# Western Painted Turtle (*Chrysemys picta bellii*) Range Map and Distribution Model Summary

August 20, 2010

This report presents range and distribution of Western Painted Turtle (ARAAD01010) in Wyoming (see Keinath et al. 2010b). Similar reports were developed by the Wyoming Natural Diversity Database for terrestrial vertebrate species of conservation need in Wyoming's State Wildlife Action Plan. This effort was supported by the Wyoming Game and Fish Department and the U.S. Geological Survey.
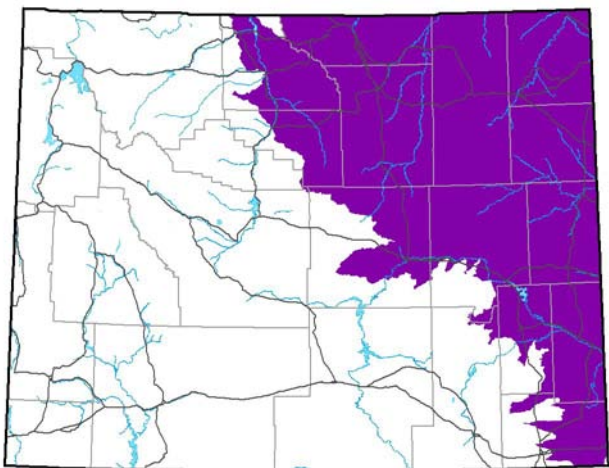
Range Map - Occupancy
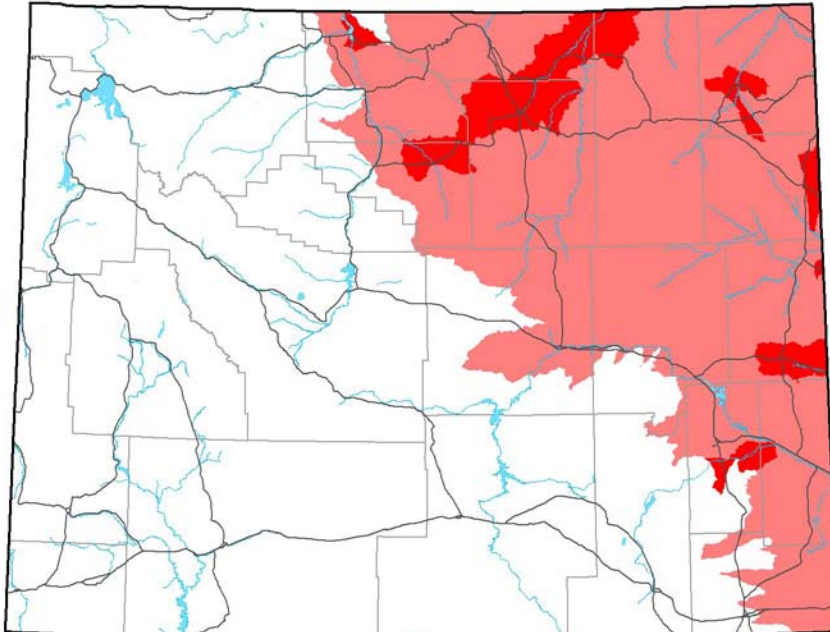
| Known | Suspected | Accidental | Historical |

Range Notes

- Version: 2010-01-19
- Proportion of range deemed known based on documented occurrences: 0.131
- Details of range map creation noted in Keinath et al. (2010a).

Range Map - Seasonality

| Year-Round | Summer | Winter | Spring/Fall |

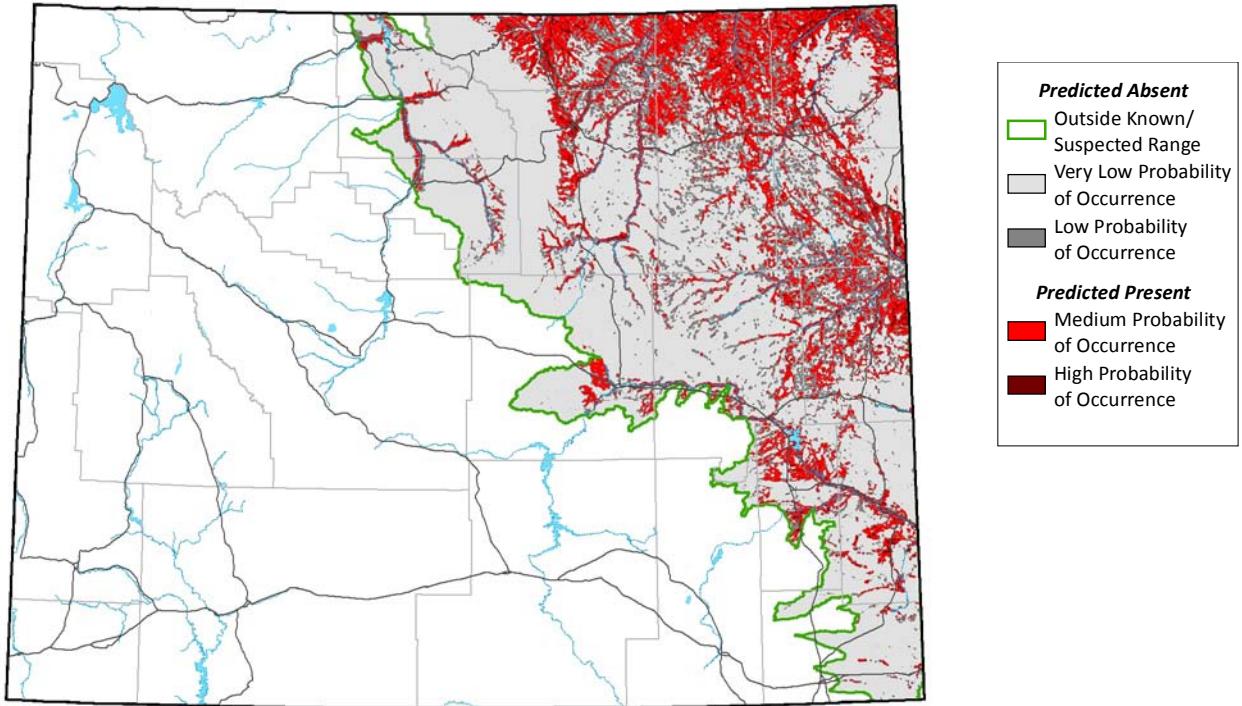Maps, models and report were created by and are available from the Wyoming Natural Diversity Database. (http://uwadmnweb.uwyo.edu/wyndd/).

Doug Keinath, Senior Zoologist

Mark Andersen, GIS Specialist

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# Distribution Model (Version: Tue Mar 16 16:58:16 MDT 2010)
Details of distribution model creation are presented in Keinath et al. (2010b)

Predicted Absent
- Outside Known/ Suspected Range
- Very Low Probability of Occurrence
- Low Probability of Occurrence

Predicted Present
- Medium Probability of Occurrence
- High Probability of Occurrence

Model Parameters
- Season Modeled: Year-Round
- Algorithm: Maxent version 3.3.1
- Feature Types: Linear, Quadratic, Hinge
- Binary Threshold Rule: Maximum training sensitivity plus specificity
- Binary Threshold Value: 0.2444950
- High-Probability Threshold Value: 0.6528385
- Low-Probability Threshold Value: 0.0956548

Model Evaluation - ROC Plot
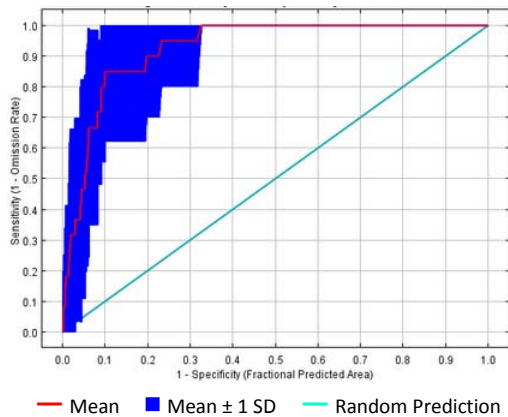
Mean   — Mean ± 1 SD   — Random Prediction

Model Quality Summary
Overall Assessment of Model Quality:
MEDIUM
Expert Assessment: Low
Occurrence Sample Size: Medium
Quality of Occurrences: High
Positive Success Rate: High
Test AUC and Model Gain: High

Model Evaluation Statistics
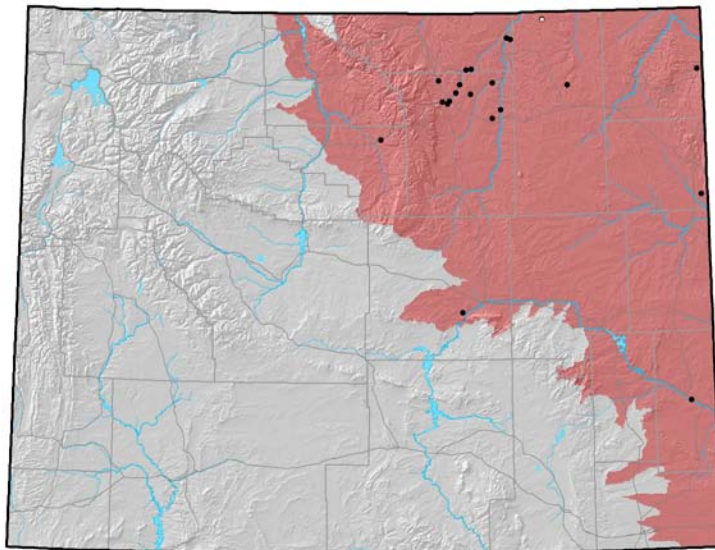### Final Model Statistics
Training AUC: 0.960
Regularized Training Gain: 1.839

Cross-Validation Statistics
- Average Test AUC: 0.926 ± 0.057
- Upper Bound on Test AUC: 0.936
- Average Test Gain: 1.495 ± 0.959
- Omission Error (fraction of test points omitted during 10-fold cross validation): 0.20± 0.35

Occurrence Data for Distribution Model

Occurrence Map

Points Used in Modeling, by Year of Observation
○ Pre-1985
• 1985 or Later

Known and Suspected Range

Occurrence Summary Statistics

- Number of Occurrences in AWVED master dataset: 25
- Number of Occurrences used to create distribution model: 21
- Average Point Quality Index (highest quality is 12.00): 9.43 ± 2.48
- Most recent occurrence used: 2008
- Oldest occurrence used: 1982
- Occurrence File: LOCAL_SAMPLE_POINTS_W_PDOG_2. csv

Comments

This species uses aspects of wetlands (e.g., dense emergent vegetation) for which statewide data are not available or reliable. This often results in low model quality because key habitat features are not mappable across the state. Great improvements in our ability to model this species distribution could be obtained by improving wetland maps.

References

Keinath, D.A., M.D. Andersen, and G.P Beauvais. 2010a. Range maps for Wyoming's species of greatest conservation need. Report prepared for the Wyoming Game and Fish Department by the Wyoming Natural Diversity Database, Laramie, Wyoming. January 19, 2010.

Keinath, D.A., M.D. Andersen, and G.P. Beauvais. 2010b. Range and modeled distribution of Wyoming's species of greatest conservation need. Report prepared by the Wyoming Natural Diversity Database, Laramie Wyoming for the Wyoming Game and Fish Department, Cheyenne, Wyoming and the U.S. Geological Survey, Fort Collins, Colorado. August 20, 2010.

## Predictor Variables used in the Distribution Model

Percent Contribution (PC) to final model

| Environmental Variable	PC
Herbaceous Cover Index	27
Elevation	19
Cottonwood Index	19
Variation of monthly precipitation	14
Conifer Index	14
Distance to Permanent Water	7

Response Curves

Each curve shows dependence of predicted suitability on input values of a single predictor variable considering correlations with others. Suitability is on the vertical axis (units: probability). Variable values are on the horizontal axis (units based on inputs; see Keinath et al 2010b for details).
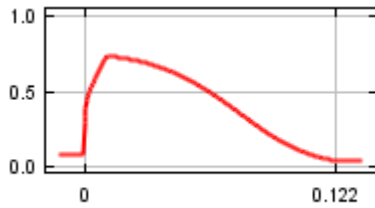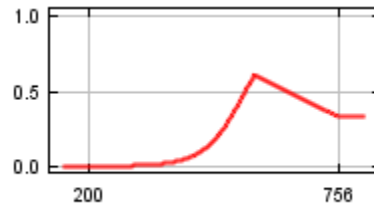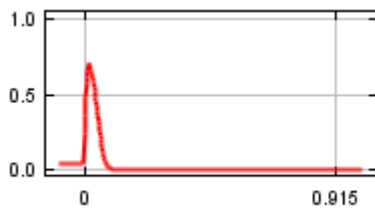
Herbaceous Cover Index
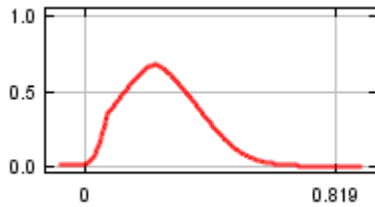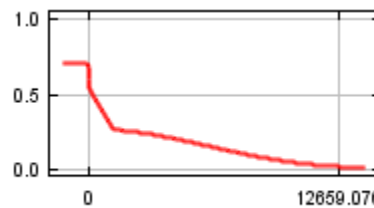

Elevation
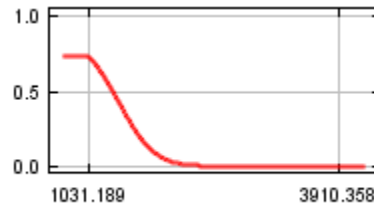
Cottonwood Index

Variation of monthly precipitation

Conifer Index
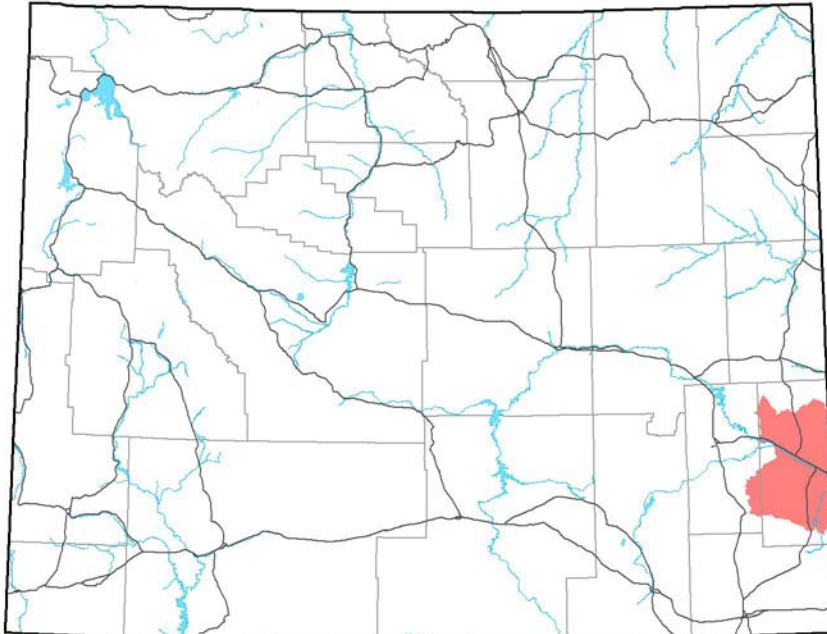

Distance to Permanent Water

Ornate Box Turtle (*Terrapene ornata ornata*)
Range Map and Distribution Model Summary

August 20, 2010

This report presents range and distribution of Ornate Box Turtle (ARAAD08020) in Wyoming (see Keinath et al. 2010b). Similar reports were developed by the Wyoming Natural Diversity Database for terrestrial vertebrate species of conservation need in Wyoming's State Wildlife Action Plan. This effort was supported by the Wyoming Game and Fish Department and the U.S. Geological Survey.
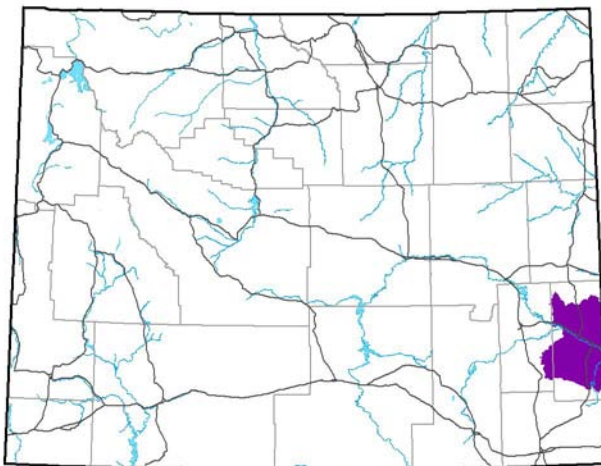
Range Map - Occupancy

Known | Suspected | Accidental | Historical

Range Notes
- Version: 2010-01-19
- Proportion of range deemed known based on documented occurrences: 0.000
- Details of range map creation noted in Keinath et al. (2010a).

Range Map - Seasonality

Year-Round | Summer | Winter | Spring/Fall

Maps, models and report were created by and are available from the Wyoming Natural Diversity Database. (http://uwadmnweb.uwyo.edu/wyndd/).

Doug Keinath, Senior Zoologist

Mark Andersen, GIS Specialist

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Comments

There were too few occurrence points to construct a distribution model for this species. Collection of additional, high-quality occurrence locations are necessary for assessment of potential distribution within Wyoming.
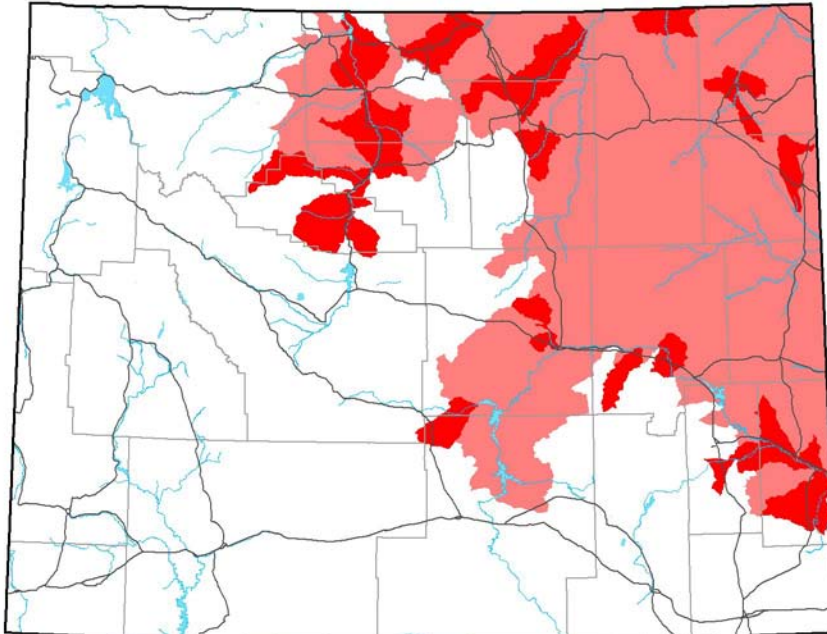
References

Keinath, D.A., M.D. Andersen, and G.P Beauvais. 2010a. Range maps for Wyoming's species of greatest conservation need. Report prepared for the Wyoming Game and Fish Department by the Wyoming Natural Diversity Database, Laramie, Wyoming. January 19, 2010.

Keinath, D.A., M.D. Andersen, and G.P. Beauvais. 2010b. Range and modeled distribution of Wyoming's species of greatest conservation need. Report prepared by the Wyoming Natural Diversity Database, Laramie Wyoming for the Wyoming Game and Fish Department, Cheyenne, Wyoming and the U.S. Geological Survey, Fort Collins, Colorado. August 20, 2010.

Western Spiny Softshell (*Apalone spinifera hartwegi*)
Range Map and Distribution Model Summary

August 20, 2010

This report presents range and distribution of Western Spiny Softshell (ARAAG01030) in Wyoming (see Keinath et al. 2010b). Similar reports were developed by the Wyoming Natural Diversity Database for terrestrial vertebrate species of conservation need in Wyoming's State Wildlife Action Plan. This effort was supported by the Wyoming Game and Fish Department and the U.S. Geological Survey.
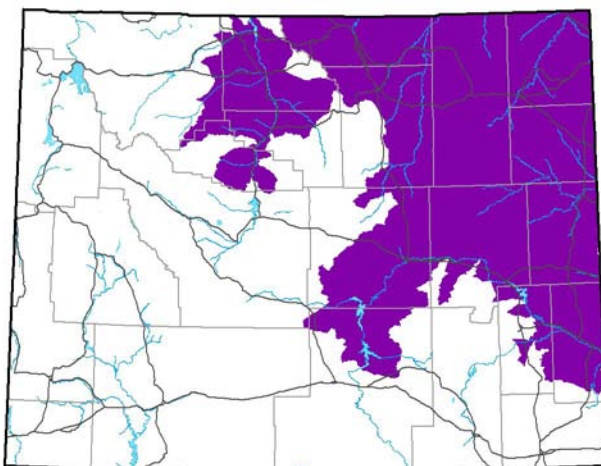
Range Map - Occupancy

Range Notes
- Version: 2010-01-19
- Proportion of range deemed known based on documented occurrences: 0.176
- Details of range map creation noted in Keinath et al. (2010a).

Range Map - Seasonality

Maps, models and report were created by and are available from the Wyoming Natural Diversity Database. (http://uwadmnweb.uwyo.edu/wyndd/).
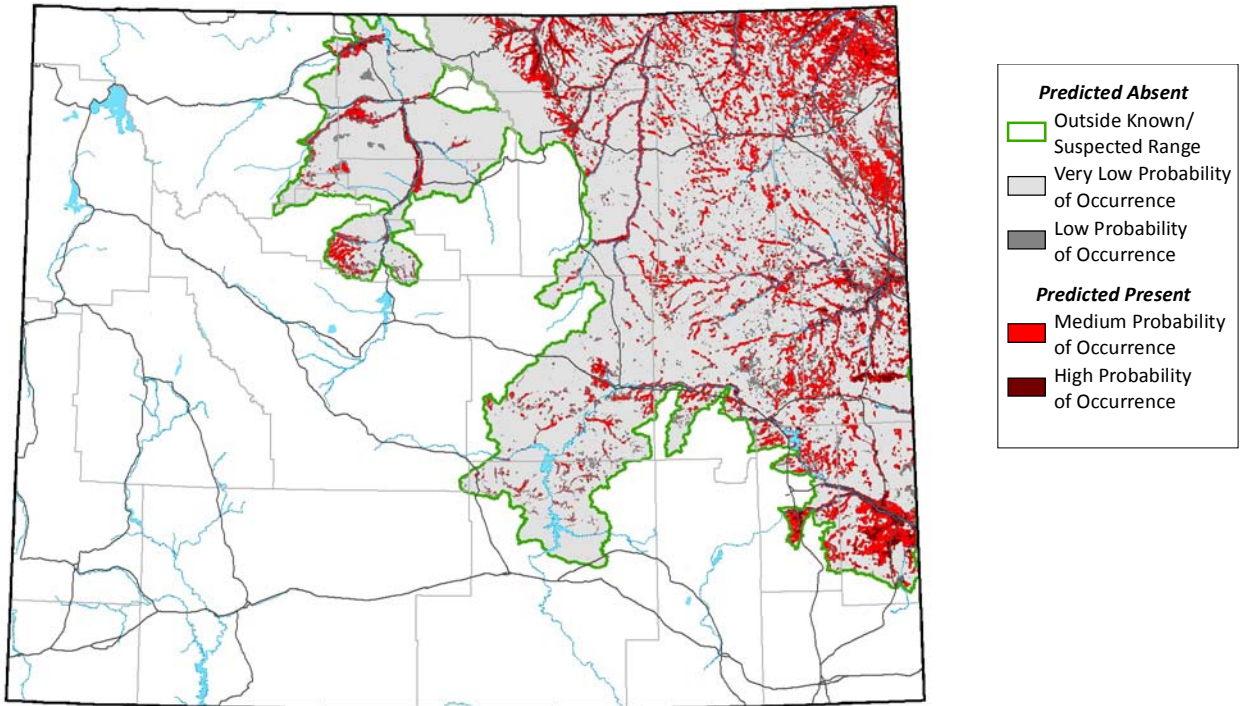
Doug Keinath, Senior Zoologist

Mark Andersen, GIS Specialist

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Distribution Model (Version: Fri Apr 23 10:42:06 MDT 2010)

Details of distribution model creation are presented in Keinath et al. (2010b)

Predicted Absent
- Outside Known/ Suspected Range
- Very Low Probability of Occurrence
- Low Probability of Occurrence

Predicted Present
- Medium Probability of Occurrence
- High Probability of Occurrence

Model Parameters

- Season Modeled: Year-Round
- Algorithm: Maxent version 3.3.1
- Feature Types: Linear, Quadratic, Hinge
- Binary Threshold Rule: Maximum training sensitivity plus specificity
- Binary Threshold Value: 0.2861360
- High-Probability Threshold Value: 0.6534006
- Low-Probability Threshold Value: 0.1815232

Model Evaluation - ROC Plot

Mean — Mean ± 1 SD — Random Prediction

Model Quality Summary

Overall Assessment of Model Quality: LOW

Expert Assessment: Low
Occurrence Sample Size: Low
Quality of Occurrences: Medium
Positive Success Rate: Medium
Test AUC and Model Gain: Medium
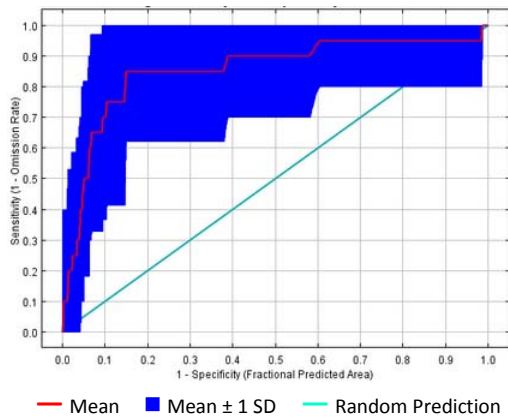
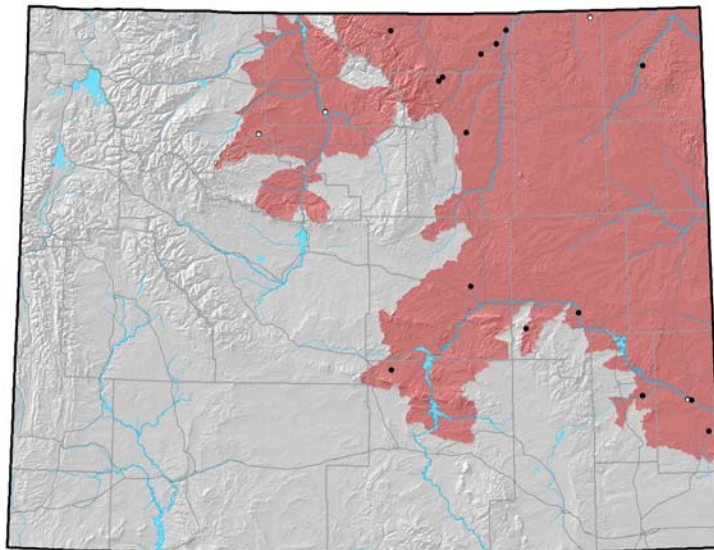## Model Evaluation Statistics

Final Model Statistics

Training AUC: 0.958
Regularized Training Gain: 1.456

Cross-Validation Statistics

- Average Test AUC: 0.854 ± 0.159
- Upper Bound on Test AUC: 0.893
- Average Test Gain: 0.643 ± 2.249
- Omission Error (fraction of test points omitted during 10-fold cross validation): 0.25± 0.35

Occurrence Data for Distribution Model

Occurrence Map

Points Used in Modeling, by Year of Observation
- ○ Pre-1985
- • 1985 or Later

Known and Suspected Range

Occurrence Summary Statistics

- Number of Occurrences in AWVED master dataset: 23
- Number of Occurrences used to create distribution model: 19
- Average Point Quality Index (highest quality is 12.00): 7.42 ± 2.67
- Most recent occurrence used: 2006
- Oldest occurrence used: 1979
- Occurrence File: LOCAL_SAMPLE_POINTS_W_PDOG_2.csv

Comments

This species uses aspects of wetlands (e.g., dense emergent vegetation) for which statewide data are not available or reliable. This often results in low model quality because key habitat features are not mappable across the state. Great improvements in our ability to model this species distribution could be obtained by improving wetland maps.

References

Keinath, D.A., M.D. Andersen, and G.P Beauvais. 2010a. Range maps for Wyoming's species of greatest conservation need. Report prepared for the Wyoming Game and Fish Department by the Wyoming Natural Diversity Database, Laramie, Wyoming. January 19, 2010.

Keinath, D.A., M.D. Andersen, and G.P. Beauvais. 2010b. Range and modeled distribution of Wyoming's species of greatest conservation need. Report prepared by the Wyoming Natural Diversity Database, Laramie Wyoming for the Wyoming Game and Fish Department, Cheyenne, Wyoming and the U.S. Geological Survey, Fort Collins, Colorado. August 20, 2010.

# Predictor Variables used in the Distribution Model

Percent Contribution (PC) to final model

Environmental Variable	PC
Cottonwood Index	33
Variation of monthly precipitation	18
Herbaceous Cover Index	16
Wettest quarter mean temperature	16
Sagebrush Index	10
Distance to Permanent Water	7

Response Curves

Each curve shows dependence of predicted suitability on input values of a single predictor variable considering correlations with others. Suitability is on the vertical axis (units: probability). Variable values are on the horizontal axis (units based on inputs; see Keinath et al 2010b for details).
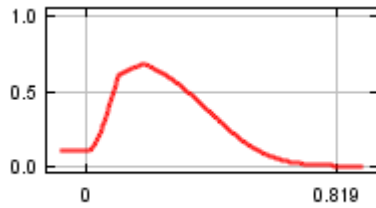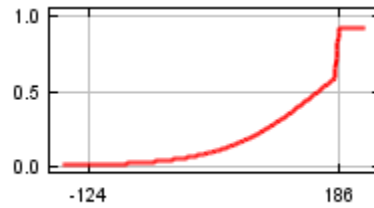
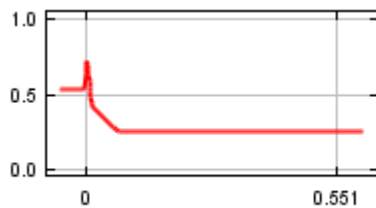**Cottonwood Index**
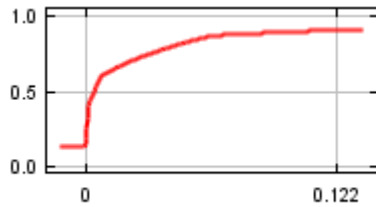
Variation of monthly precipitation
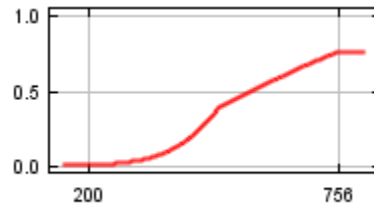
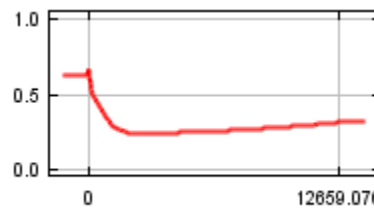**Herbaceous Cover Index**

Wettest quarter mean temperature

Sagebrush Index


Distance to Permanent Water

Great Plains Earless Lizard (*Holbrookia maculata*)
Range Map and Distribution Model Summary

August 20, 2010

This report presents range and distribution of Great Plains Earless Lizard (ARACF08020) in Wyoming (see Keinath et al. 2010b). Similar reports were developed by the Wyoming Natural Diversity Database for terrestrial vertebrate species of conservation need in Wyoming's State Wildlife Action Plan. This effort was supported by the Wyoming Game and Fish Department and the U.S. Geological Survey.
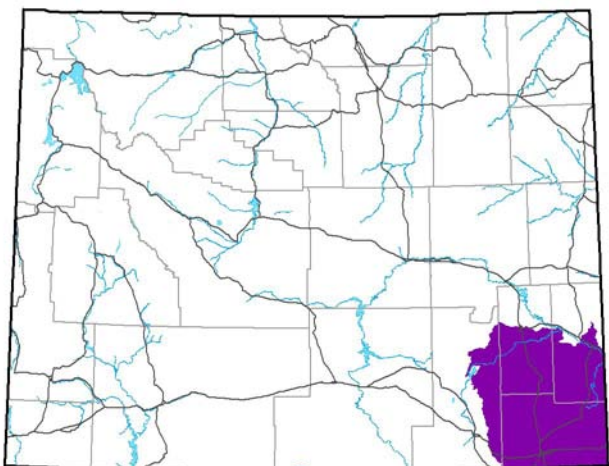
Range Map - Occupancy

Known | Suspected | Accidental | Historical
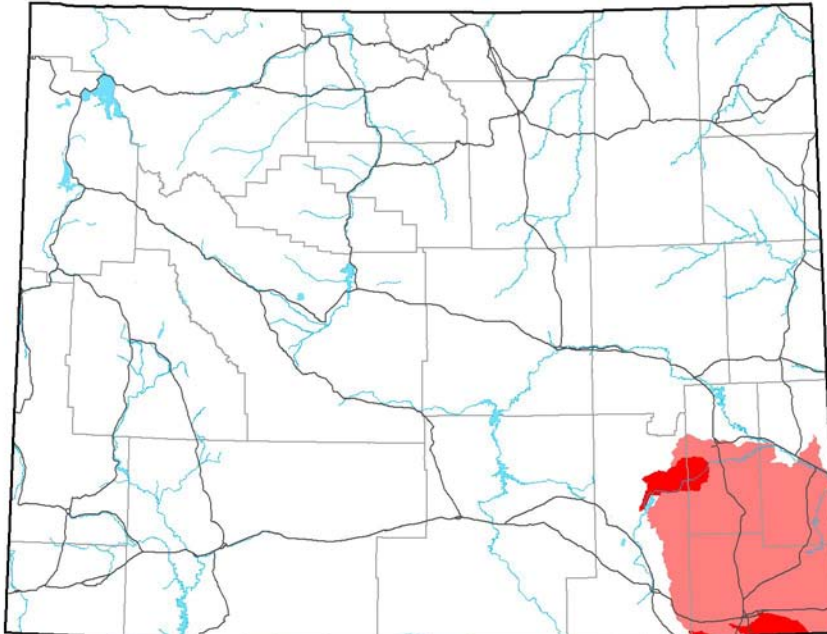
Range Notes
- Version: 2010-01-19
- Proportion of range deemed known based on documented occurrences: 0.125
- Details of range map creation noted in Keinath et al. (2010a).

Range Map - Seasonality

Year-Round | Summer | Winter | Spring/Fall

Maps, models and report were created by and are available from the Wyoming Natural Diversity Database. (http://uwadmnweb.uwyo.edu/wyndd/).
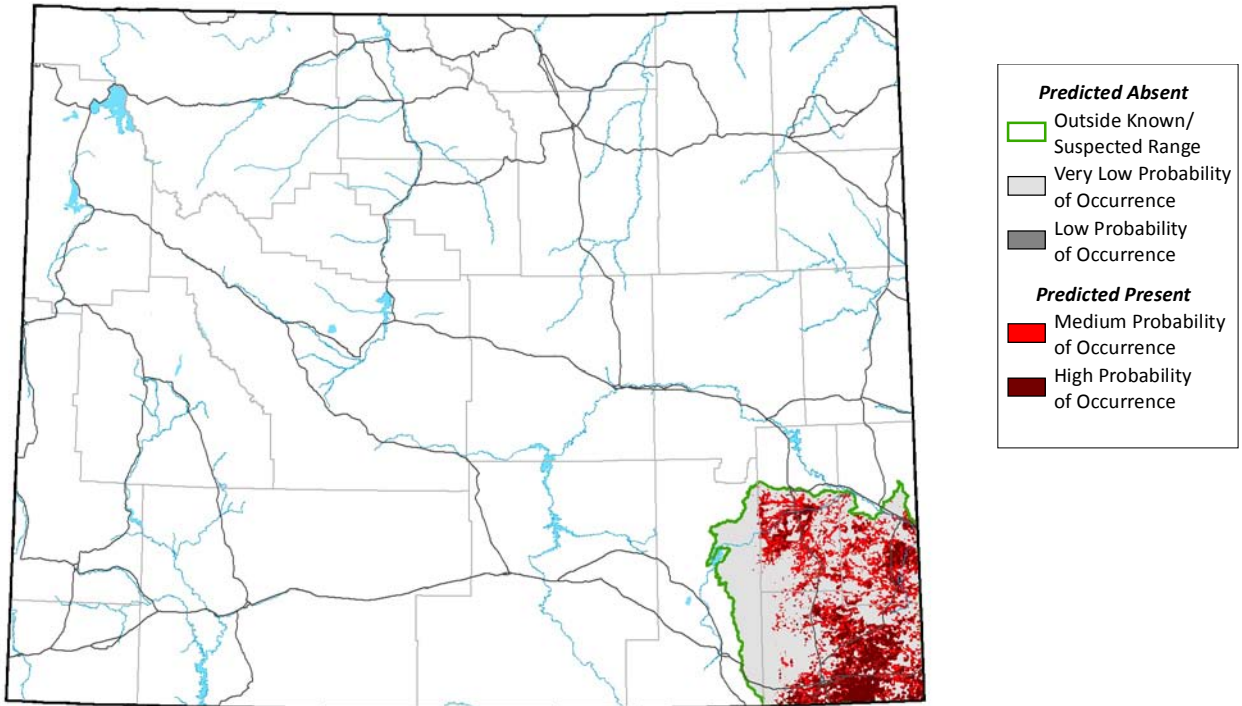
Doug Keinath, Senior Zoologist

Mark Andersen, GIS Specialist

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Distribution Model (Version: Sat Dec 05 08:51:22 MST 2009)

Details of distribution model creation are presented in Keinath et al. (2010b)

Predicted Absent
- Outside Known/ Suspected Range
- Very Low Probability of Occurrence
- Low Probability of Occurrence

Predicted Present
- Medium Probability of Occurrence
- High Probability of Occurrence

Model Parameters

- Season Modeled: Year-Round
- Algorithm: Maxent version 3.3.1
- Feature Types: Linear
- Binary Threshold Rule: Maximum training sensitivity plus specificity
- Binary Threshold Value: 0.4525850
- High-Probability Threshold Value: 0.6520455
- Low-Probability Threshold Value: 0.4525850

Model Evaluation - ROC Plot

- Mean
- Mean ± 1 SD
- Random Prediction

Model Quality Summary

Overall Assessment of Model Quality: LOW

Expert Assessment: Low
Occurrence Sample Size: Low
Quality of Occurrences: Low
Positive Success Rate: Low
Test AUC and Model Gain: Low
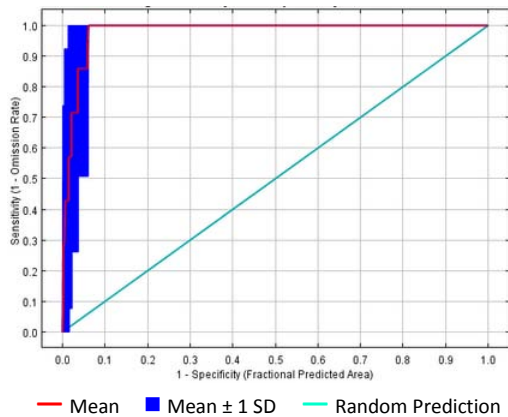
Model Evaluation Statistics
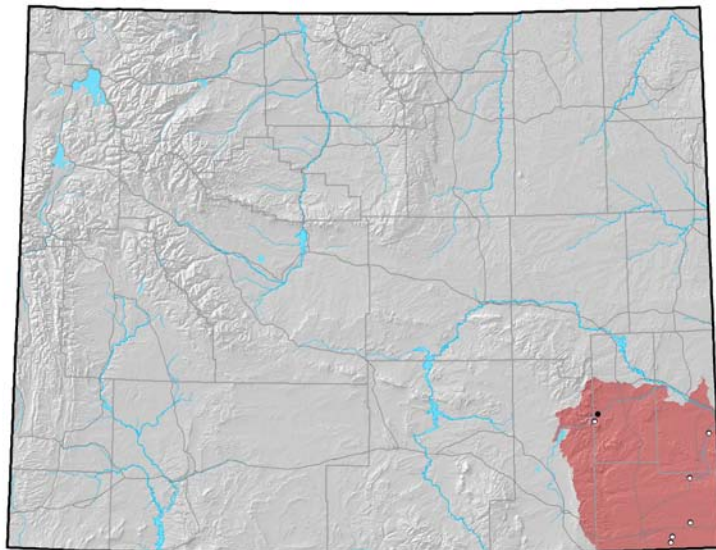
Final Model Statistics

Training AUC: 0.989
Regularized Training Gain: 2.535

Cross-Validation Statistics

- Average Test AUC: 0.687 ± 0.474
- Upper Bound on Test AUC: 0.961
- Average Test Gain: 1.904 ± 1.637
- Omission Error (fraction of test points omitted during 7-fold cross validation): 0.43± 0.53

Occurrence Data for Distribution Model

Occurrence Map

Points Used in Modeling, by Year of Observation
- Pre-1985
- 1985 or Later

Known and Suspected Range

Occurrence Summary Statistics

- Number of Occurrences in AWVED master dataset: 11
- Number of Occurrences used to create distribution model: 7
- Average Point Quality Index (highest quality is 12.00): 5.43 ± 1.40
- Most recent occurrence used: 1987
- Oldest occurrence used: 1940
- Occurrence File: LOCAL_SAMPLE_POINTS.csv

Comments

The model for this species is based on a small sample size of occurrence locations, which often results in low model quality. Collection of additional, high-quality occurrence locations could greatly improve the modeled distribution for this species.

References

Keinath, D.A., M.D. Andersen, and G.P Beauvais. 2010a. Range maps for Wyoming's species of greatest conservation need. Report prepared for the Wyoming Game and Fish Department by the Wyoming Natural Diversity Database, Laramie, Wyoming. January 19, 2010.

