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A review of wolf management in Poland and Germany with recommendations for future transboundary collaboration

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Cover picture: top: 4 month old wolf pup of the Seenland pack in a former coal mining area (S. Koerner); middle: green bridge over a highway in Western Poland (Association for Nature “Wolf”); down: livestock guarding dogs in combination with electric fences are an effective method to prevent wolf attacks on sheep (LUPUS, Wildlife Consulting)

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1. Summary

The return of the wolf to Central Europe is an outstanding achievement of nature conservation, and at the same time one of its major challenges. In order to mitigate conflicts and achieve coexistence between wolves and humans active wolf management is needed. The wolves that have recently settled in western Poland and eastern Germany belong to the same population - the "German-Western Polish" population (LINNELL et al. 2008), but traditions and experiences with wolves differ between both countries, as so do the management approaches taken. In Poland, wolves have been always present; hence, some form of management has always been applied, although a formalised management plan for wolves has not been officially accepted, yet. Nevertheless, Poland has defined population goals for the national wolf population. Germany, a wolf country for only about 12 years now, already has numerous regional plans in place delineating approaches on how to minimise conflicts and responsibilities on a regional scale. However, the country does not have a national plan, the population goals have not been defined yet. Consequently, the framework to develop and implement uniform regional plans guiding wolf management is also missing.

Since the term "German – Western Polish population" no longer fits its geographic distribution, we propose to name it "Central European population" instead. In winter 2011 / 2012 there were 24 packs (including two scent marking pairs) known in the Polish portion of the population. 14 packs and three scent marking pairs were confirmed in Germany. However, it is not known how many of these territories are transboundary, so double counting of packs on both sides of the border is likely to occur. This is because neither a common cross border monitoring plan exists nor common monitoring standards allowing for the comparability of monitoring data.

The main threats to the Central European population are fragmentation, reduced connectivity to neighbouring populations, traffic accidents and poaching. Although the attitude of the general public toward wolves is generally positive, there is largely a lack of acceptance of wolves among hunters in both countries. Wolf-livestock conflicts are moderate, both in Poland and Germany.

The legal frame in both countries is the same; the wolf is a strictly protected species. While in Germany the wolf is included in Annex IV of the Habitats Directive, in Poland it is included in Annex V. Nevertheless, in Poland the species has been strictly protected under national law since 1998 and is not listed as a game species. In Germany, several Länder endeavour to list the wolf as a game species; however, this will not alter its legal status. In both countries a system of strict protection has to be maintained for the wolf.

In Poland, a centralised wolf management system was established under the responsibility of the Ministry of the Environment and the General Directorate for Environmental Protection. In Germany, the federalist system of government calls for decentralised management. The nature conservation authorities of the Länder are the bodies responsible for wolf management, and in some Länder responsibility has even been further delegated to the administrative districts. In accordance with the decentralised system, compensation and prevention schemes vary between the German Länder. In Poland, a national compensation law defines compensation payment regulations for the whole country. Prevention measures, however, are generally only funded within the scope of temporary projects.

Currently, Poland is defining favourable reference values (favourable reference range and favourable reference population) for two bioregions (continental and alpine). Germany has not defined minimum population goals. While Germany has monitoring standards for large

carnivores, Poland has not defined such standards yet. Rather, the country has concentrated on developing wolf monitoring methods and indicators of population status and habitat quality. Therefore, a common robust assessment of the transboundary population is not possible at this point in time.

Having the same legal framework, common management of the Central European wolf population seems both feasible and reasonable, and development of a joint population level management plan is recommended. While it may take some time to develop such a plan, we strongly recommend collaborating on some issues as soon as possible:

- Development of common monitoring standards.
- Improvement of monitoring structures in Germany and Poland.
- Announcement of an institution to consistently compile data (across intranational boundaries), and which can provide up to date information on national (population based) population size on demand.
- Yearly common assessment of population size and area of occurrence for the CE population.
- Development of favourable reference values for the entire CE wolf population.
- Research on habitat utilization and territory size in Germany and Western Poland → updating the habitat models for wolves as a basis for robust FRR analyses.
- Joint genetic monitoring.
- Establishment and protection of the joint ecological network.
- New structuring of the German-Polish wolf working group; inclusion in the group of Czech representatives.

Streszczenie

Powrót wilka do Europy Środkowej jest ogromnym sukcesem ochrony przyrody a zarazem jej wielkim wyzwaniem. Aby złagodzić konflikty i zapewnić koegzystencję ludzi i drapieżników niezbędny jest odpowiedni plan zarządzania populacją wilka. Wilki, które niedawno zrekolonizowały Polskę Zachodnią oraz wschodnią część Niemiec należą do tej samej „niemiecko-zachodniopolskiej" populacji (LINNELL et al. 2008), jednakże stosunek i doświadczenie w kontaktach z wilkami różnią się w obu państwach, podobnie jak podejście do zarządzania ich populacją. W Polsce wilki zawsze były obecne, zawsze też istniał jakiś sposób zarządzania ich populacją, jak dotąd jednak żaden program zarządzania populacją wilka nie został tu oficjalnie zaakceptowany. Kraj ten zdefiniował jednak główne cele rozwoju (wartości referencyjne) dla krajowej populacji wilka. Tymczasem Niemcy, kraj zasiedlony przez wilki zaledwie od 12 lat, posiada wiele regionalnych planów zarządzania populacją tego drapieżnika, w których określono sposoby minimalizowania konfliktów oraz zdefiniowano zakresy kompetencji poszczególnych instytucji w skali regionalnej. Jednak brak tam krajowego programu zarządzania populacją wilka, nie zdefiniowano również krajowych celów rozwoju populacji tego gatunku (właściwych wartości referencyjnych), a tym samym nie istnieje żaden punkt odniesienia dla istniejących regionalnych planów zarządzania.

Ponieważ termin "niemiecko-zachodniopolska" populacja wilka nie odpowiada jej obecnemu geograficznemu rozmieszczeniu, proponujemy by nazwać ją populacją „środkowoeuropejską". Zimą 2011/2012 populacja ta liczyła 24 watahy (w tym dwie

znakujące pary) w części polskiej oraz 14 watah i trzy znakujące pary w części niemieckiej. Jednak nie wiadomo ile z tych watah zajmuje terytoria transgraniczne, więc możliwe jest podwójne liczenie tych samych wilczych grup rodzinnych po obu stronach granicy państwowej. Wynika to z braku wspólnego transgranicznego monitoringu populacji oraz odmiennych standardów monitoringu uniemożliwiających porównanie istniejących danych.

Głównymi zagrożeniami dla środkowoeuropejskiej populacji wilka są: fragmentacja środowiska, ograniczona łączność pomiędzy sąsiednimi populacjami, a także śmiertelność powodowana przez kolizje z pojazdami i kłusownictwo. Pomimo tego, że nastawienie ogółu społeczeństwa do wilka jest raczej pozytywne, akceptacja tego drapieżnika ze strony myśliwych jest w obu krajach znacznie niższa. Konflikty pomiędzy wilkami i gospodarką hodowlaną są natomiast umiarkowane zarówno w Niemczech, jak i w Polsce Zachodniej.

W obu krajach status prawny wilka jest taki sam – gatunek ten jest objęty ścisłą ochroną. Jednak, podczas gdy w Niemczech wilk jest umieszczony w załączniku IV Dyrektywy Siedliskowej, to w Polsce został on włączony do załącznika V. Pomimo tego, w Polsce wilk jest ściśle chroniony przez prawo krajowe od 1998 r., i od tego czasu nie znajduje się na liście gatunków łownych. W Niemczech kilka krajów związkowych (Landów) ma zamiar umieścić wilka na liście gatunków łownych, jednak nie zmieni to jego statusu prawnego w całym kraju. Ścisła ochrona wilka powinna być utrzymana w obu krajach.

W Polsce system zarządzania populacją wilka jest scentralizowany, a instytucjami odpowiedzialnymi za jego ochronę są Ministerstwo Środowiska oraz Generalna Dyrekcja Ochrony Środowiska. W Niemczech, system federalistyczny decyduje o decentralizacji zarządzania populacją tego drapieżnika. W każdym z krajów związkowych istnieją odpowiednie służby ochrony przyrody odpowiedzialne za zarządzanie populacją wilka, a w niektórych Landach odpowiedzialność tą przekazano nawet do niższych jednostek

Zusammenfassung

Die Rückkehr des Wolfes nach Mitteleuropa ist zugleich ein herausragender Erfolg und eine der größten Herausforderungen für den Naturschutz. Um eine Koexistenz von Menschen und Wölfen zu erreichen und Konflikte zu minimieren, ist ein aktives Wolfsmanagement notwendig. Die Wölfe in Westpolen und Deutschland gehören der deutsch-westpolnischen Population (LINNELL et al. 2008) an. Allerdings unterscheiden sich sowohl die Erfahrungen als auch die Traditionen im Umgang mit Wölfen und folglich auch die Managementansätze zwischen beiden Ländern. In Polen war der Wolf nie ausgerottet und entsprechend hat es immer irgendeine Form von Wolfsmanagement gegeben, auch ohne einen formal akzeptierten Managementplan. Allerdings hat Polen Populationsziele für den nationalen Wolfsbestand definiert. In Deutschland, erst seit 12 Jahren wieder Wolfsland, haben in dieser kurzen Zeit bereits mehrere Länder eigene, regionale Managementpläne entwickelt, in denen Zuständigkeiten und Wege der Konfliktminimierung definiert sind. Jedoch gibt es auch in Deutschland keinen nationalen Managementplan, Populationsziele wurden bisher nicht definiert, das heißt, noch fehlt der Rahmen für die regionalen Managementpläne.

Die Bezeichnung „deutsch-westpolnische Population“ entspricht nicht mehr ihrem geographischen Vorkommen, wir schlagen daher vor sie stattdessen „Mitteleuropäische Population“ (Central European population) zu nennen. Im Winter 2011 / 2012 waren 24 Rudel (inklusive zwei Wolfspaare) im polnischen Teil dieser Population bekannt. 14 Rudel und drei Wolfspaare wurden im deutschen Populationsteil nachgewiesen. Allerdings gibt es keine Daten darüber, wie viele der Territorien sich auf beiden Seiten der Grenze erstrecken.

Doppelzählungen von Rudeln beiderseits der Grenze sind daher wahrscheinlich. Bisher gibt es weder ein gemeinsames grenzübergreifendes Monitoring, noch gemeinsame Monitoringstandards, welche die Vergleichbarkeit der Monitoringdaten ermöglichen würden.

Die Hauptgefährdungsursachen für die Mitteleuropäische Population sind Fragmentierung, wenig Austausch mit benachbarten Populationen, sowie anthropogen bedingte Mortalität, wie Verkehrsunfälle und illegale Abschüsse. Obwohl die Bevölkerung in beiden Ländern Wölfen gegenüber insgesamt überwiegend positiv eingestellt ist, ist die Akzeptanz in der Jägerschaft dem Wolf gegenüber deutlich geringer. Wolf – Nutztierkonflikte sind in Polen und Deutschland moderat.

Der rechtliche Rahmen ist in beiden Ländern derselbe, der Wolf ist streng geschützt. Während Deutschland ihn im Anhang IV der Fauna-Flora-Habitatrichtlinie listet, führt Polen ihn im Anhang V. Trotzdem ist er auch in Polen auf nationaler Ebene seit 1998 streng geschützt. Der Wolf unterliegt in Polen nicht dem Jagdrecht. In Deutschland gibt es in einigen Ländern die Bestrebung den Wolf dem Jagdrecht zu unterstellen. Dies würde seinen rechtlichen Status nicht ändern; der strenge Schutzstatus muss in beiden Ländern aufrecht erhalten werden.

Polen hat ein zentralisiertes Managementsystem. Zuständig für das Wolfsmanagement sind das Umweltministerium und die Generaldirektion für Umweltschutz. Der Föderalismus in Deutschland bringt dagegen ein dezentralisiertes Managementsystem mit sich. Zuständig sind hier die Naturschutzbehörden der Länder; in einigen Ländern wurden die Zuständigkeiten sogar noch an die Behörden der Landkreise weiter delegiert. Entsprechend des dezentralisierten Systems variieren die Kompensations- und Präventionssysteme von Land zu Land. In Polen ist die Kompensation von wolfsverursachten Schäden an Haustieren dagegen landesweit in einem nationalen Kompensationsgesetz geregelt. Präventionsmaßnahmen werden in Polen in der Regel nur im Rahmen von zeitlich befristeten Projekten finanziert.

Derzeit definiert Polen günstige Referenzwerte für Wölfe (günstiges Referenzgebiet und günstige Referenzpopulation) für zwei biogeographische Regionen (kontinental und alpin). Deutschland hat bisher keine Mindestziele definiert. Während Deutschland Monitoringstandards für Großraubtiere definiert hat, existieren in Polen bisher keine solchen Standards, sondern dort wurde sich vor allem auf die Entwicklung von Monitoringmethoden und Indikatoren für Populationsstatus und Habitatqualität konzentriert. Eine robuste, gemeinsame, grenzübergreifende Populationsschätzung ist daher zum gegenwärtigen Zeitpunkt nicht möglich.

Auf Grund des übereinstimmenden rechtlichen Rahmens in Polen und Deutschland erscheint ein gemeinsames grenzübergreifendes Management der mitteleuropäischen Population machbar und sinnvoll. Ein gemeinsamer Populationslevel Management Plan ist empfehlenswert. Während die Entwicklung eines solchen Plans jedoch einige Zeit in Anspruch nehmen wird, empfehlen wir nachdrücklich einige Punkte möglichst zeitnah umzusetzen:

- Entwicklung gemeinsamer Monitoringstandards.
- Verbesserung der Monitoringstrukturen in beiden Ländern.
- Schaffung / Ernennung einer Institution, die die nationalen Daten zum Wolf über innerstaatliche Grenzen hinweg kompiliert und in der Lage ist, bei Bedarf jederzeit aktuelle Informationen zur nationalen Populationsgröße zur Verfügung zu stellen.

- Jährliche gemeinsame, grenzübergreifende Schätzung der Populationsgröße und des Vorkommensgebietes der mitteleuropäischen Population.
- Entwicklung gemeinsamer günstiger Referenzwerte für die gesamte mitteleuropäische Population.
- Forschung zu Habitatnutzung und Territoriumsgröße in Deutschland und Westpolen, um die Habitatmodelle, die als Grundlage für die Definition des günstigen Referenzgebietes dienen, aktualisieren und robuste Modelle rechnen zu können.
- Gemeinsames genetisches Monitoring.
- Herstellung und Schutz eines gemeinsamen ökologischen Netzwerkes.
- Neustrukturierung der deutsch-polnischen Wolfsarbeitsgruppe; einbeziehen der Tschechischen Vertreter in die Arbeitsgruppe.

2. Introduction

The return of the wolf (*Canis lupus*) to the center of Europe is one of the few outstanding success stories of species conservation during the last decades. In fact, the homecoming of this large predator to a habitat so tremendously altered since its eradication so long ago is a real sensation. There are few species that are able to cope with our crowded, human-dominated European landscape. The wolf, of all species, made it back when we gave it a chance. Its reception, however, has been guarded.

The comeback of the wolf in western Poland and (not only) eastern Germany during the last 10 years, its rise in numbers and subsequent spread, happened much faster than most people anticipated. And, as usually happens when wolves live in close proximity to humans they came into conflict with human activities, mostly with livestock farming and hunting. These conflicts are often more pronounced in areas where large carnivores (LCs) have been absent for several decades. For people living in these areas nature conservation is largely associated with flowering landscapes, pretty birds and butterflies, but not necessarily with a large, long-toothed predator. Although the majority of the public in Germany and Poland have a positive attitude towards nature including the return of the wolf, hunters and farmers in areas that have been newly occupied by wolves are generally not quite so enthusiastic about this form of biodiversity enhancement.

In order to mitigate conflicts and achieve coexistence between wolves and humans, active wolf management is needed. The wolves that have resettled in western Poland and eastern Germany belong to the same population, the so called "German-Western Polish" population (LINNELL et al. 2008); however, traditions and experiences with wolves differ between both countries, as does the approach to their management. In Poland, where wolves have always been present, at least in the east and south of the country, some form of wolf management has always been applied, even without formalised management plans. In Germany, where the wolf was exterminated in the middle of the 19th century, several of the Länder developed regional wolf management plans within the first ten years of the wolf's return. These regional plans mainly aim at minimising conflicts on a local scale. However, wolves need large areas, their territories in Poland and Germany may encompass up to 200 – 300 km², often stretching across administrative borders either within or between countries. In order to address this challenge management should not be constrained within administrative units but conquer boundaries and focus on the biological unit that is the population (LINNELL et al. 2008). This approach directs to a joint Polish-German management of the shared wolf population.

The issue of population level management was discussed by a group of conservation authorities from both countries. In 2009, representatives from Polish and German authorities and ministries as well as wolf experts from both countries met in Potsdam to exchange information about wolves on both sides of the border. In consequence of this first meeting, a bilateral wolf working group was established and all attendees agreed that wolves in western Poland and eastern Germany belonged to a common population. In the following meetings, several wolf issues mainly regarding wolf-livestock conflicts and monitoring were discussed. Obviously the management issues in both countries are similar; however, the feasibility of joint management remained unclear. At the third meeting in March 2011, the members of the working group decided to commission a feasibility study for joint management of the common Polish-German wolf population.

The mandate to compile a "Review of wolf management in Poland and Germany with recommendation for future transboundary cooperation" was given to LUPUS Wildlife

Consultants (Ilka Reinhardt and Gesa Kluth) on condition that a wolf scientist from Poland was engaged as a co-author especially for the chapters outlining the Polish situation. As Dr. Sabina Nowak and Dr. Robert W. Mysłajek from the Association for Nature “Wolf” have been responsible for monitoring wolf recovery in western Poland since 2001, and Dr. Nowak is a member of the German-Polish wolf working group they were invited as co-authors of the report. The elaborations regarding the wolf situation and management in Poland and Germany were made by the authors of the respective countries, while LUPUS was additionally responsible for the chapters outlining the European situation. Chapter 6.3 and 7 are the result of a working meeting and reflect the common perspective of the team of authors. Wherever perceptions differ this is indicated.

The term “German-West Polish” was created a few years ago by the authors of the “Guidelines for population level management plans for Large Carnivores in Europe” (LINNELL et al. 2008). At that time, only a few wolf family groups were scattered throughout western Poland and eastern Germany (in Germany it is often referred to as the West Polish – East German population). This name is too complicated and no longer does the current wolf range justice. Meanwhile, in Poland, wolves belonging to this population have also settled in the middle of the country, and, in Germany, they have started to spread into the western part. It is just a matter of time that this population will also extend into the Czech Republic. Therefore, instead, we recommend using the name Central European population.

3. Conservation status of wolf populations in Europe, Poland and Germany

3.1 Europe

3.1.1 Historical outline

Just a few centuries ago, the wolf roamed throughout Europe. Human persecution dramatically changed wolf distribution patterns, and between the 17th and 19th centuries the large carnivores were driven to extinction in many parts of Europe. With the decline in many areas of wild ungulate, either through hunting or competition with livestock, the already persecuted wolf was forced to subsist on domestic animals, further exacerbating human animosity (BOITANI 2003). At the beginning of the 20th century, Central and Northern Europe were almost wolf-free. One last resort in Western Europe was France. In 1883, the hunting bag was still about 1,386 wolves (VICTORE AND LARIVIERE 1980 *fide* BOITANI 2003), but just a few decades later, in 1927, the last wolf was killed in France (BEAUFORT 1987 *fide* BOITANI 2003).

The remaining populations in South and Eastern Europe declined even further. Wolves did not survive in these areas because habitat requirements were best or human densities especially low; rather, wolf extermination was less well-organized and persistent (Boitani 1995). Populations in Italy and Poland (which today number several hundred animals) were down to only 100 individuals or even fewer (ZIMEN AND BOITANI 1975; OKARMA 1993). In some populations, such as the Italian and the Iberian ones, poison was thought to be the main reason for the rapid decline in the middle of the last century. A few decades later, these populations too had practically vanished. Around the 1960s, the wolf population in Europe was at an all time low (BOITANI 2000). However, public attitudes changed and interest in wildlife conservation including large carnivores began to grow. Populations recovered when the wolf was put under partial or strict protection in many European countries. Of course, this recovery was not restricted to the countries were they had survived but spilled over into areas where they had been eradicated decades or more before. Recovery of wolf populations was not only permitted by political circumstances, it was also favoured by environmental conditions. As people left rural areas to settle in urban centres wild ungulate populations spread and increased (BOITANI AND CIUCCI 2009).

Changes in number and distribution of wolves in the 20th in century Poland

In Poland, the legal status of the wolf changed in the 20th century from pest, to game animal to protected species. Although wolves were persecuted in Poland for many years, they were never totally extirpated. In the 20th century, the range and number of wolves fluctuated from a very low number limited to the eastern and south-eastern most part of the country to wide distribution, when all forests of eastern Poland, the whole of the Polish Carpathian Mts. and most large forests of western Poland were occupied by wolves (WOLSAN et al.1992). The sparse distribution and low density of wolves in western Poland, which was regularly recorded, resulted both from a longer distance to the source population in eastern Europe (JĘDRZEJEWSKI et al. 2004a) and a more efficient removal of this species from forests west of the river Vistula.

In 1927, the status of the wolf switched from pest to game species with a year-round hunting season; however, no distinctive changes in population size or distribution were recorded until World War II. The largest population range and number of this species in the 20th century

was recorded after World War II at the turn of the 40s and 50s, when these predators had re-colonized most of the forests east and west of the river Vistula. This was possible due to a still existing connection with the source wolf population in eastern Europe. At the time, wolves were reported from all large forest tracts in north-eastern Poland but also from many woodlands of western Poland. Wolves were also recorded in the Karkonosze Mts, the highest part of the Sudety Mts. (WOLSAN et al. 1992; BRZUSKI AND OKARMA 1997, NOWAK AND MYSŁAJEK 2011). The population size was estimated at about 1,000 wolves (OKARMA 1992).

The situation changed radically in the mid-fifties, when the legal status of the wolf was changed and a large scale anti-wolf campaign introduced in Poland (KOWALSKI 1953a). Surprisingly, despite systematic persecution, wolves still persisted in the forests of eastern and western Poland, and some of these individuals roamed to Germany, crossing the rivers Neisse and Oder. This was confirmed by wolf culls there at the onset of the sixties (BUTZECK 1993). When wolf persecution stopped at the beginning of the seventies, the population had been reduced to only several dozen individuals, and wolves had been exterminated from most forest ranges of western Poland (PUCEK AND RACZYŃSKI 1983, WOLSAN et al. 1992, BRZUSKI AND OKARMA 1997, KUREK 2002). In 1975, the wolf again became a game species in Poland, with a four months protection season in western Poland. In the late 70s and early 80s, the range expanded as restrictions on their harvest came into place, but the recovery of wolf populations was probably also helped by the on-going economic crisis, which caused a significant reduction in road traffic, and, consequently, low mortality of animals on roads.

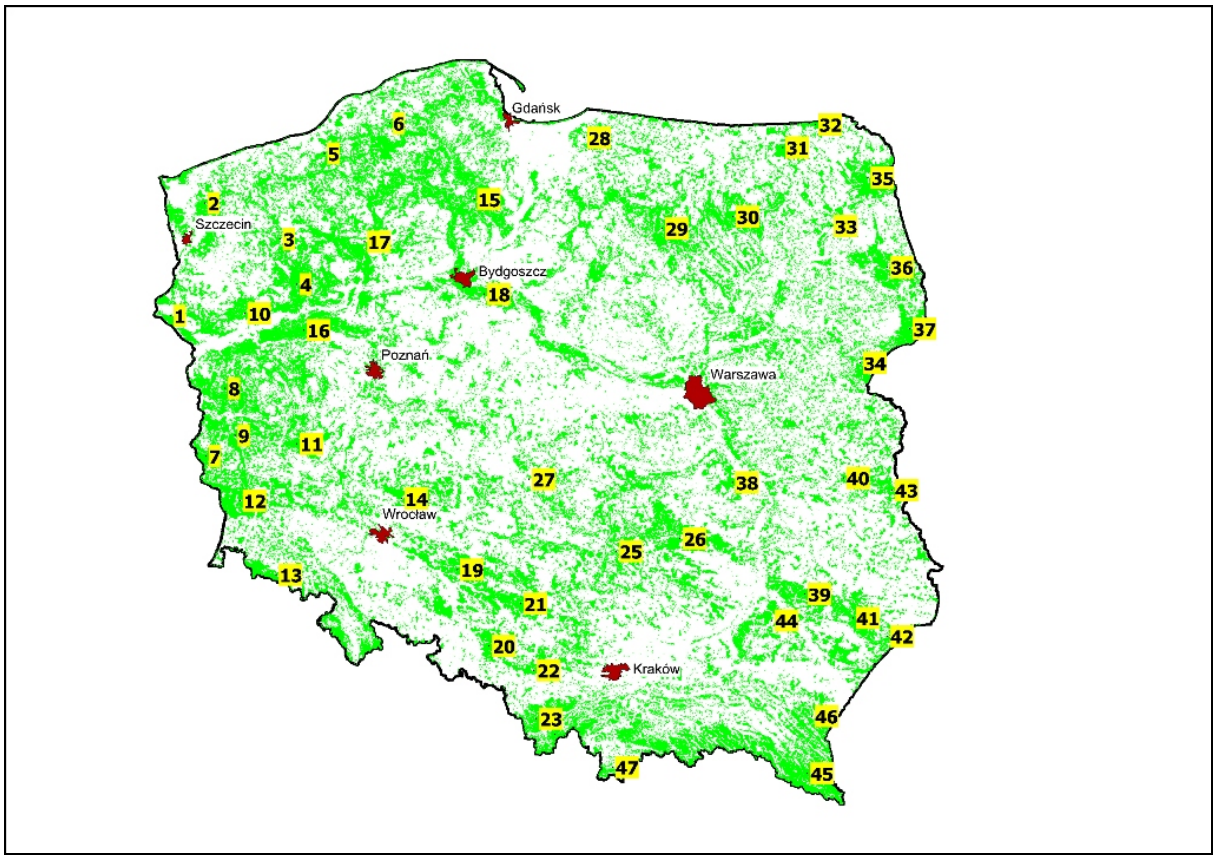

Fig. 1: Forest tracks in Poland where wolves were recorded in the first half of the 20th century. 1 – Cedynia forest, 2 – Goleniów forest, 3 – Drawsko forest, 4 – Drawa forest, 5 – Koszalin forest, 6 – Słupsk forest, 7 – Lubsko forest, 8 – Rzepin forest, 9 – Zielona Góra forest, 10 – Gorzów forest, 11 – Sława forest, 12 – Lower Silesian forest, 13 – Sudety Mountains, 14 – Milicz forest, 15 – Tuchola forest, 16 – Noteć forest, 17 – Wałcz forest, 18 – Bydgoszcz forest, 19 – Stobrawa forest, 20 – Racibórz forest, 21 – Lubliniec forest, 22 – Pszczyna forest, 23 – Silesian Beskid Mountains, 24 – Żywiecki Beskid Mountains, 25 – Włoszczowa forest, 26 – Święty Krzyż forest, 27 – Sieradz forest, 28 – Elbląg forest, 29 – Napiwoda-Ramuki forest, 30 – Pisz forest, 31 – Borecka forest, 32 – Romincka forest, 33 – Biebrza river valley, 34 – Mielnik forest, 35 – Augustów forest, 36 – Knyszyn forest, 37 – Białowieża Primeval Forest, 38 – Kozienice forest, 39 – Janów forest, 40 – Parczew forest, 41 – Solska forest, 42 – Roztocze forest, 43 – Sobibór forest, 44 – Sandomierz forest, 45 – Bieszczady Mountains, 46 – Przemyśl foothills, 47 – Tatra Mountains. Map: AfN “Wolf”.

Until the mid-nineties, the presence of wolves was recorded in western Poland in the Goleniów and Cedynia forests, the Wałcz forest, the Gorzów forest, the Tuchola forest, the Bydgoszcz forest, the Drawsko forest, the Wałcz forest, the Noteć forest, the Sława forest, the Rzepin forest, the Zielona Góra forest and the Lower Silesian forest (WOLSAN et al. 1992; NOWAK AND MYSŁAJEK 2011). Despite the fact that wolves became protected in the Gorzów and the Poznan provinces (in 1992), and measures were undertaken for their conservation in other provinces (NOWAK 1996, SKROBAŁA AND BERESZYŃSKI 1997, BRZUSKI AND OKARMA 1997), they were still hunted west of the river Vistula. Between 1982 and 1992 at least 30 individuals were shot by hunters there (BERESZYŃSKI 1998; NOWAK AND MYSŁAJEK 2011).

After the wolf was put under a strict protection regime in most of the country in 1995, including the entire western and central parts of Poland, these predators still only occurred in the large forest complexes east of the river Vistula and in the greater part of the Carpathian Mountains. Although there were suitable habitats and abundant wild prey, wolves were very rare in the western part of the country, where only small, isolated packs or lone individuals

were observed. The main reason for their absence was high, human-related mortality: wolves were killed illegally by hunters and poachers, but they were also hit by cars on busy roads.

Finally, in 1998, the species became protected in the whole Poland, leading to a gradual increase of its range in eastern Poland.

Historical outline Germany

In Germany, wolves were eradicated in the 19th century. The last wolf in Bavaria was killed in 1847, and by 1899 they had completely disappeared in the Rhine region (Zimen 1978) and the very last wolf – a disperser – was shot in Saxony in 1904, where wolves had already been absent for about 100 years (RÖCKEL 1999).

After 1945, single dispersing wolves repeatedly showed up in Germany. In every decade after the Second World War, wolves migrating from Poland were shot in Germany. At least 19 wolves were killed between 1945 and 1990 (REINHARDT AND KLUTH 2007). Most of them appeared in the north-east of Germany. Preventing resettlement of the wolf was the pronounced goal of the German Democratic Republic, while in the Federal Republic of Germany, the species had been strictly protected, albeit absent since 1980 (REINHARDT AND KLUTH 2007).

After German reunification, the wolf became a protected species in the whole country. Although protected on paper, at least six wolves were shot in the 1990s. It was not until the end of the 90s that two wolves succeeded in establishing a territory in Germany. In 2000, the first litter of wild born wolf pups was confirmed on active military grounds in Saxony close to the Polish border (REINHARDT AND KLUTH 2007). This was the starting point for recolonalisation (see chapter 3.3.1).

3.1.2 Current distribution and conservation status in Europe

In the Action Plan for the Conservation of Wolves (*Canis lupus*) in Europe (BOITANI 2000), the wolf population trend for most countries is given as stable or positive. Following centuries of persecution, this is a remarkable result for a species. The reason for this comeback can only partly be explained by the current legal status. To a great extent, recovery has to do with the enormous adaptability of wolves. Wolves can basically survive wherever they can find a source of food, and this can be of various forms, from wild animals, to livestock and garbage. The only limiting factor seems to be human persecution. As a result, the conservation of wolves is not so much an ecological issue as a social one (SALVATORY AND LINNELL 2005). Wolves have a greater potential for reproduction and expansion than other large carnivores. This means, given a chance, wolves are better able to regain lost areas than many other species. This process can currently be observed in former wolf-free Central Europe.

In 2008, LINNELL et al. identified 10 wolf populations in Europe (table 1). Two of them, the Sierra Morena population and the population in Germany / western Poland were classified as critically endangered. Table 1 lists the population size and trend of the wolf in single European countries as well as the IUCN red listing from 2007 (LINNELL et al. 2008). Most of these data are now more than five years old. Whereever possible we have used more recent data.

