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Distribution, ecology and conservation of *Ommatotriton vittatus* and *Salamandra infraimmaculata* in Syria

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Abstract. The distribution, ecology and conservation status of the Syrian urodeles *Salamandra infraimmaculata* and *Ommatotriton vittatus* are poorly known. We present the results of a field study, conducted in February 2009. *Salamandra infraimmaculata* was found at six localities, ranging from 228 to 960 m a.s.l., and co-occurred with *O. vittatus* at three localities. All localities were near small, clear streams or springs. Temperatures ranged from 9.4 to 16.4°C, pH 7.5–8.5, GH 3–18 and KH 3–18. The distribution model of *S. infraimmaculata* reveals that the distribution of this species is nearly entirely shaped by precipitation in the coldest quarter "92.9% contribution to the model". The rarity of suitable surface waters is probably the main reason for the supposed scarcity of this species in northwestern Syria. Tapping a water source for drinking water resulted in one case in extensive mortality of larvae. *Ommatotriton vittatus* was found at nine different localities, ranging from 172 to 960 m a.s.l. Habitat characteristics, water quality and morphological data were recorded. The average total length of adult *O. vittatus* was 116 mm (range 93–138 mm, n = 22) for males and 93 mm (range 86–108 mm, n = 34) for females. Mean weight was 6.7 g for males and 3.9 for females. The mean body condition index of females was comparable to that of males. Water temperatures ranged from 8.7 to 14.6°C, pH 7.5–8.5, GH 3–18 and KH 3–18. The distribution model of *O. vittatus* reveals that the distribution of this species is mainly shaped by precipitation, both during the winter and summer periods. The collection of large numbers of adult *O. vittatus* for fish bait was observed.

Key words. Amphibia, Caudata, Salamandridae, Near East, Syria, *Ommatotriton*, *Salamandra*, herpetofauna, modelling, geography, life history, habitats.

Introduction

Two urodelan species have been reported from the Mediterranean parts of the Levant (Syria, Lebanon, Israel and Palestinian Territories), namely *Salamandra infraimmaculata* and *Ommatotriton vittatus* (Müller & Wettstein 1933, Werner 1939, Degani & Mendelssohn 1983, Esterbauer 1987, 1992, Geffen et al. 1987, Degani & Kaplan 1999, Hraoui-Bloquet et al. 2001, Hraoui-Bloquet et al. 2002). One single *O. vittatus* has been found in Jordan in 1981, but no other specimens have been reported since, and it is therefore regarded as not occurring in Jordan (Disi & Amr 2010).

Salamandra infraimmaculata (Martens, 1885), the Near-Eastern Firesalamander, (Arabic: Arouss Al Ayn) is a large salamander, reaching up to 324 mm in total length (Degani 1996). The subspecies occurring in Syria is *S. i. infraimmaculata* (Steinfartz et al. 2000).

Ommatotriton vittatus (Gray in Jenyns, 1835), the Southern Banded Newt (Arabic: Samandal alma) is a medium-sized newt of 90–110 mm in total length. The subspecies occurring in Syria is *O. v. vittatus* (Borkin et al. 2003) although Franzen & Schmidtler (2000) show a single individual of a newly discovered population near Kilis, Turkey, which is very close to the Syrian border, which exhibits characteristics of *O. v. cilicensis* (Franzen 2001). The urodeles of Syria are poorly known in terms of their distribution, ecology and current threats. Past records from Syria for *O. vittatus* include the ruins of Ugarit near Latakia and Tartus (Werner 1902), Qalat al Husn and 25 km north of Daraa (Arntzen & Olgun 2000), and the Basofan area (Amr et al. 2007). Borkin et al. (2003) give more details on the distribution of *O. vittatus*. Scattered localities have been reported for *S. infraimmaculata* by Esterbauer (1987, 1992) and Eiselt (1958) from southwestern Syria and by Sindaco et al. (2006) from the Fir Cedar Reserve.

The present work is based on the first field study on the salamanders and newts of Syria. We have gathered new data on their current distribution, identified habitats, and present data on their ecology.

Materials and methods

Distribution assessment and habitat characteristics

In February 2009, a survey of one week was conducted along coastal areas and Al Ghab in western Syria. Permanent and temporary water bodies (ponds, pools, streams, springs, flooded areas, ditches, etc.) were inspected at daytime for the presence of salamanders and newts. We searched for eggs, larvae, juveniles and adults. Localities were recorded with GPS (Garmin Etrex Legend). The water temperature was measured to the nearest 0.1°C. Water samples were examined for their pH, GH and KH values, using standard colorimetric tests (Tetra, Melle, Germany). Specimens were collected by hand or using a dip net, measured to the nearest mm, and weighed. The following measurements were recorded: Total length (TL), snout–vent length (SVL) and tail length (TaL).

