to the training environmental layers
The coefficients of the model
The omission and predicted area for varying cumulative and raw thresholds
The prediction strength at the training and (optionally) test presence sites
Results for all species modeled in the same Maxent run, with summary statistics and (optionally) jackknife results

Regularized training gain is 0.973, training AUC is 0.872, unregularized training gain is 1.094.
Unregularized test gain is 1.060.
Test AUC is 0.868, standard deviation is 0.004 (calculated as in DeLong, DeLong & Clarke-Pearson 1988, equation 2).
Algorithm converged after 1760 iterations (49 seconds).

The follow settings were used during the run:
2842 presence records used for training, 947 for testing.
12840 points used to determine the Maxent distribution (background points and presence points).
Environmental layers used: aspect(categorical) aspect_simple(categorical) elevation geomorp05110

(categorical) landcover(categorical) landcoverdiversity landcovermajority(categorical) landcoverreidgrp (categorical) precip_annual slope ssurgo_drainage(categorical) ssurgo_hydro(categorical) ssurgo_mukey (categorical) temp_max temp_min
Regularization values: linear/quadratic/product: 0.050, categorical: 0.250, threshold: 1.000, hinge: 0.500
Feature types used: hinge product linear quadratic
responsecurves: true
jackknife: true
outputdirectory: D:\Users\mendries\DataRequests\ReidR\HENA\Maxent\Output\CellCenterpoint
samplesfile: D:\Users\mendries\DataRequests\ReidR\HENA\Maxent\EOData\RasterCenterpointEOsPlus.csv
environmentallayers: D:\Users\mendries\DataRequests\ReidR\HENA\Maxent\EnvironmentalLayers
randomtestpoints: 25
maximumiterations: 5000
Command line used:

Command line to repeat this species model: java density.MaxEnt nowarnings noprefixes -E "" -E Hexastylis_naniflora responsecurves jackknife outputdirectory=D:\Users\mendries\DataRequests\ReidR\HENA\Maxent\Output\CellCenterpoint samplesfile=D:\Users\mendries\DataRequests\ReidR\HENA\Maxent\EOData\RasterCenterpointEOsPlus.csv environmentallayers=D:\Users\mendries\DataRequests\ReidR\HENA\Maxent\EnvironmentalLayers randomtestpoints=25 maximumiterations=5000 -t aspect -t aspect_simple -t geomorp05110 -t landcover -t landcovermajority -t landcoverreidgrp -t ssurgo_drainage -t ssurgo_hydro -t ssurgo_mukey

From: Marshall, Michael E
To: Endries, Mark
Cc: Reid, Rebekah N; Stephanie DeMay; Becker, Drew N
Subject: Re: Maxent model results for Hexastylis Naniflora
Date: Wednesday, February 14, 2018 9:24:36 AM
Importance: High

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Thanks,

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Rebekah Reid

US Fish and Wildlife Service
Asheville Ecological Services Field Office
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To: Marshall, Michael E
Cc: Endries, Mark; Reid, Rebekah N; Stephanie DeMay
Subject: Re: Maxent model results for Hexastylis Naniflora
Date: Wednesday, February 14, 2018 9:25:15 AM
Importance: High

---

works for me

Drew Becker
Recovery Coordinator
U.S. Fish and Wildlife Service
Southeast Region
1875 Century Boulevard
Atlanta, GA 30345
404-679-7226
drew_becker@fws.gov

Our Mission is to w*ork with others to conserve, protect and enhance fish, wildlife and plants and their habitats for the continuing benefit of the American people.*

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To: Marshall, Michael E
Cc: Endries, Mark; Stephanie DeMay; Becker, Drew N
Subject: Re: Maxent model results for Hexastylis Naniflora
Date: Wednesday, February 14, 2018 10:37:32 AM
Importance: High

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To: Reid, Rebekah N
Cc: Endries, Mark; Stephanie DeMay; Becker, Drew N
Subject: Re: Maxent model results for Hexastylis Naniflora
Date: Wednesday, February 14, 2018 10:40:58 AM
Importance: High

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Mark Endries
USFWS
160 Zillicoa St
Asheville, NC 28801
Office: 828.258.3939 ext. 231
Mobile: 828.215.1740

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Mike Marshall
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From: Becker, Drew N
To: Marshall, Michael E
Cc: Reid, Rebekah N; Endries, Mark; Stephanie DeMay
Subject: Re: Maxent model results for Hexastylis Naniflora
Date: Wednesday, February 14, 2018 10:42:41 AM
Importance: High

---

yes works for me

Drew Becker
Recovery Coordinator
U.S. Fish and Wildlife Service
Southeast Region
1875 Century Boulevard
Atlanta, GA 30345
404-679-7226
drew_becker@fws.gov

Our Mission is to w*ork with others to conserve, protect and enhance fish, wildlife and plants and their habitats for the continuing benefit of the American people.*

On Wed, Feb 14, 2018 at 10:40 AM, Marshall, Michael <michael_marshall@fws.gov> wrote:

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> Thanks,
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> > Mike,
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> > Friday is fine but can we move it to the morning...like 9 or 10? Mark and I will both be gone that afternoon.
> >
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Thanks Mark!

I'd like to set up a Core Team all for Friday as we discussed.....would 1:00 pm est work ok for folks?

Thanks,

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To: Endries, Mark
Cc: Reid, Rebekah N; Stephanie DeMay; Becker, Drew N
Subject: Re: Maxent model results for Hexastylis Naniflora
Date: Wednesday, February 14, 2018 1:12:32 PM
Importance: High

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Cc: Reid, Rebekah N; Stephanie DeMay; Becker, Drew N
Subject: Re: Maxent model results for Hexastylis Naniflora
Date: Wednesday, February 14, 2018 2:13:41 PM
Importance: High

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To: Endries, Mark
Cc: Reid, Rebekah N; Stephanie DeMay; Becker, Drew N
Subject: Re: Maxent model results for Hexastylis Naniflora
Date: Wednesday, February 14, 2018 2:16:36 PM
Importance: High

Hi Mark,

Understood....it's a quick turn around....other option could be to just provide tables and figures for which I could put in a placeholder summary (1 paragraph), and send along the Maxent output as an appendix for review....by the time we put the entire SSA together, we could put the real methods writeup into the full draft.

Mike

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Work Schedule 1st Week
Monday-Thursday --> In Office 7:30-4:30 CST

Work Schedule 2nd Week
Monday-Thursday --> In Office 7:30-4:30 CST

This email correspondence and any attachments to and from this sender is subject to the Freedom of Information Act and may be disclosed to third parties.

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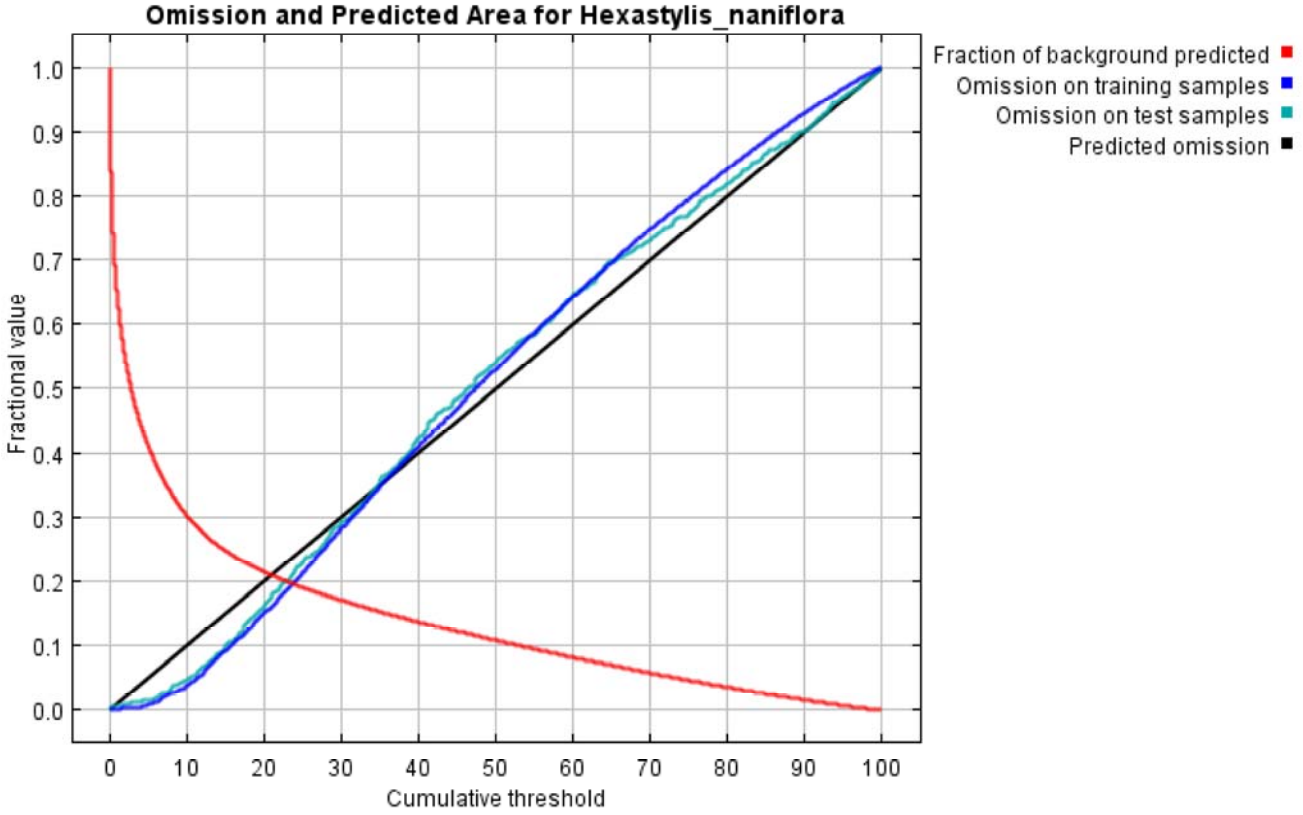
Maxent model for Hexastylis_naniflora

