

**HABITAT SUITABILITY AND RECOMMENDATIONS FOR THE REINTRODUCTION OF  
THE EUROPEAN POND TURTLE *EMYS ORBICULARIS* (LINNAEUS 1758) TO THE  
AREA OF COMMUNITY INTEREST “LÖCKNITZTAL” IN BRANDENBURG  
(GERMANY)**

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BY

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A thesis submitted in partial fulfilment of the requirements for the degree of

Master of Science in Biodiversity Management and Research at

University of Namibia and Humboldt-Universität zu Berlin

By

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## 0. Abstract

The European pond turtle (*Emys orbicularis*) is one of the most endangered vertebrate species in Germany. The species conservation programme “Europäische Sumpfschildkröte”, which was initiated in 1993 / 94, deals with the exploration of biology and the protection of the few still existing small populations. For the protection of the species, reintroduction to its former range is taken into consideration.

The present study evaluates the habitat suitability of the nature reserve and FFH (Flora-Fauna Habitat) area “Löcknitztal” (Brandenburg) for *Emys orbicularis*.

The study area is characterised by natural and remote appearance, high conservation status, high public interest in *Emys orbicularis* promoted by the “Freundeskreis Wappentier” (Supporters of the Emblem Animal) and a great voluntary engagement for the maintenance of the conservation area by the “Interessengemeinschaft Löcknitztal” (Löcknitztal Community of Interest).

Historical sources were reviewed to reconstruct the historical development of the study area and to identify when and where important changes in landscape structures occurred. The present biotope structures were analysed using data sheets which were developed with special focus on habitat requirements of *Emys orbicularis*. The biotope structure analysis comprised a review of terrestrial habitats and aquatic habitats. The assessment was conducted from land, water and air. Furthermore, diet availability and predator pressure were estimated.

The research determined that suitable aquatic and terrestrial structures are still present in the northeastern part of the study area. The analysis of potential food items

proved sufficient availability of prey species. The high predator pressure could have a negative impact on the reintroduction.

To maintain the suitability of the area for *Emys orbicularis*, habitat management is required. It should be realised in cooperation with the IG – Löcknitztal and the sheep company Kölpin - Fritsche active in the valley. These conservation measures would not only support the turtle population but also contribute to the maintenance and increase of biodiversity in the conservation area.

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### **3. Declarations**

I, Kathleen Merz, hereby declare that this study is a true reflection of my own research and that this work or part thereof has not been submitted for a degree to any other institution of higher education.

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## 4. Introduction

*Emys orbicularis* occupies a very large distribution area. Within this distribution area 13 genetic distinct variations of *Emys orbicularis* have been determined up to now. The turtle occurs throughout Germany but mostly in exotic forms not originating from Germany. Native *Emys orbicularis* being characterized by the mitochondrial haplotype IIb do only occur in small relict populations in northeastern Germany (FRITZ & GÜNTHER, 1996; SCHNEEWEIß, 1997, 1998; SCHNEEWEIß & FRITZ, 2000). These populations suffer from a strong decline due to habitat destruction, trade and competition with exotic species, among other reasons. Conservation measures are required to maintain the few still existing native populations in northeastern Germany.

Therefore, the conservation project “Europäische Sumpfschildkröte” was initiated in the State of Brandenburg in 1994. Up to now it focused on the status of wild populations and threats. Further conservation measures like artificial incubation, securing of nesting sites and landscape management for habitat protection have been applied. In future, the project aims to continue the present work and invest further energy in the search for more relict populations and the reintroduction of animals to suitable sites (SCHNEEWEIß, 2004, 2006).

Reintroduction is an important tool in nature conservation to support the survival of endangered species. Nevertheless, it is always connected with high effort and expenses and should therefore only be applied after ensuring a high probability of success. Suitable habitat features for the reintroduced species and exclusion of

negative impacts, which have led to the extinction in the first place, need to be addressed (PULLIN, 2002).

According to historical reports (FRIEDRICHS, 1910), the Löcknitz river valley was once very rich in *Emys orbicularis*. The historical occurrence and also the natural appearance of the nature reserve are promising indicators for a suitable habitat where a reintroduction attempt of *Emys orbicularis* could be successful.

The present thesis will evaluate historical sources and determine habitat structures in the field to assess the habitat suitability. Further factors like predators and utilisation within the area will be evaluated. The collected data will be the basis for a discussion whether *Emys orbicularis* can be successfully reintroduced to the nature reserve with a justifiable effort.

## **5. Aspects of Research Knowledge to Date**

### **5.1. Current situation of *Emys orbicularis* in Germany**

*Emys orbicularis* occupies a huge distribution area including regions of different climatic conditions such as temperate, Atlantic, continental, Mediterranean and steppe climate. The west – east extension stretches from Moroccan Atlantic coast up to Aral Lake in Asia. The north – south distribution extends from Moscow in Russia down to the Turkish – Syrian border area near Antakya. (FRITZ, 2003)

*Emys orbicularis* is considered to be the most endangered vertebrate species in Germany and is threatened by extinction in the whole country (BEUTLER *et al.* 1998). Furthermore, the species is classified as threatened by extinction in the Red Data Book of the State of Brandenburg (SCHNEEWEIB *et al.* 2004).

The high conservation priority of *Emys orbicularis* in Germany is also reflected in the FFH (Flora-Fauna Habitat) guidelines, where the species is listed in Appendices II and IV (FFH-RL 92/43/EWG), which not only demand the protection of the species but the creation of conservation sites for its safekeeping as well.

Opinions about the decline of *Emys orbicularis* differ. SCHNEEWEIB and FRITZ (2000) conclude that the interaction between different factors like habitat destruction due to land use change and high loss of wetlands, vegetation succession, persecution for trade, the influence of predators and climate change has resulted in the decrease of *Emys orbicularis*.

Up to the early 1990s *Emys orbicularis* was considered to be a monotypic species with a very large geographic range. Extensive research (FRITZ, 1989, 1993a and b, 1994, 1995b and c, 1996, 1998b and FRITZ *et al.* 1998a and b, 2005; JESU *et. al.*,

2004) demonstrated the existence of distinct subspecies as well as a distinct species of pond turtle on Sicily. Therefore *Emys orbicularis* is identified as the most fragmented reptilian taxa of the western Palearctic (FRITZ 1998a and 2000a).

An evaluation of numerous investigations (SCHNEEWEIß & FRITZ, 2000; FRITZ *et al.* 2004) about *Emys orbicularis* in Germany provided evidence that native pond turtles can only be found in southern Mecklenburg – Western Pomerania and Brandenburg. The turtles distributed in the catchment of the Oder River are characterised by a specific mitochondrial haplotype (IIb) (LENK *et al.* 1998 and 1999), which is endemic to northeastern Germany and neighbouring Poland. The few individuals belonging to these populations are regarded as native.

Investigations (PODLOUCKY, 1998; BUDDE, 1998) of other turtle populations in Germany showed that the majority of the individuals belong to released or escaped specimens. Therefore, PODLOUCKY (1998) concluded that native *Emys orbicularis* are extinct in the northwestern part of Germany and most probably in the whole western part of the country. This underlines the high responsibility of the State of Brandenburg for the conservation of the species.

Allochthonous turtles from southern Europe are a serious threat to the indigenous populations; they differ not only genetically but also in breeding strategy, so that a loss of adaptation to the northern environment could occur after hybridization (SCHNEEWEIß, 2003; FRITZ, 2003).

Extensive research within the frame of the species conservation programme “Europäische Sumpfschildkröte” in the State of Brandenburg has determined six small relict populations up to now. Some of the areas where these populations occur were already known for their richness in turtles 200 years ago. Population size was

estimated with three to twelve individuals per population (SCHNEEWEIß, 2003, 2004). Without conservation measures the European pond turtle will become extinct due to declining individual numbers and low breeding success in the last decades. However, due to conservation measures, like artificial incubation and securing of nesting sites, the number of juvenile and subadult individuals has increased since 2001 (SCHNEEWEIß, 2004).

## **5.2. Historical occurrence of *Emys orbicularis* in Brandenburg and the Löcknitz Valley**

*Emys orbicularis* must have been widely distributed in central and eastern Germany during the 18th century (BEKMANN, 1751). DÜRIGEN (1897) reviewing the situation of *Emys orbicularis* in Germany doubts the occurrence of native specimen in Saxony and Bavaria. He points out that most of the observed specimen are very likely to be released or escaped from human captivity. According to DÜRIGEN (1897), *Emys orbicularis* was spread across entire Brandenburg except for the southern part. Furthermore, he mentions that *Emys orbicularis* occurred in high numbers, so that a lively trade was conducted especially from Wriezen and Frankfurt/Oder in the late 18<sup>th</sup> century. The species was traded from Brandenburg to Bohemia, Bavaria and Austria too, where it was a favourite food during Lent. But DÜRIGEN (1897) also hints at the decline of the species which had been realised already by SCHNEIDER (1783). DÜRIGEN (1897) holds the hunting with nets and fish traps as well as the draining of wetlands responsible for the decreasing abundance of *Emys orbicularis*. Due to this decline he questions if the statement "...das man ganze Tragekörbe voll Schildkröten bis nach Frankfurt a. d. Oder bringe..." ("...that baskets full of pond

turtles have been brought to Frankfurt / Oder...” (DÜRIGEN, 1897, p. 23) written by Professor VOIGT in 1837 was still valid at the end of the 19<sup>th</sup> century.

Additionally, he describes evidences of turtles in various bodies of water including the Spree near Fürstenwalde, Müncheberg and numerous lakes in Märkische Schweiz, which are all linked to the Löcknitz River Valley.

The decrease of *Emys orbicularis* is taken up again by ECKSTEIN *et al* (1909) at the beginning of the 20th century.

WERMUTH (1952) describes the Mark Brandenburg as the western border of the original range of *Emys orbicularis*, where the species occurred far more often than it would appear. He mentions the more or less regular catches of turtles in fishing nets.

A collection of home articles compiled by the Kulturbund DDR (Cultural Association GDR) (1956) mentions the occurrence of *Emys orbicularis* in Wupatzsee and Bauernsee near Kagel as well as in the Löcknitz River. Only a couple of years later *Emys orbicularis* seemed to become a mythic animal. People were talking about the occurrence of the turtle in the lake Trebuser See and in the Löcknitz River, but no real evidence seemed to be present. So RICHTER (1965) confesses his insecurity about the occurrence of pond turtles, but he remembers that when he was still at school a teacher told him that pond turtles lived in the lake Trebuser See. And in 1927 a turtle was caught in Grünheide which could not doubtlessly be identified with certainty as a wild one and was considered to be escaped. An information and hiking notebook (NIEDZBALLA, 1987) mentions the otter and European pond turtle as treasures of the Löcknitz area.

Furthermore, friends of nature who later formed the GNU (specialised group in the cultural association of the GDR, later Interessengemeinschaft Löcknitztal) were very

involved in the declaration of the Löcknitz River Valley as a nature reserve from 1979 on. The justification for the conservation proposal was based on the protection of rare plant and animal species including the European pond turtle. Furthermore, the proposal suggested the prohibition of fishing within the planned nature reserve due to its threat for the *Emys orbicularis* population (UNB/FILE 2006). After the declaration in 1984, the GNU compiled a stocktaking of the reserve including hydrology and some aspects of flora and fauna (ZIEBARTH *et al.* 1988; GELBRECHT *et al.* 1993).

While mentioning the occurrence of some amphibian and reptile species in the nature reserve, the European pond turtle was not referred to, indicating that it had already vanished or had such a rare occurrence that observations were hardly possible.

Nevertheless, *Emys orbicularis* must once have been numerous in the Löcknitz. A summary of known finding places compiled by FRIEDRICHS (1910) mentions that 29 pond turtles were caught in the Löcknitz between Klein Wall and Kienbaum using weir basket traps in May 1902 and 1903. Furthermore, it was mentioned that the valley was very swampy and not easily accessible, concluding that it must be a suitable habitat. FRIEDRICHS (1910) reviews that "...the Löcknitz must be that water body where the European pond turtle has recently been observed most frequently (...die Löcknitz als dasjenige Gewässer angesehen werden, in welchem die Schildkröte in neuerster Zeit am häufigsten beobachtet worden ist)" (FRIEDRICHS (1910 p. 204).

*Emys orbicularis* is of high public interest in the community Grünheide. In 1934 the community gained permission from the Ministry of Internal Affairs to use the European pond turtle as their coat of arms. Due to the high interest in the species the association "Freundeskreis Wappentier" (Supporters of the Emblem Animal) was

founded in 2003 (TESCH, 2004). Besides searching for turtles within the area, the society created an enclosure with 12 turtles, thus contributing to environmental education and awareness.

### **5.3. Habitat requirements**

As mentioned before, the European pond turtle occurs in a very large distribution area. Attention must be paid to differences in habitat requirements in the different regions. Nevertheless, one big similarity in habitat requirements occurs within the whole range: The high dependence on a network of different habitats, meaning that a combination of rich structured aquatic and terrestrial habitats is strictly needed (FRITZ, 2003).

Furthermore, FRITZ (2003) refers standing or very slowly flowing water bodies with dense submersed and emersed plant cover and muddy ground as preferred habitat in Germany. PAUL (1997) observed during her research in the State of Brandenburg that broad zones of newly formed land, extensive shallow water areas and floating leaf zones with dense submerged vegetation were preferred living territories. Favourite basking sites, like dead wood, bushes, hummocks, reeds and shore line are mentioned in SCHNEEWEIß (2003). Moreover, he observed that water sections strongly shadowed in summer and with a very high abundance of dead logs in the water are avoided. These habitats are only utilised in spring / early summer and winter when leaf cover is low. Sufficient sun supply is crucial because basking is a very important behaviour, and the occurrence of suitable basking sites can be a limiting factor in the northern range of the species.

Furthermore, shorelines offering low cover are avoided. The surroundings of an aquatic habitat are often characterised by a well-developed landscape relief like a terminal moraine or a hilly ground moraine (SCHNEEWEIß & MÜLLER, 2001).

The main home range, which does not include excursions to the nesting sites, could be determined on monitored individuals in Brandenburg with 2300 – 4800 m<sup>2</sup> (PAUL & ANDREAS, 1998) and 770 – 4900 m<sup>2</sup> (SCHNEEWEIß, 2003). A population home range was ascertained with 74 ha (PAUL, 2003).

Under middle and eastern European conditions nesting sites play a crucial role in successful reproduction. Females migrate approximately 100 to 900 m to the nesting sites, in some cases even more than 2000 m (PAUL & ANDREAS, 1998; SCHNEEWEIß & STEINHAEUER, 1998; ANDREAS, 1999; FRITZ, 2003; SCHNEEWEIß, 2003), indicating the importance of a patchwork landscape offering aquatic habitats in close relationship with dry land and open territories. The literature (PAUL, 1997; SCHNEEWEIß *et al.* 1998; ANDREAS, 1999; MEESKE *et al.* 2002; SCHNEEWEIß, 2003) provides characteristics of a number of monitored nesting sites. South, southeast or southwest exposition is a very essential feature ensuring a high number of sunshine hours and warm soil temperatures. Nesting sites were found flat to strongly inclined. Well-drained sandy patches covered with xerothermic sand grassland related to *Spergulo – Corynephorum* are used as nesting sites. Often they can be found at the outskirts of pine groves. A spongy substrate ensures permeation of heat of sunshine and easy evaporation or ooze of humidity in the soil. Characteristic vegetation communities and plant species for nesting sites can be found among others in SCHNEEWEIß (2003), PAUL (1997) and JABLONSKI & JABLONSKA (1998). Furthermore, the vegetation coverage on the nesting sites was observed to vary

within a small scale between 30 – 90% (MEESKE *et al.* 2002) and 20 – 80% (SCHNEEWEIB, 2003).

According to SCHNEEWEIB (1998), the development of hatchlings depends on sufficient sunshine and high temperatures in summer. In most cases hatchlings hibernate in the nest in Brandenburg. Nevertheless their survival requires mild winters. Soil temperatures  $< -6$  °C can be seen as critical for the survival of the hatchlings (SCHNEEWEIB & JABLONSKY, 1999; SCHNEEWEIB, 2004).

## 6. Materials and Methods

### 6.1. Study area

The Löcknitz River Valley is situated in the northeastern part of Germany in the State of Brandenburg, district Oder – Spree, within the community Grünheide. The northern part of the Löcknitz Valley is located between the two glacial deposit high areas “Barnim” and “Lebus” within an outwash plain (sander) area. The southern part falls into the Berlin glacial valley. (GELBRECHT *et al.*, 1993)

The very natural part of the valley between

Große Wall Brücke in the south and

Kienbaum in the north was declared a nature reserve in 1984. Moreover, in 1995 the area was designated an area of community interest (FFH – RL 1992).

The conservation area covers approximately 488,89 ha and comprises important vegetation structures like *Molinia* meadows (*Molinion caeruleae*), xerix sand calcareous grassland (*Koelerion glaucae*), lowland hay meadows (*Arrhenatherion*, *Brachypodio-Centaureion nemoralis*) and transition mires and quaking bogs. The natural water course of the plain is basically enclosed by sedge communities, reeds, tall herbaceous vegetation and alder and willow swamp forest.

Between Klein Wall and Kienbaum an approximately four-hectare oligotrophic to mesotrophic cauldron moor can be found called Post Luch.



