Declines of amphibians and reptiles in Georgia during the 20th century: virtual vs. actual problems

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Rückgang von Amphibien und Reptilien in Georgien während des 20. Jahrhunderts: vermeintliche und tatsächliche Probleme

Zur Zeit sind aus Georgien 12 Amphibien- und 54 Reptilienarten bekannt. Wir analysierten 437 Fundortangaben von Amphibien und Reptilien aus der Zeit vor 1930, die wir der Literatur der letzten 40 Jahre entnahmen und verglichen sie mit Ergebnissen unserer aktuellen Beobachtungen. 49 der 437 früheren Arten/Habitate konnten wir nicht mehr bestätigen – trotz regelmäßiger Beobachtungen an den alten Fundorten. Allerdings zeigt die Analyse der Daten, dass in der Mehrzahl der Fälle der Grund für fehlende aktuelle Nachweise nicht das tatsächliche Aussterben ist, sondern Fehlbestimmungen der Arten durch die früheren Autoren, Änderungen in der Nomenklatur, falsche oder ungenaue Fundortangaben sowie falsche Etikettierung der Sammlungen. Es verbleiben lediglich 20 Fälle, für die das Aussterben einer Art an einem Fundort anzunehmen ist. Dies betrifft überwiegend Amphibien- und Reptilienarten, die auf trockene, steppenartige Landschaften oder Gebüschformationen angewiesen sind, die in Georgien an ihre nördliche Arealgrenze stoßen. Die Nordgrenze der Verbreitung von *Pelobates syriacus, Eirenis collaris, Malpolon monspessulanus* und *Vipera lebetina* hat sich im Laufe des 20. Jh. um 8–50 km nach Süden verschoben; die obere vertikale Verbreitungsgrenze der Arten *Lacerta strigata, Typhlops vermicularis* und *Eryx jaculus* verschob sich um 200–300 m nach unten. *Triturus karelinii* und *Bufo viridis* verschwanden aus dem südwestlichen (adjarischen) Teil der georgischen Schwarzmeerküste. Es fällt auf, dass ein Aussterben besonders für die Arten der trockenen, baumlosen Landschaften anzunehmen ist und in keinem Fall für Arten der mesophilen Wald-Habitate.

Schlüsselbegriffe: Amphibia, Reptilia, Georgien, Rückgang, 20. Jahrhundert.

Summary

Currently, 12 amphibian and 54 reptile species are known for Georgia. We analysed 437 records of amphibian and reptile localities that belong to the period before 1930, and compared them with the current distribution of the same species. The data derive from publications from the last 40 years, and the author's observations. 49 out of 437 old species/habitats could not be confirmed, in spite of regular recent analysis of a location. However, the analysis demonstrates that the reason species an absent is wrong species identification by earlier authors, nomenclatural changes, wrong or imprecise localisation, or miss-labelling, rather than real extinction. In only 20 cases must an extinction of a species from a locality be assumed. This applies mainly to amphibian and reptile species that are dependent on dry, steppe-like, or shrubby landscapes, which are found in Georgia at the northern edge of their ranges. The northern border of the distribution of *Pelobates syriacus, Eirenis collaris, Malpolon monspessulanus*, and *Vipera lebetina* retreated 8–50 km southwards during the 20th century; the upper altitudinal borders of the distributions of *Lacerta strigata, Typhlops*

vermicularis and *Eryx jaculus* in eastern Georgia have been displaced 200–300 m downwards. *Triturus karelinii* and *Bufo viridis* disappeared from the south-western (Ajarian) fragment of the Georgian Black Sea coast. It is remarkable that extinction was assumed most often for species that depend on relatively dry treeless landscapes and never for species that depend on mesophylic forest habitats.

Key words. Amphibia, Reptilia, Georgia, decline, 20th century.

1 Introduction

Georgia lies in the south-western part of the Caucasus region. The country, although relatively small (69000 km²) has a great variety of landscapes, from humid forests to dry semi-deserts. The biodiversity of the country was formed due to an interaction of at least three different units of the Palaearctic faunistic region (GAJIEV 1985, TUNIYEV 1995, TARKHNISHVILI 1996). The herpetological fauna is quite diverse: it includes at least 12 species of amphibians, and at least 54 species of reptiles (the number of specific names indicated for Georgia depends on the taxonomic views of different authors; TUNIJEV 1995, TARKHNISHVILI & GOKHELASHVILI 1999). The list of amphibian and reptile species recorded for Georgia (NIKOLSKY 1913, DJANASHVILI 1963, DAREVSKY 1967, MUSKHELISHVILI 1970, BAKRADZE & DAREVSKY 1974, BANNIKOV et al. 1977, BAKRADZE & CHKHIKVADZE 1992, CHKHIKVADZE & BAKRADZE 1993, TARKHNISHVILI 1995) is given in Table 1.

Tab. 1: Amphibian and reptile species recorded for Georgia. Supposedly erroneous records that were repeatedly brought into doubt by later authors and that never had documented approvals are marked with *. Species names after ANANYEVA et al. (1988) and TUNIYEV (1995).
Liste der Amphibien und Reptilien Georgiens. Mit * sind wahrscheinliche Falschmeldungen markiert, die von späteren Autoren wiederholt angezweifelt worden sind und für die keine dokumentierten Belege vorliegen. Artnamen nach ANANYEVA et al. (1988) und TUNIYEV (1995).

Order	Family	Genus	Species (old name)	Species (new name)
Caudata	Salamandridae	*Mertensiella*	*(Salamandra) caucasica*	*caucasica*
		Triturus	*(Molge) vittata*	*vittatus*
			vulgaris	*vulgaris*
			cristatus	*karelinii*
Anura	Pelobatidae	*Pelobates*	*syriacus*	*syriacus*
	Pelodytidae	*Pelodytes*	*caucasicus*	*caucasicus*
	Bufonidae	*Bufo*	*bufo*	*bufo, verrucosissimus*
			viridis	*viridis*
	Hylidae	*Hyla*	*arborea savignyi*	*savignyi*
			arborea	*arborea*
	Ranidae	*Rana*	*esculenta, ridibunda*	*ridibunda*
			macrocnemis, camerani, agilis	*macrocnemis*
Chelonia	Testudinidae	*Testudo*	*graeca*	*graeca*
	Emydidae	*Emys*	*orbicularis*	*orbicularis*
		Mauremys	*(Clemmys) caspica*	*caspica*
Squamata	Gekkonidae	*Gymnodactylus*	*caspius*	*caspius*
	Scincidae	*Eumeces*	*schneideri*	*schneideri*
		Ablepharus	*pannonicus*	*pannonicus*
	Agamidae	*Laudakia*	*(Agama) caucasica*	*caucasica*

Chamaeleontidae*	*Chamaeleo**	*chamaeleon**	*chamaeleon**
Anguidae	*Anguis*	*fragilis*	*fragilis*
	Ophisaurus	*apus*	*apodus*
Lacertidae	*Eremias*	*velox*	*velox*
		arguta	*arguta*
		-	*strauchi**
	Ophisops	*(Ophiops) elegans*	*elegans*
	Lacerta	*agilis*	*agilis*
		strigata, viridis	*strigata*
		viridis, trilineata	*media*
	Darevskia	*(Lacerta) saxicola*	*saxicola*
		saxicola caucasica	*caucasica*
		saxicola defilippii	*raddei*
		saxicola gracilis?	*daghestanica*
		saxicola caucasica?	*alpina*
		saxicola rudis	*rudis*
		derjugini	*derjugini*
		praticola	*praticola*
		saxicola, portschinskii	*portschinskii*
		mixta	*mixta*
		saxicola gracilis?	*parvula*
		saxicola ?	*clarkorum*
		saxicola valentini	*valentini*
		saxicola, portschinskii	*dahli*
		saxicola armeniaca	*armeniaca*
		saxicola ?	*unisexualis*
		*boettgeri**	*chlorogaster**
Typhlopidae	*Typhlops*	*vermicularis*	*vermicularis*
Boidae	*Eryx*	*jaculus*	*jaculus*
Colubridae	*Natrix*	*(Tropidonotus) natrix*	*natrix*
		(T.) natrix	*natrix, megalocephala*
		(T.) tesselatus	*tesselata*
	Coronella	*austriaca*	*austriaca*
	Eirenis	*(Contia) modesta*	*modestus*
		collaris	*collaris*
	Coluber	*(Zamenus) gemonensis*	*jugularis, caspius*
		germonensis	*jugularis, schmidti*
		ravergieri	*ravergieri*
		najadum, dahli	*najadum*
	Elaphe	*(Coluber) dione*	*dione*
		hohenackeri	*hohenackeri*
		quatuorlineatus	*quatuorlineata*
		longissima	*longissima*
		leopardinus	*situla**
	Telescopus	*(Tarbophis) iberus*	*fallax*
	Malpolon	*(Coelopeltis) monspessulana*	*monspessulanus*
Viperidae	*Vipera*	*lebetina*	*lebetina*
		ammodytes	*ammodytes*
		kaznakovi	*kaznakovi*
		renardi, berus dinniki	*ursini, dinniki*
		renardi, berus dinniki	*ursini, darevskyi*