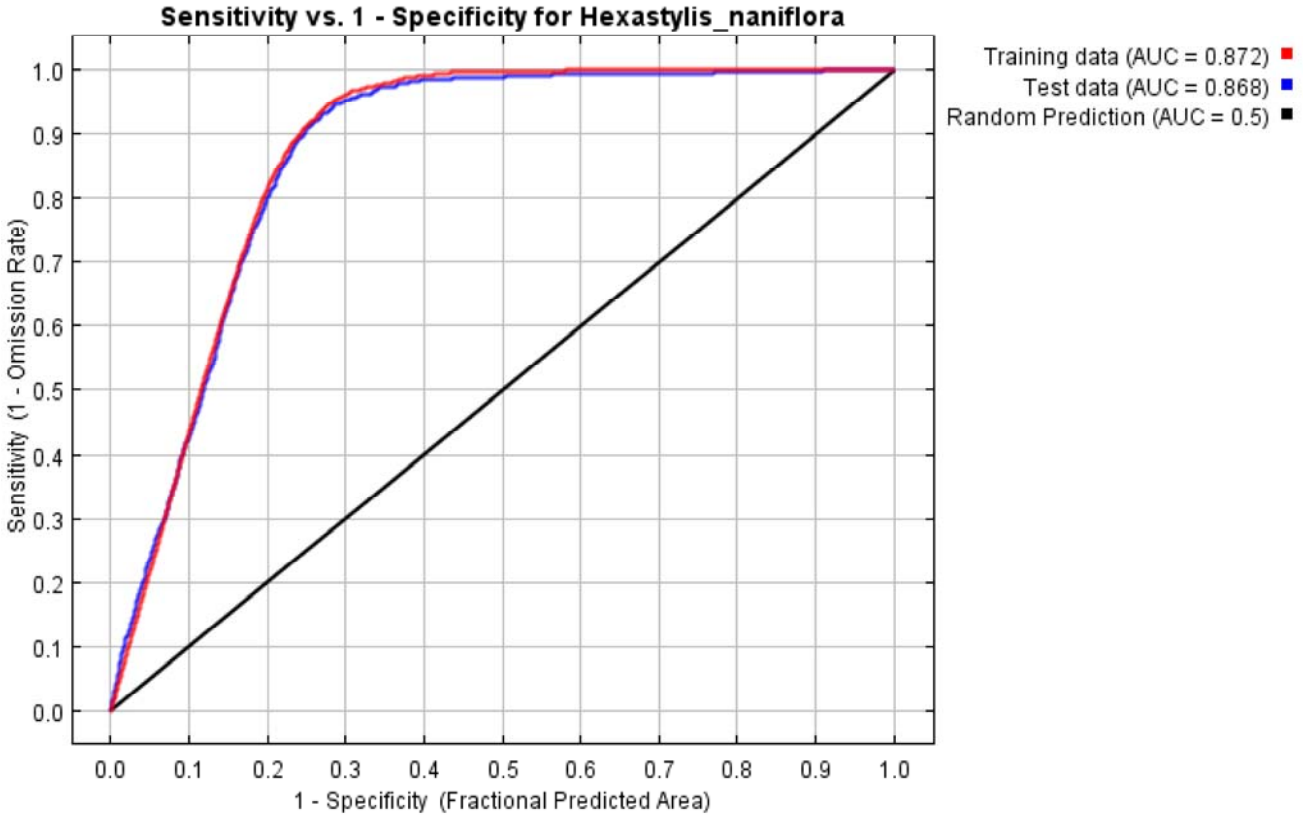
This page contains some analysis of the Maxent model for Hexastylis_naniflora, created Mon Feb 12 14:16:51 EST 2018 using Maxent version 3.4.1. If you would like to do further analyses, the raw data used here is linked to at the end of this page.

Analysis of omission/commission

The following picture shows the omission rate and predicted area as a function of the cumulative threshold. The omission rate is is calculated both on the training presence records, and (if test data are used) on the test records. The omission rate should be close to the predicted omission, because of the definition of the cumulative threshold.



The next picture is the receiver operating characteristic (ROC) curve for the same data. Note that the specificity is defined using predicted area, rather than true commission (see the paper by Phillips, Anderson and Schapire cited on the help page for discussion of what this means). This implies that the maximum achievable AUC is less than 1. If test data is drawn from the Maxent distribution itself, then the maximum possible test AUC would be 0.859 rather than 1; in practice the test AUC may exceed this bound.



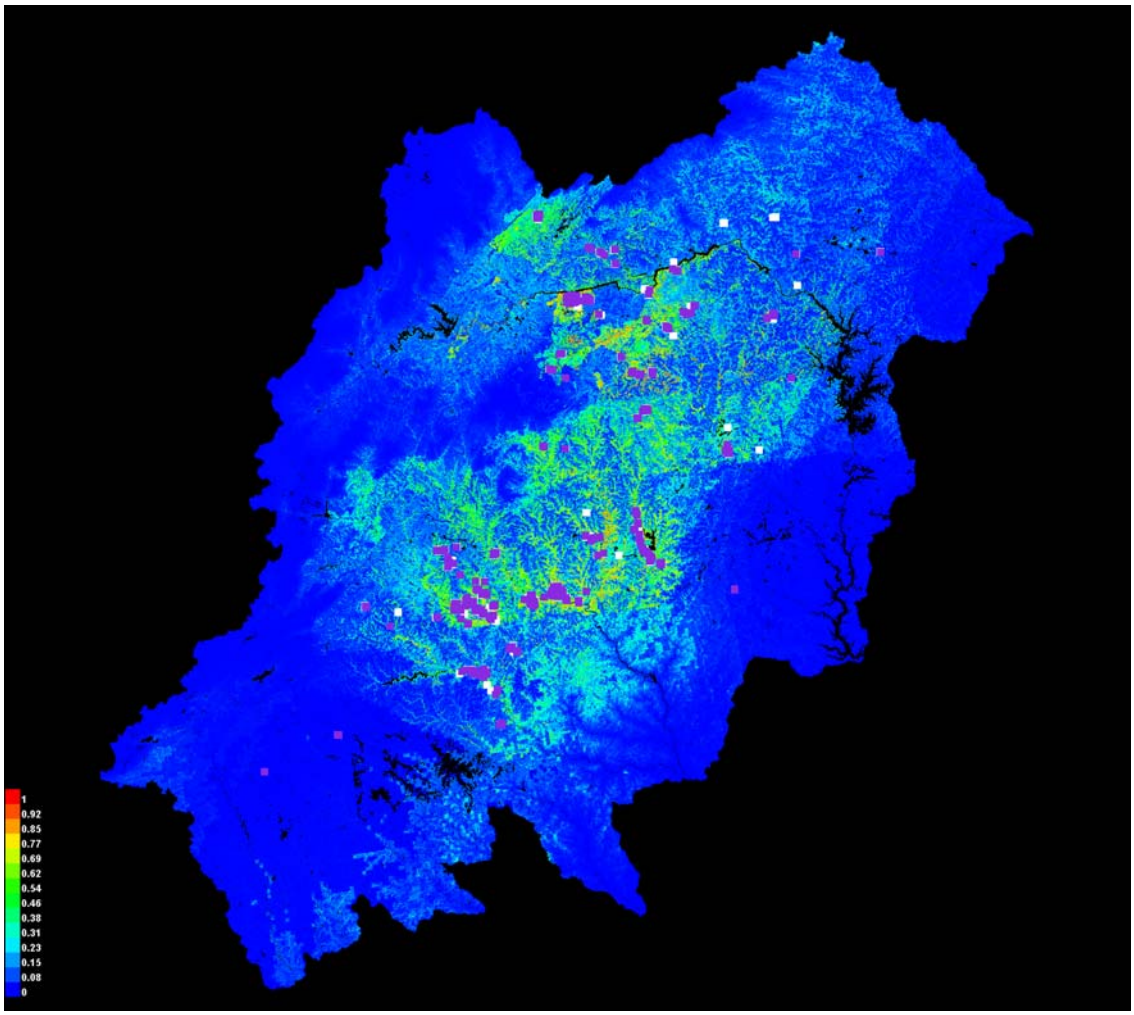
Some common thresholds and corresponding omission rates are as follows. If test data are available, binomial probabilities are calculated exactly if the number of test samples is at most 25, otherwise using a normal approximation to the binomial. These are 1-sided p-values for the null hypothesis that test points are predicted no better than by a random prediction with the same fractional predicted area. The "Balance" threshold minimizes 6 * training omission rate + .04 * cumulative threshold + 1.6 * fractional predicted area.