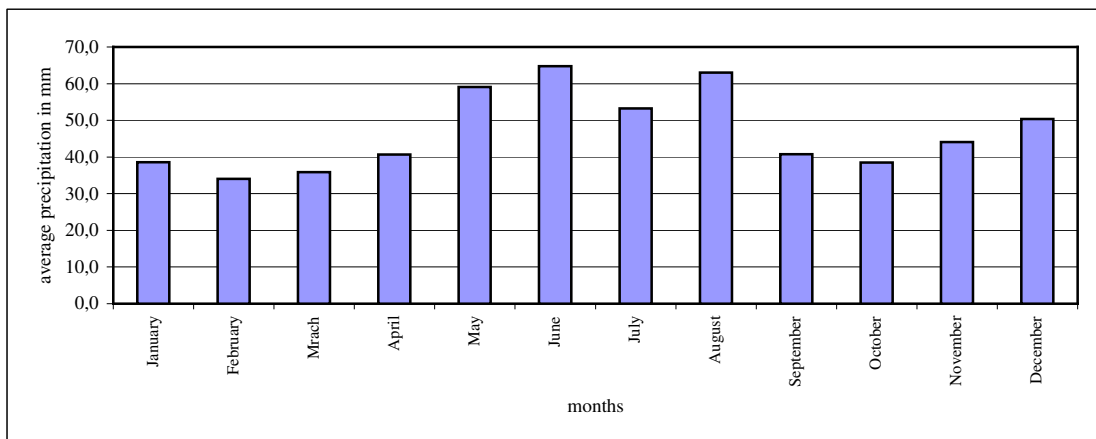
**Photo 1:** Overview of Germany with the study area in the north east

### 6.1.1. Climatic conditions

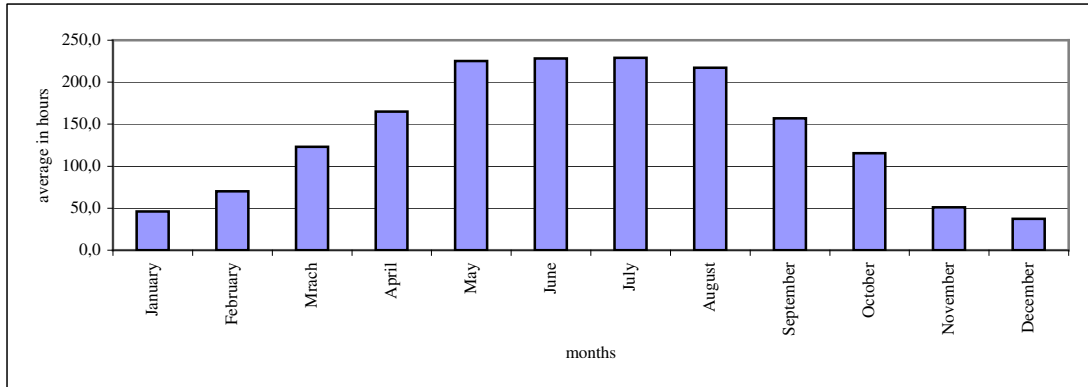
The data used to characterise climatic conditions in the study area were measured at the observatory in Lindenberg near Beeskow in the State of Brandenburg. This weather station is situated 35 km southeast of the Löcknitz River Valley. According to the measurements of the German Weather Service, the study area receives an average annual precipitation of 536 mm. Over the long term, the average highest precipitation occurs at the beginning and end of summer (see Fig. 1). The highest value of 64.8 mm can be observed in June.

The highest amount of sunshine occurs in May, June, July and August with values between 217.1 and 228.2 hours (Fig. 2).

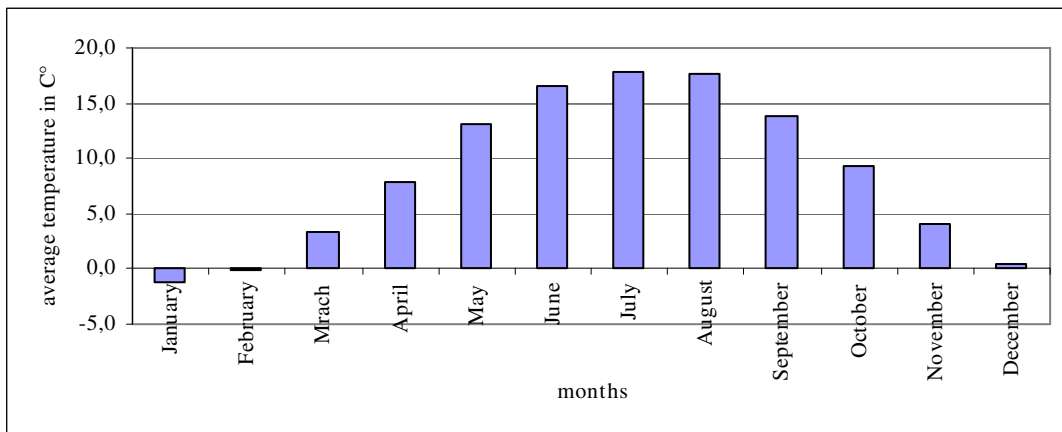
The long-term average shows summer temperatures (Fig. 3) of 16.5° C (June), 17.9°C (July) and 17.6° C (August). In winter the long-term average varies between 0.4° C and – 1.2°C.



**Figure 1:** Long-term (1961 –1990) average values for precipitation per months taken at the Lindenberg Observatory (height over sea level: 98m; latitude: 52°12' N; longitude: 14°07' E) source: www.dwd.de



**Figure 2:** Long-term average (1961-1990) values for sunshine per months taken at Lindenberg Observatory, source: [www.dwd.de](http://www.dwd.de)



**Figure 3:** Long-term (1961-1990) average values for temperature per months taken at Lindenberg Observatory, source: [www.dwd.de](http://www.dwd.de)

### 6.1.2. Hydrology

The Löcknitz receives water from three sources. In the west, water is supplied by the Kagler chain of lakes (Elsensee to Liebenberger See) and the Stöbber, which drains into the Rote Luch. The Mühlenfließ brings water from the north and the Maxsee from the east. The draining of the Kagler chain of lakes, Stöbber and Mühlenfließ unite just north of Kienbaum forms the Löcknitz River. For approximately 13 km the Löcknitz flows through a narrow valley which opens up to a width of 100 m at some

locations. The valley is very natural and only the last 4 km near Fangschleuse, which do not belong to the research area, are channelled. The river has an average gradient of 0.020 %.

Since the Löcknitz receives water from two lake systems, a short-term rise in water level in form of high water is not to be expected. The lake works as buffer in case of high water, storing a large amount of the additional water flow.

Ground water just above Kienbaum flows towards Löcknitz. This explains why the percolation mean over the long term is increasing between Kienbaum and Fangschleuse even if there are no surface tributaries. Regular measurements of percolation at the measuring point in Kienbaum and Klein Wall have taken place since 1966. The highest water level occurs in winter and spring and the lowest in late summer (DRIESCHER, 1996).

According to data provided by Brandenburg State Office for the Environment, the water level at the measuring point at the weir in Klein Wall (top water level) experienced a strong increase at the end of the 1980s.

The monthly average water level between November 1980 and December 1989 varied around 36.87 cm above PNP. The average for the following years until October 1996 with 65.81 cm above PNP was nearly double as high as the earlier average (figure 14, Appendix). The fish farming in Klein Wall required the raising of water level in 1988/89. After the fish stairs were built in 2001, the water level dropped again. Nevertheless, a slight water retention above Klein Wall is still required, since the fish ponds which receive Löcknitz water are higher than the Löcknitz River bed.

The Leibniz Institute of Fresh Water Ecology and Inland Fisheries monitored the most important water parameters at measuring points in Kienbaum and Fangschleuse in 1991, 1992 and 1994. Annual average water temperature was 9.2 °C (n=79) in Kienbaum and 9.4 °C (n=41) in Fangschleuse. Accordingly, minimum and maximum temperatures measured were 0 and 22.0 °C in Kienbaum and 0.1 and 21.3 °C in Fangschleuse. (GELBRECHT & DRIESCHER, 1996) The Löcknitz is densely grown with macrophyta between Kienbaum and Fangschleuse, excluding sections which are highly shaded by adjacent swamp forest. The river bed is dominated by substrates of neutral, humus sand- and mud soils. (BÖHME, 1996)

### **6.1.3. Utilisation**

Fishing in the Löcknitz has been documented back to the 13th century (KELLING, 1921). Up to 1990 the stream was regularly electronically fished one or twice a year. In the following years fishing was given up due to low economy and legal insecurities. In 1988 a trout plant was established which has had a significant impact on the landscape. At the beginning of 1990 the utilisation was changed to limited keeping with reduced feeding and fishing ponds. Furthermore, fish stairs were built in 2001, decreasing the water level above Klein Wall to its initial height and increasing permeability for the migration of species. There has been no legal fishing in the Löcknitz since 1992. In 1998 the stream, including the section flowing through the conservation area, was leased for fishery utilisation to the company "Löcknitzforelle". (UNB/FILE, 2006) According to the owner of the company (oral communication 27<sup>th</sup> of June 2006) the stream is used for fishing with two to four weir basket traps between Kienbaum and Große Wall Brücke.

The Löcknitztal Community of Interest e.V. (IG – Löcknitztal), founded in 1993, has taken over some conservation measures in the valley, aiming to reduce alder swamp forest and keep at least 20 % of the area open (ZIEBARTH *et al.* 1988; GELBRECHT *et al.* 1993). This contributes to the conservation goal laid down in the Resolution of 22nd March 1984. The goal is to maintain a relatively uninfluenced stream with its shorelines.

A small group of members who implement practical nature conservation measures voluntarily in their spare time can only make a contribution to achieving the conservation goal. A draft of care guidelines developed by R. ZIEBARTH (2001) suggests focussing on the maintenance of the value of existing open area and where possible to increase grasslands. Furthermore, the guidelines aim to preserve a patchy diverse landscape in the valley, consisting of alder swamp forests in different succession stages, extensive reeds, wet meadows belonging to *Molinion caeruleae* and *Phragmitea australis* and dry grassland relating to *Koelerio – Corynephoretea*.

Beside the IG – Löcknitztal, two additional parties are active in the valley.

A sheep herd owned by Kölpin – Fritsche is using different areas (owned or leased by the company) within the valley, contributing to the maintenance of wet meadows. Furthermore, the community Grünheide made the decision in 1995 to keep 6 areas open as compensation measures for the B-plan “Neue Ortsmitte” (new centre of the community) for a duration of twenty years.

The conservation measures were conducted on all selected sites in the first years. Unfortunately problems in implementation have been observed recently.

## **6.2. Historical research**

In order to collect historical material about the study area, libraries and archives like the Berlin State Library – Prussian Cultural Heritage, Leibniz Institute of Fresh Water Ecology and Inland Fisheries (Berlin), the district archive (Beeskow) and the main archive for the State of Brandenburg (Potsdam) were visited to study historical records.

## **6.3. Terrestrial habitats**

After reviewing aerial photographs, terrestrial habitats were evaluated on several inspections in June. Potential sites were mapped using GPS. A record sheet (see Appendix) was developed after ANDREAS (1999) and SCHNEEWEIB & MÜLLER (2001). The sheet includes information about the vegetation structure, exposition and neighbouring vegetation. Furthermore, it is accompanied with vegetation relevés according to BRAUN BLANQUET (1964). Vegetation relevés covering 5 x 5 m have been produced at representative patches on all accessed sites.

Vegetation communities have been identified as far as possible using SCHUBERT *et al.* (1995).

## **6.4. Aquatic habitats**

The aquatic habitats were assessed by several terrestrial inspections and one examination from the boat and air.

The research area was investigated on the ground on several days in April and May. The stream was divided into sections of approximately 300 m. Starting and ending points were fixed with a GPS of the type Garmin 12. A record sheet (see Appendix)

was developed to assess the important structures of each section. Special attention was paid to vegetation structure (vegetation form, layers and density) and river morphology. It was not always possible to stick to the chosen distance of 300 m because not all parts of the shoreline are easily accessible. Therefore, sections sometimes had to be smaller or larger. For additional orientation, a digital aerial photograph taken in 2002 was used.

The inspection of the stream by boat took place under the supervision of N. SCHNEEWEIß on the 10th of May 2006. A small boat was navigated with paddles from Kienbaum to Klein Wall. The Löcknitz between Klein Wall and Große Wall Brücke was not investigated by boat since numerous dead logs in the water made it hardly possible to navigate a boat through this section. Habitat structures were examined carefully. Notes were taken accompanied by GPS points.

On the 19th of June the river valley between Kienbaum and Klein Wall was observed from a plane, and aerial photographs were taken. A Cessna 172 D – EOQK was used. It was flown by J. DORF and photographs were taken by N. SCHNEEWEIß (camera: Nikon D2 with 12 Nikkor 28 – 105 mm) and Garmin 12 XL). Special attention was paid to lentic waters between the shore line reeds which were difficult to observe from the ground.

The data gained in the three different approaches have been combined and sections were ranked in four classes of suitability. Next, the data were loaded into ArcView to depict the sections with their assigned degree of suitability.

Finally, data collected in aquatic and terrestrial habitat assessment were combined in a map showing spatial distribution of suitable aquatic and terrestrial sites. ArcView 3.2a was used to evaluate the distances between aquatic and terrestrial sites.

## **6.5. Determination of *Emys orbicularis* in the nature reserve**

Experience showed that the observation of specimens during excursions in the spring is very unlikely in areas with very low abundance. Therefore, local people were interviewed within the species protection programme about their sightings. In some cases this approach resulted in the discovery of relict populations (SCHNEEWEIß & MÜLLER, 2001).

Since the probability of *Emys orbicularis* occurring in the Löcknitz was estimated as very low, a similar approach was chosen. Several local people were interviewed about their observations of *Emys orbicularis* in the river valley.

A common method for determination of turtle occurrence is trapping with weir basket traps. Experiences (SCHNEEWEIß, personal communication) in areas with known populations showed that catching probability in a population with only few individuals is low even with a large number of traps in a small area.

The research area consists of a several kilometres long river section which would require a high number of traps. Moreover, some parts along the shoreline are not easy to access. Therefore, effort and expected success (no turtles were observed during the boat excursion despite perfect weather and low impact of the boat on the turtles) were compared and a decision was made against the application of weir

basket traps. Nevertheless, sites which might be used for nesting were visited several times in the evening hours in June.

## **6.6. Food resources**

The habitat suitability for a species also includes the availability of food. Therefore, aquatic organisms were determined with focus on the availability of prey species. Since it was not the aim to get an overview about diversity of aquatic organisms in the Löcknitz River, the shoreline was not searched systematically. However, spot checks were made along the waterfront between Kienbaum and the first 1.5 km stream stretch.

Species were identified at low level only because the body size of available prey species is more important than the determination of species level.

Samples were taken in the middle and end of May. Two different aquatic net types were applied. A coarse aquatic net with a mesh wide of approximately 5 x 7 mm was used in the mud and between plants to appraise macrozoobenthos, meso- and macroplankton. Furthermore, a plankton net with a mesh width of 1 x 0.5 mm was employed to assess smaller organisms.

Each spot check included two samples with the coarse net and one with the plankton net. The net was moved through the water in three to four movements. The organisms were sorted out into a water-filled bowl. Afterwards they were identified as far as possible in the field using ENGELHARDT (1989) and BARNDT *et al.* (1990) and counted using a second bowl. Next, the organisms were released into the water.

## 7. Results

### 7.1. Historical review

The Löcknitz River was first mentioned in a document in the middle of the 13th century. The name “Löcknitz” evolved from the Slavonic term for “water lily”. This implies that the stream must have been rich in water lilies already in earlier times. Furthermore, it is mentioned that honey production played an important role in the valley (DRIESCHER, 1996). Therefore, flowery meadows must have existed.

Up to the 1950s the meadows in the valley were frequently used in one or two cuts annually depending on their degree of wetness. Bushes and trees could only be found along the property borders of the small meadows and along the reeds bordering the river. Alder swamp forests could only establish themselves on the patches which could not be utilised (ZIEBARTH, 2001).

With the intensification of agriculture, the utilisation of the wet meadows was not economical anymore. The missing annual cut subsequently resulted in that the alder swamp forest reduced the once rich diversity in the valley. An investigation (ZIEBARTH & GELBRECHT, 1996) conducted in 1994 determined that approximately 200 ha of the valley consist of 75 % swamp forest (mainly dominated by *Alnus glutinosa*) and 25% vegetation formations with an open character like reeds, meadows and tall herbaceous vegetation.

Further water plants and mud in the Löcknitz were removed annually in late spring up to the reunification of Germany. (ZIEBARTH, 2001)

### **7.1.1. Map description**

#### Schmettau's map work (1:50000)

The oldest map which could be accessed for the study area is part of Schmettau's map work, which was produced between 1767 and 1789. The whole river valley is depicted as grassland. The valley is surrounded by cultivated forest. Just south of Klein Wall at the north shore of the river an open area is portrayed between valley and forest. Those might have been interesting nesting sites. The stream was widened just north of Klein Wall due to utilisation of water power in the mill in Klein Wall. The Post Luch occurring on both sides of the river is present as wet meadow. The adjacent area at the northern part of the valley between Post Luch and Kienbaum is depicted as open area, most probably as heath. Approximately at the height of Kagel, the area at the southern border of the valley is present as heath too.

#### Decker's map work (1:25000)

Decker's map work was produced between 1816 and 1824. It shows an open valley covered with grassland / wet grassland between Große Wall Brücke and Klein Wall. Forest is adjacent to the valley. Similar to Schmettau's map, the area south of Klein Wall bordering on the northern valley is depicted as open / heath area. Even between Klein Wall and Kienbaum the whole valley is presented as grassland / wet grassland. The valley is surrounded by forest. Similar to Schmettau's map, the area bordering the valley is illustrated as open / heath land. But Decker's map shows a loose occurrence of trees at the northern border of the valley. This difference to Schmettau's map might be due to the different scales but it might also indicate increased tree growing in that area. There is a time period of at least 20 years

between the production of these two maps. Therefore the growing of trees would be possible.