Keinath, D.A., M.D. Andersen, and G.P. Beauvais. 2010b. Range and modeled distribution of Wyoming's species of greatest conservation need. Report prepared by the Wyoming Natural Diversity Database, Laramie Wyoming for the Wyoming Game and Fish Department, Cheyenne, Wyoming and the U.S. Geological Survey, Fort Collins, Colorado. August 20, 2010.

# Predictor Variables used in the Distribution Model

Percent Contribution (PC) to final model

| Environmental Variable	PC
Coldest quarter mean temperature	63
Variation in monthly radiation	15
Herbaceous Cover Index	13
Contagion Index	9
Radiation of the darkest month	0
Wettest quarter mean temperature	0

Response Curves

Each curve shows dependence of predicted suitability on input values of a single predictor variable considering correlations with others. Suitability is on the vertical axis (units: probability). Variable values are on the horizontal axis (units based on inputs; see Keinath et al 2010b for details).
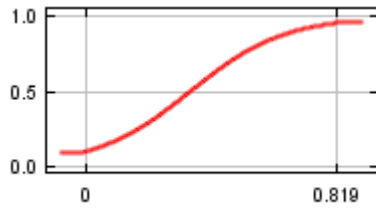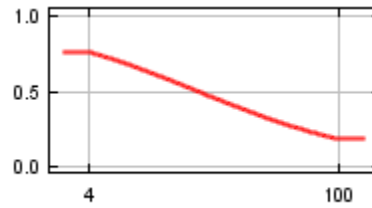
Coldest quarter mean temperature
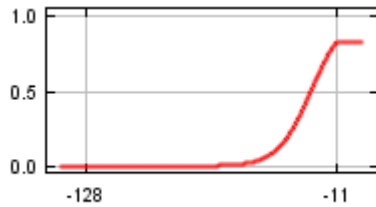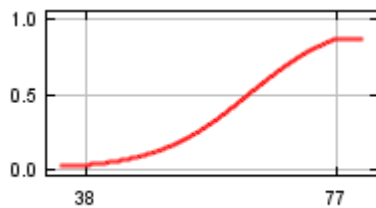

Variation in monthly radiation
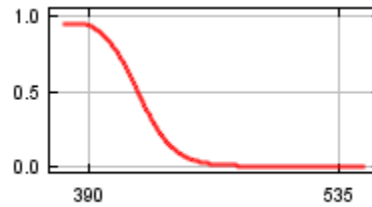
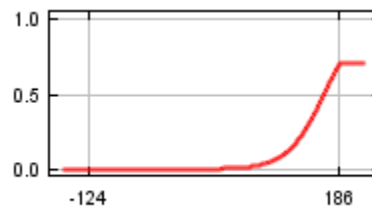**Herbaceous Cover Index**

Contagion Index

Radiation of the darkest month

**Wettest quarter mean temperature**

Greater Short-horned Lizard (*Phrynosoma hernandesi*) Range Map and Distribution Model Summary

August 20, 2010

This report presents range and distribution of Greater Short-horned Lizard (ARACF12080) in Wyoming (see Keinath et al. 2010b). Similar reports were developed by the Wyoming Natural Diversity Database for terrestrial vertebrate species of conservation need in Wyoming's State Wildlife Action Plan. This effort was supported by the Wyoming Game and Fish Department and the U.S. Geological Survey.
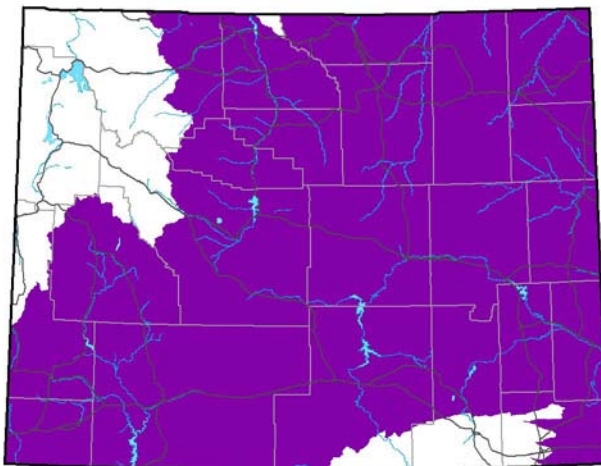
Range Map - Occupancy
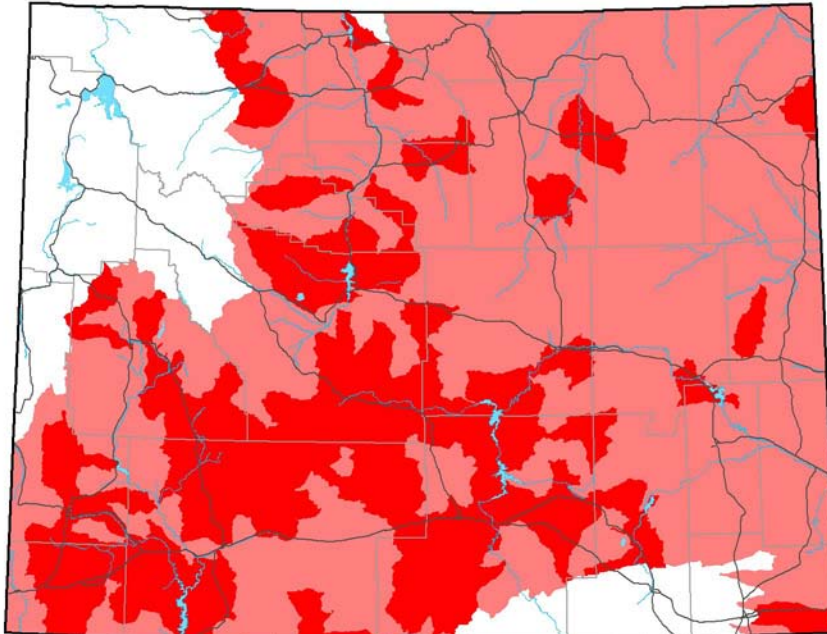
Known | Suspected | Accidental | Historical

Range Notes

- Version: 2010-01-19
- Proportion of range deemed known based on documented occurrences: 0.285
- Details of range map creation noted in Keinath et al. (2010a).

Range Map - Seasonality

Year-Round | Summer | Winter | Spring/Fall

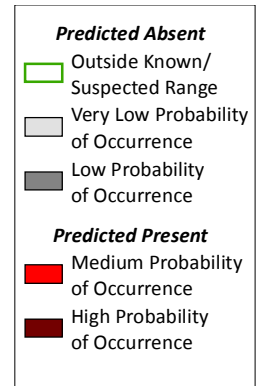Maps, models and report were created by and are available from the Wyoming Natural Diversity Database. (http://uwadmnweb.uwyo.edu/wyndd/).
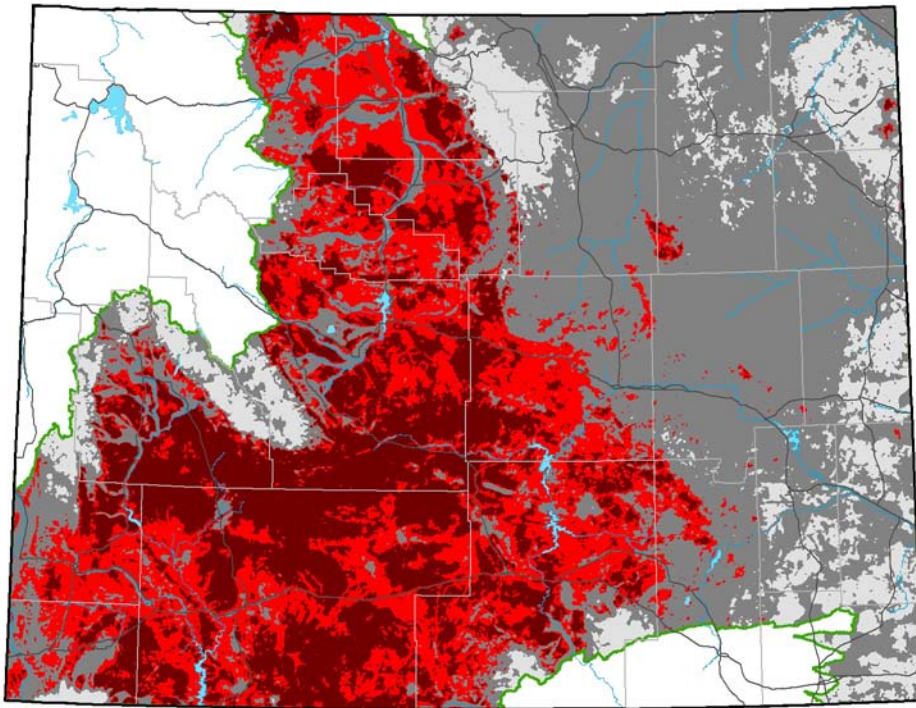
Doug Keinath, Senior Zoologist

Mark Andersen, GIS Specialist

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# Distribution Model (Version: Thu Apr 22 11:06:44 MDT 2010)

Details of distribution model creation are presented in Keinath et al. (2010b)

Predicted Absent
- Outside Known/ Suspected Range
- Very Low Probability of Occurrence
- Low Probability of Occurrence

Predicted Present
- Medium Probability of Occurrence
- High Probability of Occurrence

Model Parameters

- Season Modeled: Year-Round
- Algorithm: Maxent version 3.3.1
- Feature Types: Linear, Product
- Binary Threshold Rule: Maximum training sensitivity plus specificity
- Binary Threshold Value: 0.3602060
- High-Probability Threshold Value: 0.5386674
- Low-Probability Threshold Value: 0.0295598

Model Evaluation - ROC Plot

Mean ■ Mean ± 1 SD Random Prediction
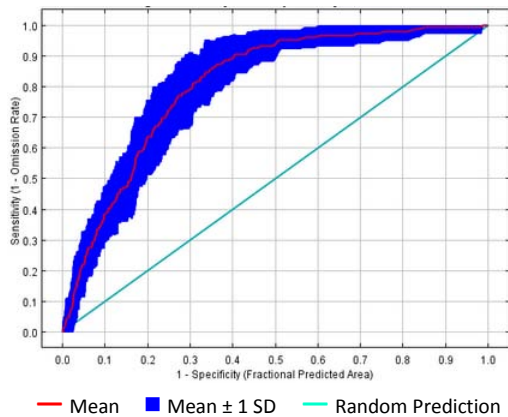
Model Quality Summary

Overall Assessment of Model Quality: HIGH
Expert Assessment: High
Occurrence Sample Size: High
Quality of Occurrences: High
Positive Success Rate: High
Test AUC and Model Gain: Medium

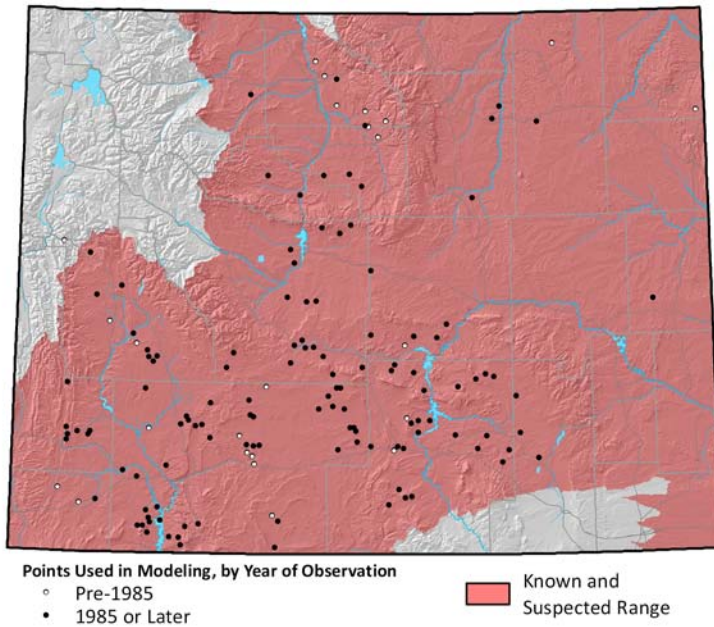## Model Evaluation Statistics

Final Model Statistics
Training AUC: 0.829
Regularized Training Gain: 0.729

Cross-Validation Statistics
- Average Test AUC: 0.808 ± 0.045
- Upper Bound on Test AUC: 0.817
- Average Test Gain: 0.605 ± 0.296
- Omission Error (fraction of test points omitted during 10-fold cross validation): 0.19± 0.13

Occurrence Data for Distribution Model

Occurrence Map

Points Used in Modeling, by Year of Observation
○ Pre-1985
• 1985 or Later

Known and Suspected Range

Occurrence Summary Statistics

- Number of Occurrences in AWVED master dataset: 184
- Number of Occurrences used to create distribution model: 148
- Average Point Quality Index (highest quality is 12.00): 8.11 ± 2.47
- Most recent occurrence used: 2008
- Oldest occurrence used: 1890
- Occurrence File: LOCAL_SAMPLE_POINTS_W_PDOG_2.csv

Comments

There are no additional comments specific to this species range map or distribution model.

References

Keinath, D.A., M.D. Andersen, and G.P Beauvais. 2010a. Range maps for Wyoming's species of greatest conservation need. Report prepared for the Wyoming Game and Fish Department by the Wyoming Natural Diversity Database, Laramie, Wyoming. January 19, 2010.

Keinath, D.A., M.D. Andersen, and G.P. Beauvais. 2010b. Range and modeled distribution of Wyoming's species of greatest conservation need. Report prepared by the Wyoming Natural Diversity Database, Laramie Wyoming for the Wyoming Game and Fish Department, Cheyenne, Wyoming and the U.S. Geological Survey, Fort Collins, Colorado. August 20, 2010.

## Predictor Variables used in the Distribution Model

Percent Contribution (PC) to final model

| Environmental Variable	PC
Bare Ground Index	37
Precipitation of the warmest quarter	19
Sagebrush Index	19
Forest Cover Index	10
Distance to Permanent Standing Water	8
Variation in monthly Relative Humidity	6

Response Curves

Each curve shows dependence of predicted suitability on input values of a single predictor variable considering correlations with others. Suitability is on the vertical axis (units: probability). Variable values are on the horizontal axis (units based on inputs; see Keinath et al 2010b for details).
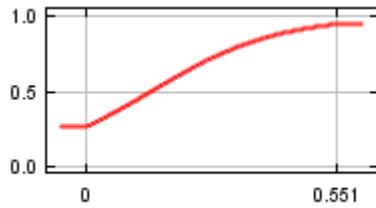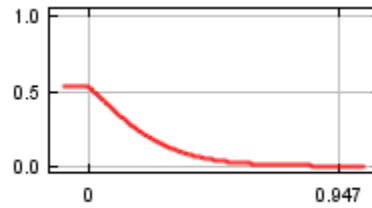
Bare Ground Index
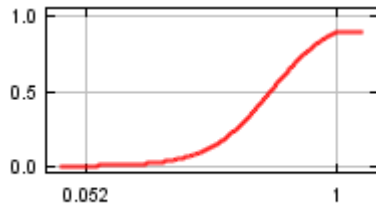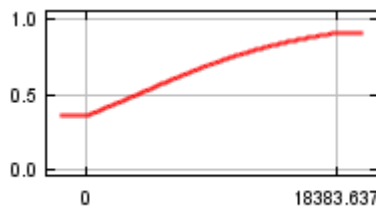

Precipitation of the warmest quarter
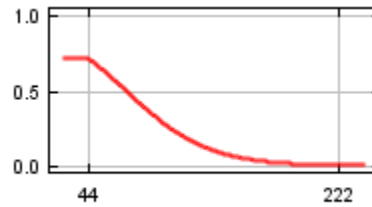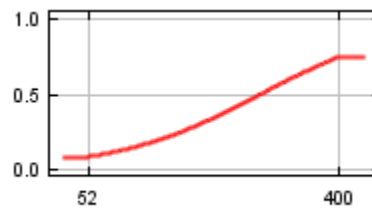

Sagebrush Index

Forest Cover Index

Distance to Permanent Standing Water

**Variation in monthly Relative Humidity**

Northern Sagebrush Lizard (*Sceloporus graciosus graciosus*)
Range Map and Distribution Model Summary

August 20, 2010

This report presents range and distribution of Northern Sagebrush Lizard (ARACF14030) in Wyoming (see Keinath et al. 2010b). Similar reports were developed by the Wyoming Natural Diversity Database for terrestrial vertebrate species of conservation need in Wyoming's State Wildlife Action Plan. This effort was supported by the Wyoming Game and Fish Department and the U.S. Geological Survey.

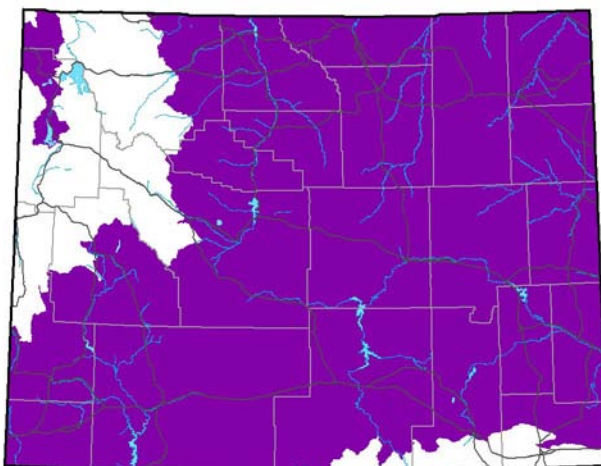### Range Map - Occupancy
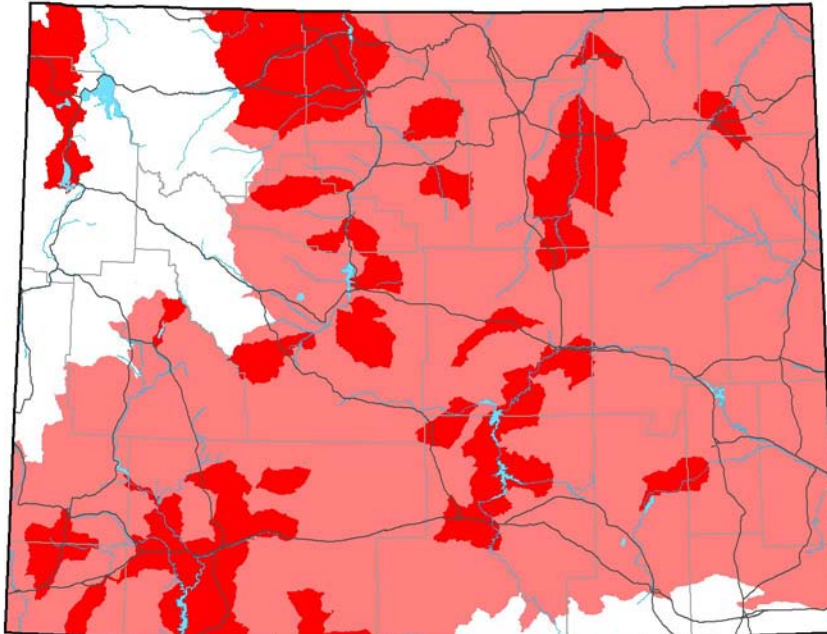
Known   Suspected   Accidental   Historical

Range Notes
- Version: 2010-01-19
- Proportion of range deemed known based on documented occurrences: 0.194
- Details of range map creation noted in Keinath et al. (2010a).

Range Map - Seasonality

Year-Round   Summer   Winter   Spring/Fall

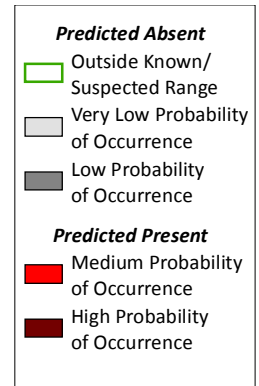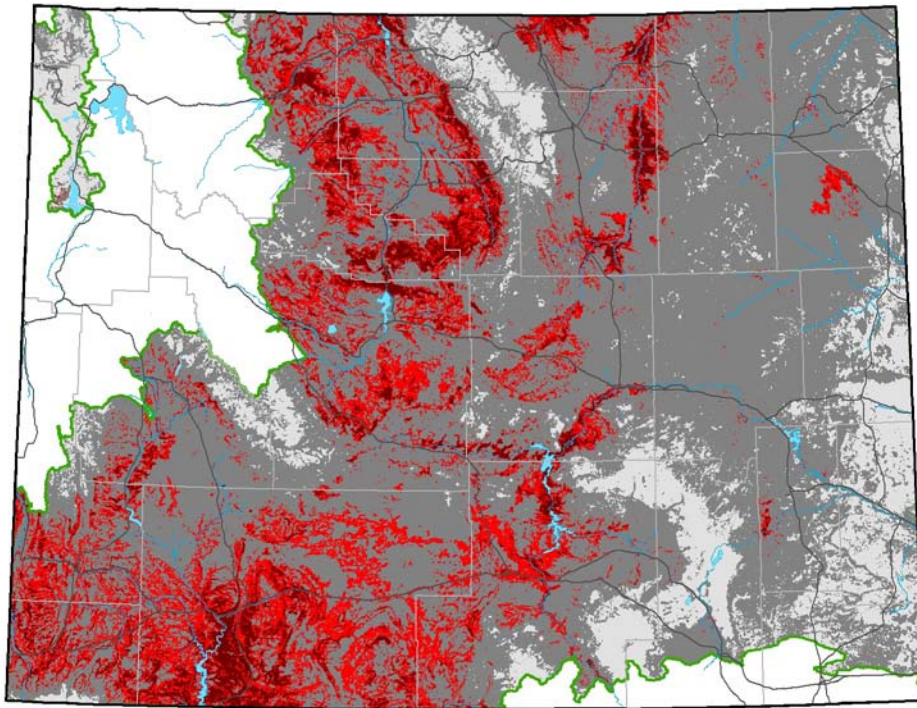Maps, models and report were created by and are available from the Wyoming Natural Diversity Database. (http://uwadmnweb.uwyo.edu/wyndd/).

Doug Keinath, Senior Zoologist

Mark Andersen, GIS Specialist

© 2010, WYNDD

# Distribution Model (Version: Tue Mar 16 21:48:27 MDT 2010)

Details of distribution model creation are presented in Keinath et al. (2010b)

Predicted Absent

☐ Outside Known/ Suspected Range

☐ Very Low Probability of Occurrence

■ Low Probability of Occurrence

Predicted Present

■ Medium Probability of Occurrence

■ High Probability of Occurrence

Model Parameters

- Season Modeled: Year-Round
- Algorithm: Maxent version 3.3.1
- Feature Types: Linear, Product, Quadratic, Hinge, Threshold
- Binary Threshold Rule: Maximum training sensitivity plus specificity
- Binary Threshold Value: 0.2881990
- High-Probability Threshold Value: 0.5325928
- Low-Probability Threshold Value: 0.0050249

Model Evaluation - ROC Plot
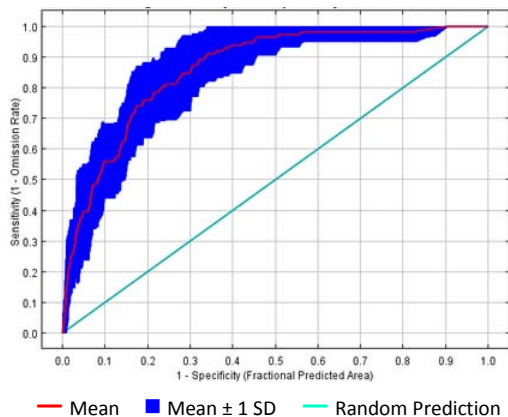
— Mean   ■ Mean ± 1 SD   — Random Prediction

Model Quality Summary

Overall Assessment of Model Quality: HIGH

Expert Assessment: Medium
Occurrence Sample Size: High
Quality of Occurrences: High
Positive Success Rate: High
Test AUC and Model Gain: Medium

Model Evaluation Statistics

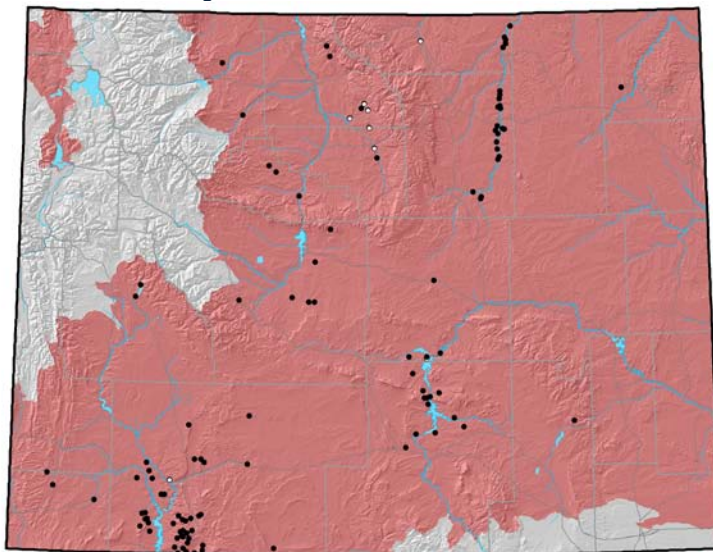### Final Model Statistics

Training AUC: 0.902
Regularized Training Gain: 1.163

Cross-Validation Statistics

- Average Test AUC: 0.861 ± 0.051
- Upper Bound on Test AUC: 0.870
- Average Test Gain: 0.974 ± 0.419
- Omission Error (fraction of test points omitted during 10-fold cross validation): 0.19± 0.13

Occurrence Data for Distribution Model

Occurrence Map

Points Used in Modeling, by Year of Observation
∘ Pre-1985
• 1985 or Later

Known and Suspected Range

Occurrence Summary Statistics

- Number of Occurrences in AWVED master dataset: 263
- Number of Occurrences used to create distribution model: 112
- Average Point Quality Index (highest quality is 12.00): 9.54 ± 3.00
- Most recent occurrence used: 2008
- Oldest occurrence used: 1910
- Occurrence File: LOCAL_SAMPLE_POINTS_W_PDOG_2.csv

Comments

This is a sagebrush obligate species for which model quality would likely improve if an accurate statewide estimate of sagebrush structure (i.e., density and/or height) were available. Conclusive identification of this species is difficult unless the observer is experienced with the species. We suspect numerous occurrences could be in error, thus resulting in lower than expected model quality. The lack of supporting data provided with many occurrences (notably those from the Wildlife Observation System) makes it impossible to assess the accuracy of such observations. Supplementation/replacement of the existing data set with high-quality occurrence locations could greatly improve the modeled distribution for this species.

References

Keinath, D.A., M.D. Andersen, and G.P Beauvais. 2010a. Range maps for Wyoming's species of greatest conservation need. Report prepared for the Wyoming Game and Fish Department by the Wyoming Natural Diversity Database, Laramie, Wyoming. January 19, 2010.

Keinath, D.A., M.D. Andersen, and G.P. Beauvais. 2010b. Range and modeled distribution of Wyoming's species of greatest conservation need. Report prepared by the Wyoming Natural Diversity Database, Laramie Wyoming for the Wyoming Game and Fish Department, Cheyenne, Wyoming and the U.S. Geological Survey, Fort Collins, Colorado. August 20, 2010.

Predictor Variables used in the Distribution Model

Percent Contribution (PC) to final model

| Environmental Variable	PC
Precipitation of the wettest month	53
Vector Ruggedness Measure	21
Pinon-Juniper Index	12
Contagion Index	8
Annual temperature range (T3 – T4)	3
Warmest quarter mean temperature	2

Response Curves

Each curve shows dependence of predicted suitability on input values of a single predictor variable considering correlations with others. Suitability is on the vertical axis (units: probability). Variable values are on the horizontal axis (units based on inputs; see Keinath et al 2010b for details).
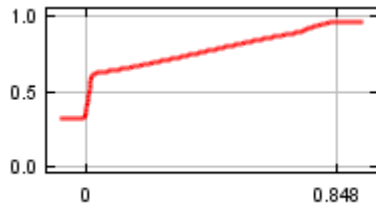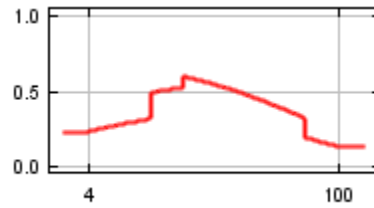
Precipitation of the wettest month
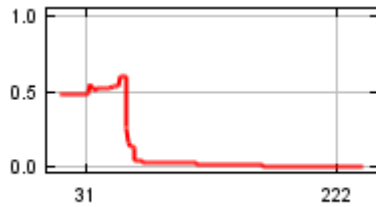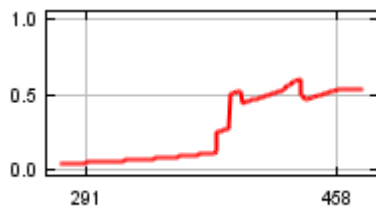
Vector Ruggedness Measure
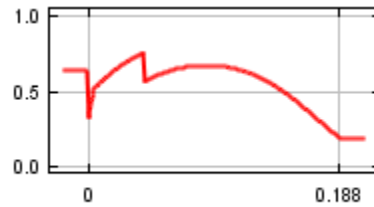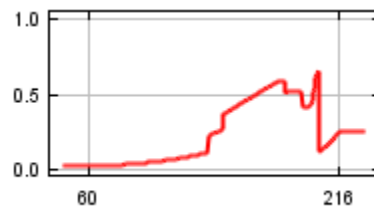
Pinon-Juniper Index

Contagion Index

Annual temperature range (T3 – T4)

Warmest quarter mean temperature

Plateau Fence Lizard (*Sceloporus tristichus*)
Range Map and Distribution Model Summary

August 20, 2010

This report presents range and distribution of Plateau Fence Lizard (ARACF14130Q) in Wyoming (see Keinath et al. 2010b). Similar reports were developed by the Wyoming Natural Diversity Database for terrestrial vertebrate species of conservation need in Wyoming's State Wildlife Action Plan. This effort was supported by the Wyoming Game and Fish Department and the U.S. Geological Survey.
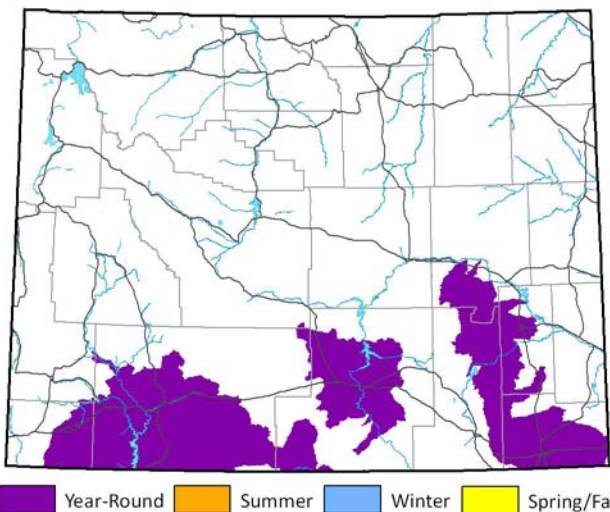
Range Map - Occupancy

Known   Suspected   Accidental   Historical
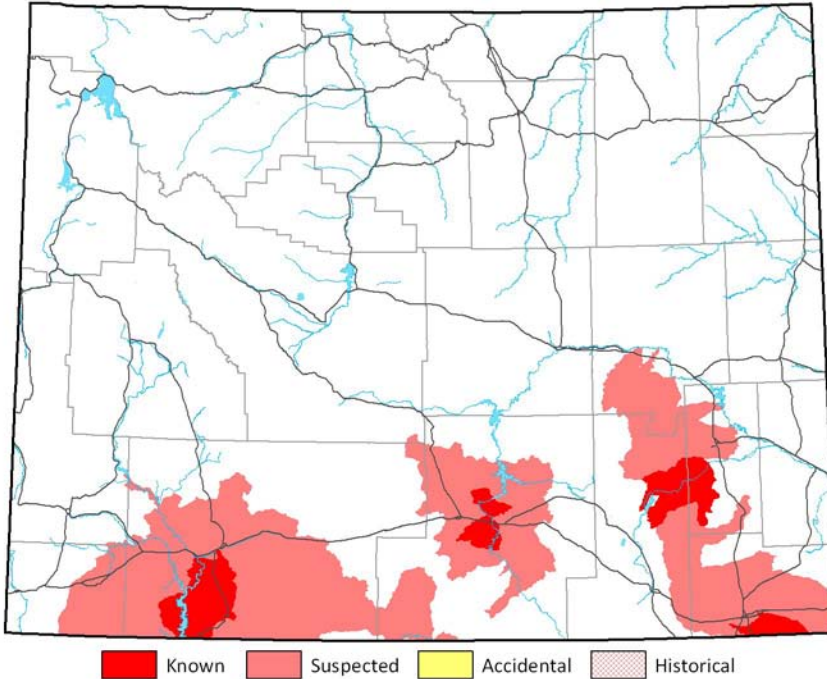
Range Notes
- Version: 2010-01-19
- Proportion of range deemed known based on documented occurrences: 0.145
- Details of range map creation noted in Keinath et al. (2010a).

Range Map - Seasonality

Year-Round   Summer   Winter   Spring/Fall

Maps, models and report were created by and are available from the Wyoming Natural Diversity Database. (http://uwadmnweb.uwyo.edu/wyndd/).
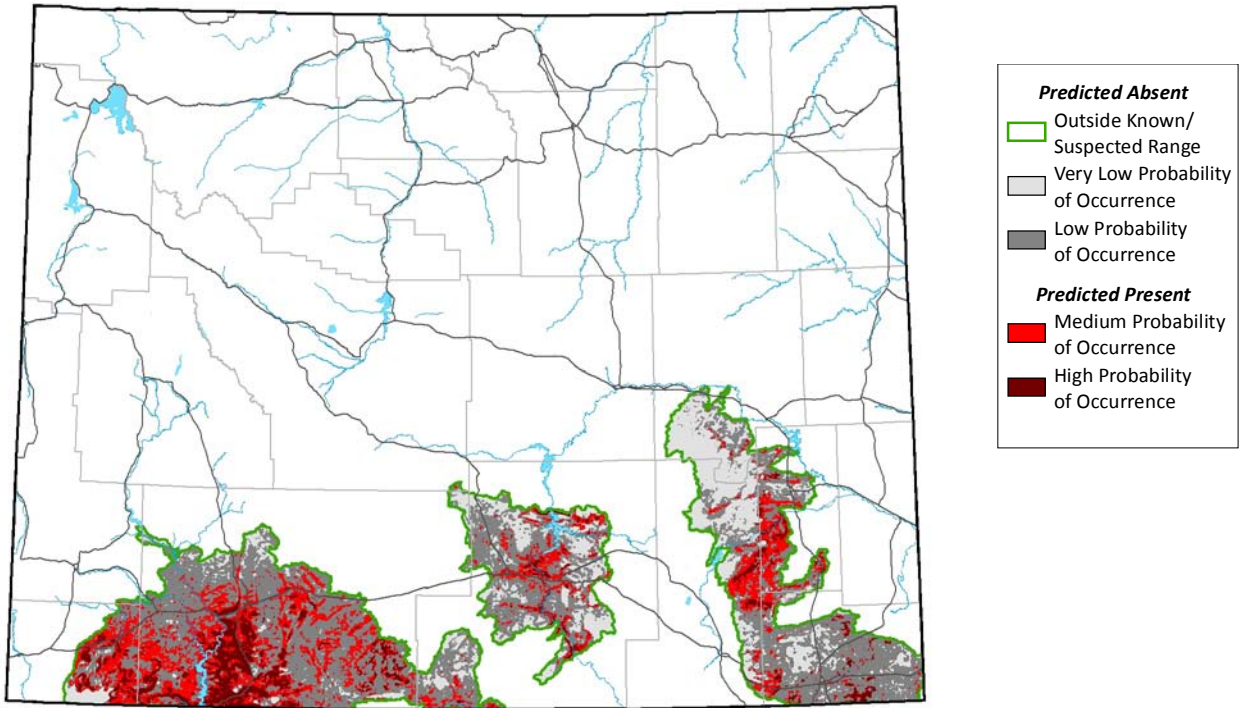
Doug Keinath, Senior Zoologist

Mark Andersen, GIS Specialist

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Distribution Model (Version: Wed Dec 09 16:12:26 MST 2009)

Details of distribution model creation are presented in Keinath et al. (2010b)

Predicted Absent
Outside Known/
Suspected Range
Very Low Probability
of Occurrence
Low Probability
of Occurrence

Predicted Present
Medium Probability
of Occurrence
High Probability
of Occurrence

Model Parameters

- Season Modeled: Year-Round
- Algorithm: Maxent version 3.3.1
- Feature Types: Linear, Quadratic, Hinge
- Binary Threshold Rule: Maximum training sensitivity plus specificity
- Binary Threshold Value: 0.3227750
- High-Probability Threshold Value: 0.6046611
- Low-Probability Threshold Value: 0.0660673

Model Evaluation - ROC Plot

— Mean   ■ Mean ± 1 SD   — Random Prediction

Model Quality Summary

Overall Assessment of Model Quality: LOW

Expert Assessment: Low
Occurrence Sample Size: Medium
Quality of Occurrences: Medium
Positive Success Rate: Medium
Test AUC and Model Gain: High
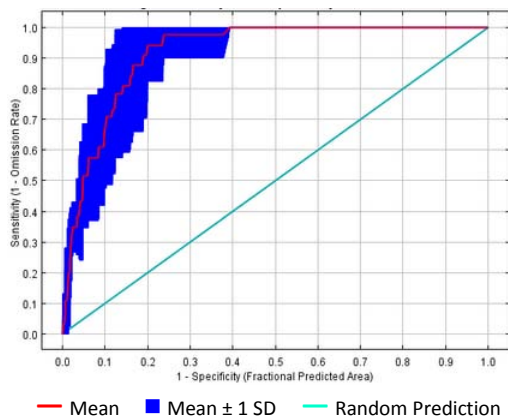
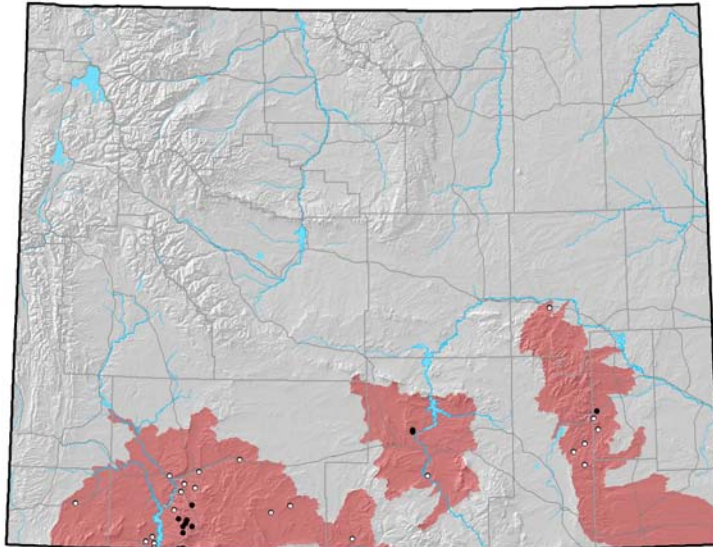## Model Evaluation Statistics

Final Model Statistics

Training AUC: 0.953
Regularized Training Gain: 1.674

Cross-Validation Statistics

- Average Test AUC: 0.919 ± 0.036
- Upper Bound on Test AUC: 0.921
- Average Test Gain: 1.431 ± 0.434
- Omission Error (fraction of test points omitted during 10-fold cross validation): 0.29± 0.23

Occurrence Data for Distribution Model

Occurrence Map

Points Used in Modeling, by Year of Observation
○ Pre-1985
• 1985 or Later

Known and Suspected Range

Occurrence Summary Statistics

- Number of Occurrences in AWVED master dataset: 155
- Number of Occurrences used to create distribution model: 34
- Average Point Quality Index (highest quality is 12.00): 7.26 ± 3.60
- Most recent occurrence used: 2006
- Oldest occurrence used: 1907
- Occurrence File: LOCAL_SAMPLE_POINTS.csv

Comments

Qualitative expert review of this model suggests that the binary version may over-predict the distribution of this species in Wyoming. Conclusive identification of this species is difficult unless the observer is experienced with the species. We suspect numerous occurrences could be in error, thus resulting in lower than expected model quality. The lack of supporting data provided with many occurrences (notably those from the Wildlife Observation System) makes it impossible to assess the accuracy of such observations. Supplementation/replacement of the existing data set with high-quality occurrence locations could greatly improve the modeled distribution for this species.

References

Keinath, D.A., M.D. Andersen, and G.P Beauvais. 2010a. Range maps for Wyoming's species of greatest conservation need. Report prepared for the Wyoming Game and Fish Department by the Wyoming Natural Diversity Database, Laramie, Wyoming. January 19, 2010.

Keinath, D.A., M.D. Andersen, and G.P. Beauvais. 2010b. Range and modeled distribution of Wyoming's species of greatest conservation need. Report prepared by the Wyoming Natural Diversity Database, Laramie Wyoming for the Wyoming Game and Fish Department, Cheyenne, Wyoming and the U.S. Geological Survey, Fort Collins, Colorado. August 20, 2010.