Cumulative threshold	Cloglog threshold	Description	Fractional predicted area	Training omission rate	Test omission rate	P-value
1.000	0.031	Fixed cumulative value 1	0.635	0.002	0.008	0E0
5.000	0.115	Fixed cumulative value 5	0.409	0.010	0.015	0E0
10.000	0.226	Fixed cumulative value 10	0.302	0.040	0.049	0E0
0.261	0.011	Minimum training presence	0.774	0.000	0.005	1.297E-59
15.573	0.392	10 percentile training presence	0.243	0.100	0.106	0E0
23.665	0.568	Equal training sensitivity and specificity	0.196	0.196	0.210	0E0

11.850	0.282	Maximum training sensitivity plus specificity	0.278	0.055	0.067	0E0
22.903	0.556	Equal test sensitivity and specificity	0.200	0.187	0.200	0E0
13.534	0.333	Maximum test sensitivity plus specificity	0.260	0.078	0.080	0E0
4.074	0.097	Balance training omission, predicted area and threshold value	0.441	0.005	0.014	0E0
6.084	0.137	Equate entropy of thresholded and original distributions	0.379	0.013	0.021	0E0

Pictures of the model

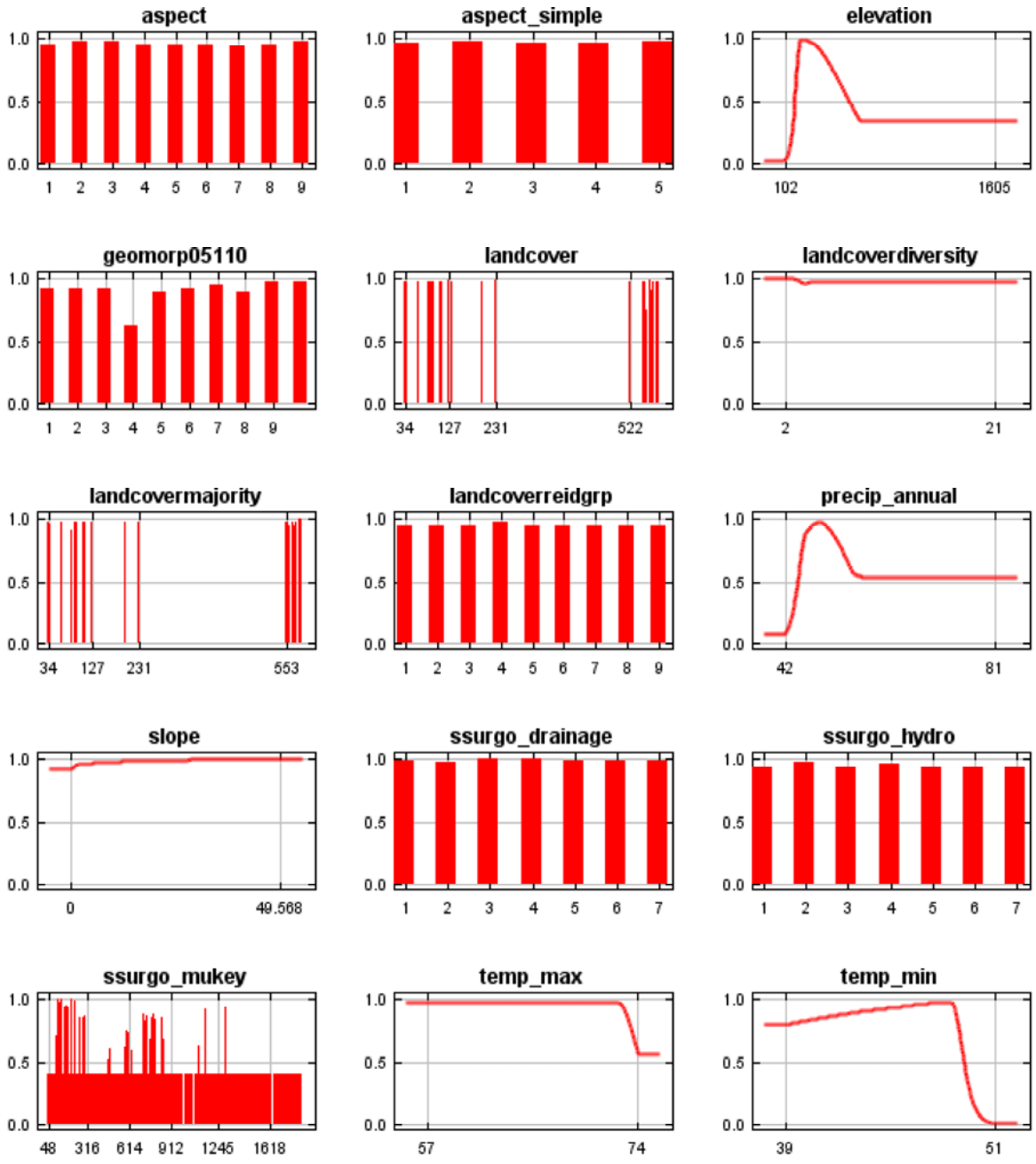
This is a representation of the Maxent model for Hexastylis_naniflora. Warmer colors show areas with better predicted conditions. White dots show the presence locations used for training, while violet dots show test locations. Click on the image for a full-size version.



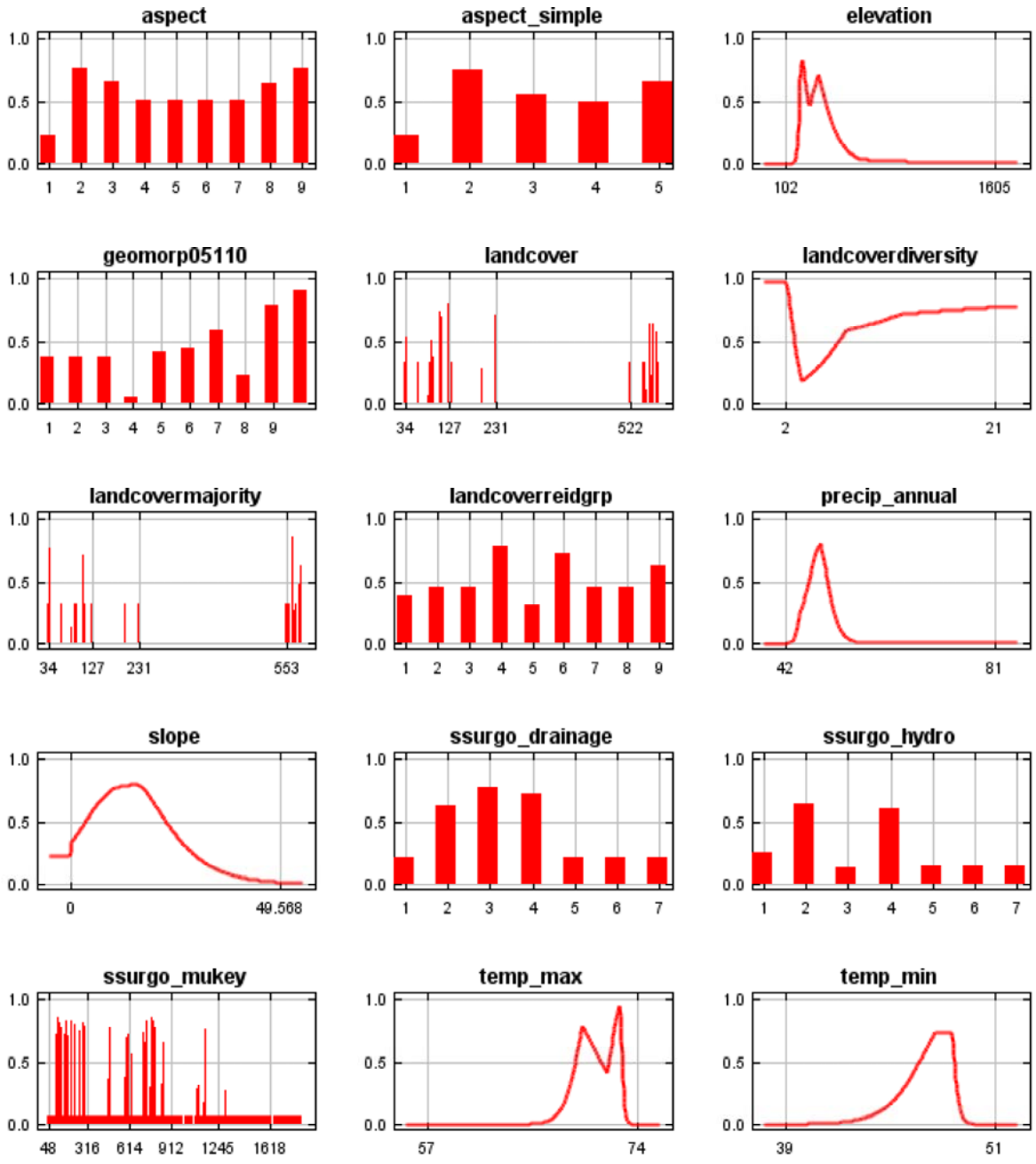
(A link to the Explain tool was not made for this model. The model uses product features, while the Explain tool can only be used for additive models.)

Response curves

These curves show how each environmental variable affects the Maxent prediction. The curves show how the predicted probability of presence changes as each environmental variable is varied, keeping all other environmental variables at their average sample value. Click on a response curve to see a larger version. Note that the curves can be hard to interpret if you have strongly correlated variables, as the model may depend on the correlations in ways that are not evident in the curves. In other words, the curves show the marginal effect of changing exactly one variable, whereas the model may take advantage of sets of variables changing together.



In contrast to the above marginal response curves, each of the following curves represents a different model, namely, a Maxent model created using only the corresponding variable. These plots reflect the dependence of predicted suitability both on the selected variable and on dependencies induced by correlations between the selected variable and other variables. They may be easier to interpret if there are strong correlations between variables.



