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Distribution patterns and habitat suitability for three species of the genus *Hyla* Laurenti, 1768 in the Western Palearctic

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Abstract: *Hyla* is one of the genera in the family Hylidae that is distributed in the Old World. Three tree frog species of this genus are distributed in Eurasia and especially inhabit semiaquatic regions. Several studies were conducted on the genus with different methodologies to delimit the species level. In the present study, we modeled the potential distribution areas for three frogs (*Hyla orientalis*, *Hyla savignyi*, and *Hyla felixarabica*) to determine the suitable habitat of each species separately. Models of all three species had a good fit as indicated by the high area under the curve (AUC) values (*H. orientalis* = 0.987, SD = ±0.004; *H. savignyi* = 0.988, SD = ±0.002; *H. felixarabica* = 0.994, SD = ±0.002). Three important climate variables had high contributions to species presence as isothermal temperature and precipitation variables. Because of the sensitivity of these frogs to moisture and temperature levels, they have declined in unsuitable regions, and we can assume that these variables form a natural barrier for species dispersion. It is clear that separation of *H. felixarabica* from the complex of *H. savignyi* is completely related to these natural barriers in central Arabia. However, the population in Jordan will be synonymized with *H. savignyi* because of the continuous distribution range in the Middle East.

Key words: Climate condition, *Hyla*, *Hyla savignyi*, *Hyla orientalis*, *Hyla felixarabica*, Middle East, potential distribution

1. Introduction

Amphibians are one of the most endangered groups of animals in semiarid regions (Stuart et al., 2004; Rissler and Apodaca, 2007; D'Amen and Bombi, 2009) and loss of their biodiversity is currently a major international concern (Blaustein and Kiesecker, 2002). This global concern regarding amphibians' decline is mainly due to their role as indicators of environmental stress and their impact on other animals (Blaustein et al., 1994; Blaustein and Wake, 1995; Fouquet et al., 2010). Amphibians are more sensitive to environmental toxins and changes in patterns of temperature or rainfall than other terrestrial vertebrate groups because of their highly permeable skins and because they inhabit both terrestrial and aquatic habitats during their life cycles at different stages (Alford and Richards, 1999). They are important components of many ecosystems where they may constitute the highest fraction of vertebrate biomass (Blaustein et al., 1994). Currently, 475 (7.7%) out of 6200 known amphibian species worldwide are classified as "Critically Endangered" (D'Amen and Bombi, 2009) and biologists believe that alarming declines of amphibians have occurred (Alford and Richards, 1999; Wake and Vredenburg, 2008; D'Amen and Bombi, 2009). Overall, complex causes including diseases, invasive species, pollution, climate change, solar radiation, and habitat fragmentation are associated with amphibian population declines that vary across species and areas (Alford and Richards, 1999; Blaustein and Kiesecker, 2002; Guisan and Thuiller, 2005; D'Amen and Bombi, 2009). Preservation of species requires an understanding of their biodiversity patterns. Knowledge about history, biology, and the relationship between species occurrence and climate condition can greatly support conservation planning (Rissler and Apodaca, 2007).

Tree frogs of the genus *Hyla* Laurenti, 1768 are widely distributed throughout the Middle East. These small and semiaquatic vertebrates are generally dependent on open waters for their reproduction (e.g., pools, springs, artificial water reservoirs). Therefore, their distribution is limited by the availability of such habitats. Because of their relatively low mobility, the high and cold mountain ridges of Anatolia or the Iranian highlands and deserts in central Iran, the eastern Levant, or most of the Arabian Peninsula might be effective barriers to their dispersal (Gvoždík et al., 2008, 2010; Gül et al., 2012, 2013; Stöck et al., 2012).

In this study, the maximum entropy (Maxent) method was employed to predict the potential distribution areas for three species of the genus *Hyla* (*H. orientalis* Bedriaga,

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1890; *H. felixarabica* Gvozdik, Moravec, Klutsch & Kotlik, 2010; and *H. savignyi* Audouin, 1827). This approach identifies the regions that are ecologically similar using points of locality information used to build the models (Rissler and Apodaca, 2007). Maxent, unlike other distributional modeling techniques, uses only presence data instead of presence and absence data and uses data independently of the record number (Sillero, 2011). This method has been shown to perform well in comparison with alternative approaches (Hernandez et al., 2006; Elith et al., 2011; Navarro-Cerrillo et al., 2011). Maxent creates species distributional models by linking presence-only data with climatic variables using a statistical approach known as maximum entropy.