Predictor Variables used in the Distribution Model

Percent Contribution (PC) to final model

| Environmental Variable	PC
Pinon-Juniper Index	38
Radiation of the darkest month	19
Annual precipitation range (P3 – P2)	14
Conifer Index	12
Contagion Index	8
Coldest month mean minimum temperature	8

Response Curves

Each curve shows dependence of predicted suitability on input values of a single predictor variable considering correlations with others. Suitability is on the vertical axis (units: probability). Variable values are on the horizontal axis (units based on inputs; see Keinath et al 2010b for details).
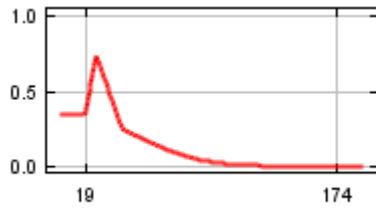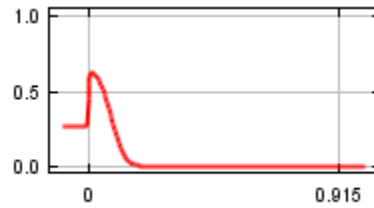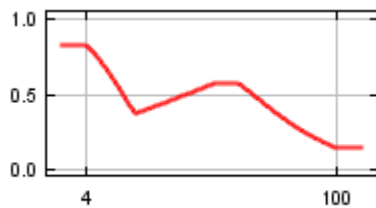
Pinon-Juniper Index
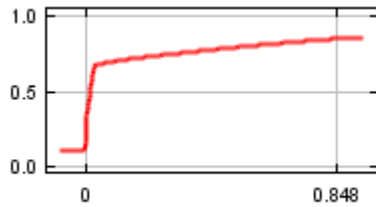
Radiation of the darkest month
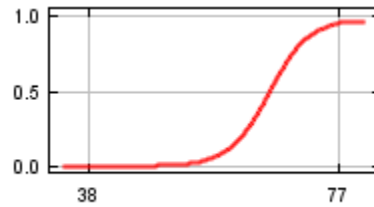
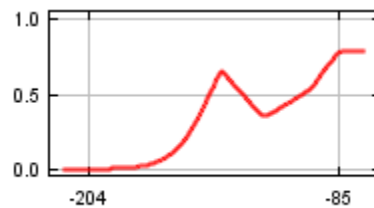**Annual precipitation range (P3 – P2)**

Conifer Index

Contagion Index

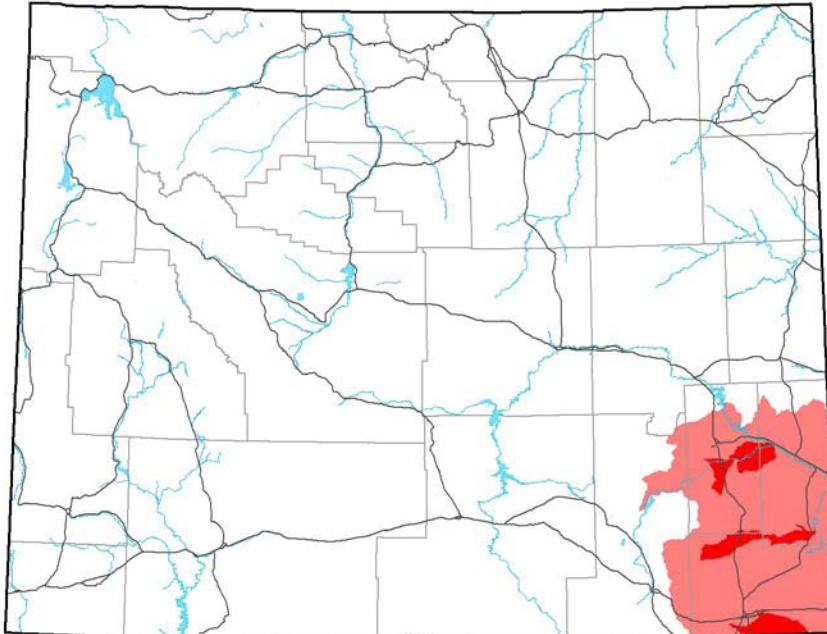**Coldest month mean minimum temperature**

Prairie Lizard (*Sceloporus consobrinus*)
Range Map and Distribution Model Summary

August 20, 2010

This report presents range and distribution of Prairie Lizard (ARACF14135) in Wyoming (see Keinath et al. 2010b). Similar reports were developed by the Wyoming Natural Diversity Database for terrestrial vertebrate species of conservation need in Wyoming's State Wildlife Action Plan. This effort was supported by the Wyoming Game and Fish Department and the U.S. Geological Survey.
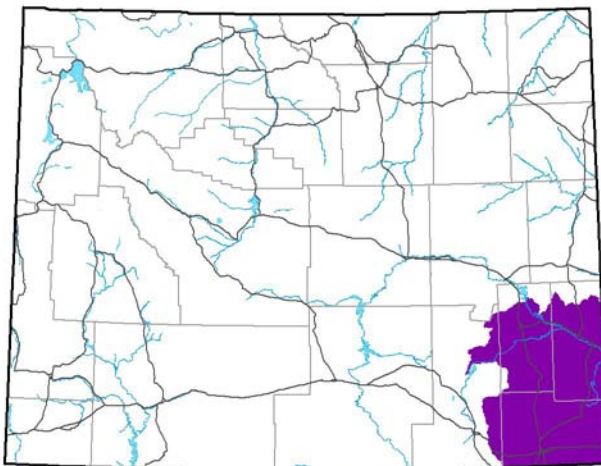
Range Map - Occupancy

Known   Suspected   Accidental   Historical

Range Notes
- Version: 2010-01-19
- Proportion of range deemed known based on documented occurrences: 0.114
- Details of range map creation noted in Keinath et al. (2010a).

Range Map - Seasonality

Year-Round   Summer   Winter   Spring/Fall

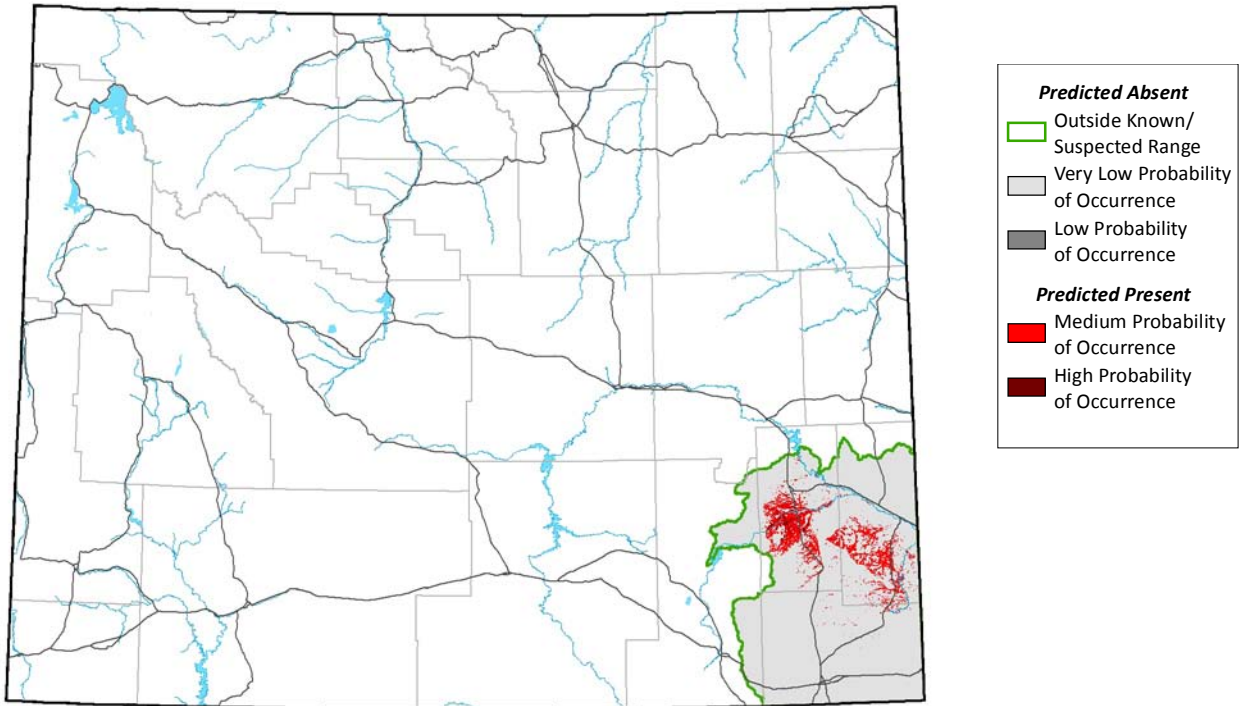Maps, models and report were created by and are available from the Wyoming Natural Diversity Database. (http://uwadmnweb.uwyo.edu/wyndd/).

Doug Keinath, Senior Zoologist

Mark Andersen, GIS Specialist

© 2010, WYNDD

Distribution Model (Version: Sat Dec 05 23:16:55 MST 2009)

Details of distribution model creation are presented in Keinath et al. (2010b)

Predicted Absent
- Outside Known/ Suspected Range
- Very Low Probability of Occurrence
- Low Probability of Occurrence

Predicted Present
- Medium Probability of Occurrence
- High Probability of Occurrence

Model Parameters

- Season Modeled: Year-Round
- Algorithm: Maxent version 3.3.1
- Feature Types: Linear
- Binary Threshold Rule: Maximum training sensitivity plus specificity
- Binary Threshold Value: 0.3366590
- High-Probability Threshold Value: 0.8023145
- Low-Probability Threshold Value: 0.3366590

Model Evaluation - ROC Plot

— Mean   ■ Mean ± 1 SD   — Random Prediction

Model Quality Summary

Overall Assessment of Model Quality: LOW

Expert Assessment: Low
Occurrence Sample Size: Very Low
Quality of Occurrences: Medium
Positive Success Rate: Low
Test AUC and Model Gain: Low
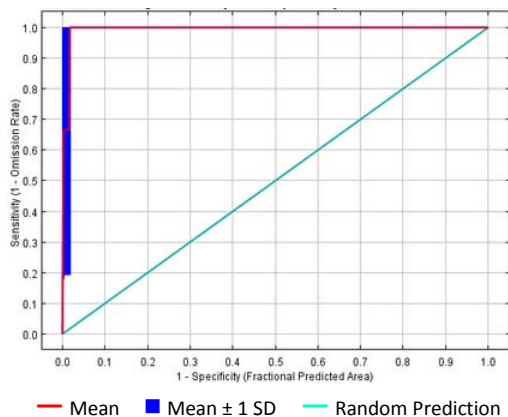
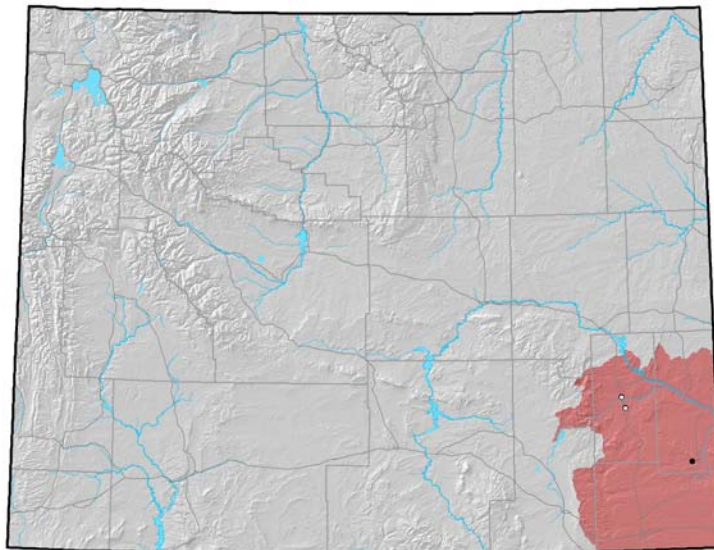## Model Evaluation Statistics

Final Model Statistics

Training AUC: 0.995
Regularized Training Gain: 3.634

Cross-Validation Statistics

- Average Test AUC: 0.298 ± 0.480
- Upper Bound on Test AUC: 0.987
- Average Test Gain: 0.948 ± 1.918
- Omission Error (fraction of test points omitted during 3-fold cross validation): 0.33± 0.58

Occurrence Data for Distribution Model

Occurrence Map

Points Used in Modeling, by Year of Observation
  ○ Pre-1985
  • 1985 or Later

Known and Suspected Range

Occurrence Summary Statistics

- Number of Occurrences in AWVED master dataset: 5
- Number of Occurrences used to create distribution model: 3
- Average Point Quality Index (highest quality is 12.00): 7.00 ± 1.73
- Most recent occurrence used: 2000
- Oldest occurrence used: 1941
- Occurrence File: LOCAL_SAMPLE_POINTS.csv

Comments

The model for this species is based on a small sample size of occurrence locations, which often results in low model quality. Collection of additional, high-quality occurrence locations could greatly improve the modeled distribution for this species.

References

Keinath, D.A., M.D. Andersen, and G.P Beauvais. 2010a. Range maps for Wyoming's species of greatest conservation need. Report prepared for the Wyoming Game and Fish Department by the Wyoming Natural Diversity Database, Laramie, Wyoming. January 19, 2010.

Keinath, D.A., M.D. Andersen, and G.P. Beauvais. 2010b. Range and modeled distribution of Wyoming's species of greatest conservation need. Report prepared by the Wyoming Natural Diversity Database, Laramie Wyoming for the Wyoming Game and Fish Department, Cheyenne, Wyoming and the U.S. Geological Survey, Fort Collins, Colorado. August 20, 2010.

# Predictor Variables used in the Distribution Model

Percent Contribution (PC) to final model

| Environmental Variable	PC
Coldest quarter mean temperature	52
Isothermality (T2/T5)	16
Depth to Shallowest Restrictive Layer	13
Coldest month mean minimum temperature	10
Distance to Water	6
Vector Ruggedness Measure	4

Response Curves

Each curve shows dependence of predicted suitability on input values of a single predictor variable considering correlations with others. Suitability is on the vertical axis (units: probability). Variable values are on the horizontal axis (units based on inputs; see Keinath et al 2010b for details).
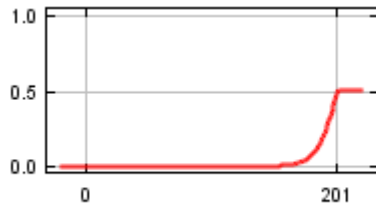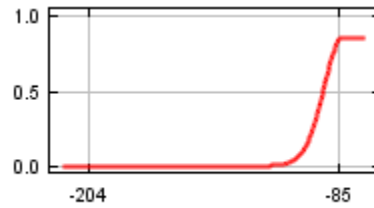
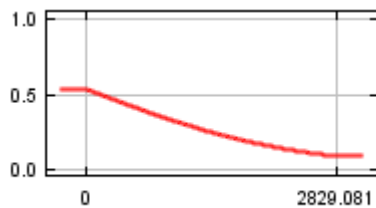**Coldest quarter mean temperature**
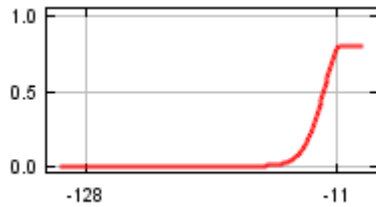
Isothermality (T2/T5)
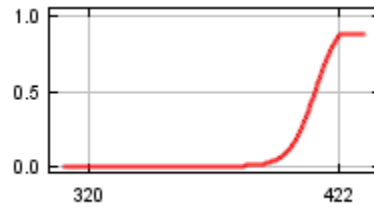
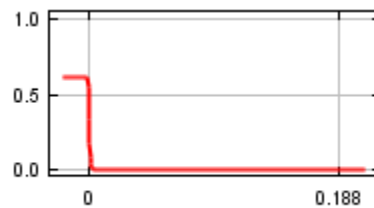**Depth to Shallowest Restrictive Layer**

Coldest month mean minimum temperature

Distance to Water
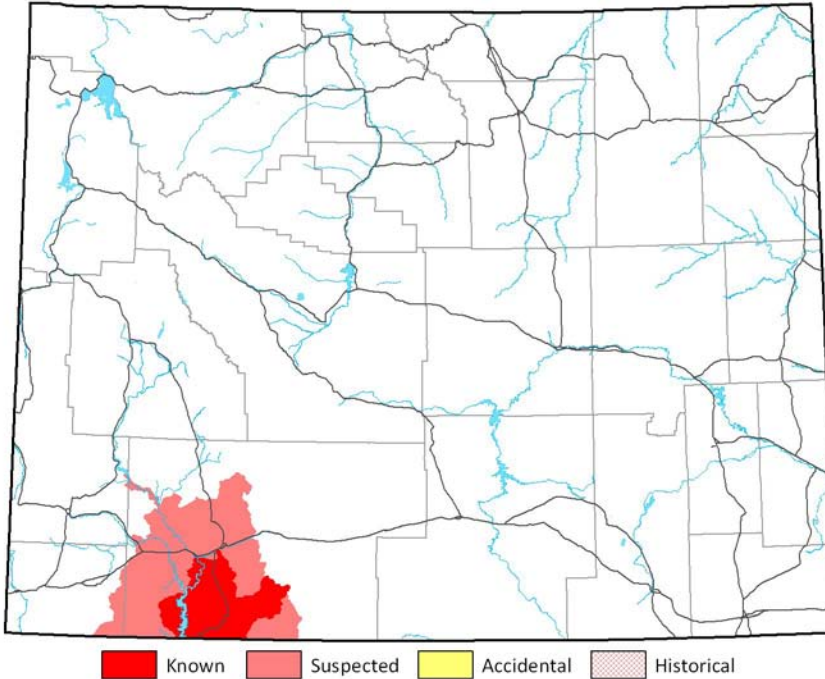

Vector Ruggedness Measure

Northern Tree Lizard (*Urosaurus ornatus wrighti*)
Range Map and Distribution Model Summary

August 20, 2010

This report presents range and distribution of Northern Tree Lizard (ARACF16030) in Wyoming (see Keinath et al. 2010b). Similar reports were developed by the Wyoming Natural Diversity Database for terrestrial vertebrate species of conservation need in Wyoming's State Wildlife Action Plan. This effort was supported by the Wyoming Game and Fish Department and the U.S. Geological Survey.
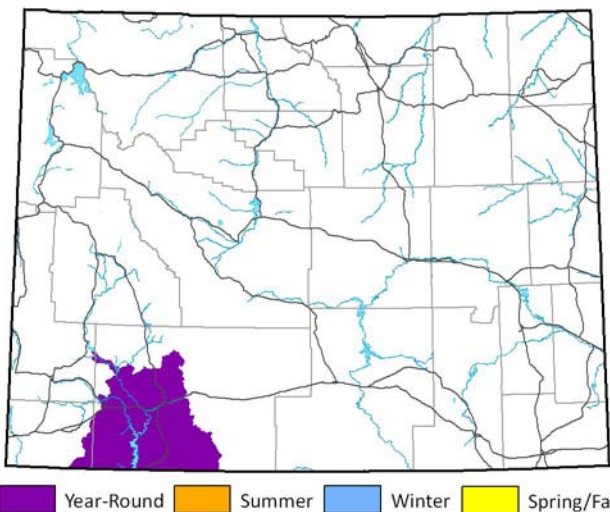
Range Map - Occupancy

Known   Suspected   Accidental   Historical

Range Notes

- Version: 2010-01-19
- Proportion of range deemed known based on documented occurrences: 0.375
- Details of range map creation noted in Keinath et al. (2010a).

Range Map - Seasonality

Year-Round   Summer   Winter   Spring/Fall

Maps, models and report were created by and are available from the Wyoming Natural Diversity Database. (http://uwadmnweb.uwyo.edu/wyndd/).
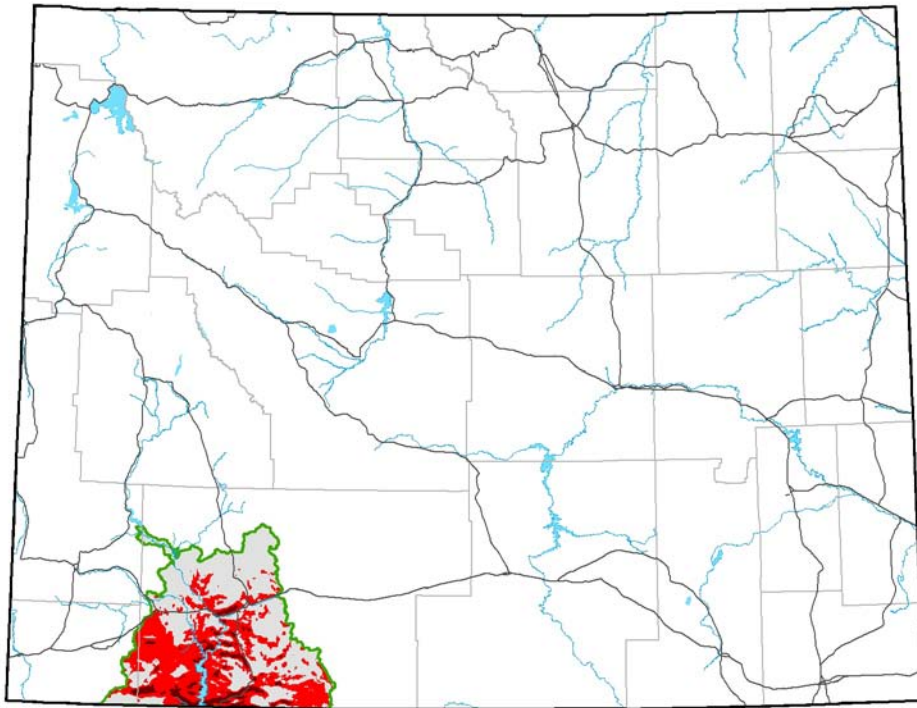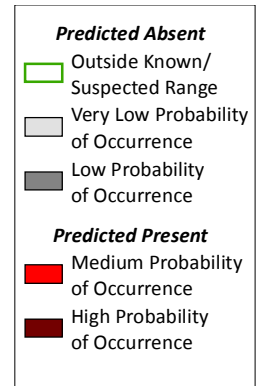
Doug Keinath, Senior Zoologist

Mark Andersen, GIS Specialist

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Distribution Model (Version: Wed Mar 17 03:05:28 MDT 2010)

Details of distribution model creation are presented in Keinath et al. (2010b)

Predicted Absent
- Outside Known/ Suspected Range
- Very Low Probability of Occurrence
- Low Probability of Occurrence

Predicted Present
- Medium Probability of Occurrence
- High Probability of Occurrence

Model Parameters

- Season Modeled: Year-Round
- Algorithm: Maxent version 3.3.1
- Feature Types: Linear, Quadratic
- Binary Threshold Rule: Maximum training sensitivity plus specificity
- Binary Threshold Value: 0.2181800
- High-Probability Threshold Value: 0.5923660
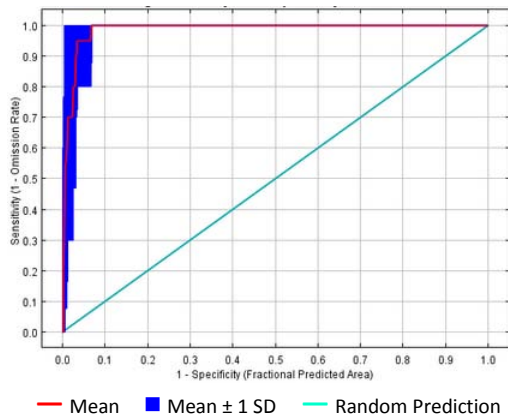- Low-Probability Threshold Value: 0.2181796

Model Evaluation - ROC Plot

— Mean   ■ Mean ± 1 SD   — Random Prediction

Model Quality Summary

Overall Assessment of Model Quality: MEDIUM

Expert Assessment: Medium
Occurrence Sample Size: Low
Quality of Occurrences: Medium
Positive Success Rate: Very High
Test AUC and Model Gain: High

Model Evaluation Statistics
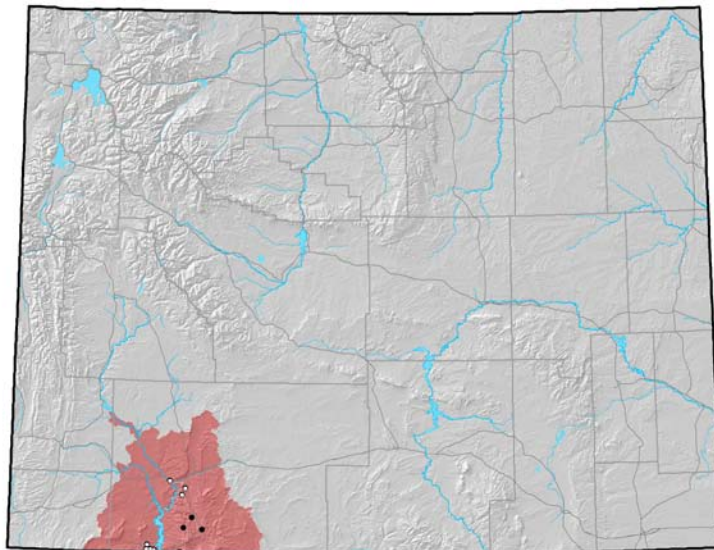
Final Model Statistics
Training AUC: 0.988
Regularized Training Gain: 2.768

Cross-Validation Statistics
- Average Test AUC: 0.986 ± 0.015
- Upper Bound on Test AUC: 0.967
- Average Test Gain: 3.105 ± 0.986
- Omission Error (fraction of test points omitted during 10-fold cross validation): 0.05± 0.16

Occurrence Data for Distribution Model

Occurrence Map

Points Used in Modeling, by Year of Observation
○ Pre-1985
• 1985 or Later

Known and Suspected Range

Occurrence Summary Statistics

- Number of Occurrences in AWVED master dataset: 62
- Number of Occurrences used to create distribution model: 13
- Average Point Quality Index (highest quality is 12.00): 7.62 ± 3.25
- Most recent occurrence used: 2006
- Oldest occurrence used: 1939
- Occurrence File: LOCAL_SAMPLE_POINTS_W_PDOG_2.csv

Comments

Conclusive identification of this species is difficult unless the observer is experienced with the species. We suspect numerous occurrences could be in error, thus resulting in lower than expected model quality. The lack of supporting data provided with many occurrences (notably those from the Wildlife Observation System) makes it impossible to assess the accuracy of such observations. Supplementation/replacement of the existing data set with high-quality occurrence locations could greatly improve the modeled distribution for this species.

References

Keinath, D.A., M.D. Andersen, and G.P Beauvais. 2010a. Range maps for Wyoming's species of greatest conservation need. Report prepared for the Wyoming Game and Fish Department by the Wyoming Natural Diversity Database, Laramie, Wyoming. January 19, 2010.

Keinath, D.A., M.D. Andersen, and G.P. Beauvais. 2010b. Range and modeled distribution of Wyoming's species of greatest conservation need. Report prepared by the Wyoming Natural Diversity Database, Laramie Wyoming for the Wyoming Game and Fish Department, Cheyenne, Wyoming and the U.S. Geological Survey, Fort Collins, Colorado. August 20, 2010.

# Predictor Variables used in the Distribution Model

Percent Contribution (PC) to final model

| Environmental Variable	PC
Radiation of the darkest month	63
Relative Humidity of most humid month	14
Wettest quarter mean temperature	11
Pinon-Juniper Index	7
Annual mean temperature	5
Warmest quarter mean temperature	0

Response Curves

Each curve shows dependence of predicted suitability on input values of a single predictor variable considering correlations with others. Suitability is on the vertical axis (units: probability). Variable values are on the horizontal axis (units based on inputs; see Keinath et al 2010b for details).
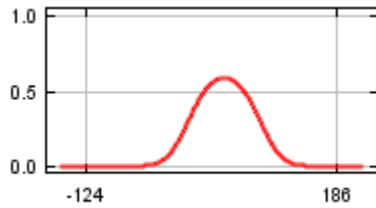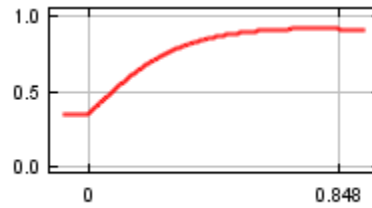
Radiation of the darkest month
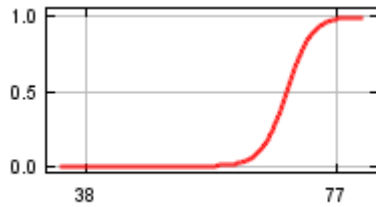
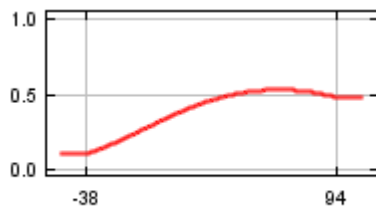**Relative Humidity of most humid month**
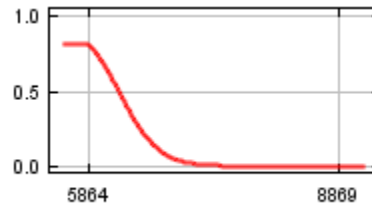
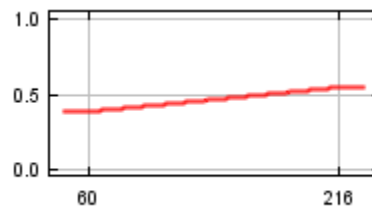**Wettest quarter mean temperature**

Pinon-Juniper Index

Annual mean temperature
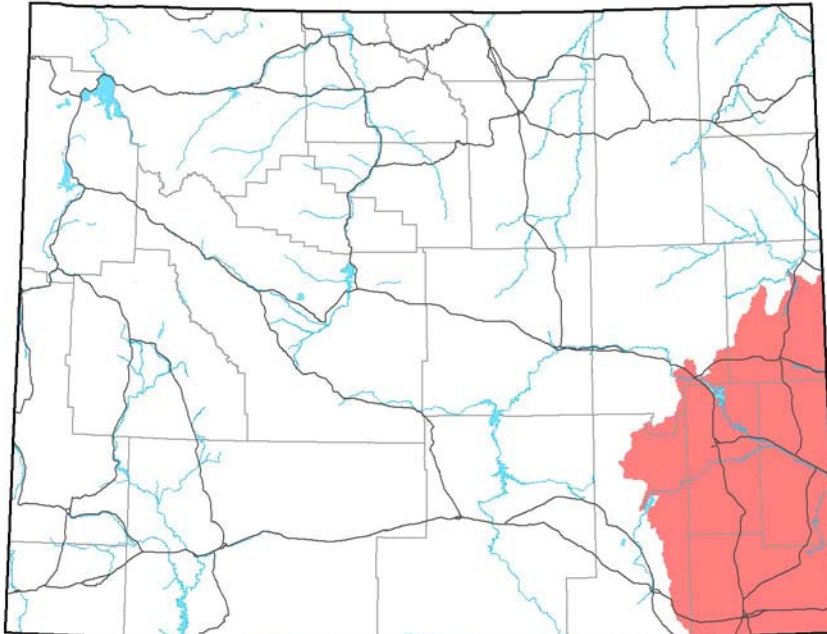
Warmest quarter mean temperature

Northern Many-lined Skink (*Eumeces multivirgatus*)
Range Map and Distribution Model Summary

August 20, 2010

This report presents range and distribution of Northern Many-lined Skink (ARACH01090) in Wyoming (see Keinath et al. 2010b). Similar reports were developed by the Wyoming Natural Diversity Database for terrestrial vertebrate species of conservation need in Wyoming's State Wildlife Action Plan. This effort was supported by the Wyoming Game and Fish Department and the U.S. Geological Survey.
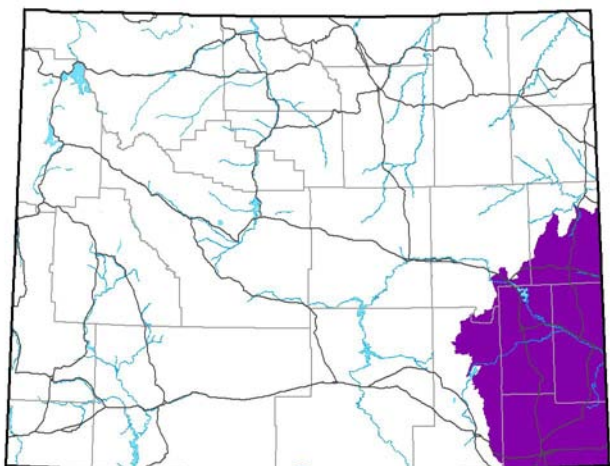
Range Map - Occupancy

Known   Suspected   Accidental   Historical

Range Notes
- Version: 2010-01-19
- Proportion of range deemed known based on documented occurrences: 0.000
- Details of range map creation noted in Keinath et al. (2010a).

Range Map - Seasonality

Year-Round   Summer   Winter   Spring/Fall

Maps, models and report were created by and are available from the Wyoming Natural Diversity Database. (http://uwadmnweb.uwyo.edu/wyndd/).
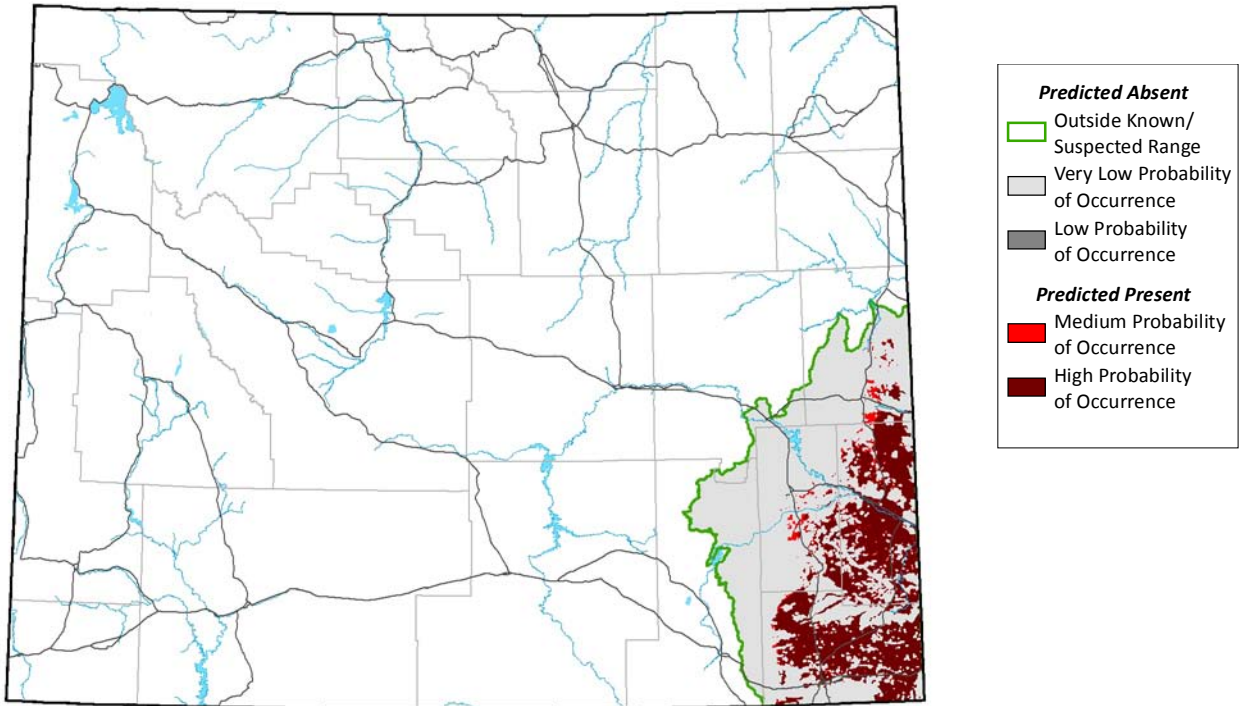
Doug Keinath, Senior Zoologist

Mark Andersen, GIS Specialist

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Distribution Model (Version: Sun Dec 06 05:53:44 MST 2009)

Details of distribution model creation are presented in Keinath et al. (2010b)

Predicted Absent
Outside Known/ Suspected Range
Very Low Probability of Occurrence
Low Probability of Occurrence

Predicted Present
Medium Probability of Occurrence
High Probability of Occurrence

Model Parameters

- Season Modeled: Year-Round
- Algorithm: Maxent version 3.3.1
- Feature Types: Linear
- Binary Threshold Rule: Maximum training sensitivity plus specificity
- Binary Threshold Value: 0.5308380
- High-Probability Threshold Value: 0.5563779
- Low-Probability Threshold Value: 0.5308380

Model Evaluation - ROC Plot

- Mean
- Mean ± 1 SD
- Random Prediction

Model Quality Summary

Overall Assessment of Model Quality: LOW

Expert Assessment: Low
Occurrence Sample Size: Low
Quality of Occurrences: Low
Positive Success Rate: Low
Test AUC and Model Gain: High
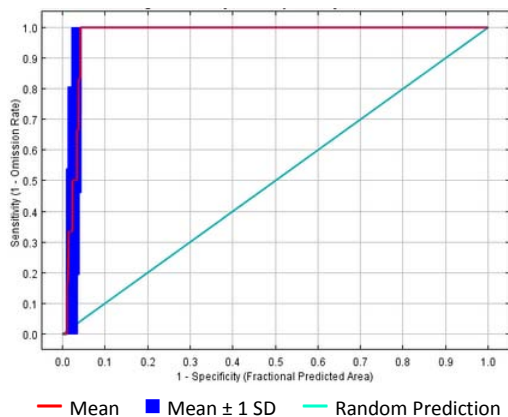
Model Evaluation Statistics

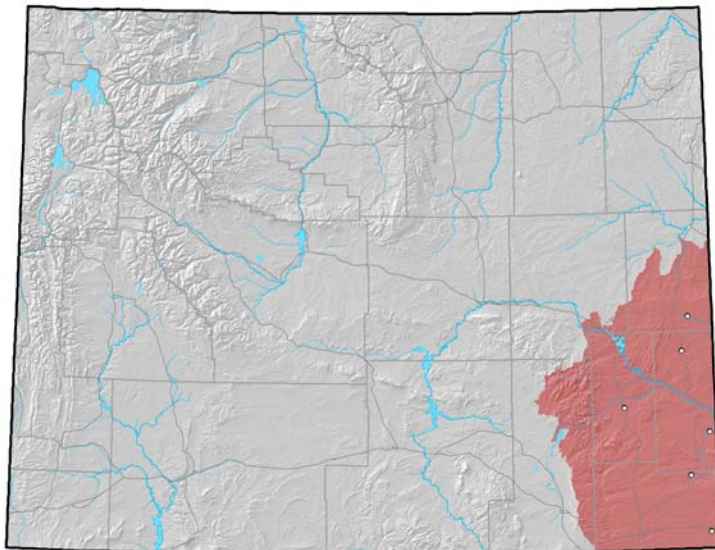### Final Model Statistics

Training AUC: 0.982
Regularized Training Gain: 2.660

Cross-Validation Statistics

- Average Test AUC: 0.973 ± 0.503
- Upper Bound on Test AUC: 0.974
- Average Test Gain: 1.600 ± 1.422
- Omission Error (fraction of test points omitted during 6-fold cross validation): 0.50± 0.55

Occurrence Data for Distribution Model

Occurrence Map

Points Used in Modeling, by Year of Observation
○ Pre-1985
• 1985 or Later

Known and Suspected Range

Occurrence Summary Statistics

- Number of Occurrences in AWVED master dataset: 6
- Number of Occurrences used to create distribution model: 6
- Average Point Quality Index (highest quality is 12.00): 4.17 ± 0.41
- Most recent occurrence used: 1983
- Oldest occurrence used: 1940
- Occurrence File: LOCAL_SAMPLE_POINTS.csv

Comments

The model for this species is based on a small sample size of occurrence locations, which often results in low model quality. Collection of additional, high-quality occurrence locations could greatly improve the modeled distribution for this species.

References

Keinath, D.A., M.D. Andersen, and G.P Beauvais. 2010a. Range maps for Wyoming's species of greatest conservation need. Report prepared for the Wyoming Game and Fish Department by the Wyoming Natural Diversity Database, Laramie, Wyoming. January 19, 2010.

Keinath, D.A., M.D. Andersen, and G.P. Beauvais. 2010b. Range and modeled distribution of Wyoming's species of greatest conservation need. Report prepared by the Wyoming Natural Diversity Database, Laramie Wyoming for the Wyoming Game and Fish Department, Cheyenne, Wyoming and the U.S. Geological Survey, Fort Collins, Colorado. August 20, 2010.