Localities from previous studies and of specimens deposited in European museums (Senckenberg Museum Frankfurt am Main = SMF and Zoologisches Forschungsmuseum Alexander Koenig, Bonn = ZFMK) were also incorporated in the distribution maps to compile an up-to-date distribution map for both species (see Appendix).

For English names we used the following reference: http://en.wikipedia.org/wiki/List_of_cities_in_Syria. We use the English name "Frunlok protected area" for the area that lies in the northwestern part of Syria in the al-Bayer area and extends over an area of 53.36 hectares. It is considered the most complete environmental forest system in Syria. It is also referred to as Al-Frunluq, or Foronlok.

Predictive distribution modelling

In order to assess the extent of suitable environmental conditions for *S. infraimmaculata* and *O. vittatus* in Syria, the distribution of these species was predicted using maximum entropy species distribution modelling (MaxEnt v.3.3.3k; Phillips et al. 2006). MaxEnt uses environmental parameters in combination with species occurrence records to predict the distribution of the species of interest. Maximum entropy is achieved by the constraint that the expected value for each variable under the estimated distribution has to match its empirical average: In other words, the mean value of a random set of coordinates within the distribution (Phillips et al. 2006). The model output displays the relative occurrence probability of a species within the grid cells of the study area. Ten models based on varying test locality sites (replicated run type = crossvalidation) were averaged to produce predictive distribution maps, which were plotted in a logistic format. Jackknife testing was used to produce estimates of the average contribution and response of each parameter to the model. Thus, each parameter was excluded in turn, upon which a model with the remaining parameters was created. Additionally, a model using each parameter in isolation and a model using all parameters were created. For detailed information regarding the use of MaxEnt we refer to Phillips et al. (2006) and Elith et al. (2011). All models were tested with receiver operating characteristics (ROC) curve plots, which plot the true-positive rate against the false-positive rate. The average area under the curve (AUC) of the ROC plot of ten models was taken as a measure of the overall fit of each model. AUC values range between 0.00 (highly unsuitable) and 1.00 (highly suitable), and display the probability that a randomly chosen presence site will be ranked above a randomly chosen absence site (Phillips et al. 2006).

Localities used for modelling comprised both historical and contemporary records (see Appendix). In total, 17 localities were used to model *S. infraimmaculata*, while 22 were available for *O. vittatus*. An uncorrelated (Pearsons $r < 0.7$) dataset of 8 environmental parameters at 1 × 1 km scale was compiled, consisting of aspect (in degrees), slope (% inclination), temperature seasonality (standard deviation *100), mean temperature of the driest quarter, mean temperature of the coldest quarter, precipitation seasonality (coefficient of variation), precipitation of the driest quarter and precipitation of the coldest quarter (full description in Hijmans et al. 2005).

Results

Salamandra infraimmaculata

The species was found at eight localities in total (Table 1). Larvae proved to be the most readily detected indication of this species being present. Near a Roman well, 7 km northeast of Slinfah, a juvenile was found. The only live adult was found just outside of Arrawda in the Frunlok protected area (Figure 1). This was a female measuring 11.5 cm in snout–vent, 7.0 cm in tail-length, and weighing 32.7 g. At the same locality, two specimens were found killed on the road.

S. infraimmaculata larvae were found mainly in springs (e.g., Ain Ghadran, Ain Asharkia, a concrete-lined source and the Roman well). Only in Ain Al Thahab did we observe larvae in a small stream. This stream was heavily polluted with garbage. In one case, the tapping of a water source for drinking water resulted in extensive mortality of larvae. During half an hour of continuous water tapping, the larvae living in the shallow reservoir under the tap were left dry and perished as a result. All these habitats are situated in the Mediterranean mountains of Syria. Within the Al Qadmus area, the two species coexisted. Other

Figure 1. *Salamandra infraimmaculata*, adult specimen found just south of the Frunlok protected area.