Original ordnance survey map (1:25000)

Similar to the two maps already mentioned, the original ordnance survey map (developed around 1843) depicts the river valley between Große Wall Brücke and Klein Wall as grassland / wet grassland with forest adjacent at the slopes. Another similarity is the open area at the north slope of the valley south of Klein Wall. But different from the two maps above, a tree island is depicted here. This indicates succession.

There are some peat ditches just south of Klein Wall. The valley between Klein Wall and Post Luch is represented as grassland / wet grassland, surrounded by forest as well. The Post Luch can be found on both sides of the stream as a wet grassland area. Like in Decker's map, the region south of Kienbaum exists as open area / heath with the appearance of some trees which might indicate succession. More peat ditches can be found in the valley between Post Luch and Kienbaum, indicating a swampy area.

Prussian land records 1903 (1:25000)

Like the three maps mentioned above, the Prussian Land Records represent the section between Große Wall Brücke and Klein Wall as grassland / wet grassland. Another similarity is the open district south of Klein Wall. Just above Klein Wall the river is presented a bit wider. Furthermore, the whole section of the valley between Klein Wall and Kienbaum is depicted as grassland / wet grassland. The Post Luch can be found on both sides of the river. Interestingly, the forest on the northern side of the valley starts not at the Post Luch as in the maps before but only at the height of

Kagel. The open area at the southern part of the river seems to be smaller as in the earlier maps as well.

Silva hiking map 1927 (1:30000)

The valley section between Große Wall Brücke and Klein Wall is depicted as grassland (not as grassland partially wet as in the earlier maps) bordered by forest. The open area south of Klein Wall seems to be smaller than earlier. The stream just above Klein Wall is widened. The rest of the valley up to Kienbaum is presented as grassland (not as grassland partially wet as in the earlier maps). The valley is bordered by forest. The Post Luch at the northern side of the valley is presented as wet meadow. There seems to be some open area south of Kienbaum, but unfortunately this part is not depicted on the map anymore.

Aerial photograph 1953 (1:22000)

The earliest aerial photograph available from the research area was taken in 1953. The scale has enlarged a lot compared to the earlier maps. The valley section between Große Wall Brücke and Klein Wall can be recognised as open area covered with grassland. Some tree islands can be found within the valley. The valley is partly bordered by forest or agricultural area. Especially the northern margin of the valley just south of Klein Wall consists of larger open areas in form of agricultural ground. The aerial photograph does not show a widened stream part just above Klein Wall as do Schmettau's map and the Silva hiking map. The section between Klein Wall and Post Luch is presented as open area, too. But some small tree groups can be found within the valley. The valley is basically bordered by forest. Only very few tree groups can be found in the open valley between Post Luch and Kienbaum. The adjacent forest does not seem to be very dense. South of Kienbaum at the north side

of the valley a large agricultural area is situated. The south margin of the valley possesses agricultural ground too. In general the landscape around the valley appears very patchy with small areas of different usage and succession stage. So the photograph presents a side-by-side view of the agricultural area, grassland, forests of different age and even open patches within the forest.

Aerial photograph 2002 (1:12000)

Fifty years after the first aerial photograph, the valley between Große Wall Brücke and Klein Wall is basically stocked with trees. Within the valley there are still some small grasslands which are often shadowed by the adjacent forest. The valley is framed by forest on both sides. What was once an open area (agriculture) south of Klein Wall in the photograph of 1953 is now covered with trees. A similar picture can be found between Klein Wall and Post Luch. But still some striking differences need to be mentioned. An electricity line crosses the stream approximately 600 m north east of Klein Wall. Here the valley opens up a bit more, creating an open side stocked with reeds and young trees. After a narrow section, the valley opens up again at what was named Post Luch at the southern part of the valley. Still the stream is framed by trees, sometimes closer, sometimes further away from the water. This is a big difference to the photograph from 1953, where the whole valley was covered with grassland. The stream is hemmed by reeds, sedges, alder and willows. Two bigger green lands are present. The section between Post Luch and Kienbaum is more or less open. Some parts particularly at the northern side are treeless, especially close to the stream shore. A very strong increase in trees within the valley has to be recognised compared to 1953. The valley is surrounded by forest of different ages. An oil line is situated south of the valley in a distance of approximately 300 m. The

valley opens up again just south of Kienbaum, partly covered by grassland and swampy forest. Furthermore, there are some agricultural areas adjacent to the northern margin of the valley. Another electricity line crosses the stream. Here the valley possesses a bigger grassland-covered area. Some of these dry grassland patches are so lean that they do not get stocked with pine trees and remain open. The big open areas south of Kienbaum which could be found in the earlier maps have vanished and are now covered with forest.

In summary, the valley must have been open up to middle of 20th century. It was surrounded by forest, but open patches like agricultural or heath areas were present, too. An essential change can be observed up to beginning of the 21st century. The valley is predominantly covered with swamp forest which shadows the stream. Especially between Große Wall Brücke and Klein Wall the stream is almost completely shadowed with trees. GELBRECHT *et al.* (1993) also assumed that the open character of the valley evolved after deforestation measures many years ago. The grasslands and fens have been used as extensive fodder and litter meadows. After the utilisation cessation from the 1950s onwards a natural succession to alder swamp forest and birch – pine forests occurred. Furthermore, the landscape was influenced by changing water levels over the years.

Compared to the latest aerial photograph, the woody plants within the valley are significantly increasing. The open character of the valley has changed to an appearance of a patchwork landscape consisting of different types of grassland and swampy forests of different age. The northern part of the valley possesses some grassland patches close to the stream. Trees do not always shadow the river.

Especially at the northern shore trees often do not stand clear up to the water. Open spaces as they were present near Kienbaum have almost completely vanished. GELBRECHT *et al.* (1993) mentions the scattered occurrence of *Juniperus communis* in the surrounding forests. *Juniperus communis* is a light-loving plant. Its presence implies the existence of a more open landscape.

Up to the 1950s, habitat conditions for *Emys orbicularis* must have been suitable in large parts of the observed stream section. The vegetation of the valley consisted of wet meadows which were flooded occasionally. Therefore suitable aquatic habitats were given. The absence of trees within the valley ensured a sufficient sun supply for basking. Open patches were present along the whole stream, offering nesting sites in close distance to the aquatic habitat.

## **7.2. Determination of the status in the area**

The determination of the status of *Emys orbicularis* in the nature reserve involved the estimation of an approximate point in time when the turtle disappeared. Several local people have been interviewed about their personal observations of *Emys orbicularis* in the research area. The result is shown in Table 1.

During the examination of aquatic habitats with the boat, special attention was paid on the observation of basking turtles. The 10th of May was a warm, very sunny day, offering optimal conditions for basking. Approaching the turtles by boat has a lower impact on the escape behaviour of the turtles than approaching them on land. Therefore an optimal situation was given for the observation of turtles. Nevertheless, none could be sighted. Furthermore, nesting sites 1, 2 and 3 were observed on some

evenings in the middle of June to reveal whether they are still used for egg-laying.

But no turtle was found.

**Table 1:** results of interviews of local people: sightings of *Emys orbicularis* within or near the study area

who	when	where	how
Alscher	1955	Meadow, approx. 900 m upstream from electricity line near Klein Wall	During the breaks when she was working on the meadow
K. Vogt	1970 - 75	Approx. 1 – 2 km south of Kienbaum in cove	Turtle was basking for approximately 10 min; K. Vogt was observing birds
F. Sendel	approx. 1975	Just south of Kienbaum	While observing nature
B. Sendel	approx. 1994	Electricity line near Kienbaum	During walking
Nickel	approx. 1946	Approx. 1 km south of Kienbaum	
B. Heuer	end of 1970s	Street margin between Löcknitz and Spree near Hangelsberg Spree shore in Hangelsberg	Both animals were brought to Mr. B. Heuer who identified them as <i>Emys orbicularis</i> , they were released into the Spree again

### 7.3. Terrestrial habitats

All mapped sites are characterised by the presence of substrate type sand and south, southwest or southeast exposition because without these conditions, sites are not suitable for nesting anyway.

Vegetation cover may occur in a broad range. A low cover with open sandy patches is advantageous but patches with higher cover might be used, too, as long as the vegetation is of small growth. Plants short in height like mosses and lichens do not impair the sun's radiation on the nest. Additionally, the stability of the conditions on the site is a very important factor. Stability includes natural succession and

utilisation. An agricultural field which is tilled every year is an unsuitable nesting site as well as a site which is increasingly shaded by upcoming forest plantation.

Vegetation found on the assessed nesting sites can be grouped into *Koelerio – Corynephoretea*. This vegetation class is characterised by SCHUBERT *et al.* (1995) as gappy formation with heat and dryness-tolerant, light-loving plants. The characteristic species are often of small growth and weak in competition. On a higher level of the vegetation community, the assessed nesting sites consist of elements of *Sedo – Scleranthetalia* and *Corynephorretalia canescentis* and *Festuco – Sedetalia*. A consultation of the indicator values by ELLENBERG (Floraweb, 2006) of the determined plant species confirms the domination of light-loving plants that are tolerant to dryness and poor in nitrogen.

Results of the relevés and the indicator species for the mentioned vegetation communities can be found in Table 4 (see Appendix). Spatial distribution of the sites within the study area are depicted on Map 1 (see Appendix).

### **7.3.1. Site 1 – clearing near Kienbaum**

#### General appearance

The area is dominated by light-loving plants like *Hieracium pilosella*, *Corynephorus canescens* and *Rumex acetosella*. The vegetation coverage ranges between 70 and 100%. The occurrence of grasses is very gappy and cover is mainly represented by short growing plants like *Hieracium pilosella*, mosses and lichens (*Cladonia spec.* and *Peltigera spec.*) (see Photo 3). A path is leading along the western and northern part. A hunting seat is present at the southeastern site from where the salt stone in the middle of the area can be observed. Some scattered *Pinus sylvestris* occur and *Arrhenatherum elatius* is present on some patches.

### Neighbouring vegetation

*Pinus sylvestris* plantation is neighbouring the site at four edges. In the northeast the xerothermic vegetation is changing into fresh meadow dominated by *Arrhenatherum elatius*. The shade of the bordering trees has only a low impact since the area is big enough; therefore sun reaches most of the site.

### Utilisation / threats

The site seems only to be utilised for hunting. The path is used for walks by the local people. The observation of egg-laying turtles by locals could be a threat. The occurrence of the species would be known by the public, increasing the danger of collecting animals.

Additionally, the presence of *Arrhenatherum elatius* patches indicates the occurrence of higher nitrogen values. The input of nutrients is to be avoided. Furthermore, the scattered occurrence of juvenile *Pinus sylvestris* implies beginning succession. The IG – Löcknitztal removed young trees already a couple of years ago. They still monitor the site and are prepared to intervene again.

## **7.3.2. Site 2 – electricity line near Kienbaum, left side of the stream**

### General appearance

In the south a path leads along the site. Vegetation consists of different patches, each dominated by *Rumex acetosella*, *Anthoxanthum odoratum*, *Corynephorus canescens*, *Hieracium pilosella* and *Euphorbia cyparissias*. Vegetation cover ranges between 50% and 90%. In part, lichens (*Cladonia* spec. and *Peltigera* spec.) (Photo 5) are very abundant. Some patches are strongly dominated by grasses. One hunting seat can be found. The landscape bends slightly north towards the river. In general,

vegetation cover might be too high for suitable nesting sites; only small patches offer the required conditions (see Photo 4).

#### Neighbouring vegetation

Southwest to southeast a *Pinus sylvestris* plantation is adjacent. In the north vegetation turns into *Arrhenatherum elatius* when moving closer to the Löcknitz River. At the western edge it is bordered by the electricity line running southeast to northwest.

#### Utilisation / threats

Similarly as mentioned at site 1, the path is used by local people who might observe turtles during egg deposition. This could result in the collecting of specimens, which would have a negative impact on the success of a reintroduction. Some invading pine trees can be found implying succession.

To maintain the dry grassland IG – Löcknitztal removed juveniles trees some years ago. The site is still monitored, and IG – Löcknitztal is ready to intervene again.

### **7.3.3. Site 3 – crossing of electricity line and oil line near Kienbaum**

#### General appearance

This site is characterised by very low vegetation cover ranging between 5 – 30% and xerothermic plant species like *Echium vulgare*, *Hieracium pilosella*, *Helichrysum arenarium* and *Corynephorus canescens* (Photo 6). A path runs along the site. The crossing of the two energy lines ensures high sun supply. A hunting seat is present.

#### Neighbouring vegetation

To the southeast, the electricity line is adjacent, offering suitable nesting patches as well. The northwestern part of the electricity line is dominated by high growing grass, with low function for nesting. The oil line runs east-west.

#### Utilisation / threats

Energy supplying companies are responsible for the maintenance of the lines; therefore natural succession is not to be expected. Nevertheless, small patches with *Calamagrostis epigejos* can be found. The path is used by local people. Therefore egg-depositing turtles could be discovered by the public.

### **7.3.4. Site 4 – electricity line near Kienbaum right side of the stream**

#### General appearance

The site is dominated by *Rumex acetosella* and *Corynephorus canescens* (Photo 8). A hunting seat is present. No path leads down here; therefore low disturbance by walking people can be expected. Furthermore, the site slopes slightly to the south, increasing sun exposition. Grasshoppers are present as well as some butterflies belonging to *Lycaenidae*.

#### Neighbouring vegetation

In the south *Phragmites australis*, *Salix spec.* and *Urtica dioica* adjoin the site, followed subsequently by the Löcknitz River (Photo 7). To the west and east, the site is bordered by a *Pinus sylvestris* plantation.

The electricity line runs further in a northern direction offering more suitable patches for oviposition. These patches are mostly dominated by *Hieracium pilosella*, *Corynephorus canescens* or lichens.

#### Utilisation / threats

Low disturbance by humans is expected. One possible threat might be the invasion of *Urtica dioica* or other ruderal plants. Succession and ruderalisation need to be avoided.

### **7.3.5. Site 5 – near Kagel**

#### General appearance

Site 5 has the shape of an “L”. This very large area is surrounded by a forest path. Several hunting seats are present. The margins are characterised by *Rumex acetosella* and grasses. In the centre, patches with bare open sand can be found (Photo 9). Succession stage is lower in the southern part than in the northern one. At the northern edge *Corynephorus canescens* is occurring in a higher abundance, with scattered appearance of *Helichrysum arenarium* and *Sedum acre* as elements of dry meadow and *Berteroa incana* indicating ruderalisation. Especially the southern part is characterised by grasses. Apart from *Rumex acetosella*, hardly any herbs can be found.

#### Neighbouring vegetation

The whole area is surrounded by *Pinus sylvestris* plantation.

#### Utilisation / threats

The site no longer exists. Some juvenile *Pinus sylvestris* can be found on the area, indication of beginning succession.

### **7.3.6. Site 6 – near Kagel**

#### General appearance

Site 6, which is situated in close proximity to site 5, is characterised by xerothermic vegetation, too (Photo 10). At the southern margin *Holcus lanatus* occurs, merging

into *Phragmites australis* at the shoreline of the Löcknitz River (Photo 11). Ten to twenty juvenile *Pinus sylvestris* occur in the middle of the area, indicating beginning succession. The northern part is more influenced by humans. Tracks of heavy machines are present as well as plants like *Tripleurospermum maritimum*, *Berteroa incana* and *Convolvulus arvensis*, indicating higher nutrient supply. A hunting seat is present in the south.

#### Neighbouring vegetation

The southern edge of the site is bordered by *Phragmites australis* and *Salix* spec. as accompanied vegetation of the Löcknitz River. In the east a *Pinus sylvestris* plantation is adjacent, and a forest path leads down to the river most probably used with low frequency. The western edge is bordered by an agricultural field. At the western side of the field a Christmas tree plantation is adjacent. In the north first houses of Kagel follow.

#### Utilisation / threats

The site itself is not utilised. The adjoining agricultural field is used by Kölpin – Fritsche. They agreed to fertilise the field only half way to the Löcknitz to reduce nutrient deposition near the stream. In the northern part first signs of nitrification can be observed. Kölpin – Fritsche, who are members of IG –Löcknitztal, could be cooperative partners in necessary maintenance measures like securing nesting sites with fences. The Christmas tree plantation emerged only in recent years. A further reforestation of this area would not only endanger potential nesting sites but also destroy dry meadow as important habitat for endangered plant and insect species.

### **7.3.7. Site 7 – electricity line near Klein Wall**

#### General appearance

Only a small patch of the clearing under the electricity line near the Löcknitz River possesses the required vegetation structures for a suitable nesting site for *Emys orbicularis*. This patch is dominated by *Rumex acetosella* and *Agrostis vinealis* (Photo 12). Vegetation cover ranges between 60 – 90% but a patch of bare ground can be found, too (see Photo 13). Twenty to thirty juvenile *Pinus sylvestris* occur in the area indicating the threat of succession.

#### Neighbouring vegetation

High-growing grasses like *Calamagrostis epigejos* and *Avenella flexuosa* occur in close proximity to the suitable patch. Furthermore, the clearing is surrounded by *Pinus sylvestris* plantations and some *Betula pendula* at their margins. To the northwest, at a distance of approximately 60 m, the Löcknitz flows.

#### Utilisation / threats

The forest path does not lead directly alongside the suitable patch. Therefore, a low disturbance by humans can be assumed. Succession needs to be avoided.