# Predictor Variables used in the Distribution Model

Percent Contribution (PC) to final model

| Environmental Variable	PC
Wettest quarter mean temperature	41
Depth to Shallowest Restrictive Layer	22
Sagebrush Index	20
Variation in monthly radiation	13
Pinon-Juniper Index	4
Precipitation of the warmest quarter	0

Response Curves

Each curve shows dependence of predicted suitability on input values of a single predictor variable considering correlations with others. Suitability is on the vertical axis (units: probability). Variable values are on the horizontal axis (units based on inputs; see Keinath et al 2010b for details).
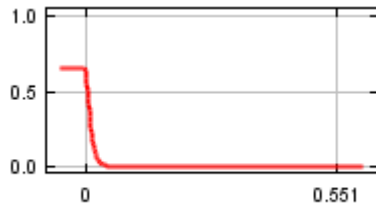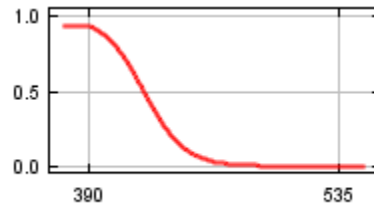
Wettest quarter mean temperature
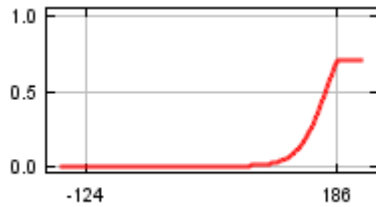
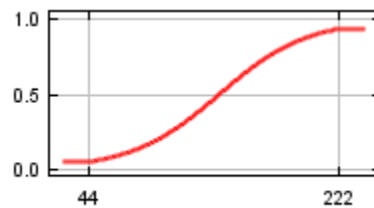**Depth to Shallowest Restrictive Layer**
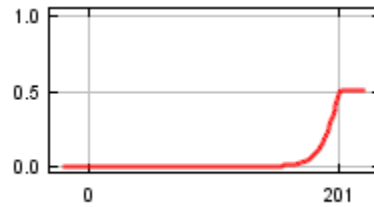
Sagebrush Index

Variation in monthly radiation

Pinon-Juniper Index

**Precipitation of the warmest quarter**

Great Basin Skink (*Plestiodon skiltonianus utahensis*)
Range Map and Distribution Model Summary

August 20, 2010

This report presents range and distribution of Great Basin Skink (ARACH01113) in Wyoming (see Keinath et al. 2010b). Similar reports were developed by the Wyoming Natural Diversity Database for terrestrial vertebrate species of conservation need in Wyoming's State Wildlife Action Plan. This effort was supported by the Wyoming Game and Fish Department and the U.S. Geological Survey.
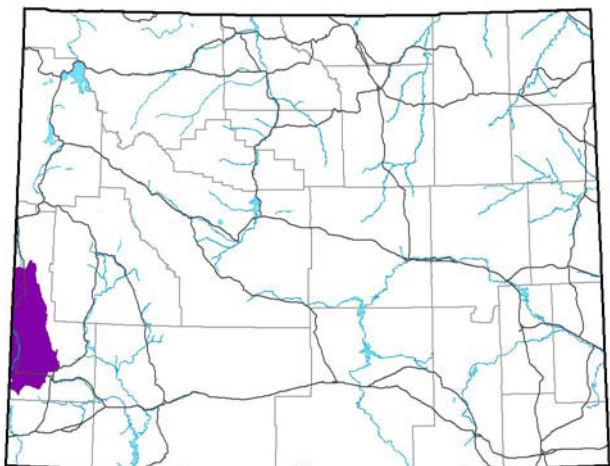
Range Map - Occupancy

Known | Suspected | Accidental | Historical
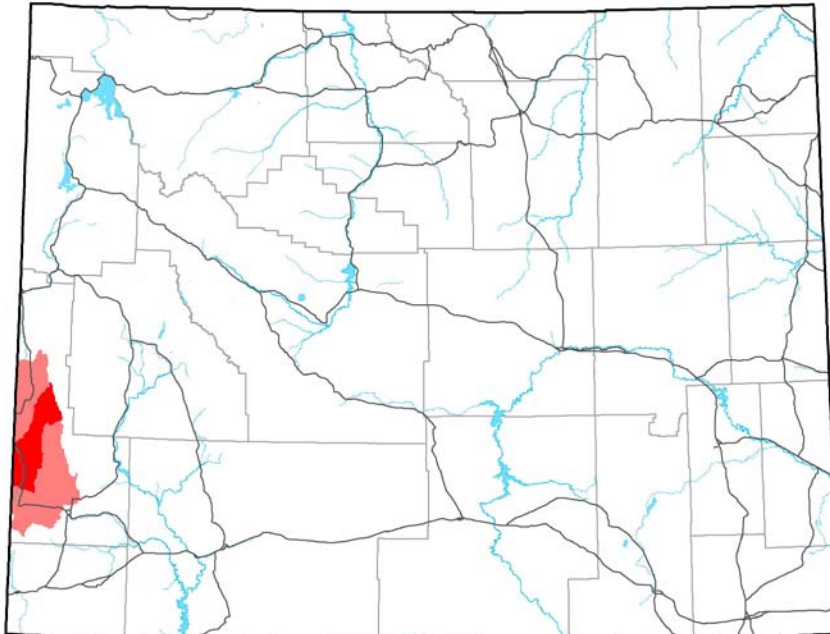
Range Notes
- Version: 2010-06-05
- Proportion of range deemed known based on documented occurrences: 0.286
- Details of range map creation noted in Keinath et al. (2010a).

Range Map - Seasonality

Year-Round | Summer | Winter | Spring/Fall

Maps, models and report were created by and are available from the Wyoming Natural Diversity Database. (http://uwadmnweb.uwyo.edu/wyndd/).

Doug Keinath, Senior Zoologist

Mark Andersen, GIS Specialist

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Comments

This species was first discovered in Wyoming in June 2010. There were too few occurrence points to construct a distribution model. Collection of additional, high-quality occurrence locations are necessary for assessment of potential distribution within Wyoming.

References

Keinath, D.A., M.D. Andersen, and G.P Beauvais. 2010a. Range maps for Wyoming's species of greatest conservation need. Report prepared for the Wyoming Game and Fish Department by the Wyoming Natural Diversity Database, Laramie, Wyoming. January 19, 2010.

Keinath, D.A., M.D. Andersen, and G.P. Beauvais. 2010b. Range and modeled distribution of Wyoming's species of greatest conservation need. Report prepared by the Wyoming Natural Diversity Database, Laramie Wyoming for the Wyoming Game and Fish Department, Cheyenne, Wyoming and the U.S. Geological Survey, Fort Collins, Colorado. August 20, 2010.

Prairie Racerunner (*Aspidoscelis sexlineatus viridis*)
Range Map and Distribution Model Summary

August 20, 2010

This report presents range and distribution of Prairie Racerunner (ARACJ02110) in Wyoming (see Keinath et al. 2010b). Similar reports were developed by the Wyoming Natural Diversity Database for terrestrial vertebrate species of conservation need in Wyoming's State Wildlife Action Plan. This effort was supported by the Wyoming Game and Fish Department and the U.S. Geological Survey.
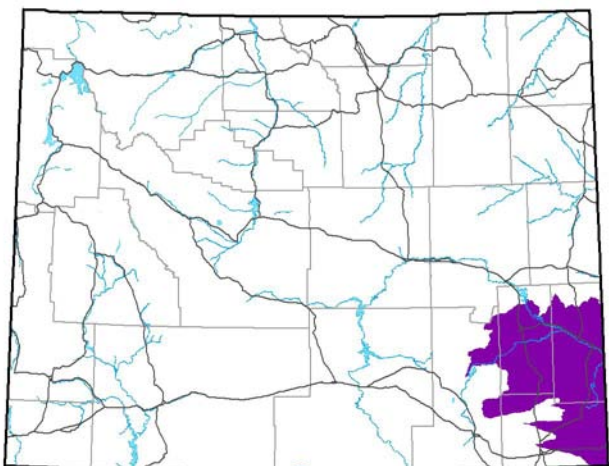
Range Map - Occupancy

Known | Suspected | Accidental | Historical
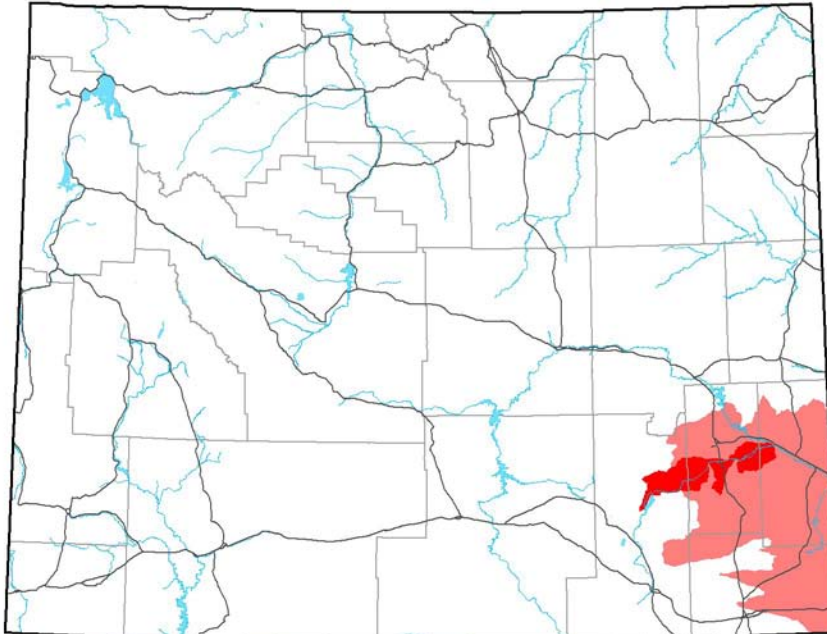
Range Notes
- Version: 2010-01-19
- Proportion of range deemed known based on documented occurrences: 0.077
- Details of range map creation noted in Keinath et al. (2010a).

Range Map - Seasonality

Year-Round | Summer | Winter | Spring/Fall

Maps, models and report were created by and are available from the Wyoming Natural Diversity Database. (http://uwadmnweb.uwyo.edu/wyndd/).
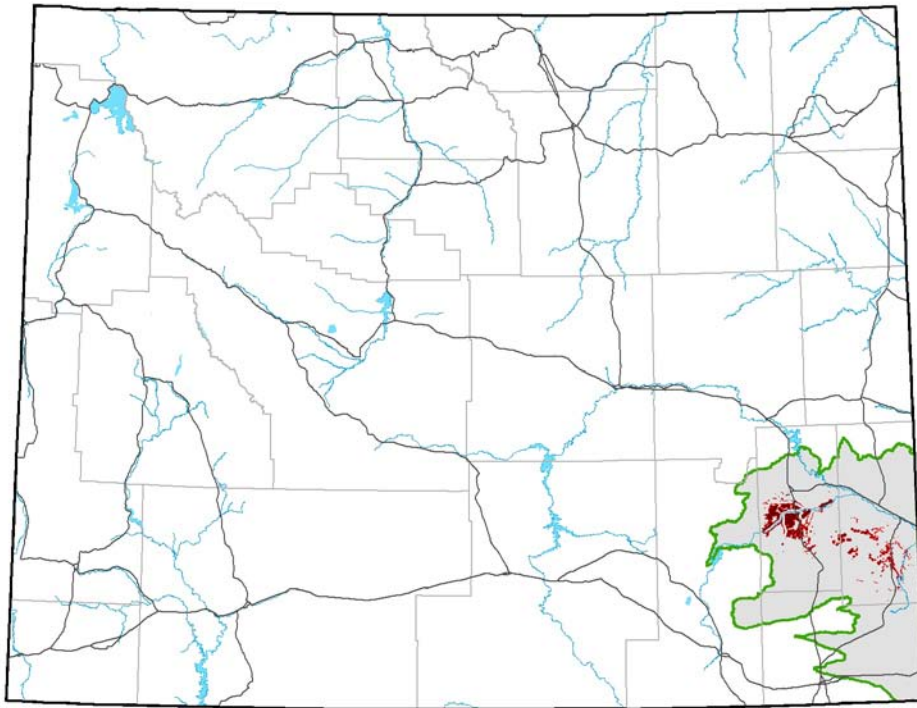
Doug Keinath, Senior Zoologist

Mark Andersen, GIS Specialist

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Distribution Model (Version: Fri Dec 04 11:54:04 MST 2009)

Details of distribution model creation are presented in Keinath et al. (2010b)

Predicted Absent
- Outside Known/ Suspected Range
- Very Low Probability of Occurrence
- Low Probability of Occurrence

Predicted Present
- Medium Probability of Occurrence
- High Probability of Occurrence

Model Parameters

- Season Modeled: Year-Round
- Algorithm: Maxent version 3.3.1
- Feature Types: Linear
- Binary Threshold Rule: Maximum training sensitivity plus specificity
- Binary Threshold Value: 0.5061240
- High-Probability Threshold Value: 0.6158926
- Low-Probability Threshold Value: 0.5061240

Model Evaluation - ROC Plot

— Mean   ■ Mean ± 1 SD   — Random Prediction

Model Quality Summary

Overall Assessment of Model Quality: LOW

Expert Assessment: Low
Occurrence Sample Size: Very Low
Quality of Occurrences: Low
Positive Success Rate: Low
Test AUC and Model Gain: Low
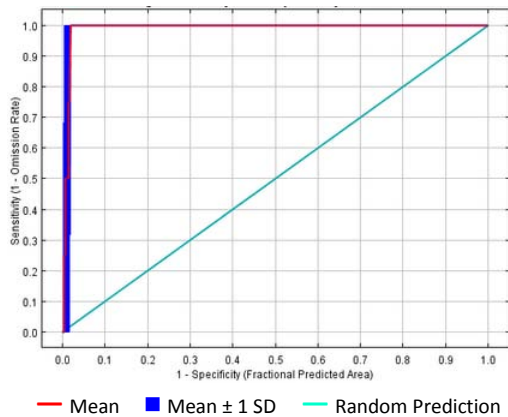
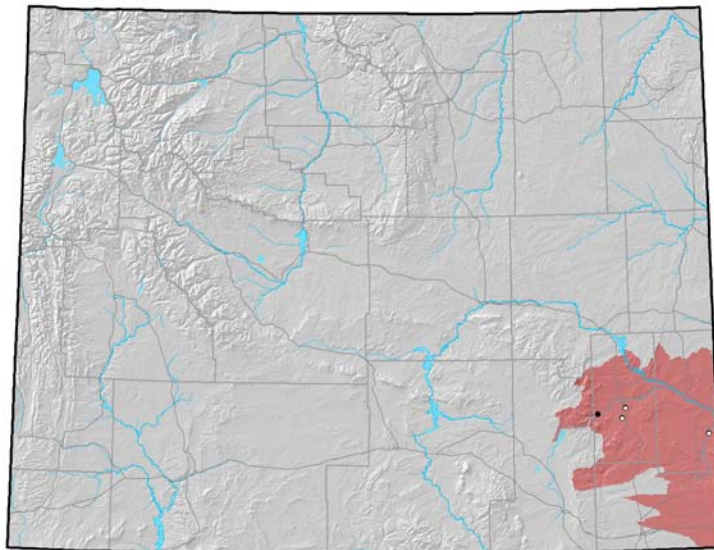## Model Evaluation Statistics

Final Model Statistics

Training AUC: 0.996
Regularized Training Gain: 3.749

Cross-Validation Statistics

- Average Test AUC: 0.396 ± 0.511
- Upper Bound on Test AUC: 0.990
- Average Test Gain: 1.241 ± 1.770
- Omission Error (fraction of test points omitted during 4-fold cross validation): 0.50± 0.58

Occurrence Data for Distribution Model

Occurrence Map

Points Used in Modeling, by Year of Observation
○ Pre-1985
• 1985 or Later

Known and Suspected Range

Occurrence Summary Statistics

- Number of Occurrences in AWVED master dataset: 44
- Number of Occurrences used to create distribution model: 4
- Average Point Quality Index (highest quality is 12.00): 4.50 ± 1.00
- Most recent occurrence used: 1987
- Oldest occurrence used: 1941
- Occurrence File: LOCAL_SAMPLE_POINTS.csv

Comments

The model for this species is based on a small sample size of occurrence locations, which often results in low model quality. Collection of additional, high-quality occurrence locations could greatly improve the modeled distribution for this species.

References

Keinath, D.A., M.D. Andersen, and G.P Beauvais. 2010a. Range maps for Wyoming's species of greatest conservation need. Report prepared for the Wyoming Game and Fish Department by the Wyoming Natural Diversity Database, Laramie, Wyoming. January 19, 2010.

Keinath, D.A., M.D. Andersen, and G.P. Beauvais. 2010b. Range and modeled distribution of Wyoming's species of greatest conservation need. Report prepared by the Wyoming Natural Diversity Database, Laramie Wyoming for the Wyoming Game and Fish Department, Cheyenne, Wyoming and the U.S. Geological Survey, Fort Collins, Colorado. August 20, 2010.

# Predictor Variables used in the Distribution Model

Percent Contribution (PC) to final model

Environmental Variable	PC
Coldest quarter mean temperature	72
Depth to Shallowest Restrictive Layer	12
Distance to Permanent Water	8
Isothermality (T2/T5)	3
Cottonwood Index	3
Coldest month mean minimum temperature	1

Response Curves

Each curve shows dependence of predicted suitability on input values of a single predictor variable considering correlations with others. Suitability is on the vertical axis (units: probability). Variable values are on the horizontal axis (units based on inputs; see Keinath et al 2010b for details).
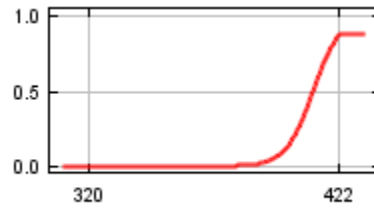
Coldest quarter mean temperature
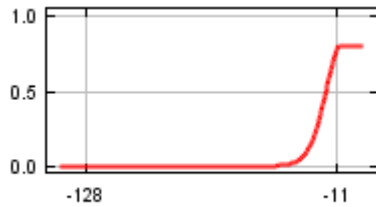
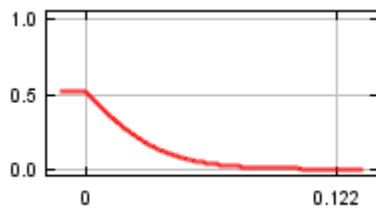**Depth to Shallowest Restrictive Layer**
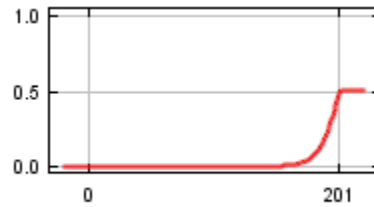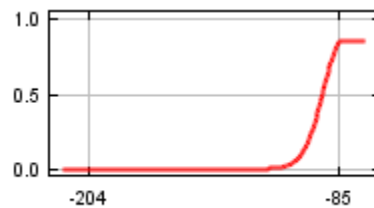

Distance to Permanent Water
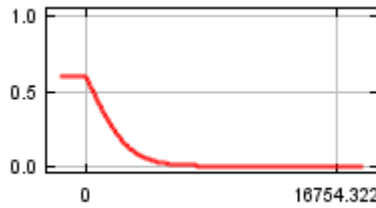
Isothermality (T2/T5)

Cottonwood Index

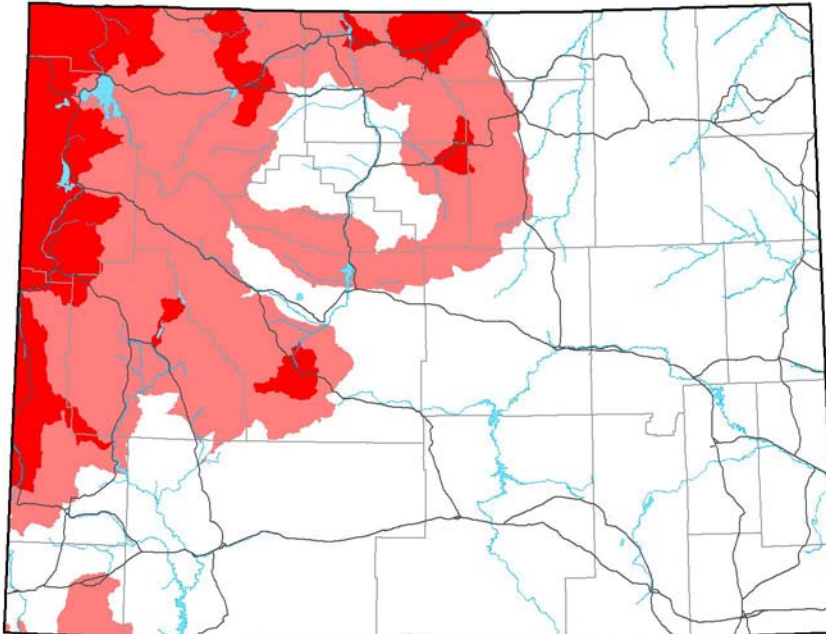**Coldest month mean minimum temperature**

Rubber Boa (*Charina bottae*)
Range Map and Distribution Model Summary

August 20, 2010

This report presents range and distribution of Rubber Boa (ARADA01010) in Wyoming (see Keinath et al. 2010b). Similar reports were developed by the Wyoming Natural Diversity Database for terrestrial vertebrate species of conservation need in Wyoming's State Wildlife Action Plan. This effort was supported by the Wyoming Game and Fish Department and the U.S. Geological Survey.
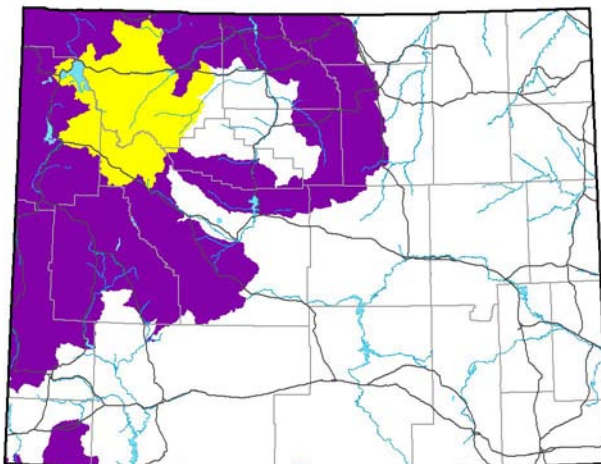
Range Map - Occupancy

Known | Suspected | Accidental | Historical

Range Notes

- Version: 2010-01-19
- Proportion of range deemed known based on documented occurrences: 0.375
- Details of range map creation noted in Keinath et al. (2010a).

Range Map - Seasonality

Year-Round | Summer | Winter | Spring/Fall

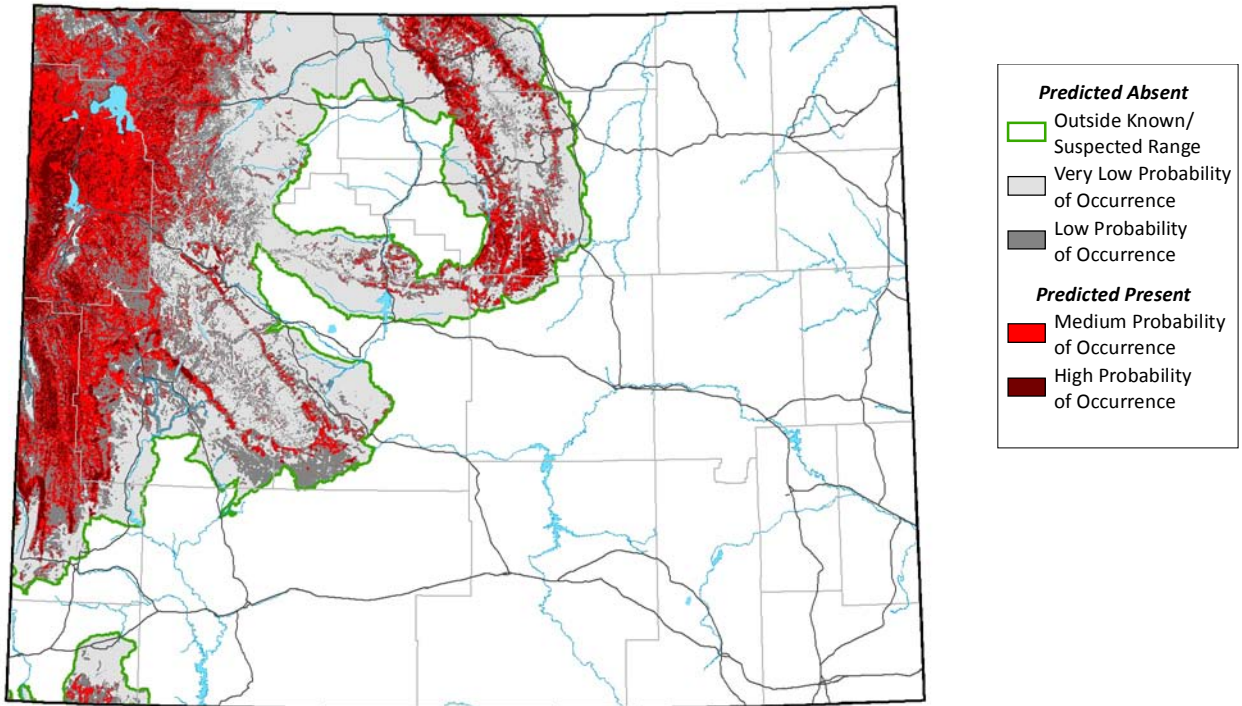Maps, models and report were created by and are available from the Wyoming Natural Diversity Database. (http://uwadmnweb.uwyo.edu/wyndd/).

Doug Keinath, Senior Zoologist

Mark Andersen, GIS Specialist

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# Distribution Model (Version: Fri Dec 04 15:08:45 MST 2009)

Details of distribution model creation are presented in Keinath et al. (2010b)

Predicted Absent
- Outside Known/ Suspected Range
- Very Low Probability of Occurrence
- Low Probability of Occurrence

Predicted Present
- Medium Probability of Occurrence
- High Probability of Occurrence

Model Parameters

- Season Modeled: Year-Round
- Algorithm: Maxent version 3.3.1
- Feature Types: Linear, Quadratic, Hinge
- Binary Threshold Rule: Maximum training sensitivity plus specificity
- Binary Threshold Value: 0.3208680
- High-Probability Threshold Value: 0.5875406
- Low-Probability Threshold Value: 0.1024961

Model Evaluation - ROC Plot
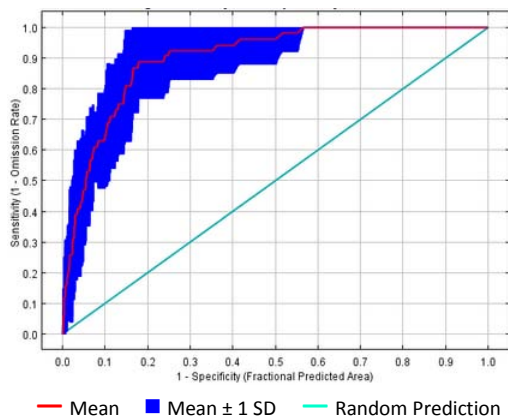
— Mean ■ Mean ± 1 SD — Random Prediction

Model Quality Summary

Overall Assessment of Model Quality: MEDIUM

Expert Assessment: Medium
Occurrence Sample Size: Medium-High
Quality of Occurrences: Medium
Positive Success Rate: Medium
Test AUC and Model Gain: High

Model Evaluation Statistics
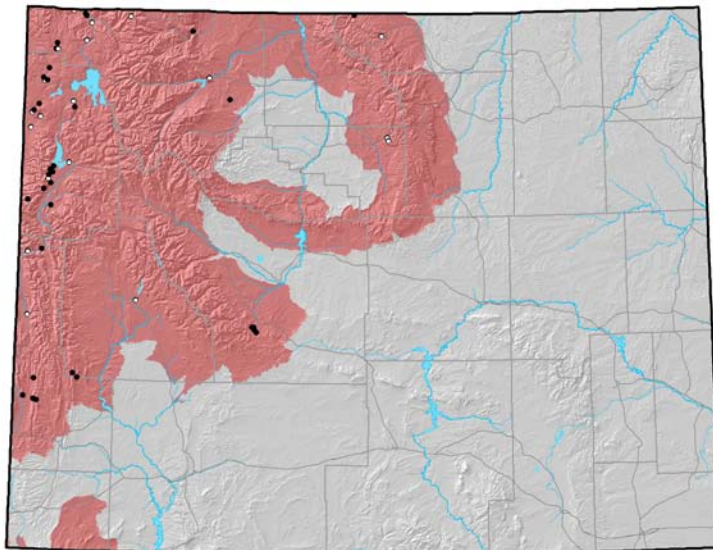
Final Model Statistics
Training AUC: 0.933
Regularized Training Gain: 1.412

Cross-Validation Statistics
- Average Test AUC: 0.901 ± 0.044
- Upper Bound on Test AUC: 0.903
- Average Test Gain: 1.343 ± 0.458
- Omission Error (fraction of test points omitted during 10-fold cross validation): 0.25± 0.20

Occurrence Data for Distribution Model

Occurrence Map

Points Used in Modeling, by Year of Observation
- Pre-1985
- 1985 or Later

Known and Suspected Range

Occurrence Summary Statistics

- Number of Occurrences in AWVED master dataset: 80
- Number of Occurrences used to create distribution model: 51
- Average Point Quality Index (highest quality is 12.00): 6.90 ± 2.09
- Most recent occurrence used: 2002
- Oldest occurrence used: 1921
- Occurrence File: LOCAL_SAMPLE_POINTS.csv

Comments

The map of range seasonality for rubber boa is likely inaccurate. Despite the fact that this is the map that was approved by state experts, all hyrdologic units within it's range should probably be labled "year-round". We have left the range as shown until formal review reveiw results in an official change to the approved map.Qualitative expert review of this model suggests that the binary version may over-predict the distribution of this species in Wyoming.

References

Keinath, D.A., M.D. Andersen, and G.P Beauvais. 2010a. Range maps for Wyoming's species of greatest conservation need. Report prepared for the Wyoming Game and Fish Department by the Wyoming Natural Diversity Database, Laramie, Wyoming. January 19, 2010.

Keinath, D.A., M.D. Andersen, and G.P. Beauvais. 2010b. Range and modeled distribution of Wyoming's species of greatest conservation need. Report prepared by the Wyoming Natural Diversity Database, Laramie Wyoming for the Wyoming Game and Fish Department, Cheyenne, Wyoming and the U.S. Geological Survey, Fort Collins, Colorado. August 20, 2010.

# Predictor Variables used in the Distribution Model

Percent Contribution (PC) to final model

| Environmental Variable	PC
Conifer Index	25
Precipitation of the coldest quarter	17
Wettest quarter mean temperature	16
Forest Cover Index	16
Vector Ruggedness Measure	14
Pinon-Juniper Index	12

Response Curves

Each curve shows dependence of predicted suitability on input values of a single predictor variable considering correlations with others. Suitability is on the vertical axis (units: probability). Variable values are on the horizontal axis (units based on inputs; see Keinath et al 2010b for details).
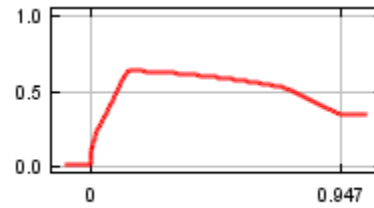
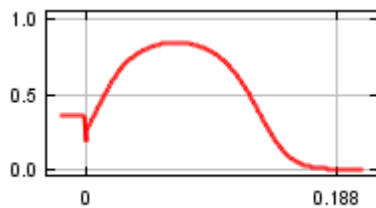**Conifer Index**
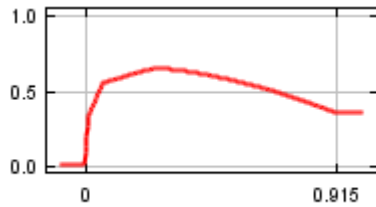
Precipitation of the coldest quarter
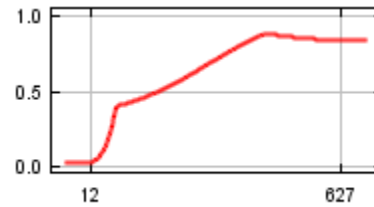
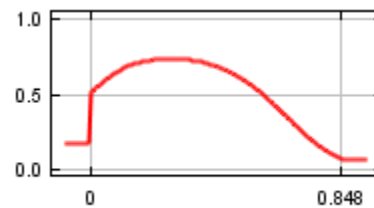**Wettest quarter mean temperature**
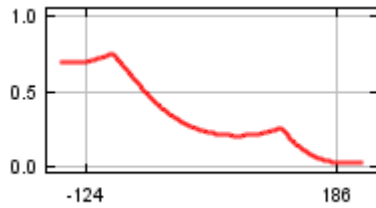
Forest Cover Index

Vector Ruggedness Measure
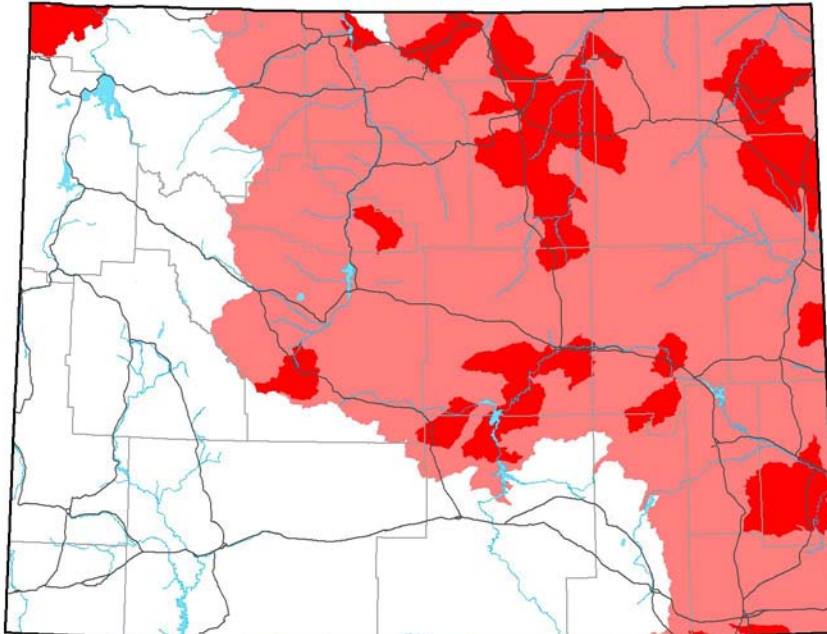

Pinon-Juniper Index

Eastern Yellow-bellied Racer (*Coluber constrictor flaviventris*) Range Map and Distribution Model Summary

August 20, 2010

This report presents range and distribution of Eastern Yellow-bellied Racer (ARADB07014) in Wyoming (see Keinath et al. 2010b). Similar reports were developed by the Wyoming Natural Diversity Database for terrestrial vertebrate species of conservation need in Wyoming's State Wildlife Action Plan. This effort was supported by the Wyoming Game and Fish Department and the U.S. Geological Survey.
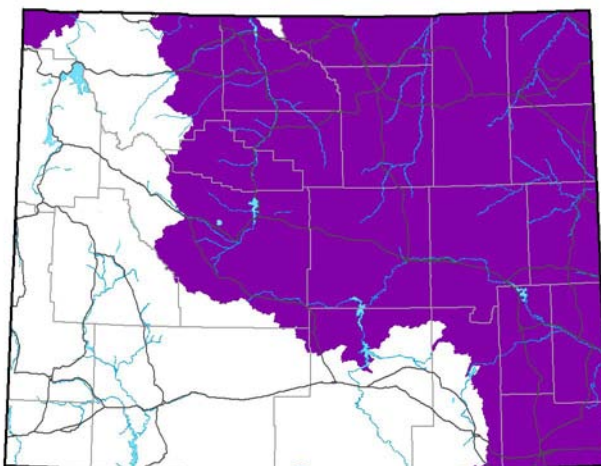
Range Map - Occupancy

Known   Suspected   Accidental   Historical

Range Notes

- Version: 2010-01-19
- Proportion of range deemed known based on documented occurrences: 0.176
- Details of range map creation noted in Keinath et al. (2010a).

Range Map - Seasonality

Year-Round   Summer   Winter   Spring/Fall

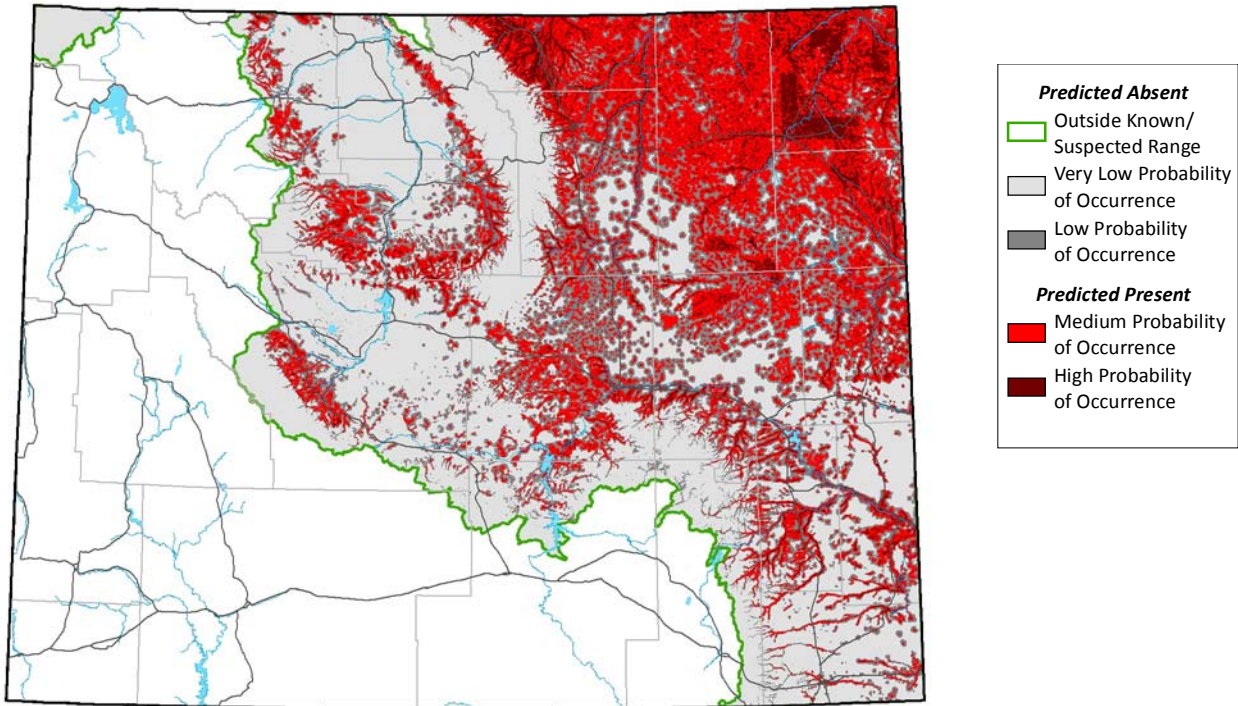Maps, models and report were created by and are available from the Wyoming Natural Diversity Database. (http://uwadmnweb.uwyo.edu/wyndd/).

Doug Keinath, Senior Zoologist

Mark Andersen, GIS Specialist

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# Distribution Model (Version: Fri Dec 04 19:17:32 MST 2009)

Details of distribution model creation are presented in Keinath et al. (2010b)

Predicted Absent
- Outside Known/ Suspected Range
- Very Low Probability of Occurrence
- Low Probability of Occurrence

Predicted Present
- Medium Probability of Occurrence
- High Probability of Occurrence

Model Parameters

- Season Modeled: Year-Round
- Algorithm: Maxent version 3.3.1
- Feature Types: Linear, Quadratic, Hinge
- Binary Threshold Rule: Maximum training sensitivity plus specificity
- Binary Threshold Value: 0.2922430
- High-Probability Threshold Value: 0.5871243
- Low-Probability Threshold Value: 0.1192337

Model Evaluation - ROC Plot
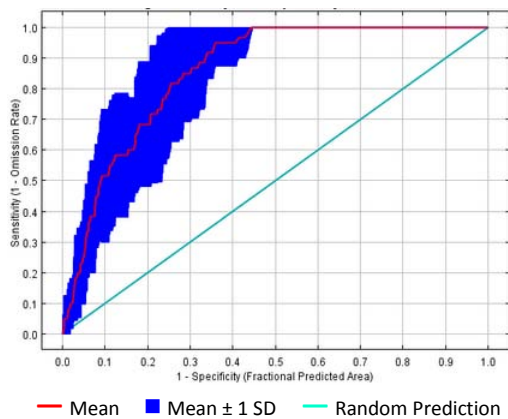
Mean — Mean ± 1 SD — Random Prediction

Model Quality Summary

Overall Assessment of Model Quality:
MEDIUM

Expert Assessment: Medium
Occurrence Sample Size: Medium-High
Quality of Occurrences: Medium
Positive Success Rate: High
Test AUC and Model Gain: Medium

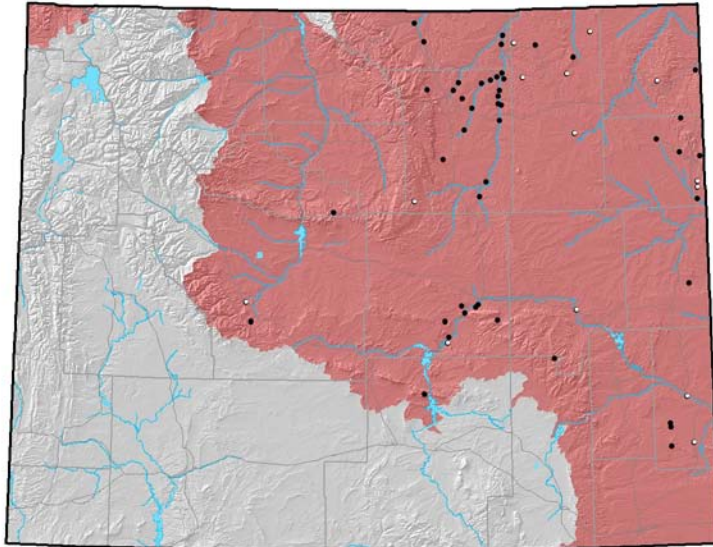## Model Evaluation Statistics

Final Model Statistics
Training AUC: 0.886
Regularized Training Gain: 1.017

Cross-Validation Statistics
- Average Test AUC: 0.856 ± 0.057
- Upper Bound on Test AUC: 0.865
- Average Test Gain: 0.912 ± 0.418
- Omission Error (fraction of test points omitted during 10-fold cross validation): 0.13± 0.15

Occurrence Data for Distribution Model

Occurrence Map

Points Used in Modeling, by Year of Observation
- Pre-1985
- 1985 or Later

Known and Suspected Range

Occurrence Summary Statistics

- Number of Occurrences in AWVED master dataset: 83
- Number of Occurrences used to create distribution model: 60
- Average Point Quality Index (highest quality is 12.00): 7.63 ± 3.20
- Most recent occurrence used: 2008
- Oldest occurrence used: 1906
- Occurrence File: LOCAL_SAMPLE_POINTS.csv

Comments

Qualitative expert review of this model suggests that the binary version may over-predict the distribution of this species in Wyoming.

References

Keinath, D.A., M.D. Andersen, and G.P Beauvais. 2010a. Range maps for Wyoming's species of greatest conservation need. Report prepared for the Wyoming Game and Fish Department by the Wyoming Natural Diversity Database, Laramie, Wyoming. January 19, 2010.

Keinath, D.A., M.D. Andersen, and G.P. Beauvais. 2010b. Range and modeled distribution of Wyoming's species of greatest conservation need. Report prepared by the Wyoming Natural Diversity Database, Laramie Wyoming for the Wyoming Game and Fish Department, Cheyenne, Wyoming and the U.S. Geological Survey, Fort Collins, Colorado. August 20, 2010.