Wolves live in family groups (packs). Since the number of pack members changes over the year and a variable part of the population is made up of dispersing wolves or floaters that are not organized in packs, the actual number of wolves in a population is very difficult to assess. Some countries such as France and Sweden or provinces like the Piedmont have a very intense monitoring system in place, with detailed genetic sampling taking place every year. With the help of capture-recapture analysis it is indeed possible to come up with a robust estimate of wolf numbers (including confident intervals). Where this effort is not made it is much easier and more reliable to give minimum number of wolf packs rather than individual numbers. Still, most population sizes in table 1 are quoted as individual numbers. We would like to stress that many of these numbers are only a rough estimate. What is indicated as population trend is often more likely the trend of the distribution area. Without implementation of a robust monitoring system it is difficult to detect a change in population trend. It is more likely that a change in the area occupied by wolves will become conspicuous. In addition, the number of reproductive units (packs / scent marking pairs) has a much greater explanatory power than the number of individuals.

A review of the status of wolves and other large carnivores in Europe is currently in preparation (LCIE *in prep*.).

Definition of a population

Nowadays, the population concept is part of general education: a group of individuals of the same species that live in the same area and can potentially interbreed with each other. However, concepts are developed by humans to make the world more concrete and clear to understand. This does not mean that any natural entity can be pigeonholed. As for populations that are not totally isolated from each other it is often hard to tell where one population ends and the other begins. LINNELL et al. (2008) give an overview of the different concepts of populations and population viabilities.

For purposes of large carnivore conservation in Europe, LINNELL et al. (2008) operationalised the population concept as follows: Populations can be viewed as a nested hierarchy of entities. The term “metapopulation” refers on a large scale to the entirety of individuals that share a broadly similar genetic structure. The distribution of the metapopulation may be spatially discontinuous, but there should be sufficient (potential) connectivity to permit the dispersal of individuals that ensures gene flow and some degree of demographic stabilisation. LINNELL et al. (2008) assume that this may be on the level of a few individuals per generation. BOITANI AND CIUCCI (2009) propose to consider European wolves as one large metapopulation. This clearly makes sense for the continental conservation approach the authors ask for. It is also reasonable in relation to the population concept. On an evolutionary scale, isolation of the single European wolf populations (see below) is very short termed. Considering the overall positive population trends (LINNELL et al. 2008; BOITANI AND CIUCCI 2009) and the dispersal abilities of wolves (MECH AND BOITANI 2003), it is reasonable to propose that most populations will be to some degree connected to neighbouring populations within the next decades.

The metapopulation contains a number of “subpopulations” that consist of individuals *within a reasonable continuous distribution*. These individuals interact with much greater frequency such that the demography of the group is mainly influenced by birth and death rather than by immigration of animals from neighbouring subpopulations. These subpopulations are what we usually call populations and what the Habitat Directive refers to (Linnell et al. 2008).

Within a subpopulation (hereafter called population) there may also be some fine scaled spatial units or clusters. LINNELL et al. (2008) refer to it as “population-segments”. The Lusation part of the German-West Polish wolf population is such a cluster or “population segment”.

Populations are units where a given species has a more or less continuous distribution such that individuals can interact often enough to constitute a demographic unit (Linnell et al. 2008).

Tab. 1: Wolf populations in Europe and number of (wolves) packs in European countries (Source: LINNELL et al. 2008; BOITANI AND CIUCCI 2009). Where available, more recent data were used: for Karelia KOJOLA (2011); for the Alps MARBOUTIN (2011) and MARUCCO (2011), for Germany REINHARDT AND KLUTH (unpubl. data), for Poland National wolf census 2009, Western Poland NOWAK AND MYSŁAJEK (2011, unpubl. data), for Lithuania BALCIAUSKA 2008, 2010; for Scandinavia ARONSON (2011), for Belorussia Belorussian Wolf MP (2009), for Slovakia Friends of the Earth Czech Republic (FoE CR 2011).

Population Country	**Approximate no. of packs (wolves)**	**Population trend**	**Legal protection**	**IUCN red listing**
Iberian				near threatened
Spain	? (2,500)	stable	game species (protected south of the river Duero)	
Portugal	? (300)	stable	fully protected	
Sierra Morena				critically endangered
Spain	? (< 50)	stable	fully protected	
Western Alps				endangered
Italy	16 [1] (?)	stable	fully protected	
France	19 [1] (< 200)	increasing	fully protected (removal of single individuals allowed)	
Switzerland	single individuals	-	fully protected (removal of single individuals allowed)	
Italian peninsula				vulnerable
Italy	? (600 - 800)	increasing	fully protected	
Dinaric-Balkan				least concern
Slovenia	? (60 - 80)	increasing	fully protected	
Croatia	? (130 - 170)	increasing	protected (hunting quota)	
Bosnia-Herzegovina	? (500?)	stable?	no protection	
Serbia-Montenegro	? (500?)	stable?	no protection	
Macedonia	? (800 – 1,000)	increasing?	no protection (bounty)	
Albania	? (900 – 1,200)	stable	protected (legal killing can be authorized)	
Bulgaria	? (1,000)	stable	game species (hunting permitted all year, bounties)	
Greece	? (500 – 700)	stable	fully protected only south of the 39° parallel	
Carpathian				least concern
Romania	? (3,000 – 4,000)	increasing	game species	

Hungary	- (> 10)	-	fully protected	
Ukraine	? (500)	stable?	no protection	
Czech Republic	- (2 – 5)	-	fully protected	
Slovakia	? (252 - 410)	decreasing	game species	
Poland	51 (210 – 260)	stable	fully protected	
Baltic				least concern
Poland	77 (270 - 360)	increasing	fully protected	
Estonia	? (100 – 150)	stable	game species	
Lithuania	? (200 – 300)	increasing	game species	
Latvia	? (300 – 500)	stable	game species	
Belarus	195 (834)	?	no protection	
Ukraine	? (500 – 2,000)	stable	no protection	
Russia	? (10,000 – 20,000)	?	no protection	
Central European (German-West Polish)				critically endangered
Germany	14 (?)	increasing	fully protected	
Poland	24 (100 - 110)	increasing	fully protected	
Karelian				near threatened
Russia	? (200)	decreasing	no protection	
Finland	16[2] (160)	decreasing	protected (hunting quota)	
Scandinavian				endangered
Sweden	24[3] (227 - 270)	stable[4]	fully protected (in 2010 and 2011 hunting quota)	
Norway	3[3] (?)	stable[4]	protected within zoning system	

[1] thereof 2 cross-border packs
[2] thereof 10 cross-border packs
[3] thereof 2 cross-border packs
[4] kept stable due to management measures

In the following section, we will give a short overview of the wolf status in countries neighbouring Poland and Germany, beginning in the north and continuing clockwise. Unless stated otherwise the information is taken from SALVATORI AND LINNELL (2005).

Russia / Kaliningrad

No information available.

Lithuania

The wolf population in Lithuania is estimated to number 200 – 300 individuals distributed throughout the country. Since there is no scientific population survey in place, the official

numbers may be misleading. The wolf is designated a game species in Lithuania with a yearly hunting quota (on average 40 wolves) and a hunting season from 1st December to 1st April. Currently, a project of the Wolf Management Plan is being prepared for the Ministry of the Environment proposing lethal control in order to limit the population number to 200 individuals (BALČIAUSKAS 2012).

Belarus

According to the Wolf Management Plan (WMP) of the Republic of Belarus (2009), from 2006 – 2008 the population size was 195 packs. The wolf can be legally hunted all year round and methods can be used such as destroying small pups at the den site. Belarus plans a sharp population reduction with the goal of 75 packs as the "optimum" number, equating to a population decrease of more than 60%. Such a reduction is bound to have a strong negative impact on those portions of the Baltic wolf population bordering Belorussia. Implementation of the management plan should have taken place between 2011 and 2012. The Polish Minister of Environment has expressed his concern to Belarus and to the EU that this will have an adverse effect on the conservation status and pose a threat to stability of the Polish portions of the Baltic wolf population. Currently the Belarus Ministry has presented comments and explanations in a statement to the Polish Ministry, with very minor changes in the WMP. The Plan has been approved by the Board of the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus; thus it is under implementation.

Ukraine

The wolf population in the Ukraine is estimated to number around 2,000 individuals. However, there is no scientific survey in place, and the population number is therefore based on hunter estimates. The species is still considered a pest species and bounties are paid for each wolf culled. In spite of having ratified the Bern Convention in 1996, with exceptions, a National law (623/2427 of 1997) still supports the eradication of wolves in the Ukraine.

Slovakia

The official number for 2004 - 2006 for Slovakia was 252 – 410 wolves. (http://cdr.eionet.europa.eu/Converters/convertDocument?file=sk/eu/art17/envrlqbva/species-canis-lupus.xmlandconv=rem_24). Except for some areas where the species is protected the whole year round, in Slovakia, the wolf is a game species, with the hunting period lasting from 1st October to 31th January,. A robust monitoring system is not in place. The Ministry of Agriculture, Environment and Regional Development defined a hunting quota of 150 wolves (FoE CR 2011) for the 2010/2011 hunting season, which represents 37 – 59.5 % (ø 48 %) of the official population estimation. This is certainly not a sustainable harvest (FULLER et al. 2003) and will affect wolf populations and occurrences in neighbouring countries. The Slovakian portion of the Carpathian wolf population shares a stretch of 540 km with the Polish population segment, which is strictly protected. Wolves living in transboundary packs are fully protected on the northern side of their territory but can be hunted in the southern part. The wolves in Slovakia would be the main source for population spread into the Czech Republic and Hungary.

Czech Republic

Wolves migrating from adjacent Poland and Slovakia began to re-colonize the very east of the Czech Republic. However, currently there are only 2 – 5 single individuals (M. KUTAL, pers. communication). Overhunting in Slovakia is assumed to be the main reason for this stagnation in wolf re-colonisation. Although wolves have reproduced in Germany about 30

km from the German - Czech border since 2000, to date, there is no single confirmation of a wolf on the Czech side of Saxony. Occasionally, signs of wolf are reported in the Šumava Mountains on the Bavarian-Austrian border. However, so far, there is no proof for permanent establishment of wolves in this area. Wolves are strictly protected throughout the whole year in the Czech Republic, although listed as game species under the country's Act on Hunting.

Austria

Wolves were eradicated in Austria about 150 years ago. Since 2000 there has been an increase in wolf reports. In 2010, 8 – 10 individuals from three different populations where confirmed in Austria via genetic sampling - mostly from livestock kills (G. RAUER, pers. communication). Wolves from the Dinaric, the Italian or Western Alpine and from the Carpathian population could be distinguished in the genetic samples. In 2011, only two wolves from the Italian / West Alpine population could be confirmed (G. RAUER, pers. communication) leading to the question of what happened to the others. At the beginning of 2012, a radio collared wolf from Slovenia was observed wandering through Austria. The wolf is strictly protected by national nature conservation law and at the same time listed as a game species with year round protection in all the Länder except Vienna.

Switzerland

In Switzerland, there are only individual wolves originating from the west alpine population. This status – single wolves, no reproduction - has been about the same for more than ten years. In 2011, eight individuals were confirmed by genetic analysis, some of them for the second or third year in a row. Since 1998, 38 different individuals, seven of them female, have been genetically confirmed in Switzerland (www.kora.ch) even without a regular wolf monitoring in place. Given this level of immigration and proximity to the expanding west alpine population, the absence of any reproduction is difficult to explain by biological reasons. According to the federal law on hunting and protection of mammals and birds, the wolf is considered a strictly protected species in Switzerland. However, the Swiss Wolf Management Plan allows elimination of "problem" individuals, e.g. wolves killing too many livestock. So far, 12 permits have been granted and seven wolves have been killed legally since 1998 (www.pronatura.ch).

Currently, Switzerland has submitted a proposal to have the Bern Convention changed to that effect that individual parties will be allowed not only to make reservations prior to but also subsequent to adopting the Bern Convention. When adopting the Bern Convention in 1980, Switzerland did not made reservations regarding the wolf. If the Bern Convention accepts amendment of article 22 of the Bern Convention, Switzerland will make a reservation to allow the wolf to be hunted (BAFU Press release 16.11.2011, http://www.bafu.admin.ch/dokumentation/medieninformation/00962/index.html?lang=deandmsg-id=42250).

France

In 1992, the first two wolves migrated into the Parc national du Mercantour in France (HOUARD AND LEQUETTE 1993). They originated from the Italian population that had spread all over the Apennine arch finally reaching the Piedmont and the Maritime Alps (BOITANI 1992). In 2010 there were 19 packs (including 2 cross-border territories with the Piedmont) in the French Alps (MARBOUTIN 2011). The population is increasing and spreading further, with dispersing individuals turning up far away from the next reproductive pack in the Massif Central or in the Pyrenees in the 1990ies (VALIERE et al. 2003).

In France, the wolf is a protected species. The Ministry of the Environment is in charge of wolf management, together with the Ministry of Agriculture. A great deal of effort is put into mitigating wolf–livestock conflicts. In 2010 more than 1 million Euros were paid in compensation and more than 6 million Euros invested in prevention (most of this is spent on subsidising extra herding; MARBOUTIN 2011). While the Ministry of the Environment is responsible for compensation, the Ministry of Agriculture is in charge of prevention.

The French Wolf Action Plan (2004) foresees derogation for the killing of single wolves in depredation hot spots. Such hot spots are defined as 10 – 20 attacks to a single flock with up to 80 livestock killed during one grazing season. If attacks continue despite improvement of prevention measures and although the shepherd has been given permission to use a shot gun to shoot a wolf close to the flock in self defence, permission can be granted to kill one wolf in the area of the resident pack. Between 2004 and 2010, 19 permits were issued and six wolves were killed.

Belgium

After having been absent for more than 100 years, Belgium's first wolf was confirmed by camera trap in 2011. Belgium can expect to receive single dispersing wolves from the west alpine population as well as from the Central European population spreading westwards from eastern Germany and western Poland. The wolf is a strictly protected species in Belgium.

Netherlands

In 2011, there were rumours of a wolf in the east of the Netherlands. Some people took photographs of an animal thought to be a wolf. Evaluation of these pictures by LUPUS Wildlife Consulting could neither rule out nor confirm that it was indeed a wolf. (SCALP category C3). The wolf is strictly protected in the Netherlands and its return is expected. Authorities and NGOs are beginning to prepare and are increasingly asking for information and advice from Germany.

Denmark

The last wolf was already killed in Denmark in 1772 (BOITANI 1995). In the last years, there have been repeated rumours of wolf sightings, but so far none of these could be confirmed. However, it would not be impossible for a single dispersing animal to reach the country to the north of Germany. In 2007, a young wolf was killed in a car accident in Schleswig-Holstein, about 110 km from the Danish border. The wolf is a strictly protected species in Denmark.

3.2 Poland

3.2.1 Overview on re-colonalisation of wolves in Poland

In the first five years of the 21st century, wolves slowly started to recover forests west of the river Vistula, where they had been extirpated many years previously. Data collected during the National Wolf and Lynx Census co-ordinated by the Mammal Research Institute of the Polish Academy of Science from Białowieża (MRI PAS) and the Association for Nature "Wolf" (AfN Wolf) revealed that in 2000 / 2001 wolves mainly inhabited the north-eastern, eastern and southern (Carpathian Mts.) parts of Poland. Isolated occurrences in the large forest complexes of western Poland near the German-Polish border comprised only a few individuals. The number of wolf packs was estimated at about 110, and the total number of wolves at about 550 individuals for the whole country. Mean pack size ranged from 5.5 wolves in the Carpathians, to 4 in north-east Poland, and 2.4 in the western part of the

country (JĘDRZEJEWSKI *et al.* 2002a). Hosting about 200 individuals, the Carpathian Mts and Carpathian foothills offered the biggest refuge for Polish wolves. This population was partly shared with Slovakia and the Ukraine. The other main wolf areas were the large forest complexes of north-eastern Poland, where about 160-190 wolves occurred, although some wolf packs had transboundary territories with Belarus and Russia. During the next four years, the results of the census revealed an increase in population range and numbers in the forests east of the the river Vistula and a very slow development of the wolf population in areas west of the the river Vistula.

Since 2001, the Association for Nature "Wolf" has monitored wolf recovery in western Poland. It started by surveying forests within a 100 km zone along the Polish-German border. In subsequent years, these surveys were expanded to all larger forests that had been inhabited by wolves in the past, or which were suitable for large carnivores due to their size and wild ungulate density. The first wolf family groups to rear pups were recorded in the Wałcz forest (2002), the Bydgoszcz forest and the Rzepin forest (2004), the Tuchola forest (2005) and the Święty Krzyż forest (2006). From 2007, wolves started to recover the Lower Silesian forest (near the Muskau Heath) from its eastern-most edge (area of the Przemków Heath), where the first wolf family group was observed. In 2008, a wolf pack successfully bred for the first time in the Notec forest (NW of Poznań). In 2009, resident wolf family groups were also recorded in the Cedynia forest (near the Unteres Odertal NP), the Drawsko military training grounds, and the Zielona Góra forest (near Lubsko and Forst). In 2010, subsequent packs were reported from the Drawa forest and the Słupsk forest.

The most dynamic development of the wolf population was observed in the following forest tracts: the Lower Silesian forest, the Noteć forest and the Wałcz forest. During the 10 years of survey, a short-term presence (lasting 1 or 2 years) of wolves was also reported in many other areas.

3.2.2 Current wolf distribution and population numbers in Poland

According to results obtained by the National Wolf Census in 2009, the number of wolf packs living in the whole of Poland was estimated at between 129 - 144 (mean 135), and the number of wolves at 543 - 687 (mean 615) individuals (http://www.zbs.bialowieza.pl/artykul/528.html).

In 2009, the biggest number of wolf packs was recorded in the lowlands of north-eastern Poland (51 - 56 packs, 201 - 264 wolves) and eastern Poland (16 - 21 packs, 66 - 95 wolves). The second most densely inhabited region was the Polish part of the Carpathan Mts., where 47 - 51 packs lived, comprising about 209 - 254 wolves. In 2009, the wolf population in western Poland was estimated at 15 - 16 packs and 67 - 78 wolves. The only region from which wolves were not reported was the Sudety Mts. (south-western Poland). However, since data were not provided by all of the forest divisions with wolf observations, these numbers should be considered as minimal. Since 2010 and 2011, data on the wolf distribution in Poland, but not population estimates has been available on the web site of the National Wolf Census (http://www.zbs.bialowieza.pl/artykul/557.html). According to this information all favourable wolf habitats east of the river Vistula, which together cover about 22,600 km^2 are inhabited by wolves (JĘDRZEJEWSKI et al. 2008). Habitats include the large lowland forests, the Przemysl foothills and the whole of the Carpathian Mts. According to the monitoring conducted by AfN "Wolf" in western Poland, at least 22 resident wolf family groups and 2 scent marking pairs comprising 100 - 110 animals occured there at the

beginning of 2012 (NOWAK AND MYSŁAJEK 2011, NOWAK AND MYSŁAJEK, unpubl.). Wolves were present in all large forest tracts of western Poland. Six family groups were confirmed in the Lower Silesian forest adjacent to the Muskau Heath on the German side. Recent genetic studies have proved that new packs were founded there by wolves dispersing from north-eastern Poland and from Germany (Saxony) (Czarnomska et al. 2013, Nowak and Mysłajek, unpubl.). The proximity of the German wolf population has sped up the recovery process. Three packs have been recorded in the Noteć forest, while the Wałcz and the Bydgoszcz forests are inhabited by at least two packs each; in all probability, new packs will soon form. Interestingly, very little information about lone wolves has been collected from the Sudety Mts. Altogether at the end of 2011 the wolf number was 750 - 800 wolves throughout the whole of Poland (NOWAK AND MYSŁAJEK, unpubl.).

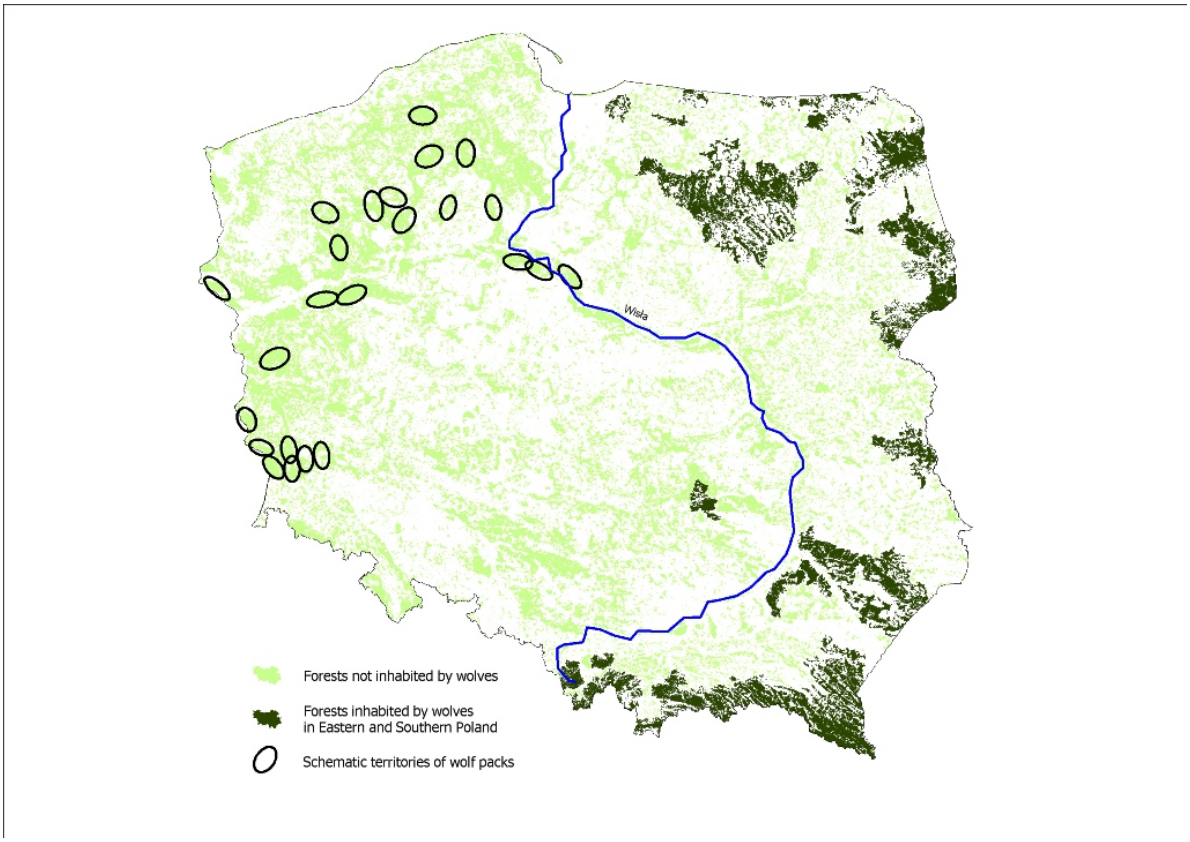

Fig. 2: Wolf distribution in Poland at the beginning of 2012 (after: Nowak and Mysłajek 2011, updated, and National Wolf Census http://www.zbs.bialowieza.pl/wilkrys).

3.2.3 Polish wolf population from a continental perspective

According to the Guidelines for Population Management Plans for Large Carnivores (LINNELL et al. 2008), wolves living in Poland belong to three European wolf populations: the Baltic – consisting of altogether 3,600 wolves (together with Estonia, Latvia, Lithuania, Russia, Belarus and Ukraine), the Carpathian – 4,000 wolves (together with Czech Republic, Slovakia, Romania, Hungary, Ukraine and Serbia), and the only recently founded Central European (German-western Polish) population. Analysis of wolf DNA has revealed that the Central European population was founded from individuals originating from the Baltic population in north-eastern Poland. Individuals from the Carpathian wolf population differ significantly genetically from other wolves in Poland. Thus, the classification of wolves from north-eastern and southern Poland into two separate populations by Linnell et al. 2008 has

been secured by genetic results (PILOT et al. 2006, CZARNOMSKA et al. 2013). So far, there is little genetic exchange between the Carpathian and the other two populations. The Baltic and the Carpathian populations have a status of Least Concern. The wolf population in western Poland, together with wolves inhabiting eastern Germany has been classified as Critically Endangered. Despite the significant increase of number and range of wolves in the forests of western Poland, the population is still too small and scattered to survive in isolation in the long term. Thus, maintaining the connectivity with the more numerous and more genetically diverse Baltic population, as well as re-establishing a connection with the Carpathian Mts. is an important issue.

3.2.4 Transboundry wolf populations

Poland shares a substantial part of its wolf population with neighbouring countries: Russia (Kaliningrad province), Lithuania, Belarus, Ukraine, Slovakia and Germany. As Polish borderline runs through large forests, a large number of wolf packs have transborder territories, e.g. in the Carpathian Mts. (NOWAK et al. 2008, FINĎO AND CHOVANCOVÁ 2004), in north-eastern and eastern Poland (OKARMA et al. 1998b, JĘDRZEJEWSKI et al. 2002) and probably also in western Poland (NOWAK AND MYSŁAJEK 2011). According to wolf pack distribution (National Wolf Census 2009 http://www.zbs.bialowieza.pl/artykul/528.html), Poland shares at least 21 transborder packs with Slovakia, 9 packs with the Ukraine, 9 - 10 packs with Belarus, 1 - 2 packs with Lithuania, and 2 - 3 packs with Russia (Kaliningrad province). Altogether this gives 42 - 45 packs and about 30 % of the whole Polish wolf population. There might also be transboundary wolf territories along the Polish - German border (e.g. in the Lower Silesian forest), but further DNA analyses are necessary to confirm this assumption.

The largest number of transboundary packs inhabit the Carpathian Mountains where 25 - 26 wolf family groups are shared between Poland and neighbouring countries (Slovakia - 21 and Ukraine – 4 - 5), and almost all Polish packs have territories within a 23 km zone of the border. In a study by JĘDRZEJEWSKI et al. (2001), 23 km was calculated to be the mean daily movement distance for wolves. In the area along the Polish - Belarussian border, 9 packs maintain transborder territories, and another 11 Polish wolf family groups live in radius of 23 km from the Belarussian border, which taken together make up about 15 % of the whole Polish wolf population.

3.3 Germany

3.3.1 Overview of re-colonalisation of wolves in Germany

From the first reproduction in 2000 to the most recent in 2011, 43 litters comprising more than 170 wolf pups have been confirmed in Germany (REINHARDT AND KLUTH unpubl. data). Establishment of a second wolf pack in 2005 marked the starting point for rapid population growth (Fig. 3). The spread of the wolf population is not as fast. The reproductive core of the German population part is still Lusatia, the region in the north-east of Saxony and south-east of Brandenburg where it all started.

In 2009, the first reproduction was confirmed outside the Lusatian core area in Saxony-Anhalt. In 2011, three reproductive events were already documented in this area, making the development of a second reproductive core in eastern Saxony-Anhalt and western Brandenburg likely.

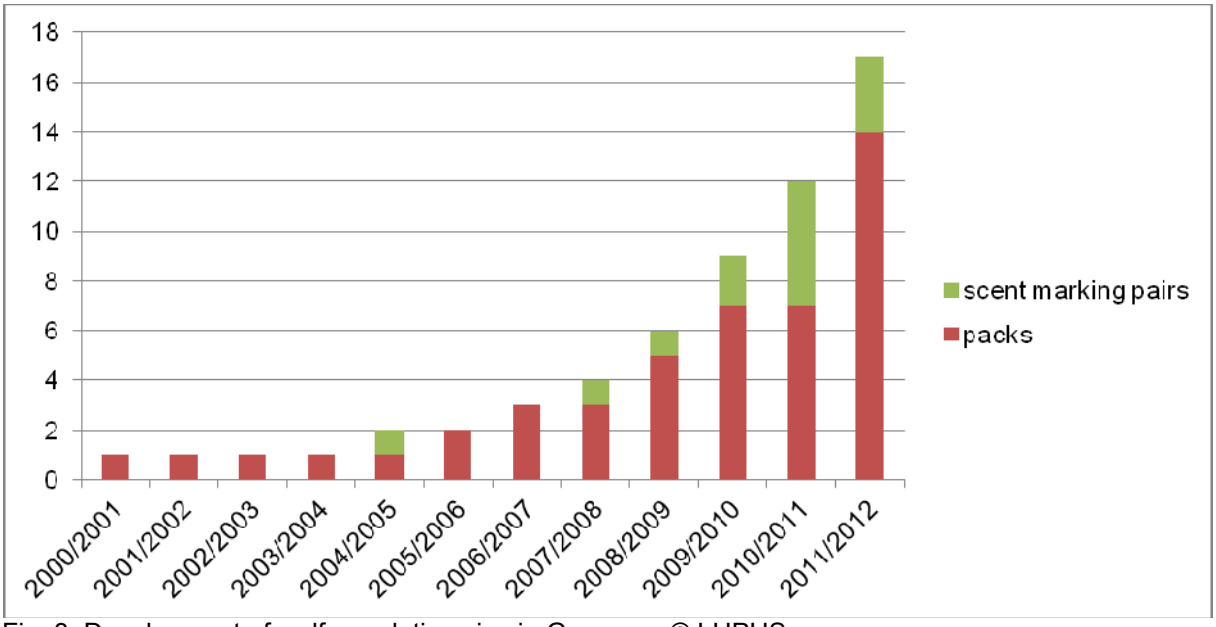

Fig. 3: Development of wolf population size in Germany. © LUPUS.

3.3.2 Current distribution and population number of wolves in Germany

The German portion of the Central European population contains two population segments: one in Lusatia with direct connection to the wolves in the Lower Silesian forest, consisting 2011 of 11 wolf packs on the German side (and six more in Poland; number of transboundary packs not known), and a second population segment comprising three wolf families located about 120 km to the north-east. In addition, several other occurrences of mostly single resident wolves have been confirmed.

Altogether, in 2011, at least 14 wolf packs were living three German Länder (Saxony, Brandenburg and Saxony-Anhalt) (Fig. 4). In two more Länder (Mecklenburg-Pomerania and Lower Saxony), single resident wolves or scent marking pairs were confirmed in 2011, and wolves were verified in four more Länder in the years before (but not in 2011).

Telemetry and genetic analyses have proved that wolves from the Lusatian wolf area have dispersed east a straight line distance of 800 km to Belarus (REINHARDT AND KLUTH 2011) or more than 350 km to the west to Lower Saxony (HARMS, REINHARDT AND KLUTH, SMUL, LFWKN unpupl. data). However, wolves settling near their parent's territory are clearly the more successful reproducers. Most breeding wolves in Lusatia are closely related to each other (HARMS, REINHARDT AND KLUTH, unpubl. data). So far, the fraction and reproductive success of long distance dispersers are unknown (REINHARDT AND KLUTH 2011).

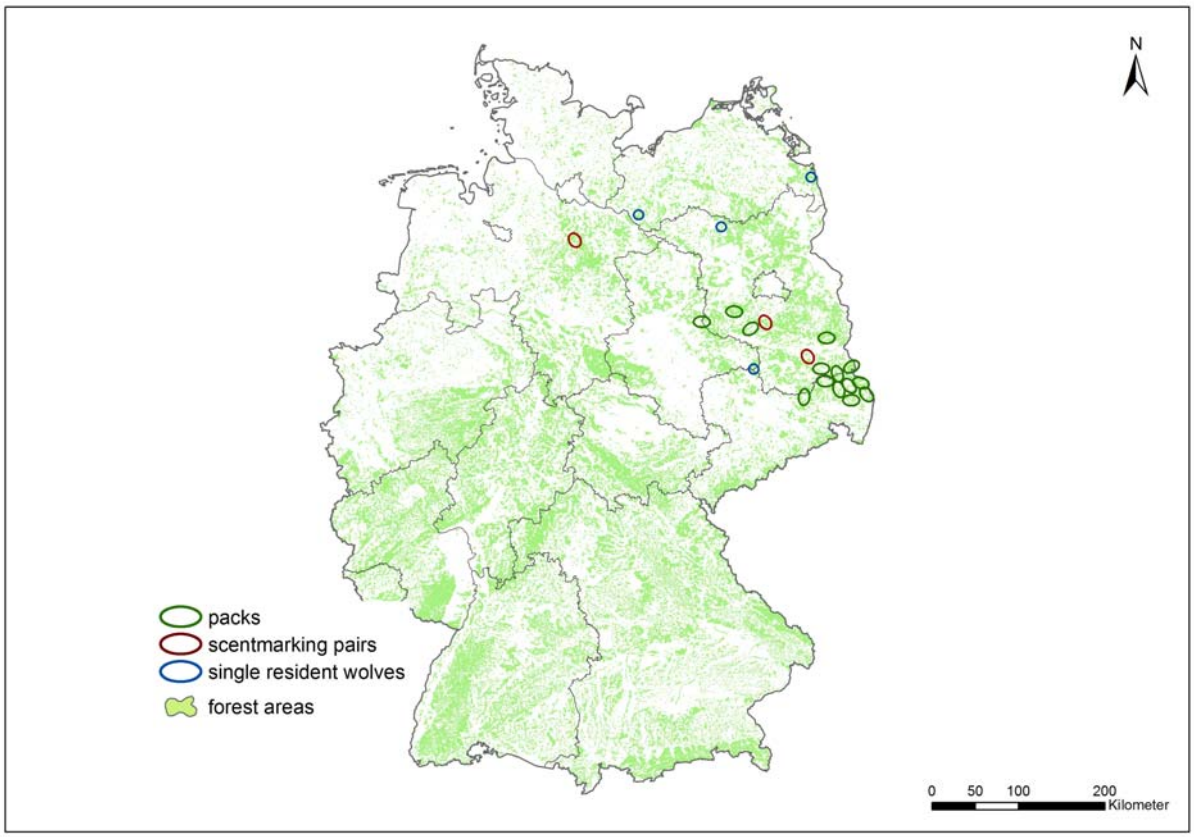

Fig. 4: Wolf occurrence in Germany, 2011/2012. Map: LUPUS.

