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Distribution and status of the medicinal leech (*Hirudo medicinalis* L.) in Turkey

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Abstract

A survey of all the major potential habitats in western Turkey showed that medicinal leeches, *Hirudo medicinalis* L., are widely distributed over the country and are not rare. They occur in practically all suitable habitats and the only region where they were found to be absent is that of the large river deltas in the south of the country (Çukurova deltas, Göksu delta). There may be zoogeographic reasons for this (Taurus mountains barrier). The application of a semi-quantitative survey method using collecting efficiency (number of leeches collected per hour by a single person) allowed a rapid assessment to be made of its status in a large number of wetlands. Leech density varied considerably from wetland to wetland, and the results enabled a ranking of the Turkish wetlands to be made according to their importance for medicinal leeches. Taking both the leech density and the size of leech habitats into account, the largest populations were identified on the Black Sea coast (Kızılırmak delta, Yeşilırmak delta and Karagöl Marshes near Sinop) and in inner and south-west Anatolia (Eber Gölü, Karamık and Sultan Marshes). Commercial exploitation for the pharmaceutical industry and for other purposes takes place at only a few places and does not appear to affect the population seriously. However, many populations are threatened by the draining of their habitats.

Introduction

Leeches have been used for medicinal purposes for centuries, with the earliest reports coming from India as long ago as the 5th century BC. In the Roman Empire, the systematic foundations for the treatment of patients with leeches were laid. It was in that period that the leech incision was referred to for the first time, as a method of increasing blood-letting in which the sucking leech is itself cut (Arndt, 1940). Leeches experienced a considerable boom particularly in Europe in the 19th century, when they virtually became a fashion. Researchers have calculated that leeches were abstracting in Paris alone a total of 84 000 l of blood per year at the beginning of the 19th century (Herter, 1968). The utilisation of leeches, however, decreased in the early 20th century with the advent of 'modern' medicines. Even by the 18th and 19th centuries, the populations of the medicinal leech (*Hirudo medicinalis*) in Central Europe were unable to meet the considerable demand. Excessive, non-sustainable collecting led to their decrease and even extinction in many areas. Pollution and the drainage of habitats further added to their decline. Leeches were then imported into Central European states from the Ottoman Empire (Anatolia), North Africa and Russia.

Today, medicinal leeches are used in Europe mainly for two purposes. The first is the classical blood-letting therapy, which has experienced a certain revival in recent years in the context of the revival of natural remedies and traditional curing practices. The second is the production of remedies containing an extract of Medicinal Leeches. The main areas of application are for blunt injuries (traumas) with or without haematomas, superficial inflammations of the veins, haemorrhoids, perianal thromboses and

anal eczemas. The application of the leeches' active substances through a medicine rather than through a living, blood-sucking animal has again led to an increase in the demand for leeches in Europe, which again cannot be met by European populations. Several tons of medicinal leeches are used annually by the pharmaceutical industry.

Because of the threat of extinction to many populations of the medicinal leech (IUCN, 1993), and because the extensive international trade in this species has been identified as a major threat to natural populations, it was added to Appendix II of the "Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)" in 1987. It is the only parasitic species listed in this international treaty. *Hirudo medicinalis* is also listed in the appendices of the "Convention on the Conservation of European Wildlife and Natural Habitats" (Council of Europe, 1998) and consequently is under European protection.

Despite conservation efforts within the framework of CITES and other international conventions on nature conservation, little was known about the actual status of the Medicinal Leech in the various countries of its distribution range, extending from western and southern Europe to the Ural mountains and in countries bordering the eastern Mediterranean (cf. Wells & Coombes, 1987). In a first assessment of the main trade routes and the numbers of leeches involved, commissioned by the Scientific CITES Authority of Germany, Kasparek (1994) identified Turkey as the main country of origin of medicinal leeches for international trade, and also found that almost no information was available on the population status of the medicinal leech in Turkey. Its status in the Levant remains completely unclear, especially as many records attributed to the medicinal leech apparently refer to the similar Nile leech *Limnatis nilotica* (El-Shimy, 1986). Leech exports took place from Egypt to Europe, especially to France, in the 19th and early 20th centuries, but no recent information on status and species identity is available. In Israel, the medicinal leech still occurs at a few places (Bromley & Ortal, 1988).