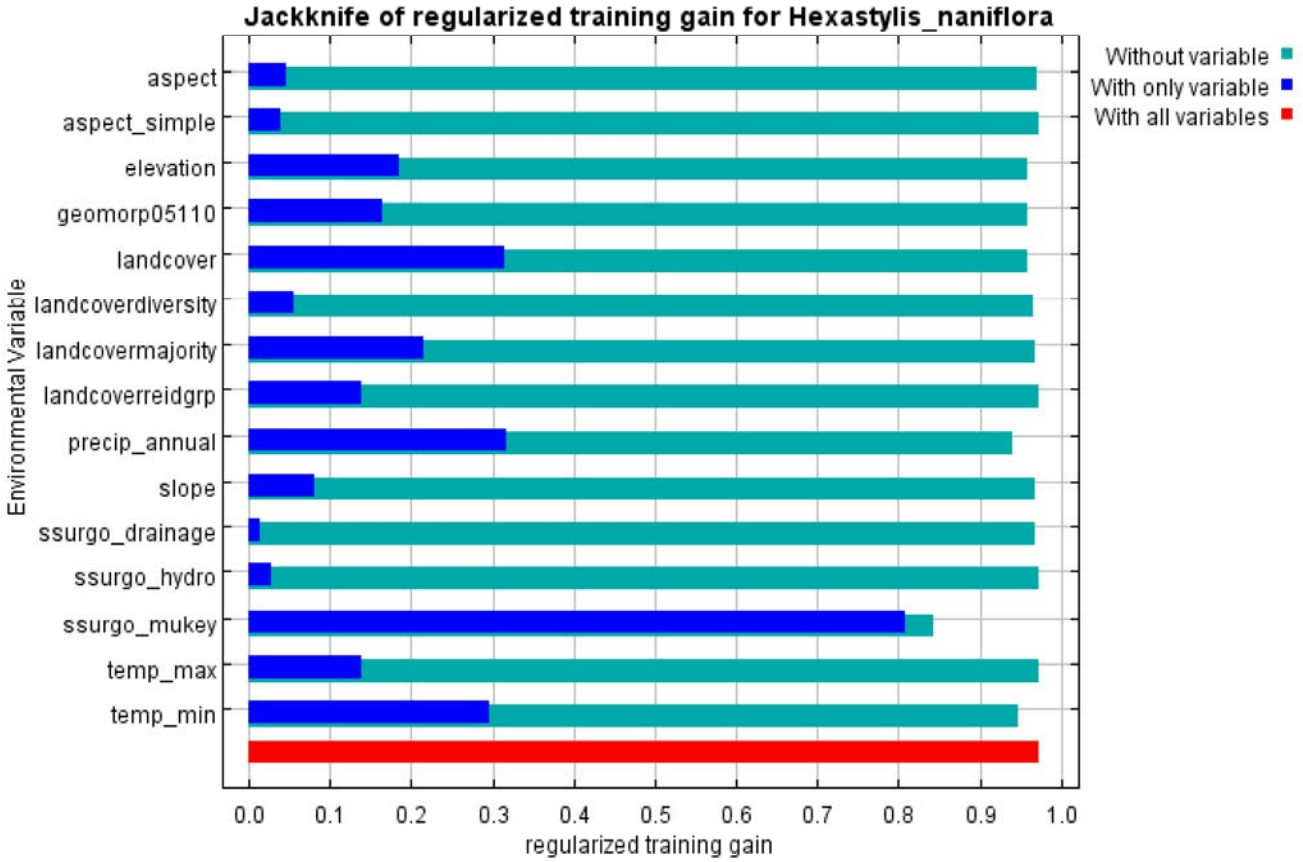
Analysis of variable contributions

The following table gives estimates of relative contributions of the environmental variables to the Maxent model. To determine the first estimate, in each iteration of the training algorithm, the increase in regularized gain is added to the contribution of the corresponding variable, or subtracted from it if the change to the absolute value of lambda is negative. For the second estimate, for each environmental variable in turn, the values of that variable on training presence and background data are randomly permuted. The model is reevaluated on the permuted data, and the resulting drop in training AUC is shown in the table, normalized to percentages. As with the variable jackknife, variable contributions should be interpreted with caution

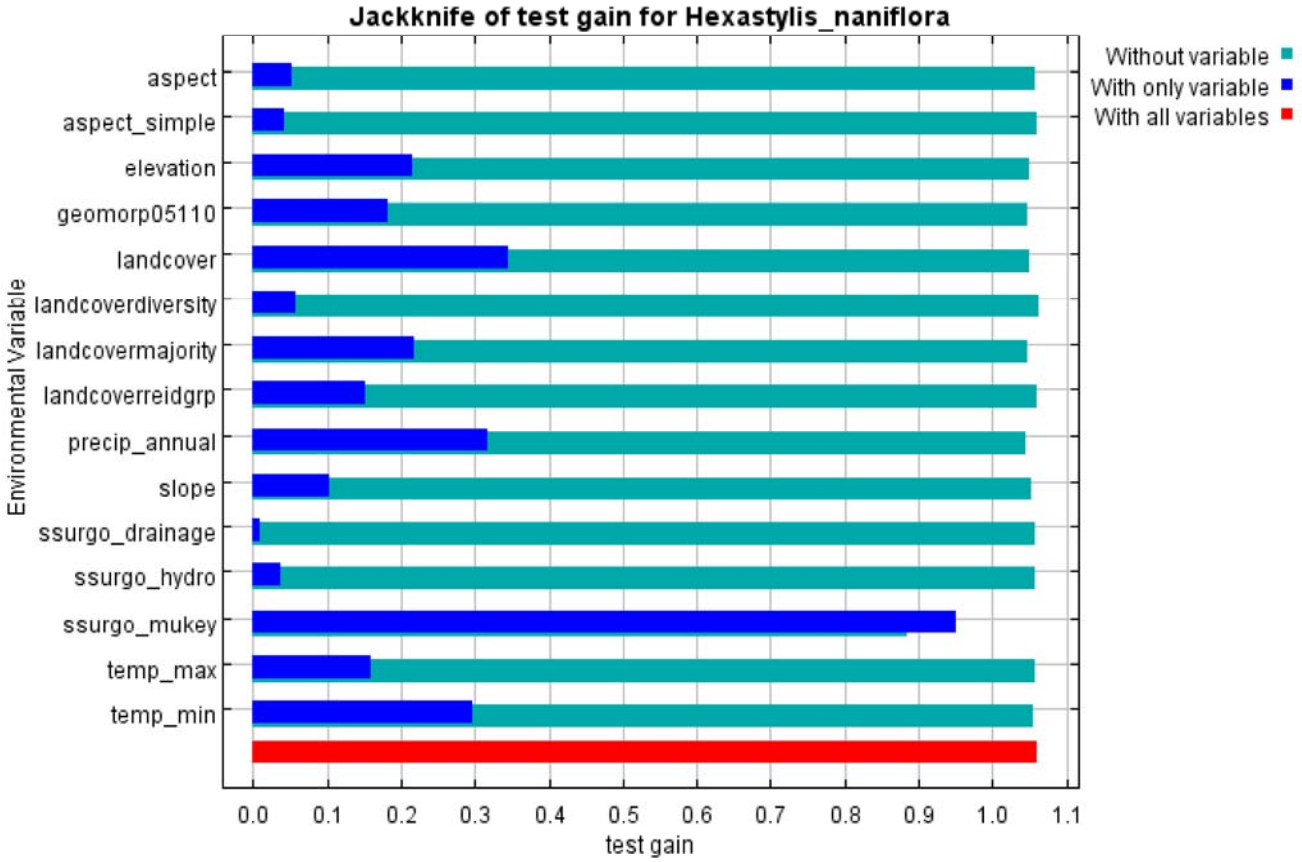
when the predictor variables are correlated.

Variable	Percent contribution	Permutation importance
ssurgo_mukey	21.3	34.7
temp_min	18.9	20.8
precip_annual	15.5	17.7
landcover	11.4	4.2
landcovermajority	9.9	0.9
geomorp05110	7.6	2.2
landcoverreidgrp	6.2	0.4
elevation	5	13.2
aspect_simple	1.3	0.2
ssurgo_drainage	0.9	3.1
landcoverdiversity	0.8	0.9
slope	0.5	1
aspect	0.4	0.5
temp_max	0.1	0.3
ssurgo_hydro	0	0.1

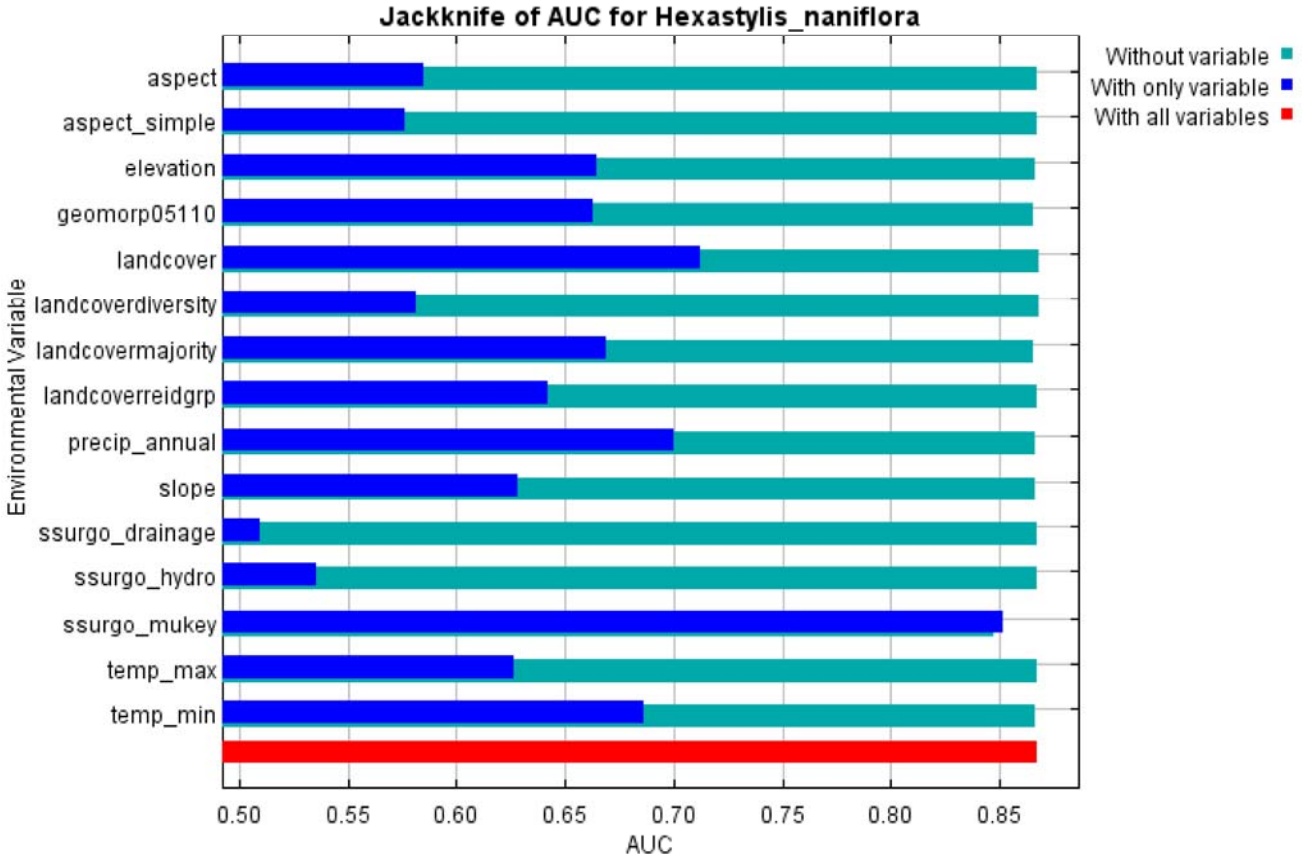
The following picture shows the results of the jackknife test of variable importance. The environmental variable with highest gain when used in isolation is ssurgo_mukey, which therefore appears to have the most useful information by itself. The environmental variable that decreases the gain the most when it is omitted is ssurgo_mukey, which therefore appears to have the most information that isn't present in the other variables.