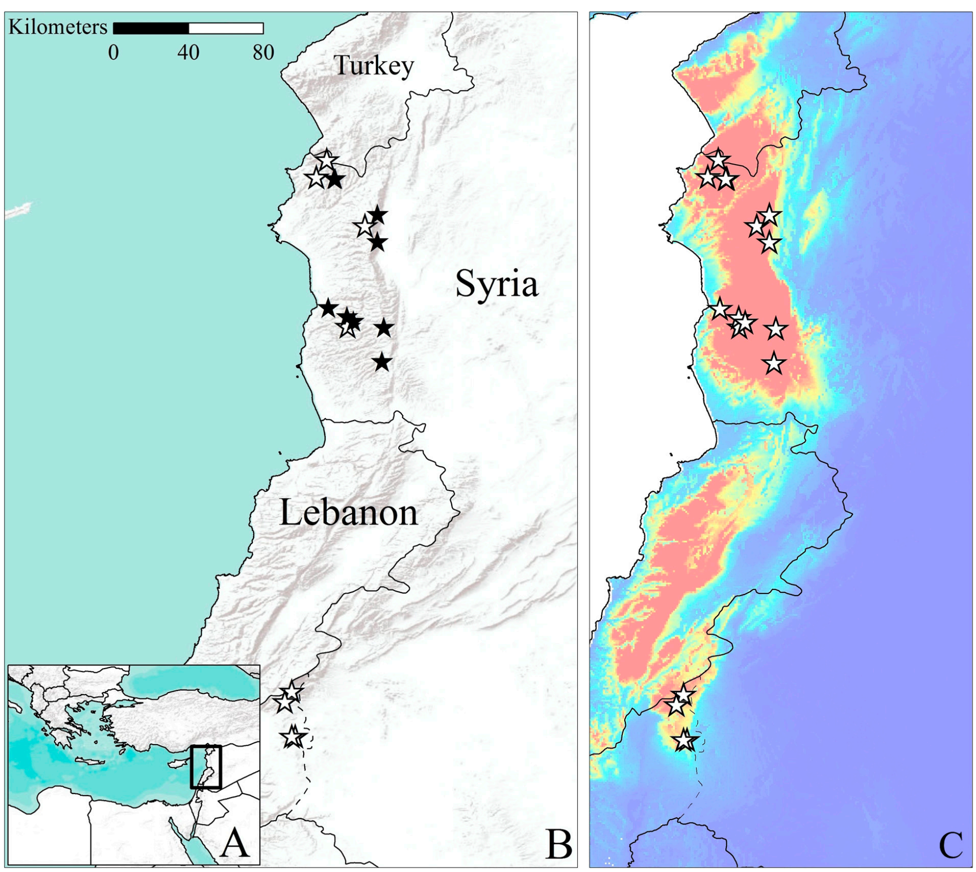

Figure 2. Map of the western part of Syria (A), showing the distribution of *Salamandra infraimmaculata* (B). Solid stars represent new localities and open stars localities from the literature or museum records (see Appendix). C shows the results of our predictive distribution model; warmer colours indicate higher suitability.

Table 1. Coordinates and site descriptions of all localities for *S. infraimmaculata* (*S. i.*) and *O. vittatus* (*O. v.*) found within the study period. Locality names and numbers correspond with the data presented in other tables.

Species	Coordinates	Height (m)	Estimated surface of the breeding water	Aquatic vegetation	Locality	Site description
O. v.	N 34°42.9 E 36°35.9	514	> 10 × 40 m	Yes	Homs	Winter rain-flooded meadow with Eucalyptus trees, along the highway from Homs to Tartous
S. i.	N 35°11.3 E 36°00.4	228	0,5 × 2 m	No	Ain Ghadran	Water well, with small concrete ditches, head of a now-dry stream on karst mountain slope, near Ain Ghadran, road from Baniyas to Al Qadmus, Barmitra
S. i.	N 35°08.7 E 36°05.8	687	2 × 4 m	No	Ain Asharkia	Water well along the road in extensively used agricultural fields, Ain Asharkia, Quatania
S. i. *O. v.*	N 35°07.4 E 36°07.7	788	about 15 × 15 m	Yes	W Al Quadmus	Large pond, in a karst landscape with maquis vegetation and some extensively used agricultural fields, 2 km west of Al Qadmus
O. v.	N 35°05.8 E 36°12.4	933	5 × 5 m	Yes	E Al Quadmus	Man-made cistern built from large stones, east of Al Qadmus
S. i. *O. v.*	N 35°05.6 E 36°16.4	960	2 × 6 m	No	Ain Hassan Garbeye	Temporarily rain-filled ditch along the road in a karst landscape, Ain Hassan Garbeye, 7 km northwest of Masyaf
O. v.	N 35°36.5 E 36°05.3	603	35 × 35 m	Yes	Al Haffah	Large pond inbetween arable lands, Al Haffah, near junction road to village Aramo
S. i.	N 34°55.8 E 36°15.9	915	1–1,5 m wide stream, basin about 6 × 4 m	No	Ain Al Thahab	Small stream and concrete water basin in agricultural landscape in Ain Al Thahab
O. v.	N 35°48.0 E 36°02.4	586	1,5 × 0,5 (well) 6 × 4 (basin)	No	Arrawda 1	Water well overflowing into a large concrete basin, Arrawda, Frunlok protected area
O. v.	N 35°48.2 E 36°02.3	596	1 × 1	No	Arrawda 2	Concrete water basin, Arrawda, Frunlok protected area
S. i. *O. v.*	N 35°48.5 E 36°02.1	586	5 × 5	No	Arrawda 3	Pond with pine forest land habitat, Arrawda, Frunlok protected area
S. i.	N 35°30.3 E 36°14.6	740	2 × 2	No	Sharre	Water well, source on road from Sharre to Slinfah
S. i.	N 35°38.2 E 36°14.6	582	2,5 × 1,5	No	Roman well	Water well, built in roman times, karst hill slope with maquis vegetation, 7 km northeast of Slinfah
O. v.	N 35°43.2 E 36°17.8	172	4 × 100	Yes	Ghani Ditch	Ditch in intensively used agricultural fields, 5 km south of Ghani

Table 2. Water analysis for sites where larvae of *S. infraimmaculata* were found. No measurements were taken at the Sharre locality.