The aim of the present study is to predict the most suitable distribution range of these three frog species and to evaluate the climatic layers to determine which are the most important for the potential distribution of these frog species.

2. Materials and methods

2.1. Occurrence points

All coordinates of three species of the genus *Hyla* (*H. savignyi*, *H. orientalis*, and *H. felixarabica*) in the Middle East were obtained from the California Academy of Science (CAS) and from our field excursions in Georgia (Batumi) and Turkey during 2008–2010. The records consisted of two types: some of the records had precise coordinates, but others had locality addresses and relevant coordinates obtained from Google Earth. We obtained 21 records for *H. felixarabica*, 160 records for *H. savignyi*, and 82 records for *H. orientalis*.

2.2 Data preparation and analysis

The original layers were downloaded from the WorldClim website (www.worldclim.org) in 30-s resolution and the relevant part of the world (the Middle Eastern region) was cropped using ArcGIS 9.2. One thousand random points were obtained from www.geomidpoint.com/random/. To get the correlation ratios between variables, Openmodeller (V. 1.0.7) (Muñoz et al., 2011) was employed using Pearson's correlation coefficient (Elith et al., 2006). We selected variables with correlation of <0.75 to reduce problems due to multicollinearity among environmental variables and also to select the variables that are ecologically important for each species separately according to our personal observations and to describe habitat preferences from the literature.

The following variables were included in the final analysis: BIO5 (maximum temperature of warmest month), BIO6 (maximum temperature of coldest month), BIO8 (mean temperature of wettest quarter), BIO9 (mean temperature of driest quarter), BIO16 (precipitation of wettest quarter), BIO17 (precipitation of driest quarter), BIO18 (precipitation of warmest quarter), BIO19 (precipitation of coldest quarter), and slope. The habitat suitability and potential distribution map were created using the maximum entropy software MaxEnt 3.3.3e (Phillips et al., 2006; Phillips and Dudik, 2008). To reach the best model for the species, 10 replicates of the analysis were done and the beta multiples were defined as 1 to contract predictive regions into real values. The result of the receiver operating characteristic (ROC) curve is important for model sensitization and the value of the area under the curve (AUC) closest to 1 indicated the best model performance. A value near 0.5 suggests that the result is not better than random (Raes and ter Steege, 2007; Gallien et al., 2012).

3. Results

We obtained 263 records of the three recognized species of the genus *Hyla* (Appendix). The distribution of these species includes western and northern Iran, Iraq, Yemen, southern Saudi Arabia, Turkey, Syria, Israel, Georgia, and generally the southeastern part of Europe (Gvoždík et al., 2010). The final constructed models of the three species resulted in good and high AUCs and less standard deviation: for *H. savignyi* 0.988 ± 0.002, for *H. orientalis* 0.987 ± 0.004, and for *H. felixarabica* 0.984 ± 0.008 (Figure 1). Three important or highly contributing variables for each species were detected as follows: precipitation of coldest quarter (BIO19), temperature seasonality (standard deviation × 100) (BIO4), and mean temperature of wettest quarter (BIO8) for *H. savignyi*; temperature annual range (BIO7), BIO8, and mean diurnal range (BIO2) for *H. orientalis*; and BIO4, slope, and precipitation seasonality (standard deviation / mean) (BIO15) for *H. felixarabica* (Table). The model for *H. felixarabica* predicted the distribution range of the species in the highlands of southern Arabia, Yemen, and Israel and the fragmented distribution of the species has been confirmed using a comparison of environmental variables. *H. orientalis* is distributed in the Talysh Mountains and the Caucasus region in the Middle East and Turkey (around the Black Sea) and reached the southeastern part of the Europe (Czech Republic and Ukraine). In addition to the previous distribution records, our model suggests that there are more suitable potential regions in southern Europe (like Italy and Greece), southwestern Europe (Spain), and Tunisia in North Africa according to the climate variables. There are probably important barriers to species dispersion and that species has not yet been recorded from these areas. *H. savignyi* is an important tree frog in the Middle East and our predicted model confirmed the species distribution range. Southwestern Turkey is another region that has

Table. Relative importance (in percentages) of variables used in Maxent model for three species of the genus *Hyla*.