Although the medicinal leech has thus been known for a long time to occur in Turkey in numbers which are subject to commercial exploitation (Kannenberg, 1897; Arndt, 1940; Artüz, 1990, 1997), hardly any information exists in the scientific literature (see Sciacchitano, 1958; Rückert, 1985).

The objective of this study was, therefore, to examine the population status of the medicinal leech in Turkey as the main country of origin for the international trade, to collect information on distribution and population size, and to elaborate recommendations for the management of medicinal leeches in Turkey.

Materials and methods

In order to assess the distribution and population status of the medicinal leech in Turkey, a field survey was carried out in spring and summer 1997 which covered all the large wetlands of Western Anatolia. In order to enhance the comparability of the results, most wetlands were surveyed within a period of 4 weeks only (June, 1997). Only a few additional wetlands were surveyed at other seasons and/or in 1998.

The assessment of the population status of this highly mobile parasitic species proved to be difficult. For the purpose of this study, a semi-quantitative method was selected: within a certain wetland, all habitats which seemed to be suitable for medicinal leeches were screened, in particular shallow water with dense submerged and surface vegetation. The leeches were attracted by disturbing the water, and were collected by hand and put into bags and bottles. To obtain an idea of the abundance of leeches, leech collecting was carried out for 1 h, and the number of leeches collected in this period was used as an indicator for the species' abundance.

The 'collecting efficiency' was calculated as the number of leeches collected per hour by a single collector. All surveys, even when not lasting for exactly 1 h and/or when more than one collector was involved, were calculated for the number of leeches/hour/collector. This value indicates the leech density.

Recently, a capture-recapture method was applied to assess the population size of medicinal leeches (Gülen et al., 1998). This method requires the individual marking of leeches by dissecting certain parts of the body. The dissection requires long experience, and even experienced researchers cannot be sure that the leech has not been injured. The re-capture rate may, therefore, be influenced by the abnormal behaviour of injured leeches and/or an increased mortality among marked leeches. This method is not suitable for rapid assessment approaches. Furthermore, the results obtained by Gülen et al. (1998) sometimes contradict those results obtained from superficial surveys.

Table 1. Survey of Turkish wetlands for the occurrence of medicinal leeches in June 1997 (with additional records from other months in 1997 and 1998). The table lists the wetlands together with their approximate surface area in ha, the size of the potential leech habitat in ha and the recorded leech density. In most cases, precise information on the extent of marshy land within a certain wetland was not available and had to be estimated. The marshland sizes given here are thus more an order of magnitude than an exact size. When more than one figure was available for leech density, all figures are given. For Efteni Gölü and Poyrazlar Gölü, where continuous studies were carried out, the typical range of leech density is given. When the leech density was assessed from a single point without moving around, this value is given in brackets. n.a. = not applicable