3.3.3 Wolves in Germany from a continental perspective

Germany harbours a fraction of the Central European wolf population. The population range is divided into two segments more than 100 km apart, and several small occurrences. In the last years, two wolves originating from the Alpine wolf population were confirmed in Germany. The rapid development of this population not only means immigration of single individuals, but that expansion of the Alpine wolf population into the south of Germany is likely to happen in the near future.

3.4 Threats to wolves

3.4.1 Threats to wolves in Europe

Where human influence is low or absent wolves die of a variety of natural causes, including starvation, accidents (e.g. with prey animals), disease and intraspecific strife (FULLER et al. 2003). However, mortality in wolves living in cultural landscapes is largely anthropogenic in cause (see below).

As L. BOITANI wrote in 1995 “the most important issue in wolf conservation is public opinion”. Ten years later SALVATORI AND LINNELL (2005) stated: “Human acceptance of wolves appears to be a major problem in many areas, especially in areas where wolves have returned after an absence. This lack of acceptance is linked to many different conflicts, including livestock depredation, competition with hunters, predation on domestic dogs, fear and wider social conflicts for which wolves become symbols. It is important to not underestimate these conflicts, or to believe that they are only linked to livestock.

Understanding the reasons why acceptance varies so much between countries could be important for finding solutions." Consequently one of the major threats to wolves in Central Europe is poaching.

Poaching is a widespread problem in many countries with very diverse socio-economic backgrounds. There is a clear need for effective education and law enforcement throughout wolf range. The sometimes chronic lack of control over poaching greatly reduces management flexibility through legal means because of the need to account for this uncertainty (SALVATORI AND LINNELL 2005). Poaching is not a phenomenon in protected populations only. In Spain, poaching makes up to 50% of the known mortality in areas where wolves can be hunted (north of the river Duero), while in areas where wolves are protected almost 100% of the detected mortalities are due to illegal killing (J. C. BLANCO on 17th May 2010 at the 2nd Wolf Working Group meeting of the DG environment in Brussels).

In Finland, the wolf population increased between 1996 and 2006 from four to 25 packs (excluding transboundary packs), or a total number of about 250 wolves. Four years later, the population was down to 160 individuals. In April 2011, there were only six packs left in Finland (excluding transboundary packs). This extreme population decline occurred despite a yearly hunting quota of about 15 % of the population that was meant to raise acceptance for this predator (KOJOLA 2011). The hunting quota by itself cannot explain the dramatic shrinkage of the population (see FULLER et al. 2003), especially not the vanishing of 75 % of all packs.

In Scandinavia, poaching accounted for about half of the total wolf mortality and more than two thirds of all poaching remained undetected (LIBERG et al 2011). The authors of the study demonstrate that without poaching during the past decade, the population would have been almost four times as large in 2009 (990 instead of 263 wolves).

Thus, in many European countries poaching is one of the main threats to wolf populations. It can reach magnitudes that may even reverse the conservation effort like in Finland. Certainly, most of the poaching is cryptic (LIBERG et al. 2011). However, even if culprits are known law enforcement is very weak, thus actually taking conservation laws ad absurdum.

In some countries like Belarus or Slovakia, legal **overharvest** still is or has again become an issue (see chapter 3.1.1). Such countries may act as a sink for neighbouring population parts. Management fragmentation is therefore another threat that can hinder or even reverse the conservation efforts of single states. We would like to stress that in numerous cases population estimates are no more than an educated guess because many of the countries listed in table 1 lack a robust monitoring. Therefore, a negative population trend, especially in large populations, would only be noticed if it were immense. As long as the distribution area is not on the decline, a negative population trend can only be detected with a sophisticated monitoring approach. Besides management fragmentation, lack of a robust monitoring, especially in regions with large populations that act as a source for others could become a pitfall.

Fragmentation and isolation is one of the greatest threats, particularly to small wolf populations. Only a few centuries ago, wolves roamed across Europe. Today, only the large populations in the east (Dinarian, Balcan, Baltic and Fenno-Karelian population) are still somehow connected, while the others are to a large extent isolated from each other. The extent of this isolation questions the long term viability of especially the small populations. Inbreeding depression was proved to be severe in the Scandinavian wolf population (LIBERG et al. 2005). The immigration rate from the neighbouring Fenno-Karelian population is low

since wolves dispersing through the reindeer husbandry area in northern Fenno-Scandia face a high risk of being killed either legally or illegally (KOJOLA 2006, 2009; LIBERG et al. 2011).

In many areas of Europe, road construction increases habitat fragmentation between wolf populations and probably slows down the exchange between neighbouring populations. Incidental killing through **traffic accidents** can be a serious mortality factor locally (MARRUCO 2011; REINHARDT AND KLUTH 2011).

Cross-breeding with dogs can be a threat especially for small or fragmented wolf populations (ANDERSONE et al. 2002), or in areas with very low wolf density (LINNELL et al. 2008). Under special circumstances like in some areas of Italy, the sheer quantity of stray or feral dogs that by far outnumber wolves may lead to increased **hybridisation** (BOITANI 1984, 1999).

Diseases such as rabies, canine distemper and parvovirus, or parasites such as heartworm or sarcoptic mange might be important causes of death in wolves (FULLER et al. 2003). Canine distemper, parvovirus and sarcoptic mange can lead to an increased mortality rate especially among pups (KREEGER 2003). However, so far, cases from Europe are mainly anecdotal.

3.4.2 Threats to and conflicts with wolves in Poland - needs for wolf conservation and management in Poland

To survive in the long-term, wolves need suitable habitats with abundant prey and safe refuges in which to successfully breed and raise their young. When forests are fragmented they need ecological corridors to roam between habitats in order to find unrelated mates and vacant territories. Currently, there are several main threats to wolves in Poland, of which the most important are: habitat fragmentation and isolation, disruption of ecological corridors, disturbance of wolves in their refuges, natural and human-caused mortality (diseases, illegal killing, hunting of wolves from transborder areas) and conflicts with animal husbandry.

Fragmentation and isolation of wolf habitats and disruption of ecological corridors by transportation infrastructure. In Poland, the size and integrity of wolf habitats and the connectivity between them are threatened by urban expansion, large investments within forest areas and rapid development of the transportation infrastructure. The road and railway infrastructure is currently being developed and upgraded within the framework of the European Union program of Trans-European Transportation Network (TEN-T). Modernization of about 1,700 km of existing roads and construction of 1,500 km of new motorways and 1,600 km of express roads is to be completed by 2013. Under Polish law, all the motorways and express roads must be fenced. Because of the economic crisis in Europe and shortage of financial resources for investment, some road and railway sections will be completed later and some will not be realized or upgraded at all. However, the extent of transportation infrastructural expansion harbours the huge threat of habitat fragmentation and the population decline of many species of flora and fauna, including the wolf.

A proposition to establish an ecological corridors network linking Natura 2000 sites within the scope of the planned development of the transportation infrastructure network revealed many conflicts and threats to habitat connectivity, and showed locations where mitigation measures should be introduced (JĘDRZEJEWSKI et al. 2004d, 2005c, 2009).

Fragmentation and isolation of wolf habitat by urbanization. There is no doubt that increasing urbanisation of the Polish countryside is associated with an array of other complex issues. Unfortunately, urbanisation entails building houses along local roads or rivers, increasing linear barriers in the environment and disrupting ecological corridors. In regions with the highest human density like the Upper Silesian province, the western-most part of the Carpatian Mts., or areas adjacent to the biggest Polish towns in Central Poland, numerous villages adjoin each other; there is no gap between them. Regulations governing Polish spatial planning are still weak, small towns and villages should be more densely built so as not to threaten the connectivity between wildlife habitats. It seems therefore that this is an important factor contributing to the disruption of ecological corridors in the nearest future.

Disturbance in refuges. Most of the Polish forests are state-owned. They are protected under special regulations against conversion into investment areas or arable land. Conversion takes a long time and is expensive; however, it is possible, especially for investments of public importance. The EIA procedure should also help to protect forests against destructive activities, especially within Natura 2000 sites. However, pressure to develop various activities in forested areas has increased significantly in the past several years. The most common are investments to develop huge recreational and tourist attractions, e.g. holidays centres, hotels, ski resorts, weekend cabins. In many cases, they cause significant devastation of important habitats of rare species and generate many activities (e.g. off-road driving, cross motorbikes, snowmobiles) that disturb wolves in their refuges, both in summer and winter. The most controversial example is the week-long off-road “Rallye Breslau” regularly organised by the German-owned private company Rallye Breslau International GmbH and Co. KG http://www.rally-breslau.com at the end of June in Poland. 300 off-road cars, trucks, cross bikes and quads from all over Europe take part in the rally. During the 6-day event, particpants drive through several Natura 2000 sites near Drawsko Pomorskie (the Drawsko forest) and near Żagań (the Lower Silesian forests) in western Poland, causing devastation to the natural habitats of rare and protected species, among them the wolf.

Recently, investments of public interest, such as major construction projects for the extraction of natural and shale gas, as well as sand mining, have cause irreversible destructiion of wolf habitats in forests.

Direct mortality factors

Poaching. There are two ways in which wolves are exposed to poaching in Poland: (1) Indirect, when poachers targeting wild ungulates set snares along paths used by deer or wild boar and the wolves become accidental victims of this type of activity, (2) Direct, when poachers deliberately poach wolves by setting snares or leg-hold traps or by shooting animals. Intentional poaching of wolves is mostly an expression of conflict of human interests and wolf predation. In Poland, livestock owners rarely poach wolves. The most frequent reason for the illegal killing of wolves is competition between hunters and wolves for wild ungulates, but also hunter reluctance and fear of these predators.

The intensity with which wild ungulates are poached varies from region to region. It is most common is in the easternmost part of the Carpathians, north-eastern, eastern and north-western parts of Poland, thus within areas inhabited by the wolf population. Deliberate poaching of wolves with snares is rare, unlawful shooting is more common. Because gun

ownership requires a special permit under Polish law, not many Poles own a weapon; thus, the bulk of illegal wolf shootings is perpetrated by hunters. Generally, most wolves are killed from raised hides during individual hunts when the hunter can keep the incident under wraps. There is evidence that some wolves are also shot during drive hunts, when they are accidently driven toward the hunters and either killed intentionally or by mistake. In Poland there are two laws regulating punishment for poaching protected species:

(1) The Penal Code (June 6, 1996), article 181 § 2, 3 and 4 state that: Whoever, deliberately destroys or damages plants or animals which are legally protected, thus causing significant damage to the population, will be punished with the penalty of restriction of liberty or imprisonment of up to 2 years. If the perpetrator acts unintentionally, he will be subject to a fine or imprisonment.

(2) The Nature Conservation Act (April 16, 2004), article 127 states that: Whoever deliberately breaks prohibitions applicable to animals which are legally protected will be punished with jail or with a fine.

Enforcement of the law allowing punishment of poachers is weak in Poland. Only three cases of poaching of a protected species (brown bear and European bison) have been prosecuted in the last several years. The true range and extent of wolf poaching in Poland is difficult to estimate, as only few such cases are officially reported. Data is only available from regions where scientific projects have been conducted, e.g. of 12 radiocollared wolves in the Białowieża Primeval Forest, six were poached in snares or shot from 1994 - 1999 (THEUERKAUF et al. 2003a). From 2002 – 2006, at least five wolves were shot or snared in the Bieszczady Mts. of which one female of three radiocollared animals was shot from a raised hide (THEUERKAUF et al. 2007, GULA 2008b).

Data collected within the scope of the National Wolf Census, as well as for the database of the Association for Nature “Wolf” revealed that of 25 wolves poached between 1998 and 2012, 10 had been shot and 15 had been snared, of which in turn 3 individuals were released alive. In December 2011, wolves were shot illegally in the Głusko forest division, which is situated within the Natura 2000 site "Uroczyska Puszczy Drawskiej" PLH320046 (north-western Poland). Two animals (female and male) were killed at the same time by two Belgium hunters during a driven hunt on wild ungulates. The case was immediately reported to the police and the public prosecutor’s office, and currently prosecution proceedings are pending.

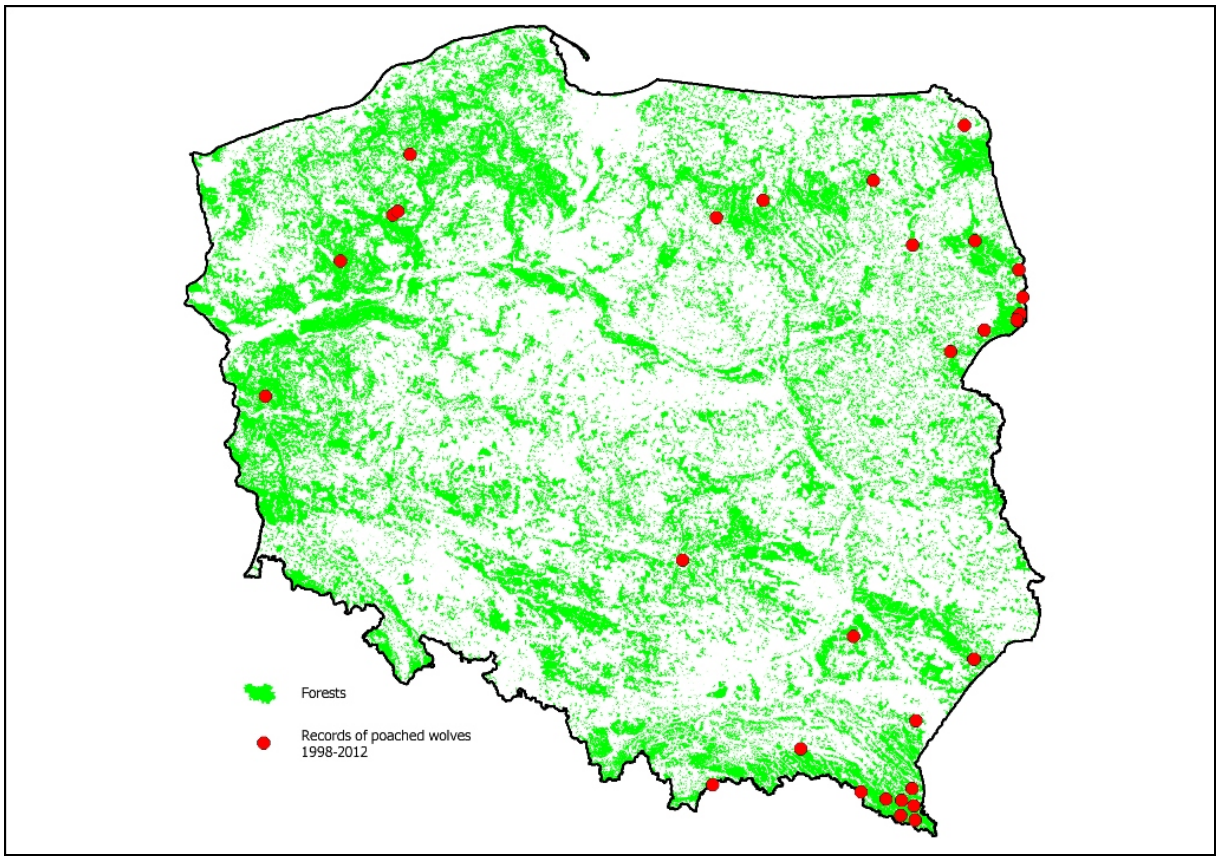

Fig. 5: Locations of wolves poached in Poland, 1998-2012. Map: AfN "Wolf".

There is opinion among some scientists and most hunters that poaching and illegal killing of wolves is wide-spread and should be considered an important mortality factor preventing development of the wolf population in western Poland (GULA 2008b). According to this opinion, the only way to limit this practice is to legalise wolf hunting. However, recent evidence of rapid recolonization of most of the suitable forests tracts in western Poland by wolves (NOWAK AND MYSŁAJEK 2011, and unpubl.), combined with the increase in population density and range in eastern Poland, shows that wolf poaching may not be as high as believed and will not hinder the population from developing. These findings are interesting if compared to the situation in the 1990s, when wolves were still legally hunted and the population range and their number significantly decreased, at least in western Poland.

Traffic casualties. In Poland about 65 % of national roads deter animals from crossing (> 6,000 v/d), and traffic exceeded 15,000 vehicles per day (v/d) on 12 % of the roads. South, south-west and central Poland have the highest traffic density (18,000-11,000 v/d), the north-east and north-western parts of the country have the lowest < 7,000 v/d. Such traffic causes a high level of road mortality among wildlife, including wolves. Since 2000, 26 wolves have been reported to be killed by cars and trains in Poland (23 adults and 3 pups). Even in western Poland, where the wolf population is lowest, at least 10 wolves (7 males and 3 females) have been hit and killed by cars in the last six years (between 2005 and 2011), including one wolf by a train (NOWAK AND MYSŁAJEK, unpubl.). Like with poaching, it is very difficult to assess the actual number of wolves that die every year in accidents involving the national transportation infrastructure, as such cases are rarely discovered and reported to Nature Conservation departments.

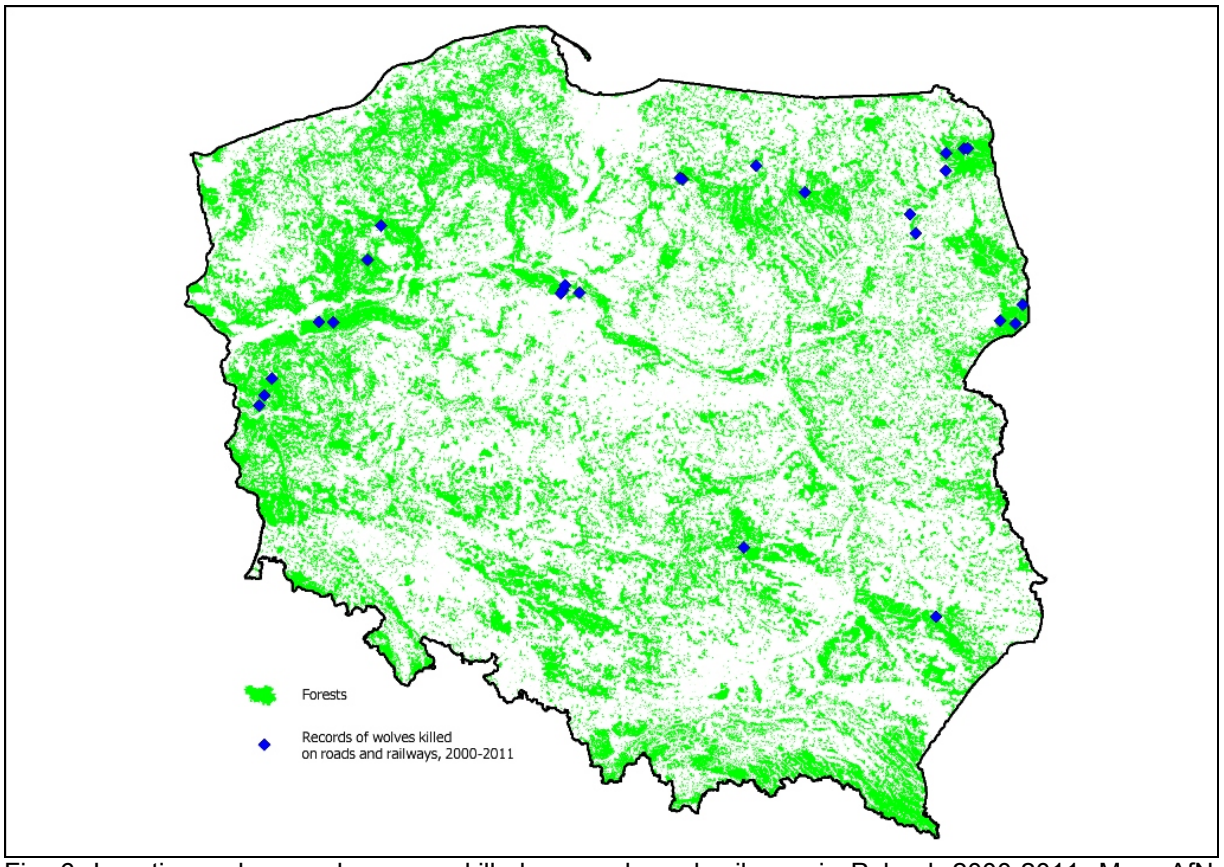

Fig. 6: Locations where wolves were killed on roads and railways in Poland, 2000-2011. Map: AfN "Wolf".

Although according to article 12 p. 4 of the Habitat Directive there is an obligation for member states to monitor the incidental capture and killing of animals listed in Annex IV, and according to the Polish Nature Conservation Act regional directorates of the environment are obligated to report all cases of incidental capture and killing of strictly protected animals, there is no regional or national system of registering such cases (road kills and poached animals) in Poland. Dead wolves are mostly reported when the local forest division applies to the Regional Directorate for Environmental Protection for permission to stuff the dead wolf. There are also no special research or conservation measures in place to ensure that incidental capture and killing do not have a significant negative impact on the wolf population.

Diseases. Wolves in Poland are subject to a number of diseases. A study conducted in different parts of the country based on scats analyses as well as examination of dead wolves revealed the presence of 19 species of helminth parasites in wolves (KLOCH et al. 2005, POPIOŁEK et al. 2007, SZCZĘSNA-STAŚKIEWICZ 2009). In lowlands the prevelance and diversity of helminth parasites was much higher than in the Carpathian Mts. In half the cases, wolves in lowlands were infected with two or more parasites (up to six), in mountains mostly with one. Also, three protozoan parasites (including *Babesia gibsoni*, a factor of babesiosis, very common deadly disease in dogs) have been found in wolves in north-eastern Poland. However, there are no detailed data on the level of mortality caused by these factors in wolves.

Wolves severely infected with sarcoptic mange have been observed in different regions of Poland, such as the western Carpathian Mts. (Żywiecki Beskid Mts.) (NOWAK et al. 2008), the eastern Carpathian Mts. (Bieszczady Mts.), the Romincka forest (NE Poland), where two

dead wolves, a male and a female, were recently found. Similarly, in western Poland, a wolf with advanced mange was observed in the Rzepin forest in 2009, the same time the local pack suddenly decreased in number there (NOWAK AND MYSŁAJEK 2011).

A program of oral vaccination of wildlife (especially foxes) launched in Poland in 1993 caused more than a hundredfold decrease in the incidence of rabies in wild animals, including wolves (SADKOWSKA-TODYS AND KUCHARCZYK 2009). In the last ten years, only two rabid wolves have been recorded in the whole country, one in 2000 and one in 2004. Present cases of rabies among wild and domestic animals occur mainly in eastern and north-eastern Poland, close to the border with Ukraine, Belarus and Russia, where oral vaccination programs have not been introduced. As is mentioned in the Wolf Population Management Plan of the Republic of Belarus (2011), there are about 7 cases of rabies amongst wolves per year. Wolves can also suffer from tuberculosis, and 3 of 6 animals shot in 2005 - 2008 in the Bieszczady Mts. were infected with *Mycobacterium tuberculosis*, bacteria associated with cows and humans (SALWA et al. 2011). The source of the infection could be depredation of wolves on cattle, or remains of cattle left at baiting stations set by hunters, of which there are many in the mountains.

Hunting of wolves from transboundry populations. In most of our neighbouring countries wolves are game species, and hunting them like in Lithuania and Slovakia, or persecution like in Russia, Belarus or the Ukraine is legal. Wolves are strictly protected only in Germany and the Czech Republic. We share a part of our wolf population with all these countries. The biggest impacts on the Polish wolf population have been culls of wolves in Slovakia, Ukraine and Belarus.

In Slovakia, the hunting season lasts from 1st of October to 31st of January. During the season 2010/2011, a total of 159 wolves were shot, while a hunting quota was set at 150 animals by the Ministry of the Agriculture. The estimated population number ranged from 350 - 450 individuals. At least 27 wolves (17.6% of the total harvest) from transborder territories were shot within an 8 km zone along the Polish-Slovakian border. Altogether, about 60% of the harvest takes place within the 23 km zone along the Polish-Slovakian border (NOWAK AND MYSŁAJEK, unpubl.). During the past several years, the harvest quotas have remained similar: 2011/2012 – 135 wolves (hunting quota – 120 animals), 2009/2010 – 138 wolves, 2008/2009 – 127 wolves, 2007/2008 – 123 wolves; during the past five years, 682 wolves have been killed in Slovakia (http://www.wolf.sk/sk/vlky). Studies of 3 transborder packs in the Żywiecki Beskid Mts., the western-most part of Carpathian Mts., showed that from 1999 – 2003 culls of wolves in the adjacent area in Slovakia were responsible for 83 % of the total wolf mortality within the study area (NOWAK et al. 2008). Recently the Polish-Slovakian Large Carnivore Working Group achieved a preliminary agreement on creating in Slovakia a 23 km hunting ban zone along the Polish-Slovakian border to protect the transborder population of wolves (details in a chapter 5.2). However its acceptance by the Slovakian government is still pending.

In Belarus, wolves are hunted all year round. The “Wolf population management plan” developed in 2009 proposes large-scale reduction of the population of this species. It provides for the elimination of more than 60% of wolf packs in Belarus, and interference with the other family groups using methods such as removing pups from dens and killing them, which is inhumane and unacceptable, and prohibited under the provisions of international law (art. 6 of the Bern Convention, art. 12 of the Habitat Directive). Because there is a plan to reduce the existing 52 wolf packs to 16 in the Grodno and Brest provinces bordering with

Poland, it poses a real threat to wolf family groups living in north-eastern Poland. The wolf population in Grodno and Brest provinces is heavily exploited; thus, there is a high probability that most of the young wolves born on the Polish side will disperse to the Belarusian side to repopulate vacant territories. Therefore, the survival of the population in Grodno and Brest provinces in Belarus depends on the supply of wolves from the Polish population. In 2010, the Management Plan was rejected by the Polish Ministry of the Environment and it refused to endorse a repeal of the ban on imports of wolf-derived hunting trophies from Belarus to the European Union.

Generally, there is regular and intensive exploitation of wolves from transboundry populations in countries bordering Poland to the east and south. This generates a typical source-sink mechanism, when the protected wolf population in Poland serves as a source of wolves migrating to adjacent countries to repopulate vacant territories, from which wolves have been extirpated. Without the regular supply of wolves from the Polish side it is likely that populations in these countries (especially those in regions close to the Polish border) would be unstable or that they probably wouldn't even survive in the long-term. This process limits the number of wolves migrating to the west, and will impact on the speed of wolf recovery in western Poland and Germany. Moreover, there is a real threat that wolves travelling in the opposite direction from west Poland and Germany will be killed in adjacent countries.

Exploitation of transboundary populations of large carnivores without co-operation between the countries sharing these populations is not consistent with the preamble and articles 1, 10 and 11 of the Bern Convention (Slovakia and Ukraine are parties to this convention), and especially with Recommendation No. 115 (2005) on the conservation and management of transboundary populations of large carnivores http://www.lcie.org/Docs/Legislation/Rec115_2005.pdf

Depredation on livestock. As the damage compensation system is quite well-established in Poland and the corresponding law functional, conflicts with breeders are generally quite rare. However, some cases of depredation, mostly those that happen regularly at certain farms or in areas newly re-colonised by wolves cause difficulties for breeders and involve media interest. Thus, every year 1-3 applications are submitted to the General Director for the Environment for permission to cull wolves responsible for regular damage. The National Council of Nature Conservation expresses its opinion about applications and then permits indicating the number of wolves, the time and place of the cull are either issued or refused, when it is not reasonable. From 2000 to the middle of 2012, a total of 24 such permits were issued for 49 wolves, of which 9 were shot (see table 3).

Although the compensation system is considered to be well established and efficient, wolf depredation on livestock is frequently used as an argument by hunters to change the legal status of the species. Moreover, sometimes hunters use the threat of damage to domestic animals to reinforce and augment negative attitudes towards wolves in local communities.

3.4.3 Threats to and conflicts with wolves in Germany

Threats to wolves in Germany are clearly associated with humans (table 2). At first glance traffic appears to be the main cause of mortality. However, traffic accidents with large animals are mostly reported to the police for insurance purposes, while illegal killings are

generally not made public. Yet 35 % of known mortality cases are due to illegal killing, an alarming number but in accordance with experience in other European countries (see above). The amount of cryptic poaching activity (LIBERG et al. 2011) is probably much higher.

Tab. 2: Causes of wolf mortality in Germany (REINHARDT AND KLUTH 2007, unpubl. data).

	legal* / illegal** killing	traffic accident	natural causes	unknown
1945 - 1990	19*	-	-	-
1990 - 2011	14**	23	3	3

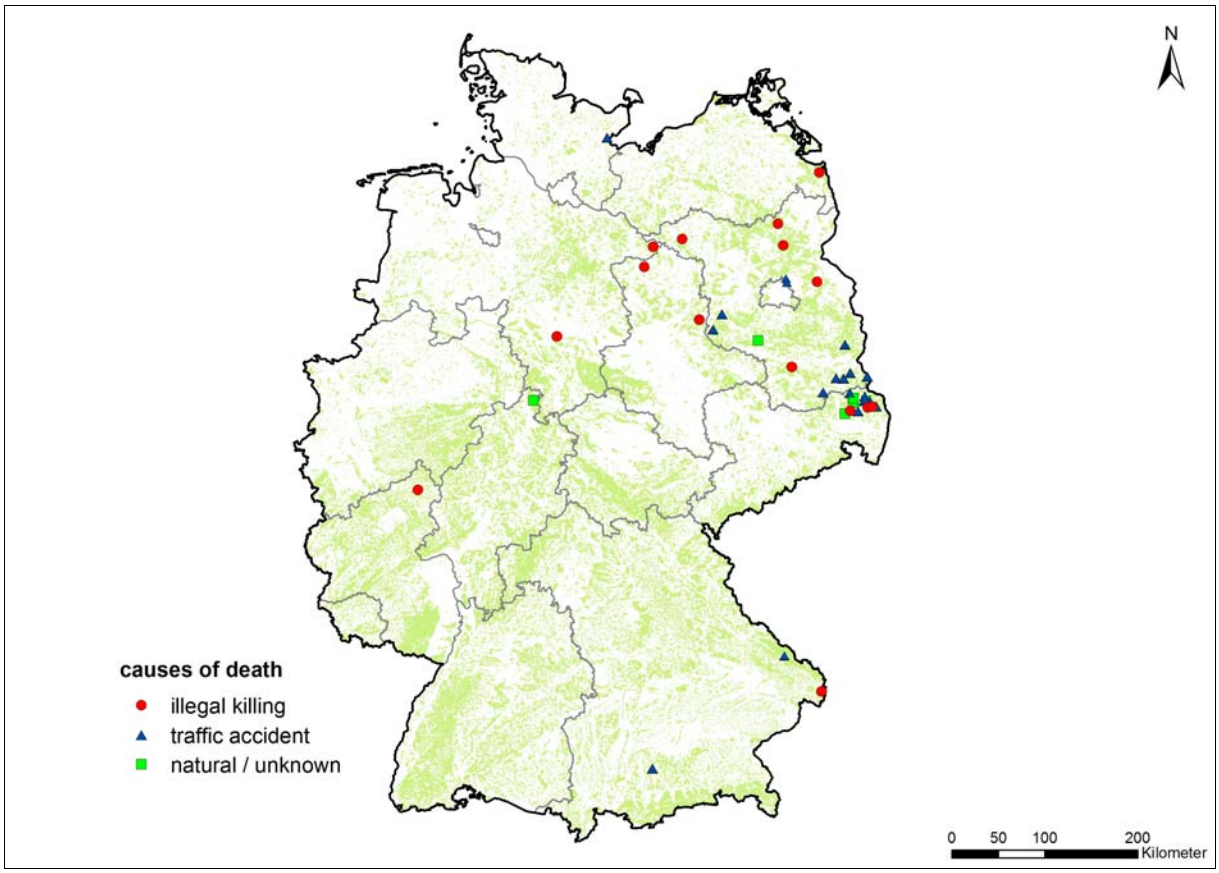

Fig. 7: Wolves found dead between 1990 and April 2012 in Germany. Map: LUPUS.