### **7.3.8. Site 8 – oil line between Klein Wall and Kienbaum**

#### General appearance

The clearing above the oil line comes from the southern direction. It turns southwest – northeast for approximately 4.5 km parallel to the Löcknitz. The clearing has a width of roughly 20 m, offering sufficient sunshine supply. The first 1.5 km east of Klein Wall can be characterised by vegetation relevés 8 and 8-1 (see Table 4). However, the clearing changes direction slightly, adjusting more south – north. Here vegetation is dominated by high-growing *Calamagrostis epigejos* and *Pteridium*

*aquilinum*, crucially reducing suitability as a nesting site. After another 1.5 km, the direction moves back to southwest – northeast and vegetation offers more suitable structures again (Photo 14)). The Müggel-Spree hiking trail runs through the clearing and several hunting seats can be found. Furthermore, the aisle is used for wood storage.

#### Neighbouring vegetation

*Pinus sylvestris* plantations are growing left and right along the clearing.

#### Utilisation / Threats

Succession needs to be avoided. The hiking trail is most likely only used with low frequency, reducing probability of hikers observing egg-laying turtles.

### **7.3.9. Site 9 – south slope near Kienbaum**

#### General appearance

The site is situated on a southerly exposed slope providing optimal sun exposure. Vegetation cover ranges around 30%. At the forest margin some lichens are present. Vegetation aspect varies on a very small scale. Patches are dominated by xerothermic species like *Corynephorus canescens*, *Sedum acre* and *Hieracium pilosella*. At the bottom of the slope *Echium vulgare* can be found and xeric grassland merges into *Arrhenatherum elatius*, followed by *Phragmites australis* growing at the shoreline of the Löcknitz (Photo 15). *Anthemis arvensis* occurring between the xerothermic vegetation does not fit into the vegetation community and might be a sign of higher nitrogen availability provided by nodule bacteria in the roots of some juvenile *Robinia pseudoacacia*. Furthermore, some juvenile *Pinus sylvestris* and *Quercus robur* can be found.

#### Neighbouring vegetation

The patch is surrounded by *Pinus sylvestris* plantation. In the south reeds grow and the Löcknitz River flows.

#### Utilisation / threats

The presence of juvenile trees implies succession which needs to be avoided to maintain high sun exposure. A special threat is the occurrence of *Robinia pseudoacacia*, producing nitrogen and altering soil conditions, resulting in a change of vegetation community. Therefore young trees should be removed.

### **7.3.10. Site 10 – old training site**

#### General appearance

Vegetation cover ranges between 50 % to 90 %. Especially at the northern forest border, cover is lower with plants of short growth like *Hieracium pilosella* and lichens. In general, the site is dominated by *Agrostis vinealis* (Photo 16). In the middle of the area a small island consisting of *Calamagrostis epigejos* can be found. The clearing is extremely rich in butterflies.

#### Neighbouring vegetation

The site is surrounded by *Pinus sylvestris* plantation. Due to its size the shading influence by trees is negligible, especially at the northern margin, which is perfectly southeast – southern exposed, offering suitable conditions for nesting.

#### Utilisation / threats

The site belongs to a former drill ground of the Russian Army. Since the reunification of Germany it has not been used anymore. Today the site is leased to the company Kölpin – Fritsche.

Juvenile *Pinus sylvestris* emerging on the site indicate beginning succession, which needs to be avoided. Maintaining the site would not only contribute to providing potential nesting sites for *Emys orbicularis* but also to providing a habitat for rich butterfly fauna, supporting overall biodiversity in the conservation area.

### **7.3.11. Site 11**

#### General appearance

Site 11 is located in close proximity to the Löcknitz River (Photo 17). Vegetation cover and species dominance is changing on a small scale. In general it is dominated by *Agrostis vinealis*. Further dryness-tolerating plants like *Helichrysum arenarium*, *Hieracium pilosella* and *Jasione montana* occur. Vegetation cover ranges between 20 % to 90 %. There is a slight inclination towards the north, reducing favourable conditions for nesting. At the northern margin an old hunting seat is present. The existence of litter indicates the occasional presence of humans.

#### Neighbouring vegetation

The site is bordered by *Pinus sylvestris* plantations in the east, south, and west. In the north alder swamp forest interspersed with *Phragmites australis* is adjacent.

#### Utilisation / threats

Like site 10, the area was used by the Russian Army and is abandoned now. Measures like removing juvenile trees and mowing or pasturing would be necessary to maintain dry grassland vegetation.



**Photo 2:** Overview site 1



**Photo 3:** Site 1: small growing vegetation



**Photo 4:** Site 2: suitable patch dominated by *Hieracium pilosella* and *Corynephorus canescens*



**Photo 5:** Site 2: earth lichens



**Photo 6:** Site 3: low vegetation coverage with high sun exposition



**Photo 7:** View from site 4 down to the Löcknitz



**Photo 8:** Vegetation at site 4 with *Rumex acetosella*, *Corynephorus canescens* and *Hypericum perforatum*



**Photo 9:** Overview site 5: grasses at the margins and bare sand in the middle



**Photo 10:** Site 6: view from south to north, dominated by *Rumex acetosella* and *Corynephorus canescens*



**Photo 11:** Site 6: border line between xerothermic grassland and *Phragmites australis* at the shoreline of the Löcknitz



**Photo 12:** Overview site 7



**Photo 13:** Patch with bare sand on site 7



**Photo 14:** Site 8: suitable part of the oil line parallel to Löcknitz River between Klein Wall and Kienbaum



**Photo 15:** View in southern direction towards Löcknitz River from site 9



**Photo 16:** Overview site 10



**Photo 17:** Overview site 11

## **7.4. Aquatic habitat**

Water temperature in a section near Kienbaum was determined at 15 °C in 10 cm depth in May.

Chapter 5.3 summarises the most important requirements for aquatic habitats. Suitability depends a lot on the presence of muddy ground, structured shorelines, sufficient sun - exposure for basking and lentic water areas in form of coves and standing water areas within the shoreline vegetation. Therefore the following main criteria were selected for assessing the suitability of the aquatic habitat:

- ground substrate
- degree of shading
- presence of lentic water
- shoreline vegetation
- water vegetation

The degree of shading will give information about sun – exposure of the shorelines. Presence of lentic water, shoreline vegetation and water vegetation present the structure of the habitat. The evaluation of literature and the survey in the field showed that Löcknitz is a natural valley characterised by a mosaic of alder swamp forest and reed communities and fens. Well-developed water vegetation occurs where insolation is sufficient. Furthermore, the inspections determined low flowing velocity in most sections and the predominant presence of muddy ground and a water depth varying between approximately 30 – 170 cm. Since low flowing velocity and muddy ground are predominantly present in the whole observed area, the sections essentially differ in shading, shoreline vegetation and presence of lentic areas. The

shading is strongly influenced by the shoreline vegetation. A river section flowing through a swamp forest will have significantly higher shading than a section framed by fen. Therefore, the shading was identified as the most important criterion for the habitat suitability. The conservation status of the study area ensures a low human influence. Furthermore, the field inspections determined that low shading is associated with fen or reed vegetation, which offers suitable habitats for *Emys orbicularis*. Based on these considerations, the following suitability classes have been developed:

#### High suitability

The section shows low shading varying between 0 to 25%. This low shading is associated with fen or reed communities which might be combined with some woody vegetation increasing the biotope structure. The high sun – exposure of the stream ensures the occurrence of well-developed water vegetation.

Lentic water areas (coves or standing water areas within the shoreline vegetation) with shallow water are present. Therefore the section is suitable for adult and juveniles likewise.

#### Moderate suitability

The section shows low shading varying between 0 to 25%. This low shading is associated with fen or reed communities which might be combined with some woody vegetation increasing the biotope structure. The high sun – exposure of the stream ensures the occurrence of well-developed water vegetation.

The section provides suitable conditions for adults but not for juveniles due to missing lentic areas with shallow water.

#### Connection element

The shading varies between 26 % to 50 % due to the partial occurrence of swamp forest and fen or reed communities along the stream. Shoreline might be highly structured but the low sun – exposure does not allow sufficient basking. Lentic areas might be present but their occurrence in highly shaded swamp forest makes them unsuitable for juveniles.

#### Unsuitable

Sections which are shaded more than 51 % can be classified as unsuitable. They are predominately associated with swamp forest, offering insufficient conditions for basking. The sections are often highly pierced by dead wood which is avoided by *Emys orbicularis*. Lentic waters might be present but are unsuitable due to the high degree of shading.

Results of this classification can be seen in Map 1.

### **7.4.1. Description of aquatic habitats**

In the following, the biotope structure of the Löcknitz will be described briefly. The river is divided into 14 sections (neighbouring sections which had the same degree of suitability in the field investigations were summarised). The sections are numbered with the flowing direction of the Löcknitz from Kienbaum down to the bridge at the

street from Fangschleuse to Grünheide. It should be considered that a clean cut between the sections is not possible since borders are fluent.

#### Section 1 – Suitable

The first section starts just south of Kienbaum going on in a southwest direction for approximately 1.5 km. The shoreline is partly accompanied by trees, but extensive reed vegetation dominates the general appearance. Reeds occur mostly on a swampy underground. Especially between Kienbaum and the electricity line, dead arms and potholes can be found between the reeds, providing lentic water areas especially for juveniles (see Photos 18 and 24).



**Photo 18:** Lentic zones between reeds as preferred habitat for juveniles; N. SCHNEEWEIß

Along the shoreline of this section, most important areas are situated where IG – Löcknitztal is conducting maintenance measures regularly, as for example on a wet meadow bordering the Löcknitz between Kienbaum and the electricity line. The site is dominated by *Polygonum bistorta*, and *Iris sibirica* also occurs. Juvenile alders are

cut down to avoid succession. The cutting material is disposed of at the margins of the swampy meadow.

Furthermore, the large wet meadow starting under the electricity line extending southeast along the shoreline is taken care of regularly every second to third year.

The meadow is mowed carefully and young willows along the shoreline are removed. Therefore it can be expected that this open area offering high sun – exposure will remain in future.

Downstream behind the electricity line, suitability decreases slightly. The shoreline vegetation is still dominated by reeds, but small lentic areas between reeds are missing. Therefore conditions are suitable for adults that can sit at the margins of the main channel. But structures are only suboptimal for juveniles. However, a short distance of only approximately 300 m needs to be bridged before the quality of the shoreline structures increases again. Coves and potholes between the reeds create a suitable habitat for juveniles, too (Photo 25).

The water depth varies on a small scale on the whole length of the section. Deeper zones of about 1.5 m are present as well as muddy shallow water areas of approximately 30 – 40 cm. Water vegetation like water lilies are present – partly in high abundance (see Photo 22). Traces of beaver have been observed.

In summary, the section offers shallow water which warms up fast (15 °C in 10 cm depth in May) and sufficient hiding and basking opportunities. Additionally, some willow scrubs (see Photo 23) can be found at the shoreline as preferred hibernation places. Therefore, this part of the Löcknitz can be classified as very suitable for adult and juvenile turtles.

### Section 2 – Connection

Section 2 roughly has a length of 450 m. The land observation determined that shoreline vegetation is dominated by reeds and sedges. Especially the first part adjoining to section 1 should still be classified as suitable. A large meander provides lentic zones, the stream is accompanied by extensive reeds, and shading by woody plants is negligible.

Nevertheless, conditions are changing. The second part of the section is partly shaded by trees up to 50 %, decreasing conditions for basking. Here the stream goes through alder swamp forest. Towards the end of the section a bigger very remarkable cove can be found offering nice structures. Due to strong shading by alders it is not very suitable for the turtle. (see Photos 19 and 26)



**Photo 19:** ○: Big cove strongly shaded (see photo 26); ○: Lentic zones between reeds, belonging to section 3; N. SCHNEEWEIß

In summary, the first part of the section can be classified as suitable while the second part is ranked as a connection element due to high shading. Its close occurrence to appropriate stream parts would allow a reintroduction since turtles could easily move to preferred places.

#### Section 3 – Suitable

Shoreline vegetation of the approximately 340 m long section is dominated by extensive reeds. It is difficult to approach the stream from land since the major part of the shoreline is covered by swampy fen. Dense willow scrubs are present, too. The total shading of the section was estimated at 11– 25 %. During the land observation the stream seemed to be quite narrow, but the from the boat the view changed. Some parts open up nicely. Additionally, some lentic zones between the reeds are present (Photo 19). Combined with a swallow cove habitat, conditions are suitable for adults and juveniles.

#### Section 4 – Moderate

The next segment has a length of approximately 680 m. During the observation from the boat three weir basket traps were found, proving fishing activities in the monitored part of the Löcknitz.

Shoreline vegetation comprises extensive reeds and alder swamp forest reaching up to the water. Therefore shading is partly up to 50 % high. Additionally, shallow lentic zones are not present on the whole length of the section. Therefore, it is partly only suitable for adults. Nevertheless, biotope structures are changing on a small scale, alternating between more narrow parts and opening up of the stream. The reason for its classification as moderate is due to its partial unsuitability for juveniles.

Optimal structures as could be found in section 1 are decreasing. However, in general the section offers good structures at least for adults.

#### Section 5 – Connection

The Löcknitz opens up nicely, but still the shoreline structure is very poor. Adults may still be able to cope with the low supply of basking and hiding places, but in general conditions are only suboptimal for them. Due to the missing shallow water zones the present segment is unsuitable for juveniles. Compared with sections 1, 2, and 3, the habitat quality is decreasing significantly. After approximately 390 m section 6 starts, offering a better environment again.

#### Section 6 – Suitable

Section 6 has an approximate length of 1 km. Shoreline vegetation consists predominantly of reeds (*Phragmites australis*, *Typha* spec.) and sedges. The valley opens up nicely and trees are seldom adjacent right next to the stream. Therefore shading is low, and the sun - exposure is sufficient. In some places the structure is less rich, offering suitable conditions only for adults. Nevertheless, it is balanced by shallow mud banks and lentic zones



**Photo 20:** Lentic zones along the shoreline; N. SCHNEEWEIß

between reeds following downstream (see Photo 20). Additionally, it can be observed that alders standing close to the water are dying, indicating the water level is still dynamic. Another advantage is the assurance of high sun - exposure. In summary, the section offers predominantly suitable habitat structures for adults and juveniles.

#### Section 7 – Unsuitable

At the end of section 6 the stream is suddenly covered under dense willow scrubs, making it difficult to get through with the boat. Section 7 has an approximate length of 690 m. Alder swamp forest occurs right next to the stream, preventing sufficient sun - exposure for basking.

### Section 8 – Connection

Extensive, open reed vegetation along the shoreline as it occurs in section 1, 2, 3 is not present in high abundance anymore. Some patches with reeds and sedges can still be found, but shoreline vegetation is dominated by alder swamp forest and willow scrubs. The shading of the stream has been estimated at 26 – 50%. Due to a partly high degree of shading, lack of suitable shoreline vegetation and absence of lentic zones in close association with the stream, the next 2.2 km are classified as a connection element between suitable habitats. However, on a small scale some moderate to suitable patches occur. Especially at the beginning and the end of the section better habitat structures can be found. At the beginning some parts are not shaded by trees, and very small lentic zones are present between sedges (see Photos 27 and 28). It is likely that they dry up when water level decreases. Similar structures can be found at the end of the section close to the electricity line near Klein Wall. Here sun – exposure of the stream is high due to the dying of alders. Where light supply is sufficient, water plants occur. But generally the section is dominated by trees and shrubs growing right at the shore and shading the water (see Photo 29). Furthermore, several wallows of wild boar were observed.

### Section 9 – Moderate

Section 9 is located between the electricity line near Klein Wall and the mill pond in Klein Wall. It has an approximate length of 1000 m. During the land observation shading was estimated at 0 -10 % on the first 300 m, ensuring sufficient sun - exposure.

Fen vegetation can be found along a richly structured shoreline (see Photo 30). It could be observed that water level and moisture within the fen changes during the

year. Therefore, it is very likely that small lentic zones between sedges dry up in times with low water level, thus losing their function for juvenile turtles.



**Photo 21:** The Löcknitz is supplied with water under the electricity line near Klein Wall, potholes can be found between the vegetation, they dry up with decreasing water level; N. SCHNEEWEIß

Additionally, the development of young willows and alders can be observed. Current succession might lead to a decreasing habitat value. Due to the unpredictable continuation of the potholes the section can only be classified as moderate. (see Photo 21)

These favourable habitat features deteriorate in the middle of the section. On a stretch of approximately 180 m the water course still has rich structures with very small coves and lentic zones caused by dead wood lying in the water. But swamp forest occurs right at the stream or at least in close proximity, shading the stream to a high degree (Photo 31).

Water lilies contributing to habitat structure are present in high abundance. On the last part the degree of shading decreases again. Especially the mill pond offers interesting structures for the European pond turtle.

#### Section 10 – Unsuitable

After the Löcknitz leaves Klein Wall in a southern direction it flows through a dense alder swamp forest which shades the water up to 100% (Photo 32). Only scattered small patches of reeds can be found along the stream. Some parts of the accompanied forest are very wet and swampy so one can easily get stuck. On drier patches vegetation in the herb layer consists mainly of forest species like fern, *Galium aparine*, *Urtica dioica*, *Corydalis spec.* Sun- exposure of the banks for basking is missing almost entirely. The shoreline structure is poor, and shallow lentic areas for juveniles are missing. Therefore the section is classified as unsuitable as a turtle habitat.

#### Section 11 – Connection

For a small distance of roughly 200 m the Löcknitz flows along a fen, offering different conditions than in the alder swamp forest. Light supply is sufficient here but lentic zones within the vegetation are missing. This small section lies in between two long unsuitable sections.