The next picture shows the same jackknife test, using test gain instead of training gain. Note that conclusions about which variables are most important can change, now that we're looking at test data.



Lastly, we have the same jackknife test, using AUC on test data.



Raw data outputs and control parameters

The data used in the above analysis is contained in the next links. Please see the Help button for more information on these.
The model applied to the training environmental layers
The coefficients of the model
The omission and predicted area for varying cumulative and raw thresholds
The prediction strength at the training and (optionally) test presence sites
Results for all species modeled in the same Maxent run, with summary statistics and (optionally) jackknife results

Regularized training gain is 0.973, training AUC is 0.872, unregularized training gain is 1.094.
Unregularized test gain is 1.060.
Test AUC is 0.868, standard deviation is 0.004 (calculated as in DeLong, DeLong & Clarke-Pearson 1988, equation 2).
Algorithm converged after 1760 iterations (49 seconds).

The follow settings were used during the run:
2842 presence records used for training, 947 for testing.
12840 points used to determine the Maxent distribution (background points and presence points).
Environmental layers used: aspect(categorical) aspect_simple(categorical) elevation geomorp05110

(categorical) landcover(categorical) landcoverdiversity landcovermajority(categorical) landcoverreidgrp (categorical) precip_annual slope ssurgo_drainage(categorical) ssurgo_hydro(categorical) ssurgo_mukey (categorical) temp_max temp_min
Regularization values: linear/quadratic/product: 0.050, categorical: 0.250, threshold: 1.000, hinge: 0.500
Feature types used: hinge product linear quadratic
responsecurves: true
jackknife: true
outputdirectory: D:\Users\mendries\DataRequests\ReidR\HENA\Maxent\Output\CellCenterpoint
samplesfile: D:\Users\mendries\DataRequests\ReidR\HENA\Maxent\EOData\RasterCenterpointEOsPlus.csv
environmentallayers: D:\Users\mendries\DataRequests\ReidR\HENA\Maxent\EnvironmentalLayers
randomtestpoints: 25
maximumiterations: 5000
Command line used:

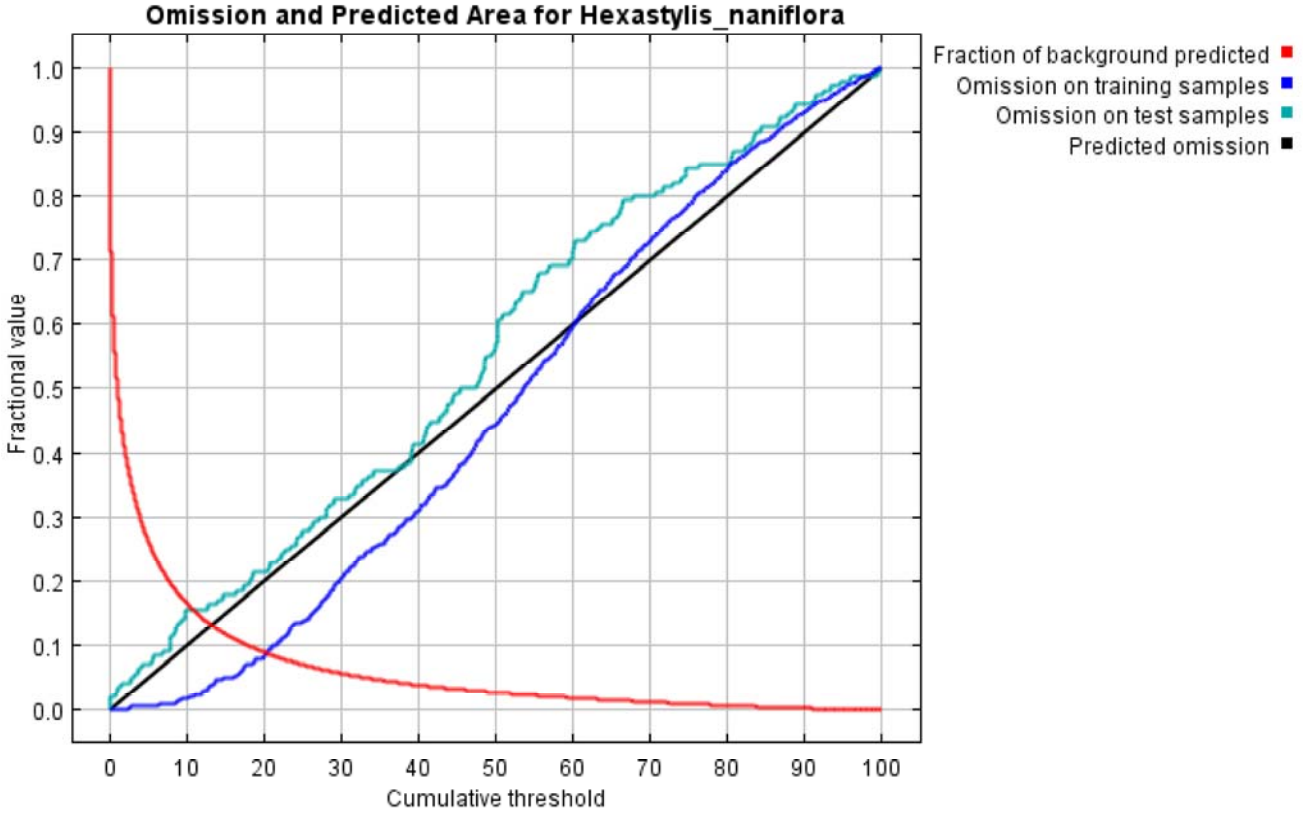
Command line to repeat this species model: java density.MaxEnt nowarnings noprefixes -E "" -E Hexastylis_naniflora responsecurves jackknife outputdirectory=D:\Users\mendries\DataRequests\ReidR\HENA\Maxent\Output\CellCenterpoint samplesfile=D:\Users\mendries\DataRequests\ReidR\HENA\Maxent\EOData\RasterCenterpointEOsPlus.csv environmentallayers=D:\Users\mendries\DataRequests\ReidR\HENA\Maxent\EnvironmentalLayers randomtestpoints=25 maximumiterations=5000 -t aspect -t aspect_simple -t geomorp05110 -t landcover -t landcovermajority -t landcoverreidgrp -t ssurgo_drainage -t ssurgo_hydro -t ssurgo_mukey

Maxent model for Hexastylis_naniflora

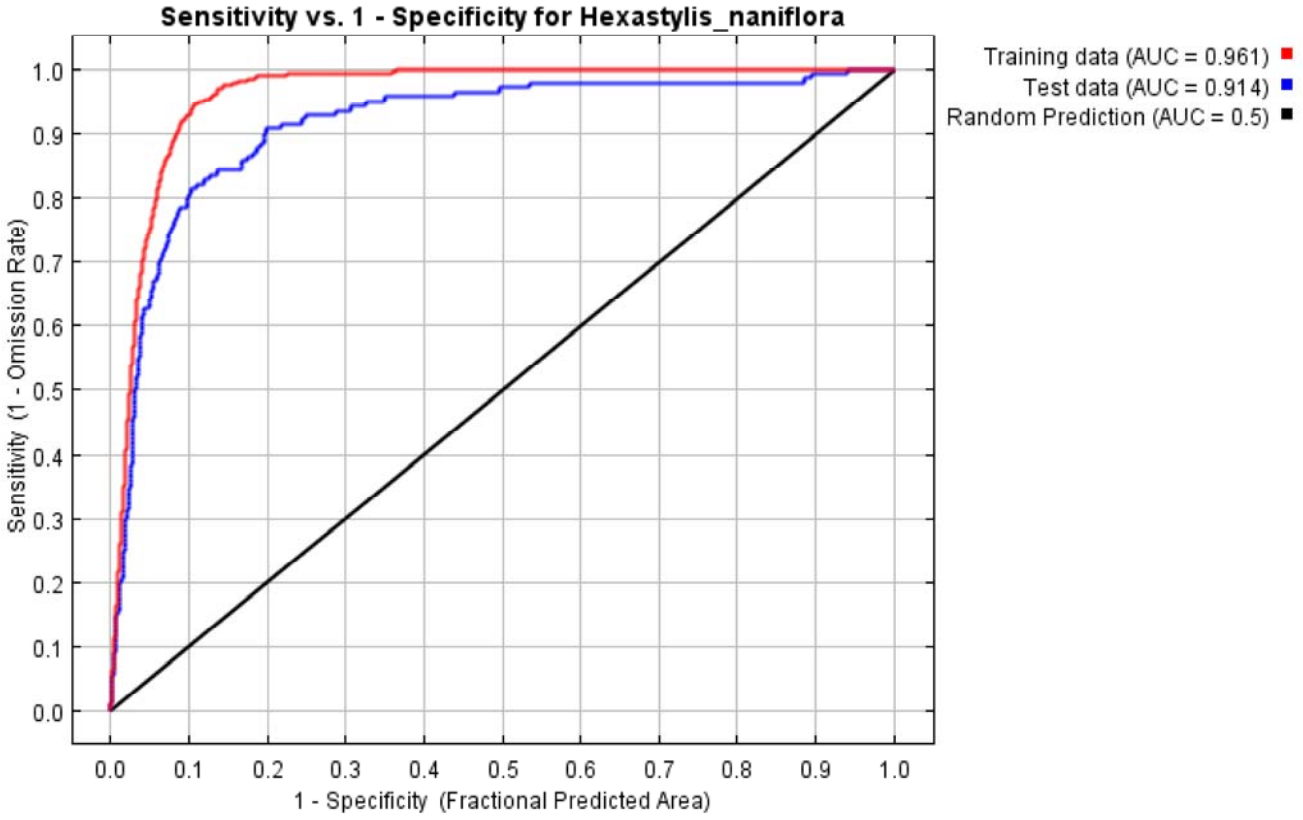
This page contains some analysis of the Maxent model for Hexastylis_naniflora, created Fri Feb 09 11:25:53 EST 2018 using Maxent version 3.4.1. If you would like to do further analyses, the raw data used here is linked to at the end of this page.