Law enforcement is weak when it comes to illegal wolf killings in Germany. Most enquiries are abandoned and some cases are not even investigated. Even when the alleged culprit is known, the procedure is generally either dismissed or not even opened. So far, a fine has been imposed in one case only.

The number of traffic accidents is not surprising since the German wolf area has the highest known road density of all wolf regions in Europe (REINHARDT AND KLUTH 2011). However, there are hot spots of accidents with wolves that could and should be mitigated. The B156 in Saxony is such a spot where eight wolves have been killed by traffic in five years. While five of these animals were pups of the resident pack three were dispersers from Poland - genetically valuable individuals for the German portion of the population.

Looking at the distribution map of wolves in Germany, it is remarkable that the expansion appears to be directional while it should not be (WABAKKEN et al. 2001, MECH AND BOITANI

2003, KOJOLA et al. 2006). This is a strong hint that there might be threats hindering a south-west expansion of wolves.

The rapid population increase in the Lusatian wolf area from one wolf pack in 2000 to 11 packs in 2011, and the contrastingly slow increase outside the core area might reflect an increased mortality in dispersing wolves, as has been shown in Scandinavia (LIBERG et al. 2010), though the data for Germany are still missing.

The increase in wolf population numbers and areas of occurrence cannot obscure the fact that wolf distribution will be highly fragmented in Germany, possibly dividing the German part of the population into several population fragments (KNAUER 2010). Maintaining connectivity between these population clusters will be important to enhance viability of the population as a whole.

Long-distance dispersal of some wolves (REINHARDT AND KLUTH 2011) does not alter the fact that connectivity to neighbouring populations in the East is still weak. This is the conclusion drawn from the preliminary results of genetic analyses of wolves in Lusatia showing a considerably amount of inbreeding and a so far lacking introgression of external genes into this part of the Central European population (HARMS, KLUTH, REINHARDT, SMUL, unpubl. data).

Although monitoring standards for LCs have been in place in Germany since 2009, which is big progress, a structure ensuring robust area-wide monitoring is however still missing in most of the Länder. This harbours the danger of wolves making themselves known - usually by killing sheep - in regions that are unprepared. This will almost certainly be accompanied by a decrease in acceptance especially among the rural people. Another issue arising from monitoring fragmentation and, in consequence, highly diverse monitoring efforts is an unsatisfactory picture of the wolf situation in Germany as a whole. For instance, as long as all the Länder do not have their genetic samples analysed within a reasonable time frame the genetic picture for the whole country will remain incomplete.

Wherever this species occurs, the main conflicts are related to livestock issues and to competition with hunters. The same applies in Germany. However, wolf – livestock conflicts seem moderate compared to many other European countries (REINHARDT et al. 2010). In the German lowlands, where most of the wolves occur prevention measures are much easier to implement than in the high mountain areas of the Alps. However, a systematic prevention scheme is still not the rule in the German Länder (REINHARDT et al. 2010).

Overall, public attitudes towards the return of the wolf are positive in Germany (KACZENSKY 2006). However, this opinion stands on shaky ground and can easily turn (KACZENSKY 2006) if problems with wolves increase and people have the feeling they are being left alone.

In Germany, the main area of conflict is the lack of acceptance of wolves by hunters. Contrary to the general public, hunters´ attitudes towards wolves are much more negative (GÄRTNER AND HAUPTMANN 2005, KACZENSKY 2006).

4. Legal aspects of wolf management in the EU, Poland and Germany

4.1 Legal aspects of wolf management in the EU

At the international level, the wolf is included in several conservation agreements. CITES (Convention on International Trade in Endangered Species of the Wild Fauna and Flora (03.03.1973)) lists the wolf in Appendix II except the populations of Bhutan, India, Nepal and Pakistan, which are included in Appendix I (species in danger of extinction) (22.12.2011). Appendix II lists "all species which although not necessarily now threatened with extinction may become so unless trade in specimens of such species is subject to strict regulation in order to avoid utilization incompatible with their survival". CITES is implemented in the EU through a set of Regulations known as the Wildlife Trade Regulations.

Council Regulation (EC) No. 338/97 deals with the protection of species of wild fauna and flora by regulating trade in these species. It lays down the provisions for import, export and re-export as well as internal EU trade in specimens of species listed in its four Annexes. It provides for procedures and documents required for such trade (import and export permits, re-export certificates, import notifications and internal trade certificates) and it regulates the movement of live specimens. It also sets out specific requirements for Member States to ensure compliance with the Regulation and to impose adequate sanctions for infringements (http://ec.europa.eu/environment/cites/legis_wildlife_en.htm).

On the European level, the wolf is included in Appendix II (strictly protected species) of the Bern Convention (Convention on the Conservation of European Wildlife and Natural Habitats, 19.09.1979). The aim of the Bern Convention is "to conserve wild flora and fauna and their natural habitats, especially those species and habitats whose conservation requires the co-operation of several States, and to promote such co-operation", with particular emphasis given to endangered and vulnerable species. It was adopted and signed in Bern, Switzerland in September 1979, and came into force on 1st June 1982 (Directorate of Culture and Cultural and Natural Heritage, 2003).

The Convention establishes obligations for Parties on the protection of natural habitats and on the protection of a large number of species mentioned in three appendices (strictly protected flora species in Appendix I, strictly protected fauna species in Appendix II, protected fauna species in Appendix III) and also on prohibited means and methods of killing, capture and other forms of exploitation in Appendix IV. The contracting parties have undertaken, *inter alia,* to protect the habitats of wild flora and fauna species (Chapter II), and to give special attention to the conservation of the wild flora and fauna species listed in Appendices I and II, as well as to the protection of the fauna species listed in Appendix III (Chapter III) (Directorate of Culture and Cultural and Natural Heritage, 2003).

Hence, the wolf and its habitat receive full protection, whereby enforcement relies on the contracting parties. The Standing Committee of the Bern Convention also adopted a recommendation on the protection of the wolf in Europe (Rec. No. 17/1989), urging parties to implement numerous activities in order to meet the obligations of the convention. However, several countries made reservations regarding the wolf before adopting the Bern Convention: Bulgaria, Czech Republic, Finland, Latvia, Lithuania, Macedonia, Poland, Slovenia, Slovakia, Spain, Turkey and the Ukraine.

Currently Switzerland has applied for amendment of article 22 of the Bern Convention to allow contracting parties to make reservations after adopting the Convention. This would allow Switzerland to make a reservation against protection of the wolf. Another application for

amendment from 29th September 2004 to delete the wolf from appendix II and include it in Appendix III failed.

The European Commission implements the Bern Convention through Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (Habitats Directive), which establishes a legally binding and directly enforceable regime of habitat and species conservation for Member States, all of which are also Parties to the Convention (SHINE 2005).

The Directive designates the wolf as a species of Community interest for which measures shall be designed to maintain or restore it to favourable conservation status. However, requirements are differentiated for certain wolf populations as a result of negotiations prior to adoption of the Directive (or accession by newer Member States) (SHINE 2005). The wolf is listed in Appendix II (needs habitat conservation) apart from populations in Estonia, Finland, Greece (north of the 39°longitude), Latvia, Lithuania and Spain (north of the river Duero). It is also listed in appendix IV (fully protected) with the exceptions of the populations in Bulgaria, Estonia, in Finland in the semi-domestic reindeer husbandry area, Greece (north of the 39°longitude), Latvia, Lithuania, Poland, Slovakia and Spain (north of the river Duero) where the wolf is listed in Appendix V (species of community interest whose taking in the wild and exploitation may be subject to management measures).

Member states may derogate from the strict protection provided that there is 1) no satisfactory alternative, 2) the impact to the favourable conservation status and 3) one of the five derogation reasons is satisfied (art 16, Habitat Directive). Unlike the Bern Convention, EC law imposes legal obligations that can be directly enforced through the national and European courts. On 13 January 2005, the European Commission initiated proceedings against Finland in the European Court of Justice (C-342/05) on the grounds that the systematic hunting of wolves, with hunting licences granted on the basis of certain predetermined quotas not focused on individual animals causing serious damage, did not meet the conditions laid down in Article 16 and that other satisfactory alternatives existed (Shine 2005). However, the European court has handed down the ruling. Although it states that by authorising wolf hunting on a preventive basis Finland has failed to fulfil its obligations under Articles 12(1) and 16(1) (b) of that directive, the ruling also rejects several points of the European Commission's case (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:62005CJ0342:EN:PDF). The court ruling confirmed that the use of a maximum regional limit to kill individual wolves in game management districts is not per se contrary to art 16(1) of the Habitat Directive (C-342/05 paragraph 45).

Currently, there is a dialogue between Sweden and the EC regarding the licence hunt in Sweden in 2010 and 2011. The Commission is concerned about several aspects of Swedish wolf policy and especially about the hunting of wolves when the species is not in favourable conservation status. Therefore, on the proposal by Environment Commissioner Janez Potočnik, it has decided to launch a formal infringement procedure by sending a Letter of Formal Notice. The Commission highlights that the concerns are related to Sweden's use of derogation for a licensed hunt, not its separate use of specific derogations for shooting of a more limited number of wolves in order to prevent serious damage to livestock (http://europa.eu/rapid/pressReleasesAction.do?reference=IP/11/95andformat=HTML).

France as an example has used derogations in so called depredation hot spots in a very restricted manner for years without coming into conflict with the commission (see above).

For species listed in Appendix II Habitat Directive, special areas of conservation (SACs) have to be designed. The Birds Directive requires the establishment of special protection areas (SPAs). Together the SPAs and SACs make up the Natura 2000 network of protected areas. The SPAs are designated directly by each EU member state while the SACs follow a more elaborate process: each EU Member State must compile a list of the best wildlife areas containing the habitats and species listed in the Habitats Directive; this list must then be submitted to the European Commission after which an evaluation and selection process will take place on European level in order to become a Natura 2000 site.

Obviously conservation of a species like the wolf cannot be restricted to protected areas. Only a few protected areas in Europe are large enough to contain the territories of several wolf packs. Still, as the wolf is listed in Appendix II, Natura 2000 sites are required for this species of community interest.

The European Parliament also approved (24.1.1989) a resolution (Doc. A2-0377/88, Ser.A) which calls for immediate steps for wolf conservation in all European States, adopts the IUCN Wolf Manifesto and invites the European Commission to expand and provide financial means to support wolf conservation.

The aim of the Habitat Directive is to “ensure bio-diversity through the conservation of natural habitats and of wild fauna and flora”. In order to achieve this, measures “shall be designed to maintain or restore, at favourable conservation status, natural habitats and species of wild fauna and flora of Community interest” (art 2 Habitat Directive). Large carnivores need a lot of space. Wolf territory size in Europe varies from 100 to 2000 km² (e.g. JEDRZEJEWSKI et al. 2001; SAND et al. 2010) depending on habitat productivity. This implies that wolves are never really abundant, with densities typically varying between 0.1 to 3 or 4 individuals per 100 km². Wolf populations in favourable conservation status therefore extend over huge distribution areas that will usually be fragmented by many different administrative borders. 29 out of 33 large carnivore populations in Europe are transboundary and the remaining four are not in favourable conservation status (LINNELL et al. 2008). Thus it becomes apparent that the scale for conservation planning should not be just the friction of a population that falls within country boundaries. Rather it should be the entire biological unit; that is the population (LINNELL et al. 2008).

There is no single recipe for the management of large carnivores, and populations spanning several countries face a great diversity of management approaches as can be seen in table 1. Different local situations may demand potentially different management solutions. However, local management solutions must be set in the context of the large scale they are working on and of the most appropriate biological unit. Therefore, a population approach is needed.

Against this background, in 2005 the European Commission (EC) authorised the development of “Guidelines for population level management planning for large carnivores in Europe”. The result is an expert written document of the same title (LINNELL et al. 2008) to which the EC refers to since as best practice guidelines. These guidelines follow the principle of “freedom within frames” (LINNELL 2005). As long as the goals are decided on a large scale there is some flexibility to modify the mechanism used to achieve this goal on a more local scale (LINNELL et al. 2008). In other words “think global, act local”. The authors state that within large populations there is far more room for different approaches and freedom of action than within small populations (or within the friction of a population falling within one country).

From a conservation perspective, the overall goal would be to establish a metapopulation of interconnected populations, each at a level of favourable conservation status (FCS). For single populations the goal should be to make species status as favourable as possible not just to achieve a minimum viable population. Hence the intention of the Habitat Directive appears to be that countries should not set limits on large carnivore expansions once they have achieved (in cooperation with neighbouring countries) a minimum level of FCS (LINNELL et al. 2008).

LINNELL et al. (2008) recommend that by default large carnivores should be allowed to recolonise as many areas as possible, but accept that there may be limits to this and that the favourable reference range (FRR) can be less than the maximum potential range.

However, the absolute minimum requirements that member states must meet are:

(1) Countries sharing one population, or segments of a population, contribute to ensuring between them that the population reaches and maintains FCS, and

(2) They allow for connectivity between neighbouring populations and segments within the same population, and

(3) Management activities do not create a sink that can influence the FCS of a population, and

(4) Populations should in general not be allowed to go below the level they had when the Directive came into force on their territory.

Though the reporting routines of the Habitat Directive require that FCS is evaluated within each country, more precisely for each biogeographical region within the country, the guidelines' (LINNELL et al. 2008) recommendations of a population level assessment is still in accordance with the Directive as stated in the guidance documents: Populations should be seen as biological populations irrespective of political borders. In cases where populations are transboundary member states are encouraged to undertake a common assessment but to report separately (DocHab 04-03/03-rev.3). A population approach as it is already the intention of the Bern Convention is reasonable since most countries will hardly be able to host LC populations in their own territory that can reach FCS. To achieve Directive goals for a species group like LCs spatial scales that span borders must be considered. Thus population level management plans can simply be viewed as an instrument to achieve this goal (LINNELL et al. 2008).

Although the approach is strikingly reasonable, to date no population level management plans have been developed for large carnivores in Europe.

4.2 Poland

Bern Convention: Poland ratified the Bern Convention in 1995, but the wolf was excluded from the Appendix II.

Habitats Directive: According to the derogation obtained by Poland, the wolf has been left in Annex II, but moved from Annex IV to Annex V of the Habitats Directive. It allowed creating Natura 2000 sites which protect wolf habitats (for details see below).

Council Regulation (EC) No. 338/97: Poland has adopted the regulation and there are special procedures regulating the trade of trophies and body parts of wolves within Poland

and from abroad. All permits for import or export of wolf trophies must be accepted by the National Council of Nature Conservation.

National regulations: Despite these derogations, at the national level, the wolf has been a strictly protected species in the whole of Poland since 1998. Furthermore, the wolf is listed among species requiring active protection. Consequently, a seasonal protection zone encompassing a radius of 500 m may be established around wolf pup-rearing areas from 1st April to 31st August. However enforcement of the law is very weak.

Derogations regarding wolf killing and capturing procedures

According to the Nature Conservation Act (April 16, 2004), article 56 p.1, since 2008, a derogation regarding wolves can only be granted by permission of the General Director for Environmental Protection (GDEP) in those cases where wolves pose a serious threat to humans or cause numerous damage to livestock and there is no other/alternative way of preventing it. All applications for derogations submitted to the GDEP should include the name and address of the applicant; the purpose of implementing the proposed activities, a description of the activities for which a license is being sought, the number of individuals concerned, the manner, methods and equipment used to capture, trap or kill the animals, the place and time of the action, the ensuing risks and an indication of who will capture or kill the animals. Most such applications are submitted by local communities, only few by individual livestock owners. In most of cases, the National Council of Nature Protection (an advisory body for GDEP) is asked for an opinion on whether the derogation is reasonable and necessary. Since 2000, a total of 25 permits have been issued to kill 49 wolves, 10 of which have been shot so far (the last permit for 2 wolves has not expired yet). In 4 cases, the wolves were in a very poor state of health (sarcoptic mange, rabies or other disease), in 1 case the wolves had escaped from an enclosure. In 20 cases, the decisions were justified with the statement that “the wolves pose a serious threat to humans and/or livestock”; however, the threat to humans was not based on reliable research or facts but on the stance or convictions expressed in applications by local communities to the General Director for Environmental Protection (table 3).

Tab. 3: Derogations from the Polish Nature Conservation Act issued by the Polish Ministry of Environment (2000 -2007) and the General Directorate for Environmental Protection to shoot wolves in Poland, 2008 - 2012.

Year the permit was issued	Number of wolves permitted to kill	Number of wolves actually killed	Reason the permit was issued
2000	1	0	Poor health status; potential risk for people.
2001	2	?	Individuals specialised in livestock killing.
2001	1	?	Individuals posing a threat to humans and livestock.
2002	1	?	Individual posing a threat to humans and livestock
2003	3	1	Numerous damage to livestock.
2003	3	0	Individuals posing a threat to humans and livestock
2003	2	0	Numerous damage to livestock.
2003	1	0	Individuals posing a threat to humans and livestock
2003	3	0	Numerous damage to livestock.
2003	3	0	Numerous damage to livestock.
2003	1	0	Individuals posing a threat to humans and livestock
2004	1	0	Poor health status; potential risk for people.
2004	1	1	Suspected rabies.
2004	2	0	Individuals escaped from captivity.
2004	1	0	Numerous damage to livestock.
2005	2	0	Numerous damage to livestock.
2005	2	0	Numerous damage to livestock.
2005	4	3	Numerous damage to livestock.
2007	6	4	Numerous damage to livestock.
2007	2	1	Numerous damage to livestock.
2008	2	0	Numerous damage to livestock.
2008	1	0	Injured individual.
2008	1	0	Numerous damage to livestock.
2009	1	0	Individuals posing a threat to humans and livestock.
2012*	2	?	Numerous damage to livestock.
Total	49	10	

* - permission in progress till 2013.
? - no data.

4.3 Germany

Germany adopted the Bern Convention in 1984 without reservations regarding the wolf. According to the Habitats Directive, the wolf is listed in Appendix II and IV in Germany. In the Federal Republic of Germany the wolf has been strictly protected since 31st August 1980 (BArtSchV). In the German Democratic Republic, the wolf was classified as a game species, and since 1984 wolves could and were to be hunted all year round. Consequently, individuals immigrating from Poland were shot. After reunification in 1990, the wolf became a fully protected species in Germany. For a number of years, some of the New Länder still kept the wolf as a game species with a closed season. In 1999, Mecklenburg-Western Pomerania was the last of the Länder to remove the wolf from the domain of hunting law. Today, the wolf is solely governed by the Federal Nature Conservation Act, where it is listed as strictly protected (§44 BNatschG 29.07.2009); enforcement relies on the Länder. §44 BNatschG defines bans on access, possession and on marketing for strictly protected species. According to this paragraph it is illegal to capture, injure or kill wolves or to disturb them in a way (for example at their breeding places) that the conservation status of the "local population" will be degraded. The term "local population" is legal jargon, which with regard to the wolf is interpreted by conservation experts as the territorial unit, e.g. the pack or the pair.

Currently, it is the intention of some Länder (Saxony, Brandenburg) to bring the wolf under the additional control of hunting law. The driving forces behind this move are hunting associations and their desire to gain more influence on wolf population development. Legally, it would not affect the protection status of the wolf; however, the administration would increase and management of the species become more awkward. Furthermore, often, regional hunting legislation does not comply with the Habitats Directive (LOUIS AND MEYER-RAVENSTEIN 2009). To put a strictly protected species in the domain of regional hunting legislation would first entail major revision of the law.

Germany has allocated 4,619 SACs or 9.3 % of its terrestrial land cover (www.bfn.de) for implementation of the Habitats Directive. However, most of these areas are very small in comparison to wolf territory sizes. Only five Natura 2000 areas (4 in Saxony, 1 in Brandenburg) ranging from 329 ha to 13,732 ha were allocated for the wolf. The reason for this low figure is that most SACs were designated in 2004 and 2005, when many Länder authorities still could not imagine the wolf spreading. So far, the Länder have missed the opportunity to subsequently register the wolf as an object of protection in SACs, to which the species has immigrated since the areas were initially designated. To date, derogations according to art. 16 Habitats Directive have not been issued in Germany. According to various wolf management plans of the Länder, derogation for removal of a wolf can be granted if a wolf cannot be stopped from killing protected livestock by any other means, or if a wolf poses a threat to humans (e.g. SMUL 2009). However, so far no such cases have occurred.

To date, six official removals of wolves are known:

2000, Brandenburg: a three legged male wolf became interested in a German shepherd female in heat. It tried to get close to the dog while ignoring people. The wolf was captured and placed permanently in an enclosure where it lived for several years.

2004, Bavaria: a single wolf that showed up in the Bavarian Forest showed little fear of humans. The wolf was killed by police order. A self proclaimed wolf expert had "identified" the animal as a hybrid. The persons responsible were charged. Charges were dropped.

2008, Saxony: a 4.5 month old disorientated wolf pup showed up in a city some 15 km outside the Saxonian wolf area. The pup was captured. Genetic analysis showed that it derived from the nearest pack. However, the wolf was almost tame and blind. Officials gave orders to euthanize it.

2011, Brandenburg: 1 wolf was shot by police after having been severely injured by a car. 1 wolf was put down by order of the authorities after the animal was involved in a road accident. The veterinarian diagnosed a complicated fracture of the femur. Wolf experts and the vet recommended euthanizing the animal.

2012, Saxony: a wolf found in bad condition in the forest was euthanized by order of the authorities after the veterinarian found the animal to be in very poor health and experts recommended putting the animal down.

5. Scientific and technical aspects of wolf management in the EU, Poland and Germany

5.1 Scientific and technical aspects of wolf management in the EU

The aims of the Habitats Directive are to achieve and maintain a "favourable conservation status" (FCS) for all habitats and species of European importance, and to protect the biodiversity of natural habitats, and of wild fauna and flora, in the Member States (DocHab 04-03/03-rev.3).

In the "Guidelines for Population Level Management Plans for Large Carnivores in Europe" (LINNELL et al. 2008), the term "favourable conservation status" (FCS) is defined as follows:

A population is considered to have a favourable conservation status if all of the following eight conditions are fulfilled:

1 – The population is stable or increasing in size.

2 – It has sufficient suitable habitat.

3 – The habitat in question will retain its quality.

4 – The population size for the "favourable reference population" (FRP) has been achieved (according to the IUCN's Red List criteria D or E).

5 – The population size is equal to or greater than it was at the time the Directive came into force.

6 – The "favourable reference range" (FRR) has been occupied.

7 – Connectivity within and between populations is being maintained or enhanced (at least one genetically effective immigrant per generation).

8 – An effective, robust monitoring programme has been established.

The Guidelines (LINNELL et al. 2008) also present practicable definitions of FRP and FRR. According to that source, an FRP must fulfil the following criteria:

1) The population must be at least as large as it was at the time the Habitats Directive came into force. AND

2) The population must be at least as large as (preferably, considerably larger than) the minimum viable population (MVP) as defined by the IUCN viability criteria D (>1000 mature animals) or E (extinction risk based on a quantitative PVA – population viability analysis <10 % within a period of 100 years). AND

3) The population is being continually monitored via a robust monitoring programme.

Monitoring should provide a clear picture of the situation. In addition, to permit analysis at the EU level, the final report submitted to the Commission should be comparable to, and compatible with, those of other countries. As a result of these requirements, monitoring efforts need to be standardised, and interpretation of their results need to be standardised as well, at both the national and international levels.

So far, there are no pan-European standards for the monitoring of large carnivores. Monitoring efforts and data interpretation vary greatly between countries (chapter 3.1.2). The guidelines (LINNELL et al. 2008) give at least a best practice recommendation (LCIE policy support statement) for LC monitoring. Therein the authors recommend using the so called SCALP criteria (classification of observations into hard facts / confirmed observations /

unconfirmed observations) for analysis of species distribution. For population size estimation, methods are recommended that calculate a mean and an error and thus give an idea of the statistical precision of the measure. Such estimations are generally based on "capture-recapture" (CR) statistics and thus on a method that allow to distinguish individuals from each other. The required data can be obtained for instance due to genetic analysis for wolves and bears or with camera traps for lynx.

To date, only France and the Piedmont have established such an intense genetic wolf monitoring programme and are using CR analysis resulting in population size estimates with confidence intervals (MARUCCO et al. 2009, CUBAYES et al. 2010). Genetic samples are systematically collected during the five to six month snow season in the Alps. In France, in addition to intensive sign survey during winter within all previously detected wolf territories, extensive survey is also conducted during the year by a network of about 1000 trained persons who are dispatched to cover the alpine range and report signs of wolf presence (MARESCOT et al. 2011).

MARUCCO et al. (2009) showed that wolf abundance obtained from snowtracking alone was underestimated by about 36 % compared to CR analysis. However, the devil is in the detail, and CR analyses can also be misleading. Individual detection heterogeneity may lead to strong bias in the estimation of population abundance with CR analysis (CUBAYES et al. 2010). MARESCOT et al. (2011) show that the population growth rate is much less sensitive to individual detection heterogeneity than abundance is. The authors therefore recommend using population growth rate estimated with capture-recapture data as a robust method to monitor wolf populations. They suggest population growth rate as the better metric for conservation especially in a small population for which a precise estimate of abundance is not a helpful indication of its status. In other situations, e.g., for large harvested populations, population growth rate alone is not sufficient for making management decisions and an estimate of population size is required (MARESCOT et al. 2011).

The use of population size indices like the number of wolf packs and the number of scent marking pairs is much more robust than trying to "count" single individuals. In particular, the number of packs is biologically more meaningful than the number of wolf individuals. That is why wolf biologists recommend working with such indices especially if the statistical precision of the data is unknown.

In 2001, the first Alpine Wolf Workshop was initiated by French wolf biologists in order to facilitate a regular information exchange and effective collaboration between France, Italy and Switzerland. Several years later, the Alpine Wolf Group was appointed as the technical advisory board in the frame of wolf management by the French, Italian and Swiss governmental authorities. In 2006, the "*Protocollo di collaborazione italofranco- svizerra per la gestione del lupo nelle Alpi*" ("Italian-French-Swiss collaboration protocol for the wolf management in the Alps") was signed by the authorities. Although no population level management plan is yet in place, there is an official two levelled board for wolf management and monitoring. On the administrative level (involving French, Italian and Swiss governmental authorities) monitoring data required and other scientific or technical reports needed are defined and given as working objective to the technical advising board. The Alpine Wolf Group can by itself also recommend monitoring and other issues that should be worked on to the administrative board.

The Alpine Wolf Group has worked on standardizing methods to collect process and analyse data across country boundaries. Sharing and pooling data was a priority in order, for instance, to produce presence maps, range expansion indices or demographic indices at the

population level, regardless of national boundaries (MARBOUTIN 2008). Meanwhile a common protocol has been developed and is used by the different genetic labs involved in genetic monitoring in these countries. This makes it possible for an individual wolf that was once genotyped in one lab to be be recognized by any other of the labs involved.

Research in France and the Piedmont is clearly monitoring and therefore management related. Special focus is given to the reliability and improvement of monitoring methods and data analysis used (MARUCCO et al. 2009, CUBAYES et al. 2010, MARBOUTIN et al. 2010, MARESCOT et al. 2011). CHAPRON et al. (2003) developed demographic models to evaluate the effect of different management measures like zoning or lethal control on population viability. The results are used in French wolf management for planning for the potential number of wolves that can be removed by lethal control each year while ensuring a population growth rate > 1.

Scandinavia operates joint wolf monitoring, partly even in cooperation with Finland. In Sweden, county administrative boards perform the fieldwork and collection of field data (snow-tracking, DNA-samples), whereas under a contract with the management authorities the Wildlife Damage Center (VSC) at Grimsö Research Station is responsible for evaluating and summarizing the results of the wolf monitoring activities. In Norway, the wolf biologists at Hedmark University College are responsible, in cooperation with the Norwegian Nature Inspectorate (SNO), for monitoring resident and non-resident wolves, respectively. Furthermore, cooperative wolf pack monitoring is carried out in Fennoscandia in collaboration with Finland (WABAKKEN et al. 2010). The results are published yearly in a common Fennoscandian status report (http://skandulv.nina.no/english/Publications/Reports.aspx).

The estimated number of wolves in Scandinavia is mainly based on long distances of ground tracking on snow, but also on radio-telemetry and DNA-analysis. To guarantee the quality of the reports used, the majority are checked in the field by the project or other personnel with experience of ground tracking wolves on snow. The results are presented as minimum-maximum numbers where the minimum are based exclusively on field-checked reports, while the maximum also include other reports (WABAKKEN et al. 2010). Field personnel specifically trained for censusing large carnivores are employed by the responsible authorities. 950 man days of tracking were used each winter in recent years (LIBERG et al. 2010).

In addition to joint monitoring, the Scandinavian wolf project (SKANDULV) was formally initiated in 2000. Partners in SKANDULV are the Norwegian Institute for Nature Research (NINA), the Hedmark University College (HIHM) and the Grimsö Wildlife Research Station. Funding is provided by the Norwegian Directorate for Nature Management and the Research Council of Norway together with the Swedish Environmental Nature Protection Agency, the Swedish Research Council Formas and a number of Swedish NGOs and trusts. Since 2000 numerous groundbreaking research projects have been and are still being carried out (a number of publications can be downloaded from the SKANDULV home page at http://skandulv.nina.no). Central themes of wolf research are population dynamics, geographical expansion of the population and genetics, social behaviour and predation. The human dimensions of wolf ecology, including depredation and human attitudes are also studied. SKANDULV involves a number of scientific institutions, and is actually a consortium of several subprojects with separate budgets (http://skandulv.nina.no).

The comeback of the wolf in Scandinavia was monitored scientifically from an early stage and knowledge of this wolf population is unique. Researchers have managed to compile and maintain a complete pedigree of the population (LIBERG 2002, LIBERG et al. 2005). The focus

is on gaining genetic samples from the scent marking wolves in each territory during every snow tracking season. By doing so, all (potential) parents are known and any wolf can be tracked to its natal territory or identified as immigrant. Population growth rates, natal rates, survival rates of various age classes and number and the reproductive success of immigrating wolves from Finland are known due to intensive monitoring and research. This enables Sweden to conduct PVAs and to predict the impact of such actions like quota hunting in detail, and also to follow up the actions to determine their effect (LCIE 2010). To our knowledge, such detailed data are not available for any other wolf population in Europe.

Despite extensive cross-border collaboration in monitoring and research, a formalized population level management plan coordinated between Norway and Sweden is still lacking. This was the main point of criticism put forward in the Position statement from the Large Carnivore Initiative for Europe on the 2010 Swedish wolf hunt (LCIE 2010).