Locality (date)	T	pH	GH	KH
Ain Ghadran (03.02.2009)	11.9	8.5	8	7
Ain Asharkia (03.02.2009)	16.3	7.5	14	12
W Al Qadmus (03.02.2009)	9.4	7.5	9	9
Ain Hassan Garbeye (03.02.2009)	16.4	8.0	9	9
Ain Al Thahab (03.02.2009)	11.6	8.0	3	3
Arrawda 3 (05.02.2009)	11.2	8.0	18	18
Roman well (06.02.2009)	14.5	7.5	12	12

herpetofauna observed in *S. infraimmaculata* habitats were *Hyla savigny, Bufo bufo, Bufo viridis, Pelophylax bedriagae, Mediodactylus kotschyi, Phoenicolacerta laevis, Ophisops elegans* and *Ablepharus budaki*. At three of the seven localities, we found larvae of different size groups, ranging from 40 to 70 mm.

Results of water analysis for sites containing *S. infraimmaculata* are presented in Table 2. Water temperatures

Table 3. Contributing (%) of each parameter for predictive distribution modelling.

Parameter	*S. infraimmaculata*	*O. vittatus*
Precipitation in the coldest quarter	92.2	52.7
Precipitation in the driest quarter	0.9	11.8
Precipitation seasonality	0.9	6.1
Mean temperature in the coldest quarter	0.4	0.0
Mean temperature in the driest quarter	0.0	0.2
Temperature seasonality	3.0	3.8
Aspect	2.5	1.5
Slope	0.1	24.0

ranged from 9.4–16.4°C; pH values ranged from 7.5 to 8.0; General Hardness and Carbonate Hardness ranged from 3 to 18 for both. Only in Ain Al Thahab, GH and KH were very low.

The distribution model of *S. infraimmaculata* (Fig. 2c) in combination with the overview of contributing parameters (Tab. 3) reveals that the distribution of this species is nearly entirely shaped by precipitation in the coldest quarter (92.9% contribution to the model). Jackknife tests showed a positive relation between suitability and the amount of precipitation in the coldest quarter. The average test AUC of the model was 0.934.

Ommatotriton vittatus

The species was found at nine localities (Tab. 1). During the study period, adults and freshly laid eggs were observed in several breeding waters. Habitats ranged from a rain-flooded area near Homs to temporary and permanent ponds (small and large), around small springs with seepage water, concrete basins used by the locals as reservoirs, to a ditch in an agricultural area fed by water from mountains.

Results of water analysis for breeding sites of *O. vittatus* are presented in Table 4. Water temperatures ranged from 8.7 to 14.6°C, with an average of 11.4°C; pH values ranged from 7.5 to 8.0, and GH and KH ranged from 3 to 18 for both, with an average of 11.4 and 10.4, respectively.

Other herpetofauna observed in the habitats of *O. vittatus* were *Hyla savigny, Pelophylax bedriagae, Mauremys rivulata*, *Phoenicolacerta laevis, Lacerta media* and *Trachylepis vittata*.

The number of observed specimens varied from one site to another. For example, in Arrawda, near Jabal Dawnhan, located at the edge of the Frunlok protected area, a small concrete pond of approximately 1x1 m, contained at least 3 males and 10 females. The pond near Al Haffah, with an estimated diameter of about 35 m, contained so many