## Predictor Variables used in the Distribution Model

Percent Contribution (PC) to final model

| Environmental Variable	PC
Variation of monthly precipitation	49
Distance to Permanent Water	15
Elevation	12
Cottonwood Index	10
Precipitation of the wettest month	8
Herbaceous Cover Index	7

Response Curves

Each curve shows dependence of predicted suitability on input values of a single predictor variable considering correlations with others. Suitability is on the vertical axis (units: probability). Variable values are on the horizontal axis (units based on inputs; see Keinath et al 2010b for details).
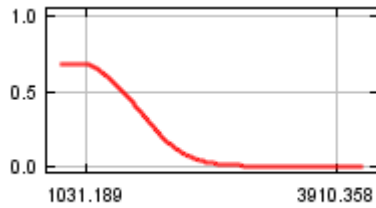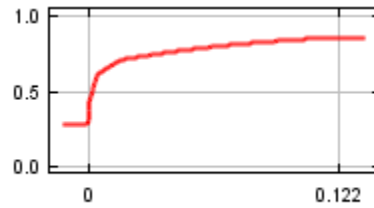
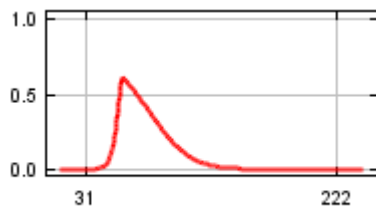**Variation of monthly precipitation**
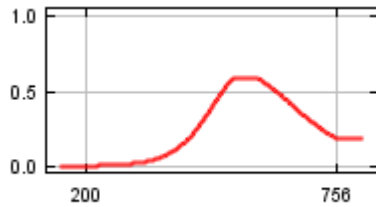
Distance to Permanent Water
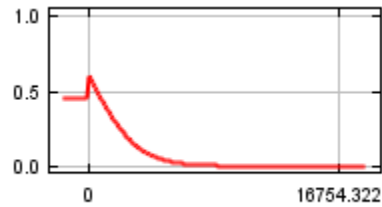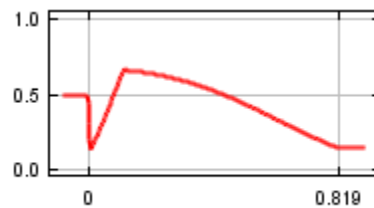

Elevation

Cottonwood Index

Precipitation of the wettest month
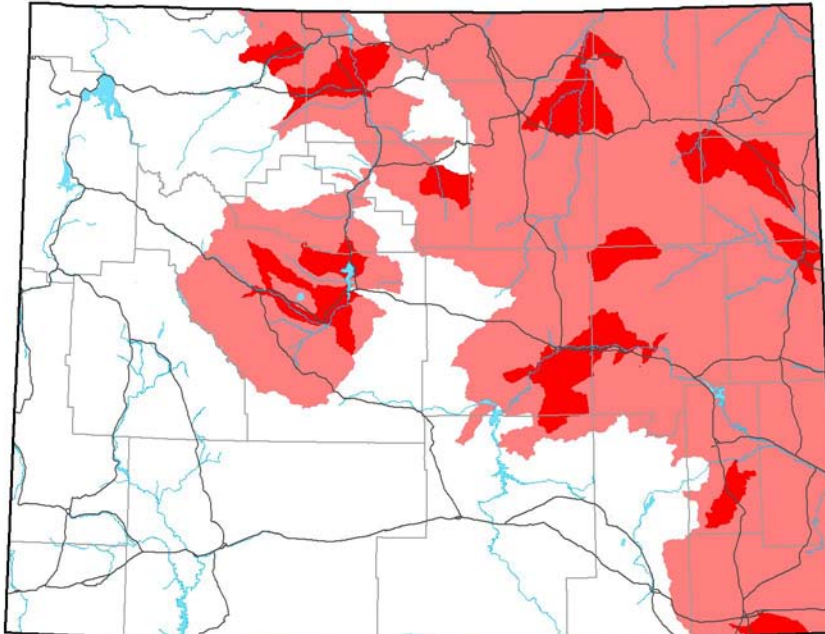

Herbaceous Cover Index

Plains Hog-nosed Snake (*Heterodon nasicus*)
Range Map and Distribution Model Summary

August 20, 2010

This report presents range and distribution of Plains Hog-nosed Snake (ARADB17010) in Wyoming (see Keinath et al. 2010b). Similar reports were developed by the Wyoming Natural Diversity Database for terrestrial vertebrate species of conservation need in Wyoming's State Wildlife Action Plan. This effort was supported by the Wyoming Game and Fish Department and the U.S. Geological Survey.
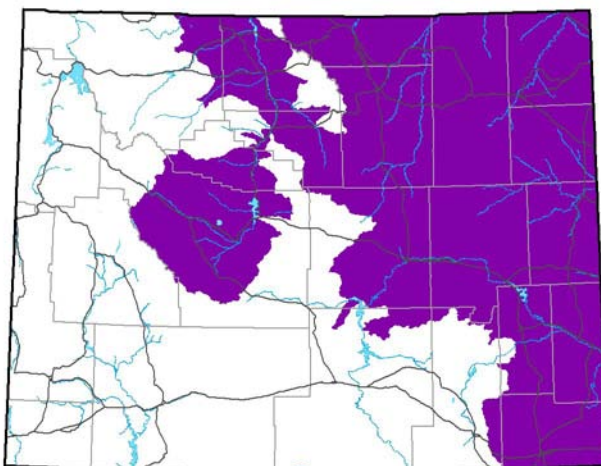
Range Map - Occupancy

Known   Suspected   Accidental   Historical

Range Notes
- Version: 2010-01-19
- Proportion of range deemed known based on documented occurrences: 0.114
- Details of range map creation noted in Keinath et al. (2010a).

Range Map - Seasonality

Year-Round   Summer   Winter   Spring/Fall

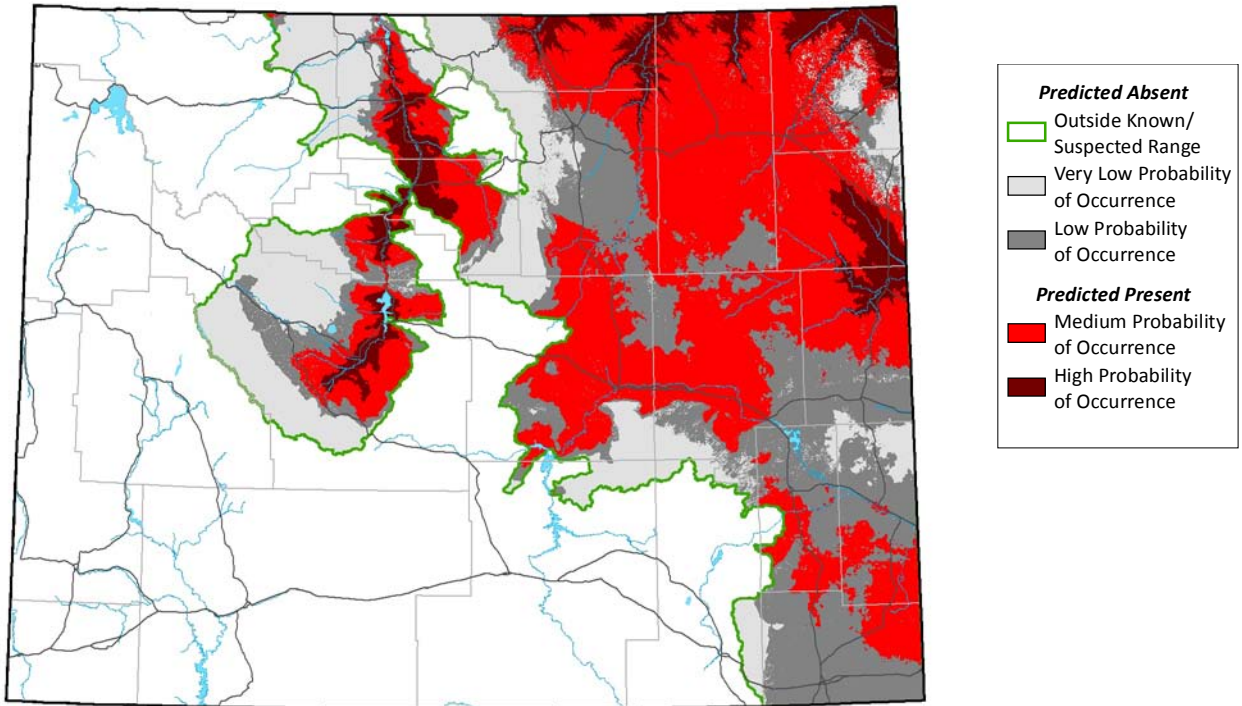Maps, models and report were created by and are available from the Wyoming Natural Diversity Database. (http://uwadmnweb.uwyo.edu/wyndd/).

Doug Keinath, Senior Zoologist

Mark Andersen, GIS Specialist

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# Distribution Model (Version: Thu Apr 22 09:39:12 MDT 2010)

Details of distribution model creation are presented in Keinath et al. (2010b)

Predicted Absent
- Outside Known/ Suspected Range
- Very Low Probability of Occurrence
- Low Probability of Occurrence

Predicted Present
- Medium Probability of Occurrence
- High Probability of Occurrence

Model Parameters

- Season Modeled: Year-Round
- Algorithm: Maxent version 3.3.1
- Feature Types: Linear, Quadratic, Hinge
- Binary Threshold Rule: Maximum training sensitivity plus specificity
- Binary Threshold Value: 0.3387860
- High-Probability Threshold Value: 0.5649360
- Low-Probability Threshold Value: 0.2126335

Model Evaluation - ROC Plot
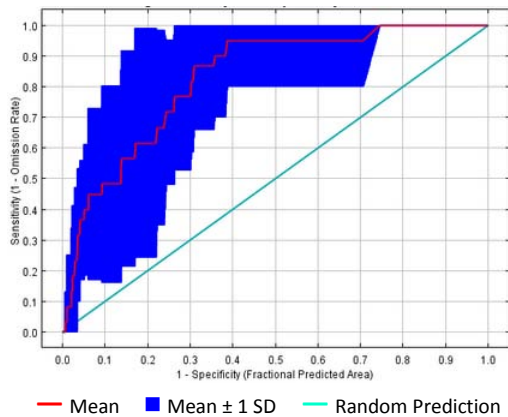
Mean — Mean ± 1 SD — Random Prediction

Model Quality Summary

Overall Assessment of Model Quality:
MEDIUM

Expert Assessment: Medium
Occurrence Sample Size: Medium
Quality of Occurrences: Medium
Positive Success Rate: Very High
Test AUC and Model Gain: Medium

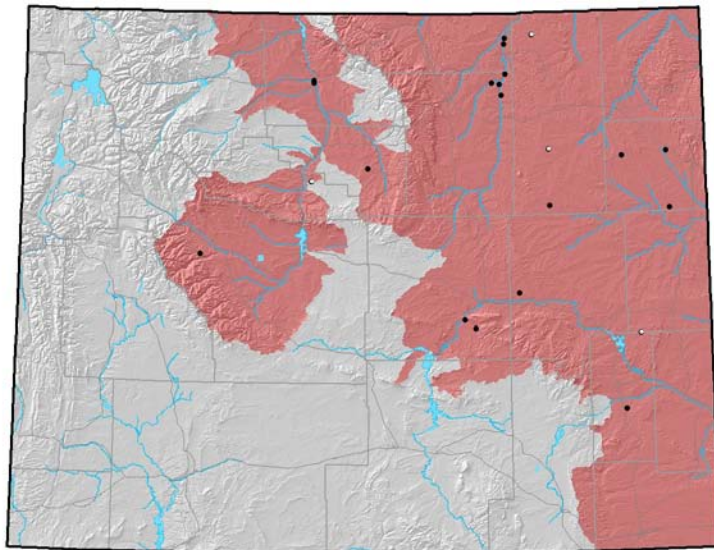## Model Evaluation Statistics

Final Model Statistics

Training AUC: 0.884
Regularized Training Gain: 0.911

Cross-Validation Statistics

- Average Test AUC: 0.829 ± 0.133
- Upper Bound on Test AUC: 0.845
- Average Test Gain: 0.697 ± 1.029
- Omission Error (fraction of test points omitted during 10-fold cross validation): 0.00± 0.00

Occurrence Data for Distribution Model

Occurrence Map

Points Used in Modeling, by Year of Observation
- ○ Pre-1985
- • 1985 or Later

Known and Suspected Range

Occurrence Summary Statistics

- Number of Occurrences in AWVED master dataset: 24
- Number of Occurrences used to create distribution model: 22
- Average Point Quality Index (highest quality is 12.00): 7.32 ± 3.05
- Most recent occurrence used: 2008
- Oldest occurrence used: 1980
- Occurrence File: LOCAL_SAMPLE_POINTS.csv

Comments

There are no additional comments specific to this species range map or distribution model.

References

Keinath, D.A., M.D. Andersen, and G.P Beauvais. 2010a. Range maps for Wyoming's species of greatest conservation need. Report prepared for the Wyoming Game and Fish Department by the Wyoming Natural Diversity Database, Laramie, Wyoming. January 19, 2010.

Keinath, D.A., M.D. Andersen, and G.P. Beauvais. 2010b. Range and modeled distribution of Wyoming's species of greatest conservation need. Report prepared by the Wyoming Natural Diversity Database, Laramie Wyoming for the Wyoming Game and Fish Department, Cheyenne, Wyoming and the U.S. Geological Survey, Fort Collins, Colorado. August 20, 2010.

# Predictor Variables used in the Distribution Model

Percent Contribution (PC) to final model

| Environmental Variable	PC
Variation of monthly precipitation	47
Elevation	31
Standard deviation of monthly temperature	14
Warmest quarter mean temperature	5
Percent Forest Cover	2

Response Curves

Each curve shows dependence of predicted suitability on input values of a single predictor variable considering correlations with others. Suitability is on the vertical axis (units: probability). Variable values are on the horizontal axis (units based on inputs; see Keinath et al 2010b for details).
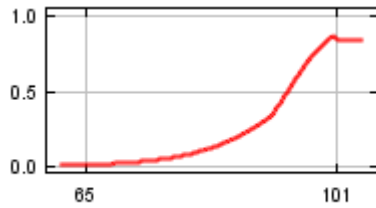
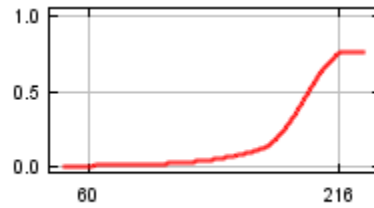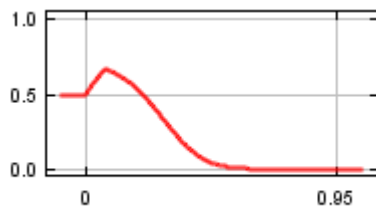**Variation of monthly precipitation**
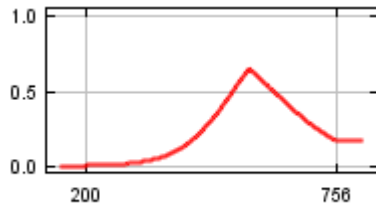
Elevation
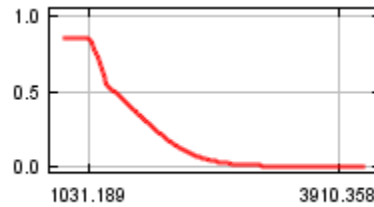
Standard deviation of monthly temperature

Warmest quarter mean temperature

Percent Forest Cover

Pale Milksnake (*Lampropeltis triangulum multistriata*)
Range Map and Distribution Model Summary

August 20, 2010

This report presents range and distribution of Pale Milksnake (ARADB19050) in Wyoming (see Keinath et al. 2010b). Similar reports were developed by the Wyoming Natural Diversity Database for terrestrial vertebrate species of conservation need in Wyoming's State Wildlife Action Plan. This effort was supported by the Wyoming Game and Fish Department and the U.S. Geological Survey.
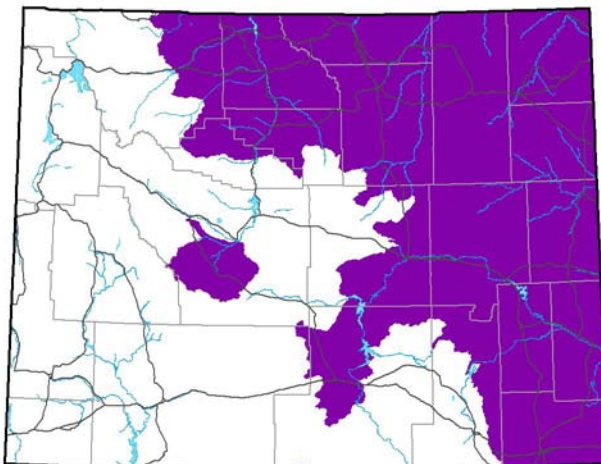
Range Map - Occupancy
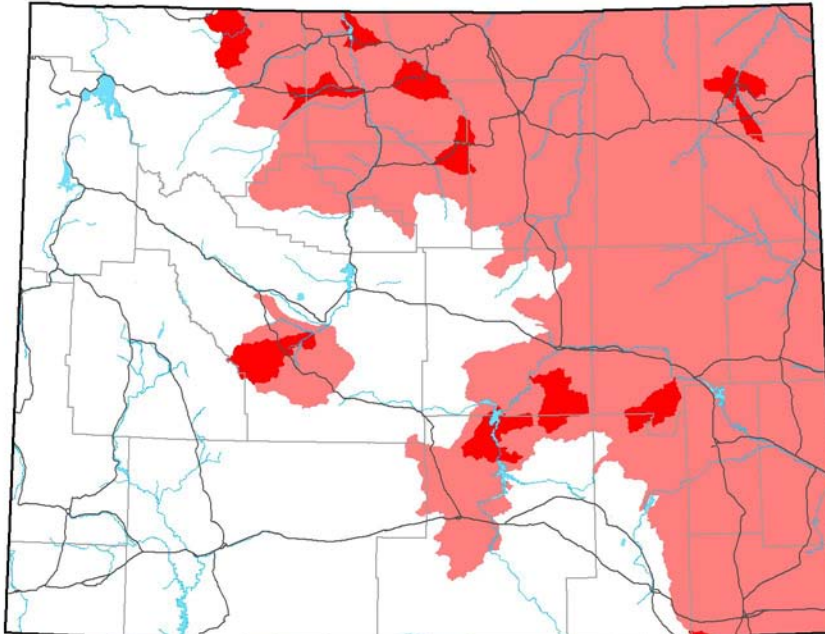
Known   Suspected   Accidental   Historical

Range Notes
- Version: 2010-01-19
- Proportion of range deemed known based on documented occurrences: 0.057
- Details of range map creation noted in Keinath et al. (2010a).

Range Map - Seasonality

Year-Round   Summer   Winter   Spring/Fall

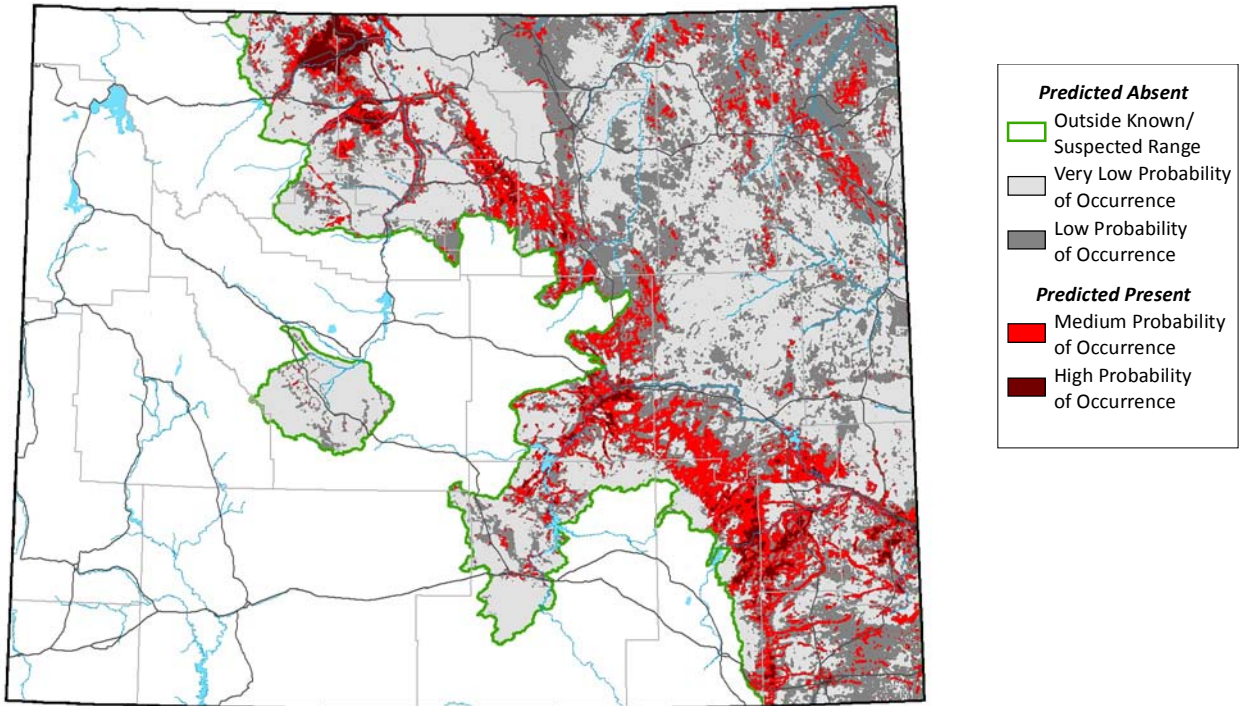Maps, models and report were created by and are available from the Wyoming Natural Diversity Database. (http://uwadmnweb.uwyo.edu/wyndd/).

Doug Keinath, Senior Zoologist

Mark Andersen, GIS Specialist

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Distribution Model (Version: Sat Dec 05 03:19:17 MST 2009)

Details of distribution model creation are presented in Keinath et al. (2010b)

Predicted Absent
- Outside Known/ Suspected Range
- Very Low Probability of Occurrence
- Low Probability of Occurrence

Predicted Present
- Medium Probability of Occurrence
- High Probability of Occurrence

Model Parameters

- Season Modeled: Year-Round
- Algorithm: Maxent version 3.3.1
- Feature Types: Linear, Quadratic, Hinge
- Binary Threshold Rule: Maximum training sensitivity plus specificity
- Binary Threshold Value: 0.3225460
- High-Probability Threshold Value: 0.6715417
- Low-Probability Threshold Value: 0.1259588

Model Evaluation - ROC Plot

— Mean   ■ Mean ± 1 SD   — Random Prediction

Model Quality Summary

Overall Assessment of Model Quality: LOW

Expert Assessment: Low
Occurrence Sample Size: Low
Quality of Occurrences: Medium
Positive Success Rate: Medium
Test AUC and Model Gain: Medium
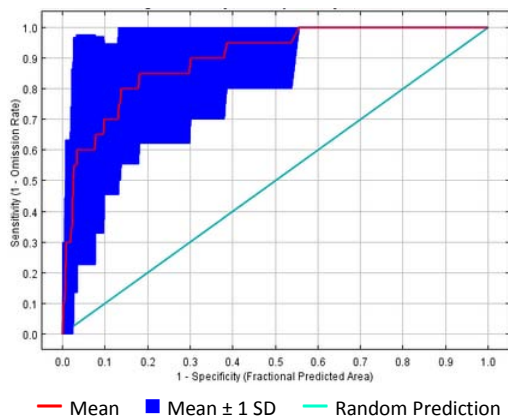
Model Evaluation Statistics
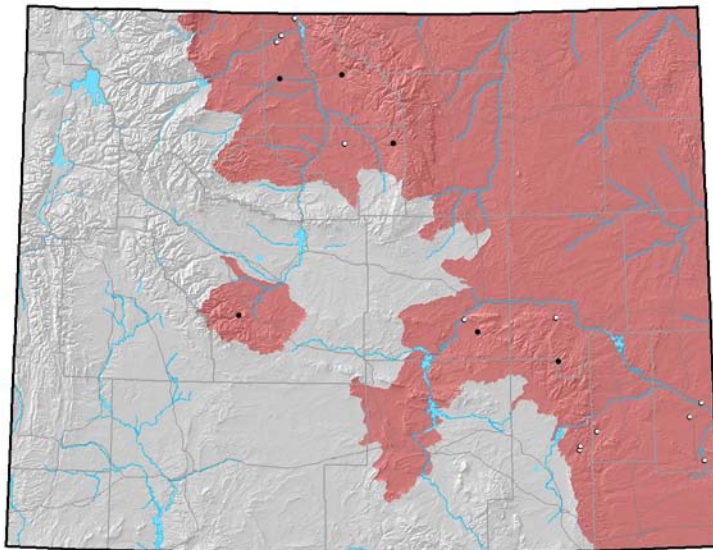
Final Model Statistics

Training AUC: 0.950
Regularized Training Gain: 1.427

Cross-Validation Statistics

- Average Test AUC: 0.898 ± 0.099
- Upper Bound on Test AUC: 0.880
- Average Test Gain: 1.502 ± 1.133
- Omission Error (fraction of test points omitted during 10-fold cross validation): 0.30± 0.26

Occurrence Data for Distribution Model

Occurrence Map

Points Used in Modeling, by Year of Observation
- ○ Pre-1985
- • 1985 or Later

Known and Suspected Range

Occurrence Summary Statistics

- Number of Occurrences in AWVED master dataset: 21
- Number of Occurrences used to create distribution model: 19
- Average Point Quality Index (highest quality is 12.00): 6.26 ± 1.79
- Most recent occurrence used: 2006
- Oldest occurrence used: 1856
- Occurrence File: LOCAL_SAMPLE_POINTS.csv

Comments

There are no additional comments specific to this species range map or distribution model.

References

Keinath, D.A., M.D. Andersen, and G.P Beauvais. 2010a. Range maps for Wyoming's species of greatest conservation need. Report prepared for the Wyoming Game and Fish Department by the Wyoming Natural Diversity Database, Laramie, Wyoming. January 19, 2010.

Keinath, D.A., M.D. Andersen, and G.P. Beauvais. 2010b. Range and modeled distribution of Wyoming's species of greatest conservation need. Report prepared by the Wyoming Natural Diversity Database, Laramie Wyoming for the Wyoming Game and Fish Department, Cheyenne, Wyoming and the U.S. Geological Survey, Fort Collins, Colorado. August 20, 2010.

Predictor Variables used in the Distribution Model

Percent Contribution (PC) to final model

| Environmental Variable	PC
Variation of monthly precipitation	44
Contagion Index	13
Herbaceous Cover Index	12
Coldest month mean minimum temperature	12
Conifer Index	11
Interannual variation in annual frost days	8

Response Curves

Each curve shows dependence of predicted suitability on input values of a single predictor variable considering correlations with others. Suitability is on the vertical axis (units: probability). Variable values are on the horizontal axis (units based on inputs; see Keinath et al 2010b for details).
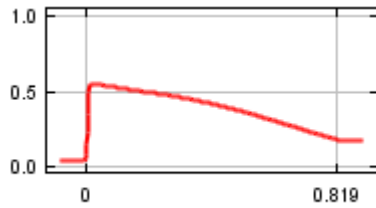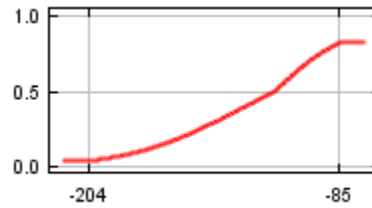
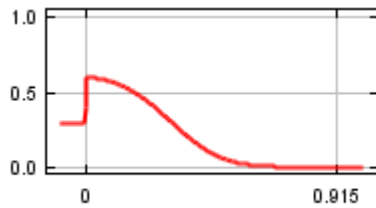**Variation of monthly precipitation**
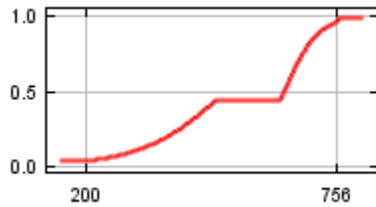
Contagion Index
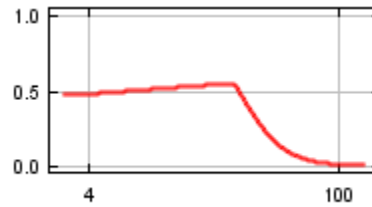
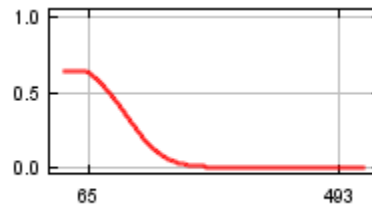**Herbaceous Cover Index**

Coldest month mean minimum temperature

Conifer Index

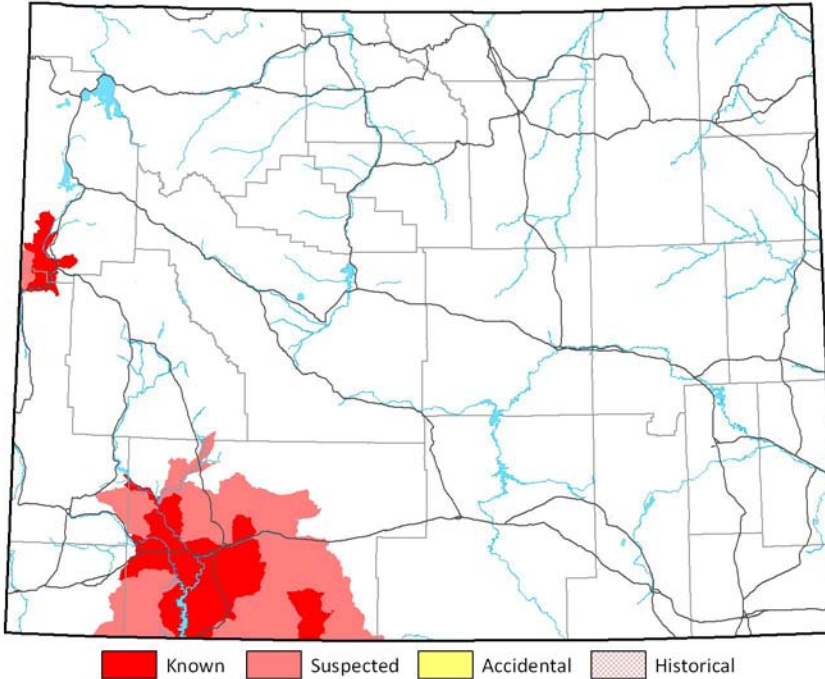
Interannual variation in annual frost days

Great Basin Gophersnake (*Pituophis catenifer deserticola*)
Range Map and Distribution Model Summary

August 20, 2010

This report presents range and distribution of Great Basin Gophersnake (ARADB26022) in Wyoming (see Keinath et al. 2010b). Similar reports were developed by the Wyoming Natural Diversity Database for terrestrial vertebrate species of conservation need in Wyoming's State Wildlife Action Plan. This effort was supported by the Wyoming Game and Fish Department and the U.S. Geological Survey.
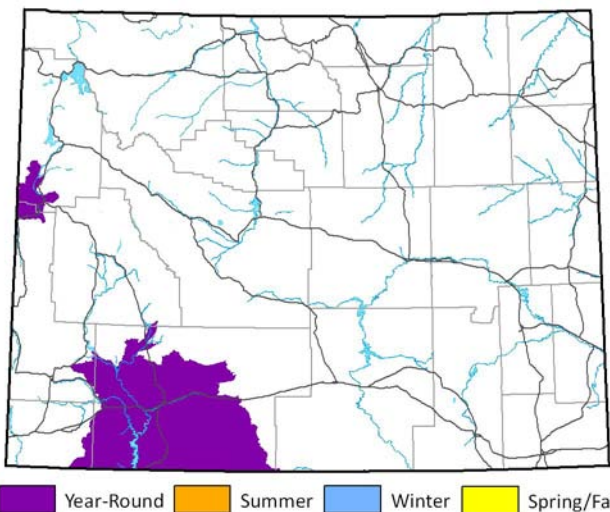
Range Map - Occupancy

Known   Suspected   Accidental   Historical

Range Notes
- Version: 2010-01-19
- Proportion of range deemed known based on documented occurrences: 0.300
- Details of range map creation noted in Keinath et al. (2010a).

Range Map - Seasonality

Year-Round   Summer   Winter   Spring/Fall

Maps, models and report were created by and are available from the Wyoming Natural Diversity Database. (http://uwadmnweb.uwyo.edu/wyndd/).
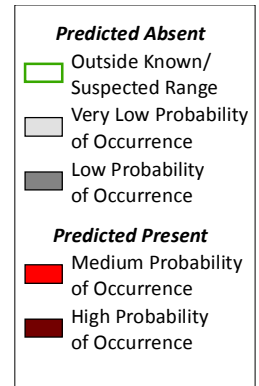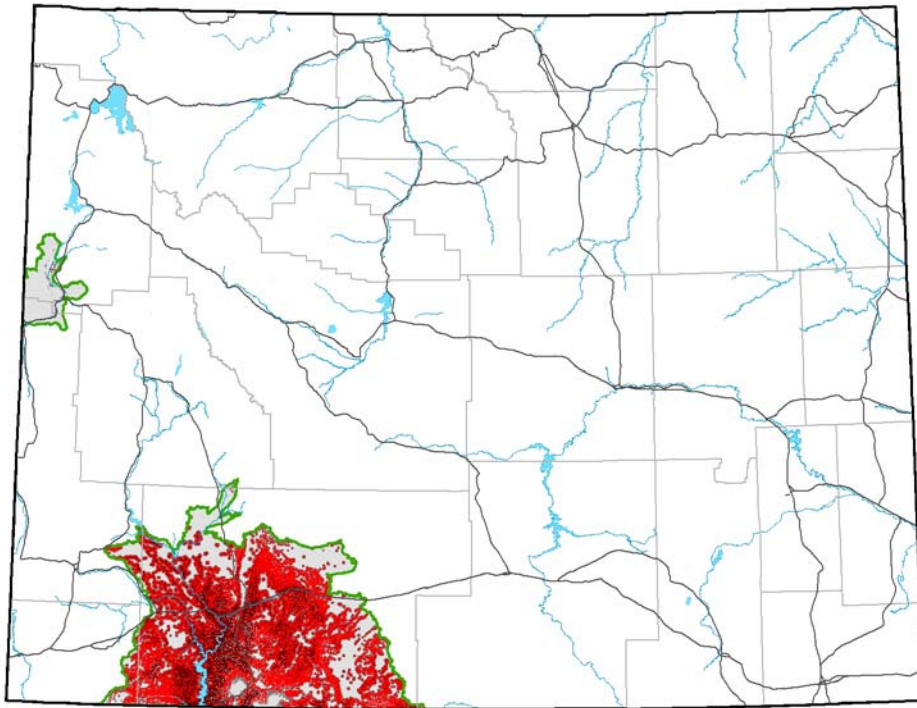
Doug Keinath, Senior Zoologist

Mark Andersen, GIS Specialist

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Distribution Model (Version: Tue Mar 16 21:09:06 MDT 2010)

Details of distribution model creation are presented in Keinath et al. (2010b)

Predicted Absent
- Outside Known/ Suspected Range
- Very Low Probability of Occurrence
- Low Probability of Occurrence

Predicted Present
- Medium Probability of Occurrence
- High Probability of Occurrence

Model Parameters

- Season Modeled: Year-Round
- Algorithm: Maxent version 3.3.1
- Feature Types: Linear, Product
- Binary Threshold Rule: Maximum training sensitivity plus specificity
- Binary Threshold Value: 0.2571420
- High-Probability Threshold Value: 0.6456544
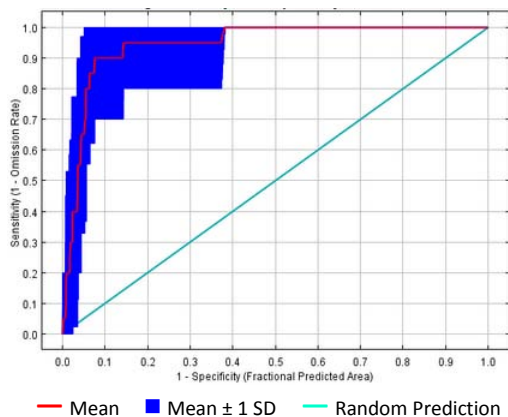- Low-Probability Threshold Value: 0.1021669

Model Evaluation - ROC Plot

Mean   Mean ± 1 SD   Random Prediction

Model Quality Summary

Overall Assessment of Model Quality: MEDIUM

Expert Assessment: Medium
Occurrence Sample Size: Low
Quality of Occurrences: Medium
Positive Success Rate: Very High
Test AUC and Model Gain: High

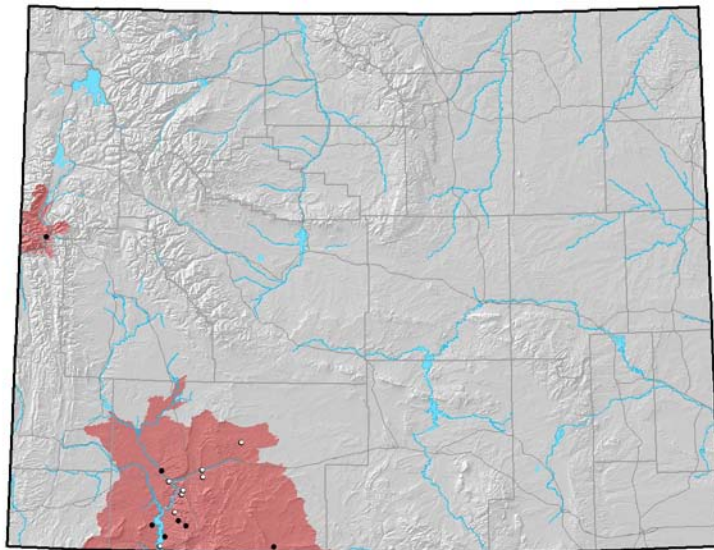## Model Evaluation Statistics

Final Model Statistics
Training AUC: 0.953
Regularized Training Gain: 1.644

Cross-Validation Statistics

- Average Test AUC: 0.944 ± 0.053
- Upper Bound on Test AUC: 0.926
- Average Test Gain: 1.854 ± 0.640
- Omission Error (fraction of test points omitted during 10-fold cross validation): 0.10± 0.21

Occurrence Data for Distribution Model

Occurrence Map

Points Used in Modeling, by Year of Observation
- ∘ Pre-1985
- • 1985 or Later

Known and Suspected Range

Occurrence Summary Statistics

- Number of Occurrences in AWVED master dataset: 28
- Number of Occurrences used to create distribution model: 15
- Average Point Quality Index (highest quality is 12.00): 6.93 ± 2.79
- Most recent occurrence used: 2006
- Oldest occurrence used: 1980
- Occurrence File: REVISED_SAMPLE_POINTS_ALL_SPP.csv

Comments

There are no additional comments specific to this species range map or distribution model.

References

Keinath, D.A., M.D. Andersen, and G.P Beauvais. 2010a. Range maps for Wyoming's species of greatest conservation need. Report prepared for the Wyoming Game and Fish Department by the Wyoming Natural Diversity Database, Laramie, Wyoming. January 19, 2010.

Keinath, D.A., M.D. Andersen, and G.P. Beauvais. 2010b. Range and modeled distribution of Wyoming's species of greatest conservation need. Report prepared by the Wyoming Natural Diversity Database, Laramie Wyoming for the Wyoming Game and Fish Department, Cheyenne, Wyoming and the U.S. Geological Survey, Fort Collins, Colorado. August 20, 2010.

# Predictor Variables used in the Distribution Model

Percent Contribution (PC) to final model

| Environmental Variable	PC
Precipitation of the wettest month	53
Interannual variation in annual frost days	19
Potential for Rock Outcrop	14
Percent Forest Cover	13
Distance to Permanent Water	0
Pinon-Juniper Index	0

Response Curves

Each curve shows dependence of predicted suitability on input values of a single predictor variable considering correlations with others. Suitability is on the vertical axis (units: probability). Variable values are on the horizontal axis (units based on inputs; see Keinath et al 2010b for details).
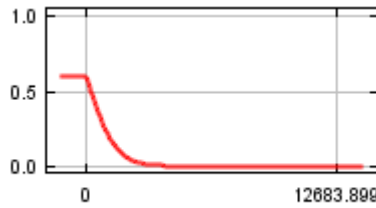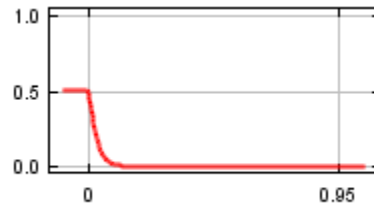
Precipitation of the wettest month
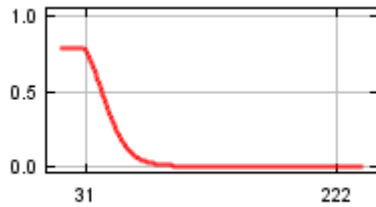
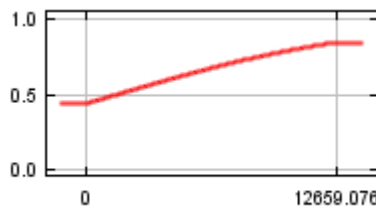**Interannual variation in annual frost days**
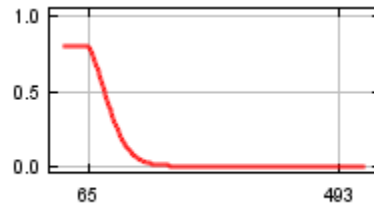
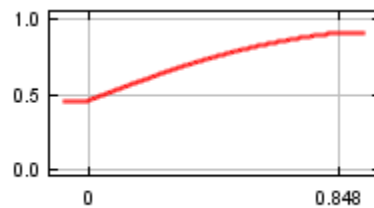**Potential for Rock Outcrop**

Percent Forest Cover

Distance to Permanent Water


Pinon-Juniper Index

Bullsnake (*Pituophis catenifer sayi*)
Range Map and Distribution Model Summary

August 20, 2010

This report presents range and distribution of Bullsnake (ARADB26024) in Wyoming (see Keinath et al. 2010b). Similar reports were developed by the Wyoming Natural Diversity Database for terrestrial vertebrate species of conservation need in Wyoming's State Wildlife Action Plan. This effort was supported by the Wyoming Game and Fish Department and the U.S. Geological Survey.
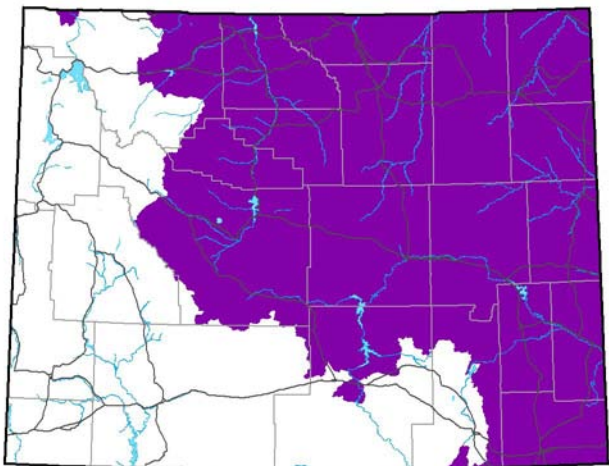
Range Map - Occupancy
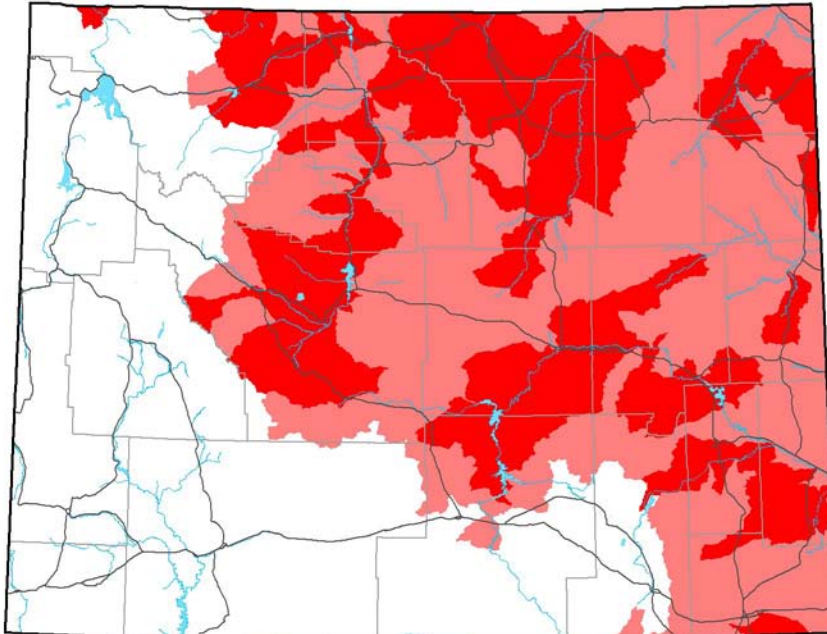
Known Suspected Accidental Historical

Range Notes
- Version: 2010-01-19
- Proportion of range deemed known based on documented occurrences: 0.369
- Details of range map creation noted in Keinath et al. (2010a).