Since the second half of the 19th century, herpetological records in Georgia are relatively intensive. NIKOLSKY (1913, 1918) summarised all findings starting from ca. 1850s and finishing in the first decade of the 20th century. Following the appearance of this monograph, several further papers on the distribution of amphibians and reptiles in Georgia have been published (SHUGUROV 1914, ROSTOMBEKOV 1930, BARACH 1930 etc.). Thirty years ago, MUSKHELISHVILI (1970) summarised reptile findings in the eastern part of Georgia, including those of the beginning of the 20th century. All in all, researchers working between 1850 and 1930 indicated at least 98 locations of amphibians and reptiles (the reduced figure follows synonymisation of identical or neighbouring localities). At least 47 species (according to the recent taxonomic views; exact number of recorded species is difficult to recover, due to changes in taxonomic practise) were recorded for these localities. The locations are distributed fairly evenly through Georgia (Fig. 1, Tab. 2). In total, 437 species/locations were recorded. These records, together with recent investigations (BAKRADZE 1969, 1975, 1976, NEGMEDZYANOV, & BAKRADZE 1977, DAREVSKY 1987, TUNIYEV 1985, ZHORDANIA et al. 1975), provide basis for investigating changes that have happened during the 20th century in amphibian and reptile distribution in Georgia.

Because 'old' locations cover almost the entire country's area and represent a significant part of local amphibian and reptile species, the recent information about presence or absence of species in these locations helps to develop a general idea about the dynamics of the herpetological fauna, including answers to following questions: (1) has the distribution pattern of amphibians and reptiles in Georgia substantially changed during 20th century? (2) which species or group of species (if any) endured the most extreme decline? (3) are declines of individual species (if observed) associated with direct habitat destruction? The present paper examines these and associated questions.

2 Methods

Because the study encompasses wide geographic scale, up to several tens of kilometres between locations, the disappearance of a species from a location does not allow us to judge the extent of decline (how many local populations have actually gone extinct). The present work rather reveals general trends in the distribution ranges, instead of estimating decline in terms of individual local populations.

Two potential difficulties are obvious when re-analysing old distribution data. The first is connected with nomenclatural changes, the second with changes of geographic names, required for precision in the description of locations. The last decades of the 20th century were marked with increased taxonomic revision of species in the Caucasus region, which resulted in the split of some old taxa into several new ones. This applies especially to species of rock lizards from the genus *Darevskia* (DAREVSKY 1967, MURPHY et al. 1996) and otters of subgenus *Pelias* (VEDMEDERYA et al. 1986, ORLOV & TUNIEV 1986). Our analysis applies to bibliographic references and not museum voucher specimens. Therefore, mentioning of an obsolete specific name for a certain locality we treat as an indication of presence of at least one of currently recognised species that falls under this name. In Table 1, an approximate correspondence between

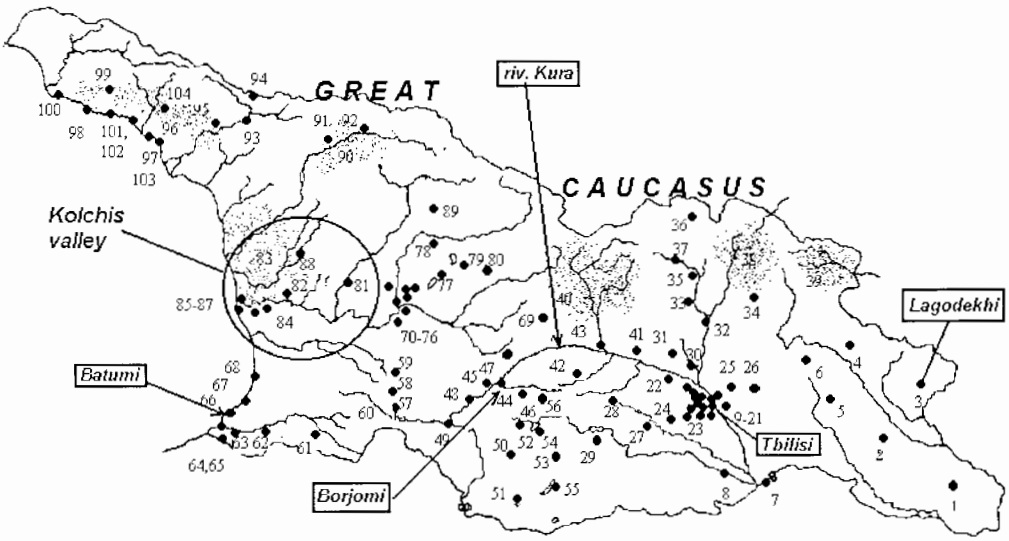

Fig. 1: The map of Georgia with localities mentioned in herpetological publications before 1930; see Tab. 2 for description of the localities.
Karte von Georgien mit den vor 1930 in herpetologischen Publikationen erwähnten Fundorten. Zur Beschreibung der Fundorte siehe Tab. 2.

species names used at the beginning of the 20th century and current usage (ANANYEVA et al. 1988, TUNIYEV 1995) is given.

Changes of geographic names could be followed by comparison of old and newer geographic maps. A more important problem is inaccurate or imprecise description of locations. For instance, the names of several large settlements (Tiflis or Tbilisi), Lagodekhi, Borjomi, Batumi) were often used in labelling specimens that were collected far away from these settlements. In order to interpret such labels, we used them as an evidence of the presence of a species in a region that can be plausibly associated with a place-name (Fig. 1). In a similar way, we treated location names that describe larger regions within Georgia ('Mingrelia'; Khevsureti etc). In Table 2, names of locations are given hierarchically. Thus, names such as 'Tiflis' could belong to any one of the more precisely described locations given in this Table.

In the course of the analysis, we summarised data published during 1980–1999, personal observations of the first author during the same period, and data obtained during field trips undertaken during 1999–2000. The goal was to confirm the presence/absence of a species in a locality, from which it was recorded before 1930.

However, current absence of a species often cannot be used as evidence of its extinction in this location. When analysing field data, we used differential approach to different species, dependent on the likelihood of overlooking a population if it actually presents in a locality. For the majority of Georgian amphibians (except for the Caucasian salamander, *Mertensiella caucasica*), presence of a species can be confirmed by inspecting appropriate breeding sites by dip-netting during the period of larval development (optimally in June). In sunny weather throughout the warm period,

Tab. 2 : List of findings of amphibians and reptiles in Georgia during the period before 1930. Locations that lie at a distance less than 10 km and in similar landscapes are pooled together. * species that were not indicated in NIKOLSKY'S list. Sources: NIKOLSKY (1913), MUSKHELISHVLI (1970), ROSTOMBEKOV (1930), BARACH (1925); Figures after a species name: last record of a species. Non-approved locations are underlined, if a species was recorded from a neighbouring area and landscape was not markedly changed since the beginning of 20th century (i.e. no reasons to assume wrong locality or extinction). 89 and later – author's direct observations; before 89 mostly resulting from bibliography, including: DIDMANIDZE (1962), MUSKHELISHVILI (1959, 1970), BISCHOFF & ENGELMANN (1976), TUNIEV (1985), RUDIK (1989). Boldface: findings that were not confirmed by further studies. Bold italics: extinction assumed. Location name (1) – place-name that can be used for any of the locations listed in the column Location name (2).