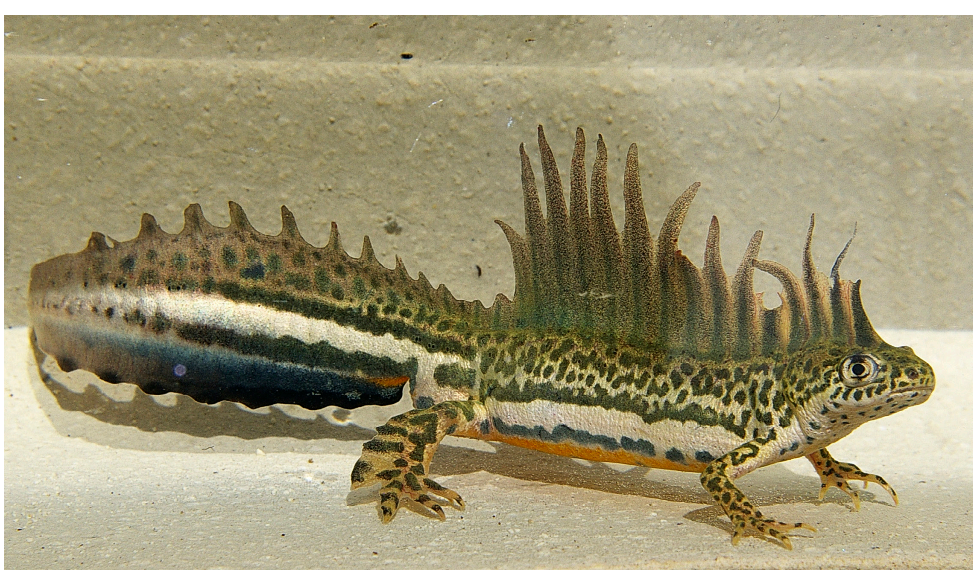

Figure 3. A male *Ommatotriton vittatus* collected from a pond east of Al Haffah, showing interrupted black lateral lines and strongly denticulate dorsal and tail crests.

Table 4. Water analysis for breeding sites of *O. vittatus*.

Locality (date)	T	pH	GH	KH
Homs (02-02-2009)	10.5	7.5	10	8
W Al Qadmus (03-02-2009)	9.4	7.5	9	9
E Al Qadmus (03-02-2009)	8.7	7.5	13	12
Al Haffah (04-02-2009)	11.5	7.5	3	3
Arrawda 1 (basin) (05-02-2009)	9.8	8.0	11	8
Arrawda 1 (well) (05-02-2009)	14.6	8.0	11	8
Arrawda 2 (05-02-2009)	13.2	7.5	14	14
Arrawda 3 (05-02-200)	11.2	8.0	18	18
Ghani (ditch) (06-02-2009)	14.0	7.5	14	14

adults that several of them were caught with a small dip net in a single sweep. Along the highway from Homs to Tartus, we could only find one male, one female, a juvenile and many eggs in a rain-flooded area. The presence of freshly laid eggs and the absence of larvae suggested that our study period coincided with the early breeding season.

Aggressive behaviour in *O. vittatus* males was observed repeatedly at localities in Frunlok and Al Quadmus where the water was clear. Males were apparently occupying and defending territories by biting at and chasing away rival males when they came too close. The open spaces between the males varied from a few dm to 0.7–0.8 m, but as the males were actively moving towards and away from each other, there seemed to be a continuous change in balance. There was a remarkably high density of newts in the pond near Al Haffah where the water was clouded.

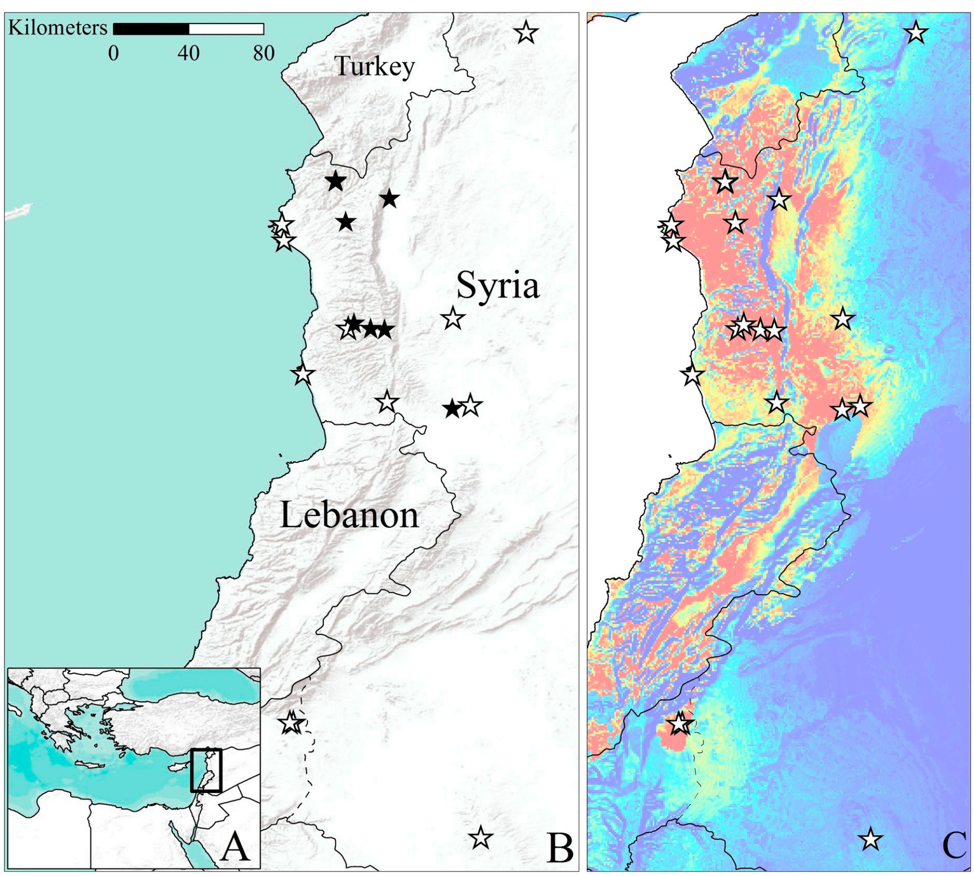

Figure 4. Map of the western part of Syria, (A) showing the distribution of *Ommatotriton vittatus* (B). Solid stars represent new localities and open stars localities from the literature and museum records (see Appendix). C shows the results of our predictive distribution model; warmer colours indicate higher suitability.