#### Section 12 – Unsuitable

The last section, with a length of 2.5 km, ends at Große Wall Brücke on the road to Erkner. It is characterised by the same features as section 10. The Löcknitz is shaded to nearly 100 % by dense alder swamp forest. Small patches of reeds can be found occasionally. The stream is characterised by a high number of dead trunks lying in the water. Water lilies are less abundant than in the northern sections. In some parts

of the alder swamp forest, many temporary lentic waters (Photo 33) are present – but highly shaded. Traces of wild boar can be observed.



**Photo 22:** High abundance of water vegetation



**Photo 23:** Willow scrubs along the shoreline which might be used for hibernation



**Photo 24:** Big cove; low water level can be recognised on dry shoreline in front of the picture



**Photo 25:** Large meander provides lentic zones with extensive reeds



**Photo 26:** Big cove but hardly suitable for juveniles due to low structure and high degree of shade



**Photo 27:** Suitable patches in section 8; a few lentic zones are present which might dry up with decreasing water level



**Photo 28:** Moderate part of section 8; sun supply is better in some parts but here structures for juveniles are missing



**Photo 29:** General appearance of section 8, scrubs and trees growing right at the shoreline shade the water to a high degree



**Photo 30** Lentic zones can be found along the shoreline but they tend to dry up with falling water level



**Photo 31:** Swamp forest occurs close to the stream, partly shading to a high degree

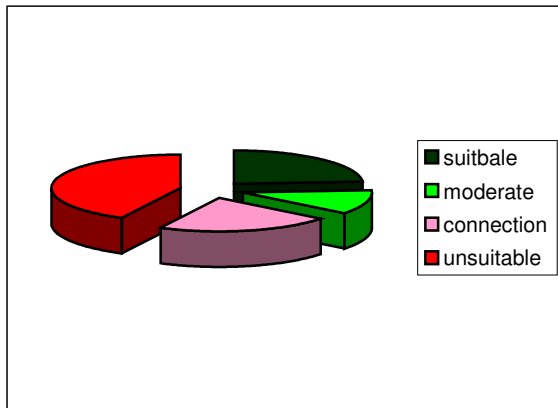


**Photo 32:** Section 10 is strongly shaded by swamp forest, many dead logs can be found in the water



**Photo 33:** Temporary lentic waters can be found in section 12 but they dry up with decreasing water level and are shaded by surrounded swamp forest

Most of the study area offers insufficient aquatic habitat conditions for *Emys orbicularis*. Only a stream segment of approximately 3.4 km length could be determined as suitable. The segments with suitable, moderate, connection and unsuitable conditions are shown in Figure 4.



**Figure 4:** Different qualities of aquatic habitat on a 14 km stream segment

Map 1 shows the spatial distribution of the stream sections with their assigned quality as *Emys orbicularis* habitat and potential nesting sites. Unsuitable sections are concentrated in the southeastern part of the study area while suitable sections are

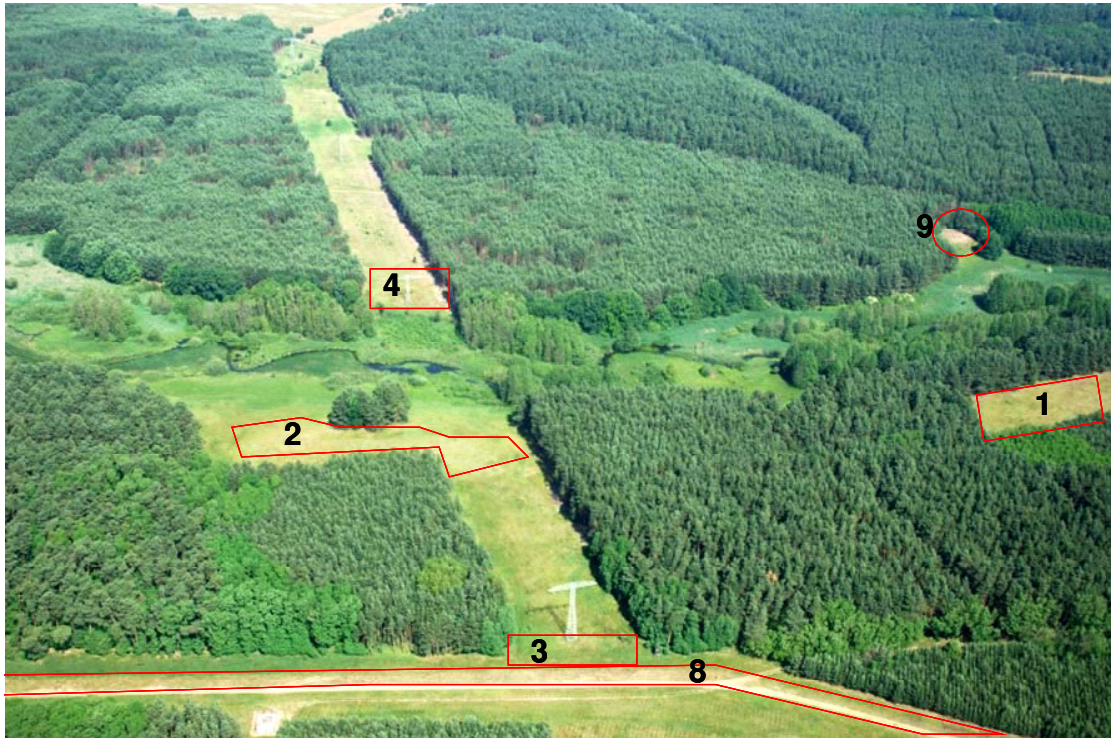
assembled in the northwestern part. Map 3 depicts a buffer of 250 m, 500 m and 750 m around suitable sections.

In the northeastern part, sites 1, 2, 3, 4 and 9 are located within 250 m of section 1 (see also Photo 34). Turtles just have to cross a reed belt to reach sites 2, 4 and 9. Even site 1 can be approached easily by crossing a reed belt and a slim strip of pine trees. The crossing of the oil line and the electricity line where site 3 and 8 meet is situated at a distance of approximately 250 m. The turtles could migrate along the electricity line through a stand of higher growing grasses.

Parts of site 8 can be reached within 250 m from stream section 3.

Furthermore, sites 10 and 11 are located within 500 m of suitable stream sections. These two sites occur in close proximity to stream section 4, which is classified as moderate (see Map 4). The same is true for site 6, which is located within 250 m

from section 4. Furthermore, it is located within 500 m from the suitable stream section 3.



**Photo 34:** Electricity line near Kienbaum: Section 1 with potential nesting sites as described in Chapter 7.3; N. SCHNEEWEIB

## 7.5. Food resources

In total, 24 samples were taken – 16 with a coarse aquatic net and 8 with a plankton net. Four different animal groups could be determined, ranging in body size between approximately 60 to 5 mm. Tables 2 and 3 present the number of individuals per species / group per sample. Furthermore, the mean number of individuals per species / groups per sample is shown. It varies from 1.0 to 21.2. The number of individuals per sample ranges from 10 to 131. On average, 58.3 individuals were caught per sample in the coarse aquatic net compared to 31.75 in the plankton net.

**Table 2:** Sampling of species: number of individuals per sample in the coarse aquatic net  
 Frequency: number of samples in which in certain species occurred; mean: mean number of individuals per sample

	12 May 2006								5 June 2006								frequency	mean
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8		
<b>Vertebrata</b>																		
<b>Amphibia</b>																		
larva					1												1	0.06
<b>Pisces</b>																		
<i>Gasterosteus aculeatus</i>		1															1	0.06
<b>Insecta</b>																		
<b>Coleoptera</b>																		
Dytiscidae	2		2	2													3	0.38
<i>Dytiscus marginalis</i>						1											1	0.06
Gyrinidae larva					1												1	0.06
larva		1					2		2			2		1			5	0.50
<b>Diptera larva</b>				1							2						2	0.19
<b>Hydrocorisae</b>																		
<i>Nepa cinerea</i>							1										1	0.06
<i>Notonecta spec.</i>									1		1						2	0.13
<b>Megaloptera larva</b>																		
<i>Sialis spec.</i>				3													1	0.19
<b>Odonata larva</b>																		
Anisoptera	2				1		2										3	0.31
Zygoptera	4								1								2	0.31
<b>Trichoptera larva</b>	3		1	1	16	17			5	2	11	6	9	15		2	12	5.50
<b>Crustacea</b>																		
<b>Amphipoda</b>																		
<i>Gammarus spec.</i>	13	71	6	11	71	45	25	3	28	17	9	6	2	8		3	15	19.88
<b>Asellidae</b>																		
<i>Asellus aquaticus</i>			6				9	2	2		14	40	1		9	5	9	5.50
<b>Annelida</b>																		
<b>Hirundinea</b>	2	2	4	1			6	11				5					7	1.94
<b>Oligochaeta</b>																		
<i>Tubifex spec.</i>							1										1	0.06
<b>Mollusca</b>																		
<b>Gastropoda</b>																		
<i>Acroloxus lacustris</i>						1											1	0.06

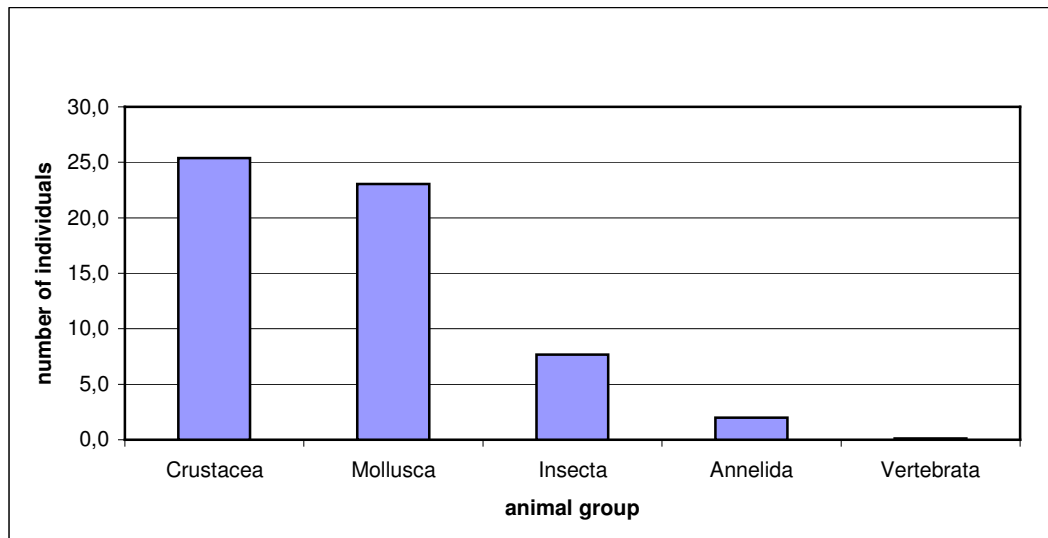
	12 May 2006								5 June 2006								frequency	mean
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8		
Lymnaeidae	7		30	16			4	2	2	8		23	3		2	1	11	6.13
Planorbidae	11	3	8	2		1	9	4	17	22	6	27	2		16	6	14	8.38
Sphaerriidae				2													1	0.13
Viviparidae			5	7	10	1	21	8	8	1	17	22	5	1	18	10	14	8.50
<b>sum</b>	<b>44</b>	<b>78</b>	<b>62</b>	<b>46</b>	<b>99</b>	<b>67</b>	<b>79</b>	<b>31</b>	<b>66</b>	<b>50</b>	<b>60</b>	<b>131</b>	<b>22</b>	<b>25</b>	<b>45</b>	<b>27</b>		<b>58.3</b>

**Table 3:** Sampling of species: number of individuals per sample in the plankton net;  
Frequency: number of samples in which in certain species occurred; mean:  
mean number of individuals per sample

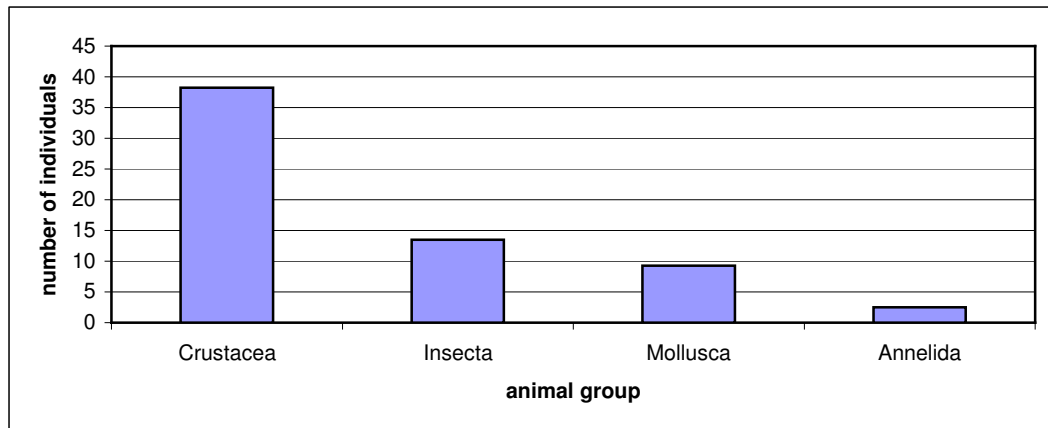
Plankton net	12 May 2006				5 June 2006				frequency	mean
	1	2	3	4	1	2	3	4		
<b>Insecta</b>										
Coleoptera										
Dytiscidae		1			1				2	0.25
larva		1		1	1		1	1	5	0.63
Diptera						1		1	2	0.25
Ephemeroptera		3	7	2					3	1.50
Gerridae		5							1	0.63
Hydrocorisae										
<i>Notonecta spec.</i>					6	1	1		3	1.00
Nematocera larva	1								1	0.13
Trichoptera larva	1	4	7	1		5		1	6	2.38
<b>Crustacea</b>										
Amphipoda										
<i>Gammarus spec.</i>	2	9	66	7	2	9	35	2	8	16.50
Asellidae										
<i>Asellus aquaticus</i>	2	1		9		6		3	5	2.63
<b>Annelida</b>										
Hirundinea	2	1	1		1	1			5	0.75
Oligochaeta										
<i>Tubifex spec.</i>				1			3		2	0.50
<b>Mollusca</b>										
Gastropoda										
Lymnaeidae				1	1		1		3	0.38
Planorbidae	2			7	5	4			4	2.25
Sphaerriidae										

Plankton net	12 May 2006				5 June 2006				frequency	mean
	1	2	3	4	1	2	3	4		
Viviparidae		5	1	2		4		4	5	2.00
<b>sum</b>	<b>10</b>	<b>30</b>	<b>82</b>	<b>31</b>	<b>17</b>	<b>31</b>	<b>41</b>	<b>12</b>		31.75

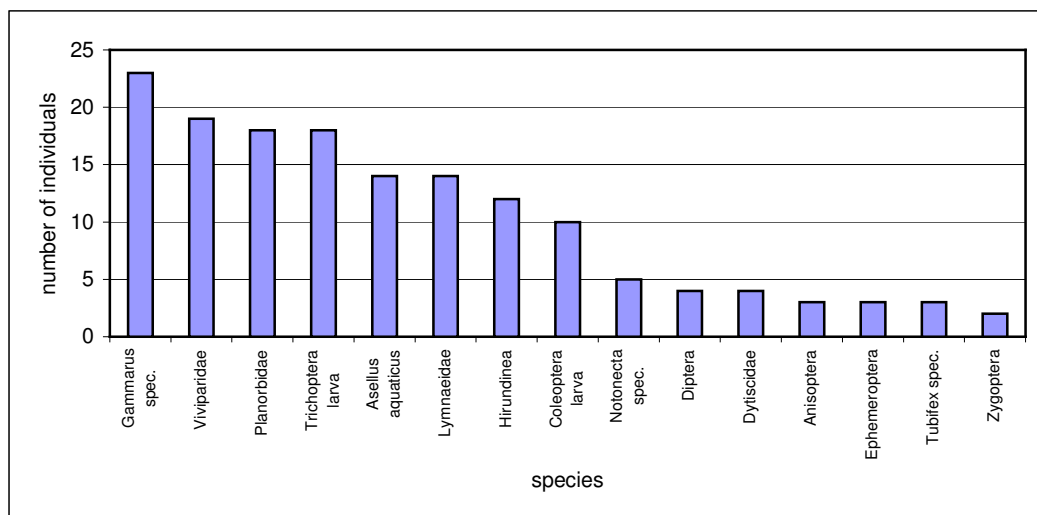
Figures 5 and 6 depict the mean number of individuals per animal group. Crustacea and Mollusca are richest in samples with the coarse aquatic net. In the plankton net samples Crustacea and Insecta were most numerous. Crustacea and Mollusca not only had the highest numbers of individuals but also occurred most frequently within the samples (see Fig. 7).



**Figure 5:** Mean number of individuals per sample in the coarse aquatic net (n=16)



**Figure 6:** mean number of individuals per sample in the plankton net (n=8)



**Figure 7:** Frequency of occurrence of species / groups in the both samples groups (coarse aquatic net, plankton net) (n=24), only species / groups occurring in more than two samples are presented

## 7.6. Predators

Predators play an essential role in the reproduction success of *Emys orbicularis*. Especially wild boar (*Sus scrofa*), fox (*Vulpes vulpes*), badger (*Meles meles*), raccoon (*Procyon lotor*), mink (*Mustela vison*) and raccoon dog (*Nyctereutes procyonoides*) have been observed to pray on nests (SCHNEEWEIß *et. al.* 1998; FRITZ, 2003) and therefore reduce reproduction success. Juveniles have been observed to be prayed on by ravens (Corvidae) (central France) (ROLLINAT, 1934 in FRITZ, 2003),

grey heron (*Ardea cinerea*) (Baden – Württemberg) and gulls (*Larus ridibundus*) (Brandenburg) (FRITZ, 2003). Furthermore it might be possible that juveniles are also preyed on by pike (*Esox lucius*) and catfish (*Silurus glanis*) (FRITZ & GÜNTHER, 1996). The fish otter (*Lutra lutra*) is specialized on hunting turtles, especially during hibernation.

