

Helminth parasites of the Grass Snake, *Natrix natrix*, and the Dice Snake, *Natrix tessellata* (Serpentes: Colubridae), from Turkey

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ABSTRACT: Twenty-one grass snakes, *Natrix natrix*, and 24 dice snakes, *Natrix tessellata*, from Turkey were examined for helminths. *Natrix natrix* harbored 5 species of Digenea: *Astiotrema monticelli*, *Encyclometra colubrimurorum*, *Macrodera longicollis*, *Paralepoderma cloacicola*, and *Telorchis assula*; 2 species of Cestoda: *Ophiotaenia europaea* and *Spirometra erinaceiueuropae*; and 2 species of Nematoda: *Rhabdias fuscovenosa* and larvae of *Eustrongylides excisus*. *Natrix tessellata* snakes harbored 1 species of Digenea, *Telorchis assula*; 1 species of Cestoda, *Ophiotaenia europaea*; and 2 species of Nematoda, *Rhabdias fuscovenosa* and larvae of *Eustrongylides excisus*. Turkey is a new locality record for *A. monticelli*, *P. cloacicola*, *T. assula*, *O. europaea*, *S. erinaceiueuropae*, larvae of *E. excisus* and *R. fuscovenosa*.

KEY WORDS: Turkey, *Natrix natrix*, *Natrix tessellata*, Colubridae, Digenea, *Astiotrema monticelli*, *Encyclometra colubrimurorum*, *Macrodera longicollis*, *Paralepoderma cloacicola*, *Telorchis assula*, Cestoda, *Ophiotaenia europaea*, *Spirometra erinaceiueuropae*, Nematoda, *Rhabdias fuscovenosa*, *Eustrongylides excisus*.

The grass snake, *Natrix natrix* (Linnaeus, 1758), occurs from Europe and northwestern Africa east to Middle Asia; the dice snake, *Natrix tessellata* (Laurenti, 1768), occurs from Middle and southern Europe to western China (Baran and Atatür, 1998). To our knowledge, there are only 2 reports of helminths from *N. natrix* collected in Turkey; Coil and Kuntz (1958) reported the trematode *Macrodera longicollis* and Schad et al. (1960) identified the nematodes *Hedruris* sp. and *Oxysomatium brevicaudatum*. The purpose of this paper is to report helminths from *N. natrix* and *N. tessellata* collected at various locations in Turkey and to present a parasite list for these 2 hosts.

MATERIALS AND METHODS

Twenty-one *Natrix natrix* snakes (3 juveniles, 9 males, 9 females), mean snout–vent length = 71 cm $\pm$ 19.98 SD, range: 34–101 cm, were collected by hand between August 1997 and June 2003 at 6 locations in Turkey: 5 in March 1999 from Dikkaldım, Bursa Province, 130 m elevation (40°12'N; 28°57'E); 7 (1 in August 1997; 3 in October 1999; 3 in June 2000) from Karacabey, Bursa Province, 70 m elevation (40°23'N; 28°23'E); 3 (2 in May 1998; 1 in June 2003) from Keles Road, Bursa Province, 350 m elevation (40°11'N; 28°57'E); 1 in June 1998 from Organize Sanayi, Bursa Province, 150 m elevation (40°17'N; 28°55'E); 1 in June 2001 from around Uluabat Lake, Bursa Province, 50 m elevation (40°11'N; 28°41'E); and 4 in May

2000 from Gölbaba Marsh, Edirne Province, 400 m elevation, (41°52'N; 26°40'E).

Twenty-four *Natrix tessellata* snakes (12 males, 12 females), mean snout–vent length = 75 cm $\pm$ 8.15 SD, range: 56–97 cm, were collected by hand between July 1993 and June 2003 at 4 locations in Turkey: 3 in July 1993, 8 in July 1995, and 7 in July 2002 from Iznik Lake, Bursa Province, 240 m elevation (40°23'N, 29°37'E); 1 in April 1997 from Misi, Bursa Province, 300 m elevation (40°12'N, 28°23'E); 1 in August 1997 from Karacabey, Bursa Province, 70 m elevation (40°23'N, 28°23'E); and 2 in July 2002 and 2 in June 2003 from around Uluabat Lake, Bursa Province, 50 m elevation (40°11'N, 28°41'E).

Snakes were killed with an overdose of sodium pentobarbital (Nembutal®). The body cavity was opened and the digestive tract was removed. The esophagus, stomach, small and large intestines, lungs, and urinary bladder were opened and separately examined for helminths under a dissecting microscope. Digeneans and cestodes were fixed in 70% ethanol, stained with iron-carmin, dehydrated, cleared, and mounted in Entellan® (Merck). Nematodes were killed in hot saline solution, fixed in 70% ethanol, cleared in a drop of glycerol, mounted on glass slides, and identified from temporary mounts. Helminth nomenclature and identifications were based upon Yamaguti (1971), Baker (1987), and Khalil et al. (1994). Helminth voucher specimens were deposited in the United States National Parasite Collection (USNPC); host specimens were deposited in the Department of Biology, Uludag University, Bursa, Turkey.