Fundortliste der georgischen Amphibien und Reptilien, die vor 1930 registriert wurden. Näher als 10 km beieinander liegende Fundpunkte in einheitlicher Landschaft wurden zusammengefasst. * Arten, die nicht in der Liste NIKOLSKYS aufgeführt sind. Quellen: NIKOLSKY (1913), MUSKHELISHVLI (1970), ROSTOMBEKOV (1930), BARACH (1925); die Zahlen hinter den Artnamen geben das Jahr der letzten Beobachtung an; nicht überprüfte Arten von Fundorten, in deren Umgebung in ähnlicher Landschaft aber die Art festgestellt wurde, sind unterstrichen (es besteht in diesen Fällen kein Grund zur Annahme einer falschen Fundortangabe oder dass die Art ausgestorben ist). Angaben von 89 und früher: eigene Beobachtungen; vor 89: meist Literaturangaben inkl. DIDMANIDZE (1962), MUSKHELISHVILI (1959, 1970), BISCHOFF & ENGELMANN (1976), TUNIEV (1985), RUDIK (1989); **fett**: Arten, die bei späteren Untersuchungen nicht bestätigt werden konnten; ***fett***: Aussterben vermutet. Die unter (1) aufgelisteten Ortsnamen können jeweils den unter der Rubrik (2) aufgelisteten Namen entsprechen.

Location name (1)		Location name (2)	Species indicated
1.	Iori valley	Eldari	Vipera lebetina98
2.	Lagodekhi	Signakhi	Lacerta 'viridis strigata'96
3.	Lagodekhi	Lagodekhi	Pelodytes caucasicus96, Bufo verrucosissimus96, B. viridis, Rana macrocnemis85, R. ridibunda96, Testudo graeca*84, Emys orbicularis62, **Laudakia caucasica**, Anguis fragilis*62, **Eremias velox***, Lacerta 'viridis strigata'70, L. derjugini96, L. praticola*, L. caucasica, L. **chlorogaster**, Natrix natrix62, Natrix tesselata*62, Coronella austriaca62, Coluber najadum62, Elaphe quatuorlineata*62, E.dione62, Telescopus fallax, **L. (saxicola gracilis)**, **Eirenis collaris**, **Typhlops vermicularis**, **Eryx jaculus**, **Vipera (dinniki)**
4.	Lagodekhi	Eniseli	Rana macrocnemis
5.	Iori valley		Laudakia caucasica*00
6.	Telavi	Telavi (Chiantba)	Triturus vulgaris94
7.	Iori valley	Karayaz	Hyla savignyi, Natrix natrix*99, Coluber najadum94, Telescopus fallax70
8.	Shulaveri	Shulaveri	Vipera lebetina77
9.	Tiflis	Grmagele	Laudakia caucasica*, Typhlops vermicularis*60
10.	Tiflis	Kumisi	Testudo graeca*99, Eryx jaculus*99, Mauremis caspica*70
11.	Tiflis	Shavnabada	Eryx jaculus*, Coluber jugularis*, C. ravergieri*, C. najadum*, Elaphe hohenackeri*, Elaphe quatuorlineata*, Telescopus fallax*
12.	Tiflis	Soganlugi	***Vipera lebetina****
13.	Tiflis (Tbilisi)	Avchala	Testudo graeca*, Laudakia caucasica, Anguis fragilis*, **Lacerta portschinskii**, Eryx jaculus*
14.	Tiflis	Tiflis (No further details given)	Triturus vittatus98, T. karelinii98, H. arborea98, **Bufo verrucosissimus**, B. viridis98, Mauremis caspica85, Emys orbicularis97, Testudo graeca00, Laudakia caucasica00, Ophisaurus apodus00, Anguis fragilis*, Ophysops elegans99, Eremias velox99, Lacerta 'viridis strigata'00, **Lacerta portschinskii**, **L. raddei**, Eryx jaculus99, Natrix natrix97, N. tesselata97, Coronella austriaca, Coluber jugularis99, C. najadum00, C. ravergieri00, Elaphe quatuorlineata00, E. hohenackeri00, **E. longissima**, **E. situla**, Eirenis modestus98, Telescopus fallax98, *Malpolon monspessulanus*, Typhlops vermicularis98, Vipera ammodytes*85, **Vipera (dinniki)**
15.	Tiflis	Sololaki	Lacerta 'viridis strigata'00, Typhlops vermicularis*98, Coluber najadum81, Eirenis modestus*98, ***E. collaris****, Telescopus fallax*, ***Malpolon monspessulanus***
16.	Tiflis	Turtle lake	***Triturus vittatus, Pelobates syriacus, Rana macrocnemis***, R. ridibunda00, ***Mauremis caspica****85, ***Emys orbicularis****, Laudakia caucasica*98, ***Natrix natrix****70, Telescopus fallax*98, ***Lacerta strigata****
17.	Tiflis	Vere valley	Testudo graeca*98, Emys orbicularis*, Ophisaurus apodus*98, Typhlops vermicularis*, Eryx jaculus*90, Natrix natrix*, Coluber jugularis*, C. najadum*97,
18.	Tiflis	Lisi lake	Testudo graeca*97, Emys orbicularis*97, Anguis fragilis*, ***Lacerta strigata****, Typhlops vermicularis, **Natrix natrix***70, Natrix tesselata*82
19.	Tiflis	Saburtalo	Laudakia caucasica*98, Telescopus fallax*83
20.	Tiflis	Mukhatgverdi	Laudakia caucasica*93
21.	Tiflis	Upper current Digomi river	Typhlops vermicularis*, Vipera ammodytes86