Table 5. Means of lengths and weights (in mm, g) and standard deviations (SD) for *O. vittatus* from all studied sites. Localities west and east of Al Quadmus and localities in Arrawda are combined. N = number of animals, TL = total length, SVL (snout–vent length, including cloaca, TaL = tail length), and BCI (body condition index).

	Males						Females					
Locality	N	TL (SD)	SVL (SD)	TaL (SD)	Weight (SD)	BCI (SD)	N	TL (SD)	SVL (SD)	TaL (SD)	Weight (SD)	BCI (SD)
Homs	1	103	57	46	4.9	26.5	1	93	50	43	2.9	23.2
Al Qadmus	5	131 (1.5)	63 (2.1)	66 (3.3)	8.8 (1.8)	35.3 (7.6)	3	102 (3.2)	53 (5.03)	49 (2.7)	4.8 (0.7)	35.8 (11.04)
Al Haffah	10	118 (8.8)	60 (4.8)	58 (4.8)	6.8 (1.4)	31.9 (7.1)	26	94 (5.5)	50 (2.65)	44 (2.7)	3.8 (0.8)	30.4 (4.6)
Arrawda	4	101 (8.2)	54 (3.2)	47 (6.2)	4.8 (1.1)	31.1 (7)	1	90	48	42	3.5	31.6
Ghani	3	113 (9.0)	60 (1.2)	53 (8.0)	6 (0.4)	27.2 (2.2)	2	93 (2.1)	50 (0)	43 (2.1)	4.7 (0)	37.6 (0)
Total	22	116 (12.3)	59.39 (4.6)	56.87 (8.3)	6.67 (1.9)	31.6 (6.7)	33	91.79 (17.1)	48.65 (9.0)	43.32 (8.3)	3.93 (0.8)	31.2 (5.6)

Dorsal colouration between animals differed only slightly. Males showed more contrast in their dark spotted pattern on a lighter background. Their crests were heavily denticulated, often also on the tail (see Figure 3). The white-coloured lateral bands differed from narrow to wider and the black stripes on the body bordering the white bands were interrupted in several places in some specimens. The stripes on the tail were broken only rarely. The black of these stripes was more greyish in larger (presumably older) specimens. These larger specimens also had more black dots on the ventral side compared to smaller (presumably younger) specimens (see Fig. 5).

Table 4 summarizes our measurements for *O. vittatus* examined at nine localities in Syria. All body measurements (total length, tail length and snout–vent length) show that males are generally larger than females at all locations (Table 5). The largest male in our samples was one from Al Haffah that measured 138 mm TL (SVL 71 mm and TaL 67 mm). The smallest male was from Frunlok and measured 93 mm TL (SVL 49 mm and TaL 44 mm). The largest female was 108 mm TL (SVL 57 mm and TaL 51 mm), also found in Al Haffah, whereas the smallest female was 86 mm TL (SVL 48 mm and TaL 38 mm) from the same locality. The body weight of males was almost