Variable	Description of variables	Species of genus *Hyla*		
		H. orientalis	*H. savignyi*	*H. felixarabica*
BIO2	Annual daily temperature difference (minimal temperature-maximal temperature)	15.8	2.2	
BIO4	Temperature seasonality (standard deviation × 100)		25.7	33.3
BIO5	Maximum temperature of the warmest month	9.6		10.3
BIO6	Minimum temperature of the coldest month		3.5	
BIO7	Annual temperature scale (BIO5 – BIO6)	28.1		5.8
BIO8	Average temperature of the wettest quarter of the year	24	22.2	9.4
BIO9	Average temperature of the driest quarter of the year	3		
BIO11	Average temperature of the coldest quarter of the year	6.8		
BIO12	Average annual precipitation	9.3		
BIO14	Precipitation of the driest month	3.4	18.9	
BIO15	Seasonality of precipitation (coefficient of variation)			12.7
BIO16	Precipitation of the wettest quarter of the year			10.9
BIO19	Precipitation of the coldest quarter of the year		27.6	
Slope	Slope			17.5

been predicted suitable for the species presence. Bushehr and southern Khuzestan are predicted as suitable regions, because these regions have suitable ponds. According to the three models, hot and arid environments are not suitable for species presence and provide a natural barrier for species dispersion (Figure 1).

4. Discussion

Previous phylogenetic studies revealed geographic distribution of cryptic diversity among both Western Palearctic and regional tree frogs in the *H. arborea* group (Stöck et al., 2008, 2012; Gvoždík et al., 2010; Gül et al., 2012). Our results were similar to previous distributions of *H. orientalis*, *H. savignyi*, and *H. felixarabica* in terms of current climatic conditions. Asia Minor and East Europe had the highest suitability for *H. orientalis* (Figure 1A). In Asia Minor, *H. orientalis* was especially present in the Black Sea, Marmara, Aegean, Western Mediterranean, Central Mediterranean, and Central Anatolian regions of Turkey; on the contrary, the most suitable habitats for *H. savignyi* were in Asia Minor, Transcaucasia, and northwestern Iran over through Syria and Lebanon to central Jordan and Israel and the southwestern Arabian Peninsula (Figure 1B). The South Anatolia region of Turkey is a major contact zone for these two species because Anatolia has four major mountain belts, the Western Anatolian Mountains, the Taurus ranges in the south, the Northern Anatolian Mountains, and the Anatolian Diagonal running from the northeast to the Mediterranean (Şekercioğlu et al., 2011); it shows the effect of a colonization barrier for several terrestrial species. Therefore, *H. orientalis* and *H. savignyi* prefer different climatic conditions across Anatolia. Furthermore, our results revealed that the distributions of these species were restricted by different climatic conditions. The occurrence of *H. orientalis* is affected by ranges of extreme temperature conditions, such as temperature annual range (28.1%), mean temperature of wettest quarter (24%), and mean diurnal range (15.8%), so it is more likely to be found in cooler and wetter regions. On the other hand, *H. savignyi* is restricted by temperature and precipitation seasonality, such as precipitation of coldest quarter (27.6%), temperature seasonality (25.7%), mean temperature of wettest quarter (22.2%), and precipitation of driest period (18.9%), because it inhabits warmer and drier habitats. Similarly, Gül (2013) showed that lineage 1 and lineage 2 of *H. savignyi*, of which there are two reciprocally monophyletic lineages in South and Southeast Anatolia, inhabited different habitats occupying localities east and west of the Amanos Mountains range such as living in different landscape types. The third species, *H. felixarabica*, is distributed in southern Arabia, Yemen, and Jordan. The species was already classified as