22.	Tiflis	Tskhneti	Testudo graeca*98, Emys orbicularis*80s, Laudakia caucasica, Ophisaurus apodus*80s, Typhlops vermicularis*, Natrix natrix*80s, Coluber najadum*, C. ravergieri*, Eirenis modestus*, Telescopus fallax*
23.	Tiflis	Kojori/ Betania/ Kiketi	Triturus vittatus82, T. karelinii82, Testudo graeca*, Emys orbicularis*, Laudakia caucasica, Anguis fragilis*82, ***Typhlops vermicularis****, ***Eryx jaculus****, Natrix natrix*, Coluber jugularis, Coronella austriaca*82, Eirenis modestus67, Vipera ammodytes*82, **Vipera (dinniki)**
24.	Tbilisi	Ekaterinenfeld	Testudo graeca
25.	Tbilisi	Sartichala (Marienfeld)	Laudakia caucasica99, Ophysops elegans99, Ophisaurus apodus*
26.	Tetritskaro	Tetritskaro	Lacerta agilis
27.	Manglisi	Manglisi	Rana ridibunda99, Lacerta agilis, **Lacerta caucasica**, L. **(saxicola gracilis)**, Coronella austriaca*
28.	Tsalka	Tsalka	Natrix tesselata, Coronella austriaca, ***Elaphe quatuorlineata***
29.	Tbilisi	Mtskheta	Emys orbicularis*, Laudakia caucasica*99, Ophisaurus apodus*98, Anguis fragilis, **L. media***75, Natrix natrix, N. tesselata, Elaphe hohenackeri74, Eirenis modestus, Typhlops vermicularis, Coluber jugularis*, Telescopus fallax75
30.	Mukhrani	Mukhrani	Hyla arborea, L. agilis, Coluber jugularis
31.	Ananuri	Ananuri	L. praticola*99
32.	Mleti	Mleti	Anguis fragilis, L. caucasica99,
33.	Tianeti	Tianeti	Lacerta praticola99,
34.	Pasanauri	Pasanauri	Anguis fragilis, L. caucasica99, Natrix natrix*
35.	Kazbegi	Kazbegi	Bufo viridis97, Rana macrocnemis97, Lacerta caucasica
36.	Gudauri	Gudauri	Lacerta caucasica99
37.	Khevsureti	Khevsureti	Coronella austriaca*, Vipera ursini*
38.	Tusheti	Tusheti	Vipera ursini*80
39.	South Osetia	South Osetia	Anguis fragilis*60s, Natrix natrix*
40.	Kaspi	Kaspi	Lacerta 'viridis var. strigata' 99
41.	Gori	Tana valley	*Triturus karelinii*, Lacerta derjugini99, Natrix tesselata*, Coronella austriaca*,
42.	Gori	Gori	Laudakia caucasica99, Lacerta 'viridis strigata'99, **L. agilis***, Natrix tesselata82
43.	Borjomi	Borjomi (no further details given)	Mertensiella caucasica98, Triturus vittatus99, T. karelinii99, Hyla arborea99, Bufo viridis99, Laudakia caucasica99, Anguis fragilis97, Lacerta 'viridis strigata', **L. praticola**, L. derjugini99, **L. (saxicola saxicola)**, Natrix natrix95, Coronella austriaca95, Vipera ammodytes96
44.	Borjomi	Likani	Natrix natrix, Coronella austriaca
45.	Borjomi	Bakuriani	Triturus vulgaris99, T. karelinii99, T. vittatus*99, Pelodytes caucasicus99, Hyla arborea99, Anguis fragilis, **Lacerta praticola** L. derjugini97
46.	Borjomi	Baniskhevi/ Lomis mta	Mertensiella caucasica98, Triturus vittatus98, *T. karelinii*, Pelodytes caucasicus99, R. macrocnemis99, Lacerta (saxicola)99
47.	Atskuri	Atskuri	Laudakia caucasica99
48.	Akhaltsikhe	Akhaltsikhe	Bufo viridis82, Natrix tesselata
49.	Akhalkalaki	Akhalkalaki	Rana macrocnemis98
50.	Khanchali	Khanchali	Rana macrocnemis98
51.	Ktsia	Ktsia	Rana macrocnemis99
52.	Levangel	Levangel	Rana macrocnemis94
53.	Tabatskuri	Tabatskuri	Rana macrocnemis99, R. ridibunda99, Bufo viridis99
54.	Paravani	Paravani	Rana macrocnemis99
55.	Tskhratskaro	Tskhratskaro	**Mertensiella caucasica**, Rana macrocnemis99
56.	Abastumani	Benari	Lacerrta 'viridis strigata'
57.	Abastumani	Abastumani	Mertensiella caucasica99, Bufo viridis 00, Laudakia caucasica99, Anguis fragilis, L. derjugini99, L. (saxicola),99, Natrix natrix, Coronella austriaca, Vipera ammodytes
58.	Abastumani	Zekari pass	Mertensiella caucasica, Anguis fragilis
59.		Adigeni	Bufo viridis
60.	Batumi	Khulo	Bufo viridis, Rana ridibunda, Anguis fragilis, Coluber najadum
61.	Batumi	Keda	Mertensiella caucasica98, Rana ridibunda99, Lacerta 'viridis strigata', L. rudis77, Natrix natrix
62.	Batumi	Kheba	Triturus vittatus, Lacerta rudis, Natrix natrix
63.	Batumi	Makhuntseti	Natrix natrix00
64.	Batumi	Chorokh	***Emys orbicularis***, Lacerta rudis, Natrix natrix, Coronella austriaca, Vipera ammodytes
65.	Batumi	Batumi	**Triturus vulgaris**, T. vittatus00, Hyla arborea00, Rana ridibunda00, Bufo verrucosissimus00, ***B. viridis***, ***Emys orbicularis***, Lacerta 'viridis strigata', L. agilis76, **L. (saxicola)**, L. rudis00, Natrix natrix, Elaphe longissima93, Coronella austriaca, L. (saxicola gracilis)97 , Vipera kaznakovi, **Vipera lebetina**
66.	Batumi	Chakva	***Emys orbicularis***, Natrix natrix, Coronella austriaca, Vipera kaznakovi
67.	Batumi	Kobuleti	Hyla arborea00, Rana ridibunda00, Anguis fragilis, Lacerta agilis, Natrix tesselata
68.	Surami pass	Surami pass	Triturus karelinii, Lacerta rudis00, Elaphe longissima
69.	Kutaisi	Choluri	**Lacerta (saxicola gracilis)**
70.	Kutaisi	Kvirila	Rana ridibunda00
71.	Kutaisi	Ajameti	Rana ridibunda98, Lacerta 'viridis strigata', L. agilis77, Natrix tesselata, Coluber najadum

72.	Kutaisi	Gelati	Lacerta 'viridis strigata'
73.	Kutaisi	Sanisli	Lacerta derjugini
74.	Kutaisi	Kutaisi	Triturus vulgaris, T. vittatus, T. karelinii, Hyla arborea, Bufo verrucosissimus, B. viridis, Rana ridibunda00, ***Emys orbicularis***, Anguis fragilis, Lacerta 'viridis strigata', L. agilis76, Natrix natrix, N. tesselata, Coronella austriaca, Elaphe hohenackeri, Coluber najadum
75.	Kutaisi	Sapirchkhia	Anguis fragilis
76.	Kutaisi	Kvaliti	Bufo verrucosissimus, Bufo viridis, Anguis fragilis
77.	Kutaisi	Sokha	Natrix natrix, Elaphe longissima
78.	Kutaisi	Zubi	Elaphe hohenackeri
79.	Tkibuli	Tkibuli	Bufo viridis, Rana macrocnemis, Anguis fragilis, Lacerta agilis, L. (saxicola gracilis), Natrix tesselata, Elaphe longissima
80.	Tskhenistskali	Tskhenistskali	Lacerta (saxicola gracilis)
81.	Mingrelia	Abasha	Bufo viridis00, Emys orbicularis98, Lacerta 'viridis strigata', Natrix natrix
82.	Mingrelia	Mingrelia	Ophisaurus apodus85, Elaphe longissima86
83.	Mingrelia	Nakalakevi	Lacerta rudis
84.	Mingrelia, Poti	Poti	**Triturus vittatus** (50 km), T. karelinii, Hyla arborea00, Rana ridibunda00, Lacerta 'viridis strigata', L. agilis00, Natrix natrix00
85.	Mingrelia, Poti	Paliastomi	Emys orbicularis98, Natrix natrix00, Natrix tesselata84
86.	Mingrelia, Poti	Mouth of Rioni	Triturus karelinii, Hyla arborea00, Rana ridibunda00, Emys orbicularis98, Anguis fragilis97, Lacerta agilis00, Natrix natrix00
87.	Mingrelia	Senaki	Triturus karelinii00
88.		Lechkhumi	Triturus vittatus
89.	Svanetia	Svanetia	Bufo viridis59, Rana macrocnemis59, Natrix tesselata, Anguis fragilis, Lacerta praticola, Vipera dinniki59
90.	Svanetia	Lentekhi	Rana macrocnemis, Lacerta caucasica, L. rudis, L. praticola
91.	Svanetia	Mulakh	Lacerta rudis, L. (saxicola gracilis)
92.	Svanetia	Tsebelda	Bufo verrucosissimus81, Angius fragilis, Lacerta 'viridis strigata', L. agilis, L. praticola, L. saxicola, Natrix natrix, N. tesselata, Coronella austriaca, Vipera kaznakovi
93.	Svanetia	Klukhor pass	Bufo viridis, Rana macrocnemis
94.	Abkhazia	Tsageri	Bufo viridis
95.	Abkhazia	Abkhazia	Bufo verrucosissimus85, Rana ridibunda, Ophisaurus apodus, Typhlops vermicularis
96.	Abkhazia	Sukhumi	Triturus vulgaris, T. karelinii, Bufo verrucosissimus76, Hyla arborea73, Rana macrocnemis, R. ridibunda76, Emys orbicularis, Lacerta agilis73, L. (saxicola gracilis), L. praticola77, Natrix natrix, Coronella austriaca, Elaphe longissima, Vipera kaznakovi, **Vipera dinniki**
97.	Abkhazia	Gudauta	Bufo verrucosissimus, Emys orbicularis, Natrix natrix, N. tesselata
98.	Abkhazia	Psyrtskha	Anguis fragilis
99.	Abkhazia	Gagra	Triturus vittatus, T. karelinii, T. vulgaris, Hyla arborea, Bufo verrucosissimus, Rana macrocnemis, ***Testudo graeca***, Lacerta (brauneri)70, Natrix tesselata, Coronella austriaca
100.	Abkhazia	Pitsunda	Triturus vulgaris89, ***Testudo graeca***, Coronella austriaca
101.	Abkhazia	Akhali Atoni	Bufo verrucosissimus
102.	Abkhazia	Bombori	Elaphe longissima
103.	Abkhazia	Shuana	Rana ridibunda, Elaphe hohenackeri

presence or absence can be established relatively reliably for those lizard species that usually build up high or medium density populations. In Georgia, there are all species of the family Lacertidae (genera *Eremias*, *Ophisops*, *Lacerta* and *Darevskia*), and a stellion *Laudakia caucasica*. The same applies to ring snakes, *Natrix natrix* and *N. tesselata*, and the European marsh turtle *Emys orbicularis*. Some species of reptiles can be overlooked in summer or autumn, but their presence can be easily established during the peak of reproductive activity (most often May). To these species, belong the Mediterranean tortoise (*Testudo graeca*), the European glass lizard *Ophisaurus apodus*, and the snakes *Typhlops vermicularis* and *Eirenis modestus*. All these species usually show high-density populations throughout the Caucasus region.