Area	Total size (ha)	Marshland size (ha)	Leech density (no. leeches/hour/collector)
Abant Gölü	128	<25	9.0
Acarlar Gölü	156	<25	14.0
Acıgöl	16 000	<25	10.3
Ağyatan (Akyayan) Gölü	2200	0	0.0
Akşehir Gölü (1)	33 500	3000	1.0
Akyatan Gölü	5000	<25	0.0
Arapçiftliği Gölü	450	0	0.0
Bafa Gölü	6700	<5	0.0
Beyşehir Gölü	65 600	1300	155.0
Bolluk Gölü	1200	0	0.0
Borabay Gölü	1000	0	0.0
Burdur Gölü	23 700	0	0.0
B. Menderes River and Delta	n.a.	<25	0.0
Çaltıçak Gölü	800	<50	32.3 / 30.3 (17.0)
Çavuşcu Gölü	1000	<25	0.0
Çöl Gölü/Ankara	600	0	0.0
Dalyan Gölü/Karacabey	180–1200	60	4.3
Dipsiz Gölü (Bolu)	5	0	0.0
Eber Gölü	5200–17 600	>4800	258.0
Efteni Gölü	4000–6000	2000–4,000	70.0
Eğirdir (Hoyran) Gölü	48 800	100–150	98.6 (57.0)
Ereğli Marshes (2)	6000–7000	5	0.0
Eşmekaya Marshes	800	300	15.0
Gala Gölü	938	700	n.a.
Gerede Gölü	50	<5	0.0
Gölcük Gölü (Bolu)	200	<25	0.0
Hotamış Marshes	0–5000	0	0.0
Işıklı (Çivril) Gölü	4000	2,000	113.0 / 140.0 (75.0)
Iznik Gölü	30 800	<250	26.0 (17.0)
Karagöl Marshes/Sinop	150–785	150–785	1830.0
Karamık Sazlığı	3700	3300	862.0
Karapınar area	n.a.	n.a.	1.0
Kızılırmak Delta (E part)	8000	6000	
• Balık Gölü			390.0 / 417.0
• Uzungöl			333.0 / 363.0
• Sarıköy			1240.0
• Çernek Gölü			104.0 / 155.0
Kızılırmak Delta (W part)	2710	2000	
• Karaboğaz Gölü			35.5
• Bedeş Marshes			10.0
• Doyran Marshes			14.0

Continued on p. 40

Table 1. Continued

Area	Total size (ha)	Marshland size (ha)	Leech density (no. leeches/hour/collector)
Kozanlı Gölü	50	25	16.0
Köyceğiz Gölü	6350	<50	n.a.
Küçük Akgöl	50	25	33.3
Küçük Mangıt Gölü	10	10	0.0
Kulu Gölü	860	0	0.0
Ladik Gölü (1)	400	5	1.0
Manyas Gölü	16 200–20 000	<50	26.6 / 73.5 (90.0)
Marmara Gölü	4400	90	74.2
Mogan Gölü	750	10	33.5
Poyrazlar Gölü	300	50	40.0
Samsam Gölü	830	0	0.0
Sapanca Gölü	4600	<50	33.0 / 43.0 / 43.0
Sarıkum Gölü (3)	56	0	0.0
Süleymaniye Gölü	1000	300	22.3
Sultan Marshes	17 200	15 500	92.0 (80.0)
Tarsus wetlands	n.a.	n.a.	0.0
Terkos Gölü	2500	1000	n.a.
Tersakan Gölü	6400	0	0.0
Tuz Gölü	260 000	0	0.0
Uluabat (Apolyont) Gölü	5700–13 600	300–700	129.0 / 107.0
Uyuz Gölü	15	10	26.0
Yeniçağa Gölü	1800	500	0.0
Yeşilırmak Delta	35 000	20 000	
• Akgöl			39.3 / 82.0 / 90.0 / 132.0
• Terme (Industry Area)			12.4
• Kargalı			85.6
• Dumanlı			0.0

Notes:
(1) Water level fallen, all reed beds dry.
(2) Marshes almost dried up at the time of the survey.
(3) Freshwater lake, but there had been an influx of saltwater prior to the survey.

Results

Distribution

A total of 65 wetlands in Turkey was surveyed in order to assess the status of the medicinal leech (Table 1). This includes all the major wetlands situated in the western half of Turkey, roughly west of a line from Trabzon to Adana. The list also includes two major wetlands in Thrace (Turkey-in-Europe), which were not covered by the present survey but for which information was available from previous visits and other sources. The wetlands covered by this study have a total surface area of 640–670 000 ha.

Medicinal leeches were found in 42 of these 65 wetlands. The species was present all over western Turkey, but no leeches were found in the Çukurova area in southern Turkey (Ağyatan Gölü, Akyatan Gölü, Tarsus wetlands). Previous surveys have also indicated that the species does not occur in the more western Göksu delta on the Mediterranean coast.