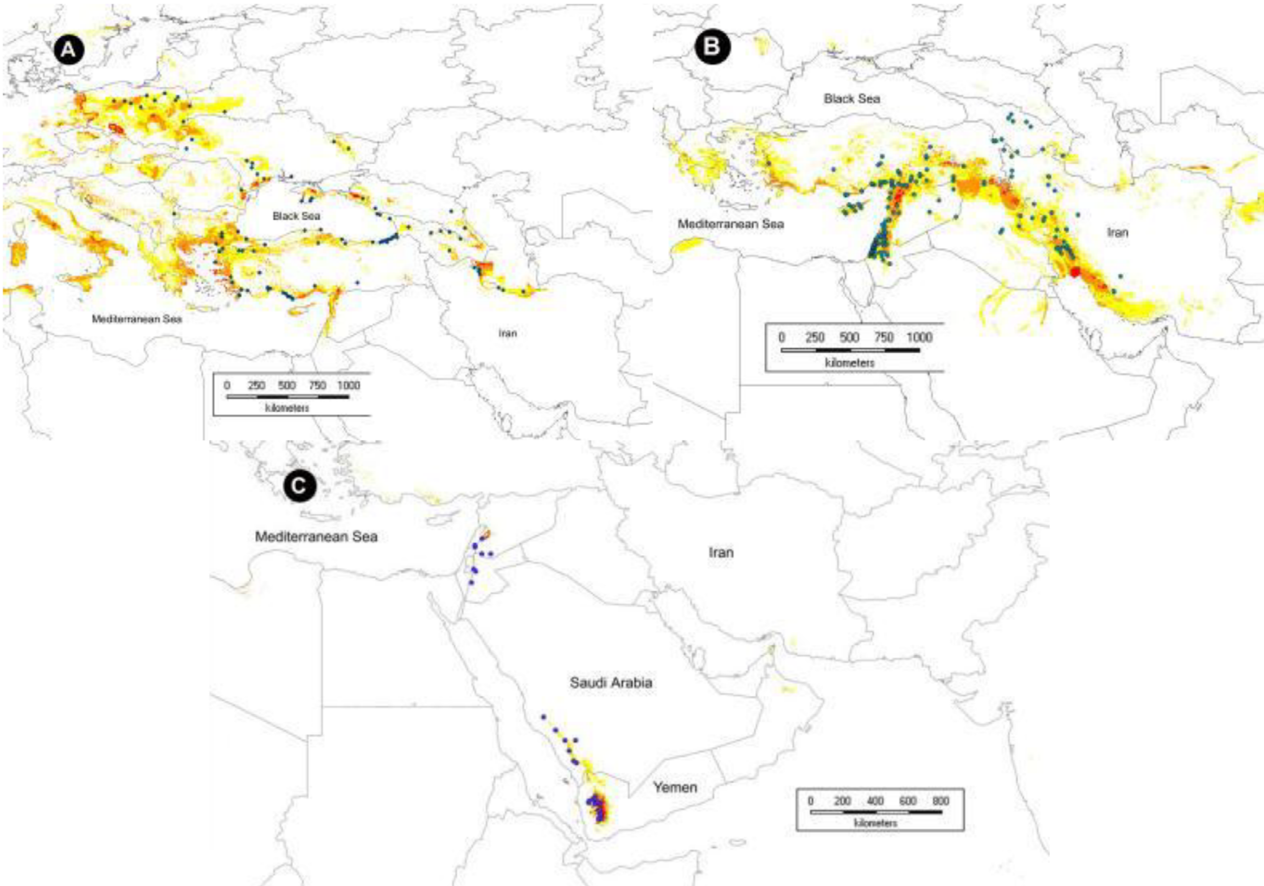

Figure 1. Distribution map of three species of the genus *Hyla* in western Asia and their potential distribution pattern in the region: A) *H. orientalis*, B) *H. savignyi*, C) *H. felixarabica*.

H. savignyi, but it recently diverged from the *H. savignyi* complex (Gvoždík et al., 2010). The model suggested that temperature seasonality (BIO4) is the important climate variable (33.3% of all contribution) for species presence, because if the distribution areas of the species are hot and dry then the presence of this sensitive frog is completely related to the temperature. Change in temperature will affect moisture levels. Mountainous restricted regions in southern Arabia created uniquely good conditions for *Hyla* presence, but the hot and dry adjacent areas are the important barriers for its dispersion. We can assume that the population of the species in Jordan is more closely related to *H. savignyi* than *H. felixarabica*. As Gvoždík et al. (2010) indicated, the northern population is closer to the *H. savignyi* complex rather than *H. felixarabica* (Figure 1C).

Finally, amphibians are undergoing an extensive crisis (Stöck et al., 2012) and climate is likely to play an especially important role in determining biodiversity patterns (Rissler and Apodaca, 2007). Our results using distributional modeling and considering associated climatic factors can be useful in understanding their biodiversity patterns and consequently can affect conservation assessments.