Natrix natrix (Linnaeus, 1758)

Twenty-one *Natrix natrix* snakes collected between August 1997 and June 2003 at 6 locations in Turkey harbored the following helminths.

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***Astiotrema monticelli* Stossich, 1904**

Prevalence, mean intensity, and range: Hosts infected, 6 of 21 (29%, 4.16 ± 1.92 , 2–6).

Temporal distribution: Karacabey: June 2000, 3 hosts with 2, 3, and 6, respectively; Gölbaba Marsh: May 2000, 3 hosts with 3, 4, and 5, respectively.

Site of infection: Intestine.

Type host and type locality: Viperine water snake, *Natrix maura* (previously *Tropidonotus viperinus*), Naples, Italy (Stossich, 1904).

Other reported hosts: *Natrix natrix*, (Shimalov and Shimalov, 2000); common adder, *Vipera berus*, (Shevechenko and Barabashova, 1958).

Geographic range: Europe (Yamaguti, 1971).

Specimens deposited: USNPC 97053.

Remarks: Turkey is a new locality record for *A. monticelli*.

***Encyclometra colubrimurorum* (Rudolphi, 1819) Dollfus, 1929**

(Syn. *Distoma colubrimurorum* Rudolphi, 1819; *Distoma allostomum* Diesling, 1850; *Distoma subflavum* Sonsino, 1892; *Distoma caudatum* Polonio, 1859; *Odhneria bolognensis* Baer, 1924; *Encyclometra natrix* Baylis and Cannon, 1924; *Paraplagiorchis timotheeri* Dollfus, 1924; *Orthorchis natrix* Mödler, 1925; *Encyclometra japonica* Yoshida and Ozaki, 1929; *Encyclometra microrchis* Yamaguti, 1933; *Encyclometra koreana* Park, 1940; *Encyclometra vitellata* Gupta, 1954.)

Prevalence, mean intensity, and range: Hosts infected, 7 of 21 (33%, 5.71 ± 3.16 , 2–11).

Temporal distribution: Karacabey: October 1999, 2 hosts with 4 and 7, respectively; June 2000, 2 hosts with 6 and 11, respectively. Gölbaba Marsh: May 2000, 2 hosts with 2 and 5, respectively. Uluabat Lake: June 2001, 1 host with 5.

Site of infection: Intestine.

Type host and type locality: *Natrix natrix* (previously *Coluber murorum*), Europe (Rudolphi, 1819).

Other reported hosts: European green treefrog, *Hyla arborea* (Düsen and Öz, 2004); laughing frog, *Rana ridibunda*; Balkan racer, *Hierophis gemonensis*; green whip snake, *Hierophis viridiflavus*; Oriental rat snake, *Ptyas mucosus*; *Natrix natrix*; Asiatic water snake, *Xenochrophis piscator* (Capuse, 1971); *Natrix*

(Biserkov, 1996; Shimalov and Shimalov, 2000); *Natrix tessellata*, (Biserkov, 1996); nose-horned viper, *Vipera ammodytes*, (Biserkov, 1996).

Geographic range: Europe (Yamaguti, 1971).

Specimens deposited: USNPC 97054.

Remarks: This is the second report of *E. colubrimurorum* in Turkey; it was first reported in *Hyla arborea* by Düsen and Öz (2004).

***Macrodera longicollis* (Abildgaard, 1788) Looss, 1899**

(Syn. *Distomum longicolle* Abildgaard, 1788; *Distomum pulmonalis colubri natrix* Viborg, 1795; *Distomum colubri natrix pulmonale* Rudolphi, 1809; *Distomum attenuatum* Rudolphi, 1814; *Distomum naja* Rudolphi, 1819.)

Prevalence, mean intensity, and range: Hosts infected, 2 of 21 (10%, 2 ± 0.60 , 2).

Temporal distribution: Karacabey: August 1997, 1 host with 2; October 1999, 1 host with 2.

Site of infection: Lungs.

Type host and type locality: *Natrix natrix* (as *Tropidonotus natrix*), Europe (Abildgaard, 1788 in Yamaguti, 1958).

Other reported hosts: Large whip snake, *Coluber jugularis* (Biserkov, 1996); European whip snake, *Hierophis gemonensis* (Yamaguti, 1958); *Natrix natrix* (Coil and Kuntz, 1958; Grabda-Kazubska, 1961; Sulgostowska, 1971; Biserkov, 1996; Shimalov and Shimalov, 2000; Borkovcová and Kopriva, 2005); *Natrix tessellata*, (Biserkov, 1996).

Geographic range: Europe (Yamaguti, 1971).

Specimens deposited: USNPC 97055.

Remarks: This is the second report of *M. longicollis* in *N. natrix* collected in Turkey; Coil and Kuntz (1958) published the first report.

***Paralepoderma cloacicola* (Lühe, 1909) Dollfus, 1950**

(Syn. *Distoma cloacicola* Lühe, 1909.)