Range Map - Seasonality

Year-Round Summer Winter Spring/Fall

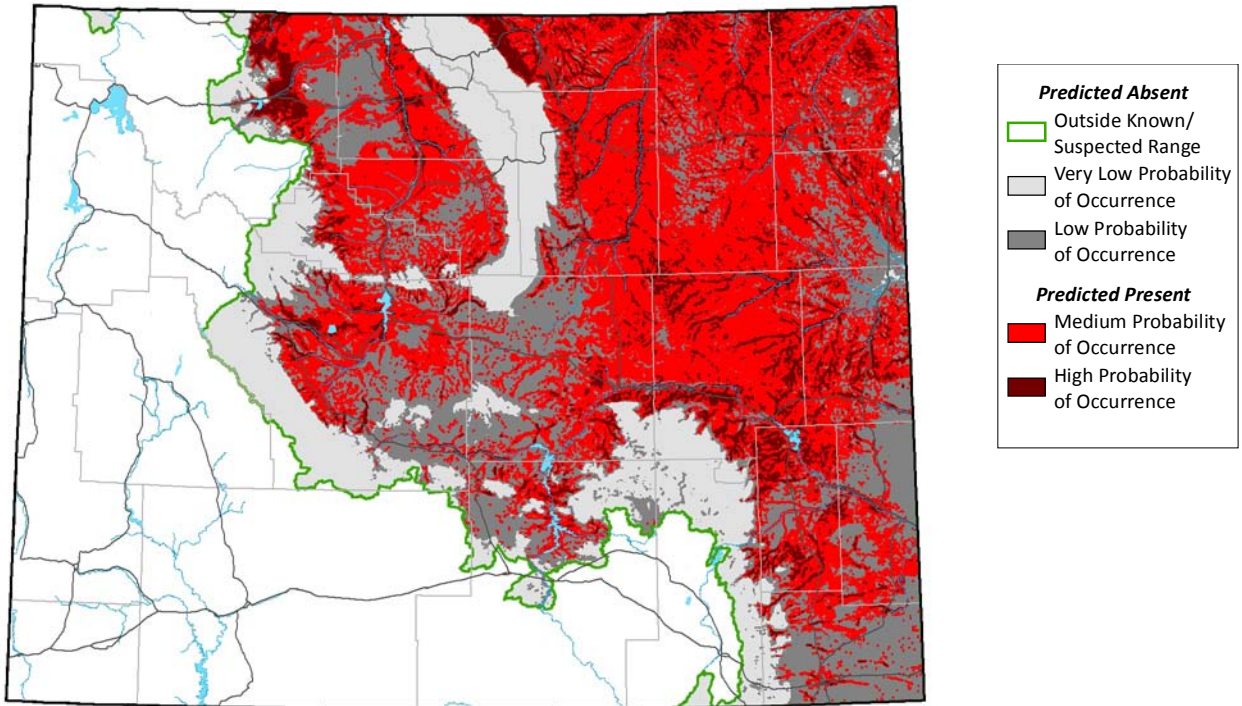Maps, models and report were created by and are available from the Wyoming Natural Diversity Database. (http://uwadmnweb.uwyo.edu/wyndd/).

Doug Keinath, Senior Zoologist

Mark Andersen, GIS Specialist

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# Distribution Model (Version: Thu Apr 01 15:03:04 MDT 2010)
Details of distribution model creation are presented in Keinath et al. (2010b)

Predicted Absent
- Outside Known/ Suspected Range
- Very Low Probability of Occurrence
- Low Probability of Occurrence

Predicted Present
- Medium Probability of Occurrence
- High Probability of Occurrence

Model Parameters
- Season Modeled: Year-Round
- Algorithm: Maxent version 3.3.1
- Feature Types: Linear, Product, Quadratic, Hinge, Threshold
- Binary Threshold Rule: Maximum training sensitivity plus specificity
- Binary Threshold Value: 0.3167540
- High-Probability Threshold Value: 0.5373218
- Low-Probability Threshold Value: 0.1010481

Model Evaluation - ROC Plot
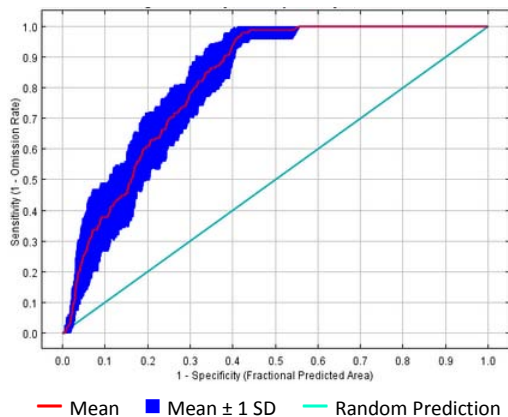
— Mean   ■ Mean ± 1 SD   — Random Prediction

Model Quality Summary
Overall Assessment of Model Quality:
MEDIUM
Expert Assessment: Medium
Occurrence Sample Size: High
Quality of Occurrences: High
Positive Success Rate: Medium
Test AUC and Model Gain: Medium

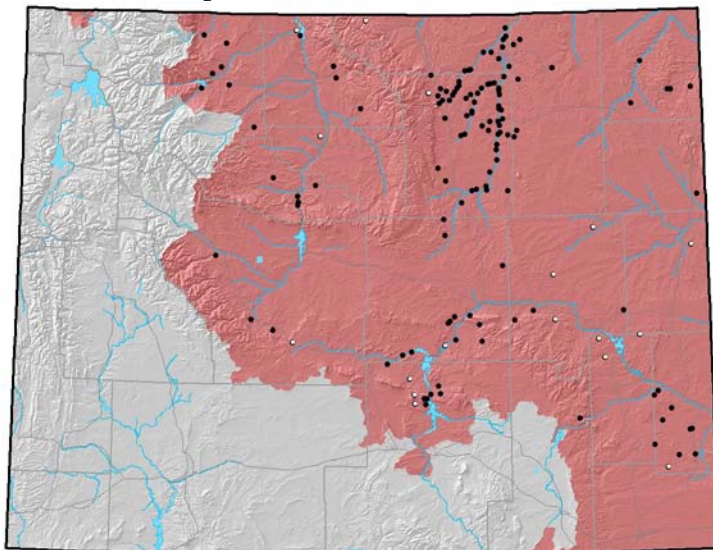## Model Evaluation Statistics
Final Model Statistics
Training AUC: 0.867
Regularized Training Gain: 0.896

Cross-Validation Statistics
- Average Test AUC: 0.822 ± 0.028
- Upper Bound on Test AUC: 0.843
- Average Test Gain: 0.779 ± 0.179
- Omission Error (fraction of test points omitted during 10-fold cross validation): 0.21± 0.10

Occurrence Data for Distribution Model

Occurrence Map

Points Used in Modeling, by Year of Observation
○ Pre-1985
• 1985 or Later

Known and
Suspected Range

Occurrence Summary Statistics

- Number of Occurrences in AWVED master dataset: 181
- Number of Occurrences used to create distribution model: 145
- Average Point Quality Index (highest quality is 12.00): 8.67 ± 2.82
- Most recent occurrence used: 2008
- Oldest occurrence used: 1981
- Occurrence File: REVISED_SAMPLE_POINTS_ALL_SPP.csv

Comments

There are no additional comments specific to this species range map or distribution model.

References

Keinath, D.A., M.D. Andersen, and G.P Beauvais. 2010a. Range maps for Wyoming's species of greatest conservation need. Report prepared for the Wyoming Game and Fish Department by the Wyoming Natural Diversity Database, Laramie, Wyoming. January 19, 2010.

Keinath, D.A., M.D. Andersen, and G.P. Beauvais. 2010b. Range and modeled distribution of Wyoming's species of greatest conservation need. Report prepared by the Wyoming Natural Diversity Database, Laramie Wyoming for the Wyoming Game and Fish Department, Cheyenne, Wyoming and the U.S. Geological Survey, Fort Collins, Colorado. August 20, 2010.

# Predictor Variables used in the Distribution Model

Percent Contribution (PC) to final model

| Environmental Variable	PC
Annual number of Frost Days	41
Variation of monthly precipitation	27
Cottonwood Index	15
Warmest quarter mean temperature	12
Elevation	5
Annual Radiation range	0

Response Curves

Each curve shows dependence of predicted suitability on input values of a single predictor variable considering correlations with others. Suitability is on the vertical axis (units: probability). Variable values are on the horizontal axis (units based on inputs; see Keinath et al 2010b for details).
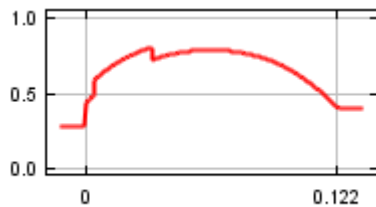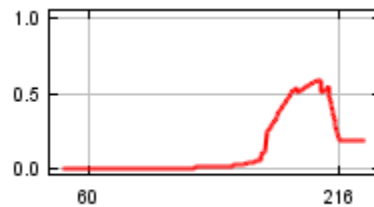
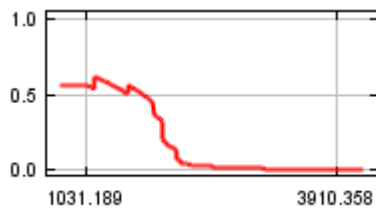**Annual number of Frost Days**
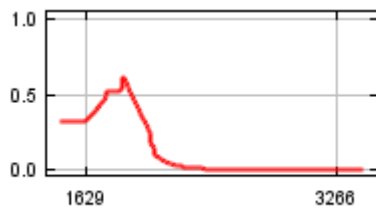
Variation of monthly precipitation
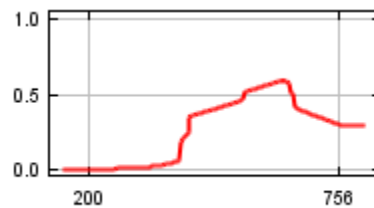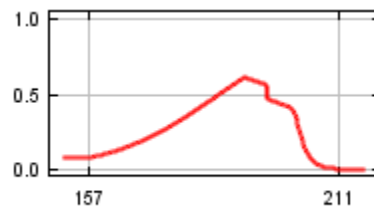

Cottonwood Index

Warmest quarter mean temperature

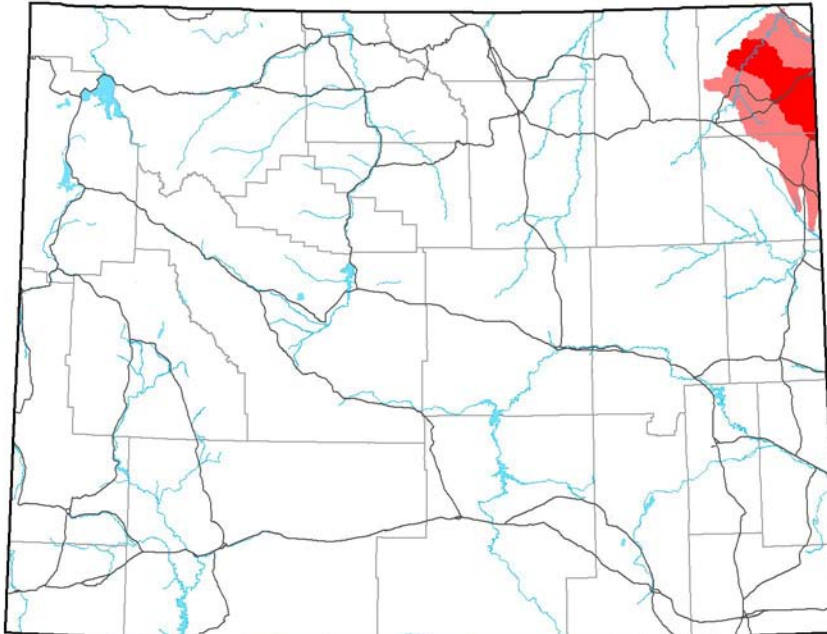**Elevation**

Annual Radiation range

Black Hills Redbelly Snake (*Storeria occipitomaculata pahasapae*) Range Map and Distribution Model Summary

August 20, 2010

This report presents range and distribution of Black Hills Redbelly Snake (ARADB34030) in Wyoming (see Keinath et al. 2010b). Similar reports were developed by the Wyoming Natural Diversity Database for terrestrial vertebrate species of conservation need in Wyoming's State Wildlife Action Plan. This effort was supported by the Wyoming Game and Fish Department and the U.S. Geological Survey.

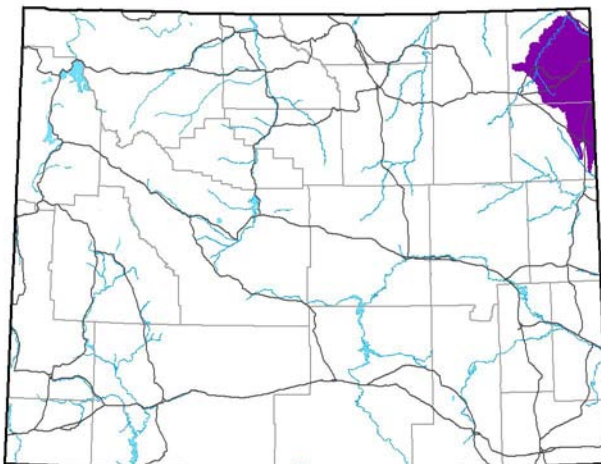### Range Map - Occupancy

Known   Suspected   Accidental   Historical

Range Notes

- Version: 2010-01-19
- Proportion of range deemed known based on documented occurrences: 0.300
- Details of range map creation noted in Keinath et al. (2010a).

Range Map - Seasonality

Year-Round   Summer   Winter   Spring/Fall

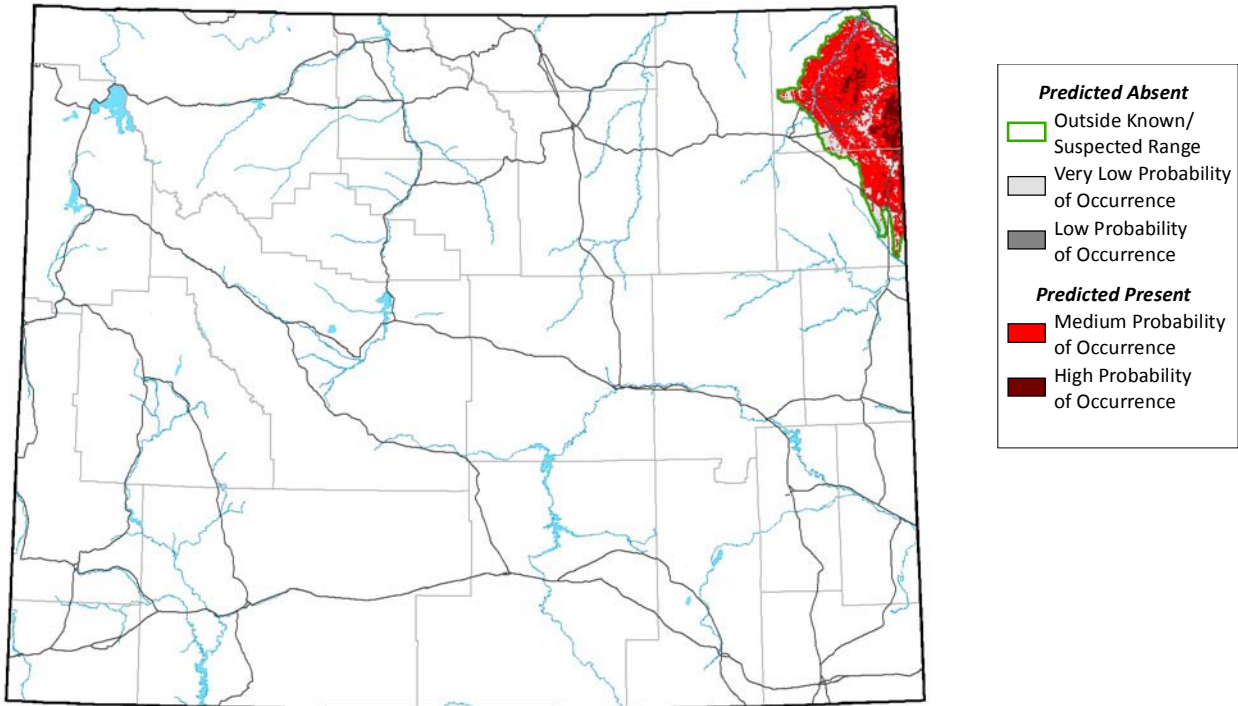Maps, models and report were created by and are available from the Wyoming Natural Diversity Database. (http://uwadmnweb.uwyo.edu/wyndd/).

Doug Keinath, Senior Zoologist

Mark Andersen, GIS Specialist

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Distribution Model (Version: Sat Dec 05 15:26:01 MST 2009)
Details of distribution model creation are presented in Keinath et al. (2010b)

Predicted Absent
- Outside Known/ Suspected Range
- Very Low Probability of Occurrence
- Low Probability of Occurrence

Predicted Present
- Medium Probability of Occurrence
- High Probability of Occurrence

Model Parameters
- Season Modeled: Year-Round
- Algorithm: Maxent version 3.3.1
- Feature Types: Linear
- Binary Threshold Rule: Maximum training sensitivity plus specificity
- Binary Threshold Value: 0.0559810
- High-Probability Threshold Value: 0.7559857
- Low-Probability Threshold Value: 0.0559810

Model Evaluation - ROC Plot

- Mean
- Mean ± 1 SD
- Random Prediction

Model Quality Summary
Overall Assessment of Model Quality: LOW
Expert Assessment: Low
Occurrence Sample Size: Low
Quality of Occurrences: Medium
Positive Success Rate: High
Test AUC and Model Gain: Medium
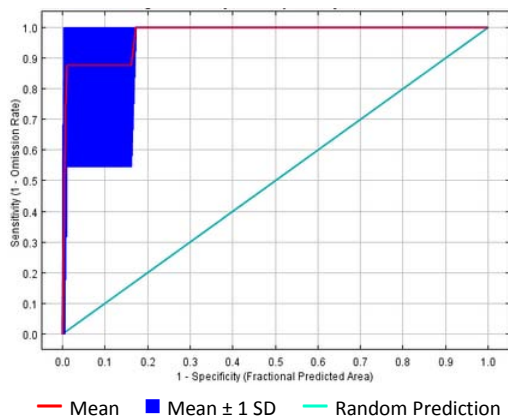
Model Evaluation Statistics
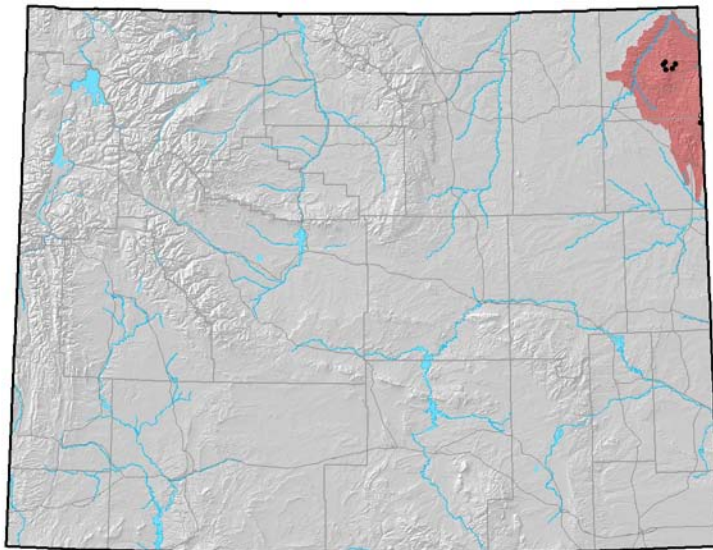### Final Model Statistics
Training AUC: 0.983
Regularized Training Gain: 2.889

Cross-Validation Statistics
- Average Test AUC: 0.780 ± 0.415
- Upper Bound on Test AUC: 0.943
- Average Test Gain: 2.663 ± 2.336
- Omission Error (fraction of test points omitted during 8-fold cross validation): 0.13± 0.35

Occurrence Data for Distribution Model

Occurrence Map

Points Used in Modeling, by Year of Observation
- ○ Pre-1985
- • 1985 or Later

■ Known and Suspected Range

Occurrence Summary Statistics

- Number of Occurrences in AWVED master dataset: 8
- Number of Occurrences used to create distribution model: 8
- Average Point Quality Index (highest quality is 12.00): 7.75 ± 3.06
- Most recent occurrence used: 1994
- Oldest occurrence used: 1962
- Occurrence File: LOCAL_SAMPLE_POINTS.csv

Comments

The model for this species is based on a small sample size of occurrence locations, which often results in low model quality. Collection of additional, high-quality occurrence locations could greatly improve the modeled distribution for this species.

References

Keinath, D.A., M.D. Andersen, and G.P Beauvais. 2010a. Range maps for Wyoming's species of greatest conservation need. Report prepared for the Wyoming Game and Fish Department by the Wyoming Natural Diversity Database, Laramie, Wyoming. January 19, 2010.

Keinath, D.A., M.D. Andersen, and G.P. Beauvais. 2010b. Range and modeled distribution of Wyoming's species of greatest conservation need. Report prepared by the Wyoming Natural Diversity Database, Laramie Wyoming for the Wyoming Game and Fish Department, Cheyenne, Wyoming and the U.S. Geological Survey, Fort Collins, Colorado. August 20, 2010.

Predictor Variables used in the Distribution Model

Percent Contribution (PC) to final model

| *Environmental Variable*	*PC*
Deciduous Forest Index	77
Radiation of the lightest month	9
Potential for Rock Outcrop	7
Soil - Fraction Sand	3
Driest quarter mean temperature	3
Wettest quarter mean temperature	2

Response Curves

Each curve shows dependence of predicted suitability on input values of a single predictor variable considering correlations with others. Suitability is on the vertical axis (units: probability). Variable values are on the horizontal axis (units based on inputs; see Keinath et al 2010b for details).
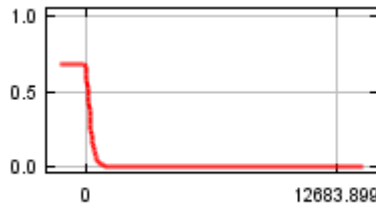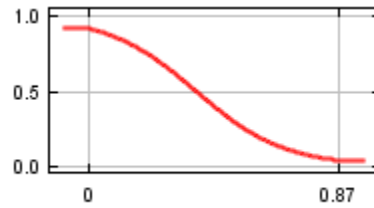
Deciduous Forest Index
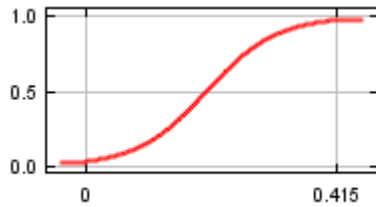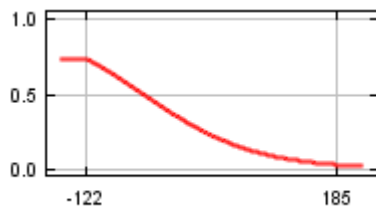

Radiation of the lightest month
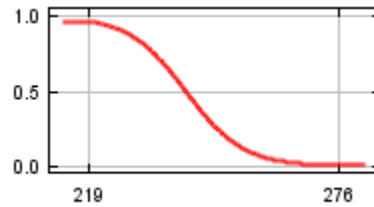
Potential for Rock Outcrop

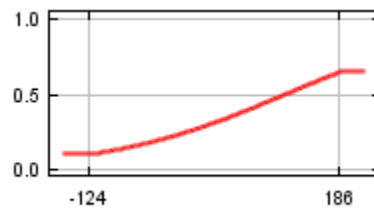**Soil - Fraction Sand**

Driest quarter mean temperature


Wettest quarter mean temperature

Plains Black-headed Snake (*Tantilla nigriceps*)
Range Map and Distribution Model Summary

August 20, 2010

This report presents range and distribution of Plains Black-headed Snake (ARADB35050) in Wyoming (see Keinath et al. 2010b). Similar reports were developed by the Wyoming Natural Diversity Database for terrestrial vertebrate species of conservation need in Wyoming's State Wildlife Action Plan. This effort was supported by the Wyoming Game and Fish Department and the U.S. Geological Survey.
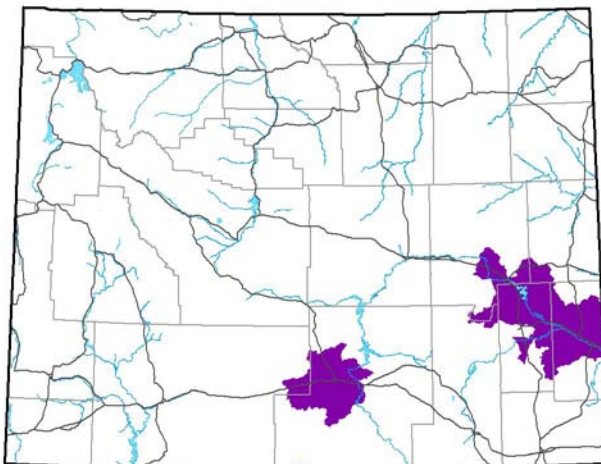
Range Map - Occupancy
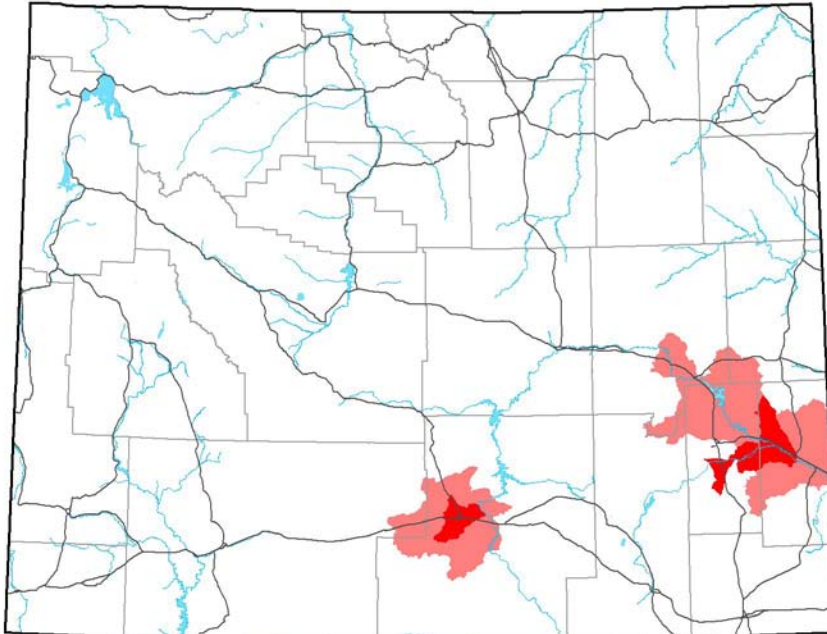
Known   Suspected   Accidental   Historical

Range Notes

- Version: 2010-01-19
- Proportion of range deemed known based on documented occurrences: 0.158
- Details of range map creation noted in Keinath et al. (2010a).

Range Map - Seasonality

Year-Round   Summer   Winter   Spring/Fall

Maps, models and report were created by and are available from the Wyoming Natural Diversity Database. (http://uwadmnweb.uwyo.edu/wyndd/).

Doug Keinath, Senior Zoologist

Mark Andersen, GIS Specialist

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Comments

There were too few occurrence points to construct a distribution model for this species. Collection of additional, high-quality occurrence locations are necessary for assessment of potential distribution within Wyoming.

References

Keinath, D.A., M.D. Andersen, and G.P Beauvais. 2010a. Range maps for Wyoming's species of greatest conservation need. Report prepared for the Wyoming Game and Fish Department by the Wyoming Natural Diversity Database, Laramie, Wyoming. January 19, 2010.

Keinath, D.A., M.D. Andersen, and G.P. Beauvais. 2010b. Range and modeled distribution of Wyoming's species of greatest conservation need. Report prepared by the Wyoming Natural Diversity Database, Laramie Wyoming for the Wyoming Game and Fish Department, Cheyenne, Wyoming and the U.S. Geological Survey, Fort Collins, Colorado. August 20, 2010.

Wandering Gartersnake (*Thamnophis elegans vagrans*) Range Map and Distribution Model Summary

August 20, 2010

This report presents range and distribution of Wandering Gartersnake (ARADB36050) in Wyoming (see Keinath et al. 2010b). Similar reports were developed by the Wyoming Natural Diversity Database for terrestrial vertebrate species of conservation need in Wyoming's State Wildlife Action Plan. This effort was supported by the Wyoming Game and Fish Department and the U.S. Geological Survey.
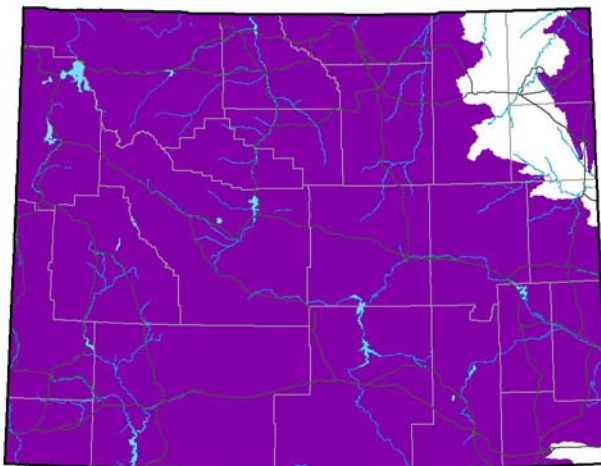
Range Map - Occupancy
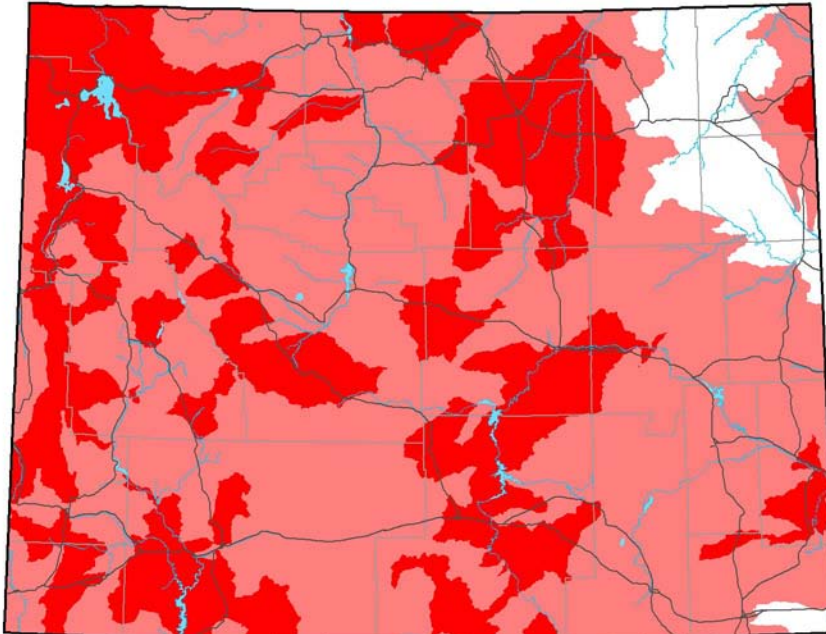
Range Notes

- Version: 2010-01-19
- Proportion of range deemed known based on documented occurrences: 0.280
- Details of range map creation noted in Keinath et al. (2010a).

Range Map - Seasonality

Maps, models and report were created by and are available from the Wyoming Natural Diversity Database. (http://uwadmnweb.uwyo.edu/wyndd/).
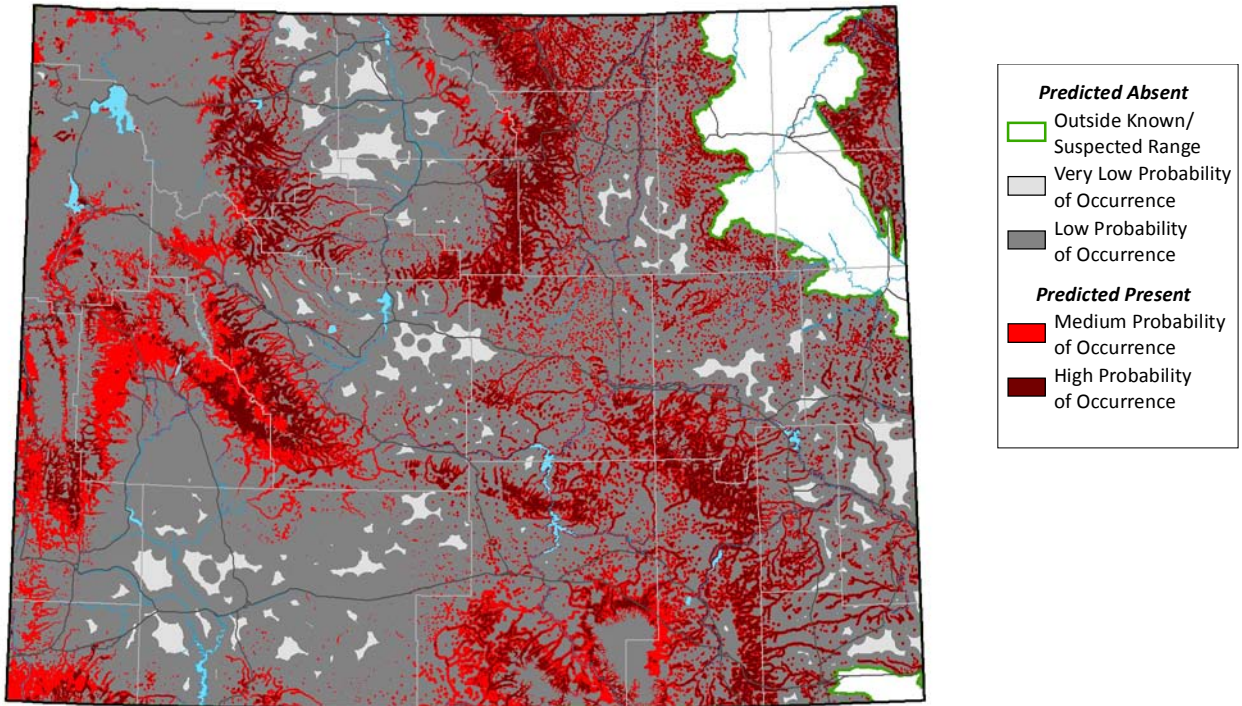
Doug Keinath, Senior Zoologist

Mark Andersen, GIS Specialist

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# Distribution Model (Version: Wed Mar 17 04:56:16 MDT 2010)

Details of distribution model creation are presented in Keinath et al. (2010b)

Predicted Absent
- Outside Known/ Suspected Range
- Very Low Probability of Occurrence
- Low Probability of Occurrence

Predicted Present
- Medium Probability of Occurrence
- High Probability of Occurrence

Model Parameters

- Season Modeled: Year-Round
- Algorithm: Maxent version 3.3.1
- Feature Types: Linear, Product
- Binary Threshold Rule: Maximum training sensitivity plus specificity
- Binary Threshold Value: 0.4359750
- High-Probability Threshold Value: 0.5259595
- Low-Probability Threshold Value: 0.0137789

Model Evaluation - ROC Plot
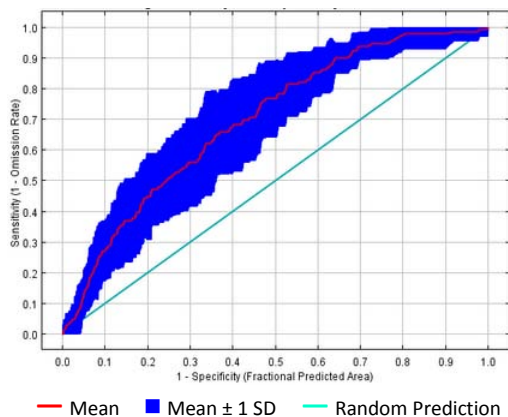
Mean — Mean ± 1 SD — Random Prediction

Model Quality Summary

Overall Assessment of Model Quality: LOW
Expert Assessment: Low
Occurrence Sample Size: High
Quality of Occurrences: High
Positive Success Rate: Low
Test AUC and Model Gain: Low

Model Evaluation Statistics
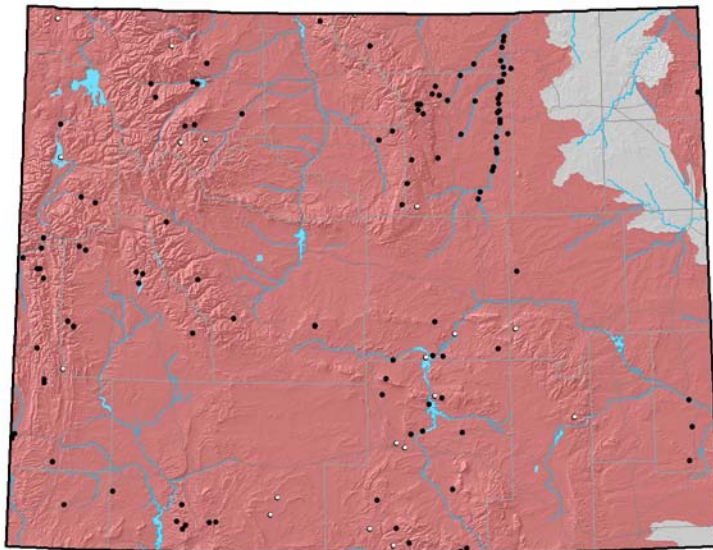
Final Model Statistics
Training AUC: 0.737
Regularized Training Gain: 0.312

Cross-Validation Statistics
- Average Test AUC: 0.696 ± 0.075
- Upper Bound on Test AUC: 0.713
- Average Test Gain: 0.137 ± 0.393
- Omission Error (fraction of test points omitted during 10-fold cross validation): 0.36± 0.14

Occurrence Data for Distribution Model

Occurrence Map

Points Used in Modeling, by Year of Observation
- Pre-1985
- 1985 or Later

Known and Suspected Range

Occurrence Summary Statistics

- Number of Occurrences in AWVED master dataset: 198
- Number of Occurrences used to create distribution model: 129
- Average Point Quality Index (highest quality is 12.00): 8.19 ± 3.08
- Most recent occurrence used: 2008
- Oldest occurrence used: 1934
- Occurrence File: LOCAL_SAMPLE_POINTS_W_PDOG_2.csv

Comments

This species uses aspects of wetlands (e.g., dense emergent vegetation) for which statewide data are not available or reliable. This often results in low model quality because key habitat features are not mappable across the state. Great improvements in our ability to model this species distribution could be obtained by improving wetland maps. Conclusive identification of this species is difficult unless the observer is experienced with the species. We suspect numerous occurrences could be in error, thus resulting in lower than expected model quality. The lack of supporting data provided with many occurrences (notably those from the Wildlife Observation System) makes it impossible to assess the accuracy of such observations. Supplementation/replacement of the existing data set with high-quality occurrence locations could greatly improve the modeled distribution for this species.

References

Keinath, D.A., M.D. Andersen, and G.P Beauvais. 2010a. Range maps for Wyoming's species of greatest conservation need. Report prepared for the Wyoming Game and Fish Department by the Wyoming Natural Diversity Database, Laramie, Wyoming. January 19, 2010.

Keinath, D.A., M.D. Andersen, and G.P. Beauvais. 2010b. Range and modeled distribution of Wyoming's species of greatest conservation need. Report prepared by the Wyoming Natural Diversity Database, Laramie Wyoming for the Wyoming Game and Fish Department, Cheyenne, Wyoming and the U.S. Geological Survey, Fort Collins, Colorado. August 20, 2010.