Potential predators, especially on the nests, occur in the Löcknitz river valley in a high abundance.

Wild boar, fox and badger belong to the indigenous fauna which have always been in the region.

According to the hunting statistics of the State of Brandenburg (MLUV, 2004), the stock of foxes has been increasing since the early 1990s due to immunisation against rabies.

Accordingly, the stock of wild boar has increased since the middle of 1990s as a result of focussing on male individuals during hunting.

The stock of wild boar in the Löcknitz River Valley has been constantly high according to B. ZIEBARTH and G. WEICHERT (personal communication). During terrestrial inspections several wallows and some specimens of wild boar and fox could be observed near the waterfront.

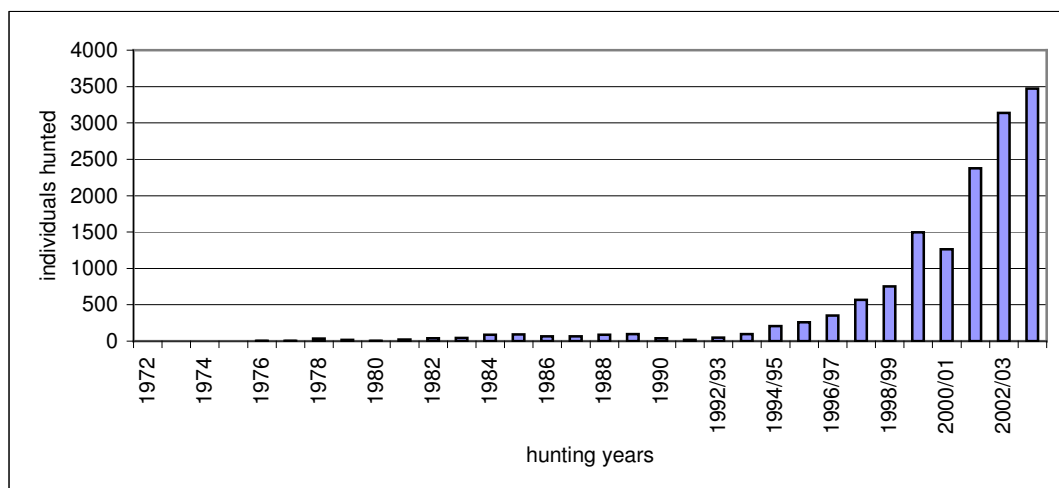
Mink, racoon and raccoon dog are alien species which emerged in the study area in the 1980s (ZIEBARTH *et al.* 1988)

The raccoon dog prefers forest areas connected with swampy sites: reed-covered shorelines of lakes and rivers. It therefore has a similar habitat to the European pond turtle. The present concentration of its distribution in Germany is situated in Mecklenburg and Brandenburg. Water is a very important habitat for the raccoon,

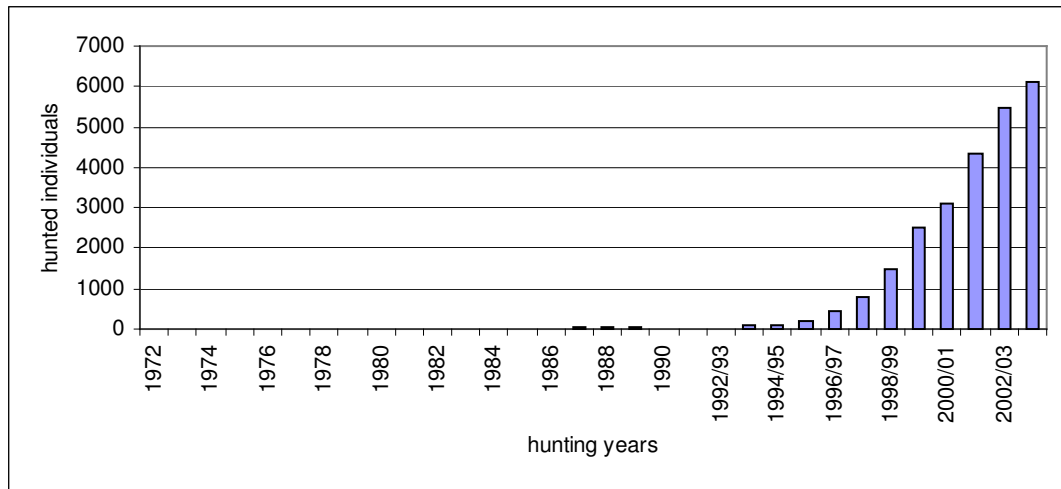
too, which is bound to the shoreline zone for feeding. Even if the hunting results for the states differ, the highest numbers occur in Mecklenburg and Brandenburg. The mink lives in semi-aquatic conditions, too. In 2001/02 the highest hunting rates occurred in the districts of Dahme – Spreewald, Oder – Spree and Märkisch Oderland. (AHRENS *et al.* 2003)

The hunting statistics of Brandenburg (MLUV, 2004) and a personal communication by the district forester (B. ZIEBARTH & G. WEICHERT) verify an increasing stock of raccoon, mink and raccoon dog (see Figures 8 – 10). A further expansion of the distribution area and compression of population can be expected with all three alien species.

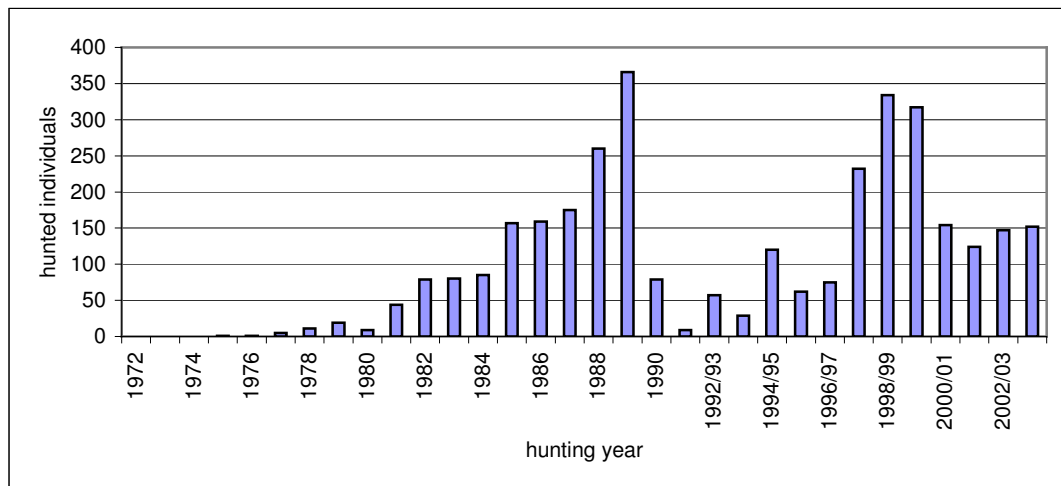
In summary, it can be said that the Löcknitz River Valley offers perfect habitat structures for predator species. Therefore, a high predator pressure on eggs and juvenile turtles must be expected.



**Figure 8:** Hunting statistics for raccoon in the State of Brandenburg  
MLUV (2004) modified



**Figure 9:** Hunting statistics for the raccoon dog in the State of Brandenburg MLUV (2004) modified



**Figure 10:** Hunting statistics for mink in the State of Brandenburg MLUV (2004) modified

## 8. Discussion

The present study evaluated the habitat suitability of the nature reserve and the FFH area Löcknitztal for the European pond turtle. Based on a literature review and the results of the field work, arguments for and against a reintroduction of *Emys orbicularis* to the study area shall be discussed.

### 8.7. Reasons for extinction

Before reintroducing a species to the wild, the reasons for extinction of the species within the area need to be determined. The historical evaluation provided evidence that the landscape within the valley changed a lot during the past 80 years. Better conditions for *Emys orbicularis* must originally have been present. Nevertheless, the present study pointed out that some sections of the stream (only in the northeastern part) still possess suitable habitat structures.

The Löcknitz stream has been utilised for fishing since the 13th century. The high relevance of fishing for the decline of *Emys orbicularis* is referred to in numerous papers (DÜRIGEN, 1897; SCHNEEWEIß, 1995, 1996, 1997, 2002; SCHNEEWEIß & FRITZ, 2000). Furthermore, the supplementary catch of turtles within the Löcknitz is confirmed as well (FRIEDRICH, 1910). Therefore it could be assumed that the negative impact of fishing and collecting animals for trade were the main reasons for the dramatic decline of the species within the study area.

The population of raccoon and raccoon dog as main predators of the turtle only increased at the end of the 20th century. Even the fox occurred only in low numbers up to the 1980s. Therefore, predator pressure may be negligible for the extinction of the turtle.

The removal of water plants and mud in the Lößnitz up to the reunification of Germany might have contributed to the decline of *Emys orbicularis* in the Lößnitz River Valley as well. FRANCK (1988) describes that turtles have been disturbed during hibernation when removing mud from their home water bodies in the Brenne / France.

Another aspect is the intensive forestry around the conservation area. A comparison with historical maps and the aerial photographs proves the extensive reforestation around the Lößnitz River Valley, which might have resulted in the destruction of suitable nesting sites for *Emys orbicularis*.

The absence of utilisation of the meadows along the stream resulted in succession to alder swamp forest in many parts of the study area, reducing sun - exposure on the shoreline vegetation.

In summary, different factors like fishing, persecution for trade and the declining habitat quality in some sections together contributed to the extinction of *Emys orbicularis* in the Lößnitz River Valley.

## **8.8. Abiotic habitat factors**

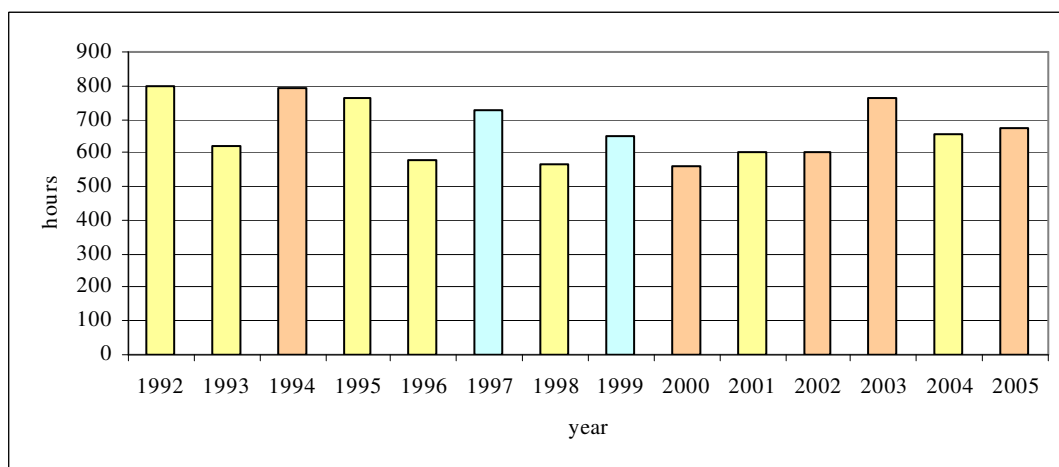
### **8.8.1. Climatic conditions**

The reproduction mechanism of the species is very sensitive to climatic conditions along its northern distribution border.

SCHNEEWEIB (2004) pointed out that hatching success depends on sufficiently warm soil temperature during incubation, which is positively correlated to sunshine hours. He determined a total number of summer sunshine hours (1 June – 31 August) of more than 675 h and a temperature sum of more than 310 md (the temperature sum

as a non – linear function is expressed in maturity degrees) as favourable conditions for embryonic development.

The long-term (1961 – 1990) monthly average (1<sup>st</sup> June – 31<sup>st</sup> August) of sunshine hours measured at the observatory in Lindenberg by the German Weather Service amounted to 674.2 h. This value lies just below the lower limit for a favourable number of sunshine hours. Figure 11 points out that only few years offer insufficient amount of sunshine during the crucial time of embryonic development. The dominance of moderate to medium amount of sunshine hours indicates the distribution border of *Emys orbicularis*. The species is a very long-living animal – FRITZ & GÜNTHER (1996) mention 120 years and more. Therefore years with low or no reproduction success can be compensated.



**Figure 11:** Sum of sunshine for summer months (1 June – 31 August) ■ > 675 h - favourable; ■ 580-675 h - moderate to medium; ■ < 580 – insufficient (SCHNEEWEIB, 2004) data source: German Weather Service, Lindenberg Observatory [www.dwd.de](http://www.dwd.de)

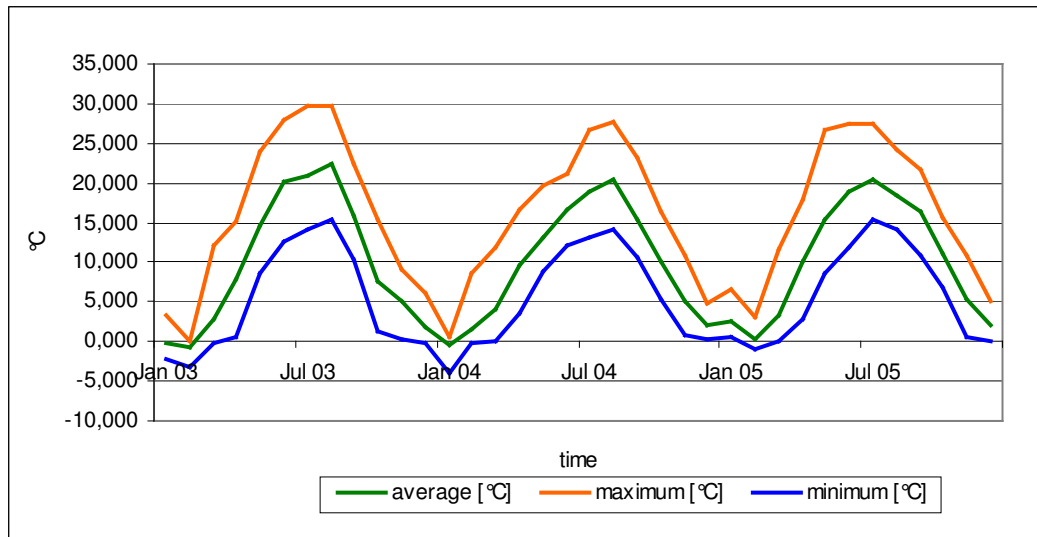
Special attention is to be paid to soil temperatures in the crucial time between 1st June and 31st August. To get an overview about soil temperature in the Oder-Spree district, data measured at the measuring field near Lindenberg (approximately 35 km southeast of the study area) have been used for comparison (Figure 12).

Average temperatures in the Löcknitz River Valley can be expected to be similar or even higher than the ones measured near Lindenberg. The measuring field is a more than 1 km long open space which is exposed to wind. The majority of potential nesting sites in the study area are only small patches surrounded by pine trees, reducing wind speed. Furthermore, vegetation cover is partly very low, allowing the sandy soil to warm up more easily, especially if the sites slope towards the south like at sites 6 and 9 in the present study.

SCHNEEWEIß (2004) refers to MOLL & LEGLER (1971), PIEAU & DORIZZI (1981) and VASSE (1983) according to whom successful embryonic development takes place between 18 and 33°C. Maximum and average temperatures measured in Lindenberg (2003 – 2005), excluding one exception (average, June 2004), always exceed 18°C. Since the average soil temperature in 10 cm depth (approximate depth of *Emys orbicularis* nests) can be expected to exceed 18°C during summer months, it can be assumed that successful embryonic development should be possible in the Löcknitz River Valley.

Between 2003 and 2005 temperatures during winter were never lower than the critical value of  $< -6$  °C (SCHNEEWEIß & JABLONSKY, 1999; SCHNEEWEIß, 2004). Therefore, a survival of juveniles in the nest can be expected.

Assuming that climatic conditions on the measuring field near Lindenberg are comparable to conditions in the study area, it can be concluded that – from a climatic point of view – the northeastern part of the nature reserve “Löcknitztal” offers suitable conditions for the long-term survival of *Emys orbicularis*.



**Figure 12:** Soil temperatures in 10 cm depth 2003 – 2005, data measured on measuring field in Lindenberg (1 km open field without any obstacles, vegetation height on average 20 cm), data were provided by German Weather Service, Lindenberg Observatory

### 8.8.2. Hydrological development of the study area

Today, within the conservation area the Löcknitz is a natural stream without any human influence, such as shaping of the shoreline or removal of aquatic plants. Especially since the end of the 1980s, macrophytic water plants have no longer been removed. The utilisation of the Löcknitz for water sports is prohibited within its conservation boundaries. Where sun is sufficient, dense aquatic vegetation has developed, and dead logs falling into the water remain there, increasing position diversity. The high abundance of aquatic macrophytes and dead logs within the stream contribute to decreasing percolation and increasing water retention, resulting in an increasing water level over the long term. Due to higher water levels, the stream is moving into shoreline vegetation and developing small potholes and temporary water bodies. This development can clearly be observed in the northern parts of the study area where water often moves between adjacent reeds, creating a

blurred shoreline. The same situation occurs in the swamp forest, which contains small standing water bodies.