Concerning the remaining species of reptiles, absence usually cannot be used as an evidence of a species absence from a location. However, some areas in Georgia have been repeatedly sampled by naturalists during several decades. Some localities in surroundings of Tbilisi (Turtle lake, Sololaki Mountain) were studied especially inten-

sively. By this reason, in these sites, absence of a taxa during several recent decades can be taken as evidence that these species are indeed absent.

In the course of planning field work, we took into account these pre-conditions, along with the likelihood of wrong localisation or contemporary absence of a species from a location. First of all, we analysed those locations where the current presence of a species, as indicated by an early record, seems doubtful, either due to the absence of appropriate habitats, or due to the absence of any later observation of a species both from an indicated and from neighbouring localities. Those locations which later authors (in particular MUSKHELISHVILI 1970) brought into doubt were also surveyed.

In the course of the present work, several new locations of amphibians and reptiles in Georgia were discovered. The list of these new records is given in Appendix 1.

3 Results and Discussion

Results of the analyses are summarised in Table 2. Of 437 species/locations, described by the early sources, the presence of a species was confirmed in 159 cases by our direct observations, during the period 1980–2000. In 31 additional cases, presence was confirmed by other authors during the last 40 years. Therefore, at least 190 local populations of 47 species, mentioned before 1930, have survived the intervening century.

200 species/locations were not studied during the recent period, but the species were recorded in neighbouring areas with similar ecological conditions. Therefore, we do not have any reason to assume a wrong location or a local extinction.

49 species/locations mentioned by early sources (10.7 % of all locations) do not exist any more (or never existed). The following are possible explanations for the absent taxa:

Misidentification of a species

This reason is especially likely in the case of *Lacerta* and *Darevskia* (rock lizards, formerly subgenus *Archaeolacerta*), but also for some other groups. Any of names such as *'Lacerta saxicola'*, *'Lacerta saxicola gracilis'* or *'Lacerta viridis strigata'* may indicate more than one currently recognised lizard species. However, in some cases these or other names are obviously applied to species that had distinct scientific names. We assume such cases to be misidentifications. The following cases probably are misidentifications or due to nomenclatural changes.

(1) *'Lacerta saxicola gracilis'* and *'Lacerta saxicola caucasica'* from Manglisi. Two rock lizard species are currently known from this locality: *Darevskia portschinskii* and *D. armeniaca* (DAREVSKY 1967; our data, 1999). By 1913, *D. portschinskii* and *D. armeniaca* were known as *Lacerta saxicola portschinskii* and *L. s. armeniaca* respectively, both listed by NIKOLSKY (1913) for other locations. Many species of Caucasian rock lizards are morphologically similar and can be easily confused with one another. *Darevskia saxicola gracilis* and *Darevskia caucasica* are found exclusively in the Great Caucasus mountain system (DAREVSKY 1967, MURPHY et al. 1995), to which Manglisi does not belong. We conclude that rock lizards from Manglisi were misidentified.

(2) The name *'Lacerta saxicola'* mentioned for Borjomi may belong to *Darevskia parvula*, which had not been described in NIKOLSKY's time. The other rock lizard listed for Borjomi, *'Lacerta praticola'*, probably was a confusion with either *Darevskia derjugini* or *D. mixta*; both of the latter species (as well as the third rock lizard from this area, *D. rudis*) had individual specific or sub-specific names recognised by NIKOLSKY. The same seems to be true for *'L. praticola'* from Bakuriani: most likely this was a misidentified *Darevskia derjugini*. The current range of *Darevskia praticola*, *D. saxicola* and *D. caucasica* does not reach the mountains of the Minor Caucasus, where Borjomi and Bakuriani are located.

(3) *'L. saxicola'* from Baniskhevi and Abastumani (upper currents of riv. Kura) must have been *Darevskia parvula*.

(4) *'L. saxicola gracilis'* from Batumi (western part of the Minor Caucasus). This could be *Darevskia parvula* or, less likely, either *D. clarkorum* or *D. rudis*, which are currently found near Batumi.

(5) *'L. saxicola gracilis'* from Choluri and Tkibuli. Extant rock lizards found in this area are *Darevskia rudis* and *D. mixta*.

(6) The specimen described as *'L. saxicola gracilis'* from Sukhumi most likely belongs to *D. saxicola brauneri*, which is currently found throughout the Abkhazian region.

(8) Indications of *Elaphe situla* from the Tbilisi area also can be a result of misidentification (NIKOLSKY 1913). Most likely the species was confused with *Elaphe hohenackeri*.

Imprecise locations

(1) Several species typical for arid or semi-arid landscapes were indicated for Lagodekhi (the town lays in an area with annual precipitation level 800–1200 mm): *Laudakia caucasica*, *Eremias velox*, *Typhlops vermicularis*, *Eryx jaculus*. All these species could have been collected either in neighbouring parts of Azerbaijan or in steppe/rocky ecosystems of south-eastern Georgia, 50–70 km from Lagodekhi. Many researchers were based in the town of Lagodekhi, and specimens collected during short excursions would bear by this place-name. One example is *L. chlorogaster* (*'L. boettgeri'*); the nearest documented locality of this species lies in SE Azerbaijan, more than 300 km away from Lagodekhi.

(2) *Vipera dinniki* (*'berus dinniki'*) from 'Lagodekhi' was obviously collected in the subalpine belt of the Lagodekhi reserve, approx. 20–30 km north of the town.

(3) *Triturus vittatus*, *Triturus karelinii*, and *Vipera ammodytes* from 'Tiflis' (Tbilisi) could have been collected in the western vicinity of the city 10–15 km west of the current city border.

(4) *Bufo verrucosissimus*, *Elaphe longissima*, and *Vipera dinniki* from 'Tiflis' could have been collected in any part of the southern Caucasus. The location of *B. verrucosissimus* nearest to Tbilisi (our data) lies in the valley of Pshavis-Aragvi, 100 km north of the city; the nearest locations of *E. longissima* are Borjomi and Lagodekhi, separated from Tbilisi by a distance over 100 km. No documented observations of *B. verrucosissimus* or *E. longissima* are available from parts of the Caucasus where the annual rainfall level is below 800 mm. *Vipera dinniki* lives in Georgia at elevations above 1500 m, i.e. at least 50 km away from Tbilisi.

(5) *Darevskia raddei* (*'Lacerta defillippii'*) from 'Tiflis' were obviously collected in distant parts of the Caucasus, possibly in Armenia or southern Georgia (although, confusion with *D. portschinskii* is also possible). Only two rock lizards are found in Tbilisi and in areas located within 50 km from the city: *Darevskia portschinskii* and *D. dahli*. In NIKOLSKY's time the last species was routinely referred to as *Lacerta portschinskii* as well.

(6) *Triturus vulgaris* from 'Batumi'. Currently, the nearest documented location of *Triturus vulgaris* lays in the southern part of the Colchis lowland, near Kobuleti (our data, 2000), ca. 30 km north from Batumi.