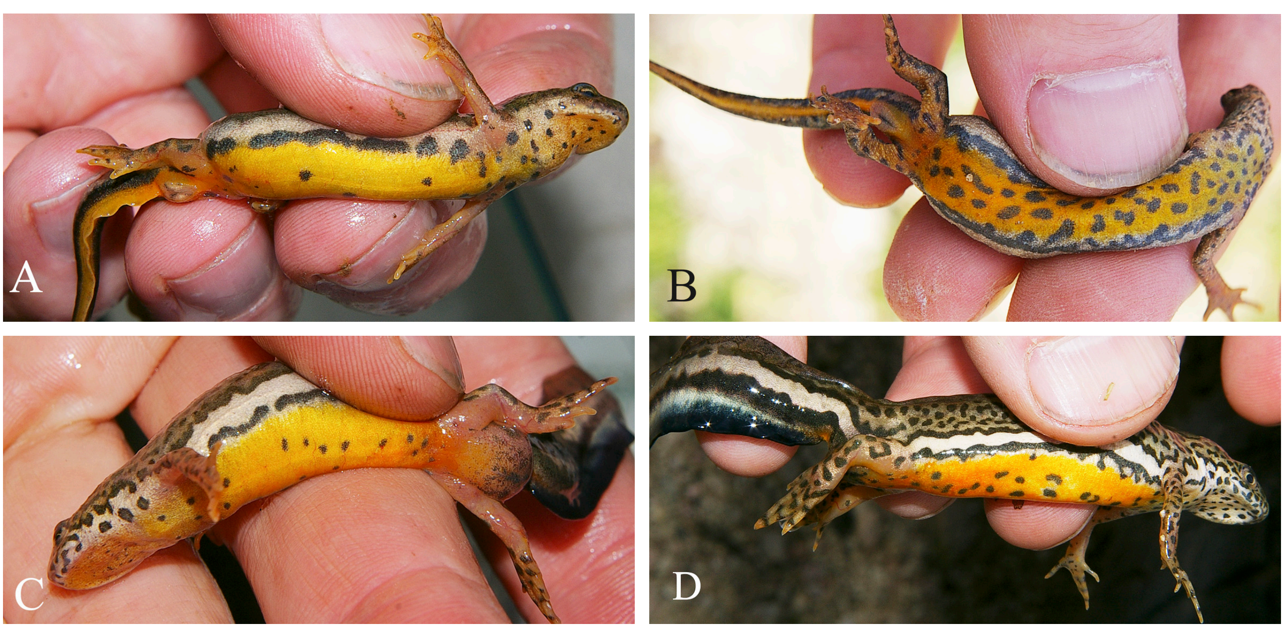

Figure 5. *Ommatotriton vittatus* showing differences in the density of ventral spots. Small (A) and larger (B) female and small (C) and larger (D) male.

Figure 6. Habitats inhabited by *O. vittatus* and *S. infraimmaculata*: A large pond in agricultural fields with *O. vittatus* east of Al Haffa (A). Pond with both *S. infraimmaculata* and *O. vittatus* in karst landscape with maquis vegetation west of Al Qadmus (B).

double that of females at all locations (Table 5). However, the mean body condition index ($BCI = 10000 \times W(g) / SVL(mm)$ of females was comparable to that of males (Tab. 5).

The distribution model of *O. vittatus* (Fig. 4c) in combination with the overview of contributing parameters (Tab. 3) reveals that the distribution of this species is mainly shaped by precipitation, both during the winter and summer periods. Additionally, the parameter slope shows a considerable contribution to the model. The Jackknife tests reveal a positive relation between both precipitation in the coldest and driest quarters, while only relatively flat terrain corresponds to the high suitability aspect for *O. vittatus*. The average test AUC of the model was 0.825.

Discussion

Our findings extend the knowledge of *S. infraimmaculata* and *O. vittatus* in Syria. The distribution of *S. infraimmaculata* is restricted to the mountains of Syria, which comprise the Golan Heights (Esterbauer 1987, 1992) and the coastal mountains where we expanded the known distribution by several new localities. The species is widely distributed in the bordering mountains of Lebanon (Hraoui-Bloquet et al. 2002). The wide and deep Orontes River Valley, located on the border between Syria and Lebanon, likely acts as a contemporary barrier between populations of *S. infraimmaculata* in the aforementioned countries. Its distribution in the Frunlok protected area continues into Turkey where it has been found in Yagladaği, Harbiye and Antakya (Baran & Öz 1994). Additionally, it must be noted that the distribution model was built using climate and topographic parameters only, due to which it likely overestimates the distribution of *S. infraimmaculata*, which is fragmented in (forested) areas. Larvae of different size groups were found, which could well indicate that larvae had been deposited during different periods (probably late autumn and early spring).

The known distribution range of *O. vittatus* is expanded by nine new localities along the Mediterranean zone of northwestern Syria, now extending from the most northwestern parts of Syria near the Frunlok protected area to as far south as Jabal Al Arab near Daraa. The latter is a highly interesting record, which we were unable to check, though. We failed to reconfirm *O. vittatus* from along the coastal zone near Tartus and Latakia, where habitats may have been lost due to the expansion of both cities. We did, however, find the species in the coastal mountain area up to 960 m a.s.l. and in the Orontes valley. We expect a wider distribution for *O. vittatus* than is currently known. We were also unable to explore the area north and northeast of Aleppo along the Turkish border where the species can be expected to occur (see Franzen & Schmidtler 2000; Franzen 2001). *Ommatotriton vittatus* displays wider environmental tolerance than *S. infraimmaculata*, which is partially confirmed by its wider predicted distribution (see Figure 2 and 4). However, the heterogeneous landscape of Syria in combination with a relatively low number of observations per climate zone might bias the model, leading to the relatively irregular prediction. The addition of distribution records from southern Turkey and Lebanon might improve the model, which is however beyond the scope of this study. There is also a record from 5 km NW Ceylanpınar (36°52' N, 40°00' E) (Franzen 2001) just north of the Syrian border with Iraq. This record suggests a hitherto unrecorded distribution area in Syria. The habitats of *O. vittatus* in Syria are comparable to those described from other parts of their distribution (see Degani & Mendelsohn 1983, Franzen & Schmidtler 2000, Pearlson & Degani 2008).