Prevalence, mean intensity, and range: Hosts infected, 6 of 21 (29%, 3.66 ± 1.83 , 2–6).

Temporal distribution: Dikkaldirim: March 1999, 1 host with 4. Karacabey: October 1999, 2 hosts with 2 and 3, respectively; June 2000, 2 hosts with 3 and 6, respectively. Gölbaba Marsh: May 2000, 1 host with 4.

Site of infection: Large intestine.

Type host and type locality: *Natrix natrix*, Italy (Lühe, 1909).

Other reported hosts: *Natrix maura* (Capuse, 1971; Navarro et al., 1987); *Natrix natrix* (Rizzo, 1902; Grabda-Kazubska, 1961; Capuse, 1971; Sulgostowska, 1971; Lewin, 1992a; Borkovcová and Kopriva, 2005; Shimalov and Shimalov, 2000); *Natrix tessellata*, (Biserkov, 1996); *Vipera ammodytes*, (Biserkov, 1996).

Geographic range: Europe (Yamaguti, 1971).

Specimens deposited: USNPC 97056.

Remarks: Turkey is a new locality record for *P. cloacicola*.

***Telorchis assula* (Dujardin, 1845)
Dollfus, 1957**

(Syn. *Distoma assula* Dujardin, 1845; *Certorchis ercollanii* Monticelli, 1893.)

Prevalence, mean intensity, and range: Hosts infected, 11 of 21 (52%, 4.63 ± 2.74 , 2–8).

Temporal distribution: Dikkaldirim: March 1999, 2 hosts with 4 and 8, respectively. Karacabey: August 1997, 1 host with 7; October 1999, 3 hosts with 3, 4, and 5, respectively; June 2000, 1 host with 3. Uluabat Lake: June 2001, 1 host with 5. Gölbaba Marsh: May 2000, 3 hosts with 2, 3, and 7 respectively.

Site of infection: Intestine.

Type host and type locality: *Natrix natrix*, France (Dujardin, 1845).

Other reported hosts: *Natrix natrix* (Rizzo, 1902; Baylis, 1928; Grabda-Kazubska, 1961; Capuse, 1971; Sulgostowska, 1971; Biserkov, 1996; Shimalov and Shimalov, 2000; Borkovcová and Kopriva, 2005); *Natrix tessellata* (Biserkov, 1996); *Vipera ammodytes* (Biserkov, 1996); *Vipera berus*, (Sharpilo, 1976); Orsini's viper, *Vipera ursinii*, (Sharpilo, 1976).

Geographic range: Europe (Yamaguti, 1971).

Specimens deposited: USNPC 97057.

Remarks: Turkey is a new locality record for *T. assula*.

***Ophiotaenia europaea* Odening, 1963**

Prevalence, mean intensity, and range: Hosts infected, 17 of 21 (81%, 7.70 ± 6.92 , 1–30).

Temporal distribution: Dikkaldirim: March 1999, 5 hosts with 2, 3, 4, 5, and 5, respectively. Karacabey: August 1997, 1 host with 5; October 1999, 3 hosts with 8, 10, and 13, respectively; June 2000, 2 hosts with 4 and 8, respectively. Keles Road: May 1998, 1 host with 15. Organize Sanayi: June 1998, 1 host with 1. Uluabat Lake: June 2001, 1 host with 10. Gölbaba Marsh, May 2000, 3 hosts with 3, 5, and 30, respectively.

Site of infection: Small intestine.

Type host and type locality: *Natrix natrix*, Germany (Odening, 1963).

Other reported hosts: *Coluber jugularis* (Biserkov, 1996); *Natrix natrix* (Biserkov, 1996; Biserkov and Kostadinova, 1997; Shimalov and Shimalov, 2000); *Natrix tessellata* (Odening, 1963; Biserkov, 1996); *Vipera berus* (Odening, 1963).

Geographic range: Europe (Odening, 1963).

Specimens deposited: USNPC 97058.

Remarks: A 3-host life cycle has been suggested for *O. europaea*, in which copepods and fish or amphibian tadpoles serve as the first and second intermediate hosts, respectively (Biserkov and Kostadinova, 1997). Biserkov and Kostadinova (1997) fed *N. natrix*, *N. tessellata*, and *Lacerta viridis* copepods containing plerocercoids of *O. europaea*. Developmental stages of *O. europaea* were recovered in the intestines although further development did not occur (Biserkov and Kostadinova, 1997). Turkey is a new locality record for *O. europaea*.