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References

Alford RA, Richards SJ (1999). Global amphibian declines: a problem in applied ecology. Annu Rev Ecol Evol Syst 30: 133–165.

Blaustein AR, Kiesecker JM (2002). Complexity in conservation: lessons from the global decline of amphibian populations. Ecol Lett 5: 597–608.

Blaustein AR, Wake DB (1995). The puzzle of declining amphibian populations. Sci Amer 272: 52–57.

Blaustein AR, Wake DB, Sousa WP (1994). Amphibian declines: judging stability, persistence, and susceptibility of populations to local and global extinctions. Conserv Biol 8: 60–71.

D'Amen M, Bombi P (2009). Global warming and biodiversity: evidence of climate-linked amphibian declines in Italy. Biol Conserv 142: 3060–3067.

Elith J, Graham CH, Anderson RP, Dudík M, Ferrier S, Guisan A, Hijmans RJ, Huettmann F, Leathwick JR, Lehmann A et al. (2006). Novel methods improve prediction of species' distributions from occurrence data. Ecography 29: 129–151.

Elith J, Phillips SJ, Hastie T, Dudík M, Chee YE, Yates CJ (2011). A statistical explanation of MaxEnt for ecologists. Divers Distribut 17: 43–57.

Fouquet A, Ficetola GF, Haigh A, Gemmell N (2010). Using ecological niche modelling to infer past, present and future environmental suitability for *Leiopelma hochstetteri*, an endangered New Zealand native frog. Biol Conserv 143: 1375–1384.

Gallien L, Douzet R, Pratte S, Zimmermann NE, Thuiller W (2012). Invasive species distribution models–how violating the equilibrium assumption can create new insights. Global Ecol Biogeogr 21: 1126–1136.

Guisan A, Thuiller W (2005). Predicting species distribution: offering more than simple habitat models. Ecol Lett 8: 993–1009.

Gül S (2013). Ecological divergence between two evolutionary lineages of *Hyla savignyi* (Audouin, 1827) in Turkey: effects of the Anatolian Diagonal. Animal Biol 63: 285–295.

Gül S, Kutrup B, Özdemir N (2012). Patterns of distribution of tree frogs in Turkey based on molecular data. Amphibia-Reptilia 33: 95–10.

Gvoždík V, Moravec J, Klütsch C, Kotlík P (2010). Phylogeography of the Middle Eastern tree frogs (*Hyla*, Hylidae, Amphibia) as inferred from nuclear and mitochondrial DNA variation, with a description of a new species. Mol Phylogenet Evol 55: 1146–1166.

Gvoždík V, Moravec J, Kratochvíl L (2008). Geographic morphological variation in parapatric Western Palearctic tree frogs, *Hyla arborea* and *Hyla savignyi*: are related species similarly affected by climatic conditions? Biol J Linn Soc 95: 539–556.

Hernandez PA, Graham CH, Master LL, Albert DL (2006). The effect of sample size and species characteristics on performance of different species distribution modeling methods. Ecography 29: 773–785.

Muñoz MES, Giovanni R, Siqueira MF, Sutton T, Brewer P, Pereira RS, Canhos DAL, Canhos VP (2011). openModeller: a generic approach to species' potential distribution modeling. GeoInformatica 15: 111–135.

Navarro-Cerrillo RM, Hernández-Bermejo JE, Hernández-Clemente R (2011). Evaluating models to assess the distribution of *Buxus balearica* in southern Spain. Applied Veg Sci 14: 256–267.

Phillips SJ, Anderson RP, Schapire RE (2006). Maximum entropy modeling of species geographic distributions. Ecol Model 190: 231–259.

Phillips SJ, Dudik M (2008). Modeling of species distributions with Maxent: new extensions and a comprehensive evaluation. Ecography 31: 161–175.

Raes N, ter Steege H (2007). A null-model for significance testing of presence-only species distribution models. Ecography 30: 727–736.

Rissler LJ, Apodaca JJ (2007). Adding more ecology into species delimitation: ecological niche models and phylogeography help define cryptic species in the black salamander (*Aneides flavipunctatus*). Syst Biol 56: 924–942.