The species was absent from saline lakes and salt marshes, and from lakes which had dried out due to seasonal fluctuations in the water level. The survey included two lakes with surrounding peat bogs (Yenicağa Gölü, Gerede Gölü), and no medicinal leeches were found there. The results show that medicinal leeches inhabit practically all suitable habitats in Turkey.

Population status and population density

The collecting efficiency (number of leeches collected per hour by a single person) which was chosen as a relative indicator for population density was found to be highest at Karagöl Marshes near Sinop, at Sarıköy in the Kızılırmak Delta, and in the Karamık Marshes in the south-west Anatolian lake district. At Karagöl, no less than 1830 leeches were collected by a single person within an hour. The values for Sarıköy were 1240 and for Karamık Marshes 862 leeches/hour/person. All other leech densities were below 500, and mostly below 100 leeches/hour/person.

For the assessment of the status of the medicinal leech in Turkey, not only population density but also the size of the wetlands was taken into account. In order to give an idea of the population size, Table 1 shows for each wetland the total surface area and the surface area of the potential leech habitat. This includes reed beds, open water with submerged vegetation and those parts of the vegetation zone along the shores which include standing water. It was estimated that the potential leech habitat in the surveyed wetlands covers approximately 65–67 000 ha (Table 1).

To obtain an idea of the relative population size in a certain wetland, the collecting efficiency was multiplied by the surface area of the leech habitat (Fig 1). This illustration also includes both Gala Gölü and Terkos Gölü, both situated in Thrace. Although quantitative information on leech density is not available, these are apparently among the top areas for leeches in Turkey according to non-standardised surveys and the large surface areas.

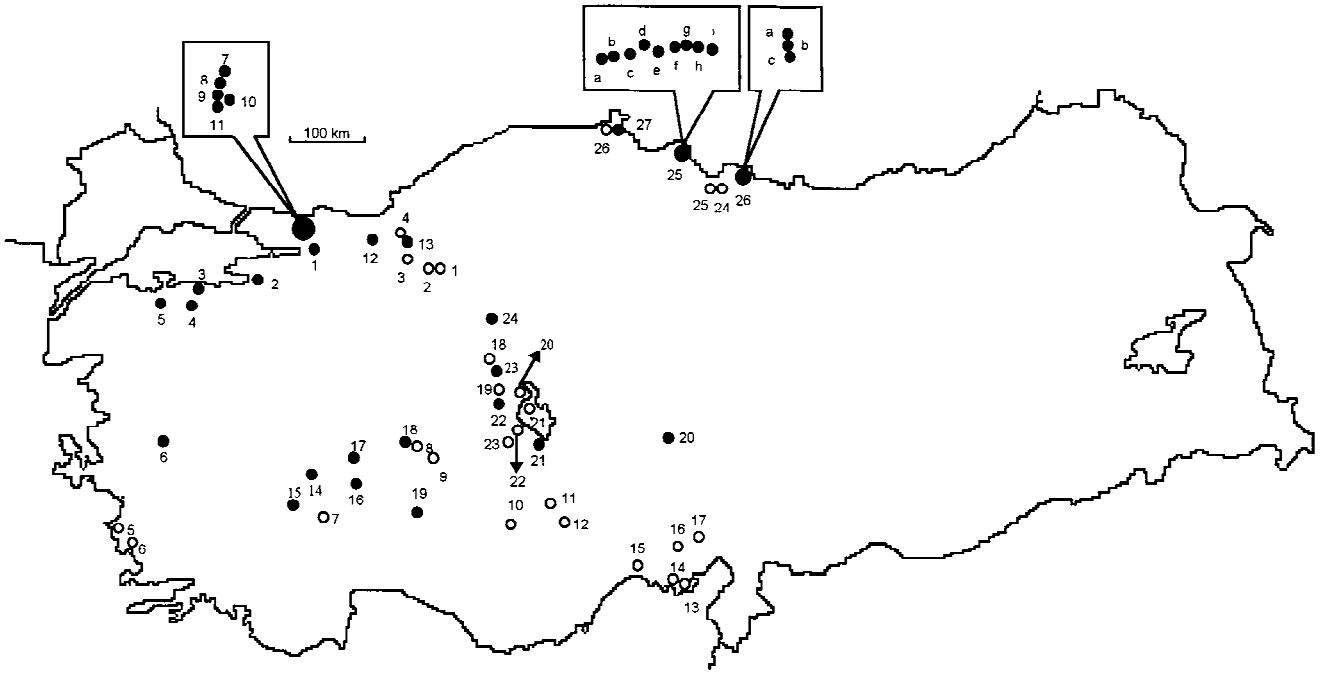
The eastern part of the delta of River Kızılırmak, including the lagoons of Balık Gölü, Uzungöl, Çernek Gölü, etc, proved to be the most important area for leeches in Turkey. Not only in terms of population density but also with a potential leech habitat of approximately 6000 ha, this area holds far more medicinal leeches than any other area in Turkey. The other top areas are Karamık Marshes in the south-west Anatolian lake district, the Yeşilırmak delta (with Akgöl and other small lakes and marshes) on the Black Sea coast, the Sultan Marshes and Lake Eber (Eber Gölü) in Central Anatolia, and Gala Gölü and Terkos Gölü in the European part of Turkey. Although less important for leeches, highly significant populations are found at the Karagöl Marshes near Sinop on the Black Sea coast, at Işıklı Gölü in the Denizli area, at Efteni Gölü in the Western Black Sea region, at Beyşehir Gölü in south-west Anatolia, in the western part of the Kızılırmak delta (including Karaboğaz Gölü) and at Uluabat (Apolyont) Gölü in the Marmara region. The areas of this second group usually have high leech densities, but the total surface area of leech habitats within these wetlands is generally less important.