***Spirometra erinaceieuropaei*
(Rudolphi, 1819) Mueller, 1937**

(Syn. *Dibium erinacei-europaei* Rudolphi, 1819; *Bothriocephalus felis* Creplin, 1825; *Bothriocephalus maculatus* Leuckart, 1848; *Dibothrium decipiens* Diesing, 1850; *Dibothrium serratum* Diesing, 1850; *Ligula reptans* Diesing, 1850; *Sparganum reptans* Diesing, 1854; *Sparganum affine* Diesing, 1854; *Ligula ranarum* Gastaldi, 1854; *Bothriocephalus sulcatus* Molin, 1858; *Sparganum ellipticum* Molin, 1858; *Sparganum lanceolatum* Molin, 1859; *Ligula pancerii* Polonio, 1860; *Bothriocephalus decipiens* Railliet, 1866; *Ligula mansonii* Cobbold, 1882; *Bothriocephalus liguloides* Leuckart, 1886; *Bothriocephalus mansonii* (Cobbold, 1882) Blanchard, 1888; *Dibothrium mansonii* Ariola, 1900; *Sparganum proliferum* Ijima, 1905; *Sparganum raillietii* Ratz, 1912; *Sparganum philippinensis* Tubangui, 1924;

Diphyllbothrium mansonii (Cobbold, 1882) Joyeux, 1928; *Diphyllbothrium erinacei* (Rudolphi, 1819) Faust, Campbell, and Kellogg, 1929; *Spirometra erinacei* (Rudolphi, 1819) Faust, Campbell, and Kellogg, 1929; *Diphyllbothrium okumurai* Faust, Campbell, and Kellogg, 1929; *Diphyllbothrium fausti* Vialli, 1931; *Spirometra janickii* Furmaga, 1953; *Sparganum cuniculi* Lizcano, 1958.)

Prevalence, mean intensity, and range: Hosts infected, 1 of 21 (5%, 2 ± 0.43 , 2).

Temporal distribution: Karacabey: August 1997, 1 host with 2.

Site of infection: Intestine.

Type host and type locality: Western European hedgehog, *Erinaceus europaeus*, Europe (Rudolphi, 1819).

Other reported hosts: Adults mainly in felid-like carnivores, occasionally in canids and humans; plerocercoids in all vertebrate groups except fish (Bray et al., 1994). Palearctic amphibian and reptilian paratenic hosts include the following: moor frog, *Rana arvalis* (Odening et al., 1980); bullfrog, *Rana catesbeiana* (Uchida, 1975); edible frog, *Rana esculenta* (Joyeux and Baer, 1927); black-spotted frog, *Rana nigromaculata* (Nagoya, 1930; Iwata, 1933); Halys pit viper, *Gloydius halys* (Kagei, 1973); Japanese rat snake, *Elaphe climacophora* (Iwata, 1933); Japanese wood snake, *Elaphe conspicillata* (Iwata, 1933); Japanese four-lined ratsnake, *Elaphe quadrivirgata* (Iwata, 1933; Kagei and Kifune, 1977; Liu et al., 2004); *Natrix natrix* (Joyeux and Baer, 1927; Odening et al., 1980; Shimalov and Shimalov, 2000); tiger keelback, *Rhabdophis tigrinus* (Iwata, 1933); habu, *Protobothrops flavoviridis* (Kagei, 1973); and *Vipera berus* (Shimalov and Shimalov, 2000).

Geographic range: Circumtropical and subtropical; United States and southern Europe (Bray et al., 1994).

Specimens deposited: USNPC 97059.

Remarks: Turkey is a new locality record for *S. erinacei* *europaei*.

***Eustrongylides excisus* Jagerskiöld, 1909 (larvae)**

Prevalence, mean intensity, and range: Hosts infected, 1 of 21 (5%, 1 ± 0.22 , 1).

Temporal distribution: Dikkaldirim: March 1999, 1 host with 1.

Site of infection: Musculature.

Type host and type locality: *Phalacrocorax carbo*, Europe (Jägerskiöld, 1909).

Other reported hosts: Palearctic amphibian and reptilian paratenic hosts: *Natrix natrix* (Biserkov, 1995; Kirin, 2002); *Natrix tessellata* (Biserkov, 1995; Kirin, 2002).

Geographic range: Europe, Southeast Asia, the Middle East, and Australia (Measures, 1988).

Specimens deposited: USNPC 97060.

Remarks: Adults are parasitic in migratory water birds; larvae in fishes, amphibians, and reptiles (Anderson, 2000). Birds become infected by eating infected paratenic hosts (Anderson, 2000). Turkey is a new locality record for larvae of *E. excisus*.

***Rhabdias fuscovenosa* (Railliet, 1899) Goodey, 1924**

(Syn. *Angiostoma fuscovenosum* Railliet, 1899; *Ascaris humilis* Leidy, 1856; *Strongylus catanensis* Rizzo, 1902; *Rhabdias ophida* Goodey, 1924; *Rhabdias annulosa* Hsu, 1933; *Rhabdias vellardi* Pereira, 1928 sensu Harwood 1932.)

Prevalence, mean intensity, and range: Hosts infected, 9 of 21 (43%, 7.66 ± 5.32 , 1–20).

Temporal distribution: Dikkaldirim: March 1999, 4 hosts with 1, 3, 7, and 20, respectively; Karacabey: June 2000, 1 host with 3; Gölbaba Marsh: May 2000, 4 hosts with 5, 10, 10, and 10, respectively.

Site of infection: Lungs.

Type host and type locality: *Natrix natrix*, France (Railliet, 1899).