Şekercioğlu ÇH, Anderson S, Akçay E, Bilgin R, Can ÖE, Semiz G, Tavşanoğlu Ç, Yokeş MB, Soyumert A, İpekdal K et al. (2011). Turkey's globally important biodiversity in crisis. Biol Conserv 144: 2752–2769.

Sillero N (2011). What does ecological modelling model? A proposed classification of ecological niche models based on their underlying methods. Ecol Model 222: 1343–1346.

Stöck M, Dubey S, Klutsch C, Litvinchuk S, Scheidt U, Perin N (2008). Mitochondrial and nuclear phylogeny of circum-Mediterranean tree frogs from the *Hyla arborea* group. Mol Phylogenet Evol 49: 1019–1024.

Stöck M, Dufresnes C, Litvinchuk SN, Lymberakis P, Biollay S, Berroneau M, Borzée A, Ghali K, Ogielska M, Perrin N (2012). Cryptic diversity among Western Palearctic tree frogs: postglacial range expansion, range limits, and secondary contacts of three European tree frog lineages (*Hyla arborea* group). Mol Phylogenet Evol 65: 1–9.

Stuart SN, Chanson JS, Cox NA, Young BE, Rodrigues AS, Fischman DL, Waller RW (2004). Status and trends of amphibian declines and extinctions worldwide. Science 306: 1783–1786.

Wake DB, Vredenburg VT (2008). Are we in the midst of the sixth mass extinction? A view from the world of amphibians. P Natl Acad Sci USA 105: 11466–11473.

Appendix. Records of the three recognized species of the genus *Hyla* used in the present study.

Species	Latitude, N	Longitude, E
Hyla flexiarabica	14.22	44.38
Hyla flexiarabica	14.27	44.25
Hyla flexiarabica	14.43	44.4
Hyla flexiarabica	14.55	44.35
Hyla flexiarabica	14.8	44.2
Hyla flexiarabica	14.8	44.28
Hyla flexiarabica	15.2	43.97
Hyla flexiarabica	15.23	44.22
Hyla flexiarabica	15.28	44.35
Hyla flexiarabica	15.3	44.2
Hyla flexiarabica	15.35	44.2
Hyla flexiarabica	15.5	43.88
Hyla flexiarabica	15.58	43.88
Hyla flexiarabica	18.07	42.7
Hyla flexiarabica	18.2	42.5
Hyla flexiarabica	18.92	42.18
Hyla flexiarabica	19.63	41.9
Hyla flexiarabica	19.63	42.63
Hyla flexiarabica	19.63	41.9
Hyla flexiarabica	20.35	41.25
Hyla flexiarabica	21.27	40.42
Hyla savignyi	30.99	36.06
Hyla savignyi	31.26	35.55
Hyla savignyi	31.44	49.53
Hyla savignyi	31.5	34.92
Hyla savignyi	31.57	35.49
Hyla savignyi	31.57	34.6
Hyla savignyi	31.58	35.89
Hyla savignyi	31.67	34.65
Hyla savignyi	31.68	35.85
Hyla savignyi	31.68	34.74
Hyla savignyi	31.72	34.63
Hyla savignyi	31.72	34.68
Hyla savignyi	31.74	48.68
Hyla savignyi	31.74	35
Hyla savignyi	31.78	34.67
Hyla savignyi	31.83	35.31
Hyla savignyi	31.84	34.7
Hyla savignyi	31.87	35.61
Hyla savignyi	31.88	34.74
Hyla savignyi	31.9	34.76
Hyla savignyi	31.9	34.84
Hyla savignyi	31.94	49.3