Some sections of the Löcknitz show features of terrestrialisation. Along large parts of the waterfront quaking bogs can be found. BICK (1999) describes the occurrence of quaking bogs as a special form of terrestrialisation where a lawn-like layer of different plants pushes into the water body. Due to the flowing of the stream, a complete terrestrialisation of the Löcknitz can be excluded.

The blurred shoreline with the shallow water zones and the muddy underground provide suitable habitat structures for *Emys orbicularis*. Due to the conservation status, a change in shoreline structure is not to be expected as long as continuous water supply is ensured.

An investigation (FREDRICH & WOLTER, 1996) on fishes occurring between Kienbaum and Fangschleuse determined six species preferring lentic zones, confirming that the Löcknitz is not characterised by flowing stream features on the whole observed stretch. Especially broader parts of the river bed develop lake-like characteristics during low percolation. These parts also function as preferred living territories for *Emys orbicularis*.

## **8.9. Predators**

The evaluation of the hunting statistics and the interviews with the responsible forester determined increasing numbers of potential predators like wild boar, marten, raccoon dog and raccoon in the study area. The high predator pressure is a threat for *Emys orbicularis* and could have a negative impact on the success of a reintroduction project. Preying on nests and attacks on adult specimens have been observed on

monitored populations (PAUL, 1997; ANDREAS, 1999; SCHNEEWEIß, 2003). SCHNEEWEIß (2003), indicating that losses of adults due to predation are low compared to losses of clutches.

To a certain extent, clutches can be secured against predators with measures like fencing of nesting sites or destroying of scent.

Furthermore, the conservation area offers good habitat conditions for the predators. Not only the raccoon and raccoon dog rely on aquatic structures, but all mentioned predators benefit from the undisturbed character of the northeastern part of the study area too. They find room for retention in the dense and inaccessible shoreline area certainly supporting the size of predator populations. The dense swamp forest offers unfavourable conditions for hunting, making it more difficult to manage and control predator populations.

Until now, some relict populations of *Emys orbicularis* have survived despite rising predator pressure in the State of Brandenburg, but the long-term influence of this development cannot be foreseen as yet. Therefore great care is required in a decision in favour of reintroduction despite the high predator pressure.

## **8.10. Food resources**

*Emys orbicularis* is a food opportunist focussing on a carnivore diet. Therefore different kinds of prey species will do when available, as long as they have the right body size. FRITZ (2003) summarises a number of studies on the *Emys orbicularis* diet, determining that prey preference differs slightly in various areas of distribution. Even if there are no surveys from eastern Germany, *Emys orbicularis* in general preys on aquatic insects and their larvae, Mollusca, Amphibia and their spawn and

small fish. The diverse and abundant occurrence of these groups could be ascertained in several shallow water areas in the northeastern part of the study area.

According to F. FREDRICH (personal communication), who recently conducted a fish survey in the Löcknitz, the stream is rich in fish. Limnophilous or rheophilous species occur, depending on the habitat features. Limnophilous species can especially be found between Kienbaum and Klein Wall, indicating the lake-like character of some sections. Where mud is deep and macrophytes abundant, fish density is lower than in other parts of the stream due to the occasional occurrence of critical values of oxygen. These locations offer good habitat conditions for juveniles.

### **8.11. Exotic specimens**

Several observations of turtles are known in the Oder-Spree district. Sightings have been reported to the Lower Nature Conservation Office (Beeskow). The most recent ones are listed as follows: Spree at the Spree bridge in Fürstenwalde (2006); Spree in Berlin (2006); Kiessee near Spreeau (2006); several supplementary catches in Maxsee (2004 – 2006); Spree near Mönchwinkel (2004) (L. ITTERMANN, oral notification). In some cases the turtles could be identified as *Graptemys* and *Trachemys* species. Only the sighting near Mönchwinkel might be an *Emys orbicularis*. Nevertheless, due to missing genetic determination it is unclear whether the observed specimen represents a native individual.

Furthermore, regularly turtle sightings are known from the Werlsee (SCHNEEWEIB, oral notification) which is not only linked to the Löcknitz River but is also located less than 2 km from the nature reserve. Exotic specimens which might be released into the lake could easily migrate into the conservation area. Even if *Graptemys* or

*Trachemys* cannot interbreed with *Emys orbicularis*, they can still endanger the survival of an introduced population through food competition and the introduction of diseases.

According to SCHNEEWEIB (2003), native turtles at the northeastern distribution margin are bigger in body size, have a longer life and a higher number of eggs in their clutches than specimens of other parts of the large distribution area. The author assumes that these features are an adaptation to the harsher climatic conditions at the northeastern distribution margin.

Therefore, the existence of exotic species, like *Graptemys* or *Trachemys* or *Emys orbicularis* specimens originating from other parts of the huge distribution area, could endanger the survival of a relict population as well as the development of a reintroduced population. The crossing of allochthonous and autochthonous turtles might result in the loss of adaptation to harsher climatic conditions (SCHNEEWEIB, 1997), endangering successful reproduction.

Therefore special attention needs to be paid to the occurrence and distribution of allochthonous specimens within the area of reintroduction.

## **8.12. Aquatic habitats**

A standing or very slow flowing water body with a rich aquatic flora and a muddy underground, as is mentioned by FRITZ (2003) as a preferred habitat for *Emys orbicularis* in Germany, could be proven on almost the whole length of the study area. PAUL (1997) refers to broad terrestrialisation zones, extensive shallow water areas and floating leaf zones with dense submerged vegetation which could be determined in the northeastern part of the Lößnitz River Valley.

Nevertheless, due to the lack of utilisation of the meadows, the habitat structures lost quality for the European pond turtle in the past 80 years. They are likely to decrease even more if care measures are missing. The maintenance of wet meadows along the shoreline and the prevention of further succession to alder swamp forest are crucial for the maintenance of suitable structure for *Emys orbicularis*.

The release of turtles into the wild requires habitat quality and quantity. The present study determined the occurrence of sufficient habitat quality in the northeastern parts of the study area. Furthermore, habitat quantity needs to be discussed.

The Löcknitz flows through a narrow valley. The stream and its adjacent reed belt have an average width of approximately 30 m. Based on the observations about home range by PAUL & ANDREAS (1998) and SCHNEEWEIB (2003), it can be assumed that *Emys orbicularis* individuals will require a stream stretch of 25 – 160 m as home range. According to observations that PAUL (2003) made on a well established population living in percolation lakes of a stream valley, it can be assumed that a whole population in the Löcknitz River Valley might require 1850 – 2114 m stream length.

The determined 3.4 km suitable stream section could be sufficient for a turtle population. The suitable stream part does not occur as a whole piece. But the single parts of suitable stream sections are connected by sections of moderate and connection quality. The turtles would be able to move within the stream on approximately 5 km, choosing their preferred habitat without having to cross an unsuitable section.

### **8.13. Terrestrial habitat**

The study area is located in a deposited landscape created by the ice age. A landscape relief like terminal moraine or hilly ground moraine is referred to by SCHNEEWEIß & MÜLLER (2001) and FRITZ (2003) as the typical landscape surrounding home water bodies of *Emys orbicularis*. Furthermore, all assessed potential nesting sites offer conditions which have been proven suitable on monitored existing populations (PAUL, 1997; SCHNEEWEIß *et al.* 1998; JABLONSKI & JABLONSKA, 1998; ANDREAS, 1999; MEESKE *et al.* 2002; SCHNEEWEIß, 2003). Especially in the northeastern part of the study area, a dense occurrence of suitable nesting sites close to the stream argues for a reintroduction attempt. Sites 4, 6 and 9 are worthy of special mention because they are not only adjacent to the reed belt along the Löcknitz but also slope southward, intensifying the sun`s radiation and thereby creating very good conditions for incubation. However, as with the aquatic habitats, a successful reintroduction is unconditionally linked to consistent, long-term management of the nesting sites.

### **8.14. Spatial distribution of suitable aquatic and terrestrial habitats**

Even if the survey determined that large parts of the study area do not provide suitable conditions for *Emys orbicularis*, the area still offers interesting structures. Unsuitable sections are concentrated in the southwestern part of the study area while suitable sections are predominantly found in the northeastern part.

Due to the conservation policy, the southern part, which is inappropriate for a reintroduction attempt, has been developed for tourist purposes. A walking trail

leading from Große Wallbrücke up to Klein Wall is used by tourists with high frequency. In part, the trail leads close along the stream. The northern part of the conservation area between Klein Wall and Kienbaum was estimated higher in value by the IG –Löcknitztal, who were very involved in the development of the conservation area. Therefore, tourist infrastructure was kept as small as possible and no trails were created close to the stream to conserve undisturbed natural habitats. Especially the northern part of this section comprises suitable structures for *Emys orbicularis*.

Here sections 1, 3 and 6 were evaluated as suitable. They are separated by one moderate element and two connection segments. Therefore, turtles could easily roam around along an approximately 5 km long stream section. Furthermore, potential nesting sites are concentrated in the northeastern part, too. The investigation proved that 5 out of 11 potential nesting sites are situated within 250 m of suitable stream sections. The fact that sites 6, 10 and 11 occur at a distance of 250 – 500 m from suitable sections does not reduce their suitability. It is confirmed (PAUL & ANDREAS, 1998; SCHNEEWEIß & STEINHAEUER, 1998; ANDREAS, 1999; FRITZ, 2003; SCHNEEWEIß, 2003) that turtles migrate up to 900 m from their home waters. In the present case, turtles could migrate along the stream, leaving the water only in section 4 (moderate), reducing migration over land to less than 250 m. In fact, turtles have been monitored to follow the water stream as far as possible on their migration to nesting sites (SCHNEEWEIß, *et al.* 1998). Migration through reed belts and on paths through pine plantations have been observed, too (PAUL, 1997).

In wild populations juvenile turtles might have an imprinting of nesting site when they hatch from their egg. If this would be true juvenile turtles released into the wild

could miss their imprinting to nesting sites and migrating corridors. This would mean that released specimens would have to find suitable nesting sites on their own. Therefore, the close association of aquatic and terrestrial habitat is especially crucial in reintroduced populations. In the present study, nesting sites 1, 2, 3, 4, 6, 7, 9 and 11 are located within 250 m from the stream, contributing to the suitability of the study area for a reintroduction attempt. Furthermore, sites 1, 2, 4, 6, 7, 9 are just as close, as turtles merely have to cross a reed belt (see Map 1). Site 11 can also be easily accessed by migrating through an alder swamp forest.

### **8.15. Recommendations**

Reintroduction projects require a very high effort, causing extensive preparation work and prior investigations. The urgent need for habitat management and consequent monitoring to evaluate the success of the measures is also referred to by ASSMANN & BOLENDER (1981) and LACOSTE *et al.* (1999), who discuss the reintroduction of *Emys orbicularis* to its former range in Germany and France. A reintroduction project within the Löcknitz area can only be started after ensuring provision of required financial and personnel resources. Monitoring in the present case would be connected with an extremely high effort. Juvenile turtles released at the age of two years are too small to be radio tracked. For their monitoring only the very time consuming mark-recapture method can be applied, meaning that traps need to be placed in the rough area. The traps will have to be checked every day. Furthermore, there is no certainty that all animals will be recaptured, even if they are still in the area. Therefore, it will be very difficult to make reliable statements about the development of the released population.

Only older animals can be radio - tracked at a later stage of the reintroduction project. The radio - tracking of subadult and adult specimens is important for the determination of nesting sites. Knowledge about nesting sites is crucial to arrange care measures (pasture or mowing, removal of juvenile trees) for the maintenance of the nesting sites or safekeeping (fences, destroying the smell with a drop of eau de Cologne (ANDREAS, 1999; SCHNEEWEIß, 1998) of clutches if necessary. Furthermore, the monitoring of reproduction success is essential for the evaluation of the success of the reintroduction project.

However, since *Emys orbicularis* reaches maturity only late, first reproduction will only be observable after 12 – 15 years. This means that failure of the project might already be apparent during the first 10 years, but first very careful statements about the success of the reintroduction can only be expected after 15 – 20 years.

Even if the present study mapped potential nesting sites, it is not given that released species are going to choose them for deposition. However, since the potential nesting sites in the research area are located very close to the stream, it is likely that the released species specimens are going to find them.

Turtles belonging to natural populations in the wild have been observed to stick with their chosen nesting sites for a long time (SCHNEEWEIß & STEINHAEUER, 1998; JABLONSKI & JABLONSKA, 1998; MEESKE *et al.*, 2002; SCHNEEWEIß, 2003) reducing efforts needed for maintenance measures on nesting sites.

Furthermore, a maintenance and development plan is needed for the study area or at least for the sections involved in the reintroduction.

The IG – Löcknitztal and the sheep company Kölpin – Fritsche should be involved in the maintenance and development plan. To achieve best results in the conservation

work, it is especially important to use the sheep herd in a way which conforms to conservation principles. This means stopping damage to wet meadows and nutrient input to poor locations. Under- or overgrazing is to be strictly avoided. The pasturing of the oil and electricity line, which is also suggested by ZIEBARTH (2001), could contribute to the maintenance of valuable biotopes and nesting sites for *Emys orbicularis*.

Furthermore, attention needs to be paid to the provision of regularly mowing of wet meadows and possibilities to deposit the litter outside of the conservation area.

Despite the high effort, considerations concerning clearings should be made. Small-scale clearings on locations along the valley slope on the northern shoreline which are poor anyway could increase the availability of nesting sites. This would be especially important along stream section 6, since potential nesting sites are missing there. Small-scale clearing of swamp forest along the southern shoreline would increase the sun supply for basking and decrease retreat possibilities for predators. As a side effect, these clearings would also contribute to the patchiness of the conservation area, increasing its biodiversity.

Finally, these clearings will demand care measures to prevent future succession.

Due to the high effort of the reintroduction, maximum success should be aimed for. In view of this background, a new designation of the nature reserve with an updated conservation ordinance should be taken into consideration to create optimal conditions for a reintroduction. It would provide the opportunity to legalise care guidelines by integrating them into the conservation ordinance. Furthermore, the unclear situation regarding fishing activities within the conservation area could consistently be tackled.

According to the present conservation ordinance, the distribution of fishing cards is to be kept at a minimum. The Löcknitz has been leased to the company “Löcknitzforelle”. During the field work one wild fishing place and three weir basket traps were found. Wild fishing is prohibited in the conservation area and the weir basket traps did not function according to conservation requirements. Therefore, the fishing activities within the Löcknitz need urgent supervision by the environmental office in Beeskow. Fishing activities in the Löcknitz, especially the use of weir basket traps, is absolutely not compatible with the reintroduction of *Emys orbicularis* to the area. For that reason, it is suggested to strive for the cessation of fishing activities within the whole conservation area.

### **8.16. Suggestions for the release of animals**

Due to the high natural appearance of the Löcknitz River within the study area and the blurry waterfront, large parts of the shoreline are very swampy. That is why the waterfront can only be reached comfortably at a few places. This is a great advantage for a reintroduction project since turtles are unlikely to be disturbed by people approaching the waterfront. This is especially important for the energy balance of the turtles. A high disturbance results in frequent fleeing into the water and less time for basking.

However, the choice of a release point requires some careful consideration. The results of the investigation showed that the northeastern part offers suitable structures for a reintroduction. Here two points (see Map 5) can be suggested for a release of animals. Both locations have advantages and disadvantages which shall be discussed in the following.

### **8.16.1. Release Point 1**

As a first option to release specimens of *Emys orbicularis*, the *Polygonum bistorta* meadow near Kienbaum can be suggested (see Map 5).

#### Advantages

This part of the Löcknitz offers optimal habitat conditions for adults and juveniles, providing a richly structured shoreline, muddy shallow water zones between extensive reed vegetation and suitable nesting sites close by.

The specimen could roam along the stream to the east and west and still find suitable conditions. After a stream segment of approximately 250 m going east, the specimen could reach nesting sites 1 and 9 after migrating 100 m over land. In western direction they could leave the stream after 250 m to arrive at nesting site 2 after 100 m or site 4 after 70 m of migration over land.

The *Polygonum bistorta* meadow is in strong focus of IG – Löcknitztal, which is monitoring the development of *Dactylorhiza majalis* population and preventing succession through regular mowing and removal of juvenile alders. Furthermore, the close-by, southern shoreline under the electricity line is kept open by the IG – Löcknitztal due to the occurrence of *Dactylorhiza* species and *Alchemilla vulgaris*. Therefore, sufficient sun supply for basking will be secured.

The potential nesting sites 4 and 9, which are located on the northern shore, slope slightly towards the south, increasing sun radiation. In combination with short-growing vegetation, the sand will obtain high temperatures, offering optimal conditions for embryonic development. Furthermore, both sites are not directly located along a path. Therefore, low disturbance due to local people walking can be assumed.

### Disadvantages

Even if tourist infrastructure is concentrated in the south of the study area, local people from Kienbaum use the valley for walks – especially along the first kilometre. During field work on only one day in June, 6 people could be observed using paths leading along potential nesting sites (1, 2, 3) for walking their dogs. Specimens would be observable during egg deposition. Too much public knowledge about the occurrence of the turtle could have a negative impact on the population.

Due to the swampy shoreline, no path leads along the waterfront; therefore disturbance of the turtles in the stream can be estimated as low. Nevertheless, prohibited fishing might occur near the village. During field work on the 2nd of June, a wild fishing place was discovered in the swamp forest near the *Polygonum bistorta* meadow.

### Urgent requirements

Care measures must be kept up on the wetlands along the southern shore line to maintain sufficient sun supply. Without any care measures, the potential nesting sites are under threat of encroachment. Therefore monitoring is necessary to determine the need of removal of juvenile *Pinus sylvestris*. Special attention is required on site 9 where some juvenile *Robinia pseudacacia* occur. Their removal and prevention of reestablishment is crucial to prevent soil nitrification accompanied by a changing vegetation community and decreasing quality as a nesting site for *Emys orbicularis*.