Predictor Variables used in the Distribution Model

Percent Contribution (PC) to final model

| Environmental Variable	PC
Distance to Permanent Water	39
Annual mean relative humidity	36
Precipitation of the driest quarter	10
Forest Cover Index	7
Conifer Index	7
Deciduous Forest Index	1

Response Curves

Each curve shows dependence of predicted suitability on input values of a single predictor variable considering correlations with others. Suitability is on the vertical axis (units: probability). Variable values are on the horizontal axis (units based on inputs; see Keinath et al 2010b for details).
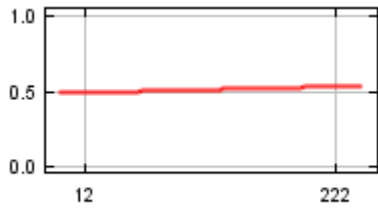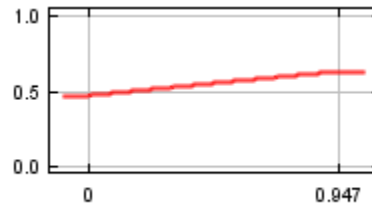
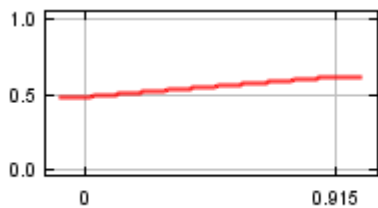**Distance to Permanent Water**
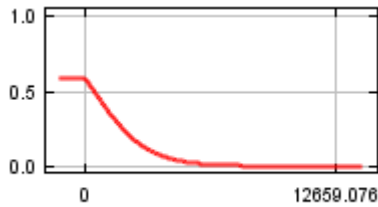
Annual mean relative humidity
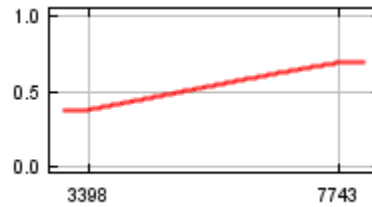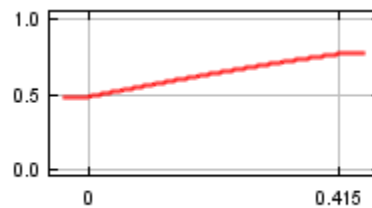

Precipitation of the driest quarter

Forest Cover Index

Conifer Index


Deciduous Forest Index

Plains Gartersnake (*Thamnophis radix*)
Range Map and Distribution Model Summary

August 20, 2010

This report presents range and distribution of Plains Gartersnake (ARADB36100) in Wyoming (see Keinath et al. 2010b). Similar reports were developed by the Wyoming Natural Diversity Database for terrestrial vertebrate species of conservation need in Wyoming's State Wildlife Action Plan. This effort was supported by the Wyoming Game and Fish Department and the U.S. Geological Survey.
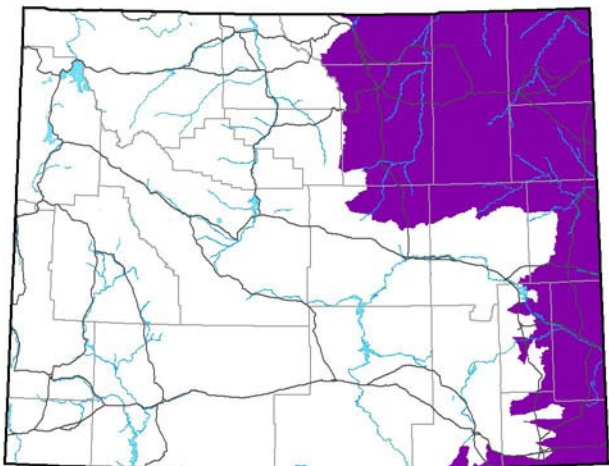
Range Map - Occupancy
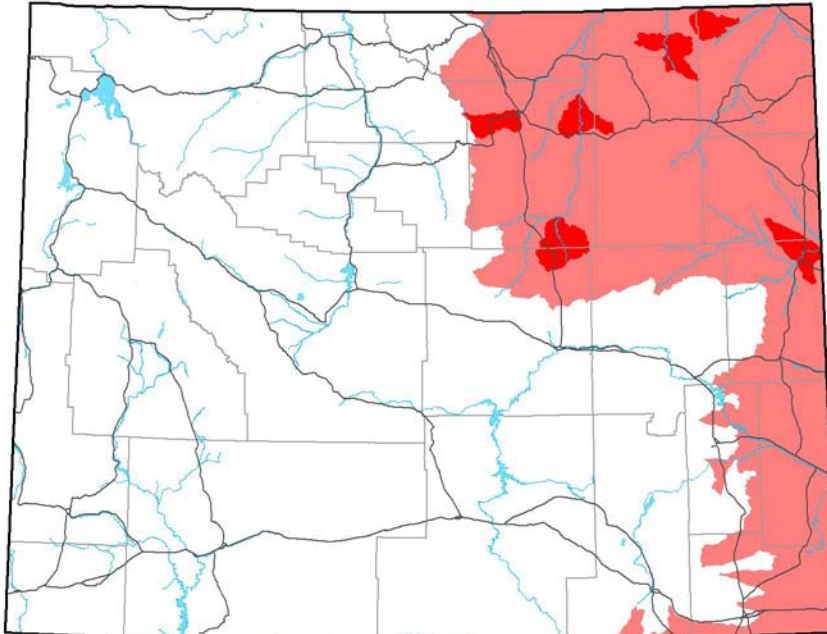
Range Notes
- Version: 2010-01-19
- Proportion of range deemed known based on documented occurrences: 0.052
- Details of range map creation noted in Keinath et al. (2010a).

Range Map - Seasonality

Maps, models and report were created by and are available from the Wyoming Natural Diversity Database. (http://uwadmnweb.uwyo.edu/wyndd/).
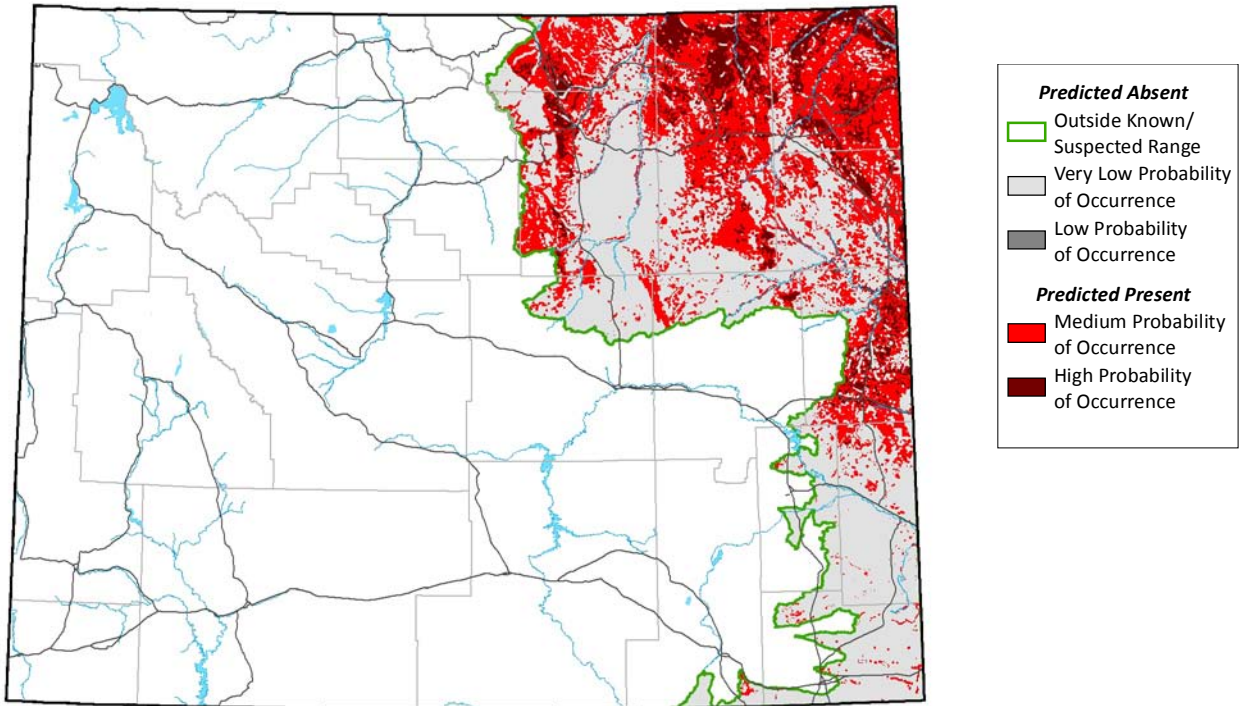
Doug Keinath, Senior Zoologist

Mark Andersen, GIS Specialist

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Distribution Model (Version: Thu Apr 22 14:37:48 MDT 2010)

Details of distribution model creation are presented in Keinath et al. (2010b)

Predicted Absent
- ☐ Outside Known/ Suspected Range
- Very Low Probability of Occurrence
- Low Probability of Occurrence

Predicted Present
- Medium Probability of Occurrence
- High Probability of Occurrence

Model Parameters

- Season Modeled: Year-Round
- Algorithm: Maxent version 3.3.1
- Feature Types: Linear, Quadratic, Hinge
- Binary Threshold Rule: Maximum training sensitivity plus specificity
- Binary Threshold Value: 0.2583430
- High-Probability Threshold Value: 0.6876158
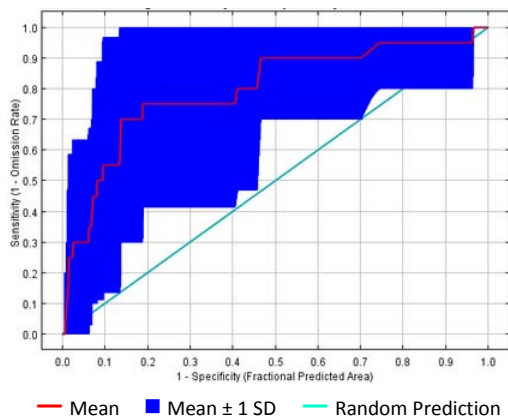- Low-Probability Threshold Value: 0.2583428

Model Evaluation - ROC Plot

Mean — Mean ± 1 SD — Random Prediction

Model Quality Summary

Overall Assessment of Model Quality: MEDIUM

Expert Assessment: Medium
Occurrence Sample Size: Low
Quality of Occurrences: Medium
Positive Success Rate: Low
Test AUC and Model Gain: Medium

Model Evaluation Statistics
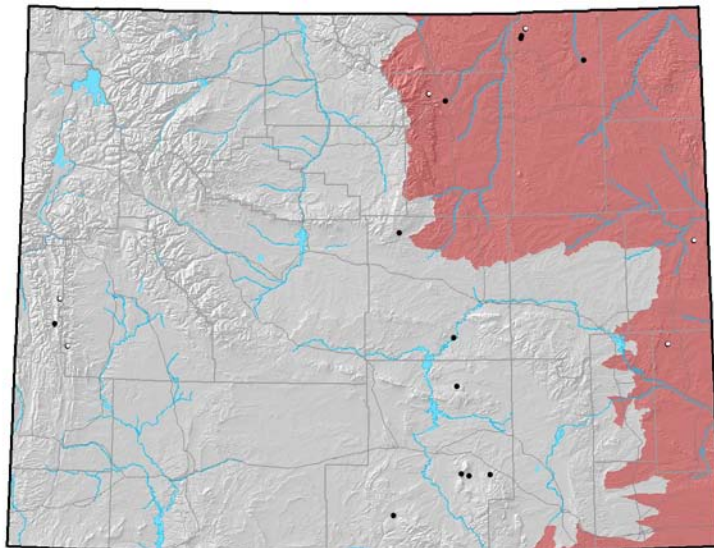
Final Model Statistics

Training AUC: 0.934
Regularized Training Gain: 1.077

Cross-Validation Statistics

- Average Test AUC: 0.796 ± 0.201
- Upper Bound on Test AUC: 0.870
- Average Test Gain: 0.272 ± 1.876
- Omission Error (fraction of test points omitted during 10-fold cross validation): 0.35± 0.41

Occurrence Data for Distribution Model

Occurrence Map

Points Used in Modeling, by Year of Observation
  ° Pre-1985
  • 1985 or Later

Known and Suspected Range

Occurrence Summary Statistics

- Number of Occurrences in AWVED master dataset: 28
- Number of Occurrences used to create distribution model: 18
- Average Point Quality Index (highest quality is 12.00): 6.50 ± 2.92
- Most recent occurrence used: 2008
- Oldest occurrence used: 1906
- Occurrence File: LOCAL_SAMPLE_POINTS_W_PDOG_2.csv

Comments

This species uses aspects of wetlands (e.g., dense emergent vegetation) for which statewide data are not available or reliable. This often results in low model quality because key habitat features are not mappable across the state. Great improvements in our ability to model this species distribution could be obtained by improving wetland maps. Conclusive identification of this species is difficult unless the observer is experienced with the species. We suspect numerous occurrences could be in error, thus resulting in lower than expected model quality. The lack of supporting data provided with many occurrences (notably those from the Wildlife Observation System) makes it impossible to assess the accuracy of such observations. Supplementation/replacement of the existing data set with high-quality occurrence locations could greatly improve the modeled distribution for this species. Due to timing of range map edits, the distribution model for plains gartersnake was created before final edits were made to the range map. As a result, several datapoints used in the model fall outside the accepted range of the species. Future versions of the model should eliminate these occurrences, as they are likely miss-identified records of other gartersnakes.

References

Keinath, D.A., M.D. Andersen, and G.P Beauvais. 2010a. Range maps for Wyoming's species of greatest conservation need. Report prepared for the Wyoming Game and Fish Department by the Wyoming Natural Diversity Database, Laramie, Wyoming. January 19, 2010.

Keinath, D.A., M.D. Andersen, and G.P. Beauvais. 2010b. Range and modeled distribution of Wyoming's species of greatest conservation need. Report prepared by the Wyoming Natural Diversity Database, Laramie Wyoming for the Wyoming Game and Fish Department, Cheyenne, Wyoming and the U.S. Geological Survey, Fort Collins, Colorado. August 20, 2010.

# Predictor Variables used in the Distribution Model

Percent Contribution (PC) to final model

Environmental Variable	*PC*
Conifer Index	29
Precipitation of the wettest quarter	18
Herbaceous Cover Index	17
Isothermality (T2/T5)	15
Cottonwood Index	13
Depth to Shallowest Restrictive Layer	8

Response Curves

Each curve shows dependence of predicted suitability on input values of a single predictor variable considering correlations with others. Suitability is on the vertical axis (units: probability). Variable values are on the horizontal axis (units based on inputs; see Keinath et al 2010b for details).
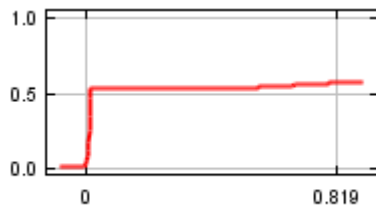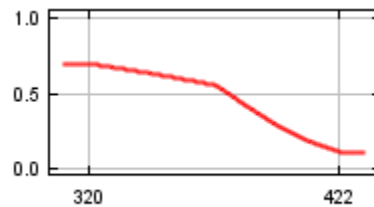
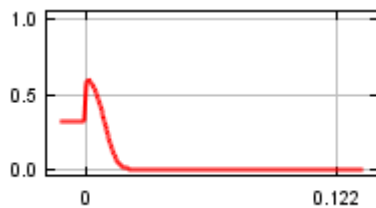**Conifer Index**
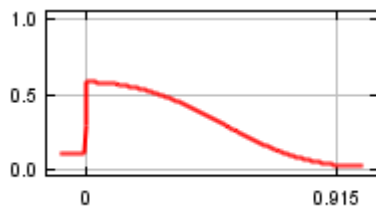
Precipitation of the wettest quarter
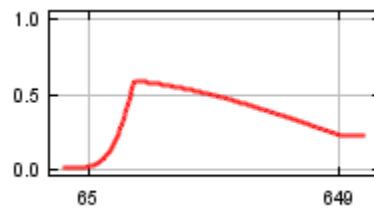
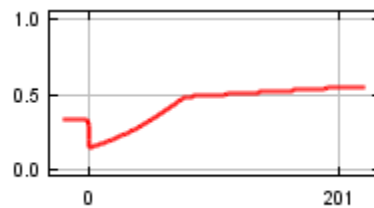

Herbaceous Cover Index

Isothermality (T2/T5)

Cottonwood Index

**Depth to Shallowest Restrictive Layer**

Red-sided Gartersnake (*Thamnophis sirtalis parietalis*) Range Map and Distribution Model Summary

August 20, 2010

This report presents range and distribution of Red-sided Gartersnake (ARADB3613C) in Wyoming (see Keinath et al. 2010b). Similar reports were developed by the Wyoming Natural Diversity Database for terrestrial vertebrate species of conservation need in Wyoming's State Wildlife Action Plan. This effort was supported by the Wyoming Game and Fish Department and the U.S. Geological Survey.
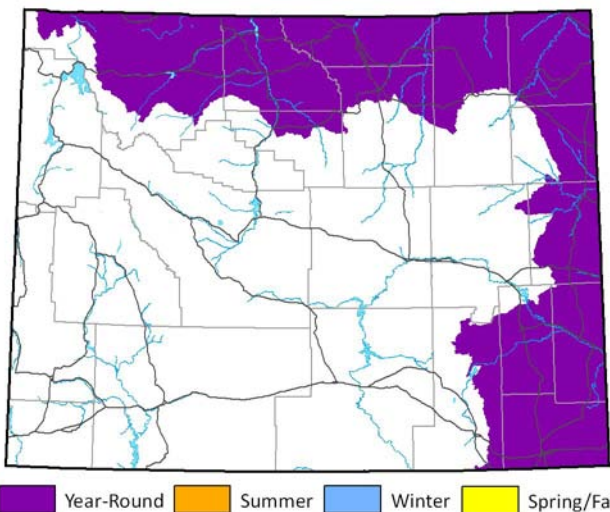
Range Map - Occupancy

Known Suspected Accidental Historical
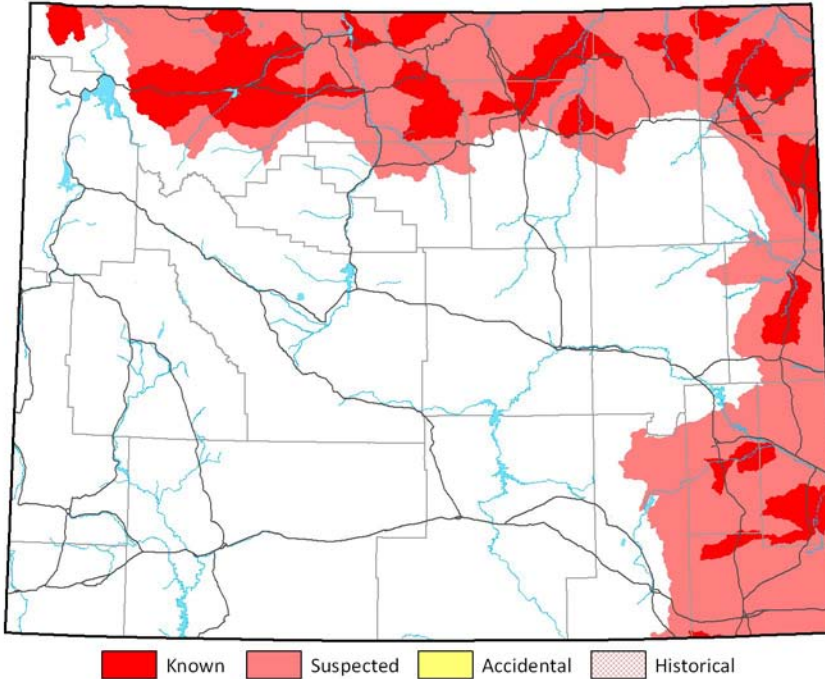
Range Notes
- Version: 2010-01-19
- Proportion of range deemed known based on documented occurrences: 0.235
- Details of range map creation noted in Keinath et al. (2010a).

Range Map - Seasonality

Year-Round Summer Winter Spring/Fall

Maps, models and report were created by and are available from the Wyoming Natural Diversity Database. (http://uwadmnweb.uwyo.edu/wyndd/).
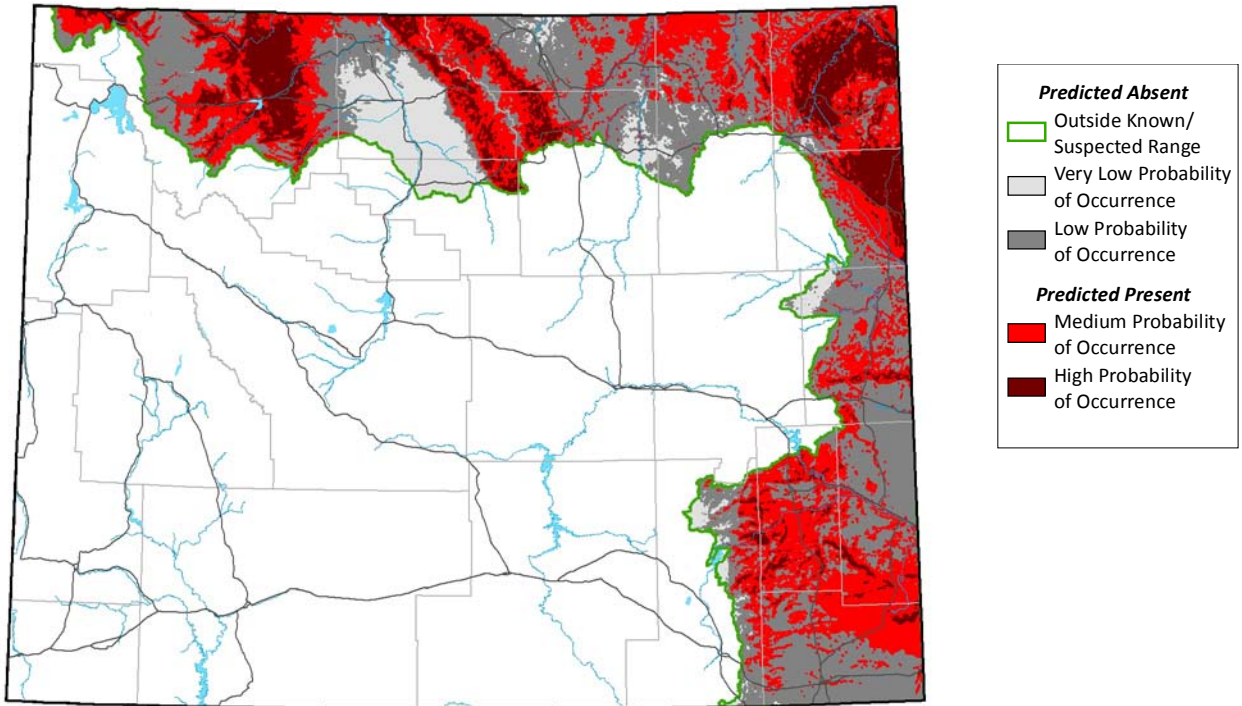
Doug Keinath, Senior Zoologist

Mark Andersen, GIS Specialist

© 2010, WYNDD

## Distribution Model (Version: Wed Mar 17 04:27:30 MDT 2010)

Details of distribution model creation are presented in Keinath et al. (2010b)

Predicted Absent
- Outside Known/ Suspected Range
- Very Low Probability of Occurrence
- Low Probability of Occurrence

Predicted Present
- Medium Probability of Occurrence
- High Probability of Occurrence

Model Parameters

- Season Modeled: Year-Round
- Algorithm: Maxent version 3.3.1
- Feature Types: Linear, Quadratic, Hinge
- Binary Threshold Rule: Maximum training sensitivity plus specificity
- Binary Threshold Value: 0.3157210
- High-Probability Threshold Value: 0.6146828
- Low-Probability Threshold Value: 0.0806229

Model Evaluation - ROC Plot
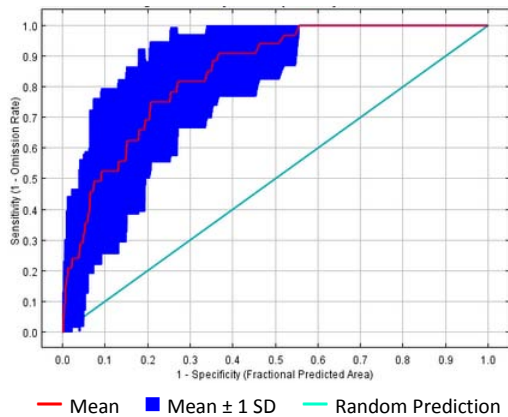
Mean — Mean ± 1 SD — Random Prediction

Model Quality Summary

Overall Assessment of Model Quality: MEDIUM

Expert Assessment: Medium
Occurrence Sample Size: Medium
Quality of Occurrences: Medium
Positive Success Rate: Medium
Test AUC and Model Gain: Medium

Model Evaluation Statistics
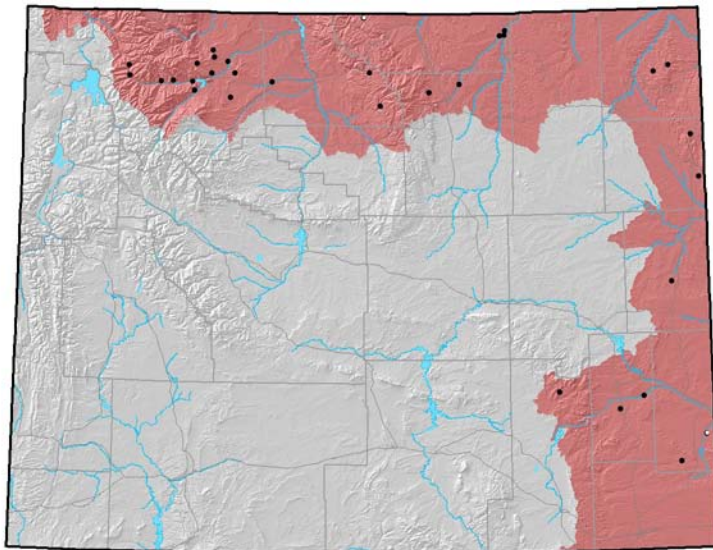
Final Model Statistics

Training AUC: 0.917
Regularized Training Gain: 1.172

Cross-Validation Statistics

- Average Test AUC: 0.847 ± 0.069
- Upper Bound on Test AUC: 0.879
- Average Test Gain: 0.868 ± 0.641
- Omission Error (fraction of test points omitted during 10-fold cross validation): 0.27± 0.22

Occurrence Data for Distribution Model

Occurrence Map

Points Used in Modeling, by Year of Observation
  ○ Pre-1985
  • 1985 or Later

Known and Suspected Range

Occurrence Summary Statistics

- Number of Occurrences in AWVED master dataset: 39
- Number of Occurrences used to create distribution model: 32
- Average Point Quality Index (highest quality is 12.00): 7.78 ± 1.91
- Most recent occurrence used: 2008
- Oldest occurrence used: 1981
- Occurrence File: REVISED_SAMPLE_POINTS_ALL_SPP.csv

Comments

Conclusive identification of this species is difficult unless the observer is experienced with the species. We suspect numerous occurrences could be in error, thus resulting in lower than expected model quality. The lack of supporting data provided with many occurrences (notably those from the Wildlife Observation System) makes it impossible to assess the accuracy of such observations. Supplementation/replacement of the existing data set with high-quality occurrence locations could greatly improve the modeled distribution for this species.

References

Keinath, D.A., M.D. Andersen, and G.P Beauvais. 2010a. Range maps for Wyoming's species of greatest conservation need. Report prepared for the Wyoming Game and Fish Department by the Wyoming Natural Diversity Database, Laramie, Wyoming. January 19, 2010.

Keinath, D.A., M.D. Andersen, and G.P. Beauvais. 2010b. Range and modeled distribution of Wyoming's species of greatest conservation need. Report prepared by the Wyoming Natural Diversity Database, Laramie Wyoming for the Wyoming Game and Fish Department, Cheyenne, Wyoming and the U.S. Geological Survey, Fort Collins, Colorado. August 20, 2010.

Predictor Variables used in the Distribution Model

Percent Contribution (PC) to final model

Environmental Variable	PC
Radiation of the lightest month	49
Wettest quarter mean temperature	15
Annual temperature range (T3 – T4)	15
Pinon-Juniper Index	9
Deciduous Forest Index	7
Annual total radiation	5

Response Curves

Each curve shows dependence of predicted suitability on input values of a single predictor variable considering correlations with others. Suitability is on the vertical axis (units: probability). Variable values are on the horizontal axis (units based on inputs; see Keinath et al 2010b for details).
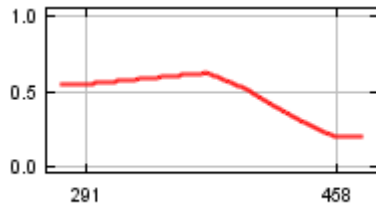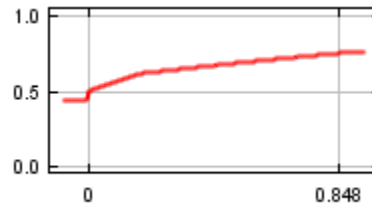
Radiation of the lightest month
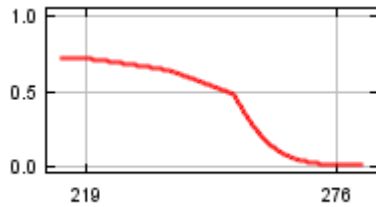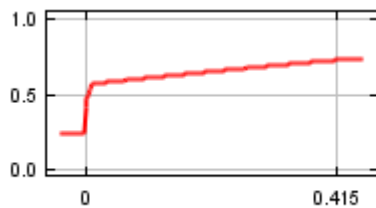
Wettest quarter mean temperature
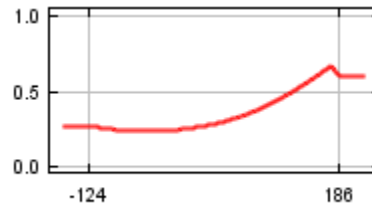
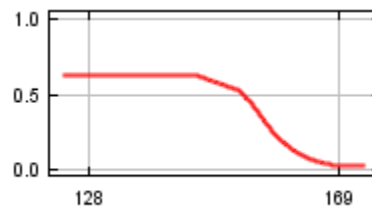**Annual temperature range (T3 – T4)**

Pinon-Juniper Index

Deciduous Forest Index

**Annual total radiation**

Valley Gartersnake (*Thamnophis sirtalis fitchi*)
Range Map and Distribution Model Summary

August 20, 2010

This report presents range and distribution of Valley Gartersnake (ARADB3613X) in Wyoming (see Keinath et al. 2010b). Similar reports were developed by the Wyoming Natural Diversity Database for terrestrial vertebrate species of conservation need in Wyoming's State Wildlife Action Plan. This effort was supported by the Wyoming Game and Fish Department and the U.S. Geological Survey.
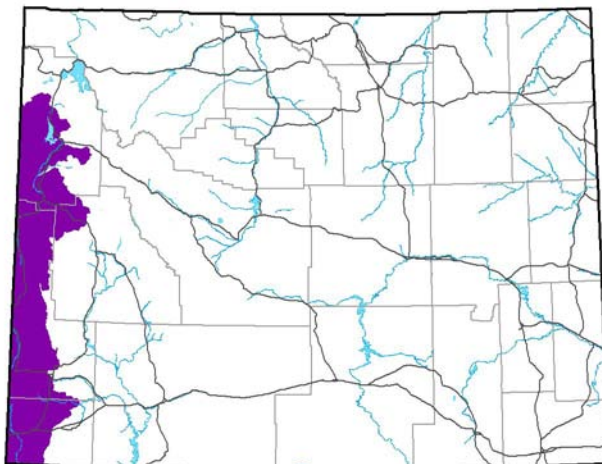
Range Map - Occupancy
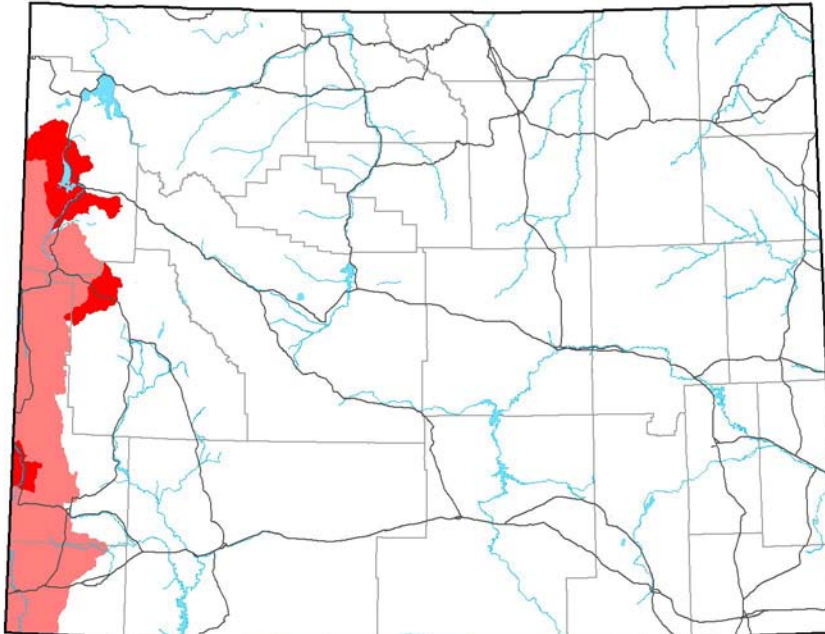
Known | Suspected | Accidental | Historical

Range Notes
- Version: 2010-01-19
- Proportion of range deemed known based on documented occurrences: 0.167
- Details of range map creation noted in Keinath et al. (2010a).

Range Map - Seasonality

Year-Round | Summer | Winter | Spring/Fall

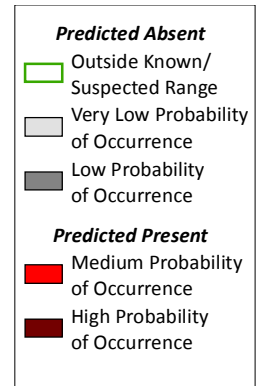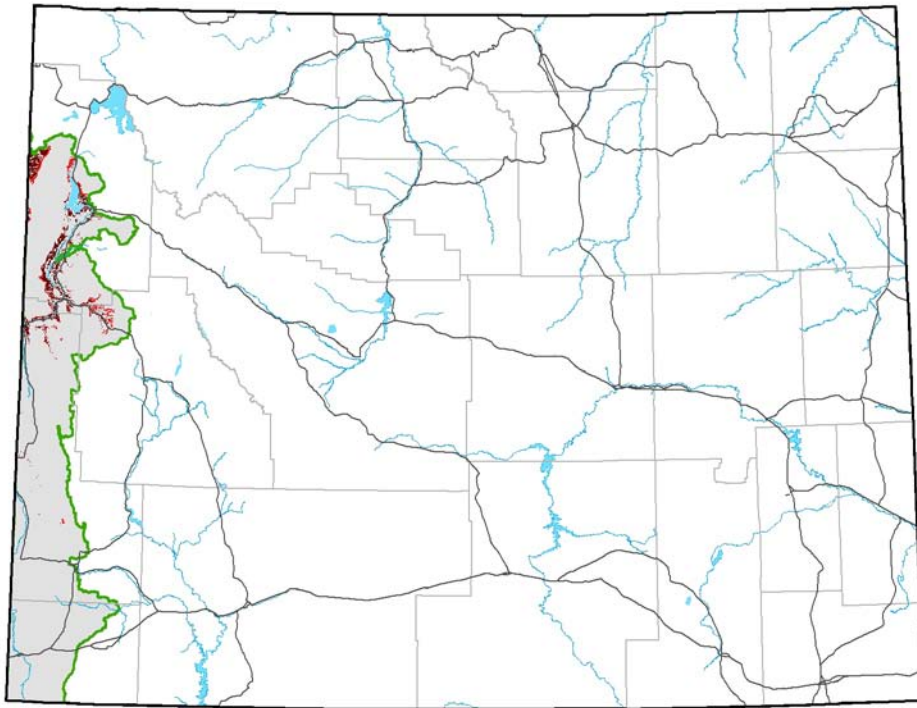Maps, models and report were created by and are available from the Wyoming Natural Diversity Database. (http://uwadmnweb.uwyo.edu/wyndd/).

Doug Keinath, Senior Zoologist

Mark Andersen, GIS Specialist

© 2010, WYNDD

Distribution Model (Version: Fri Apr 02 16:03:25 MDT 2010)
Details of distribution model creation are presented in Keinath et al. (2010b)

Predicted Absent
- Outside Known/ Suspected Range
- Very Low Probability of Occurrence
- Low Probability of Occurrence

Predicted Present
- Medium Probability of Occurrence
- High Probability of Occurrence

Model Parameters
- Season Modeled: Year-Round
- Algorithm: Maxent version 3.3.1
- Feature Types: Linear
- Binary Threshold Rule: Maximum training sensitivity plus specificity
- Binary Threshold Value: 0.5960850
- High-Probability Threshold Value: 0.6662462
- Low-Probability Threshold Value: 0.5960850

Model Evaluation - ROC Plot

— Mean   ■ Mean ± 1 SD   — Random Prediction

Model Quality Summary
Overall Assessment of Model Quality: LOW
Expert Assessment: Low
Occurrence Sample Size: Very Low
Quality of Occurrences: High
Positive Success Rate: Very High
Test AUC and Model Gain: Low
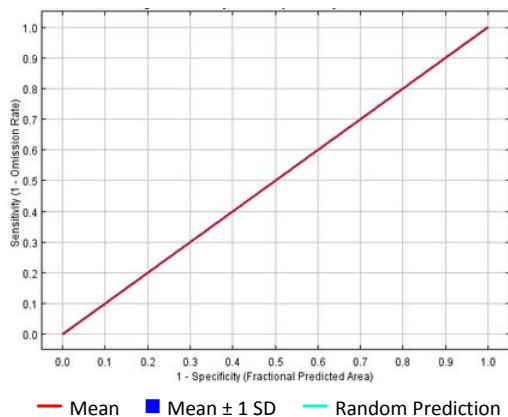
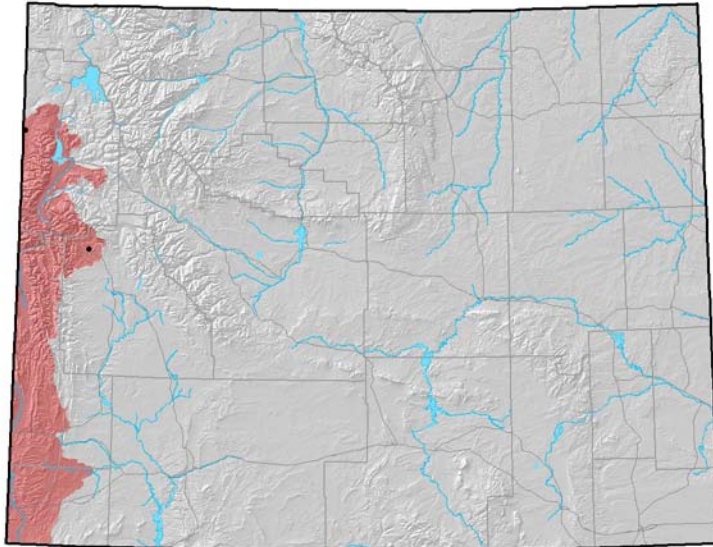## Model Evaluation Statistics
Final Model Statistics
Training AUC: 0.995
Regularized Training Gain: 3.415

Cross-Validation Statistics
- Average Test AUC: 0.100 ± 0.211
- Upper Bound on Test AUC: 0.986
- Average Test Gain: 0.000 ± 0.000
- Omission Error (fraction of test points omitted during 2-fold cross validation): 0.00± 0.00

Occurrence Data for Distribution Model

Occurrence Map

Points Used in Modeling, by Year of Observation
- ○ Pre-1985
- • 1985 or Later

■ Known and Suspected Range

Occurrence Summary Statistics

- Number of Occurrences in AWVED master dataset: 5
- Number of Occurrences used to create distribution model: 2
- Average Point Quality Index (highest quality is 12.00): 9.00 ± 1.41
- Most recent occurrence used: 2006
- Oldest occurrence used: 2004
- Occurrence File: DRAFT_3_SAGE_WATER_RERUNS.csv

Comments

The model for this species is based on a small sample size of occurrence locations, which often results in low model quality. Collection of additional, high-quality occurrence locations could greatly improve the modeled distribution for this species. Conclusive identification of this species is difficult unless the observer is experienced with the species. We suspect numerous occurrences could be in error, thus resulting in lower than expected model quality. The lack of supporting data provided with many occurrences (notably those from the Wildlife Observation System) makes it impossible to assess the accuracy of such observations. Supplementation/replacement of the existing data set with high-quality occurrence locations could greatly improve the modeled distribution for this species.

References

Keinath, D.A., M.D. Andersen, and G.P Beauvais. 2010a. Range maps for Wyoming's species of greatest conservation need. Report prepared for the Wyoming Game and Fish Department by the Wyoming Natural Diversity Database, Laramie, Wyoming. January 19, 2010.

Keinath, D.A., M.D. Andersen, and G.P. Beauvais. 2010b. Range and modeled distribution of Wyoming's species of greatest conservation need. Report prepared by the Wyoming Natural Diversity Database, Laramie Wyoming for the Wyoming Game and Fish Department, Cheyenne, Wyoming and the U.S. Geological Survey, Fort Collins, Colorado. August 20, 2010.