Hyla savignyi	32.01	34.81
Hyla savignyi	32.02	34.82
Hyla savignyi	32.02	34.82
Hyla savignyi	32.02	34.86
Hyla savignyi	32.03	49.2
Hyla savignyi	32.03	34.77
Hyla savignyi	32.03	34.77
Hyla savignyi	32.04	34.77
Hyla savignyi	32.04	49.19
Hyla savignyi	32.1	34.93
Hyla savignyi	32.11	34.9
Hyla savignyi	32.12	34.81
Hyla savignyi	32.12	48.3
Hyla savignyi	32.13	34.79
Hyla savignyi	32.14	34.81
Hyla savignyi	32.15	49.07
Hyla savignyi	32.16	34.97
Hyla savignyi	32.17	34.94
Hyla savignyi	32.18	34.82
Hyla savignyi	32.18	34.82
Hyla savignyi	32.2	48.38
Hyla savignyi	32.23	34.83
Hyla savignyi	32.23	34.83
Hyla savignyi	32.24	48.74
Hyla savignyi	32.29	34.85
Hyla savignyi	32.31	49.07
Hyla savignyi	32.33	35.62
Hyla savignyi	32.34	34.91
Hyla savignyi	32.37	34.94
Hyla savignyi	32.41	34.9
Hyla savignyi	32.43	35.2
Hyla savignyi	32.43	34.88
Hyla savignyi	32.43	35.81
Hyla savignyi	32.43	34.89
Hyla savignyi	32.43	34.89
Hyla savignyi	32.43	34.89
Hyla savignyi	32.44	34.94
Hyla savignyi	32.44	34.89
Hyla savignyi	32.48	35.5
Hyla savignyi	32.55	35.66
Hyla savignyi	32.58	35.01
Hyla savignyi	32.58	35
Hyla savignyi	32.59	35.06
Hyla savignyi	32.61	48.87
Hyla savignyi	32.61	35.05
Hyla savignyi	32.62	35.09

Hyla savignyi	32.67	35.04
Hyla savignyi	32.74	35.03
Hyla savignyi	32.79	35.02
Hyla savignyi	32.8	35.75
Hyla savignyi	32.82	35.66
Hyla savignyi	32.87	35.1
Hyla savignyi	32.93	48.25
Hyla savignyi	32.93	48.25
Hyla savignyi	32.95	35.34
Hyla savignyi	33.02	35.39
Hyla savignyi	33.03	35.39
Hyla savignyi	33.07	35.66
Hyla savignyi	33.07	35.61
Hyla savignyi	33.08	35.22
Hyla savignyi	33.08	35.6
Hyla savignyi	33.08	35.6
Hyla savignyi	33.25	35.69
Hyla savignyi	33.25	35.65
Hyla savignyi	33.25	35.65
Hyla savignyi	33.27	35.58
Hyla savignyi	33.27	35.58
Hyla savignyi	33.28	35.58
Hyla savignyi	33.29	35.78
Hyla savignyi	33.49	49.06
Hyla savignyi	33.49	48.36
Hyla savignyi	33.52	49.03
Hyla savignyi	33.72	35.7
Hyla savignyi	33.74	45.55
Hyla savignyi	33.87	35.5
Hyla savignyi	34.15	47.36
Hyla savignyi	34.51	45.66
Hyla savignyi	34.58	49.89
Hyla savignyi	34.8	39
Hyla savignyi	34.88	33.52
Hyla savignyi	35.19	33.26
Hyla savignyi	35.2	33.35
Hyla savignyi	35.38	46.66
Hyla savignyi	36.03	32.81
Hyla savignyi	36.07	32.87
Hyla savignyi	36.37	33.97
Hyla savignyi	36.81	47.72
Hyla savignyi	36.87	43
Hyla savignyi	37	43
Hyla savignyi	37.14	38.75
Hyla savignyi	37.38	47.76
Hyla savignyi	37.41	45.02

Hyla savignyi	37.83	45.05
Hyla savignyi	37.92	31.92
Hyla savignyi	38.39	27.17
Hyla savignyi	38.89	35.5
Hyla savignyi	38.94	48.78
Hyla savignyi	40	9
Hyla savignyi	40.17	44.27
Hyla savignyi	42	45
Hyla savignyi	29.01	52.51
Hyla savignyi	37.81	36.67
Hyla savignyi	37.62	36.77
Hyla savignyi	37.71	36.69
Hyla savignyi	36.77	37.22
Hyla savignyi	36.77	37.32
Hyla savignyi	36.72	37.26
Hyla savignyi	37.1	37.6
Hyla savignyi	37.21	37.63
Hyla savignyi	37.41	37.66
Hyla savignyi	37.45	38.28
Hyla savignyi	37.59	38.26
Hyla savignyi	37.51	38.3
Hyla savignyi	37.3	40.73
Hyla savignyi	37.11	40.71
Hyla savignyi	37.41	40.73
Hyla savignyi	38.18	41.48
Hyla savignyi	38.79	38.77
Hyla savignyi	38.94	38.73
Hyla savignyi	38.87	38.74
Hyla savignyi	36.83	34.73
Hyla savignyi	36.91	34.72
Hyla savignyi	36.83	34.84
Hyla savignyi	36.97	35.38
Hyla savignyi	37.01	35.36
Hyla savignyi	36.79	35.37
Hyla savignyi	37	35.7
Hyla savignyi	37	35.61
Hyla savignyi	37	35.75
Hyla savignyi	37.13	36.18
Hyla savignyi	37.07	36.22
Hyla savignyi	36.91	36.21
Hyla savignyi	37.02	36.14
Hyla savignyi	37.02	36.14
Hyla savignyi	36.67	36.35
Hyla savignyi	36.67	36.3
Hyla savignyi	40.02	43.88
Hyla savignyi	40	43.7