### **8.16.2. Release Point 2**

The second suggestion for a release point would be within stream section 3 which starts approximately 2.4 km downstream from Kienbaum.

### Advantages

Due to the increased distance to the village combined with the inaccessibility of the landscape, disturbance by humans will be extremely low. In this part of the study area the specimens are not likely to be discovered at all. Furthermore, an optimal nesting site (6) is situated close by. The turtles will have to migrate 250 m in the stream, leaving the water in section 4. They will have to travel 140 m through reeds and over land to reach nesting site 6. Due to the occurrence of low-growing plant species and southern exposition, the site offers optimal conditions for incubation. Additionally, the area is owned by members of IG – Löcknitztal, who will be cooperative in measures which might be necessary for the protection of clutches.

### Disadvantage

The suitable section only has a length of approximately 330 m. Therefore, this part of the stream provides fewer suitable structures for juveniles.

However, juveniles could be released in the suitable section. When they grow older they might start larger excursions in search for other preferred habitats.

The specimen would have to bridge 500 m to reach the next suitable section in the north. PAUL (1997) observed during her studies that some adult individuals have a large action radius, moving up to 450 m in their home water bodies a day.

Furthermore, especially the southern shoreline is accompanied with swamp forest on a large extent of the section. Therefore, sun supply might be less than in Release Option 1. There are no areas where IG – Löcknitztal conducts care measures. Therefore, further succession must be expected.

### Urgent requirements

For the maintenance of the nesting site, further reforestation south of Kagel needs to be avoided. Additionally, further development of alder swamp forest along the southern shoreline should be prevented to secure sufficient sun supply for basking. Possibilities should be considered if some section along the southern shoreline could be opened up.

In summary, it can be suggested to release animals at both points. The animals have their own will and will choose their preferred aquatic habitat and most suitable nesting site.

## **8.17. Summary of arguments for and against a reintroduction of *Emys orbicularis* to the Löcknitz River Valley**

In summary, arguments for and against a reintroduction of *Emys orbicularis* are listed in the following.

### **8.17.1. Arguments for a reintroduction attempt**

- *Emys orbicularis* is in danger of extinction in Germany (BEUTLER *et al.* 1998). Therefore conservation measures are required. The reintroduction of a species to an area of former natural distribution is legally seen as a measure for species protection (BnatschG art. 39).
- A species protection programme “Europäische Sumpfschildkröte” already exists, and a reintroduction would supplement it. Furthermore, the programme creates an optimal frame for a reintroduction attempt.

- There is strong background knowledge on the taxonomy, habitat requirements and life history of *Emys orbicularis* in northeastern Brandenburg, providing essential information required for a successful reintroduction.
- Clutches with low survival chances were removed from the wild and incubated artificially within the species protection programme. These animals were then released into their original habitat at the end of their second life year. Therefore, firsthand experience in breeding, keeping and releasing of turtles already exists (SCHNEEWEIB, 2003).
- Although at present there are not enough animals, the current establishment of a breeding group consisting of specimens originating from northeastern Germany could ensure the release of indigenous animals.
- A reintroduction should follow the reintroduction guidelines by IUCN (1998). The basic conditions in the present study are in line with the requirements in this guideline, underlining the feasibility of the project.
- Since the reintroduction of a species to its whole former range is not possible under today's conditions, the BFNL (1982) suggests aiming for the establishment of a network of local populations. These local populations should occur within a maximum distance of 50 – 100 km. This would be given in the present case since *Emys orbicularis* is also supposed to be reintroduced to Märkische Schweiz, which is located 15 – 20 km from the study area.

- According to the observation of local people (see table 1) and historical papers (FRIEDRICHS, 1910) *Emys orbicularis* occurred naturally in the study area. It can be assumed that individuals still occurred 50 – 100 years ago.
- The present study confirmed that a minimum of suitable aquatic and terrestrial habitat still occurs in the Löcknitz River Valley to support a viable population.
- Abiotic conditions of the study area like climate and hydrological development are suitable for the occurrences of *Emys orbicularis*.
- Up to now there is very low human impact in the study area and the high protection status (nature reserve and FFH area) allows the exclusion of increasing human impact in future.
- The new site should offer possibilities for further distribution. The northeastern part of Brandenburg is in general a very water-rich area due to the occurrence of numerous lakes. In the southwestern direction the Löcknitz is linked with the Spree River. In the northeastern direction a connection with the Märkische Schweiz exists through the stream Stöbber flowing through the Rotes Luch. The Märkische Schweiz is another area that is being taken into consideration for a reintroduction attempt by the species conservation project “Europäische Sumpfschildkröte”. This area is especially interesting because the occurrence of *Emys orbicularis* is more recent than in the Löcknitz River Valley.

### **8.17.2. Arguments against a reintroduction**

The high effort of a reintroduction is only justifiable when a high probability of success is given. As could be seen earlier, there are a number of arguments supporting a reintroduction of *Emys orbicularis* to the study area. Nevertheless, there are some points that are likely to endanger the success of a reintroduction of *Emys orbicularis* to the Löcknitz Valley.

- The high predator pressure in the study area is a serious threat for the success of a reintroduction project. The Löcknitz River Valley offers suitable habitat structures for mink, raccoon, raccoon dog and wild boar. They also benefit from the remoteness of the area. Therefore, continued high individual numbers can be expected.
- A reintroduction project in the Löcknitz River Valley requires long-term care measures to maintain and extend suitable habitat structures for *Emys orbicularis*. The success of the project could fail due to lacking perseverance in care measures. Currently, this can be observed in the southern part of the conservation area, where the area along the walking trail close to Klein Wall is stocked with juvenile alders. This area is supposed to be kept open by the community Grünheide, fulfilling the demands in the B – plan (Building plan) “Neue Ortsmitte”. If measures like this cannot be secured over a few years, then it is questionable whether long-term measures required by the reintroduction project will be implemented.
- The reintroduction of *Emys orbicularis* to the Löcknitz River Valley is associated with very high effort. The long reproduction cycle of *Emys*

*orbicularis* and the inaccessibility of the research area are responsible for a difficult and demanding monitoring and success evaluation.

## 9. Conclusion

Finally, it can be concluded that the northeastern part of the nature reserve “Löcknitztal” offers a minimum of suitable habitat structures for a reintroduction of *Emys orbicularis*. However, for a successful reintroduction, the maintenance and extension of these structures over the long term is crucial.

The presence of suitable aquatic habitat in close association with potential nesting sites and the low disturbance of the area are already good reasons for a reintroduction attempt. The decline of *Emys orbicularis* is linked to habitat destruction, among other factors. The impact of humans on nature is not decreasing. Therefore the Löcknitz Valley might be one of only a few still existing suitable habitats for *Emys orbicularis*.

Despite all arguments supporting a reintroduction attempt, there are serious arguments against a reintroduction, too. The demand for consistent long-term habitat management and monitoring requires a high number of personnel and great financial effort. Furthermore, it must be borne in mind that even after a large investment, there is no assurance of success of the project.

Therefore, it first needs to be clearly established if reliable long-term support for a reintroduction project can be secured. Additionally, more detailed surveys should be conducted on critical points like the development of predator numbers within the area and their possible influence on the turtle, or the abundance of fish and the shallow water areas that are crucial as habitats for juvenile turtles.

As a side effect, the reintroduction of *Emys orbicularis* to the Löcknitz River Valley with all its required measures would not only contribute to the conservation of an endangered species but also to the maintenance and increase of the conservation value of the Löcknitztal with its high biodiversity.

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## 10.2. Maps

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# 11. Appendix

## Record Sheet aquatic habitats

date			N		shore site	
section		start	E			
		end	N			
			E			
stream appearance				depth variability	sole substrate	
fast, moderate turbulent				pronounced	gravel < 20 mm	
slow 0.1 – 0.3 m/s				moderate	sand < 2 mm	
lazy 0.03 -0.1 m/s				none	mud	
not recognisably flowing				not recognisable	not recognisable	
utilisation of shoreline vegetation				potential basking sites	accessibility	
woody plants dense				many	good	
woody plants gappy				medium	medium	
wet-straw meadow				few	bad	
reeds				none		
tall perennial herbs, wet						
farmland						
riverine floodplain water bodies				shading of the water	photos	
old arm				0 - 10%		
old water				11 - 25%		
dead arm				26 - 50%		
temporal water body				51 - 75 %		
none				76 - 100%		
				water vegetation		
				submerged		
				swimming		
				emergent		
shoreline vegetation						lentic areas > 10m2
	0 - 20 %	21 - 60%	61 - 100%			with reeds and sedges
tree layer I > 15 m						submerge vegetation
tree layer II 3 - 15 m						floating vegetation
shrub layer 0,5 - 3 m						smaller areas
reeds						
sedges						
water vegetation						
dead wood						
	many	medium	few			
land						
water						

**Record sheet nesting sites**date 

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site number 

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coordinates	north	east	north	east	size	

relevé sheets	
exposition	
inclination	

**Vegetation structure**

cover	
dominant species	
vegetation community	

**Site description**

general appearance


neighbouring vegetation

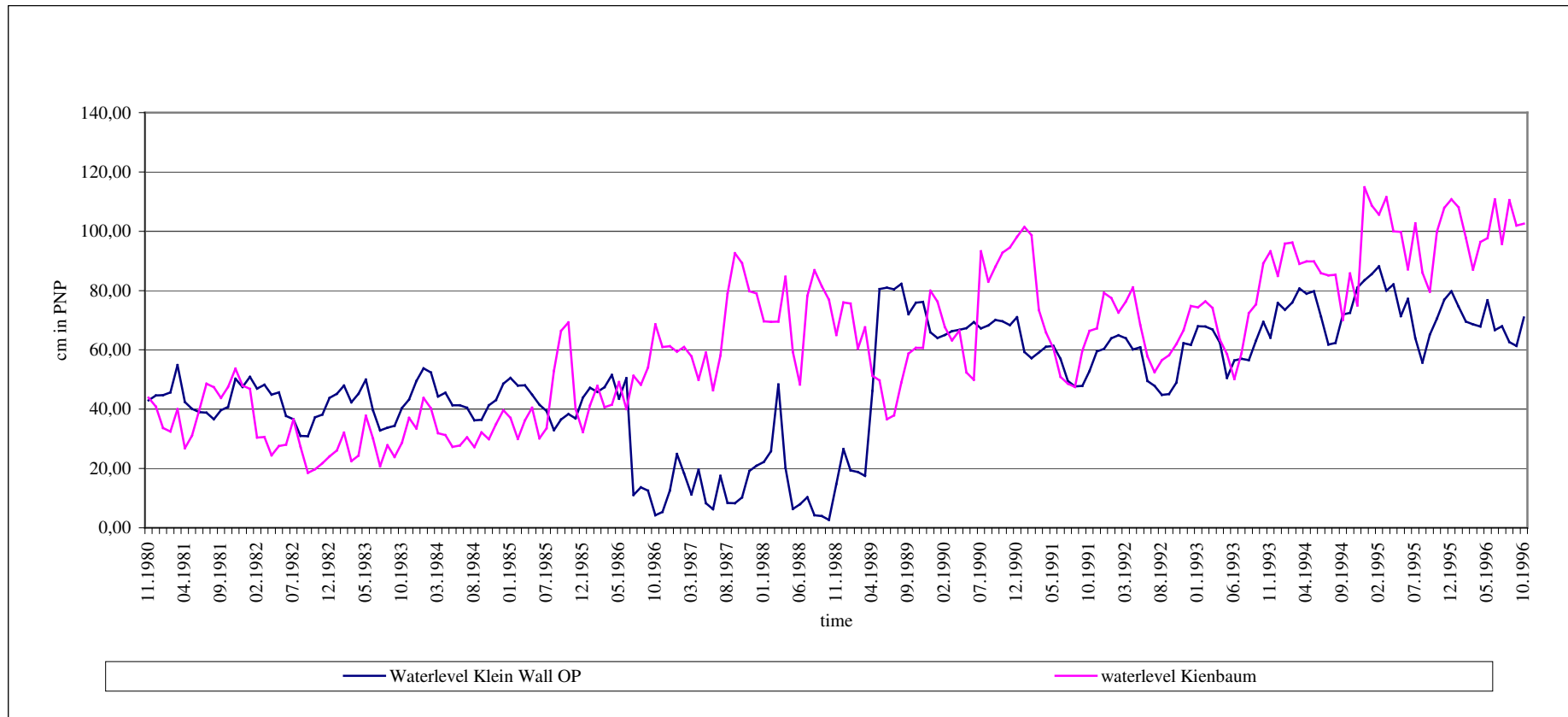

suggested measure


photos


**Table 4:** vegetation relevés on the potential nesting sites sorted according to character species of the vegetation communities, sample numbers are according to site numbers, two samples have been taken on large sites

sample number	1	10	8-1	8-2	2-1	3	2	1-1	4	9	6-1	6	8-3	11	7-1	8	7	5	5-1	frequency	
herb cover	95	65	50	60	60	30	70	70	50	40	40	50	60	70	40	35	50	50	8		
litter cover	7	5	10	10	3	3	10	3	40	10	25	20	10	15	30	15	35	10			
substrat	sand	sand	sand	sand	sand	sand	sand	sand	sand	sand	sand	sand	sand	sand	sand	sand	sand	sand	sand		sand
exposition	se-sw	s-o; s	s	s-o	se - sw	s	se-sw	se-sw	s	s-o	s	s	s-o	s	s-o	s	s-o	se-sw	se-sw		
<b>Festuco - Sedetalia</b>																					
<i>Helichrysum arenarium</i>	1	1	+	1	+	1	1	1	1	1	1	1	1	2a	1	1					16
<i>Artemisia campestris</i>		+	r	1	+	1	1	+	1	1	r		2a	2a							12
<i>Hypochoeris radicata</i>	r	1	r	+								1					+				6
<i>Festuca ovina</i>	1			1		1	3														4
<i>Agrostis capillaris</i>	1				1				1												3
<b>Corynephorretalia canescentis</b>																					
<i>Corynephorus canescens</i>	2m	1	2a	1	2a	1		2b	3	2b	2b	3	1		2b			3	2a		15
<b>Sedo - Scleranthetalia</b>																					
<i>Rumex acetosella</i>	2m	1	+		1		1	1	2b	1	2b	1	1		2a		2b	2b			14
<i>Hierachium pilosella</i>	3	2a	2b		2b	1	4	2b	1			1		1		2b					11
<b>Koelerio - Corynephoretea</b>																					
<i>Sedum acre</i>	2m				2m	1	1	1		1											6
<i>Arenaria serpyllifolia</i>	+					1															2
<i>Filago minima</i>											1										1
<i>Jasione montana</i>		1	+	1	r			r	1	1		1	1	1		1					11
mosses	2b	1		2b	3	3	2b	2a		1	2b	2a	2a	2a	2a	2a	2a				15
lichens	2b	1			3		2b						1	1							6
<i>Trifolium arvense</i>	2a	1		1	1	1	2b	1						1							8
<i>Achillea millefolium</i>	2m	+		+	1	+		+					+		r		1				9
<i>Pinus sylvestris</i>	+	2a	+	r			+	+						+				2m			8
<i>Centaurea stoebe</i>	1	+		r	1		+		1				1	1							8

sample number	1	10	8-1	8-2	2-1	3	2	1-1	4	9	6-1	6	8-3	11	7-1	8	7	5	5-1	frequency	
herb cover	95	65	50	60	60	30	70	70	50	40	40	50	60	70	40	35	50	50	8		
litter cover	7	5	10	10	3	3	10	3	40	10	25	20	10	15	30	15	35	10			
substrat	sand	sand	sand	sand	sand	sand	sand	sand	sand	sand	sand	sand	sand	sand	sand	sand	sand	sand	sand	sand	
exposition	se-sw	s-o; s	s	s-o	se - sw	s	se-sw	se-sw	s	s-o	s	s	s-o	s	s-o	s	s-o	se-sw	se-sw		
<i>Euphorbia cyparissias</i>			+		1		1	1					1			1					6
<i>Anthoxanthum odoratum</i>	2a	1			2b		2a	2b													5
<i>Solidago canadensis</i>			1					1				+				1		1			5
<i>Hypericum perforatum</i>		1	+					1						+			1				5
<i>Agrostis vinealis</i>		2a											1	2a				2b			4
<i>Festuca rubra</i>				1										1	2a		1				4
<i>Echium vulgare</i>					r								+								2
<i>Vicia lathyroides</i>	+						1														2
<i>Plantago lanceolata</i>						1								+							2
<i>Rubus fruticosus</i>				r		r															2
<i>Berteroa incana</i>								r													1
<i>Scleranthus perennis</i>		2a																			1
<i>Bromus tectorum</i>									+												1
<i>Dianthus carthusianorum</i>													1								1
<i>Dianthus deltoides</i>		r																			1
<i>Potentilla aurea</i>							1														1
<i>Trifolium dubium</i>													+								1
<i>Viola arvensis</i>												r									1
<i>Avenella flexuosa</i>															1						1
<i>Lathyrus niger</i>	+																				1
<i>Filago spec.</i>	1																				1
<i>Calamagrostis epigejos</i>			1													1					2
<i>Scabiosa spec.</i>							1														1
no. of species per sample	19	18	12	13	16	12	16	13	12	7	6	9	14	13	7	7	7	4	1		



**Figure 13:** development of water level at measuring point in Kienbaum and Klein Wall weir (top level), from 11.1980 until 10.1996, rough data provided by Brandenburg State Office for the Environment, Cottbus