Other reported hosts: Palearctic region: slow worm, *Anguis fragilis* (Borkovcová and Kopriva, 2005); sand lizard, *Lacerta agilis*, Lewin, (1992b); European green lizard, *Lacerta viridis* (Borkovcová and Kopriva, 2005); *Coluber jugularis* (Biserkov, 1995); smooth snake, *Coronella austriaca* (Shimalov and Shimalov, 2000); steppe rat snake, *Elaphe dione* (Sharpilo, 1976); Aesculapean rat snake, *Elaphe longissima* (Biserkov, 1995); tartar sand snake, *Eryx tataricus* (Sharpilo, 1976); *Gloydius halys* (Bogdanov et al., 1969); *Natrix maura* (Navarro et al., 1987); *Natrix tessellata* (Sharpilo, 1976; Biserkov, 1995); *Rhabdophis tigrinus* (Hsu and Hoeppli, 1931); *Vipera ammodytes* (Sharpilo, 1976); *Vipera berus* (Shevchenko and Barabashova, 1958); *Vipera ursinii* (Sharpilo, 1976); Chinese rat snake, *Zaocys dhumnades* (Hsü, 1933). Nearctic region: eastern hognose

snake, *Heterodon platirhinos* (Harwood, 1932); milk snake, *Lampropeltis triangulum* (Chu, 1936; Rankin, 1945); smooth green snake, *Liochlorophis vernalis* (Chu, 1936); queen snake, *Nerodia septemvittata* (Chu, 1936); northern water snake, *Nerodia sipedon* (Chu, 1936); brown snake, *Storeria dekayi* (Harwood, 1932; Chu, 1936); redbelly snake, *Storeria occipitomaculata* (Chu, 1936); northwestern garter snake, *Thamnophis ordinoides* (Chu, 1936); western ribbon snake, *Thamnophis proximus* (Harwood, 1932); eastern ribbon snake, *Thamnophis sauritus* (Chu, 1936); common garter snake, *Thamnophis sirtalis* (Chu, 1936; Rankin, 1945; Baker, 1978); rough earth snake, *Virginia striatula* (Harwood, 1932).

Specimens deposited: USNPC 97061.

Geographic range: Nearctic and Palearctic regions (Baker, 1987).

Remarks: Turkey is a new locality record for *R. fuscovenosa*.

***Natrix tessellata* (Laurenti, 1768)**

Twenty-four *Natrix tessellata* snakes collected between July 1993 and June 2003 at 4 locations in Turkey harbored the following helminths.

***Telorchis assula* (Dujardin, 1845) Dollfus, 1957**

Prevalence, mean intensity, and range: Hosts infected, 17 of 24 (71%, 7.35 ± 5.88 , 1–21).

Temporal distribution: Iznik: July 1993, 2 hosts with 7 and 18, respectively; July 1995, 8 hosts with 1, 2, 3, 3, 10, 12, 13, and 21, respectively; July 2002, 5 hosts with 2, 4, 5, 6, and 8, respectively. Uluabat: June 2003, 2 hosts with 4 and 6, respectively.

Site of infection: Intestine.

Specimens deposited: USNPC 97062.

Remarks: General information and remarks are reported under *N. natrix*.

***Ophiotaenia europaea* Odening, 1963**

Prevalence, mean intensity, and range: Hosts infected, 21 of 24 (88%, 14.28 ± 9.85 , 3–36)

Temporal distribution: Iznik: July 1993, 2 hosts with 3 and 5, respectively; July 1995, 7 hosts with 5, 10, 10, 18, 20, 24, and 27, respectively; July 2002, 6 hosts with 3, 5, 7, 7, 8, and 9, respectively. Karacabey: 21 August 1997, 1 host with 36. Misi:

April 1997, 1 host with 10. Uluabat: May 1998, 2 hosts with 20 and 28, respectively; June 2003, 2 hosts with 5 and 12, respectively.

Site of infection: Intestine.

Specimens deposited: USNPC 97063.

Remarks: General information and remarks are reported under *N. natrix*.

***Eustrongylides excisus* Jagerskiold, 1909 (larvae)**

Prevalence, mean intensity, and range: Hosts infected, 11 of 24 (46%, 2.50 ± 1.68 , 1–6)

Temporal distribution: Iznik: July 1993, 3 hosts with 1, 1, and 2, respectively; July 1995, 3 hosts with 3, 5, and 6, respectively; July 2002, 4 hosts with 1, 1, 2, and 3, respectively.

Site of infection: Musculature.

Specimens deposited: USNPC 97064.

Remarks: General information and remarks are reported under *N. natrix*.

***Rhabdias fuscovenosa* (Railliet, 1899) Goodey, 1924**

Prevalence, mean intensity, and range: Hosts infected, 10 of 24 (42%, 20.54 ± 25.49 , 1–125).

Temporal distribution: Iznik: July 1993, 2 hosts with 5 and 7, respectively; July 2002, 4 hosts with 3, 6, 7, and 15, respectively. Karacabey: August 1997, 1 host with 125. Misi: April 1997, 1 host with 1. Uluabat: May 1998, 2 hosts with 12 and 25, respectively; June 2003, 1 host with 8.