(7) *Vipera lebetina* from 'Batumi' must be an extremely imprecise location. The closest documented location of this species lays in Turkey, at least 150–200 km southeast of Batumi (BARAN & ATATÜR 1998). NESTEROV (cyt. NIKOLSKY 1913) who reported the presence of this snake in the Batumi area could have been based in Batumi and used the town for trips to what currently is eastern Turkey (e.g. Kars area).

Erroneous labelling

Two locations are obviously wrong but the reasons for the mistakes are not clear.

(1) *Vipera dinniki* from Kojori and (2) *Mertensiella caucasica* from Tskhratskaro Pass. The second case is more understandable. Tskhratskaro Pass lies several kilometres above the forest belt, the landscape is untypical for the species. Our repeated studies, including night excursions, confirmed the absence of the salamander from this area. It lies approx. 10 km south of Bakuriani, where salamanders are currently found (BISCHOF & ENGELMANN 1976). A collector could have made a short trip from Borjomi to Tskhratskaro and have collected animals on his way in Bakuriani, that lies at two-third the distance. The case with *V. dinniki* from Kojori (ca. 1000 m a.s.l) is unclear. Currently, adders of the *Vipera dinniki* group are found only in sub-alpine and alpine belts. The dominating landscape in Kojori is hornbeam forest, and localities appropriate for adders lie ca. 40–50 km eastwards. Kojori could hardly be a base for a collector, in contrast to Tbilisi or Lagodekhi. Most likely, a confusion during re-labelling of the museum specimen took place.

For the remaining 24 cases that indicate an absence of a species from a location mentioned by an early source, extinction of a population is the probable explanation: if the same location was repeatedly inspected over many years by different researchers, but the presence of a species was never re-established, and the historical indication was correct (see the 'Methods' section). This applies to local or geographic populations of 15 species: *Triturus karelinii, T. vittatus, Pelobates syriacus, Bufo viridis, Rana macrocnemis, Emys orbicularis, Testudo graeca, Lacerta strigata, Typhlops vermicularis, Eryx jaculus, Natrix natrix, Elaphe quatuorlineata, Eirenis collaris, Malpolon monspessulanus, Vipera lebetina*. Below, possible reasons of extinction are discussed.

(1) **Extinction as a result of landscape degradation**. A well-documented case is an extinction of *Triturus vittatus* and *Rana macrocnemis* from the Turtle Lake near Tbilisi. One can suppose that in the past appropriate ponds existed approximately 5 km NW of the lake, where a forest belt is bordered by a mosaic of bushes. Judging from the records of DJANASHVILI (1963), the extinction has happened before the 1950s. The presence of *Emys orbicularis* and *Natrix natrix* at Turtle lake was confirmed in the 1960s (MUSKHELISHVILI 1970). However, no records are available since the early 1980s, al-

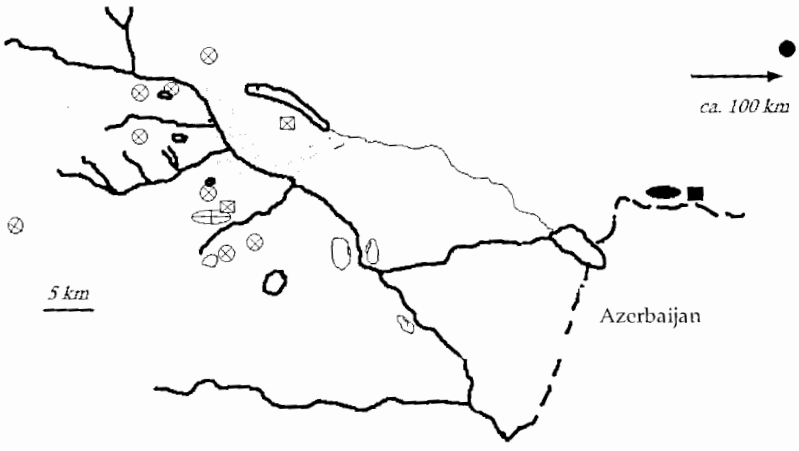

Fig. 2: Documented localities of *Pelobates syriacus* (circles), *Eirenis collaris* (squares) and *Malpolon monspessulanus* (ellipses) in Eastern Georgia. Black figures: existent localities; open figures with cross: documented localities from where the species has been extinct; grey surface: urban areas.
Dokumentierte Fundorte von *Pelobates syriacus* (Kreise), *Eirenis collaris* (Quadrate) und *Malpolon monspessulanus* (Ellipsen) in Ostgeorgien. Gefüllte Symbole: bestehende Fundorte; Symbole mit Kreuz: Fundorte, aus denen die Arten verschwunden sind; graue Flächen: besiedelte Bereiche.

though the area was repeatedly inspected during recent years. The extinction of the grass snake and marsh turtle from Turtle Lake could have been caused by the artificial change of the lake banks landscape in the 1960s. The last record of an another turtle species, *Mauremis caspica*, from Turtle Lake (DT) was in 1985; currently, this species also has been extinct.

(2) **Thinning out of a species' range without obvious landscape degradation**. There are several cases of extinction, which are not accompanied by obvious habitat degradation or landscape changes. This applies exclusively to geographic populations that lie at the border of a species' range; in no case was a local extinction observed for populations located far from the edge of distribution without obvious degradation of a habitat was documented for populations. An important factor triggering extinction in this case may be isolation, which prevents re-stocking of declining populations. Additionally, populations inhabiting the edge of a species' distribution more likely endure sub-optimal environmental conditions (HARRIS et al. 1996).

Eirenis collaris and *Malpolon monspessulanus* – from Mountain Sololaki in the south-western part of Tbilisi city. Both species are sporadically distributed in Georgia (Fig. 2). They were never recorded west and north-west of Tbilisi; thus, Sololaki represented a northernmost boundary for both these species. None of the species mentioned was recorded by ROSTOMBEKOV (1930). Therefore the extinction happened before 1930s.

Pelobates syriacus from the surroundings of Tbilisi. The species was mentioned from Turtle Lake (DELWIG 1928); during the 1980s, five isolated populations of *P. syriacus* still existed in the southern vicinity of Tbilisi (BAKRADZE et al. 1987) (Fig. 2). These populations have been extinct in the late 1980s (TARKHNISHVILI 1996). No records of the species are available in the 1990s, although old locations have been repeatedly examined by DT.

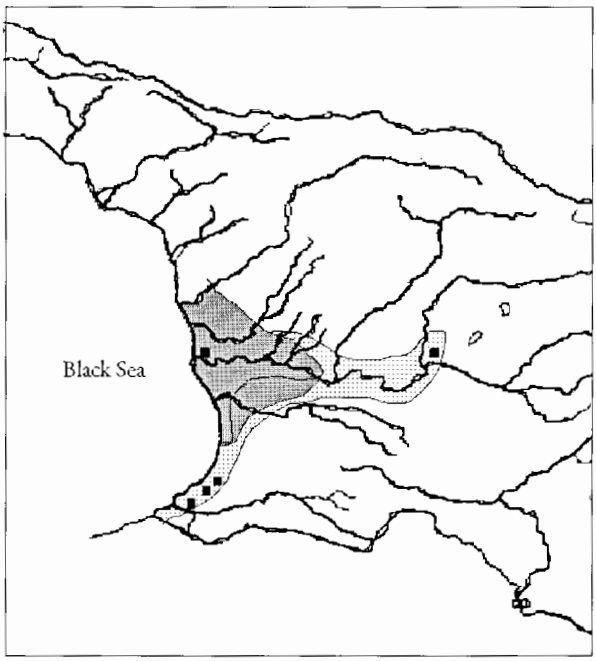

Fig. 3: Shortening of the range of *Emys orbicularis* in Georgia in 1913–1998. Black squares: records of the species before 1930; light grey shade: extrapolated range of the turtle in the western Georgia at the beginning of 20th century (following the records and the distribution of appropriate landscapes); dark grey shade: the contemporary range according to TARKHNISHVILI (1998).

Verringerung des Verbreitungsgebiets von *Emys orbicularis* in Georgien zwischen 1913 und 1998. Schwarze Quadrate: Fundpunkte vor 1930; hell gerasterter Bereich: extrapoliertes Verbreitungsgebiet zu Beginn des 20. Jh. auf Grund von Fundpunkten und nach geeigneten Lebensräumen; dunkelgrau: heutiges Verbreitungsgebiet (nach TARKNISHVILI 1998).