Analysis of omission/commission

The following picture shows the omission rate and predicted area as a function of the cumulative threshold. The omission rate is is calculated both on the training presence records, and (if test data are used) on the test records. The omission rate should be close to the predicted omission, because of the definition of the cumulative threshold.



The next picture is the receiver operating characteristic (ROC) curve for the same data. Note that the specificity is defined using predicted area, rather than true commission (see the paper by Phillips, Anderson and Schapire cited on the help page for discussion of what this means). This implies that the maximum achievable AUC is less than 1. If test data is drawn from the Maxent distribution itself, then the maximum possible test AUC would be 0.936 rather than 1; in practice the test AUC may exceed this bound.



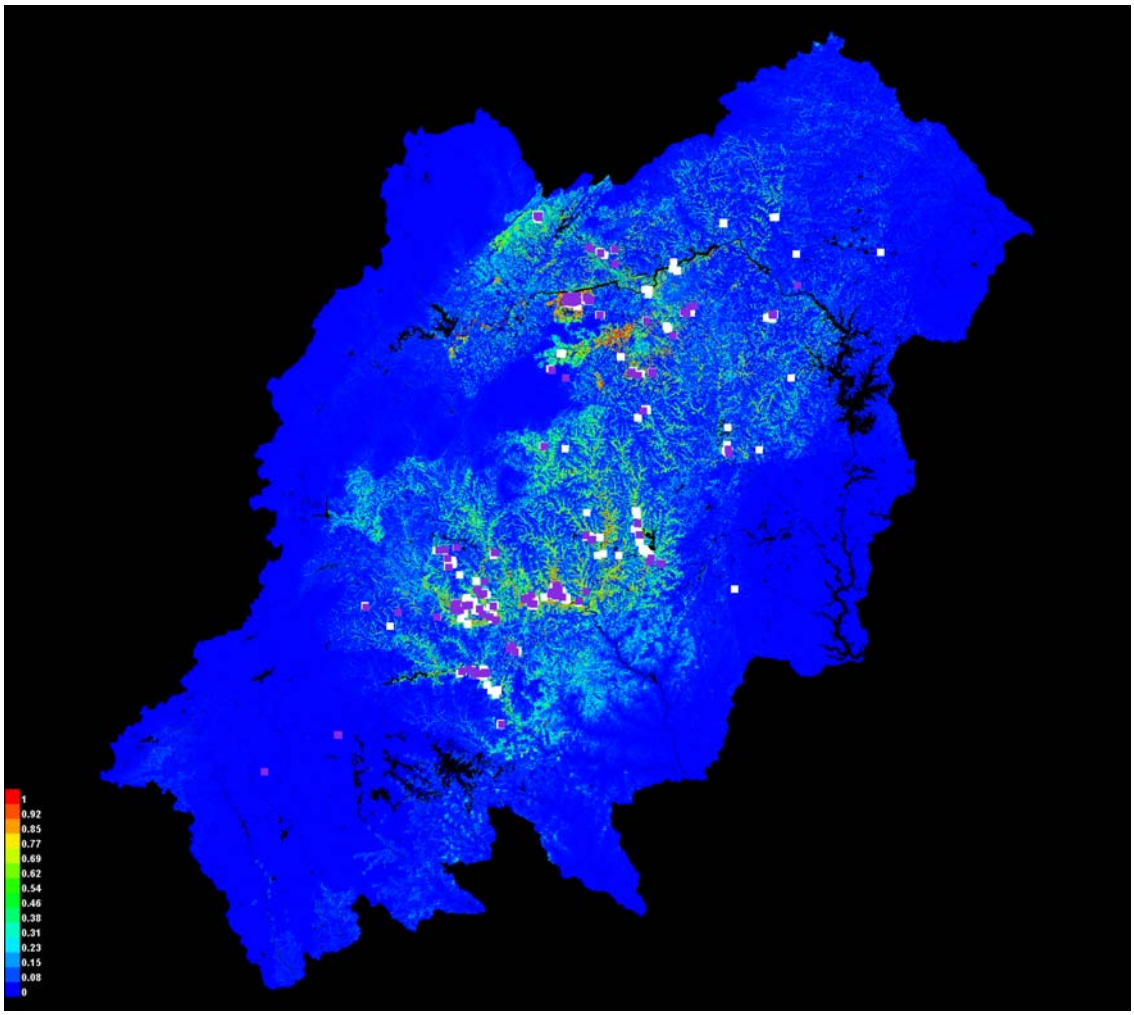
Some common thresholds and corresponding omission rates are as follows. If test data are available, binomial probabilities are calculated exactly if the number of test samples is at most 25, otherwise using a normal approximation to the binomial. These are 1-sided p-values for the null hypothesis that test points are predicted no better than by a random prediction with the same fractional predicted area. The "Balance" threshold minimizes 6 * training omission rate + .04 * cumulative threshold + 1.6 * fractional predicted area.

Cumulative threshold	Cloglog threshold	Description	Fractional predicted area	Training omission rate	Test omission rate	P-value
1.000	0.011	Fixed cumulative value 1	0.495	0.002	0.036	5.524E-29
5.000	0.049	Fixed cumulative value 5	0.262	0.007	0.071	0E0
10.000	0.114	Fixed cumulative value 10	0.165	0.019	0.157	0E0
0.528	0.007	Minimum training presence	0.573	0.000	0.021	1.533E-22
21.572	0.313	10 percentile training presence	0.083	0.099	0.229	0E0
20.339	0.294	Equal training sensitivity and specificity	0.088	0.087	0.214	0E0

16.557	0.226	Maximum training sensitivity plus specificity	0.108	0.054	0.186	0E0
10.659	0.123	Equal test sensitivity and specificity	0.157	0.021	0.157	0E0
16.228	0.219	Maximum test sensitivity plus specificity	0.110	0.054	0.179	0E0
5.878	0.059	Balance training omission, predicted area and threshold value	0.238	0.007	0.086	0E0
11.101	0.130	Equate entropy of thresholded and original distributions	0.152	0.024	0.157	0E0

Pictures of the model

This is a representation of the Maxent model for Hexastylis_naniflora. Warmer colors show areas with better predicted conditions. White dots show the presence locations used for training, while violet dots show test locations. Click on the image for a full-size version.