Water quality data show that both species are found mainly in waters that are hard due to the limestone surroundings of their sources. However, both species are not restricted to this type of water, and both can also thrive in rainwater filled ponds (see Table 2 and 4). Pearlson & Degani (2011) studied *O. vittatus* sites and reported similar findings of water quality parameters, but they were able to study their sites for a much longer period of four years.

The mean weight of *O. vittatus* in Syria is higher, 6.7 g (n = 23) for males when compared to other studies (4.4 g, n = 23 in Franzen & Schmidtler 2000; 4.8 g, n = 15 in Pearlson & Degani 2008). But our males were generally larger as well 11.6 cm (9.3–13.8, n = 23) compared to Pearlson & Degani (2008; 9–11 cm, n = 15) or Franzen & Schmidtler (2000; 8–10.8 cm, n = 31). As for females, we see little difference, as our mean was 3.9 g compared to 3.7 g, n = 27 and with similar sizes, 9–10 cm, compared with 8.5–10 cm (Pearlson & Degani 2008). But they are heavier and larger when compared to 3.3 g (n = 8) and 7.0–9.7 cm (n = 15) (Franzen & Schmidtler 2000).

So far, aggression in males of *Ommatotriton* spp. has mostly been described in respect to the now-separate species *O. ophryticus* (see Borkin et al. 2003). We can however confirm that similar aggressive behaviour occurs in *O. vittatus*.

Olgun et al. (1997) report that males of *O. vittatus* from Hatay, southern Turkey, do not have denticulate tail crests. We suspect, though, that the crests were no longer in optimal shape due to their late capturing of adults (27 March 1995). In contrast, we found many males with denticulate crests (see example Fig. 3) in all studied populations. Conservation of both species requires further assessment. *Salamandra infraimmaculata* is listed as Near Threatened in the IUCN Red Data Book according to Papenfuss et al. (2009). It is reported as being rare in Iran and Turkey, while common in Lebanon with localized distribution. In Syria, its distribution runs very much parallel to that in Lebanon, along the inner coastal mountains and southern Syria close to Mount Hermon.

We noted several threats to the local newt populations as a result of tapping of large amounts of water at a water source, which, in one instance, resulted in extensive mortality of larvae. Another observed threat is the pollution of a breeding stream with garbage. The rarity of surface waters is probably the main reason for the scarcity of this species in northwestern Syria.

According to Olgun et al. (2009) in the IUCN Red Data Book, *O. vittatus* is considered to be of Least Concern with decreasing populations. Habitat alteration and changes in land use in Syria are continuous, especially within the lower parts of its current distribution range where the development of new agricultural settlements and infrastructural projects is widespread. Pet trade does not constitute a major threat for this species in Syria, since it is not traded (Amr et al. 2007). We could, however, observe a remarkable local use of these newts. Two fishermen from Latakia were seen collecting large numbers of newts at the locality Al Haffah (Fig. 6a) and storing them in plastic barrels to serve as live bait for angling at sea.

In conclusion, although both species are locally still present in fair numbers in Syria, direct threats were noted. Both species could benefit from low-cost measures such as the construction of spring reservoirs with easy access for the adult newts to breed and/or adult salamanders to deposit their larvae. Further studies should address population size, spatial and temporal distribution, and the identification of threats for both species in Syria. Regional Red Data listing to assess the local status of amphibians and reptiles according to the IUCN categories remains a challenge for the Syrian conservation authorities.

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Appendix

Records from literature and museums used in the maps

Salamandra infraimmaculata: Previous records are: 5 km west of Arnah, border with Lebanon, 2 km south of Al Hamidyah, 5 km north of Al Qunaytirah (= Quneitra) (Esterbauer 1987, 1992). Mt. Ermon (=Hermon) (Eiselt 1958). Syria (Martens 1885). Fir Cedar Reserve, Slenfe (= Slinfah) (Sindaco et al., 2006). Museum records: SMF 75363, Alkabeer near Kasab, 28.5.1993. SMF 75483 and 75496, 3 km southeast of Kasab, 10.5.1989. SMF 75500, border crossing Turkey/Syria (Yayladagli/Kasab), 9.5.1989. SMF 75514–18 (Larvae), 13 km south of Kasab, 3.VI.1989. SMF 76054–58 (Larvae), 5 km west of Quadmus, 10.5.1994.

Ommatotriton vittatus: Previous literature records are: Latakia and Tartus (Werner, 1902), Crac des Chevaliers (= Kalat el Husn: Lymberakis, 1999), east or Taranjah and southwest of Jabaja al Khashab (Esterbauer, 1987, Esterbauer 1992). Museum records: SMF 76065–66, 5 km west of Al Qadmus, 10.5.1994. SMF 75550–69 (larvae), 6 km north of Rabi'ah, 3.6.1989. ZFMK 27506, ruins of Ugarit near Latakia. ZFMK 21000–02, Qal'at el Hosn. ZFMK 21003, 25 km north of Daraa.