The LCIE (Large Carnivore Initiative for Europe) is a Specialist group of the IUCNs Species Survival Commission. It consists of large carnivore and human dimension experts, mostly from Europe. Currently, the LCIE is preparing updated status reports on LCs in Europe. A version from 2005 is available at www.kora.ch/sp-ois/.

In 2009, the EU established a Wolf Working Group in order to facilitate the exchange of information and experience on a government level. The group was meant to thrive on requests and contributions from member states. After several meetings in 2009 and 2010 in Brussels, the group has currently suspended its activities.

Several EU co-financed LIFE and LIFE+ projects had and have the wolf in focus, for example, CROWOLFCON: “Conservation and management of wolves in Croatia” (www.life-vuk.hr) or SLO-WOLF: “Conservation and surveillance of the conservation status of the wolf (*Canis lupus*) population in Slovenia” (www.volkovi.si); some of them span several countries like LIFE-Antidoto (www.lifeantidoto.it) that aims at developing a strategy against the poisoning of large carnivores and scavenger raptors mainly by training and exploiting antipoison dog units in Spain and Italy. Another project, LIFE-COEX: “Improving coexistence of large carnivores and agriculture in Southern Europe” (www.life-coex.net), focused on reducing large carnivore – livestock conflicts due to mitigation measures like electric fencing or livestock guarding dogs.

The results of this project together with other written sources were used for a review of the efficiency of different livestock protection measures in Europe on behalf of the BfN (REINHARDT et al. 2010). The report also gave an overview on existing mitigation and compensation schemes in Europe.

Most EU member states provide a system of compensation for damages caused by large carnivores. Often these regulations have been specially developed for large carnivores, acknowledging that large carnivore conservation is in the interest of society as a whole. Consequently, the solidarity principle demands that the associated costs should be carried by society rather than be burdened onto a few directly affected farmers (KLEMM, 1996; FOURLI, 1999; REINHARDT et al. 2012). Preventing damages is better than refunding damages after they occur. Active prevention is the only system that will help to diminish damages. Thus, compensation must be linked to preventive measures (BOITANI, 2000), or else there may be weak incentive to implement accurate prevention measures. However, to date, only a few European countries do so. (REINHARDT et al. 2010).

In most countries compensation is paid if the culprit species cannot be determined. This means that in cases of doubt, i.e. when it is unclear whether a wolf or a dog caused the

damage, the losses are compensated. Some countries like Slovenia and Switzerland demand clear evidence that the damage was indeed caused by a wolf (e.g. genetic analysis). In general 100 % of the market price is paid; in Sweden even 200 % (REINHARDT et al. 2010).

Funding of prevention measures is not as common as paying compensation. Where wolves have always been present damage prevention measures are regarded best practice. If funded, financial or logistic support for upgrading or intensifying prevention measures will often come within the framework of projects such as LIFE-COEX (LIFE 04NAT/IT/000144 – COEX – Final Report). In contrast, where wolves have made a recent comeback, establishing new preventive measures is often financed in full or subsidized by government funds (e.g. France, Sweden, and the Piedmont). Which measures and to what extent prevention measures are supported financially and who is eligible to apply for support, differs from country to country, and in federal countries from region to region (REINHARDT et al. 2010).

5.2 Poland

Definition of favourable reference population

The favourable reference population for wolves in Poland was determined in the *Report on the main results of the surveillance under article 11 for annex II, IV and V species* sent to the European Commission by the Polish Government (http://cdr.eionet.europa.eu/Converters/convertDocument?file=pl/eu/art17/envrlf_pg/species-canis-lupus.xmlandconv=rem_24). The Report was developed in 2007 for the period 2000 - 2006 (table 4). It was based on results of the National Wolf Census co-ordinated by the Mammal Research Institute PAS in Białowieża.

Wolf distribution was analysed and assessed on a base of 10x10 km EU grid cells which included signs of wolf presence. The cells were considered as occupied by wolves if wolf presence had been confirmed there during the last 2 years of the reporting period.

Wolf range was estimated with two methods: (1) as a sum of grid cells which included signs of wolf presence or (2) as a sum of polygons created when locations of wolf presence (points with geographic coordinates) were surrounded by an 8 km buffer.

The favourable reference population in the report was mainly estimated on a base of the wolf habitats suitability model for Poland, which was under development at the Mammal Research Institute PAS (JĘDRZEJEWSKI et al. 2008). The approach and methods of analyses are described below in: *Availability of habitats, number of wolves and prey species.*

Tab. 4: Wolf population in Poland according to the Report on the main results of the surveillance under article 11 for annex II, IV and V of the Habitats Directive. Estimation done in 2006 for the period of 2000 - 2006.

Parameter	Bioregion		Whole country
	Alpine	Continental	
Surface range of the species (km^2)	8,600	25,200	33,800
Current habitat area estimation (km^2)	6,000	15,300	21,300
Range trend	stable	increasing	increasing
Population size estimation (individuals)	180 - 220	310 - 420	490 - 640
Favourable reference range (km^2)	8,600	95,000	104,100
Suitable habitat for the species (km^2)	6,000	53,500	59,500
Favourable reference population (individuals)	200	1,200	1,400

Monitoring of wolves

In the past, when the wolf was a game species (before 1998), assessment of wolf distribution and numbers in Poland were based on data collected by hunters within relatively small (on average *ca*. 44 km^2) hunting grounds managed by hunting clubs. This method and approach led to multiple counting of individuals belonging to the same family groups and, consequently, to overestimation of population size. Such methodology was widely criticized (OKARMA 1984, 1993, NOWAK 1999).

Currently, according to Polish law (the Environmental Conservation Act) the Chief Inspectorate of Environmental Protection (GIEP) is responsible for monitoring of Habitats Directive species and habitats in Poland. However, the animal species monitoring system does not have a defined structure. Institutions are not obliged to regularly collect data on species distribution and number, neither have adequate funds for collecting data been secured. However, in 2010, the General Inspectorate for Environmental Protection published a methodological handbook “Monitoring of animal species” describing and recommending methods of wolf population monitoring, indicators of population status, indicators of habitat status within Natura 2000 sites and other forest tracts (JĘDRZEJEWSKI et al. 2010a).

The main indicators recommended to define the population status are population density (n of individuals/100 km^2) and number of wolf packs/100 km^2.

Indicators for wolf habitat quality are forest cover, fragmentation of forests, food biomass (kg/km^2), road density and isolation of habitats.

The methods recommended for collecting data on wolf presence within areas are simultaneous winter tracking and year-round observations.

Thus, despite the fact that EU law obligates member states to conduct monitoring of species protected under the Habitats Directive, such a governmental programme has not been implemented in Poland yet. Monitoring of protected species, including wolves is conducted

by scientists within a frame of scientific projects or as projects funded by environmental organizations (NGOs).

At a local scale, scientists have conducted research projects, partly focused on wolf population dynamics (e.g. JĘDRZEJEWSKA et al. 1996, ŚMIETANA AND WAJDA 1997, NOWAK et al. 2008, GULA 2008, SEWERNIAK 2011).

The National Census of Wolves and Lynx was initiated by the Mammal Research Institute of the Polish Academy of Science in Białowieża (MRI), the Association for Nature "Wolf" (AfN WOLF) and the State Forest Service in 2000. It was conducted intensively for the next few years up to 2009, and with less effort up to the present. Results of the Census are regularly presented in reports published on a special web site http://www.zbs.bialowieza.pl/artykul/553.html.

Currently, information on wolf and lynx presence is still collected and analysed by the MRI, but with less intensity and small participation by the forest service. However, there are intentions to improve census efforts in future and involve regional directorates for environmental protection. The census is co-ordinated by the MRI and AfN WOLF. Data on wolf presence is collected by foresters and national park services, scientists and volunteers; however, they are analyzed by scientists. The main goal of the census is to assess the number of wolf packs living in Poland. Two main methods of data collecting are used: (1) simultaneous winter tracking and (2) year-round observations (1) Initially, all large forests tracts were divided into 70 census divisions using the criterion of well-defined complex limited by visible barriers such as large built-up areas, farmland, rivers, major roads, etc. Winter tracking is conducted simultaneously within these divisions about 12 - 24 hours after a snowfall. Experienced trackers (scientists, forest and park service, and hunters) walk through fixed transects along forest roads and tourist routes in order to identify and chart any wolf tracks, their size and directions and number of individuals in a group. Later, the maps with questionnaires including relevant information are sent to the MRI. (2) All year round, foresters and national parks services use special forms to record information on any signs of wolf presence found, e.g. direct observations of adults and pups, faeces and scent markings, tracks, wolf howling, wolf dens, remains of prey, depredation cases, etc. The forms are sent to the MRI quarterly.

These year-round observations are still conducted in many forest divisions and national parks. At the same time, winter tracking, which is a more laborious method, is only conducted by a few forest divisions. Moreover, information on wolf presence is provided by environmentalists and data on livestock depredation is provided by regional directorates of environmental protection in different provinces.

All these data are computed to a database at the MRI. Since 2000, more than 30,000 records have been collected. At the end of a year, data from one census period (1st April – 31st March) is analyzed with GIS tools by scientists from the MRI, based on knowledge of wolf ecology and behavior in Poland. If the data are suitable, the analyses focus on distinguishing between wolf packs, estimation of number of packs and loners, numbers of wolves in family groups, reproduction status of packs, and detection of resident packs and lone wolves out of the range. The distribution and number of wolf packs and the number of individuals in Poland has been defined until 2009. In the most recent report from 2009/2010, only distribution of the wolf population was presented http://www.zbs.bialowieza.pl/artykul/557.html. The project was supported by Euronatur (Germany) and the State Forest Service.

Monitoring of the wolf population in western Poland. Since 2001, the Association for Nature „Wolf" has been responsible for monitoring wolf recovery in western Poland and has collected data on wolf presence there. Scientists (members of AfN) experienced in wolf tracking conduct monitoring activities together with persons less experienced in order to train them. All larger forest tracts west of the river Vistula are checked regularly all year round for evidence of wolf presence. Field workers look for tracks, scats, prey remains, evidence of wolf mating and for the tracks of pups. Howling stimulation has been also used. All finds are tagged with geographic coordinates and documented with photos. Information from environmentalists, foresters, hunters and other persons is also collected via e-mail, but good quality photographs of all finds (tracks, scats, markings, direct observations) are required. The project continues with the aim to define every year the number and distribution of resident packs (at least marking pairs or breeding family groups) occupying western Poland. Furthermore, changes in the range and numbers of wolf packs in western Poland and the dynamics of population development are recorded. Each year, data gathered by AfN Wolf in the database (the Excel file is compatible with the National Wolf Census database) are analysed by AfN wolf specialists, and the results are added to the National Wolf Census report. The project has been supported for many years by the International Fund for Animal Welfare (IFAW Germany), Euronatur (Germany) and a budget from AfN Wolf. The results of the project have been described in a book "Wilki na zachód od Wisły" [Wolves west of the river Vistula] (NOWAK AND MYSŁAJEK 2011).

In 2012, the Regional Directorate for Environmental Protection (RDEP) in Szczecin started a wolf inventory together with local state forest divisions and NGOs in the Zachodniopomorskie Province using the same methodology as the National Wolf Census. The data are collected by foresters and field workers of RDEP and local NGOs and then analysed to obtain the distribution and number of wolves in the province.

In 2010, the General Directorate of Motorways and National Roads commissioned two projects focussing on wolves in the Lower Silesian Forest (western Poland), thus fulfilling recommendations by the EIA for the A4 motorway Zgorzelec-Krzyżowa section, and in compliance with environmental decisions issued by appropriate authorities. (1) Monitoring of use of 16 wildlife passages on the A4, especially by wolves and their prey species (2010 - 2013). (2) Monitoring of the wolf population in the Lower Silesian Forest with the objective of assessing the impact of the newly-built section of A4 motorway on the local wolf population (2010 - 2013). The methodology of the project includes genetic monitoring and intensive wolf tracking.

Scientific research/projects on wolf biology and management

The first monographs on wolves covering information about their biology and life history appeared in Poland from the beginning to the mid-twentieth century. However, they were mostly based on anecdotal observations and focused on the different methods of hunting wolves (ŚWIĘTORZECKI 1926, KOWALSKI 1953b). Until 1980, several scientific papers on internal parasites (FURMAGA AND WYSOCKI 1949, FURMAGA 1953, SOŁTYS 1964), morphology (SUMIŃSKI 1975b, SUMIŃSKI AND FILIPIAK 1977), diet (RZEBIK-KOWALSKA 1972) and species status (SUMIŃSKI 1975a) were published. However, in the same period, articles by mammalogists also appeared in the Polish literature and environmental journals expressing opposition to the extermination of wolves (e.g. SUMIŃSKI 1970, BUCHALCZYK 1972, KLAROWSKI 1973). Major research projects on this species started in the eighties of the 20th century (NOWAK AND JĘDRZEJEWSKI 2008). They covered a broad spectrum of topics

including anatomy, physiology, ecology, behaviour, health, as well as conservation issues (JĘDRZEJEWSKI et al. 2010). Until 2012, almost 60 scientific papers indexed in the *Thomson Reuters Journal Citation Report* have been published, and dozens of publications have appeared in journals without an impact factor. Furthermore, several monographs and popular books about wolves have been published recently (OKARMA 1992, 1997, BERESZYŃSKI 1998, NOWAK AND MYSŁAJEK 2000, 2011, WIERZBOWSKA 2011). The most comprehensive and long-term scientific projects have been conducted in the following regions: the Białowieża Primeval Forest by scientists from the Mammal Research Institute of the Polish Academy of Sciences; in the Bieszczady Mts. (the eastern-most part of Polish Carpathians) by researchers from the Jagiellonian University and two institutes of the Polish Academy of Sciences (Institute of Nature Conservation in Kraków and Museum and Institute of Zoology in Warsaw), and in the Beskidy Mountains (western Carpathians) and in western Poland by scientists from the Association for Nature "Wolf".

Wolf physiology. Relatively little attention has been paid to the anatomy and physiology of Polish wolves. Several works have been devoted to metrical characteristics of skulls (OKARMA AND BUCHALCZYK 1993), variations in number of teeth and skull asymetry (BUCHALCZYK et al. 1981), basal metabolic rate (OKARMA AND KOTEJA 1989), physiology of digestion (HOFFMANNOWA et al. 1964), food intake, and digestibility of various food items by wolves (BOBEK AND NOWICKI 1996).

Wolf distribution and number. Historical information on changes in the wolf range in Poland since 19th century was elaborated by WOLSAN et al. (1992). The first modern assessments of wolf distribution and number were based on data delivered by hunters (JAMROZY 1994), which led to an overestimation of population size. Consequently, several papers focused on a critical evaluation of the methodology (OKARMA 1984, 1989, 1993, NOWAK 1999).

Data collected within the National Wolf Census, co-ordinated by the Mammal Research Institute of the Polish Academy of Sciences and the Association for Nature "Wolf", not only provided reliable information on the distribution and number of wolves in Poland (JĘDRZEJEWSKI et al. 2002a). The data were also used for evaluation of habitat variables associated with wolf distribution and abundance both in the lowlands (JĘDRZEJEWSKI et al. 2004a) and mountains (JĘDRZEJEWSKI et al. 2005b), followed by habitat suitability models (JĘDRZEJEWSKI et al. 2008, HUCK et al. 2010) and evaluation of ecological corridors (JĘDRZEJEWSKI et al. 2005c, HUCK et al. 2011).

Population dynamics. Detailed studies on population dynamics, demography, reproduction and mortality have been conducted in the Białowieża Primeval Forest (BPF) (JĘDRZEJEWSKA et al. 1996), Eastern Carpathians (ŚMIETANA AND WAJDA 1997) and Western Carpathians (NOWAK et al. 2008). JĘDRZEJEWSKA et al. (1996) conducted an in-depth study of the dynamics of the wolf population in the Białowieża Primeval Forest in relation to hunting by humans in the19th and 20th centuries. Implementation of radio-telemetry allowed researchers to recognize the size of wolf home-ranges (OKARMA et al. 1998, JĘDRZEJEWSKI et al. 2007), distance of daily movement (JĘDRZEJEWSKI et al. 2001), speed of movement (Musiani et al. 1998), selection of pup-rearing and resting sites (THEUERKAUF et al. 2003b). Also, duration of wolf activity (THEUERKAUF et al. 2003a) and numerous factors driving activity have been analysed (JĘDRZEJEWSKI et al. 2001, THEUERKAUF et al. 2003c, THEUERKAUF et al. 2007, EGGERMANN et al. 2009, TSUNODA et al. 2009, THEUERKAUF 2009). Moreover, spatio-temporal interactions between wolves and lynx (SCHMIDT et al. 2009) and between wolves and red deer (THEUERKAUF AND RUYS 2007) have been studied. Telemetry studies influenced

introduction of new methods of wolf capture (OKARMA AND JĘDRZEJEWSKI 1997) and improvement of methodology (THEUERKAUF AND JEDRZEJEWSKI 2002). The eterritories of packs (studied by radio-telemetry and intense snow tracking) in Poland range from 150 km^2 in the Carpathians to 250-300 km^2 in the lowlands. Very little overlap (7% on average) of neighboring territories has been observed. In the Białowieza Primeval Forest, variation in territory size is shaped by abundance of wild ungulates, but is not affected by pack size. In the lowlands, wolves travel on average 23 km per day. The shortest daily routes are covered in May by breeding females and the longest by dominant males in winter.

Diet composition. The diet composition of wolves in Poland is very well recognized through studies based on analysis of stomach content (LEŚNIEWICZ AND PERZANOWSKI 1989), scats (JĘDRZEJEWSKI et al. 1992, ŚMIETANA AND KLIMEK 1993, NOWAK et al. 2005a, 2011) and prey remains (OKARMA 1984, 1991, JĘDRZEJEWSKI et al. 2000, NOWAK et al. 2005, ŚMIETANA 2005). Scientists have studied the importance of snow cover on efficiency of wolf predation and prey selectivity (BOBEK et al. 1992, JĘDRZEJEWSKI et al. 1992, GULA 2004). The wolf's diet has also been compared with the diet of other species (Okarma 1984, Reig and JĘDRZEJEWSKI 1998, JĘDRZEJEWSKI i in. 1989, MUSZYŃSKA 1996, JĘDRZEJEWSKA AND JĘDRZEJEWSKI 1998). OKARMA (1995) evaluated biogeographical patterns of wolf diet in forest ecosystems in Europe.

Wolf predation. Numerous articles have been published focussing on various aspects of impact of wolf predation on wild ungulate populations. During a long-term project conducted in the Białowieża Primeval Forest, the wolf kill rate was assessed (JĘDRZEJEWSKI et al. 2002b). The importance of wolf predation among other ungulate mortality factors has also been widely analysed (OKARMA et al. 1995, GŁOWACIŃSKI AND PROFUS 1997, JĘDRZEJEWSKA et al. 1997, KAMLER et al. 2007), and its economic significance viewed from the hunting perspective (BOBEK et al. 1995). JĘDRZEJEWSKA et al. (1994) evaluated the effect of forest exploitation and protection on wolf predation in the Białowieża Primeval Forest. Selva et al. (2005) studied the importance of wolf prey remains for scavengers. According to the results of these studies, Polish wolves prey mainly on wild ungulates (85-98% of biomass eaten), livestock constitutes less than 4% of food biomass. Red deer *Cervus elaphus* and roe deer *Capreolus capreolus* are the main kills (42-80% of biomass and 23-58% of biomass respectively), followed by wild boar *Sus scrofa*. In both species of deer, wolves often select females and juveniles. In wild boar, mainly piglets are eaten. In the Białowieża Primeval Forest, a wolf pack kills on average 3 ungulates per week. Mean daily food intake is 5.8 kg per wolf and per capita kill rate averages 42.3 ungulates per year.

Damage to livestock. As damage to livestock is frequently associated with wolf predation, this topic has also been subject to frequent analysis in Poland. Studies have covered the behaviour of wolves that pursue livestock (KOSSAK 1998), factors affecting damage in domestic animals (BOBEK et al. 1998c, NOWAK et al. 2005a, GULA 2008) and the economic cost (BOBEK et al. 1998b, NOWAK et al. 2005b). Consequently, there are also publications presenting experiences with application of Livestock Guarding Dogs (NOWAK AND MYSŁAJEK 2005, ŚMIETANA 2006) and other livestock protection methods in Poland (NOWAK AND MYSŁAJEK 1999, 2006, NOWAK ET AL. 2005B).

Wolf genetics. Development of molecular methods has allowed researchers to study genetic diversity and relatedness within packs in the Białowieża Primeval Forest (JĘDRZEJEWSKI et al. 2005), and wolf dispersal patterns in the eastern Carpathians (GULA et al. 2009). On a broader scale, the population genetic structure (PILOT et al. 2006) and phylogeography of wolves in Europe (PILOT et al. 2010) were determined. Polish scientists were also involved in

studies on the evolutionary history of canids (VAN HOLDT et al 2011). Recently, a paper describing mitochondrial and microsatellite DNA structure of Polish wolves was published (CZARNOMSKA et al. 2013). Genetic studies on a local population inhabiting BPF (Polish part, where wolves are protected, and the Belarussian part where wolves are intensely hunted), have shown that the typical wolf pack is composed of a family group (two unrelated adults plus their offspring from the current and possibly earlier years). However, severe hunting of wolves has led to instability of packs, fast turnover of individuals, breeding among close relatives and adoption of lone unrelated individuals by small packs. Analyses of wolf DNA extracted from faeces collected throughout the whole of Poland from 2001-2009 showed notable isolation of the Carpathian population of wolves from the lowland populations, suggesting that wolves colonizing the western part of the country mostly come from the north-eastern part of the wolf range. In the whole of Central-Eastern Europe, analyses of mitochondrial DNA revealed five distinct subpopulations of wolves. Such genetic differentiation among local populations – in the absence of an obvious physical barrier to movement – was correlated with ecological factors: climate, habitat types, and wolf diet composition (dominant species of ungulates).

Wolf behaviour. The behaviour of wolves living in the wild is relatively hard to study, but despite methodological difficulties, researches in Poland have attempted to evaluate their howling activity (NOWAK et al. 2007), patterns of territory marking (ZUB et al. 2004), reproductive behaviour (SCHMIDT et al. 2008) and process of pack splitting (JĘDRZEJEWSKI et al. 2004b). Studies on territory marking revealed that scats and urine marks are mostly concentrated around the breeding dens, not along the borders of territories. In lowlands, pups are born in excavated dens, whereas in the mountains (rocks, thin layer of soil) – in dense thicket or under the roots of fallen trees. During the pup rearing season, wolves frequently change their denning sites. In the BPF, females rearing young used on average 2.25 dens during a 60-day denning period. Study of wolf communication has documented that spontaneous howling, intra-pack communication (between pack mates, adults and pups, before and after hunts) prevailed over inter-pack signalling such as territory advertising or warning against strangers.

Wolf diseases. Diseases can cause population decrease and even local extinctions, so studies focusing on animal health are of great importance from the perspective of species management. In Poland, researches have mostly concentrated on internal parasites and covered many local wolf populations (KLOCH et al. 2005, POPIOŁEK et al. 2007, SZCZĘSNA-STAŚKIEWICZ 2009, SZAFRAŃSKA et al. 2010, PIRÓG 2011). Study based on scats analyses as well as examination of dead wolves has revealed the presence of 19 species of helminth parasites in wolves in Poland. At 67.37%, mean prevalence of helminth infection is high in the country, but even higher in the lowlands (72.4 %), where the most frequent species is Alaria alata, and much lower in the Carpathian Mts. (46.2 %), where the most frequent parasites belong to the Capillariidae family and *Uncinaria stenocephala*. In half the cases, wolves in the lowlands were infected with two or more parasites (up to six), in mountains mostly with one. Thus wolves in the lowlands are more affected by helminth. Also, three protozoan parasites have already been reported from north-eastern Poland. *Cryptosporidium parvum* and *Giardia* sp. were found in 65 % of scats of wolves living in the Napiwoda-Ramuki forest (NE Poland). A first case of babesiosis (*Babesia gibsoni*) was diagnosed in a tame wolf in BPF after being bitten by a tick (KARBOWIAK et al. 2008).

Ongoing or recently completed conservation and research projects concerning wolves in Poland

1) Ongoing. National wolf census (wolf number and distribution). Leading institutions: the Mammal Research Institute of the Polish Academy of Sciences in Białowieża in co-operation with the Association for Nature “Wolf”. Project supportedby the State Forest Service, EuroNatur, and budgets of both leading institutions.

2) Ongoing. Studies on wolf genetics in Poland (phylogeography, genetic diversity, etc.). Various projects conducted by several institutes of the Polish Academy of Sciences (Mammal Research Institute in Białowieża, Museum and Institute of Zoology in Warszawa, Institute of Nature Conservation in Kraków). Funded by grants from the Ministry of Science and Higher Education, the National Science Centre and budgets of responsible institutions.

3) Ongoing. Monitoring and conservation of wolves recolonising western Poland (studies on pack distribution, number, habitat preferences and the diet of wolves repopulating western Poland, education and public awareness, promotion of livestock protection measures). Project conducted by the Association for Nature “Wolf”. Funded by the International Fund for Animal Welfare (IFAW), EuroNatur and Wolves and Humans Fundation.

4) Ongoing. Monitoring of the impact of the new section of the A4 motorway on the wolf population in the Lower Silesian Forest, SW Poland. The project includes monitoring of the local wolf population and monitoring of effectiveness of wildlife crossing structures for wolves and their prey, recommended by the Environmental Impact Assessment. Project conducted by FPP Consulting Ltd. (fauna passages monitoring) and Wildlife Consulting (wolf population monitoring). Funded by the National Agency of Motorways and National Roads.

5) Ongoing. Internal parasites of wolves. Studies on parasites of wolves in Poland based on faeces and intestines from wolves killed incidentally. Conducted by the Department of Systematics and Ecology of Invertebrates of the Wrocław University of Environmental and Life Sciences. Own funds.

6) Ongoing. Behavior of captive wolves (studies on various aspects of behavior of wolves in captivity). Conducted by the Department of Zoology at the Poznań University of Live Sciences, with own funds.

7) Ongoing. Large carnivores in Poland (education, public awareness, promotion of livestock protection methods, etc.). Project of the WWF Poland. Funded by the EEA Financial Mechanism and Norwegian Financial Mechanism.

8) Ongoing. Ecology and conservation of wolves in the Western Carpathians. Studies on distribution, number, habitat preferences and the diet of wolves in the Silesian Beskid Mts., Zywiecki Beskid Mts. and Mały Beskid Mts., education of key groups, promotion of livestock protection methods. Project conducted by the Association for Nature “Wolf”. Funded by the the Ministry of Science and Higher Education, EuroNatur, Wolves and Humans Foundation.

9) Ongoing. Strengthening of the conservation status of the wolf population. Inventory and protection of breeding sites, promotion of livestock protection methods, education. Project conducted by the Regional Directorate for Environmental Protection in Katowice. Funded by the Provincial Fund for Environmental Protection and Water Management in Katowice.

10) Ongoing. Protection of biodiversity in forests, including the Natura 2000 network - promotion of best practices. Project dedicated to large carnivores and other species, focused on education of foresters and local communities and public awareness. Project conducted by

the Centre of Coordination of Environmental Projects. Funded by LIFE+ and and National Fund for Environmental Protection and Water Management.

11) Ongoing. Cooperation and competition in the family group of a top predator - spatio-temporal interactions among wolves. Studies on selected aspects of ecology in the Lower Silesian Forest). Institute of Nature Conservation of the Polish Academy of Sciences in Kraków and Museum and Institute of Zoology of the Polish Academy of Sciences in Warszawa. Funded by a grant of the National Centre of Science.

12) Recently completed. Elaboration of national strategies for management of selected endangered or conflict species. The project was conducted by the Warsaw University of Life Sciences. Funded by the European Regional Development Fund and the National Fund for Environmental Protection and Water Management.

13) Recently completed. Wolf, Bison, Beaver – campaign for damage reduction (education of farmers, promotion of livestock protection methods, public awareness). Project of the Foundation "Green Lungs of Poland". Funded by EU European Regional Development Fund and National Fund for Environmental Protection and Water Management.

14) Recently completed. Ecology of wolves in Bieszczady Mountains.Studies on various aspects of wolf ecology in Eastern Carpathians. Conducted by the Museum and Institute of Zoology of the Polish Academy of Sciences in Warsaw. Funded by a grant of the Ministry of Science and Higher Education.

15) Recently completed. In a few words about otter, beaver and wolf (education, public awareness). Project was conducted by the Foundation of the Support of Environmental Initiatives. Funded by National Fund for Environmental Protection and Water Management and Regional Fund for Environmental Protection and Water Management in Kraków.

Availability of habitats, number of wolves and prey species

The model of habitats suitable for wolves in Poland was developed by the Mammal Research Institute PAS in Białowieża (JĘDRZEJEWSKI et al. 2008). Data on distribution and numbers of wolves were based on a large-scale wolf census conducted by scientists, foresters and staff of national parks since 2000. Spatial analyses were done with GIS tools using data on land use (CORINE Land Cover 2000), density of roads and density of ungulates within 10×10 km cells with wolf presence. The frequency of records of wolf presence in a given category of land use allowed to select environments most willingly occupied by wolves, and to indicate areas which potentially meet the habitat requirements of the species. The area of selected environments and size of the wolf population in eastern Poland provided a basis for assessment of the potential numbers of wolf in the remaining part of the country. The results were then verified, taking into account food availability (biomass of wild ungulates per 1 km^2). Habitat suitability modelling for wolf population was done twice and gave similar results (JĘDRZEJEWSKI et al. 2008, HUCK et al. 2010). The extent of habitats that are generally suitable for wolves was estimated at 61,555 km^2 (JĘDRZEJEWSKI et al. 2008), among which the best habitats covers 26,133 km^2 (HUCK et al. 2010). The model showed that in the regions west of the river Vistula there are about 39,000 km^2 of forest tracts suitable for wolf habitation, while the main wolf range in eastern Poland comprises 22.600 km^2 (JĘDRZEJEWSKI et al. 2008). Habitat modelling allowed researchers to estimate the number of wolves that could potentially live in Poland. The most probable population size varies

between 1,450 and 1,540 individuals, but can be as high as 1,720 individuals (JĘDRZEJEWSKI et al. 2008). More than 900 individuals are able to live in western Poland.

Poland is inhabited by six species of native wild ungulate – roe deer *Capreolus capreolus*, red deer *Cervus elaphus,* wild boar *Sus scrofa*, moose *Alces alces*, European bison *Bison bonasus* and chamois *Rupicapra rupicapra*, and three species of non-native ones – fallow deer *Dama dama*, sika deer *Cervus nippon* and mouflon *Ovis ammon* (WAWRZYNIAK et al. 2008). However, only roe deer, red deer and wild boar are important components of wolf diet (JĘDRZEJEWSKI et al. 1992, ŚMIETANA AND KLIMEK 1993, NOWAK et al. 2005, 2011), mostly because of the limited range and low number of other species.

Mild winters have amongst other things been one of the reasons for the significant increase in the number of wild ungulates in Poland in the past ten years. According to hunters' inventories of game species, in the year 2000 there were 117,000 red deer, 600,000 roe deer and 180,000 wild boars, whereas in 2010 hunters estimated the number of red deer in Poland to have risen to 180,200 individuals, the number of roe deer to 822,000 and the number of wild boar to 249,900 (GUS, 2010). During the last four years, the harvest of these species has also increased and now comprises 25% for red deer, 31% for roe deer and 84% for wild boar, encompassing 51,000, 176,000 and 218,000 animals, respectively in 2010. Over 60% of the wild ungulate populations live in western Poland, where densities of wild boars are the biggest, and densities of red deer and roe deer are one of the biggest in our country.

Mean biomass of ungulates in Poland varies between forest complexes from 65 to 295 kg/km^2, but on average is relatively high at 200 kg/km^2 and sufficient for the vital wolf population (JĘDRZEJEWSKI et al. 2008).