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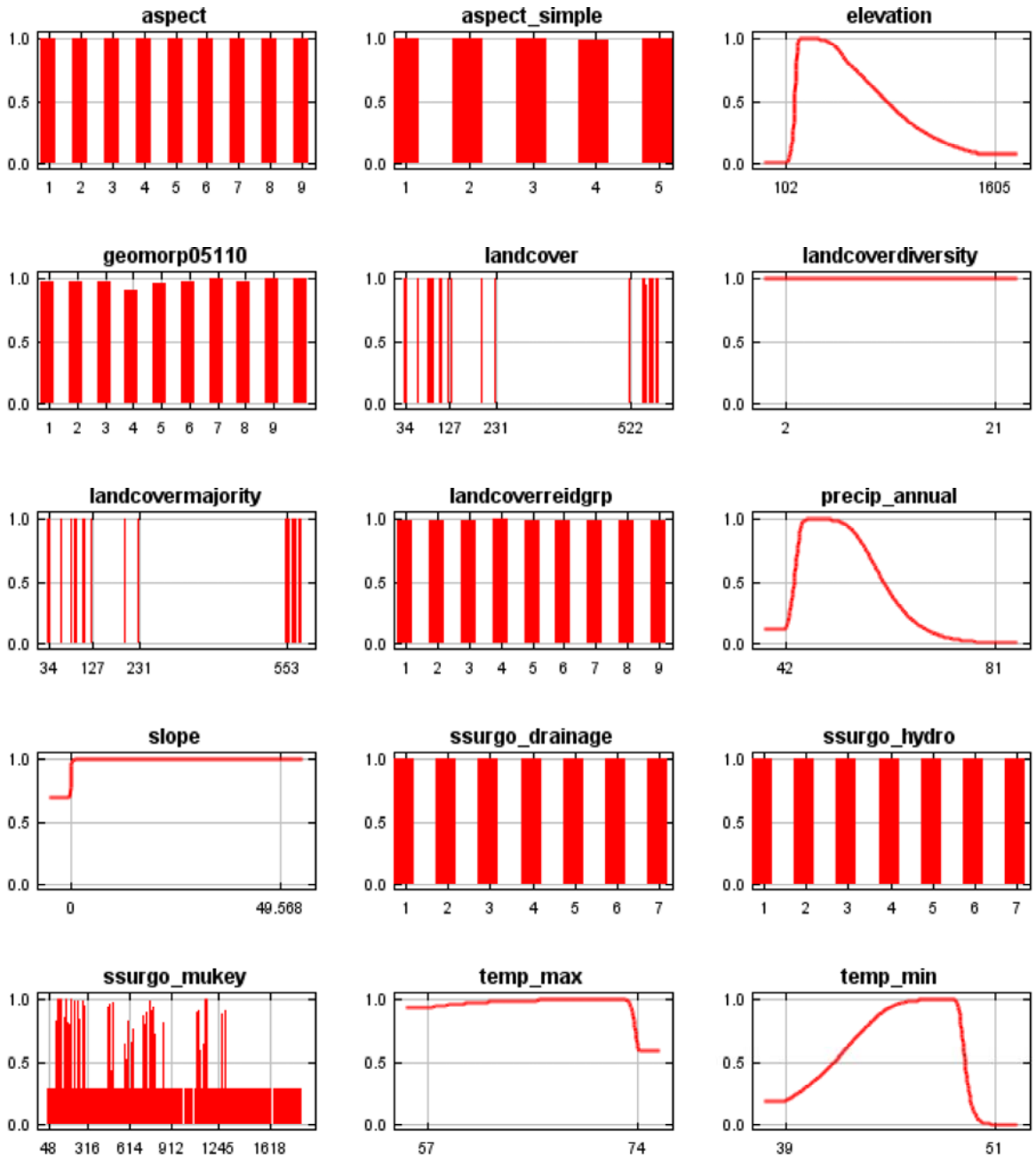
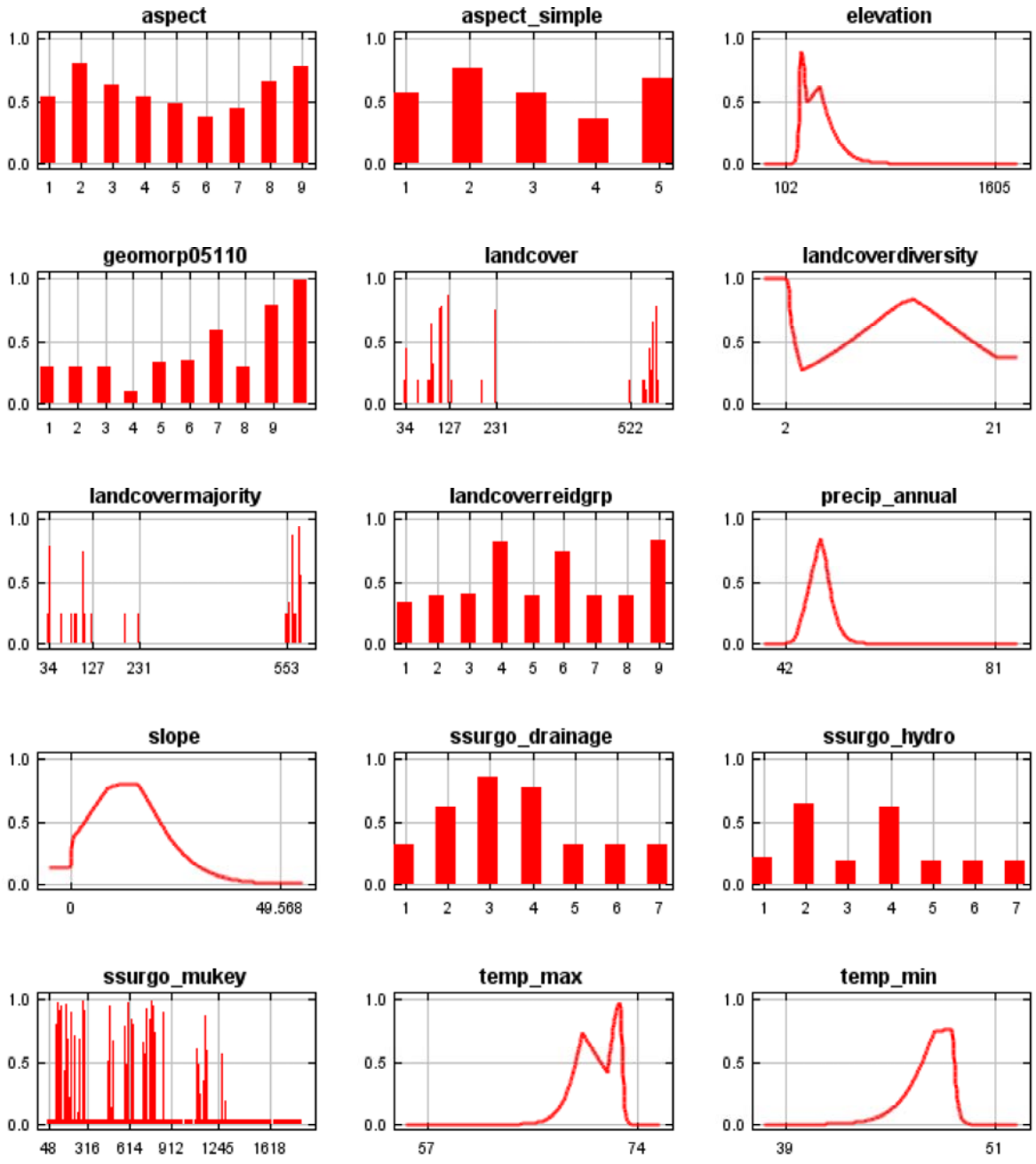
Response curves

These curves show how each environmental variable affects the Maxent prediction. The curves show how the predicted probability of presence changes as each environmental variable is varied, keeping all other environmental variables at their average sample value. Click on a response curve to see a larger version. Note that the curves can be hard to interpret if you have strongly correlated variables, as the model may depend on the correlations in ways that are not evident in the curves. In other words, the curves show the marginal effect of changing exactly one variable, whereas the model may take advantage of sets of variables changing together.



In contrast to the above marginal response curves, each of the following curves represents a different model, namely, a Maxent model created using only the corresponding variable. These plots reflect the dependence of predicted suitability both on the selected variable and on dependencies induced by correlations between the selected variable and other variables. They may be easier to interpret if there are strong correlations between variables.



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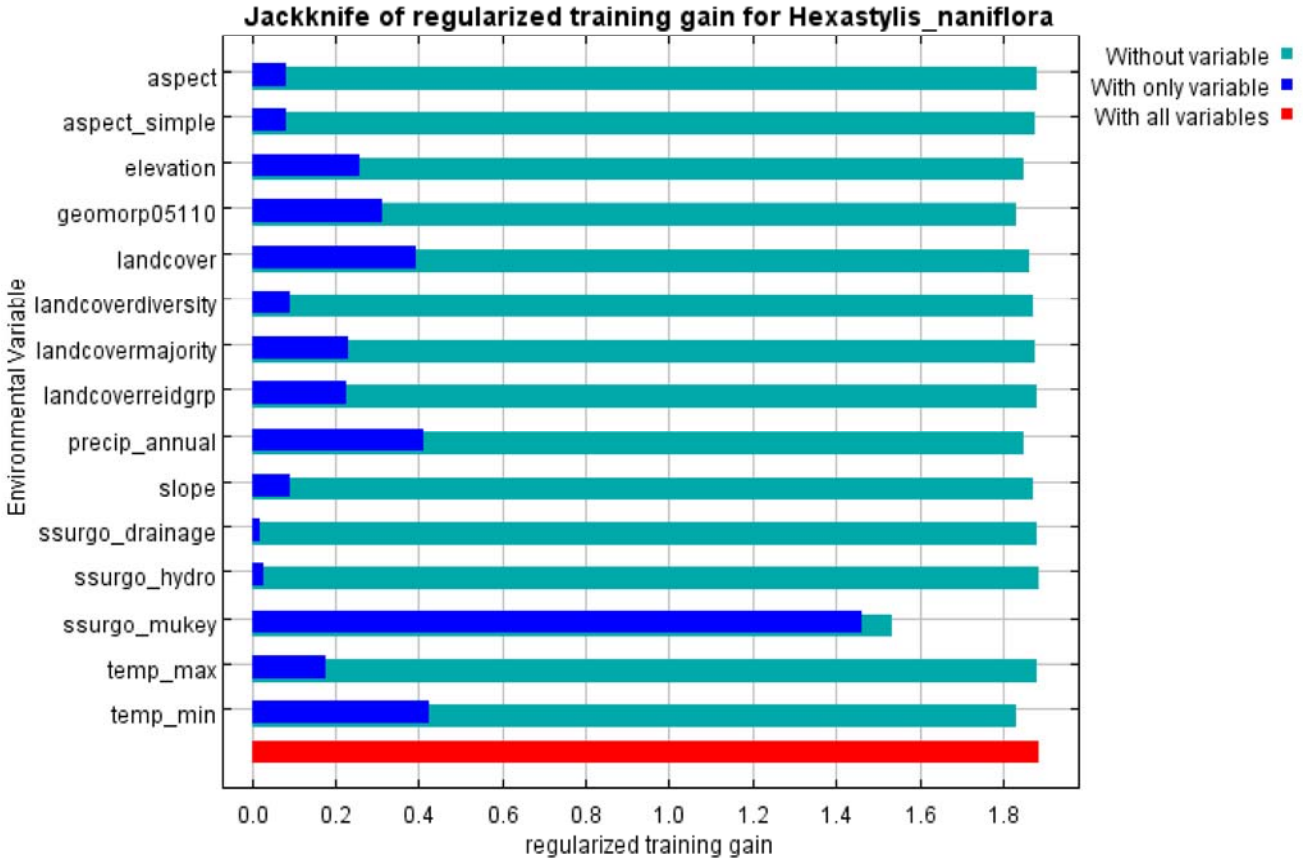
The following table gives estimates of relative contributions of the environmental variables to the Maxent model. To determine the first estimate, in each iteration of the training algorithm, the increase in regularized gain is added to the contribution of the corresponding variable, or subtracted from it if the change to the absolute value of lambda is negative. For the second estimate, for each environmental variable in turn, the values of that variable on training presence and background data are randomly permuted. The model is reevaluated on the permuted data, and the resulting drop in training AUC is shown in the table, normalized to percentages. As with the variable jackknife, variable contributions should be interpreted with caution