Discussion

For the purpose of this study, the collecting efficiency (number of leeches collected per hour by a single person) was used. It is evident that collecting efficiency depends on many different factors such as the general activity pattern (see e.g. Sawyer, 1986), environmental conditions (weather, water temperature, etc.), habitats (size of habitats, exact position of the collector within a certain habitat, type of vegetation, microhabitat) and probably also the personal experience of the collector. Nevertheless, this method proved to be suitable to assess the number of leeches in certain areas, at least on a semi-quantitative basis. Repeated assessments in the same area gave similar results. This was shown in particular at Efenti Gölü and at Poyraz Gölü, where seasonal and other studies on the leech population were carried out (unpublished results). This shows that the collecting efficiency may be used for this purpose. Although this approach is not an exact determination of the leech density, the figures give a rough idea of leech density, and, as a rapid assessment, enable a large number of wetlands to be surveyed within a relatively short period.

Our previous knowledge of medicinal leech distribution in Turkey was based on anecdotal reports, including Akşiray & Villwock (1962), Artüz (1990, 1997), Dijksen & Kasparek (1985, 1988), Hustings & Van Dijk (1994), Kasparek (1985, 1994) and Wells & Coombes (1987). However, the species was not listed in the taxonomic accounts on the Hirudineae of Turkey by Sciacchitano (1958) and Rückert (1985). The survey has therefore considerably expanded our knowledge of the distribution and status of the medicinal leech in Turkey.

The medicinal leech was found all over western Turkey, but not in the large river deltas on the eastern Mediterranean coast (Çukurova deltas and Göksu delta). There may be zoogeographic reasons for this, as many species from many different animal and plant groups reach the limit of their natural distribution at this point and the Taurus mountain ridge apparently forms an important barrier to their natural distribution