Site of infection: Lungs.

Specimens deposited: USNPC 97065.

Remarks: General information and remarks are reported under *N. natrix*.

DISCUSSION

Nineteen of 21 (90.5%) *N. natrix* snakes harbored 343 helminths representing 9 species; 3 snakes harbored 1 species, 2 harbored 2 species, 6 harbored 3 species, 5 harbored 4 species, and 3 harbored 5 species. There were 3.2 ± 1.3 SD helminth individuals per host and 3.2 ± 1.3 SD helminth species per host. Twenty-four of 24 (100%) *N. tessellata* snakes harbored 636 helminths representing 4 species; 14 snakes harbored 2 species, 9

Table 1. Helminth records for *Natrix natrix* and *Natrix tessellata*.

<i>Natrix natrix</i> Helminth		<i>Natrix tessellata</i>	
Locality	Reference	Locality	Reference
Trematoda			
<i>Alaria alata</i> (Goeze, 1782) Krause, 1914, larvae			
Belarus	Shimalov and Shimalov, 2000	—	—
Poland	Grabda-Kazubska, 1961		
Poland	Sulgostowska, 1971		
Poland	Lewin, 1992a		
<i>Allopharynx amudariensis</i> (Strom, 1928) Price, 1938			
—	—	Turkmenistan	Velikanov and Sharpilo, 2002
<i>Astiotrema monticelli</i> Stossich, 1904			
Belarus	Shimalov and Shimalov, 2000	—	—
<i>Cephalogonimus retusus</i> (Dugardin, 1845) Odhner, 1910			
Bulgaria	Kirin, 2002	Bulgaria	Kirin, 2002
<i>Diplodiscus subclavatus</i> (Pallas, 1760) Diesing, 1836			
Belarus	Shimalov and Shimalov, 2000	—	—
Poland	Bertman, 1993		
<i>Encyclometra colubrimurorum</i> (Rudolphi, 1819) Yamaguti, 1958			
Belarus	Shimalov and Shimalov, 2000	Bulgaria	Biserkov, 1996
Bulgaria	Biserkov, 1996		
Czech Republic	Borkovcová and Kopriva, 2005		
Europe	Rudolphi, 1819		
Romania	Capuse, 1971		
<i>Leptophallus nigrovenosus</i> (Bellingham, 1844) Lühe, 1909			
Belarus	Shimalov and Shimalov, 2000	—	—
Bulgaria	Biserkov, 1996		
Czech Republic	Borkovcová and Kopriva, 2005		
Italy	Rizzo, 1902		
Poland	Grabda-Kazubska, 1961		
Poland	Lewin, 1992a		
<i>Macrodera longicollis</i> (Abildgaard, 1788) Looss, 1899			
Belarus	Shimalov and Shimalov, 2000	Bulgaria	Biserkov, 1996
Bulgaria	Biserkov, 1996	Turkmenistan	Velikanov, 1982
Czech Republic	Borkovcová and Kopriva, 2005		
Europe	Abildgaard, 1788 in Looss, 1899		
Italy	Rizzo, 1902		
Poland	Grabda-Kazubska, 1961		
Poland	Sulgostowska, 1971		
Poland	Lewin, 1992a		
Turkey	Coil and Kuntz, 1958		
<i>Metaleptophallus gracillimus</i> (Lühe, 1909) Yamaguti, 1958			
Belarus	Shimalov and Shimalov, 2000	—	—
Poland	Grabda-Kazubska, 1961		
Poland	Lewin, 1992a		
<i>Neodiplostomum major</i> Dubinia, 1950, larvae			
Belarus	Shimalov and Shimalov, 2000	—	—
<i>Neodiplostomum minor</i> Dubinia, 1950			
Poland	Grabda-Kazubska, 1961	—	—
<i>Neodiplostomum spathoides</i> Dubois, 1937, larvae			
Belarus	Shimalov and Shimalov, 2000	Turkmenistan	Velikanov, 1982
Poland	Lewin, 1992a		

Table 1. Continued.