Protection of wolf habitats within Natura 2000 sites

The wolf is listed in Annex II of the Habitats Directive. Therefore numerous Natura 2000 sites have been designated to protect habitats of this species in Poland (Fig. 8, appendix 2). Altogether, 73 sites, with total area of 15,284 km^2, protect wolf habitats in the entire country. This network covers about 25 % of suitable wolf habitats in Poland (JĘDRZEJEWSKI et al. 2008).

Most of sites are located in eastern Poland (37 sites, total area 9,137 km^2) and in the Carpathians (15 sites, total area 4,268 km^2), because of the highest density and most stable range of the species in both regions. The largest sites, which may host at least several wolf packs, are: „Ostoja Knyszyńska" (the Knyszyn Forest, 1,361 km^2), „Dolina Biebrzy" (the Biebrza river valley, 1,212 km^2), „Bieszczady" (the Bieszczady Mountains, 1,115 km^2) and „Ostoja Augustowska" (the Augustów forest, 1,071 km^2).

In western and central Poland there are also Natura 2000 sites which protect important wolf habitats (21 sites, total area 1,880 km^2). The biggest site is called „Uroczyska Puszczy Drawskiej"(the Drawa forest, 744 km^2, NW Poland).

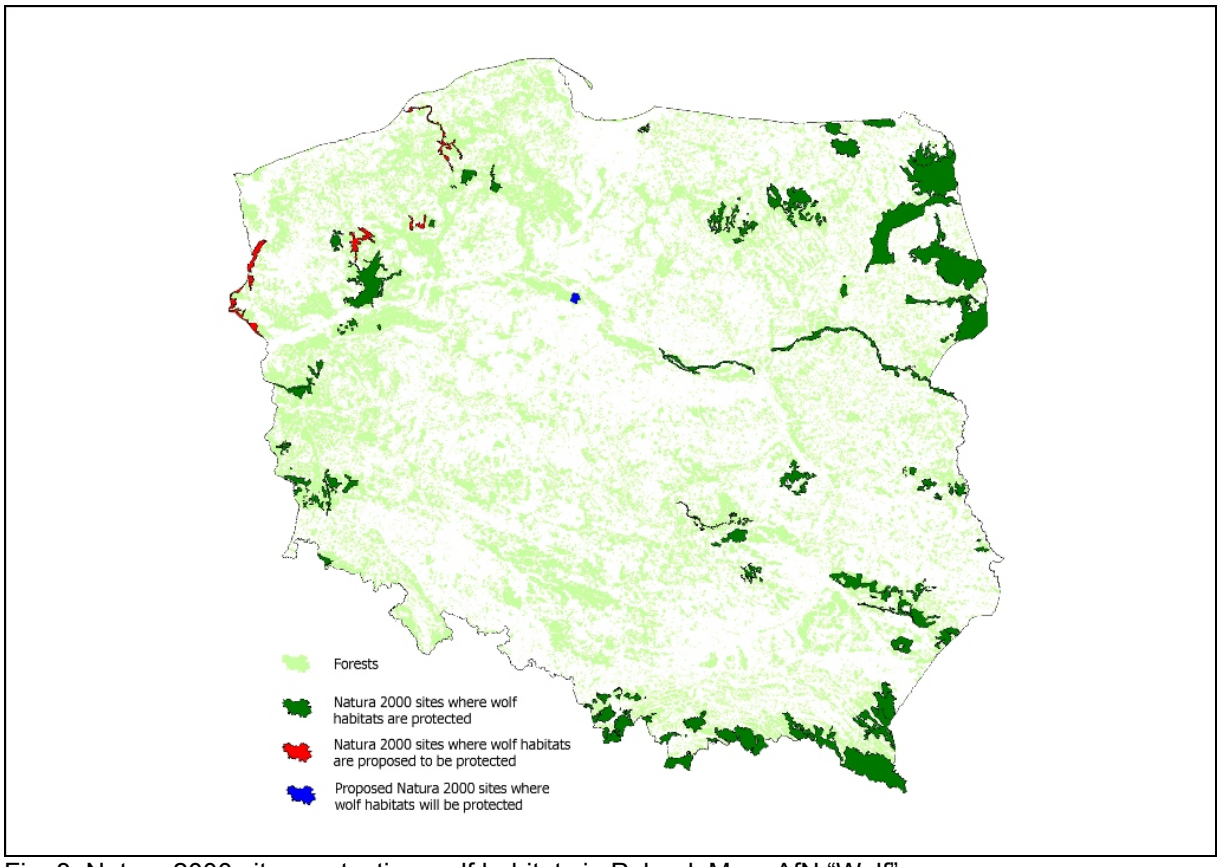

Fig. 8: Natura 2000 sites protecting wolf habitats in Poland. Map: AfN “Wolf”.

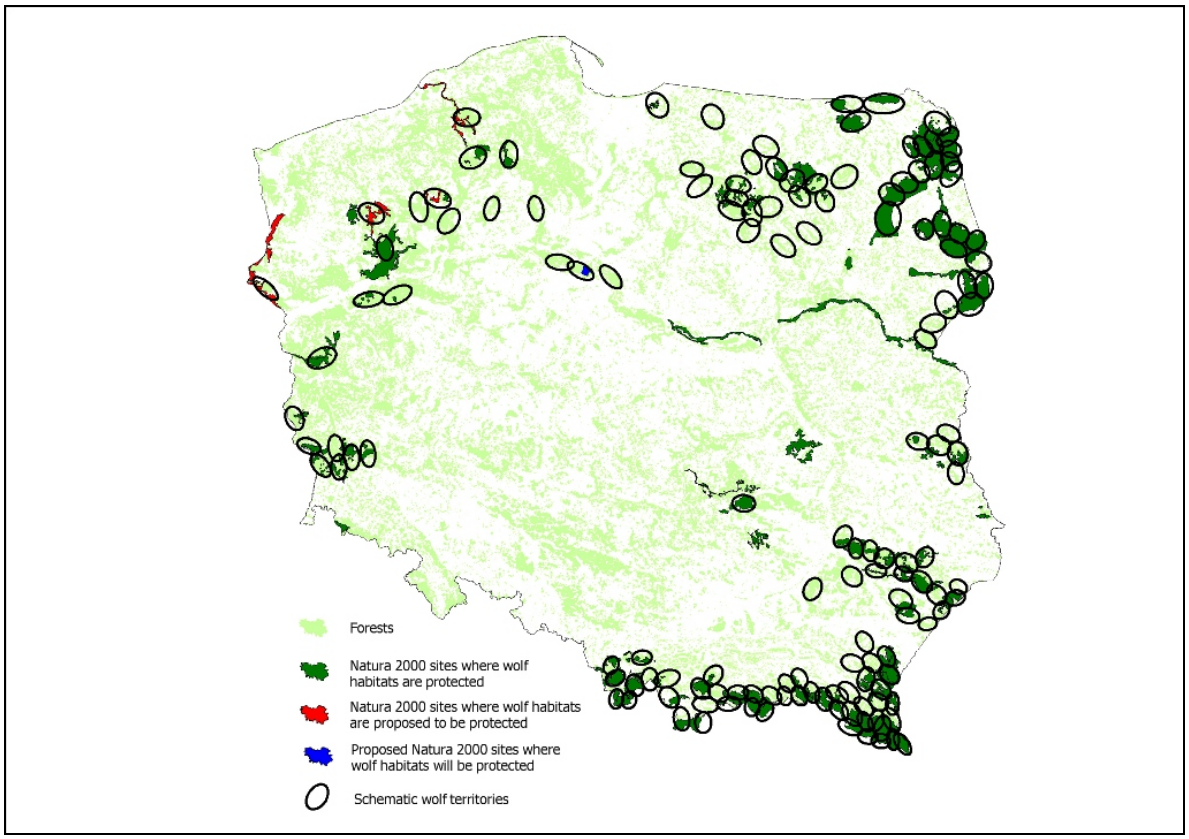

Fig. 9: Natura 2000 sites protecting wolf habitats in Poland set against wolf distribution. Map: AfN “Wolf”.

Improving connectivity of wolf habitats and populations

In the Polish lowlands, even the largest forests may host a maximum of 6 - 8 wolf packs, giving a total of 30 - 50 wolves per forest. Thus, as single areas, they are too small to harbour viable populations of these carnivores. However, the species has survived because individuals have been able to migrate between forests. This movement of individuals helps to maintain genetic diversity and allows repopulating habitats that have become vacant due to death of resident wolves from different causes. Thus all three Polish wolf (sub)populations (Carpathian, Baltic and Central European) include a number of population segments occupying forests connected by migration corridors. As a result of studies focussing on habitat availability and connectivity in which wolves and lynx were used as target species, the project "Ecological corridors linking Natura 2000 sites" was developed in Poland (JĘDRZEJEWSKI et al. 2005). Within the scope of planned expansion of the country's transportation network, the ecological corridors network was involved in identifying the biggest conflicts and locating road sections where mitigation measures should be introduced. The analyses and publications recommending the best measures to mitigate the problems was completed just before the most intense activity connected with new infrastructure planning and building commenced (JĘDRZEJEWSKI et al. 2004c, 2005c). As a result, several hundred wildlife crossing structures were planned and have been built on Polish motorways and express roads. Several fauna passes have also been built on upgraded railway sections. A law on environmental impact assessment (EIA) of transportation infrastructure on habitats has already been introduced in Poland, as well as regulations concerning use of mitigation measures for road investments, such as wildlife passages. Many problems remain to be resolved, such as, in some cases, inadequate design, size, location, number of fauna passes and low permeability of roads overall. But in general the mitigation measures introduced in Poland set a good example compared with other European countries. Recently monitoring of use of fauna passes has started on several road sections (e.g. A4, A1, S8). Furthermore, long-term monitoring of the impact of transportation infrastructure on the wolf population in the Lower Silesian forest is being conducted. Thus, based on the results of these studies, it will be possible in the near future to recommend the most efficient and cost effective measures to mitigate the threat of habitat fragmentation.

In Poland, several attempts have been made to designate a national network of ecological corridors. The first project was executed as a part of the European Ecological Network (EECONET) (LIRO et al. 1995, LIRO 1998). Within this network, ecological corridors linked nodes which consisted of areas with habitats, communities and species preserved in a near-natural state. Because the project referred mostly to aquatic habitats and substantially neglected terrestrial ecosystems, the main corridors were mostly situated along rivers.

Next, projects aimed to designate a network of Natura 2000 protected areas. The first proposal was based on EECONET-PL, but it turned out to be insufficient (KICZYŃSKA AND WEIGLE 2003). Consequently, the Polish Ministry of the Environment commissioned a project of ecological corridors to ensure ecological connectivity of the Natura 2000 sites (JĘDRZEJEWSKI et al. 2005c, Fig. 7). This network also includes most other legally protected areas like national parks, landscape parks, nature reserves and areas of protected landscape as well as other terrains of great natural value and high biodiversity. The corridors were based on reconstruction of historical dispersal pathways and on analyses of the current dispersal routes of wolves and lynx, but also on results of genetic research on wolves in Central and Eastern Europe.

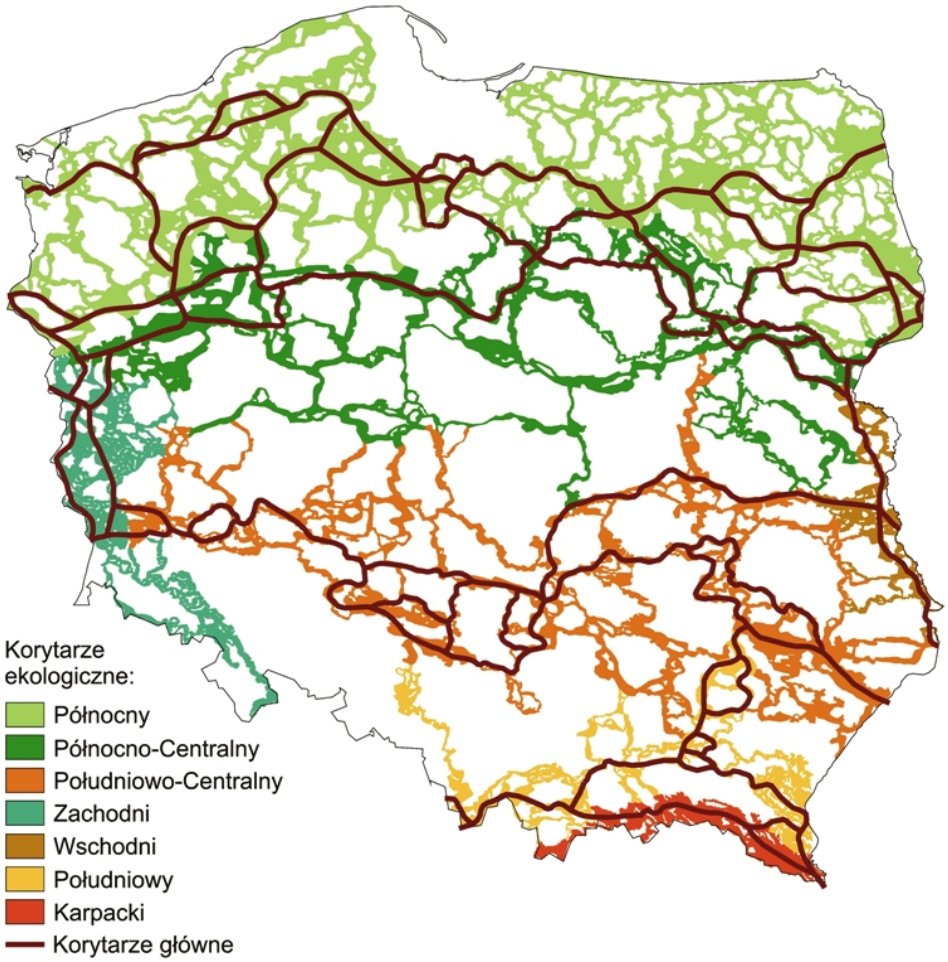

Fig. 10: Network of ecological corridors in Poland (according to Jędrzejewski et al. 2005c).

Currently, regional ecological corridor projects have already been developed or are under preparation in most of Polish provinces. These projects are mainly based on the national corridor network mentioned above, making them more detailed. In almost all provinces ecological corridors will be integrated into the new spatial management plans (MIŁOSZ-CIELMA et al. 2009).

Prevention of damage and conflicts, financial compensation

Wolves in Poland mostly feed on wild ungulates, which constitute up to 97% of the biomass eaten (JĘDRZEJEWSKI et al. 1992, 2000, OKARMA 1995, NOWAK et al. 2005, ŚMIETANA AND KLIMEK 1993, ŚMIETANA 2000, NOWAK et al. 2011). Domestic animals contribute approximately 1-3% of the biomass of a wolf's diet, but less than half of Polish wolf packs prey on livestock. Cases of depredation on livestock by wolves are not evenly distributed in Poland. In the lowlands, damage is frequent in north-eastern Poland, but rare in eastern and western Poland. In the Carpathian Mts. depredation is widespread in the eastern and central parts, but rarer in the western-most part of the mountains. Wherever livestock is taken, wolves prey most frequently on sheep and goats (in mountains) and cattle (in lowlands), and occasionally on dogs, cats and horses. Since 2005 (when re-colonisation began to speed up) there have only been few attacks on livestock in western Poland: several calves, 3 goats and 5-6 sheep. Additionally, wolf depredation has taken place at 4 fallow deer and mouflon farms,

where a total of 50 animals were killed (NOWAK et al 2011, NOWAK AND MYSŁAJEK 2011, unpubl.).

The level of damage varies from year to year, and depends on weather conditions and length of the grazing season. On average, the number of domestic animals killed is 1000 animals per year in Poland, and in 2004-2011 ranged between 800 and 1200 animals. From 1999-2008 the biggest share amongst livestock killed by wolves was sheep (75.5%), followed by cattle (19%), goats (3.5%), horses (0.5%) and others (1.5%, dogs, pigs, ostrich) (Jędrzejewski et al. unpubl.). There is a significant difference between regions. The number of livestock killed is highest in mountain regions (up to 1100 animals, sheep 92%) and is more or less increasing. In the lowlands, where cattle dominate (88% of kills), the level of damage is stable or has decreased slightly. The species structure of killed livestock corresponds well to the density of farms breeding these animals within the different regions (Jędrzejewski et al. unpubl.).

In Poland, methods of damage prevention are promoted through projects conducted by non-governmental organizations, scientific institutions, directorates of landscape parks and regional directorates for environmental protection. There are books (NOWAK AND MYSŁAJEK 1999, 2006), book chapters (MYSŁAJEK 2009), booklets (ŚMIETANA 2006), leaflets (ŚMIETANA 2010) and webpage (e.g. http://www.polskiwilk.org.pl) describing how to protect livestock against wolf attacks in Poland. Among the most recommended methods of damage prevention are: Livestock Guarding Dogs – a Polish breed called “owczarek podhalański” (eng. Tatra Mountains Shepherd Dog, Tatra Shepherd Dog or Tatra Sheep Dog) (NOWAK AND MYSŁAJEK 2005, ŚMIETANA 2005), electric fences (ŚMIETANA 2010) and fladry (NOWAK AND MYSŁAJEK 1999, 2006).

According to the Polish Nature Conservation Act, financial compensation for damage caused by wolves to livestock is paid by the State. Damage assessment and determining the amount of compensation as well as its payment is made by regional directorates for environmental protection (RDEP). The only exception is damage caused within national parks, where the director of the park is responsible. Financial compensation covers the value of the animals killed and, if necessary, the cost of veterinary treatment of injured individuals and costs of disposal of cadavers. Compensation does not include the loss of expected income, e.g. milk, wool or offspring, from which the owner would have profited if the animals had stayed alive. RDEP may develop programs of wolf damage prevention amongst local farmers. Farmers who refuse to take part in such programs are not reimbursed when wolves attack their livestock. Additionally, compensation is not paid if livestock is left unprotected on a remote pasture overnight.

There are some differences between the provinces in how the compensation systems function, but generally the pattern is the same. One to two days after a wolf attack on domestic animals has happened, a special commission including RDEP specialists inspects the place of kill, examines killed livestock and checks signs left by predators, but also the prevention methods used by the farmer. A detailed report of the damage is prepared and handed to the owner to be signed. The amount of compensation paid by the RDEP is based on the report and a regional price list for husbandry animals. If the decision to reimburse the loss is accepted, within a few weeks or months the money is paid to the livestock breeder. In some cases, when the provincial budget is limited, payment can be delayed until the following year. If the farmer does not agree with the estimation or the final decision, there is a possibility to sue the Head of the RDEP.

The mean sum of compensations paid to livestock owners from 2008 - 2010 was 391,000 PLN (Euro 94,900) per year (Fig. 8). This is 6.5% of the total amount of compensation (about 5.956,000 PLN – Euro 1,445.700) paid to farmers for damage caused by protected animal species (wolf, bear, lynx, bison and beaver). Interestingly, compensation paid for beavers made up 87.3% of the total sum.

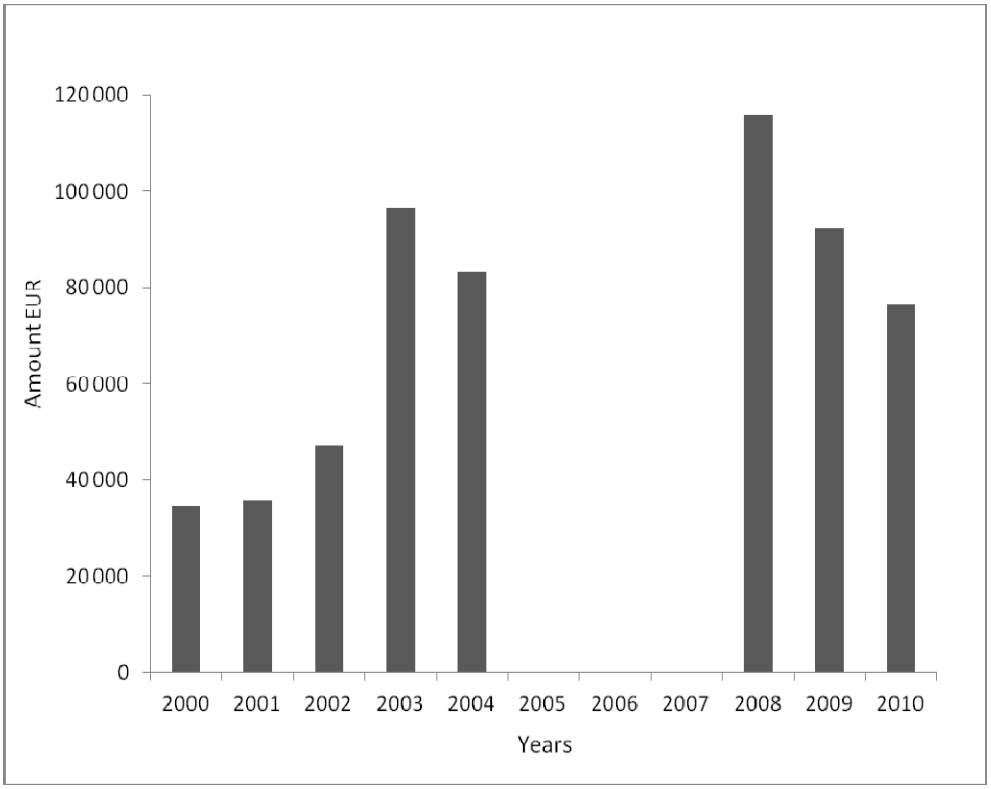

Fig. 11: Compensation paid to farmers for damage caused by wolves in Poland, 2000-2010. The numbers for 2005 - 2007 are not available.

Discussion with and involvement of stakeholders and interest groups. Cooperation of ministries/agencies/institutions/NGO involved in wolf management

There are several important issues associated with wolf conservation in Poland with respect to which various institutions have cooperated. Of these, wolf population monitoring and prevention of damage to livestock seem to be the most important.

The biggest and longest national wolf census project was conducted by staff of the State Forest Service (more than 240 forest divisions) and national parks, as well as by scientists and volunteers belonging to non-governmental organizations. The project was jointly co-ordinated by scientific (Mammal Research Institute Polish Academy of Science) and non-governmental (Association for Nature “Wolf”) institutions. Similar cooperation schemes have also been implemented within the scope of monitoring projects conducted in several provinces (e.g. Zachodniopomorskie Province, Upper Silesian Province, Podkarpackie Province).

Several programmes have been launched to implement and promote methods of livestock protection against wolf attacks in Poland. They are conducted at regional scale by non-governmental organizations (Association for Nature “Wolf”, Foundation “Green lungs of Poland”, WWF), but mostly in cooperation with scientific institutions, landscape parks and regional directorates for environmental protection. Moreover, the Association for Nature “Wolf” organises training sessions on livestock protection methods and damage assessment

for staff of regional directorates for environmental protection, as well as training programmes on wolf monitoring methods for staff of various governmental and non-governmental institutions. Currently, several projects are being initiated where cooperation and involvement by different stakeholders are planned. See above for details of ongoing or recently terminated conservation and research projects concerning wolves in Poland.

EU and national working groups established for information exchange and coordination

At international level, the most known working group dealing with wolf conservation is the Wolf Specialists Group within the Species Survival Commission (SSC) of the World Conservation Union (IUCN). Moreover, at the European level the Large Carnivore Initiative for Europe should be mentioned, which has had the official status of Specialist Group within SSC IUCN since 2010. Poland has a representative in both bodies.

Working groups have also been organized between neighbouring countries to deal with problems and issues relating to transboundary wolf conservation. A special wolf working group has been established within the Polish-German Council for Environmental Protection since 2009. The group holds meetings once or twice a year. Moreover, a Polish-Slovakian large carnivore working group has also been proposed by Polish NGOs. On a bilateral seminar organised in Krakow in spring 2011 by the Polish General Directorate of Environment recommendation to establish the LC group was agreed. In June 2012 on the first meeting of the Polish-Slovakian LC Working Group a preliminary agreement on creating buffer zones along Polish-Slovakian border to protect transborder populations of wolves and bears was achieved. The proposed buffer zones include a 23 km hunting ban zone for wolves and a 10 km zone without regulare culling of bears on the Slovakian side, and a 46 km zone of close cooperation and data exchange about LC on both sides of the borderline. A final decision of the Slovakian government on creating these zones is still pending.

There is no established national working group for information exchange and coordination of wolf conservation and management in Poland. However, before taking most decisions regarding wolves, the Ministry of the Environment and the General Directorate for Environmental Protection seek the opinion of the National Council for Nature Conservation (NCNC), which, under the Nature Conservation Act, functions as an advisory body for both institutions. The NCNC consists of 40 specialists – mostly scientists from various institutions and representatives of non-governmental organizations. The NCNC is divided into several commissions, and wolf issues are discussed within the Animal Conservation Commission, the CITES Commission and Natura 2000 Commission. Each province also has a regional council for nature conservation, which acts as advisory body to regional directorates for environmental protection. If necessary, they may also discuss issues connected with wolf conservation at a regional scale.

A project of the National Wolf Conservation and Management Strategy (OKARMA et al. 1998a), and a recently prepared project of the Wolf Conservation Strategy/Programme (OKARMA et al. 2011) proposed to establish the National Wolf Working Group; however, so far, none of these proposals have been accepted by the Polish government.

5.3 Germany

Favourable reference population in Germany

So far, favourable nationwide reference values have not been defined. With respect to the favourable reference population, Germany refers to the EU-wide definition given in the guidelines of LINNELL et al. (2008). This definition (see 5.1) was adopted in the standards for monitoring of large carnivores in Germany (KACZENSKY et al. 2009), which were accepted by all the Länder. It is interpreted as meaning that the definition refers to the population as a whole and not just to the German portion. As long as Germany does not have the data to conduct a robust PVA, the threshold for FCS would be IUCN Red List Criteria D (> 1000 mature individuals). Non-biologists frequently state that with some connection between neighbouring populations criteria D can be reduced to 250 individuals – this is wrong. LINNELL et al. (2008) clearly describe the extent of the connection needed between two populations to downgrade the threat category by one level: The population is connected to a neighbouring population in such a way that immigration can have a significant demographic effect on the extinction probability of the population and the resulting combined populations exceed the minimum threat level.

Although Germany had in 2012 less than 20 reproducing packs, and first genetic results show a considerable amount of inbreeding (which means the effective population size will be way below 40), the question is raised again and again: How many wolves are enough? The answer is given in chapter 5.1 and above. Favourable conservation status is the minimum goal; there are no recommendations for the maximum goal. The intention of the Habitats Directive appears to be that countries should not set a limit on potential large carnivore expansion even once they have reached (together with neighbouring countries) a minimum level of FCS (LINNELL et al. 2008).

However, it is clearly acknowledged that LC conservation in a crowded place like Europe is challenging and there might be reasons to selectively remove animals or limit their number / distribution at certain levels. Accordingly, equivalent management actions are considered to be both compatible with their conservation and even useful for gaining / maintaining public acceptance for such exceptional circumstances (LINNELL et al. 2008). Therefore, derogations may be used on the way to achieving the goal of gaining and maintaining FCS.

In order to use such derogations not only as single exceptional actions but in a more systematic manner (e.g. slowing down population growth or reduction of the density in some areas), in a federalist country like Germany, two conditions must be in place: 1) a nationwide (and preferably population- based) coordinated management plan and 2) a nationwide (and preferably population based) monitoring system that is able to predict the impacts of such actions in detail and also follow up the actions to determine their effect in respect to attaining FCS.

Monitoring of wolves in Germany

The standards in place for monitoring of large carnivores in Germany (KACZENSKY et al. 2009) are a first step on the way to attaining the second precondition. They define:

- what signs of large carnivores, under what conditions, can qualify as hard evidence (C1), confirmed observation (C2) or unconfirmed observation (C3),

- how hard evidence and observations are to be documented, and methods that are to be used for data collection.

Furthermore, they specify how the area of occurrence (and its trend), the range and the population size of LC species are to be documented in Germany. The standards aim to harmonise interpretation of monitoring data across the Länder and are thus the precondition for a reliable nationwide assessment of the status of wolf and lynx.

To estimate the area of occurrence and population size only hard evidence and confirmed observations are to be used. As recommended in the supporting texts for the Habitats Directive, the area of occurrence is based on a 10 x 10 km grid-cell network (EU grid). A grid cell will be considered as occupied if one C1 or at least three independent C2 signs of wolves have been provided for it. Grid cells with only C3 signs (e.g. sightings) or too few C2 are not considered to be occupied by wolves; rather, monitoring has to be improved in these areas in order to obtain clarification. Population size is given yearly as an index of the number of packs and scent marking pairs. Packs (> 2 wolves), scent marking pairs or single resident wolves have to be confirmed via C1 or C2 data as well as reproduction or the minimum pack size.

Neighbouring packs are distinguished from each other if either:

- reproduction has been confirmed at the same time in both areas OR
- reproduction was confirmed > 10km apart OR
- one pack territory is known by telemetry OR
- two centers of activity have been confirmed (by camera traps or accumulation of tracks / scats) at the same time more than 10km apart

The German monitoring standards for large carnivores (KACZENSKY et al. 2009) are currently under revision and the rules above are likely to be changed.

Since conservation and consequently monitoring too is carried out under the jurisdiction of the Länder, this is also true for data evaluation and interpretation. However, consistent data interpretation cannot be achieved with monitoring standards alone, especially if people in charge do not have the necessary field experience. To calibrate monitoring data between the Länder, and to avoid double counting of transboundary territories a yearly meeting of the persons in charge of LC monitoring is conducted. At the meeting, all C1 and C2 data used for the area of occurrence (occupied grid cells) and population size have to be presented and can be re-evaluated by the group. By doing so a yearly nationwide picture of wolf occurrence and population size is obtained.

Monitoring effort varies greatly between the Länder according to their different monitoring structures. Because of this variation the resulting overall picture is incomplete. While we may have reasonably accurate estimates of areas of occurrence and population size from some areas, on a nationwide scale these figures are likely to be underestimated.

Since 2010, the Senckenberg Institute, a German reference lab, has been available for genetic analysis of wolf and lynx. However, although genetic samples are collected from fresh scats in all known wolf areas, not all are analysed. Consequently we only have an incomplete picture of the genetic structure of the German part of the wolf population. This makes it more difficult to assess the conservation status for the still small and fragmented population. For example, to evaluate the connectivity with neighbouring populations as complete a genetic picture as possible would be necessary. The different sampling efforts

will make robust capture-recapture analysis more difficult. Although modern models account for IDH, resulting confidence intervals will be large, increasing the uncertainty of population size assessments.

Projects and scientific research on wolf biology and management

The Senckenberg Museum for Natural History in Görlitz (SMNG, former Saxonian State Museum of Natural History Görlitz) started analysis of wolf scats in 2001. To date, diet analyses of more than 3000 scats have been conducted (ANSORGE et al. 2006, WAGENER 2008, HOLZAPFEL et al. 2011), most from the Lusation wolf area in Saxony and southern Brandenburg. Meanwhile, most Länder with wolf occurrence send their wolf scat samples for dietary analysis to the SMNG.

In 2005, the German Federal Agency for Nature Conservation (BfN) financed by the BMU commissioned a technical paper on future wolf management in Germany. This report (REINHARDT AND KLUTH 2007) sets out as a basic concept for wolf management plans developed by the various Länder. It deals to a great extent with challenges and solution statements for the return of the wolf in the human dominated landscape of Germany. A broad-scale human attitude study (Kaczensky 2006), a first habitat analysis (HERDTWECK 2006) and a report on methods of resolution for wolf – hunter conflicts (WOTSCHIKOWSKY 2006) were conducted in the frame of this report.

From 2007 to 2011 a dispersal study was conducted on behalf of the BfN by LUPUS Wildlife Consulting. This pilot study provided first results on wolf dispersal in Germany as well as results on habitat use and territory sizes. Six wolves were captured and fitted with GPS-GSM collars in the frame of this project (REINHARDT AND KLUTH 2011).