● = wetlands where *H. medicinalis* was found

1 - Sapanca Gölü
2 - İznik Gölü
3 - Dalyan Gölü
4 - Uluabat Gölü
5 - Manyas Gölü
6 - Marmara
7 - Acarlar Gölü
8 - Big Akgöl
9 - Little Akgöl
10 - Poyrazlar Gölü
11 - Çaltıcak Gölü
12 - Efteni Gölü
13 - Abant Gölü
14 - Işıklı Göl
15 - Acıgöl
16 - Eğirdir Gölü
17 - Karamık Gölü
18 - Eber Gölü
19 - Beyşehir Gölü
20 - Sultan Marshes
21 - Eşmekaya Marshes
22 - Kozanlı (Saz)
23- Uyuz Gölü
24 - Mogan Gölü
25 - Kızılırmak Delta
  a - Doyran Gölü
  b - Bedeş Marshes
  c - Karaboğaz Gölü
  d - Çernek Gölü
  e - Sarıköy
  f - Balık Gölü
  g - Balikhane
  h - Uzungöl
  I - Between Yörükler canal and Uzungöl
26 - Yeşilırmak Delta
  a - Kargalı
  b - Akgöl
  c - Next to the Industry Area of Terme
27 - Karagöl
28 - Terkos Gölü
29 - Büyükçekmece Gölü
30 - Gala Gölü
31 - Süleymaniye Gölü
32 - Köyceğiz Gölü

○ = wetlands where *H. medicinalis* was not found

1 - Gerede
2 - Yeniçağa Gölü
3 - Gölcük
4 - Dipsiz Gölü
5 - Büyük Menderes River and Delta
6 - Bafa Gölü
7 - Burdur Gölü
8 - Akşehir Gölü
9 - Çavuşçu Gölü
10 - Hotamış Gölü
11 - Karapınar Area
12 - Ereğli Marshes
13 - Ağyatan Gölü
14 - Akyatan Gölü
15 - Tarsus wetlands
16 - Seyhan and Ceyhan Rivers
17 - Kücük Mangıt Gölü
18 - Çöl Gölü
19 - Samsam Gölü
20 - Kulu Gölü
21 - Tuz Gölü
22 - Tersakan Gölü
23 - Bolluk Gölü
24 - Borabay Gölü
25 - Ladik Gölü
26 - Sarıkum Gölü
27 - Dumanlı Göl
28 - Arapçiftliği Gölü

Figure 1. Map of showing the areas which were surveyed for the occurrence of medicinal leeches, *Hirudo medicinalis*. Wetlands where the species was found are indicated with dots, those where the species was not recorded with circles.