Emys orbicularis from the Black Sea coast in south-western Georgia (Chorokh, Batumi, Chakva) and from the eastern part of the Colchis valley (Kutaisi) (Fig. 3). The nearest, currently existing populations of the species are found at the mouth of the river Natanebi (20 km north of Chakva), and Samtredia (20 km west from Kutaisi) (TARKHNISHVILI 1998; our data, 2000). The European marsh turtle is less numerous and more sporadically distributed in Western Georgia than in the Kura basin (TARKHNISHVILI 1998). Local populations of this species have been extinct from marginal locations distant from the 'Colchis' population centre of *Emys orbicularis*, in the basin of the river Pichora (TARKHNISHVILI 1998).

A well-known case of decline of a geographically isolated population of a tortoise, *Testudo graeca*, inhabiting a moderately dry section of the Black Sea coast in Abkhazia (NW Georgia) (INOZEMTSEV & PERESHKOLNIK 1985). An extinction of at least two local populations of this species was published in the Red Data Book of the USSR (1985).

(3) **Other possible reasons of extinction.** BERITASHVILI & JANELIDZE (1999) compiled data on the climatic changes in Georgia during 20th century. They demonstrated some increase (at 0.3 to 0.7 °C) of mean annual temperature in the eastern part of the country, and parallel decrease of temperature in its western part during 1906–1995. The changes in the annual precipitation level between 1937–1990 were more complicated. Precipitation level strongly (at 10–15 %) increased in the easternmost part of the country, where xerophylic landscapes dominate, and in the Colchis valley, but decreased to the same extent in mountains of the Great and Minor Caucasus. Change of microclimate in surroundings of Tbilisi is also noticeable: although the level of annual precipitation increased here only slightly (0 to 5 %), the frequency of days with cloudless sky decreased almost twice (BERITASHVILI & JANELIDZE 1999).

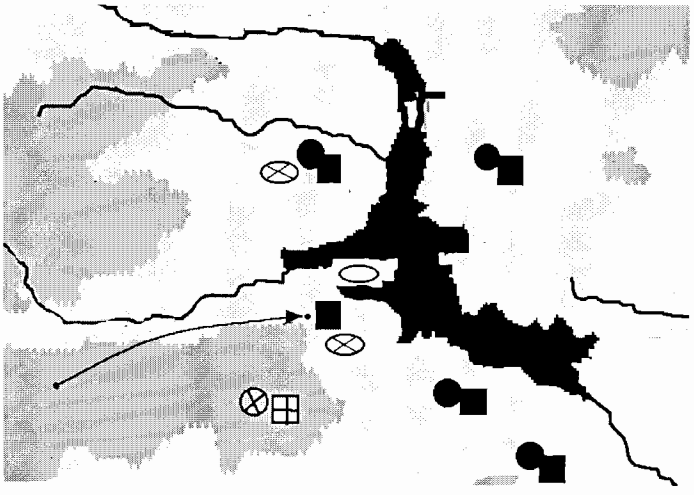

Fig. 4: Vertical displacement of some reptiles in the surroundings of Tbilisi during the 20th century. White: elevation lower than 500 m. a.s.l.; light grey: 500–1 000 m.; dark grey: more than 1 000 m; black: urbanised area. Circles (*Eryx jaculus*), squares (*Typhlops vermicularis*), ellipses (*Lacerta strigata*). Black figures: existent localities; open figures with cross: documented localities where the species has become extinct. The arrow indicates the approach of the range of *Lacerta agilis* to Tbilisi city during recent years.

Verschiebung der Vertikalverbreitung einiger Reptilien in der Umgebung von Tiflis während des 20. Jh. Weiß: Gebiete unter 200 m; hellgrau: 500–1 000 m; dunkelgrau: über 1 000 m, schwarz: Stadtgebiet. Kreise: *Eryx jaculus*; Quadrate: *Typhlops vermiculars*, Ellipsen: *Lacerta strigata*. Die ausgefüllten Symbole stehen für aktuelle, die offenen Symbole mit Kreuz für verschwundene Fundorte. Der Pfeil kennzeichnet die fortschreitende Verbreitung von *Lacerta agilis* in Richtung Tiflis während der letzten Jahre.

One of the most interesting cases of extinction is the disappearance of *Lacerta strigata* from Turtle Lake and Lisi Lake, i. e. from the surroundings of Tbilisi located at an elevation of 600–700 m a.s.l. The former presence of this lizard in mentioned locations is confirmed by vouchers stored in the museum of St. Petersburg (MUSKHELISHVILI 1970). An erroneous location is hardly possible - both place-names reflect distinct areas. Currently, *L. strigata* is found only in grassland habitats of the Vere valley, at an elevation of approx. 400 m, 3–4 km from Turtle Lake (Fig. 4). Since the 1950s, another green lizard, *Lacerta media*, is common in surroundings of both lakes. This species is less dependent on dry grassland ecosystems than *L. strigata* (MUSKHELISHVILI 1970). Unfortunately, the distribution of *L. media* near Tbilisi at the beginning of the 20th century is unknown. Displacement of *L. strigata* by *L. media* (shift of the upper border of distribution of *L. strigata* 200–400 m downwards) may have been caused by climatic changes that have happened in Tbilisi area (decreasing of insolation) and/or slow transformation of plant associations. These changes could also trigger an expansion of sand lizard (*L. agilis*) populations in vicinity of Tbilisi; until recently, this species was not observed within 30–40 km of Tbilisi (Manglisi –Kojori: 1000 m a.s.l) (NIKOLSKY 1913, MUSKHELISHVILI 1970). In 1998, we recorded *L. agilis* from the surroundings of Turtle Lake, at an elevation of 700 m (ca. 3 km from Tbilisi; Fig. 5). Therefore, slow displacement of the altitudinal boundary of the two green lizards, possibly connected with changes in humidity and associated landscape transformation, continues. This may also provide an alternative explanation for the extinction of *Eirenis collaris* and

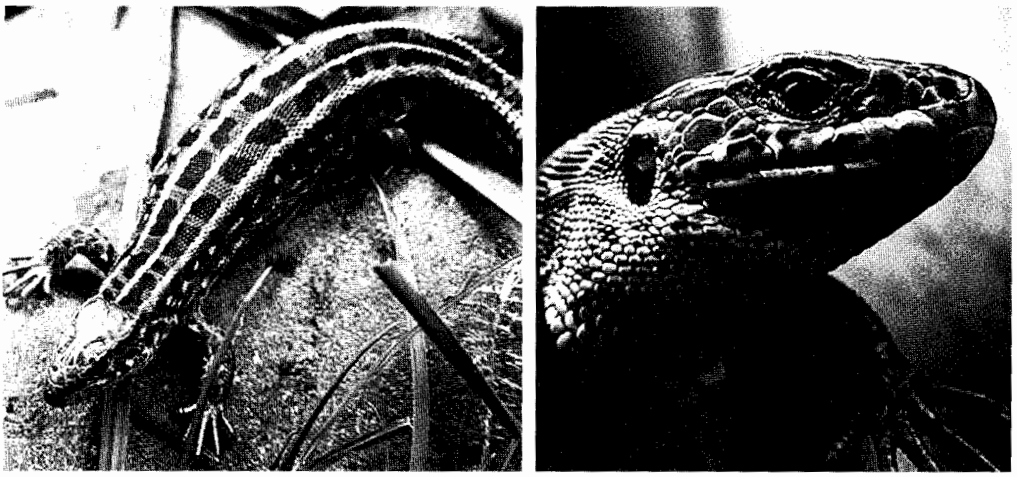

Fig. 5. *Lacerta agilis* from Turtle Lake (near Tbilisi, ca. 600 m. a.s.l).
Lacerta agilis vom Turtle Lake (nahe Tiflis, ca. 600 m üNN).