In the “Framework plan Wolf” fundamentals were developed for management concepts for the return of large carnivores. These included monitoring standards for large carnivores in Germany (KACZENSKY et al. 2009), habitat models for wolf, lynx and bear (KNAUER 2010), synopsis and evaluation of damage prevention and compensation schemes (REINHARDT et al. 2010) as well as an assessment of large carnivore individuals showing problematic behaviour and recommendations on how to deal with them (PROJECT TEAM 2010).

Since 2010, genetic analysis of wolf samples has been conducted at the Senckenberg Institute for Nature Conservation Science (Gelnhausen). In 2010 and 2011, some 500 samples were analysed, 460 of which originated from Saxony.

From the outset, the Leibnitz institute for Zoo- and Wildlife Research Berlin (IZW) has investigated the carcasses of wolves found dead in order to determine the cause of death, as well as the histological and parasitological status. Although the carcasses are returned to the Länder where they came from after analysis, most, but not all Länder send their wolf carcasses to the IZW. Currently, the IZW plans to conduct a parasitological study of wolves in Germany.

In 2011, Saxony-Anhalt launched a project entitled “Study of the spatio-temporal behaviour of wolves in Saxony-Anhalt”. In the frame of this project two wolves have been fitted with GPS-GSM collars.

From 2012 on, Saxony plans, within the scope of its wolf monitoring activities, to fit wolves in several territories with GPS transmitters. In 2012, the territories of ten wolf packs in the Lusation wolf area (Saxony and Brandenburg) already border each other, making it more and

more difficult for monitoring to keep track of newly established wolf territories. This study is supported financially by the WWF Germany, NABU, IFAW and GzSdW.

Since 2009, a red deer telemetry project has been conducted in the Saxonian wolf area. During the next few years results from both wolves and red deer telemetry will be linked to each other.

Availability of habitats and prey species

KNAUER (2010) conducted a habitat analysis of wolves in Germany based on the model of Jedrzejewsky et al. 2008. According to his results, Germany could harbour about 440 wolf packs if territory sizes were in the order of 200 km², which is a reasonable size (REINHARDT AND KLUTH 2011). According to this model there are large areas offering suitable habitats from the Polish border to the Luneburg Heath in the north-west, in the forest covered low mountain ranges in the south-west of Germany as well as in the Alps and the alpine foothills. However, the suitable habitat is rather fragmented in many places.

Wild ungulates are the wolf's natural prey. If ungulate harvest rates are taken as a basis for ungulate abundance, wild ungulates are abundant in many regions of Germany, especially in the north-east and south-west (HERTWECK 2006, REINHARDT AND KLUTH 2007). However, there are other areas with low or very low hunting bags of hoofed game like in the west of Lower Saxony, Bavaria and North Rhine-Westphalia. Some of these areas were identified as suitable habitats for wolves in the habitat model of KNAUER (2010). However, the model did not take ungulate abundance into account.

Improving connectivity of wolf habitats and populations

With 1.9 km/km², Germany has the highest road density in Europe (www.bfn.de). Accordingly, habitat fragmentation has become a major challenge for the international and national goal of restoring and maintaining biodiversity. To conserve biological diversity in the long term barriers in the form of existing or planned transportation infrastructure have to be overcome and habitats re-linked to each other. In this context, the German Federal Agency for Nature Conservation commissioned scientists from the Ecology Centre in Kiel and the Department of Ecological Site and Vegetation Science of the University of Kassel to identify priority sites for measures to overcome road-related barriers, which will serve as a basis for a connectivity concept for biodiversity in the Federal Republic of Germany (HÄNEL AND RECK 2010, 2011). In February 2012, a "Federal reintegration program" was adopted by the federal cabinet. The project aims at relinking habitat corridors that have been cut through by the supraregional road network. Focussing on the main areas of conflict that have been identified, the project's goal is to permanently safeguard ecological interactions by recreating a biotope network. The main content of the project is an investment program for green bridges.

In its national strategy for biological diversity, the German federal government has committed itself to ensuring that by 2020 the transportation infrastructure will no longer impair the habitat connectivity system. Clearly the wolf, as a wide roaming species of enormous dispersal ability, will benefit from this measure. In the comparatively sparsely populated Lusation wolf area, road density is still 1.29 km / km² and therefore much higher than in most wolf areas of Europe (REINHARDT AND KLUTH 2011). So far, road traffic accidents are the main known causes of wolf mortality.

Prevention of damages and conflicts, financial compensation

In 2010, REINHARDT et al. collected information on prevention and compensation payment schemes in Germany on behalf of the BfN and compared them to those of other European countries. Because of the Germany's federalist structure, these systems differ considerably from Land to Land. Two of the Länder with wolf presence (Saxony and Brandenburg) have linked compensation to prevention, several other Länder consider doing so. While in Germany several Länder discuss lower or upper limits for payment of compensation if damage goes below or exceeds a financial limit, none of the other European countries / regions has such thresholds.

Several German Länder have provided the legal framework ensuring financial support for preventive measures and several more plan to do so in the future. Presently, Saxony subsidizes the inititial cost of e-fences and livestock guardian dogs (LGDs) by up to 60 %, Brandenburg by up to 75 % and Saxony-Anhalt by up to 80 %. Mecklenburg-Western Pomerania subsidizes up to 75 % of additional prevention measures like higher fences, protection against digging or LGDs. Measures belonging to the defined minimum prevention standard are not funded in this Land. In Schleswig-Holstein, mitigation measures can be subsidized by up to 100 %. So far, only hobby sheep owners can be supported in Saxony-Anhalt, only professional sheep owners in Brandenburg, and both professional and hobby sheep owners in Saxony and Mecklenburg-Western Pomerania. In Saxony, prevention and compensation payment schemes are defined in the Management plan for the wolf in Saxony (SÄCHSISCHES STAATSMINISTERIUM FÜR UMWELT UND LANDWIRTSCHAFT, 2009). After a wolf attack, compensation is only paid if the sheep or goats were protected according to a clearly defined minimum prevention standard. This regulation came into effect in 2008 after a transition period of one year during which owners of small livestock were informed about the preventive methods conforming to the minimum prevention standard, funding opportunities and the fact that compensation would be coupled with prevention. Brandenburg and Mecklenburg-Western Pomerania follow this approach.

In Germany, funding of preventive methods is recommended for small livestock only. Since wolf depredation on cattle and horses is much less common in Europe (KACZENSKY 1996) and only rarely happens in Germany, the costs of funding protection measures for large livestock presently outweigh the benefits. Wild ungulates are abundant enough in many regions of Germany; protection of small livestock will not force wolves to switch to large livestock. In Saxony, funding of prevention measures is provided for livestock owners within the confirmed wolf area and an additional 30 km radius. This approach requires intensive monitoring. Wide areas of Saxony are densely populated (average population density 227 / km²), making it unlikely that wolves will recolonize them. Therefore, costs and efforts are focused on areas that are actually already inhabited by wolves. In contrast, Brandenburg (average population density 85 / km²), expect the whole region to become populated by wolves. Funding of prevention measures is provided for the whole country and is not linked to the actual area of occurrence. Most of the German Länder already follow the Saxonian model or plan to do so in future.

The amount of damages to livestock is not linked to the number of wolves, but to the husbandry technique employed (KACZENSKY 1996). In Saxony, 335 livestock were killed or wounded by wolves between 2002 and 2011, on average 33.5 animals per year. Altogether, Euro 42,179 were paid in compensation, equating to Euro 4,218 per year (note that since 2008 unprotected livestock are no longer compensated). In Brandenburg, the damage was

about 283 livestock in the last five years, on average 56.6 per year. Euro 45,040.52 (Euro 9,008 per year) in compensation were paid during this time in Brandenburg (table 5).

Tab. 5: Development of damages to livestock and compensation payment in Saxony and Brandenburg.

	Saxony			Brandenburg		
	dead / wounded livestock	**compensation* [€]**	**pop. size** (packs / pairs)**	**dead / wounded livestock**	**compensation [€]**	**pop. size** (packs / pairs)**
2002	33	8,448.00	1 / 0	0	-	-
2003	0	0	1 / 0	0	-	-
2004	3	260.00	1 / 0	0	-	-
2005	1	0	2 / 0	0	-	-
2006	40	5,215.36	3 / 0	0	-	-
2007	72	15,952.30	3 / 0	4	555.92	0 / 1
2008	60	4,424.00	5 / 0	73	10,283.19	0 / 1
2009	22	2,061.00	5 / 0	36	7,769.57	1.5 / 3
2010	16	655.50	5 / 0.5	85	20,545.25	1.5 / 4.5
2011	88	5,163.00	7.5 / 0	85	5,886.59	6
sum	335	42,178.66		283	45,040.52	

* since 2008 compensation is linked to prevention

** "half" packs / pairs are transboundary either between Saxony and Brandenburg or between Brandenburg and Saxony-Anhalt. Two "half" packs are summed up to one pack, like in the case of Brandenburg 2011.

Most livestock preyed on by wolves are sheep or occasionally goats. Sometimes wolves that have learned to dig under fences kill red deer or fallow deer in game enclosures; very rarely calves fall prey to wolves.

A considerable amount of damage is related to unprotected or insufficiently protected sheep, easy prey for wolves. Of 34 wolf attacks in Saxony in 2011 with 88 head of livestock killed or injured, 21 (44 animals) occurred on insufficiently protected livestock and were therefore not compensated.

Figure 12 corroborates the analysis presented by Kaczensky 1996 that the amount of damage is not linked to the number of large carnivores. In Germany the number of damages and compensation payment in 2008 (213 animals killed or wounded, Euro 24,010) and 2011 (215 animals, Euro 26,584) was almost the same although the wolf population was considerably larger in 2011 than in 2008.

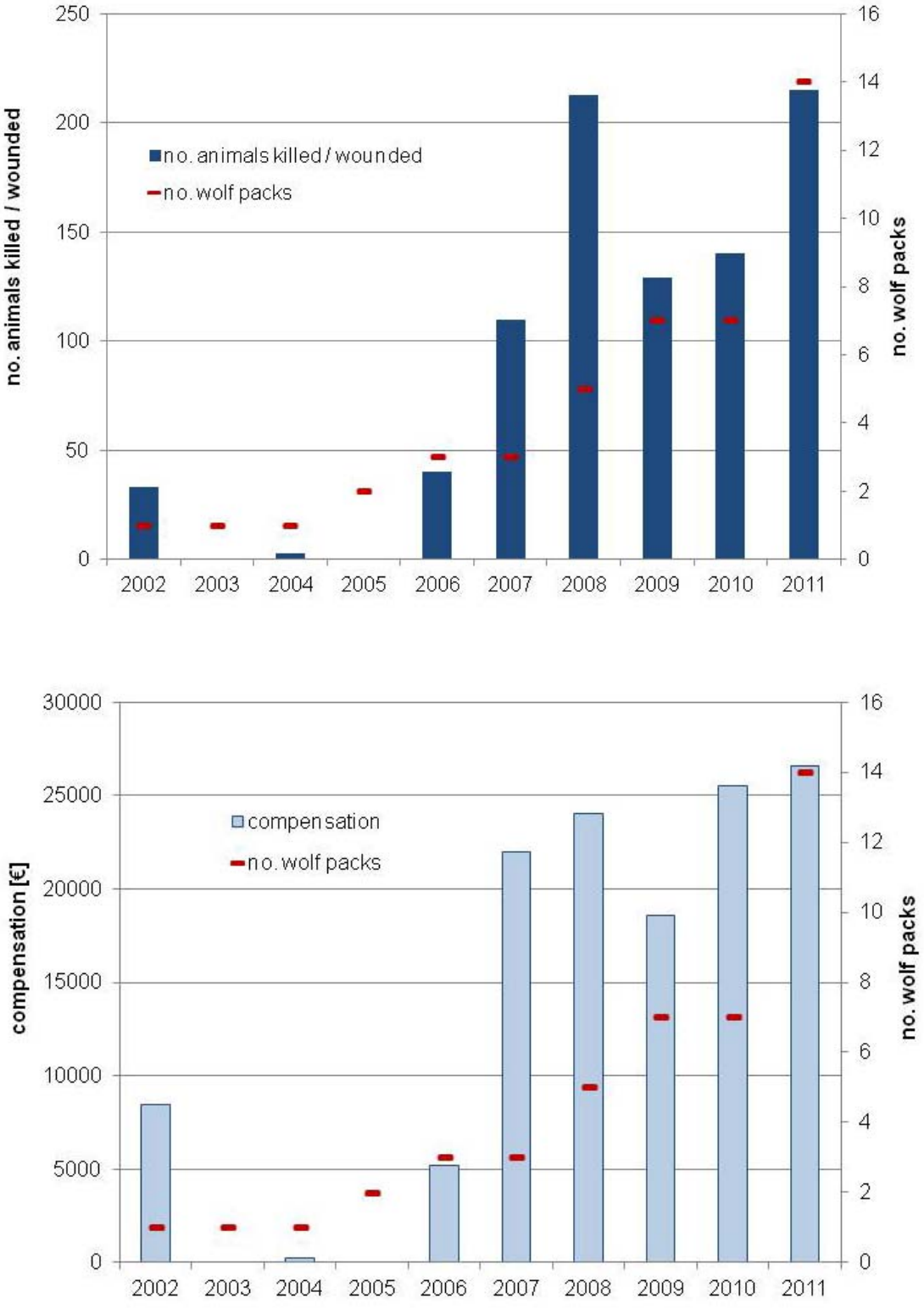

Fig. 12: Number of damages caused by wolves (above) and compensation payment (below) in Germany. Data from all the Länder with occasional or permanent wolf presence included.

Discussions with and involvement of stakeholders and interest groups

In 2004, a public relations office focussing on the wolf and with the aim of providing interest groups with serious up to date information was initiated by the Saxonian State Ministry of the Environment and Agriculture (SMUL). This regional contact office "Wolves in Saxony" (Kontaktbüro Wolfsregion Lausitz) is run under the auspices of the administrative district of Görlitz and financed by the SMUL and the EU. The office was meant to function as a contact point for the public, the media and all interest groups. It actively provides up to date, serious, science-based information provided by monitoring in lectures, press releases and on an own web site (www.wolfsregion-lausitz.de). In addition, it organizes information events or round tables on demand.

During the early years of wolf presence in Saxony, several discussion groups and round tables were initiated involving all interest groups. The round table initiated in 2004 by the regional contact office met several times. However, since the discussions at these meetings were dominated by an anti wolf group (Sicherheit und Artenschutz e.V.) which insisted that wolves in Saxony had been artificially reintroduced and were hybrids, more and more attendees lost interest and the round table meetings finally petered out.

Informative meetings between sheep breeders in the Saxonian wolf area and LUPUS Wildlife Consulting (responsible for monitoring) were held regularly during the early years. These meetings were organized by the State Agency for Agriculture (Staatliches Amt für Landwirtschaft und Gartenbau Großenhain). After several years the meetings ceased.

There have been several attempts to improve cooperation and information exchange with the Saxonian Hunters association (SNLJV). Lectures were offered and reoffered to local hunting communities by LUPUS Wildlife Consulting and the regional contact office "wolves in Saxony". Information days focussing on hunting topics were organized but poorly accepted. An offer to implement working groups between hunters and monitors at the local hunting community level was rejected. A special course to help train local hunters on recognizing wolf kills was conducted in January 2008 for 20 members of the SNLJV. The aim was for attendees to be able investigate wolf kills on their own according to a monitoring protocol and forward the protocol with photographic documentation to the wolf monitoring staff for evaluation and data archiving. Again, response to this initiative has been marginal. Only about half a dozen probable wolf kills have been forwarded in the last four years, most of them insufficiently documented. Numerous appeals to participate in wolf monitoring and to attend training courses in wolf monitoring have gone unheard.

Today, discussion and involvement of stakeholders in Saxony is mainly restricted to the forums and panels around the wolf management plan. Such management plan-bound discussion groups also exist in Brandenburg, Mecklenburg-Western Pomerania, Lower-Saxony and Bavaria.

Cooperation of ministries / agencies / institutions / NGOs involved in wolf management

Several NGOs are engaged in wolf-related activities in Germany. Some of their main focuses are given in the following, although most are also involved in other wolf-related issues. The Gesellschaft zum Schutz der Wölfe e.V. (GzSdW, German society for the protection of the wolf) set out from the start to facilitate funds for compensation and prevention as long as state regulations were not yet in place. The International Funds for Animal Welfare (IFAW) supports public relation work and monitoring in Saxony and Brandenburg. The

Naturschutzbund Deutschland (NABU, Nature and Biodiversity Conservation Union) is mainly engaged in public relation work and also supports monitoring in Brandenburg. The World Wide Fund for Nature (WWF) supports monitoring and research in several Länder. The Freundeskreis freilebender Wölfe (Friends of free living wolves) is mainly active in public relation work and to some extent supports wolf monitoring. Some of the Länder have cooperation agreements with individual or several NGOs.

Currently, Saxony has started a cooperation project on wolf telemetry in association with the WWF, NABU, IFAW and GzSdW.

Within the framework of an Interreg IIIA project a permanent bilingual (German / Polish) wolf exhibition was opened in Rietschen, Saxony in 2007. Project partners were the Saxonian State Museum for Natural History in Görlitz (SMNG), the Polish museum Przyrodnicze and the Kontaktbüro "Wolfsregion Lausitz. This project was supported financially by the NABU and the Volkswagen AG. In addition, a trilingual (German, Polish, Czech) touring exhibition was finalized.

An Interreg project planned and submitted by the WWF that will involve Brandenburg, Mecklenburg-Western Pomerania and Poland's westernmost voivodship as project partners is still pending.

In Lower Saxony, the Ministry of the Environment has signed a cooperation agreement with the regional hunting association (Landesjägerschaft Niedersachsen, LJN) and to a great extent assigned responsibility for wolf monitoring to the LJN. This has brought about criticism from other NGOs, who on the one hand feel left out and on the other are vehement that responsibility for monitoring is a state task that cannot be assigned to an NGO.

National and transboundary working groups established for information exchange and coordination

On the level of authorities, there is a wolf working group (Unterarbeitskreis Wolf) as part of the Federal/ Länder working group for nature and landscape conservation and recreation (Bund/Länder-Arbeitsgemeinschaft für Naturschutz, Landschaftspflege und Erholung, LANA). This working group was set up in 2009 and meets on demand to discuss wolf specific issues.

In 2009, a first Polish-German meeting on wolves was arranged on both sides of the border. Attendees included members of federal ministries and authorities, regional (Länder, Voivodeships) ministries and authorities as well as wolf biologists from both countries. At this meeting, it was agreed that Germany and Poland share a common wolf population, and the decision was taken to establish a transboundary wolf working group. Since then, the German-Polish wolf working group has met on average twice a year. These are informal meetings that serve for the exchange of experience.

Within the framework of the Alpine Convention, the Large Carnivores, Wild Ungulates and Society Platform (platform WISO) was set up by the Xth Alpine Conference in Evian in 2009. The objectives of the Platform WISO are to find solutions to manage large carnivores and wild ungulates harmoniously, and based on an integrated approach. The platform goes beyond a strictly ecological approach and endeavours to take into account economic and social aspects on an equal level (http://www.alpconv.org/theconvention/conv06_WG_f_en). According to the mandate, the main activities of the platform are:

International cooperation for the purpose of: 1) exchange of knowledge and experience (good-practice examples); 2) establishment of a forum for the discussion of issues

concerning the preservation, management, and use of large carnivores and wild ungulates; 3) ensuring exchange of information among relevant partners.

Cooperation in terms of content, with the aim of cross-border protection and management of wildlife at the population level.

6. Wolf management plans and conservation measures of Poland and Germany

6.1 Poland

In Poland, the only document on wolf conservation strategy commissioned by the Ministry of the Environment was developed in 1998 and entitled the “National Wolf Conservation and Management Strategy” (OKARMA et al. 1998). Other projects on strategies or management plans concerning this species developed in the past twenty years were largely initiatives taken by different interests groups (scientists, foresters, hunters, etc.)

Administrative reform in Poland in 1999 reduced the number of provinces (voivodships) from 49 small to 16 larger ones. Prior to that, wolf protection/management plans had been developed for the former Krosno province (Śmietana 1995), Nowy Sącz province (Bobek et al. 1996) and Suwałki province (BOBEK et al. 1998b). All the management plans proposed to divide the given province into several zones with different protection regimes. Following administrative reform, wolf protection plans were developed for the north-eastern region of Poland, including Warmińsko-Mazurskie and Podlaskie provinces (JĘDRZEJEWSKI AND SCHMIDT 2001), and also for the Podkarpackie province (PERZANOWSKI 2005). None of these regional conservation plans have been officially accepted and introduced.

At national level, there were also efforts to create a strategy for the protection of wolves in Poland. The first attempt was made by Prof. A. BERESZYŃSKI (1997) before implementation of legal protection of the wolf in entire Poland. The project was presented in the Polish Parliament.

After the species was put under strict protection in the whole country in 1998, the Polish Ministry of the Environment commissioned a group of experts to develop a project entitled “National Wolf Conservation and Management Strategy” (OKARMA et al. 1998a). However, only parts of this document, which concerned conditions and procedures for derogations on wolf culls and the scheme used for damage compensation have been implemented and used for further law development and enforcement.

In 2010, the Warsaw University of Life Sciences started a project entitled: *Preparing National Strategies of Management of Several Threaten or Conflict Species.* The species list included: the brown bear, the wolf, the lynx, the otter, the cormorant and the crane. The project is financed by the Operational Program Infrastructure and Environment 2007-2013 (85%) and the National Fund of Environmental Protection and Water Management (15%) (http://gatunki.sggw.pl/). Although the project was not commissioned by the General Directorate for Environmental Protection, it obtained a positive opinion from the Ministry of Environment in order to apply for EU funds.

Leading experts responsible for conducting workshops and writing the strategy projects, were chosen for each species. The leading expert chosen for the wolf was Prof. Henryk Okarma, director of the Institute of Nature Conservation of the Polish Academy of Sciences in Krakow (INC PAS). From October 2010 to December 2011 several workshops were organized to discuss the details of the strategy proposed by the leading expert. The first workshop was conducted in the Carpathian Mts. (October 2010) and focused mainly on the Carpathian wolf population; the second held in Warsaw (February 2011) concerned wolves in eastern Poland; the third held in Poznań (March 2011) focused mainly on wolves in western Poland; the fourth was an international workshop in Krakow, to which wolf specialists from Slovakia, Lithuania, Latvia and Estonia had been invited.The national workshops were

mainly attended by foresters, hunters, scientists, staff of national parks, officers from provincial and governmental environmental agencies and representatives of several Few representatives of livestock breeders took part. At the last workshop held in Warsaw (December 2011), the final draft of the Strategy was presented. The group of authors include: Prof. Henryk Okarma (INC PAS), Dr. Roman Gula (Museum and Institute of Zoology PAS in Warsaw) and Dr. Piotr Brewczyński (Regional Directorate of State Forest Service in Krosno). In the Strategy project they proposed to establish: (1) a system of wolf population monitoring based on yearly hunter surveys in the whole of Poland and genetic monitoring to be conducted every 5 years in the whole country; (2) the possibility for hunters to hunt wolves by special permission in areas of high wolf density (including the large forests of eastern Poland and the Carpthians, but also western Poland in the next few years); (3) a Wolf Specialists Group responsible for analyzing data on wolf distribution provided by hunters' surveys, together with data on wolf damage to livestock and predation on wild ungulates ("damage to wild ungulates"), as a basis for taking decisions regarding wolf population management in different regions of Poland (e.g. culling wolves by hunters). The group will also advise the Ministry of the Environment on issues relating to changes to the law, methods of livestock protection, public education, etc. A large part of the Strategy project focuses on the impact of wolf predation on domestic and wild ungulates and losses caused by wolves to game animals management. Poaching (especially illegal shooting by hunters) is presented as the only important threat to wolves, and the main reason for very slow growth of the population in western Poland. Many other factors of wolf mortality and important threats to population caused by urbanization and transportation network development are either not mentioned at all or only described in brief. There are no proposals or recommendations in place for implementation of wolf monitoring standards, procedures and methods that fulfill the requirements of existing EU directives and national legislation. The project received strong support from hunters, those foresters who are hunters themselves, and from some scientists. However, it was hardly criticized at all by other scientists, environmentalists, representatives of NGOs, staff of national parks, or officials at local, regional and national level. Generally, antagonists of the project do not agree with culling wolves in their suitable habitats because of predation on wild ungulates. In their opinion only those derogations are acceptable that are granted for cases when wolves cause regular damage to livestock or pose a threat to humans.

In April 2012, the Strategy project was presented by the project coordinator (the Warsaw University of Life Sciences) to the General Director of Environmental Protection (GDEP) for approval. Next months, the project will be proposed for public consultation and the opinion of the National Council for Nature Conservation (NCNC) sought. After possible acceptance by the GDEP, the document will be used by the officers of the Ministry of the Environment and the General Directorate of the Environment as a tool and recommendation in decision-making processes.

6.2 Germany

Brandenburg was the first of the German Länder to develop a management plan for the wolf. Already in 1994, more than ten years before the first wolf territory was confirmed in Brandenburg, this plan was commissioned and worked out in an intense public involvement process (PROMBERGER AND HOFER 1994), which at the time was a highy progressive approach. However, the plan was never implemented. Currently, Brandenburg is revising this plan completely. The new version is expected to be ready at the end of 2012.

In 2005, the BfN with funds from the BMU commissioned elaboration of the “Scientific concept for wolf management in Germany” (REINHARDT AND KLUTH 2007). These guidelines were intended to provide the scientific basis for development of wolf management plans in Germany and have been widely used ever since.

Today, several Länder have developed regional wolf management plans, action plans or guidelines of various complexities (table 6). For example, Bavaria approved a “Step 1” wolf MP in 2007 (BAYERISCHES STAATSMINISTERIUM FÜR UMWELT, GESUNDHEIT UND VERBRAUCHERSCHUTZ 2007) dealing with single individuals that disperse through Bavaria. A “Step 2” MP focusing of single resident wolves is has been under discussion since 2010.

These regional action plans or guidelines, although called management plans, mainly deal with regional conflict mitigation and competences. The plans do not define any population goals or management measures acting on a population level. A national management plan that could do so is not under consideration.

Most of these regional plans have been developed with some public and / or stakeholder participation. However, the extent of influence of those involved in the process is i generally limited because the legal framework defines the boundaries. Furthermore, there is no tradition and little experience in facilitating (to some extent) open processes of participation. In general, no professional moderator is engaged other than a chairperson leading the discussion.

In the process of developing these action plans, some of the Länder implement working groups or panels. For example, all the interest groups involved in management planning in Saxony are members of the plenum “Management plan wolf”. This plenum meets once a year to obtain information about and discuss latest developments in regard to the wolf. In the Saxonian wolf MP the plenum is defined as having an advisory capacity.

Tab. 6: Regional action plans and guidelines on the wolf in Germany.

Year	Land	Title	Remarks
1994	Brandenburg	Ein Managementplan für Wölfe in Brandenburg. 116 S. A management plan for wolves in Brandenburg. 116 pp.	MP was not implemented.
2007	Bavaria	Managementplan Wölfe in Bayern Stufe 1. 17 S. Managementplan wolves in Bavaria. Step 1. 17 pp.	Deals with single non-resident wolves only. MP step 2 (single resident wolves) in preparation.
2008	Saxony-Anhalt	Leitlinie Wolf. Grundsätze zum Umgang mit Wölfen. Handlungsempfehlungen und Managementmaßnahmen für Sachsen-Anhalt. 19 S. Wolf guideline. Principles for dealing with wolves. Management measures in Saxony-Anhalt. 19 pp.	
2009	Saxony	Managementplan für den Wolf in Sachsen. 46 S. Managementplan for the wolf in Saxony. 46 pp.	Update planned in 2013.
2010	Mecklenburg-Western Pomerania	Managementplan für den Wolf in Mecklenburg-Vorpommern. 43 S. Managementplan for the wolf in Mecklenburg-Western Pomerania. 43 pp.	
2010	Baden-Württemberg	Die Rückkehr des Wolfes nach Baden-Württemberg. Handlungsleitfaden für das Auftauchen einzelner Wölfe. 35 S. The return of the wolf to Baden-Württemberg. Action plan for the appearance of single wolves. 35 pp.	Deals with single individuals only.
2010	Lower-Saxony	Der Wolf in Niedersachsen. Grundsätze und Maßnahmen im Umgang mit dem Wolf. 47 S. The wolf in Lower Saxony. Principles and measures for dealing with the wolf. 47 pp.	
2010	Schleswig-Holstein	Positionspapier zur Wiederbesiedlung Schleswig-Holsteins durch den Wolf. 13 S. Position paper on the recolonisation of Schleswig-Holstein by the wolf. 13 pp.	
2012	Brandenburg	Managementplan für den Wolf in Brandenburg 2013 – 2017. 54 S. Managementplan for the wolf in Brandenburg 2013 – 2017. 54 pp.	
2013	Thuringia	Managemetplan für den Wolf in Thüringen. 44 S. Management plan for the wolf in Thuringia. 44 pp.	
2013	Bavaria	Managementplan Wölfe in Bayern Stufe 2. Management plan wolves in Bavaria. Step 2.	in preparation deals with single resident wolves only.

6.3 Synopsis and assessment of compatibilities and differences

Tab. 7: Synopsis and assessment of compatibilities and differences in wolf management between Poland and Germany.

What	Germany	Poland
Legal status	Strictly protected.	Strictly protected.
Game species	Currently not. Some Länder plan to include the wolf as a game species with year round protection under their regional hunting laws.	No.
Bern Convention	In appendix II	In appendix II with reservation regarding strict protection of the wolf.
Habitats Directive	In annex II and IV	In annex II and V
Derogations	Derogations can be given in certain situations according to the MPs of the Länder by the regional Länder authorities. Not applicable so far.	Derogations can be given in certain situations by the General Director of Environmental Protection.
Reporting for derogations	So far no derogations issued.	Since 2000, 25 have been issued permits to kill 49 wolves, of which 10 have been shot. Report on derogations according to article 16 of the Habitats Directive are sent to the EC every second year.
Conservation measures required by law	§44 BNatschG defines bans on access, possession and on marketing of the wolf as a strictly protected species. Other than capturing, killing or injuring individuals of strictly protected species, §44 BNatschG also prohibits disturbing their rearing places in such a way which may lead to a degradation of the conservation status of the „local population" (pack). Regional authorities may interpret this in such a way that temporary conservation zones are established around wolf dens and permission for photograph and filming near dens or rendezvous size is denied.	According to §2 of the Regulation on the Protection of Animal Species (RPAS) the wolf is listed as a strictly protected species that requires active protection. §6 RPAS allows establishing a seasonal protection zone with a radius of 500 m around wolf pup-rearing places from 1st April to 31st August. §7 RPAS stated that permission for photography and filming which may cause wolf disturbance is required. Furthermore, there are a number of other prohibitions regarding strictly protected species that are consistent with §12 of the Habitats Directive.
Natura 2000 sites for protection of wolf habitats	No Natura 2000 sites specifically designed for wolf habitat protection. In 5 Natura 2000 sites the wolf was mentioned as a species included in this site.	73 Natura 2000 sites protect wolf habitats and in all of them wolf is mentioned as an object of protection. These sites cover 15,284 km^2.
National or regional regulations regarding the protection of ecological connectivity	§21 BNatschG requires a net of interconnected protected biotopes encompassing about 10% of the Länder surfaces. The habitat network should be established across Länder boundaries. Green bridges are still rare: only 36 green bridges exist on about 53,500 km of highway and Bundesstrassen (A-roads). About the same number is planned or under construction. The goal of the federal reintegration program is that by 2020 transportation infrastructure will no longer impair the habitat connectivity system	Articles 3 and 117 of Nature Conservation Law recommend protection of animal migratory routes. §10 of RPAS includes protection of ecological corridors and building of wildlife passages among ways to protect animals. Wildlife passages are commonly used as measure to mitigate habitat fragmentation caused by constructionsof new roads. There is a national project of ecological corridors connecting Natura 2000 sites.
Management system	Decentralised, responsibilities rest with the German Länder.	Centralised.