<i>Natrix natrix</i> Helminth		<i>Natrix tessellata</i>	
Locality	Reference	Locality	Reference
<i>Opisthoglyphe ranae</i> (Froelish, 1791) Looss 1899			
Belarus	Shimalov and Shimalov, 2000	—	—
Bulgaria	Biserkov, 1996		
Bulgaria	Kirin, 2002		
Poland	Grabda-Kazubaska, 1967		
Poland	Sulgostowska, 1971		
Poland	Lewin, 1992a		
<i>Paralepoderma cloacicola</i> (Lühe, 1909) Dollfus, 1950			
Belarus	Shimalov and Shimalov, 2000	Bulgaria	Biserkov, 1996
Bulgaria	Biserkov, 1996		
Czech Republic	Borkovcová and Kopriva, 2005		
Italy	Rizzo, 1902		
Italy	Lühe, 1909		
Romania	Capuse, 1971		
Poland	Grabda-Kazubaska, 1961		
Poland	Sulgostowska, 1971		
Poland	Lewin, 1992a		
<i>Plagiorchis mentulatus</i> (Rudolphi, 1819) Strossich, 1904			
Romania	Capuse, 1971	—	—
<i>Strigea falconis</i> Szidat, 1928, larvae			
Belarus	Shimalov and Shimalov, 2000	—	—
Bulgaria	Biserkov, 1996		
Poland	Lewin, 1992a		
<i>Strigea sphaerula</i> (Rudolphi, 1803) Mathias, 1925, larvae			
Belarus	Shimalov and Shimalov, 2000	—	—
Poland	Lewin, 1992a		
<i>Strigea strigis</i> (Schränk, 1788) Abildgaard, 1790, larvae			
Belarus	Shimalov and Shimalov, 2000	Turkmenistan	Velikanov, 1982
Bulgaria	Biserkov, 1996		
Poland	Ruszkowski, 1925		
Poland	Grabda-Kazubaska, 1961		
Poland	Lewin, 1992a		
<i>Telorchis assula</i> (Dujardin, 1845) Dollfus, 1957			
Belarus	Shimalov and Shimalov, 2000	Bulgaria	Biserkov, 1996
Britain	Baylis, 1928	Romania	Capuse, 1971
Bulgaria	Biserkov, 1996	Turkmenistan	Velikanov, 1982
Czech Republic	Borkovcová and Kopriva, 2005		
France	Dujardin, 1845		
Italy	Rizzo, 1902		
Poland	Grabda-Kazubaska, 1961		
Poland	Sulgostowska, 1971		
Poland	Lewin, 1992a		
Romania	Capuse, 1971		
<i>Tetracotyle crystalline</i> (Rudolphi, 1819) Linstow 1877			
Poland	Grabda-Kazubaska, 1961	—	—
Cestoidea			
<i>Diphyllobothrium erinacaeuropaei</i> (Rudolphi, 1819) Cobbold 1858, larvae			
Belarus	Shimalov and Shimalov, 2000	—	—
<i>Mesocetoides</i> sp., larvae			
Poland	Lewin, 1992a		
<i>Ophiotaenia europaea</i> Odening, 1963			
Belarus	Shimalov and Shimalov, 2000	Bulgaria	Biserkov, 1996

Table 1. Continued.

<i>Natrix natrix</i> Helminth		<i>Natrix tessellata</i>	
Locality	Reference	Locality	Reference
Bulgaria	Biserkov, 1996	Turkmenistan	Velikanov, 1982
Bulgaria	Biserkov and Kostandinova, 1997		
<i>Ophiotaenia racemosa</i> (Rudolphi, 1819) La Rue, 1911			
Czech Republic	Borkovcová and Kopriva, 2005	—	—
<i>Spirometra erinaceieuropaei</i> (Rudolphi, 1819) Mueller, 1937			
Belarus	Shimalov and Shimalov, 2000		
Germany	Odening et al., 1980		
Italy	Joyeux and Baer, 1927		
Nematoda			
<i>Abbreviata abbreviata</i> (Rudolphi, 1819) Travassos, 1920			
Bulgaria	Kirin, 2002	—	—
<i>Anisakis</i> sp., larvae			
—	—	Turkmenistan	Velikanov, 1982
<i>Aplectana brumpti</i> Travassos, 1931			
Russia	Sharpilo, 1976	Russia	Sharpilo, 1976
<i>Aplectana macintoshi</i> (Stewart, 1914) Travassos, 1931			
Russia	Sharpilo, 1976	—	—
<i>Ascarops strongylinna</i> (Rudolphi, 1819) Alicata and McIntosh, 1933, larvae			
Belarus	Shimalov and Shimalov, 2000	—	—
<i>Camallanus lacustris</i> Zoega, 1776			
—	—	Bulgaria	Kirin, 2002
<i>Capillaria mingazzini</i> (Rizzo, 1902) Travassos, 1915			
Italy	Rizzo, 1902	—	—
Russia	Sharpilo, 1976		
<i>Contracaecum</i> sp., larvae			
—	—	Turkmenistan	Velikanov, 1982
<i>Cosmocerca ornata</i> (Dujardin, 1845) Diesing, 1861			
Czechoslovakia	Moravec and Vojtkova, 1974	—	—
Czechoslovakia	Vojtkova, 1976		
Poland	Lewin, 1992a		
<i>Dracunculus oesophageus</i> (Polonio, 1859) Desportes, 1938			
Italy	Desportes, 1938	Turkmenistan	Velikanov, 1982
Volga River	Markov, et al., 1962	Volga River	Markov, et al., 1962
England	Tadros, 1966		
<i>Dracunculus riccii</i> Deshmukh, 1970			
India	Deshmukh, 1970	—	—
<i>Eustrongylides excisus</i> Jaegerskioeld, 1909, larvae			
Bulgaria	Biserkov, 1995	Bulgaria	Biserkov, 1995
Bulgaria	Kirin, 2002	Bulgaria	Kirin, 2002
<i>Hedruris androphora</i> Nitzsch, 1821			
Poland	Lewin, 1992a	—	—
<i>Hedruris</i> sp.			
Turkey	Schad et al., 1960	—	—
<i>Hexametra quadricornis</i> (Wedl, 1861) Kreis, 1944			
Europe	Sprent, 1978	Europe	Sprent, 1978
<i>Ophidascaris schikhobalovi</i> (Mozgovoï, 1950) Sprent, 1988			
Europe	Sprent, 1988	Europe	Sprent, 1988

Table 1. Continued.