Malpolon monspessulanus from the surroundings of Tbilisi (e.g. Sololaki mt.). Both snakes live in arid stony/shrubby ecosystems. In the surroundings of Tbilisi, they were never found after the beginning of the 20th century, although superficially appropriate landscapes still exist at the same locations (it is important to stress that the locations are at the south-western border of the city, which has not change significantly for 100 years – the city was spread to the northern, south-eastern and eastern directions). This list can be completed with *Eryx jaculus* and *Typhlops vermicularis* from Kojori, at an elevation above 1000 m a.s.l. (records in 1909 and 1930, respectively). Currently, these two snakes are not found in Georgia at elevations over 500–600 m, and the Kojori finding was never re-confirmed since the beginning of the 20th century (Fig. 4). Other examples are also available: *Vipera lebetina* from the Tbilisi area (Avchala – NIKOLSKY 1913; Soganlugi – ROSTOMBEKOV 1930); *Pelobates syriacus* from the southern vicinity of Tbilisi (see above) and possibly *Elaphe quatuorlineata* were recorded, but never confirmed from Tsalka. The fragment of the Kura valley near Tbilisi provides a vertical series of environments, from dry grasslands through different types of shrubby and stony associations, to hornbeam and beech forests which currently appear at elevations above 700–800 m (GULISASHVILI 1964). One possible explanation of the cases listed is the decrease of sunny days in surroundings of Tbilisi. This could be also due to changes of landscape and climate induced by the planting of pine-trees, *Pinus eldarica*, in the 1930s–1950s and the construction of a large artificial lake in the 1950s. However, as is apparent from ROSTOMBEKOV (1930), most extinctions have happened before the late 1920s, including *Lacerta strigata* (at an elevation above 500m), *Eirenis collaris*, and *Malpolon monspessulanus*. *Vipera lebetina* has gone extinct in recent decades, along with *Pelobates syriacus*. In conclusion, extinction of some amphibian and reptile species typical for open arid ecosystems from the Tbilisi area and adjacent parts of Georgia may have been caused by increase of humidity and/or decrease of insolation, and to a lesser extent by the direct transformation of the landscape, which has not been markedly changed in most locations.

Declines of *Triturus karelinii*, *Bufo viridis*, and *Emys orbicularis* from some locations in western and central Georgia, as well as the above mentioned decline of an isolated geographic population of *Testudo graeca* in NW Caucasus, can be correlated with decreasing of mean annual temperature in this part of the country, rather than with changes of precipitation level. *Triturus karelinii* have been recorded at the beginning of the 20th century for the Tana and Baniskhevi Valleys in Central Georgia. In Tana Valley, currently there are no breeding sites appropriate for this species (probably due to the antropogenous habitat change), and this could be the cause of the extinction. However, in the lower part of the Baniskhevi valley, there are several minor suitable ponds, used by another newt, *Triturus vittatus*, which potentially could be used by *T. karelinii*. Another case are records of the green toad, *Bufo viridis*, and the marsh turtle, *Emys orbicularis*, from Batumi; currently, these species appear to be absent from the south-eastern (Ajarian) part of the Georgian Black Sea coast. The last 'strange' record is a finding of *Eryx jaculus* in the surroundings of Borchka (Okrotskali according to NIKOLSKY 1913, NE Turkey near the Georgian border). Currently, this region (mesophylic forest landscape) appears to be inappropriate for the sand boa, which is recorded in Turkey at least 200 km south-eastwards from the locality (BARAN & ATATÜR 1998).

4 Conclusion

The results of the present work reflect a relatively stable state of the Georgian herpetological fauna in the 20th century: not more than 24 out of 412 (ca. 6 %) of species/locations recorded before 1930 unambiguously become extinct during the 20th century. Most amphibian and reptile populations recorded during the 19th and the beginning of the 20th century still inhabit these locations. Most locations from which recorded species are currently absent are based on taxonomic or geographic mistakes/inaccuracies by early authors, and not on extinction. Cases of well-documented extinction during recent decades can be divided into two types. The first group includes extinction of local populations, that did not affect the general shape of a species range. Examples are *Triturus vittatus*, *Rana macrocnemis*, *Natrix natrix*, and *Emys orbicularis*, which became extinct from Turtle Lake near Tbilisi. The second type of extinction includes retreat of a species range from its historical border or a decline of the altitudinal limit of the distribution. Examples are provided by at least twelve species: *Triturus karelinii*, *Pelobates syriacus*, *Bufo viridis*, *Emys orbicularis*, *Testudo graeca*, *Lacerta strigata*, *Typhlops vermicularis*, *Eryx jaculus*, *Eirenis collaris*, *Elaphe quatuorlineata*, *Malpolon monspessulanus*, and *Vipera lebetina*. Six of these species find the northernmost limit of their distribution in SE Georgia, being restricted to arid, bushy landscapes. The ranges of these species have been displaced 8–50 km southwards. The reason of this decline is not direct habitat loss, but rather climatic change (increase of humidity and/or decrease of insolation) followed by slow transformation of habitats. Vertical displacement of the wide-spread *Lacerta strigata* and *Typhlops vermicularis* is in accordance with this hypothesis.

It is interesting to compare our data with well-recorded data on amphibian and reptile extinction in Central Europe. Particularly appropriate for such a comparison is an

analysis given by BITZ et al. (1996) for Rheinland-Pfalz (Germany). The authors of this work have summarised changes of the herpetological fauna between 1949 and the late 1990s. Most of the species are wide-spread in the region, including 12 amphibians and 6 reptiles, and did not exhibit any catastrophic decline: in 75 to 100 % of squares 10′ x 10′ where a species was recorded before 1949, it was repeatedly recorded after 1978. The situation was different for species that reached the limits of their distribution in the region. For *Pelobates fuscus*, 63 % of locations survived the second half of the 20th century; for *Bufo viridis*, 58 %; for *Hyla arborea*, 33 %; *Rana arvalis*, 50 %; *Rana ridibunda*, 67 %; *Natrix tesselata*, 25 %. Noticeably, all these species have southern- or eastern-European distribution and depend on treeless landscapes. They find their ecological optima in countries with a warmer/more continental climate. Another analogy is an extinction of a vast majority of the *Lacerta agilis* populations in southern England (CORBETT 1988). Amphibian and reptile extinction at the border of their range appears to be wide-spread in the Western Palaearctis. This applies particularly to species that can be sensitive to the increased level of humidity, decrease of insolation and/or loss of treeless habitats.

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Appendix 1: New Georgian localities of amphibians and reptiles discovered after 1990 (mostly in 1999–2000) by the authors of the present paper. Vouchers or photographs are available from the first author. A locality is assumed as new if a species was never found before at a distance less than 20 km. No observations recorded in other publications are included.

Neue Fundorte von Amphibien und Reptilien in Georgien, die nach 1990 (meist 1999 und 2000) von den Autoren entdeckt wurden. Belege oder Fotos sind über den Erstautor verfügbar. Ein Fundort wurde als neu eingestuft, wenn der nächste bekannte Fundort mindestens 20 km weit entfernt lag. Es sind nur bisher unpublizierte Fundorte aufgelistet.

Locality name	Latitude	Longitude	Species
Iormuganlo	41 35′	45 30′	*Rana macrocnemis*
Duzagrama	41 40′	45 15′	*Rana macrocnemis*
Pantishara	41 15′	46 25′	*Pelobates syriacus*
Udabno	41 30′	45 15′	*Eremias arguta*
Telavi/Chiantba	41 55′	45 25′	*Triturus karelinii*
Gremi/Eniseli	42 05′	45 40′	*Eirenis modestus*
Sioni/Tianeti	42 00′	45 00′	*Triturus vulgaris, T. vittatus, T. karelinii, Bufo verrucosissimus, Emys orbicularis, Coronella austriaca*
Tbilisi/Turtle lake	41 41′	44 45′	*Lacerta agilis*
Chitakhevi	41 45′	43 15′	*Vipera ammodytes*
Aspindza	41 35′	43 10′	*Elaphe dione*
Tsinubnistskali	41 50′	43 00′	*Mertensiella caucasica*
Riv. Pichori	42 10′	41 55′	*Emys orbicularis*
Abasha	42 11′	42 12′	*Triturus vulgaris*
Ureki	41 59′	41 45′	*Triturus karelinii, T. vulgaris*
Grigoleti	42 02′	41 45′	*Rana macrocnemis*
Churia	42 20′	41 40′	*Triturus vulgaris, T. karelinii*