# Predictor Variables used in the Distribution Model

Percent Contribution (PC) to final model

| Environmental Variable	PC
Wettest quarter mean temperature	48
Interannual variation in annual frost days	17
Percent Cover of sagebrush	14
Prevalence of Lakes/Large Rivers within 300 meters	14
Annual temperature range (T3 – T4)	3
Hottest month mean maximum temperature	3

Response Curves

Each curve shows dependence of predicted suitability on input values of a single predictor variable considering correlations with others. Suitability is on the vertical axis (units: probability). Variable values are on the horizontal axis (units based on inputs; see Keinath et al 2010b for details).
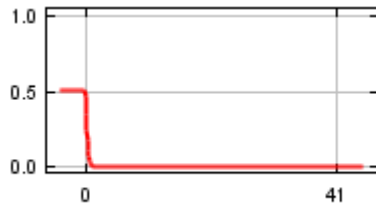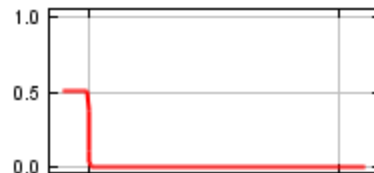
Wettest quarter mean temperature
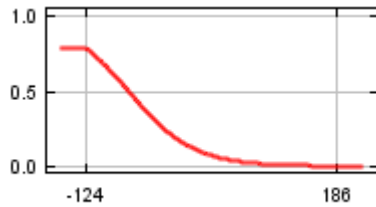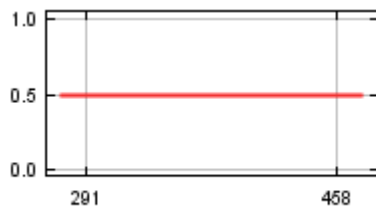
Interannual variation in annual frost days
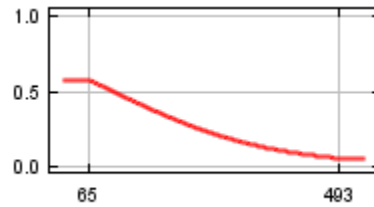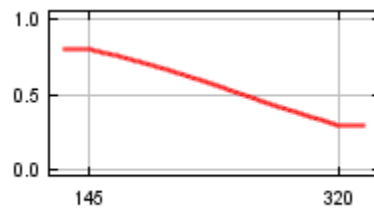
Percent Cover of sagebrush

Prevalence of Lakes/Large Rivers within 300 meters

Annual temperature range (T3 – T4)

**Hottest month mean maximum temperature**

Smooth Green Snake (*Opheodrys vernalis*)
Range Map and Distribution Model Summary

August 20, 2010

This report presents range and distribution of Smooth Green Snake (ARADB47010) in Wyoming (see Keinath et al. 2010b). Similar reports were developed by the Wyoming Natural Diversity Database for terrestrial vertebrate species of conservation need in Wyoming's State Wildlife Action Plan. This effort was supported by the Wyoming Game and Fish Department and the U.S. Geological Survey.
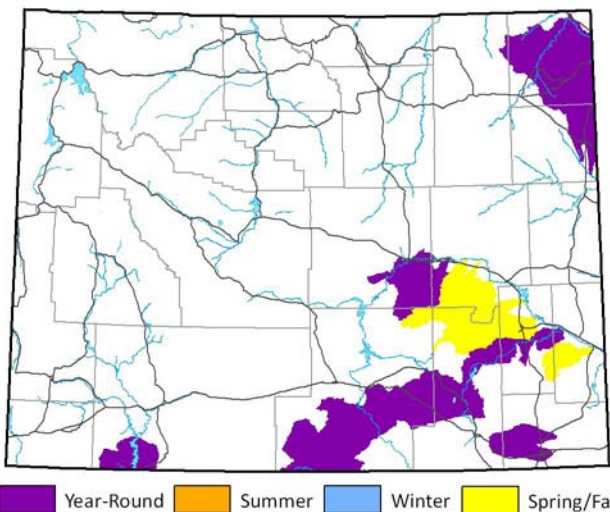
Range Map - Occupancy

Known | Suspected | Accidental | Historical
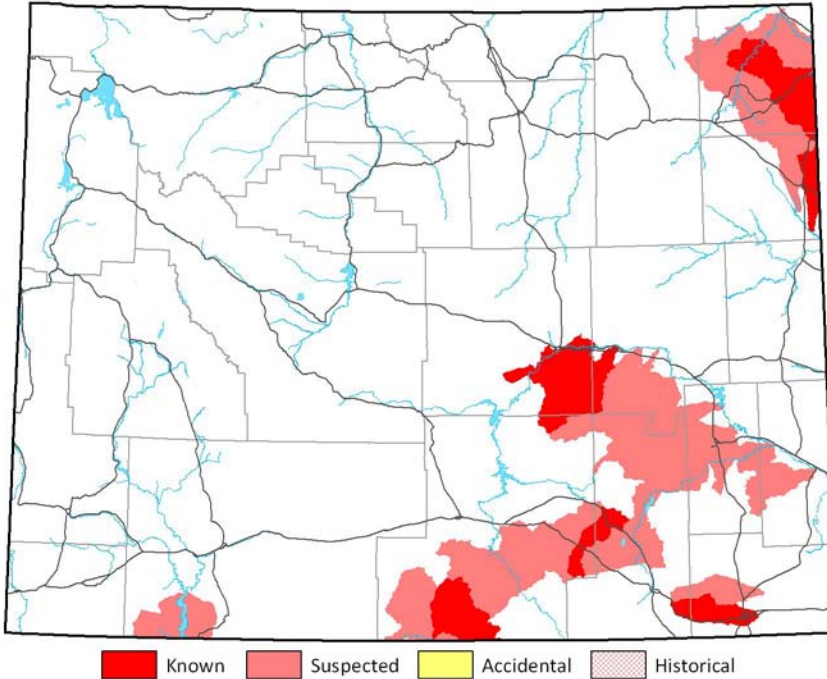
Range Notes
- Version: 2010-01-19
- Proportion of range deemed known based on documented occurrences: 0.353
- Details of range map creation noted in Keinath et al. (2010a).

Range Map - Seasonality

Year-Round | Summer | Winter | Spring/Fall

Maps, models and report were created by and are available from the Wyoming Natural Diversity Database. (http://uwadmnweb.uwyo.edu/wyndd/).
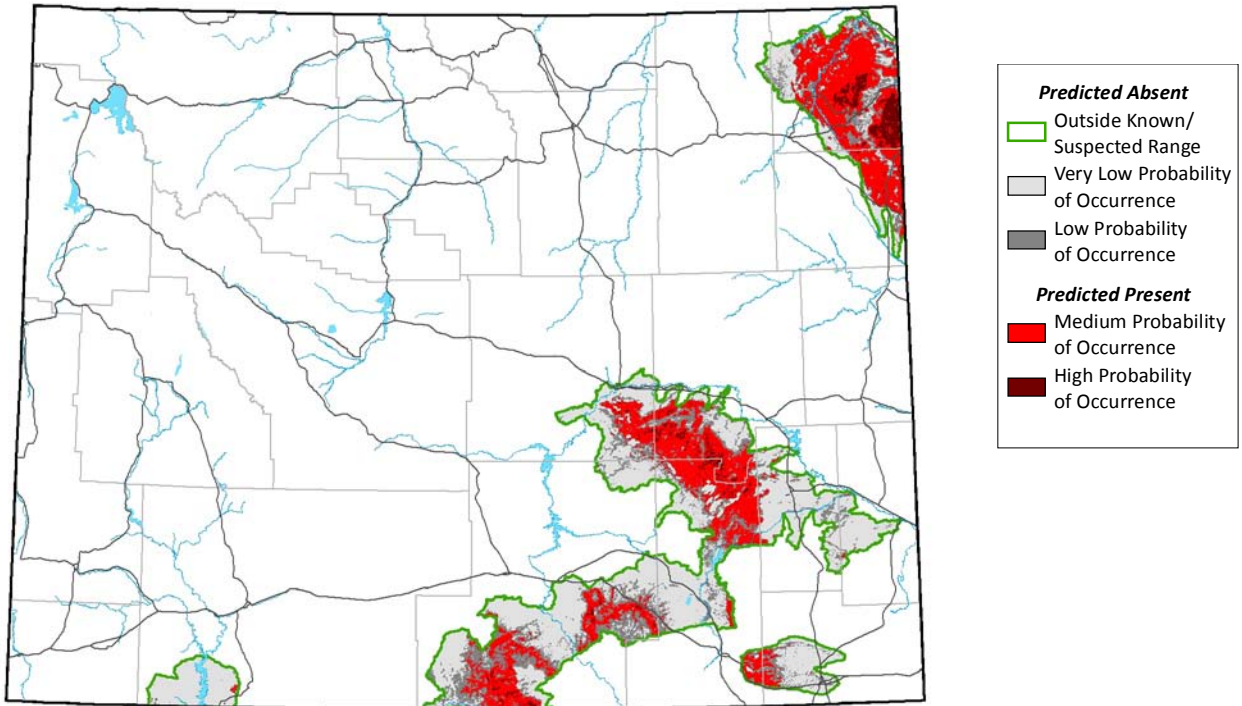
Doug Keinath, Senior Zoologist

Mark Andersen, GIS Specialist

© 2010, WYNDD

Distribution Model (Version: Sun Dec 06 20:16:29 MST 2009)

Details of distribution model creation are presented in Keinath et al. (2010b)

Predicted Absent
- Outside Known/ Suspected Range
- Very Low Probability of Occurrence
- Low Probability of Occurrence

Predicted Present
- Medium Probability of Occurrence
- High Probability of Occurrence

Model Parameters

- Season Modeled: Year-Round
- Algorithm: Maxent version 3.3.1
- Feature Types: Linear, Quadratic, Hinge
- Binary Threshold Rule: Maximum training sensitivity plus specificity
- Binary Threshold Value: 0.1173890
- High-Probability Threshold Value: 0.7417376
- Low-Probability Threshold Value: 0.0276957

Model Evaluation - ROC Plot

Mean — Mean ± 1 SD — Random Prediction

Model Quality Summary

Overall Assessment of Model Quality: MEDIUM

Expert Assessment: Medium
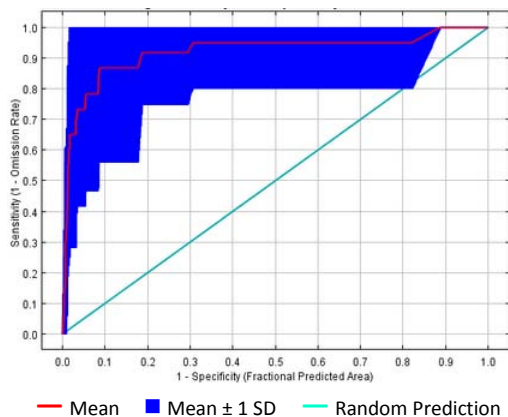Occurrence Sample Size: Medium
Quality of Occurrences: Medium
Positive Success Rate: High
Test AUC and Model Gain: High

Model Evaluation Statistics
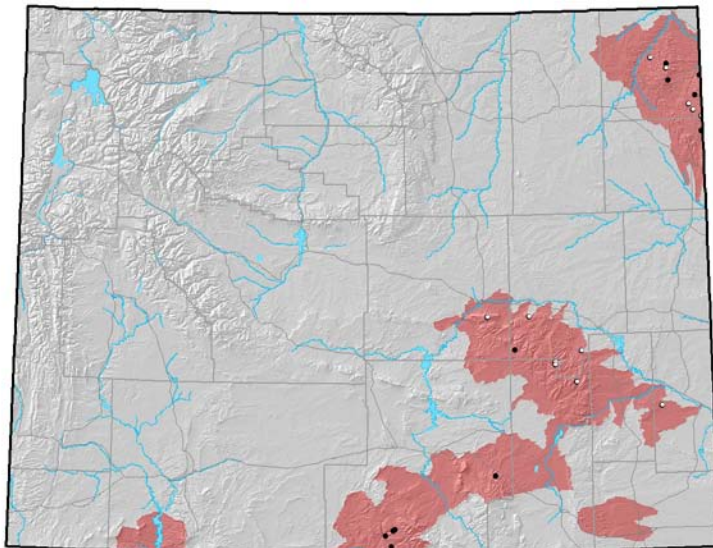
Final Model Statistics

Training AUC: 0.975
Regularized Training Gain: 2.349

Cross-Validation Statistics

- Average Test AUC: 0.921 ± 0.156
- Upper Bound on Test AUC: 0.946
- Average Test Gain: 1.933 ± 2.110
- Omission Error (fraction of test points omitted during 10-fold cross validation): 0.13± 0.32

Occurrence Data for Distribution Model

Occurrence Map

Points Used in Modeling, by Year of Observation
- ○ Pre-1985
- • 1985 or Later

■ Known and Suspected Range

Occurrence Summary Statistics

- Number of Occurrences in AWVED master dataset: 34
- Number of Occurrences used to create distribution model: 24
- Average Point Quality Index (highest quality is 12.00): 7.50 ± 2.99
- Most recent occurrence used: 2006
- Oldest occurrence used: 1938
- Occurrence File: LOCAL_SAMPLE_POINTS.csv

Comments

There are no additional comments specific to this species range map or distribution model.

References

Keinath, D.A., M.D. Andersen, and G.P Beauvais. 2010a. Range maps for Wyoming's species of greatest conservation need. Report prepared for the Wyoming Game and Fish Department by the Wyoming Natural Diversity Database, Laramie, Wyoming. January 19, 2010.

Keinath, D.A., M.D. Andersen, and G.P. Beauvais. 2010b. Range and modeled distribution of Wyoming's species of greatest conservation need. Report prepared by the Wyoming Natural Diversity Database, Laramie Wyoming for the Wyoming Game and Fish Department, Cheyenne, Wyoming and the U.S. Geological Survey, Fort Collins, Colorado. August 20, 2010.

# Predictor Variables used in the Distribution Model

Percent Contribution (PC) to final model

| Environmental Variable	PC
Deciduous Forest Index	66
Wettest quarter mean temperature	10
Vector Ruggedness Measure	10
Precipitation of the wettest quarter	6
Pinon-Juniper Index	4
Conifer Index	4

Response Curves

Each curve shows dependence of predicted suitability on input values of a single predictor variable considering correlations with others. Suitability is on the vertical axis (units: probability). Variable values are on the horizontal axis (units based on inputs; see Keinath et al 2010b for details).
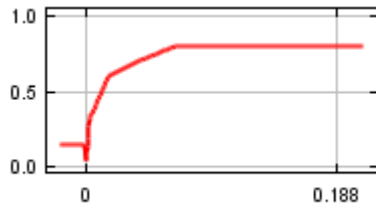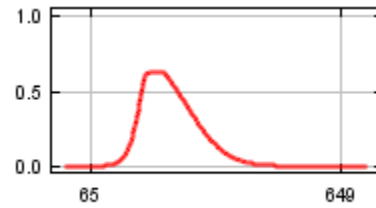
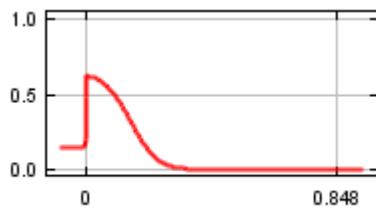**Deciduous Forest Index**
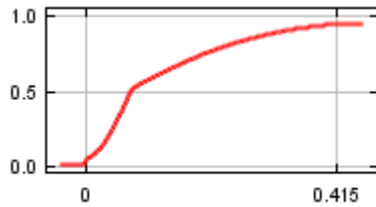
Wettest quarter mean temperature
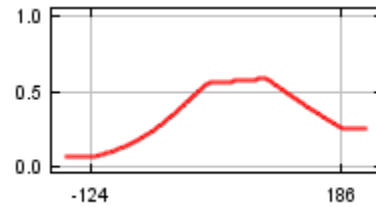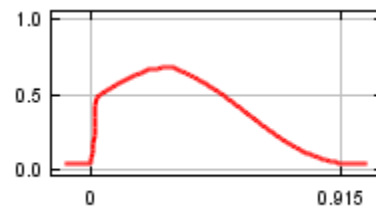
Vector Ruggedness Measure

Precipitation of the wettest quarter

Pinon-Juniper Index

Conifer Index

Prairie Rattlesnake (*Crotalus viridis*)
Range Map and Distribution Model Summary

August 20, 2010

This report presents range and distribution of Prairie Rattlesnake (ARADE02120) in Wyoming (see Keinath et al. 2010b). Similar reports were developed by the Wyoming Natural Diversity Database for terrestrial vertebrate species of conservation need in Wyoming's State Wildlife Action Plan. This effort was supported by the Wyoming Game and Fish Department and the U.S. Geological Survey.
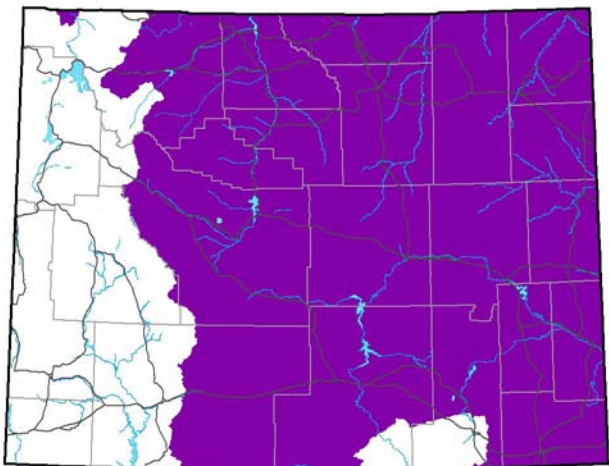
Range Map - Occupancy
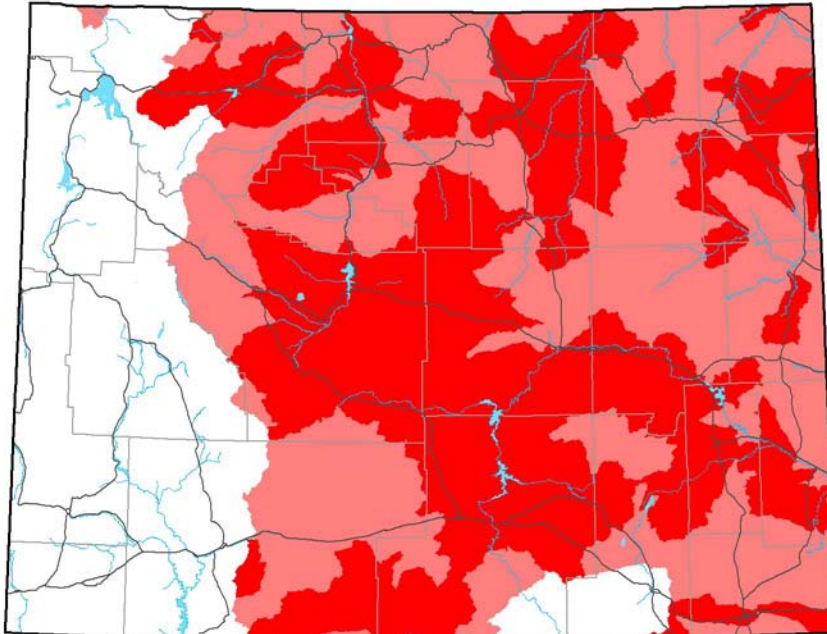
Known   Suspected   Accidental   Historical

Range Notes
- Version: 2010-01-19
- Proportion of range deemed known based on documented occurrences: 0.453
- Details of range map creation noted in Keinath et al. (2010a).

Range Map - Seasonality

Year-Round   Summer   Winter   Spring/Fall

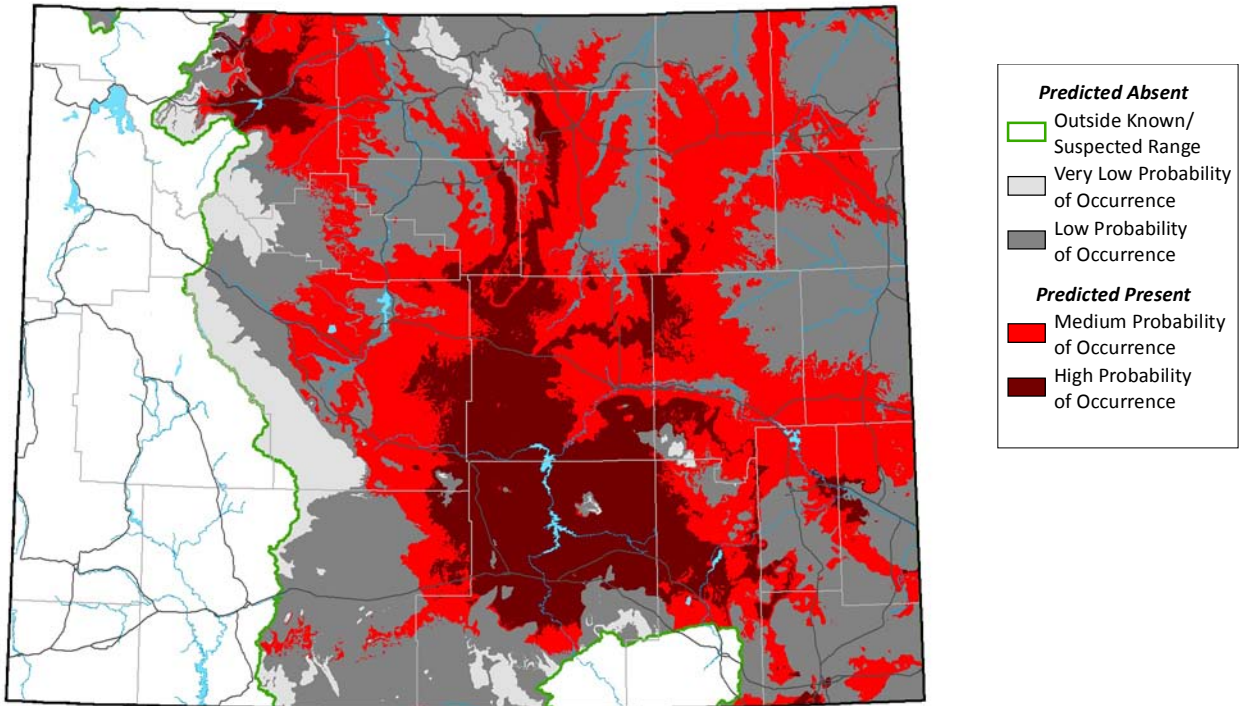Maps, models and report were created by and are available from the Wyoming Natural Diversity Database. (http://uwadmnweb.uwyo.edu/wyndd/).

Doug Keinath, Senior Zoologist

Mark Andersen, GIS Specialist

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# Distribution Model (Version: Tue Mar 16 17:04:14 MDT 2010)
Details of distribution model creation are presented in Keinath et al. (2010b)

Predicted Absent
- Outside Known/ Suspected Range
- Very Low Probability of Occurrence
- Low Probability of Occurrence

Predicted Present
- Medium Probability of Occurrence
- High Probability of Occurrence

Model Parameters
- Season Modeled: Year-Round
- Algorithm: Maxent version 3.3.1
- Feature Types: Linear, Product, Quadratic, Hinge, Threshold
- Binary Threshold Rule: Maximum training sensitivity plus specificity
- Binary Threshold Value: 0.3930900
- High-Probability Threshold Value: 0.5525965
- Low-Probability Threshold Value: 0.0351664

Model Evaluation - ROC Plot
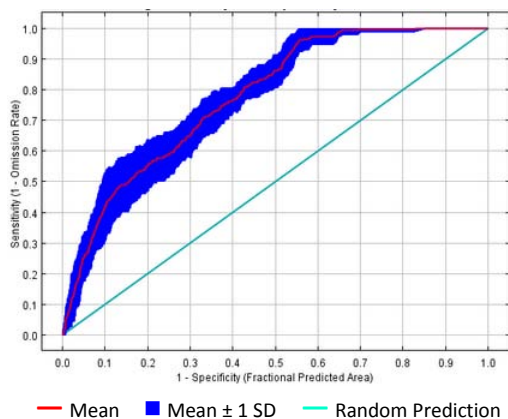
— Mean   ■ Mean ± 1 SD   — Random Prediction

Model Quality Summary
Overall Assessment of Model Quality: MEDIUM

Expert Assessment: Medium
Occurrence Sample Size: High
Quality of Occurrences: Medium
Positive Success Rate: Low
Test AUC and Model Gain: Medium

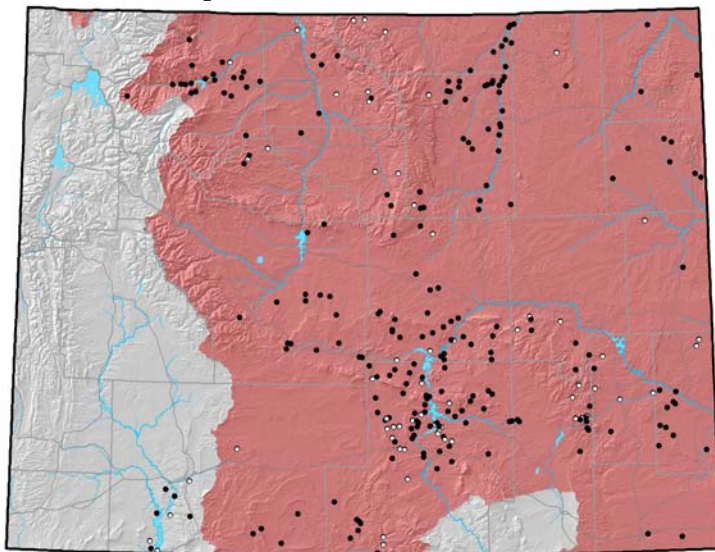## Model Evaluation Statistics
Final Model Statistics
Training AUC: 0.816
Regularized Training Gain: 0.630

Cross-Validation Statistics
- Average Test AUC: 0.777 ± 0.028
- Upper Bound on Test AUC: 0.795
- Average Test Gain: 0.573 ± 0.134
- Omission Error (fraction of test points omitted during 10-fold cross validation): 0.36± 0.10

Occurrence Data for Distribution Model

Occurrence Map

Points Used in Modeling, by Year of Observation
- ○ Pre-1985
- • 1985 or Later

■ Known and Suspected Range

Occurrence Summary Statistics

- Number of Occurrences in AWVED master dataset: 359
- Number of Occurrences used to create distribution model: 281
- Average Point Quality Index (highest quality is 12.00): 6.88 ± 2.07
- Most recent occurrence used: 2008
- Oldest occurrence used: 1935
- Occurrence File: LOCAL_SAMPLE_POINTS_W_PDOG_2.csv

Comments

There are no additional comments specific to this species range map or distribution model.

References

Keinath, D.A., M.D. Andersen, and G.P Beauvais. 2010a. Range maps for Wyoming's species of greatest conservation need. Report prepared for the Wyoming Game and Fish Department by the Wyoming Natural Diversity Database, Laramie, Wyoming. January 19, 2010.

Keinath, D.A., M.D. Andersen, and G.P. Beauvais. 2010b. Range and modeled distribution of Wyoming's species of greatest conservation need. Report prepared by the Wyoming Natural Diversity Database, Laramie Wyoming for the Wyoming Game and Fish Department, Cheyenne, Wyoming and the U.S. Geological Survey, Fort Collins, Colorado. August 20, 2010.

# Predictor Variables used in the Distribution Model

Percent Contribution (PC) to final model

| Environmental Variable	PC
Wettest quarter mean temperature	31
Coldest month mean minimum temperature	19
Annual number of Frost Days	17
Mean diurnal temperature range	13
Precipitation of the warmest quarter	11
Relative Humidity of most humid month	9

Response Curves

Each curve shows dependence of predicted suitability on input values of a single predictor variable considering correlations with others. Suitability is on the vertical axis (units: probability). Variable values are on the horizontal axis (units based on inputs; see Keinath et al 2010b for details).
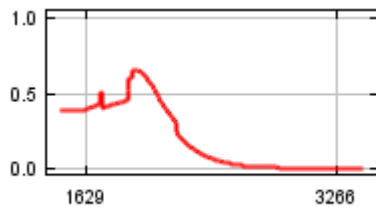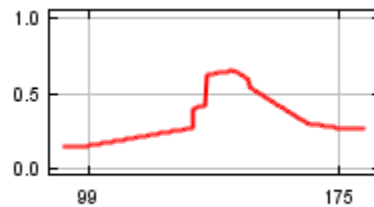
Wettest quarter mean temperature
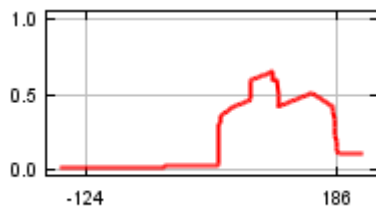
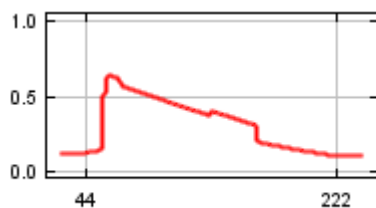**Coldest month mean minimum temperature**
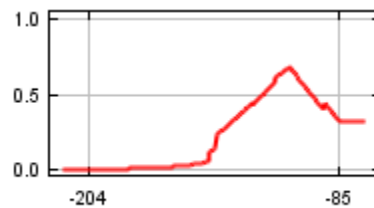
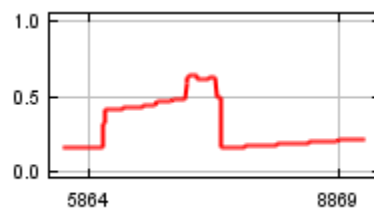**Annual number of Frost Days**

Mean diurnal temperature range

Precipitation of the warmest quarter

**Relative Humidity of most humid month**

Midget Faded Rattlesnake (*Crotalus oreganus concolor*)
Range Map and Distribution Model Summary

August 20, 2010

This report presents range and distribution of Midget Faded Rattlesnake (ARADE02123) in Wyoming (see Keinath et al. 2010b). Similar reports were developed by the Wyoming Natural Diversity Database for terrestrial vertebrate species of conservation need in Wyoming's State Wildlife Action Plan. This effort was supported by the Wyoming Game and Fish Department and the U.S. Geological Survey.
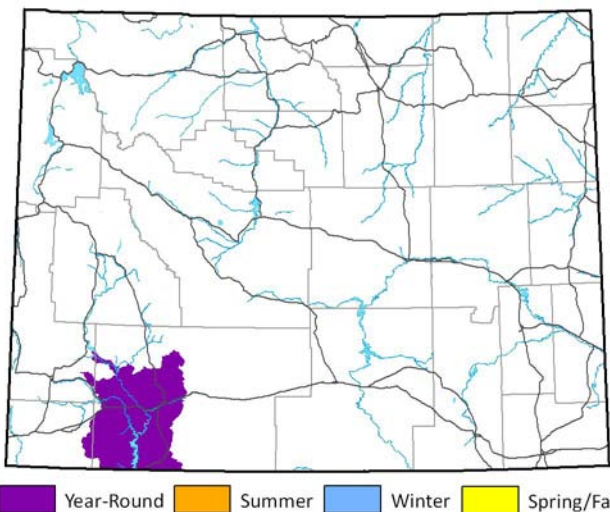
Range Map - Occupancy
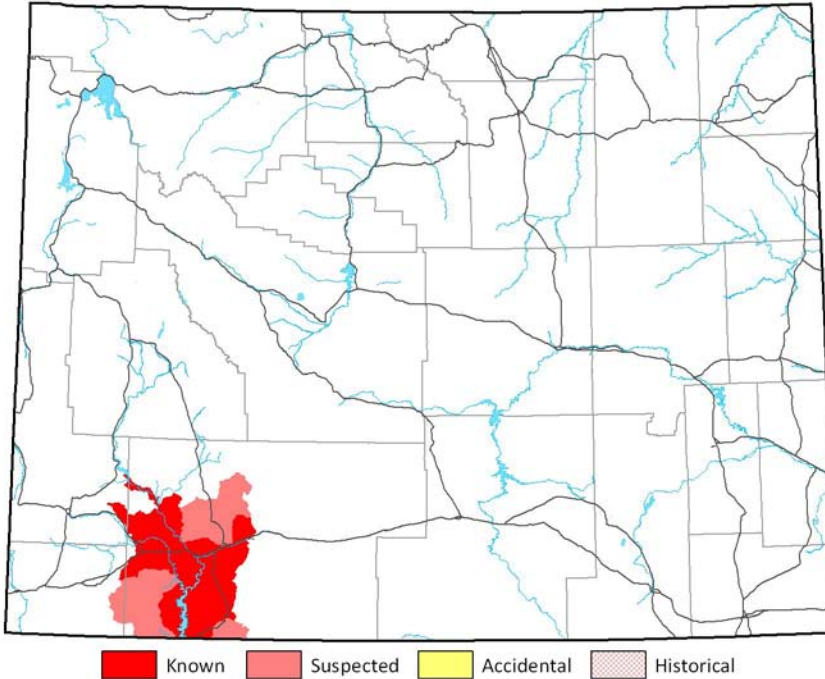
Range Notes
- Version: 2010-01-19
- Proportion of range deemed known based on documented occurrences: 0.583
- Details of range map creation noted in Keinath et al. (2010a).

Range Map - Seasonality

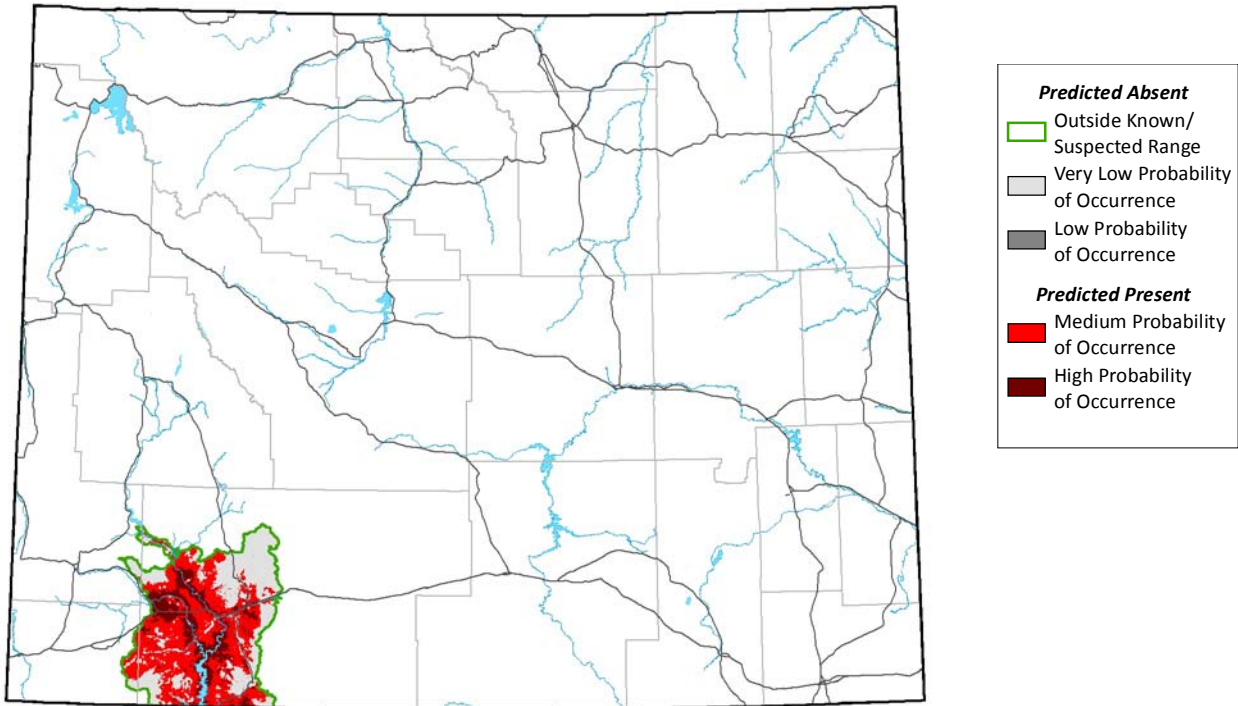Maps, models and report were created by and are available from the Wyoming Natural Diversity Database. (http://uwadmnweb.uwyo.edu/wyndd/).

Doug Keinath, Senior Zoologist

Mark Andersen, GIS Specialist

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Distribution Model (Version: Wed Mar 17 00:42:40 MDT 2010)

Details of distribution model creation are presented in Keinath et al. (2010b)

Predicted Absent
- Outside Known/ Suspected Range
- Very Low Probability of Occurrence
- Low Probability of Occurrence

Predicted Present
- Medium Probability of Occurrence
- High Probability of Occurrence

Model Parameters

- Season Modeled: Summer (1-May- 30-Sep)
- Algorithm: Maxent version 3.3.1
- Feature Types: Linear, Product
- Binary Threshold Rule: Maximum training sensitivity plus specificity
- Binary Threshold Value: 0.1603490
- High-Probability Threshold Value: 0.5274099
- Low-Probability Threshold Value: 0.1603490

Model Evaluation - ROC Plot

— Mean ■ Mean ± 1 SD — Random Prediction

Model Quality Summary

Overall Assessment of Model Quality: HIGH

Expert Assessment: Medium
Occurrence Sample Size: Medium
Quality of Occurrences: High
Positive Success Rate: Very High
Test AUC and Model Gain: High
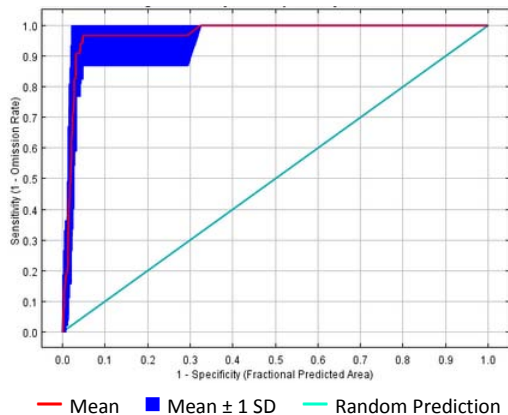
Model Evaluation Statistics
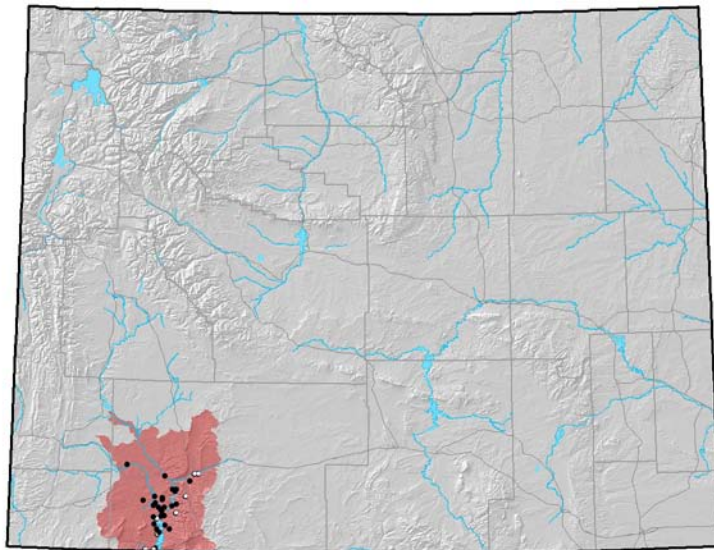
Final Model Statistics

Training AUC: 0.984
Regularized Training Gain: 2.886

Cross-Validation Statistics

- Average Test AUC: 0.973 ± 0.032
- Upper Bound on Test AUC: 0.978
- Average Test Gain: 2.572 ± 1.272
- Omission Error (fraction of test points omitted during 10-fold cross validation): 0.03± 0.11

Occurrence Data for Distribution Model

Occurrence Map

Points Used in Modeling, by Year of Observation
- ○ Pre-1985
- • 1985 or Later

■ Known and Suspected Range

Occurrence Summary Statistics

- Number of Occurrences in AWVED master dataset: 315
- Number of Occurrences used to create distribution model: 35
- Average Point Quality Index (highest quality is 12.00): 9.60 ± 3.28
- Most recent occurrence used: 2006
- Oldest occurrence used: 1946
- Occurrence File: LOCAL_SAMPLE_POINTS_W_PDOG_2.csv

Comments

There are no additional comments specific to this species range map or distribution model.

References

Keinath, D.A., M.D. Andersen, and G.P Beauvais. 2010a. Range maps for Wyoming's species of greatest conservation need. Report prepared for the Wyoming Game and Fish Department by the Wyoming Natural Diversity Database, Laramie, Wyoming. January 19, 2010.

Keinath, D.A., M.D. Andersen, and G.P. Beauvais. 2010b. Range and modeled distribution of Wyoming's species of greatest conservation need. Report prepared by the Wyoming Natural Diversity Database, Laramie Wyoming for the Wyoming Game and Fish Department, Cheyenne, Wyoming and the U.S. Geological Survey, Fort Collins, Colorado. August 20, 2010.

## Predictor Variables used in the Distribution Model

Percent Contribution (PC) to final model

Environmental Variable	PC
Annual Relative Humidity Range	47
Precipitation of the wettest month	46
Herbaceous Cover Index	5
Distance to Permanent Water	1
Vector Ruggedness Measure	1
Pinon-Juniper Index	0

Response Curves

Each curve shows dependence of predicted suitability on input values of a single predictor variable considering correlations with others. Suitability is on the vertical axis (units: probability). Variable values are on the horizontal axis (units based on inputs; see Keinath et al 2010b for details).
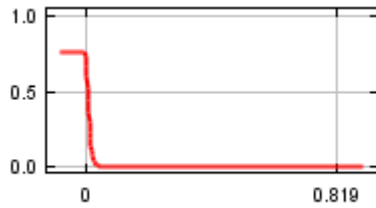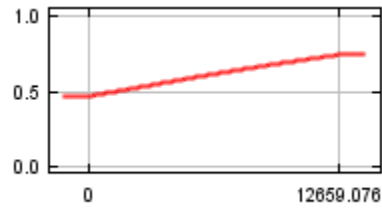
Annual Relative Humidity Range
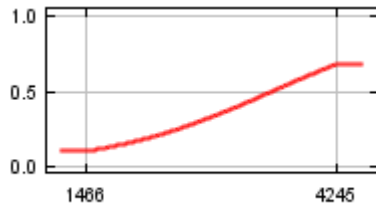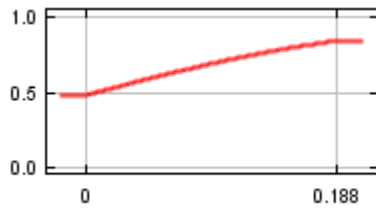

Precipitation of the wettest month
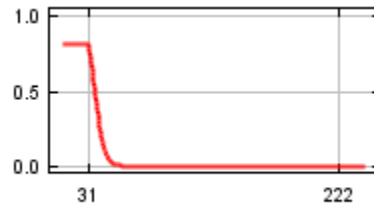
Herbaceous Cover Index

Distance to Permanent Water

Vector Ruggedness Measure

Pinon-Juniper Index