<i>Natrix natrix</i> Helminth		<i>Natrix tessellata</i>	
Locality	Reference	Locality	Reference
<i>Oswaldocruzia filiformis</i> (Goeze, 1782) Travassos, 1917			
Belarus	Shimalov and Shimalov, 2000	Russia	Sharpilo, 1976
Bulgaria	Biservkov, 1995		
Bulgaria	Kirin, 2002		
Czechoslovakia	Moravec, 1963		
Czechoslovakia	Moravec and Vojtkova, 1975		
Italy	Rizzo, 1902		
Poland	Bertman and Okulewicz, 1987		
Poland	Lewin, 1992a		
<i>Oxysomatium brevicaudatum</i> (Zeder, 1800) Railliet and Henry, 1916			
Belarus	Shimalov and Shimalov, 2000	Russia	Sharpilo, 1976
Europe	Baker, 1980		
Poland	Lukasiak, 1939		
Poland	Lewin, 1992a		
Turkey	Schad et al., 1960		
<i>Physocephalus sexalatus</i> (Molin, 1860) Diesing, 1861, larvae			
Belarus	Shimalov and Shimalov, 2000	Turkmenistan	Velikanov, 1982
<i>Porrocaecum</i> sp., larvae			
—	—	Turkmenistan	Velikanov, 1982
Protostrongylidae, larvae			
Poland	Lewin, 1992a	—	—
<i>Rhabdias fuscovenosa</i> (Railliet, 1899) Goodey, 1924			
Belarus	Shimalov and Shimalov, 2000	Bulgaria	Biservkov, 1995
Bulgaria	Biservkov, 1995	Turkmenistan	Velikanov, 1982
Bulgaria	Kirin, 2002		
Poland	Lukasiak, 1939 per Sulgostowska, 1971		
Poland	Grabda-Kazubaska, 1961		
Poland	Lewin, 1992a		
Ukraine	Ivanitzky, 1940		
United Kingdom	Goodey, 1924		
<i>Rhabdias martinoi</i> Kurochkin and Guz'kov, 1963			
Russia	Kurochkin and Gus'kov, 1963	—	—
<i>Spiroxys contorta</i> (Rudolphi, 1819) Schneider, 1866, larvae			
Bulgaria	Biservkov, 1995	Bulgaria	Biservkov, 1995
Bulgaria	Kirin, 2002	Turkmenistan	Velikanov, 1982
Spiruridae larvae			
Poland	Lewin, 1992a	—	—
<i>Streptocara</i> sp., larvae			
—	—	Turkmenistan	Velikanov, 1982
<i>Strongyloides mirzai</i> Singh, 1954			
Russia	Sharpilo, 1976	Russia	Sharpilo, 1976
		Turkmenistan	Velikanov, 1982
Acanthocephala			
<i>Acanthocephalus ranae</i> (Schrank, 1788) Lühe 1911			
Belarus	Shimalov and Shimalov, 2000	—	—
Poland	Bertman, 1993		
<i>Centrorhynchus aluconis</i> (Müller, 1780) Lühe, 1904, larvae			
Italy	Rizzo, 1902	—	—
Poland	Lewin, 1992a		

Table 1. Continued.

<i>Natrix natrix</i> Helminth		<i>Natrix tessellata</i>	
Locality	Reference	Locality	Reference
<i>Centrorhynchus buteonis</i> (Schrunk, 1788) Kostylew, 1914, larvae			
Italy	Rizzo, 1902	—	—
<i>Corynosoma strumosum</i> (Rudolphi, 1802) Lühe, 1904, larvae			
—	—	Turkmenistan	Velikanov, 1982

harbored 3 species, and 1 harbored 4 species. There were 2.5 ± 0.59 SD helminth individuals per host and 2.5 ± 0.59 SD helminth species per host. *Ophiotaenia europaea*, *Rhabdias fuscovenosa* and larvae of *Eustrongylides excisus* occurred in both *Natrix natrix* and *Natrix tessellata*. Because the diets of *N. natrix* and *N. tessellata* are similar (Baran and Atatür, 1998), correlation between food preferences and coinfection of helminths cannot be made. Helminths previously recorded in *N. natrix* and *N. tessellata* are listed in Table 1.

Baran and Atatür (1998) reported 39 species of snakes from Turkey (1 Boidae, 27 Colubridae, 1 Leptotyphlopidae, 1 Typhlopidae, and 9 Viperidae). Subsequent helminthological examinations are needed before the helminth diversity of the snakes of Turkey can be ascertained.

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