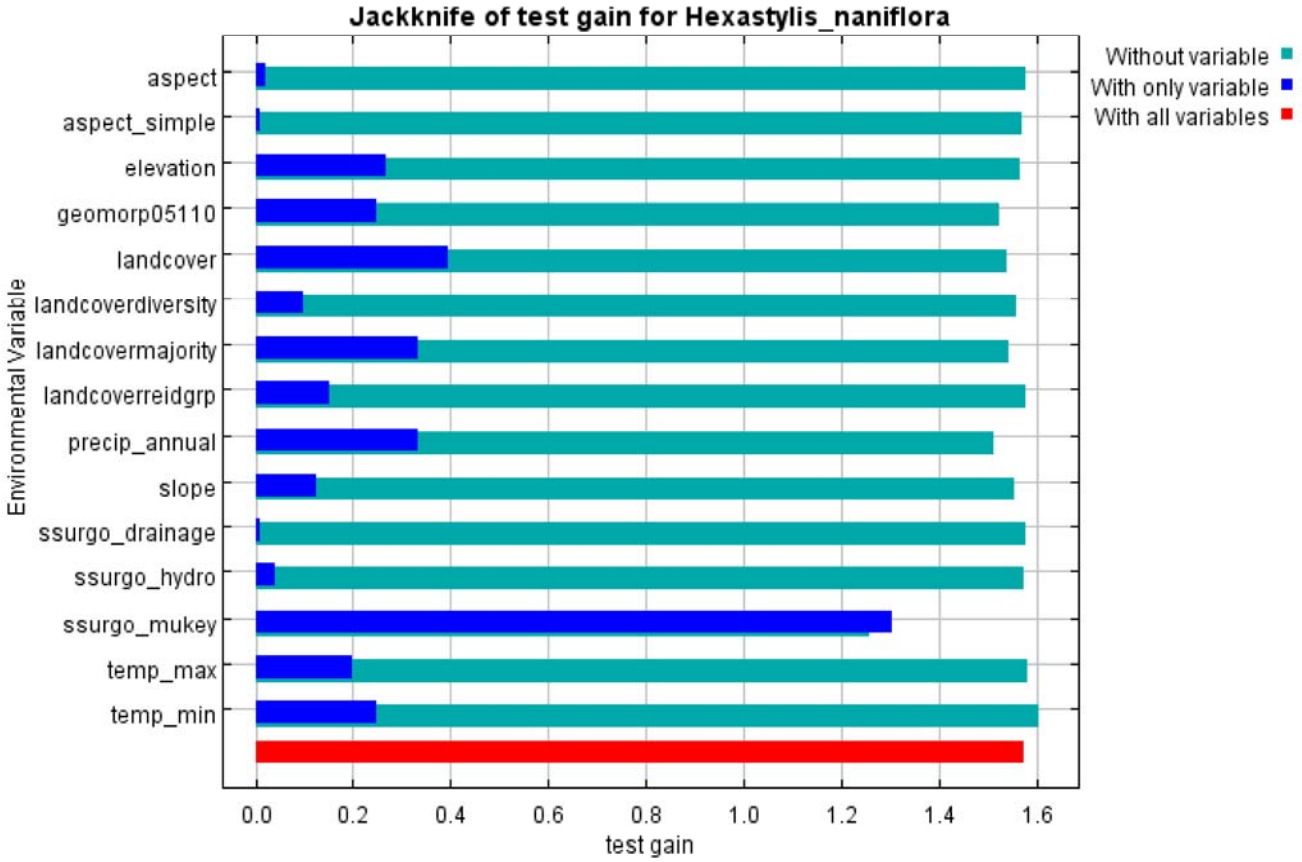
when the predictor variables are correlated.

Variable	Percent contribution	Permutation importance
ssurgo_mukey	37.2	30.4
temp_min	14.6	35.7
precip_annual	9.4	11.9
geomorp05110	8.5	3.3
landcoverreidgrp	7.9	0.9
landcover	7.8	3.9
elevation	5.2	8.8
landcovermajority	4.9	1
aspect_simple	2.6	1.1
landcoverdiversity	0.8	0.6
temp_max	0.4	0.8
slope	0.3	0.6
aspect	0.2	0.4
ssurgo_drainage	0.1	0.8
ssurgo_hydro	0	0

The following picture shows the results of the jackknife test of variable importance. The environmental variable with highest gain when used in isolation is ssurgo_mukey, which therefore appears to have the most useful information by itself. The environmental variable that decreases the gain the most when it is omitted is ssurgo_mukey, which therefore appears to have the most information that isn't present in the other variables.



The next picture shows the same jackknife test, using test gain instead of training gain. Note that conclusions about which variables are most important can change, now that we're looking at test data.



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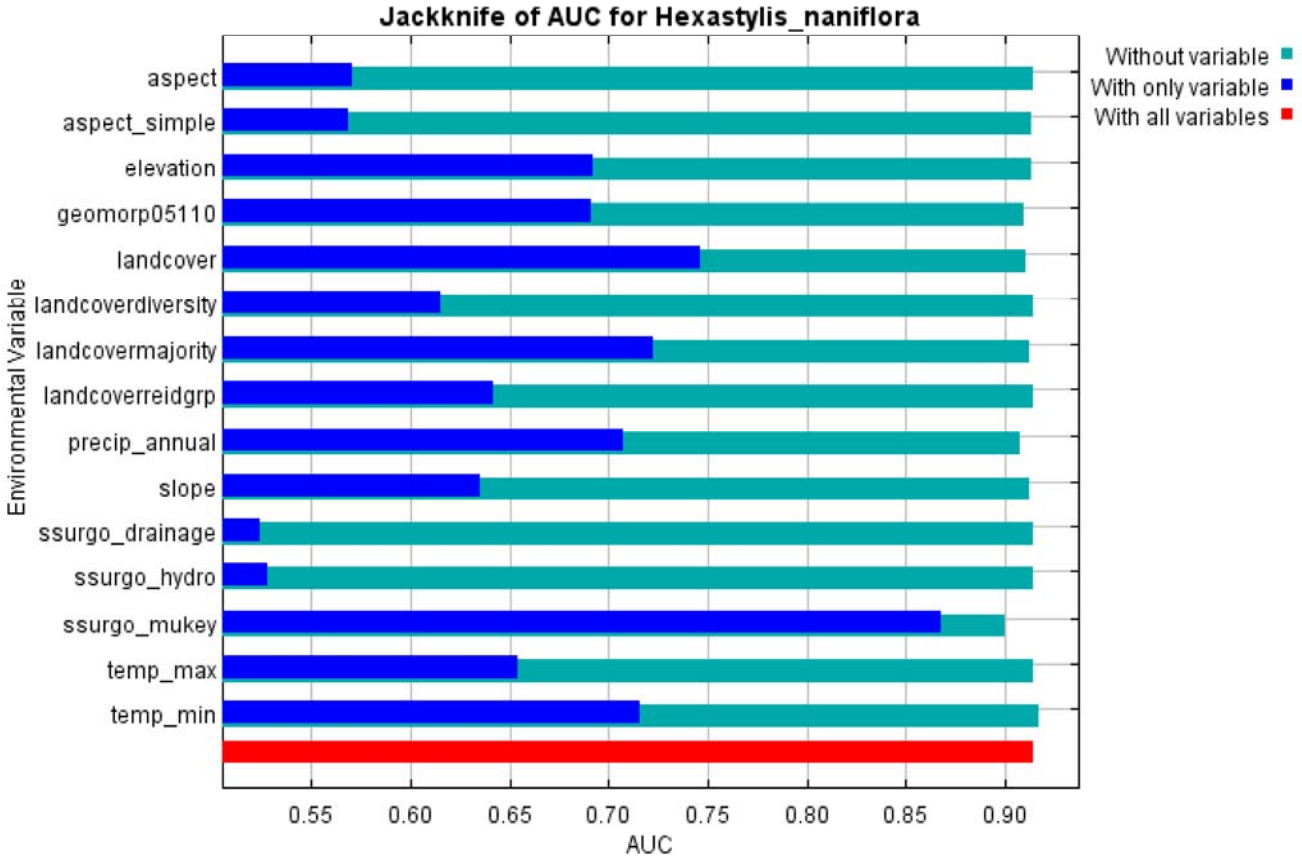

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Results for all species modeled in the same Maxent run, with summary statistics and (optionally) jackknife results

Regularized training gain is 1.885, training AUC is 0.961, unregularized training gain is 2.197.
Unregularized test gain is 1.575.
Test AUC is 0.914, standard deviation is 0.013 (calculated as in DeLong, DeLong & Clarke-Pearson 1988, equation 2).
Algorithm converged after 1740 iterations (31 seconds).

The follow settings were used during the run:
423 presence records used for training, 140 for testing.
10423 points used to determine the Maxent distribution (background points and presence points).
Environmental layers used: aspect(categorical) aspect_simple(categorical) elevation geomorp05110

(categorical) landcover(categorical) landcoverdiversity landcovermajority(categorical) landcoverreidgrp (categorical) precip_annual slope ssurgo_drainage(categorical) ssurgo_hydro(categorical) ssurgo_mukey (categorical) temp_max temp_min
Regularization values: linear/quadratic/product: 0.050, categorical: 0.250, threshold: 1.000, hinge: 0.500
Feature types used: hinge product linear quadratic
responsecurves: true
jackknife: true
outputdirectory: D:\Users\mendries\DataRequests\ReidR\HENA\Maxent\Output\Random2
samplesfile: D:\Users\mendries\DataRequests\ReidR\HENA\Maxent\EOData\RandomAll.csv
environmentallayers: D:\Users\mendries\DataRequests\ReidR\HENA\Maxent\EnvironmentalLayers
randomtestpoints: 25
maximumiterations: 5000
Command line used:

Command line to repeat this species model: java density.MaxEnt nowarnings noprefixes -E "" -E Hexastylis_naniflora responsecurves jackknife outputdirectory=D:\Users\mendries\DataRequests\ReidR\HENA\Maxent\Output\Random2 samplesfile=D:\Users\mendries\DataRequests\ReidR\HENA\Maxent\EOData\RandomAll.csv environmentallayers=D:\Users\mendries\DataRequests\ReidR\HENA\Maxent\EnvironmentalLayers randomtestpoints=25 maximumiterations=5000 -t aspect -t aspect_simple -t geomorp05110 -t landcover -t landcovermajority -t landcoverreidgrp -t ssurgo_drainage -t ssurgo_hydro -t ssurgo_mukey