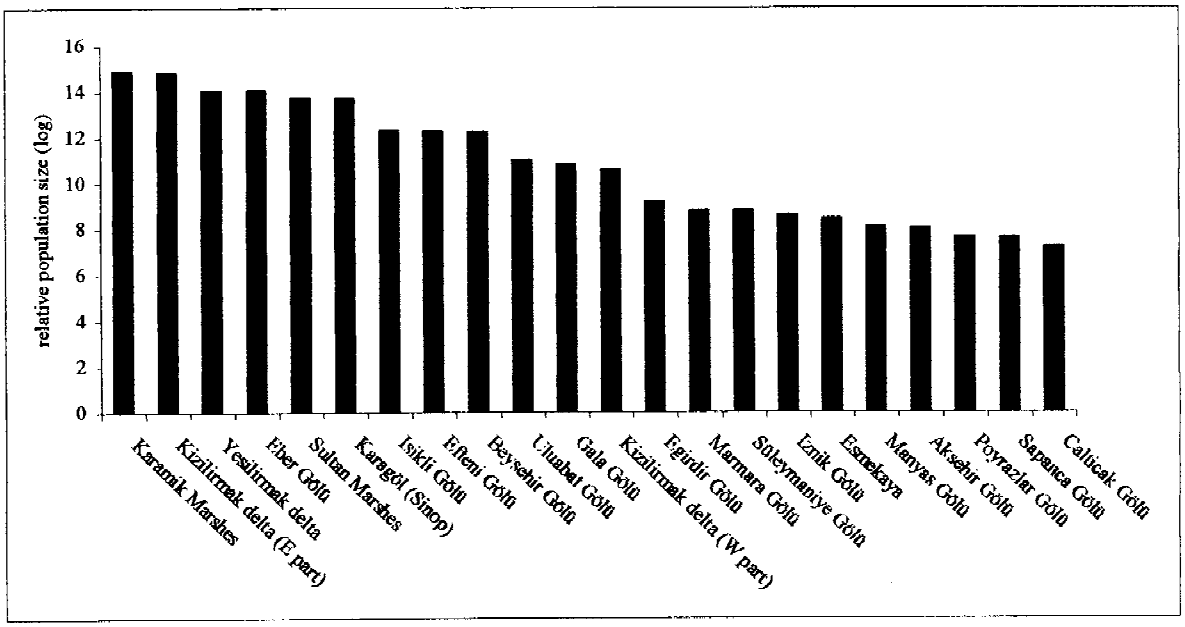


Figure 2. Ranking of the status of the medicinal leech, *Hirudo medicinalis*, at 22 Turkish wetlands. The status is described by the product of population density (collecting efficiency: for methodology, see text) and the surface size of leech habitats.

(see e.g. Demirsoy, 1979). In the western Mediterranean region and in the Aegean region, the situation is different: *H. medicinalis* occurs for instance in small wetlands around Köyceğiz Gölü. However, it is absent in the saline lagoons of Menderes delta, but occurs in ditches in the lower Menderes river valley. This agrees with a general zoogeographic pattern as the Taurus mountains, which are less high and run vertically to the Aegean Sea coast in the west, are not usually a zoogeographic barrier there.

The absence of medicinal leeches at Gerede Gölü and at Yeniçağa Gölü may be due to the existence of peat bogs around the lakes. These probably give rise to humic acids, which are usually avoided by leeches (Herter, 1968).

The eastern part of the Kızılırmak delta and the Yeşilırmak delta, both situated on the Black Sea coast, and the Karamık Marshes in south-western Anatolia were shown to have the most important leech populations in Turkey. Of these, only the populations in the Kızılırmak and Yeşilırmak deltas are being exploited for commercial purposes. Leeches in the Karamık Marshes are only occasionally collected. The list of other significant leech populations in Turkey also includes wetlands such as Eber Gölü, Sultan Marshes, Karagöl (Sinop), Işıklı Gölü, Efteni Gölü and Beyşehir Gölü, which are not used for commercial collecting, or at least not on a regular basis. Interviews with leech collectors showed that they know these lakes; the lack of collecting there, however, indicates that the demand for leeches is not high enough, and commercially operating leech collectors may well rely on a few individual collecting areas. The pressure of collecting appears not to be harming the population, at least not the entire population.

It must also be noted that medicinal leeches also occur in extremely small wetlands (see Table 1), which may even include areas such as water wells (Kasparek, 1994). Although these areas cannot contribute significantly to the country's population, they may be important for the survival of the species when conditions are severe. For example, the leech populations in small wetlands are far too small to be exploited commercially; and so these areas provide shelter for the species against collecting and may constitute important centres for the spread of the species.

In contrast to collecting, drainage of wetlands and pollution constitute a major problem in Turkey and seriously threaten the medicinal leech population. Recent overviews of the Turkish wetlands (Ertan et al., 1989; Türkiye Çevre Vakfı, 1993a; Magnin & Yarar, 1997) showed that there is hardly any wetland which does not face serious problems. Since 1960, at least 1 300 000 ha of wetland habitat across Turkey

have disappeared as a result of reclamation, drainage, irrigation, damming and other water manipulation schemes, and current plans by the Government of Turkey also envisage several hundreds of thousands of hectares to be drained (Magnin & Yarar, 1997). Here are two examples affecting the situation of the two largest populations in Turkey. Large-scale water works in the Kızılırmak delta had planned the construction of a system of channels which would have drained large parts of the delta and would have avoided the annual inundation of meadows being used for cattle grazing. However, these plans, which would have threatened Turkey's most important leech collecting area, have recently been cancelled (Kasparek, unpubl.). On the other hand, the Karamık Marshes have experienced a heavy eutrophication, mainly due to the sewerage input from a paper mill (Türkiye Çevre Vakfi, 1993). The surface area of this wetland has already decreased considerably (Demirsoy, unpubl.) and the future outlook is serious.

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