Hyla orientalis	41.65	41.65
Hyla orientalis	41.65	41.65
Hyla orientalis	41.65	41.65
Hyla orientalis	41.33	41.74
Hyla orientalis	41.33	41.74
Hyla orientalis	41.33	41.74
Hyla orientalis	37.45	38.3
Hyla orientalis	37.45	38.3
Hyla orientalis	37.45	38.3
Hyla orientalis	41.33	41.3
Hyla orientalis	41.33	41.3
Hyla orientalis	41.33	41.3
Hyla orientalis	41.23	41.19
Hyla orientalis	41.23	41.19
Hyla orientalis	41.25	41.22
Hyla orientalis	41.18	40.97
Hyla orientalis	41.18	40.97
Hyla orientalis	41.18	40.97
Hyla orientalis	41.17	40.88
Hyla orientalis	41.17	40.88
Hyla orientalis	41.17	40.88
Hyla orientalis	41.09	40.74
Hyla orientalis	40.97	40.87
Hyla orientalis	40.97	40.87
Hyla orientalis	41.02	40.5
Hyla orientalis	41.03	40.48
Hyla orientalis	41.04	40.49
Hyla orientalis	41.02	40.41
Hyla orientalis	41.02	40.41
Hyla orientalis	41.02	40.41
Hyla orientalis	40.93	40.27
Hyla orientalis	40.93	40.26
Hyla orientalis	40.97	39.63
Hyla orientalis	40.97	39.63
Hyla orientalis	40.97	39.63
Hyla orientalis	41.2	36.97
Hyla orientalis	41.2	36.97
Hyla orientalis	40.88	34.91
Hyla orientalis	40.88	34.91
Hyla orientalis	40.88	34.91
Hyla orientalis	41.28	28.69
Hyla orientalis	41.27	28.69
Hyla orientalis	41.28	28.69
Hyla orientalis	41.74	26.58
Hyla orientalis	41.75	26.58
Hyla orientalis	41.75	26.59

Hyla orientalis	40.15	26.4
Hyla orientalis	40.15	26.4
Hyla orientalis	40.15	26.4
Hyla orientalis	40.42	26.67
Hyla orientalis	40.42	26.67
Hyla orientalis	40.42	26.66
Hyla orientalis	40.23	28.06
Hyla orientalis	40.23	28.05
Hyla orientalis	40.23	28.05
Hyla orientalis	40.2	29.32
Hyla orientalis	40.2	29.32
Hyla orientalis	40.2	29.32
Hyla orientalis	40.73	30.33
Hyla orientalis	40.74	30.31
Hyla orientalis	40.74	30.3
Hyla orientalis	38.32	29.85
Hyla orientalis	38.32	29.85
Hyla orientalis	38.32	29.85
Hyla orientalis	37.03	30.55
Hyla orientalis	37.03	30.55
Hyla orientalis	36.25	32.29
Hyla orientalis	36.26	32.29
Hyla orientalis	36.58	31.88
Hyla orientalis	36.58	31.88
Hyla orientalis	36.85	28.27
Hyla orientalis	36.85	28.27
Hyla orientalis	36.78	28.81
Hyla orientalis	36.78	28.81
Hyla orientalis	37.97	27.37
Hyla orientalis	37.96	27.37
Hyla orientalis	41.88	27.99
Hyla orientalis	41.88	27.99
Hyla orientalis	36.04	32.71
Hyla orientalis	36.04	32.7
Hyla orientalis	37.17	34.61
Hyla orientalis	37.17	34.62