Institutions responsible for wolf management	Nature conservation authorities of the Länder. In some Länder regional ministries of the environment are in charge, in other Länder responsibility was further devolved to the administrative districts.	Ministry of the Environment and General Directorate of Environmental Protection
Management plans	Regional management plans without population targets implemented or will be implemented soon in 10 of 16 Länder. No national MP under consideration.	Rough strategy of wolf conservation. No official management or action plan implemented yet.
Favourable reference values	FRP / FRR not defined for Germany. Favourable reference values generally refer to those defined by Linnell et al. 2008 (chapter 5.3)	National values defined for FRR, FRP, FRA (chapter 5.2).
Monitoring system	Monitoring system and structure varies from Land to Land. Decentralized data analysis. Yearly national data evaluation and merging of data for population size and area of occurrence by the monitoring working group from all the Länder.	No official governmental monitoring system. Monitoring conducted within a framework of scientific projects for entire country or certain regions. Different monitoring schemes applied in various projects. National data evaluation and merging currently not secured.
Monitoring standards, methods and indicators	Monitoring standards are well-defined. Methods to be used are proposed and described in the monitoring standards (Kaczensky et al. 2009, revised in 2013). Indicators of population status and habitat quality are defined according to specifications of the LANA (Bund-Länderarbeitsgemeinschaft „Naturschutz, Landschaftspflege und Erholung“ der Ministerien). Methods used in Poland and Germany differ from each other as well as data interpretation.	Monitoring standards are not defined. Wolf monitoring methods and indicators of population status and habitat quality described in methodological handbook of monitoring of HD species (Jędrzejewski et al. 2010a).
Monitoring of accidental killing	State-based system. Data are collected by the Länder. Merging of data done voluntarily by LUPUS Wildlife Consultants. IZW offers pathological analysis of wolf carcasses for all the Länder.	No common system. Information collected by various institutions. No complete picture of cases of mortality in wolves.
Compensation and prevention systems		
Livestock damage compensation system	Compensation systems vary between the Länder. Compensation mostly paid by regional governments; sometimes by NGO and state-based funds. In some Länder, compensation linked to prevention.	National compensation law. Compensation paid by the State.
Authorities responsible for damage assessment and payment.	Varies from Land to Land.	Regional directorates for environmental protection and directors of national parks.
Damage prevention system	Varies from Land to Land. Mitigation measures may be funded from 0 to 100% according to regional regulations.	No national system. Prevention methods promoted within the frame of temporal projects conducted by various institutions.

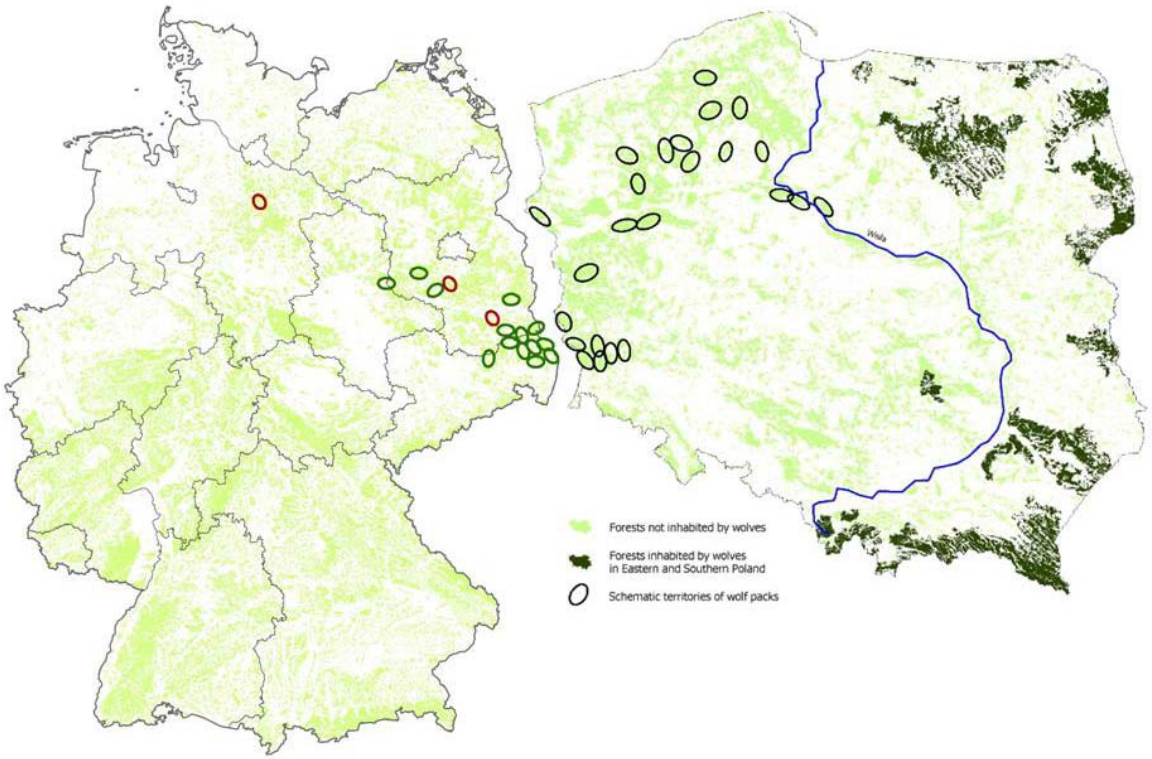

Fig. 13: Raw distribution of the Central Europen wolf population in March 2012. Note that currently it is not possible to detect transboundary territories so double counting on both sides of the border is likely to occure. Data from both countries are not comparable yet because of lacking monitoring standards. In Germany packs and pairs (dark red) are distinguished while in Poland such differentiation is not made. Data from Poland: AfN “Wolf”, data from Germany: LUPUS Wildlife Consultants.

7. Recommendations for future transboundary collaboration

In this chapter, we will put forward suggestions on how transboundary collaboration on wolf conservation may be expanded in the future, and also examine the feasibility and benefits of a joint management plan.

Wolf management varies widely between Poland and Germany as it does within Germany. However, the legal framework in both countries is the same; the wolf is a strictly protected species making common management feasible. Although in Poland the wolf is included in Annex V of the habitat directive, the species is still strictly protected by national law and is not listed as a game species. In Germany, ambition to list the wolf as a game species in several Länder will not alter its status. A system of strict protection must be maintained for the wolf, including effective, coordinated and preventive protection measures.

Since common management of the joint wolf population is not only feasible but above all reasonable, we recommend continuing and extending transboundary collaboration on the conservation of the Central European wolf population initiated in 2009 as a platform of information exchange. In order to make this platform even more effective, as a very first step, we suggest a restructuring of the German - Polish wolf working group.

Poland and Germany are both responsible for the conservation status of the Central European wolf population that they share. Accordingly, we recommend managing the wolves of this population regardless of administrative boundaries. Ideally, this should result in a population level management plan jointly developed by Poland and Germany. Such a plan should define the population goals and the measures appropriate to achieve it, but also whether and under which conditions management measures like lethal control are accepted by both parties. It is not necessary and probably not even feasible for Poland and Germany to take identical management measures; however, they should be coordinated and compatible with each other. In such a management plan, both countries should reach agreement on the population goals, measurable objectives and actions to be taken. The management plan will form the framework within which both countries agree to act. We are well aware that this is no easy feat due to the very diverse administrative demands in both countries.

While the product is clearly outlined in the guidelines for population level management plans for large carnivores in Europe (LINNELL et al. 2008, appendix 1) the process leading to the product is the really challenging part. LINNELL et al. (2008) suggest division into two parallel processes, an external international one and parallel internal national processes. Since neither Germany nor Poland have a national management plan in place, so far, neither of the countries has gone through the national process. Indeed, several of the German Länder have developed regional wolf management plans, but these regional plans do not contain any population goals since this is a national or even a supra-national task.

A good process can help people to accept a controversial product. On the other hand, even the best product might not be accepted if the process is flawed. Providing scope for public and stakeholder involvement is therefore crucial. However, since the framework is set by international treaties and national or regional laws, discussion is not about whether wolves should be conserved, but about how, and what is the best way to achieve that goal. LINNELL et al. (2008) underline that a management plan is a technical instrument for management, not a policy document, because policy already exists.

Any discussion forum involving the public, stakeholders or different management agencies (e.g. authorities from the German Länder) must be facilitated by a skilled and neutral

facilitator. In cases of disagreement about basic facts or their interpretation, it may be helpful to convene a small group of international experts to evaluate the data (LINNELL et al. 2008).

The international process should seek to harmonise existing national results and then return to their respective stakeholders / agencies involved for consultation. LINNELL et al. (2008) suggest that one country should take the lead in the international process.

- **Development of a population level management plan for the Central European wolf population**

  The recommendations above are based on the guidelines; however, so far, no population level management plans have been developed in Europe, and therefore there is no experience from which to draw.

  It is difficult to estimate the man-power and finances required for such an undertaking. A realistic time frame for developing such a plan would be two to three years. Besides professional facilitators, scientists working out the technical details would have to be engaged.
  For the technical part – considering that details such as common monitoring standards and favourable reference values have already been worked out (see below) – about 6 personal months should be calculated.
  The costs for facilitators depend on the number of workshops needed, which may vary between 5 – 30 within each country (experience from wolf management planning in Croatia and Bulgaria). It is highly recommended to engage professional facilitators who are able give all stakeholders the feeling they really are part of the process, and who are in the position to find common ground among the various interest groups.

It is up to the Polish and German authorities to decide whether they wish to confront the challenge of developing a population level management plan. Nevertheless, some of the tasks that would also be part of a population level management plan will have to be tackled soon, anyhow. The precondition for cross-border management – formalised or not – is a common population assessment. Not only is this needed to obtain reliable information on the status quo of the population but also to validate the effect of management measures. This is why we strongly focus our recommendations for the next steps of transboundary collaboration on the comparability of monitoring data. First and foremost, we suggest developing common monitoring standards and a regular common assessment of population size and trend. Prerequisites for this are the presence of robust monitoring structures and national (population)-wide data compilation. There are many more challenges that must be addressed in a population management plan, like minimising wolf-livestock conflicts or reducing anthropogenic mortality in wolves. However, for every discussion we lead or decision we take in the mean time, we need a robust data base.

In the following, we have summarized our recommendations for future transboundary collaboration together with a raw assessment of the financial and manpower requirements:

- **New structuring of the German-Polish wolf working group; including Czech representatives in the group**

  Similar to the Alpine wolf group, we propose a two-level board for wolf management and monitoring consisting of an administrative and a technical advisory board. On the administrative level, governmental authorities from Poland and Germany will define data or information requirements and give these as working objectives to the technical board, which will consist of wolf experts from both countries. The technical

advisory board can also recommend issues to the administrative board that should be addressed. Finally, we suggest offering the Czech Republic to join the working group since wolves' spreading to neighbouring countries from the Central European population is but a matter of time.

Personnel costs will be incurred depending on the way in which wolf experts are involved. This could be general consultancy contracts that include the work necessary for the German-Polish wolf working group (and could also contain the expenses necessary for the yearly common population assessment). Or contracts might be closed as required, based on the data / information needed.

- **Development of common monitoring standards**

  When considering transboundary management of the population as a whole, or even continuing the exchange of information as has been done in the past two years, we need to know what we are talking about. How many wolves or wolf packs in which areas do we have on both sides of the border and altogether? To answer these simple questions, monitoring data from both countries should be comparable. This is necessary to permit population level evaluation of population size, area of occurrence and its trends. While Germany has monitoring standards for large carnivores, Poland has not defined such standards yet; rather it has concentrated on developing wolf monitoring methods and indicators of population status and habitat quality, which have been described in the methodological handbook of monitoring of the Habitats Directive species. We strongly recommend developing common monitoring standards for the Central European population that should ideally also be comparable with those in other European countries. These standards should define data analysis and interpretation, including units of data collection (e.g. individuals or packs / pairs for population size, grid size for area of occurrence), monitoring methods should be suggested.

  A working group of wolf monitoring experts from both countries could work out the details on the basis of the already existing monitoring standards for LCs in Germany within a few months. Manpower requirement: about 3 man-months. Costs for a workshop with 2 – 3 external wolf experts should be included.

- **Improving monitoring structures in Germany and Poland**

  Persons engaged in wolf monitoring must have the manpower and financial resources to allow them to carry out their job properly. They must be embedded in monitoring structures able to keep track with a rapidly growing wolf population. This is the responsibility of the state, and in the long term cannot be devolved to NGOs alone.

  Additional man power and cost depend on the already existing structures and the occurrence of wolves.

- **Announce an institution where data are compiled (across intranational boundaries) in a consistent way and which can provide up to date information on national (population based) population size on demand**

  While yearly evaluation of population size is adequate for international cooperation, on a national basis a more contemporary picture of the situation is needed.

  Besides the working group that meets once a year, there is no continuous intranational transboundary cooperation in Germany or official institution where the data from the different Länder are compiled to give a complete picture. Figures on wolf packs and litters are often given on a Länder basis. Since many territories are located along Länder boundaries, double counting of packs and litters often happens. The same is likely to happen in Poland if provinces become more involved in monitoring, and province-based wolf projects are conducted. Therefore, we suggest that both countries create structures that enable authorities to obtain a prompt picture of the current situation regarding their wolf population portions across intranational boundaries. In Poland such (an) institution(s) is (are) required for all three wolf populations occurring in the country.

  It would be desirable that the institution responsible for compiling the population data also compile the data on wolves found dead in the country / population to ensure an overall overview on the situation. If not already done it is recommended to also compile data once a year on livestock damages and compensation on a nationwide (population) basis.

  The required man power / cost depend on the number and kind of data that are forwarded and the frequency of information requested. For Germany, 25 man-days / year should initially be planned and the amount later adjusted if necessary. In Poland at least 60 man-days / year are required.

- **Yearly common assessment of population size and area of occurrence for the CE population**

  Having common monitoring standards we recommend a yearly common assessment of population size and area of occurrence for the CE population. A bilateral working group should review the national reports especially with regard to transboundary packs. The output should be a final yearly population report outlining the situation of the whole CE wolf population.

  This could be done in 2 working days by 2 wolf experts from each country (preferably responsible for the data compilation as suggested above), including preparation of GIS maps: 8 man-days / year.

- **Develop favourable reference values for the entire CE wolf population**

  Poland is currently defining favourable reference values for two bioregions (continental and alpine). Germany has not defined minimum population goals yet. Subject to the condition that transboundary collaboration on wolf management between Poland and Germany is continued, we would suggest developing threshold values for FRP and FRR on a population basis as recommended in the guidelines (LINNELL et al. 2008) and thus for the Central European population as a whole.

Assessment of the favourable reference ranges for wolves in Poland is currently based on earlier publications of habitat suitability models (JĘDRZEJEWSKI et al. 2008, HUCK et al. 2010). However, since wolves have only recently re-immigrated into Germany and western Poland, the data to conduct a robust FRR analysis for the Central European population are still incomplete. More data on habitat use and the territory size of wolves in different regions would be needed to obtain a more detailed picture of wolf habitat utilization in Germany and Western Poland (see below).

Developing favourable reference values would require about 1 – 2 man months when all the data for such an analysis are available. Travel costs, also for wolf experts from other countries, should be included.

- **Research on habitat utilization and territory size in Germany and Western Poland → updating the habitat models for wolves as a basis for robust FRR analyses**

  The data with which to conduct a robust FRR analysis for Germany and western Poland are still incomplete. In order to obtain the missing data, it is necessary to conduct a telemetry study on habitat use and territory size of wolves in different regions.

  This would require at least a 3 (better 5) year project with telemetry of about 15 – 20 wolves in different areas.
  Material costs (per country): EUR 60,000 – 80,000
  Personnel costs (per country): about 80 – 100 man days for capture / year
  about 25 man days / for permanent data analysis
  about 150 man days for final data analysis and development of the FRR

- **Joint genetic monitoring**

  In order to obtain a complete picture of the genetic structure (relatedness, heterozygosis), the extent of isolation for the Central European population as a whole (magnitude and frequency of immigration from the Baltic and Carpathian population), and to enable identification of cross-boundary packs, joint genetic monitoring would be desirable. To do this, it would be necessary that funds be provided on both sides of the border and over the whole area of wolf occurrence. Genetic analyses of all samples should be done in the same laboratory. This type of genetic monitoring is also conducted in other European wolf populations that have only recently been established, including the Scandinavian and the Alpine population.

  However, genetic analyses are expensive. Therefore, it is necessary to consider in advance which questions should be answered with this method and on what scale. This may vary between countries and / or population segments, and needs may also change with time. For example, currently, in Germany, the focus of genetic analyses lies on relatedness, inbreeding and dispersing. For this, it is necessary to have an overview (a pedigree) of the breeding animals in the whole country. In Poland, the large scale focus lies on phylogeography, genetic structure of Polish and Eastern European wolf populations and connection to adjacent populations, while small scale

projects center on relatedness within packs, dispersal, and an effect of infrastructural barriers on gene flow.

While large scale studies on genetic diversity or the amount of connectivity with other populations can be executed and repeated every 5 – 6 years, studies on the relatedness among a population and the spread of a population (portion) must be conducted consistently. If genetic results are to be used for population size estimation, much more intense genetic sampling would be necessary in order to conduct robust capture-recapture analysis.

We therefore suggest that the authorities of both countries first define which data they need / would like to have, so that biologists can then estimate the effort and the financial support necessary to answer the questions. However, we strongly recommend conducting joint genetic monitoring in the border area in order to be able to identify cross border territories. This should include all the territories on the Oder Neisse border.

Genetic sampling can be conducted within the existing monitoring programme. The amount of sample load will depend on the questions asked. Solberg et al. (2006) recommended that studies using non-invasive genetic methods based on faecal samples should aim at collecting 2.5 – 3 times the number of faecal samples as the "assumed" number of animals (considering that in their lab analysis approximately 20 – 30% of the samples could not be genotyped). This means that to conduct capture-recapture analysis 15 to 30 samples per wolf pack and year should be analysed (assuming pack size of 5 – 10 animals and a success rate of genetic analysis of about 70 %). Currently, at the Senckenberg Institute, genetic analysis costs about 160 € / sample (including genotyping and haplotyping).

For capture-recapture analysis, about EUR 2,400 – 4,800 per year and pack must be calculated. For a population (portion) of 20 packs this would equate to EUR 48,000 – 96,000 / year (15 - 30 samples x 20 packs x EUR 160) depending on the pack sizes.
For analysis of relatedness, fewer samples per pack would do; however, it is necessary to sample breeding individuals every year.
In order to identify cross border territories, about 5 - 10 samples per year should be collected and analysed on each side of the border; EUR 800 – 1,600 per territory and country.

- **Establishing and protection of the joint ecological network**

  Wolf range expansion and long-term population survival can only be guaranteed in Central Europe if ecological connectivity is saved or re-established. To sustain wolf occurrence and its genetic diversity in Germany and Western Poland, it is necessary to define and protect ecological corridors in both countries. These ensure exchange of individuals between population parts and between adjacent populations. In Poland, a project on ecological corridors is being conducted that could be merged with corresponding German activities. It requires among other things, collaboration of scientific institutions involved in defining corridor networks in both countries and joint GIS analysis. In order to protect ecological connectivity on a European level, it would be important to define certain corridors as being of European importance, and then to build sufficient wildlife passages over roads and railways disrupting these corridors.

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Literature

ANDERSONE, Ž., LUCCHINI, V., RANDI, E. AND J. OZOLIŅŠ (2002): Hybridization between wolves and dogs in Latvia as documented using mitochondrial and microsatellite DNA markers. Mammalian Biology **67**: 79-90.

ANSORGE, H., KLUTH, G. AND S. HAHNE (2006): Feeding ecology of wolves *Canis lupus* returning to Germany. Acta Theriologica 51 (1): 99–106.

ARONSON, Å. (2011): Hur inventerar man stora rovdjur? Vargen i Skandinavien – dess utbredning och aktuella status. Paper presented at the Wolf Symposium in Vålådalen, 11. – 13.Mai. 2011.

BADEN-WÜRTTEMBERG MINISTERIUM FÜR ERNÄHRUNG UND LÄNDLICHEN RAUM (2010): Die Rückkehr des Wolfes nach Baden-Württemberg. Handlungsleitfaden für das Auftauchen einzelner Wölfe.

BAYERISCHES STAATSMINISTERIUM FÜR UMWELT, Gesundheit und VERBRAUCHERSCHUTZ (2007): Managementplan Wölfe in Bayern Stufe 1.

BERESZYŃSKI, A. (1997): Ochrona wilka w Polsce, jako przykład potrzeby zintegrowanych działań międzynarodowych w wielkoprzestrzennym systemie obszarów chronionych. Uroczyste Posiedzenie Senackiej Komisji Ochrony Środowiska, 18-19 czerwca 1997 r. Biuro Informacji i Dokumentacji Senackiej Kancelarii Senatu, Dział Ekspertyz, Seria: Opracowania Tematyczne, OT-247.

BERESZYŃSKI, A. (1998): Wilk (*Canis lupus* Linnaeus, 1758) w Polsce i jego ochrona. Wydawnictwo Akademii Rolniczej w Poznaniu, Poznań.

BERESZYŃSKI, A. AND MIZERA, T. (1995): Der Wolf im Westlichen Polen. Wolf Magazin 2: 9–11.

BOBEK, B., PERZANOWSKI K., KWIATKOWSKI Z., LEŚNIAK A., SEREMET B. (1995): Economic aspects of brown bear and wolf predation in southeastern Poland. In: Bissonette J. A., Krausman P. R. (Eds). Integrating people and wildlife for sustainable future. The Wildlife Society, Bethesda Md: 373–375.

BOBEK, B., MERTA D., PŁODZIEŃ K. (1996): Plan ochrony populacji wilka (*Canis lupus* L.) na terenie województwa nowosądeckiego. Międzynarodowy Instytut Ekologii Sp. z o. o., Kraków. Unpublished report.

BOBEK, B. AND NOWICKI P. (1996): Food intake and digestibility of various natural diets in wolves. Journal of Wildlife Research, 1 (2): 148–154.

BOBEK B., PERZANOWSKI K. AND ŚMIETANA W. (1992): The influence of snow cover on wolf Canis lupus and red deer Cervus elaphus relationships in Bieszczady Mountains. In: Bobek B., Perzanowski K. and Regelin W. (Eds.). Global trends in wildlife management. Świat Press, Kraków-Warszawa: 341–348.

BOBEK, B., BATKO M., FERREIRA A., GUGAŁA-MISKA A., KASPERCZYK D., PRZYWARA D., WIŚNIOWSKA L. (1998a): Factors affecting livestock depredation in Poland. Journal of Wildlife Research, 3 (1): 17–24.

BOBEK, B., GUGAŁA A., HARNA G., KASPERCZAK B., MERTA D., PŁODZIEŃ K., PRZYWARA D., WIŚNIOWSKA L., ZALEWSKI D. (1998b): Opracowanie strefowej ochrony wilka (*Canis lupus* L.) w województwie suwalskim. Unpublished Report.

BOBEK, B., MERTA D., PŁODZIEŃ K., WIŚNIOWSKA L. (1998c): Economic evaluation of wolf damage among domestic livestock in Poland. Journal of Wildlife Research, 3 (1): 25–30.

BOBEK, B., MERTA D., PŁODZIEŃ K., WIŚNIOWSKA L. (1998d): Economic evaluation of wolf damage among domestic livestock in Poland. Journal of Wildlife Research, 3 (1): 25–30.

BOITANI, L. (1984): Genetic considerations on wolf conservation in Italy. Bull. Zool. 51: 367-373.

BOITANI, L. (1992): Wolf research and conservation in Italy. Biological Conservation. 61: 125 – 132.

BOITANI, L. (1995): Ecological and cultural diversities in the evolution of wolf-human relationships. In: Ed. Carbyn, L.N., Fritts, S H. and D. R. Seipp. Ecology and Conservation of Wolves in a changing world. Canadian Circumpolar Institute, Occasional Publications No. 35. 642pp.

BOITANI, L. (2000): Action plan for the conservation of wolves in Europe. Council of Europe Publishing. Nature and Environment, No. 113.

BOITANI, L. (2003): Wolf conservation and Recovery. In *Wolves: Behavior, Ecology and Conservation*. The University of Chicago Press, Chicago and London. 448 pp.

BOITANI, L. AND P. CIUCCI (2009): Wolf Management across Europe: Species conservation without boundaries. In: A New Era for Wolves and People. Wolves recovery, human attitudes and policy. Ed. M. Musiani, L. Boitani and P. Paquet. University of Calgary Press. 282 pp.

BRZUSK, P. AND OKARMA H. (1997): Wilk na terenach zachodniej Polski. Polski Związek Łowiecki, Warszawa.

BUCHALCZYK, T. (1972): O nowy stosunek do drapieżników i niektórych szkodników łowieckich. Łowiec Polski 9: 14–16.

BUCHALCZYK T., DYNOWSKI J. AND SZTEYN S. (1981): Variations in number of teeth and asymetry of the skull in the wolf. Acta Theriologica 26: 23–30.

BUTZECK, S. (1993): Wolfsland Brandenburg – die wildökologische Brücke zum Osten. Natur und Landschaft in der Niederlausitz (Cottbus) 14: 27–30.

CUBAYNES, S., R. PRADEL, R. CHOQUET, C. DUCHAMP, J. M. GAILLARD, J.-D. LEBRETON, E. MARBOUTIN, C. MIQUEL, A. M. REBOULET, C. POILLOT, P. TABERLET, AND O. GIMENEZ (2010): Importance of accounting for detection heterogeneity when estimating abundance: the case of French wolves. Conservation Biology 24:621–626.

CZARNOMSKA, S., JĘDRZEJEWSKA, B., BOROWIK, T., NIEDZIAŁKOWSKA, M., STRONEN, A.V., NOWAK, S., MYSŁAJEK, R.W., OKARMA, H., KONOPIŃSKI, M., PILOT, M., ŚMIETANA, W., CANIGLIA, R., FABBRI, E., RANDI, E., PERTOLDI, C. AND JĘDRZEJEWSKI W. (2013). Concordant mitochondrial and microsatellite DNA structuring between Polish lowland and Carpathian Mountain wolves. Conservation Genetics 14: 573-588..

DIRECTORATE OF CULTURE AND CULTURAL AND NATURAL HERITAGE (2003): Bern Convention activities in the field of large carnivore conservation (1988 – 2002). DRAFT. Convention on the Conservation of European Wildlife and Natural Habitats. T-PVS/Inf (2003) 1.

EGGERMANN, J., GULA R., PIRGA B., THEUERKAUF J., TSUNODA H., BRZEZOWSKA B., ROUYS S. AND RADLER S. (2009): Daily and seasonal variation in wolf activity in the Bieszczady Mountains, SE Poland. Mammalian Biology 74: 159–163.

FINĎO S. AND CHOVANCOVÁ B. (2004): Home ranges of two wolf packs in the Slovak Carpathians. Folia Zoologica 53(1): 17–26.

FOURLI, M. (1999): Compensation for damage caused by bears and wolves in the European Union – Experiences from LIFE-Nature projects. European Commision DG XI. Luxembourg: Office for the Official Publications of the European Communities.

FRIENDS OF THE EARTH CZECH REPUBLIC (2011): Complaint to the Commission of the European Communities concerning failure to comply with Community law – hunting of

grey wolves (*Canis lupus*) in Slovakia. http://www.carnivores.cz/data/files/EU_Complaint_2011_CZ.pdf

FULLER, T.K., L.D. MECH AND J.F. COCHRANE (2003): Wolf population dynamics. In Wolves: Behavior, Ecology and Conservation. The University of Chicago Press, Chicago and London. 448 pp.

FURMAGA, S. (1953): *Spirometra janickii* sp. n. (Diphyllobothriidae). Acta parasitologica polonica 1 (2): 29–59.

FURMAGA, S. AND WYSOCKI E. (1949): Przypadek intensywnego zarobaczenia wilka. Medycyna Weterynaryjna 5: 6.

GÄRTNER, S. AND M. HAUPTMANN (2005): Das sachsische Wolfsvorkommen im Spiegelbild der Jägerschaft vor Ort - Ergebnisse einer anonymen Umfrage. Beiträge zur Jagd- und Wildforschung, 30:223-230.

GŁOWACIŃSKI, Z. AND PROFUS P. (1997): Potential impact of wolves *Canis lupus* on prey populations in eastern Poland. Biological Conservation 80: 99–106.

GULA, R. (2004): Influence of snow cover on wolf *Canis lupus* predation patterns in Bieszczady Mountains, Poland. Wildlife Biology 10: 17–23.

GULA, R. (2008a): Wolf depredation on domestic animals in the Polish Carpathian Mountains. Journal of Wildlife Management 72: 283–289.

GULA, R. (2008b): Legal protection of wolves in Poland: implications for the status of the wolf population. European Journal of Wildlife Research 54: 163–170.

GULA, R., KOZAKIEWICZ H., NIEMCZYK J., ŁUKACIJEWSKI G., PASZKIEWICZ R., SZKUTNIK M., KALINOWSKI W., WAŚKIEWICZ A. (2002): Inwentaryzacja wilków i rysi w południowo-wschodniej Polsce. Roczniki Bieszczadzkie 10: 373–389.

GULA, R., HAUSKNECHT R., KUEHN R. (2009): Evidence of wolf dispersal in anthropogenic habitats of the Polish Carpathian Mountains. Biodiversity and Conservation 18: 2173–2184.

GUS (2010): Statistical yearbook Poland 2010. Central Statistical Office, Warszawa.

HÄNEL, K. AND RECK, H. (2010): Nationwide Priorities for Ecosystem Connectivity (BundesweitePrioritäten zur Wiedervernetzung von Ökosystemen) – Final report of the R and D project (Abschlußbericht zum F+E-Vorhaben) FKZ 3507 82 090, 325 p.

HÄNEL, K.; RECK, H. (2011): Bundesweite Prioritäten zur Wiedervernetzung von Ökosystemen: Die Überwindung straßenbedingter Barrieren. Ergebnisse des F+E-Vorhabens 3507 82 090 des Bundesamtes für Naturschutz. Naturschutz und Biologische Vielfalt 108. -Bonn Bad-Godesberg.

HERTWECK, K. (2006): GIS-Analysen zur Einwanderung der Wölfe: Habitat- und bundesweite Konfliktpotentialanalyse im Rahmen des F+E-Vorhabens „Fachkonzept für ein Wolfsmanagement in Deutschland“

HOFFMANNOWA, H., GILL J., PUKARZ R. (1964): Z badań nad fizjologią trawienia u wilka (*Canis lupus lupus* L.), psa dingo (*Canis dingo* L.) i szakala (*C. aurens* L.). Wpływ histaminy na przebieg procesów trawienno-wydzielniczych w żołądku w narkozie morfinowo-eunarkonowej. Acta physiologica polonica 15 (1): 125–136.

HOLZAPFEL, M., WAGENER, C., KLUTH, G., REINHARDT, I. AND H. ANSORGE (2011): Zur Nahrungsökologie der Wölfe (*Canis lupus*) in Deutschland. Beiträge zur Jagd- und Wildforschung. Bd. 36. 117 – 128 pp.

HOUARD, T. AND LEQUETTE, B. (1993). Le retour des loups dans le Mercantour. *Riviéra Scientifique*: 61–66.

HUCK, M., JĘDRZEJEWSKI W., BOROWIK T., MIŁOSZ-CIELMA M., SCHMIDT K., JĘDRZEJEWSKA B., NOWAK S., MYSŁAJEK R. W. (2010): Habitat suitability, corridors and dispersal barriers for large carnivores in Poland. Acta Theriologica 55: 177–192.

HUCK, M., JĘDRZEJEWSKI W., BOROWIK T., JĘDRZEJEWSKA B., NOWAK S., MYSŁAJEK R. W. (2011): Analyses of least cost paths for determining effects of habitat types on landscape permeability: wolves in Poland. Acta Theriologica 56: 91–101.

JAMROZY, G. (1994): Występowanie, rozmieszczenie i stan populacji ssaków łownych w polskich Karpatach. Zeszyty Naukowe Akademii Rolniczej im. H. Kołłątaja w Krakowie, Rozprawy nr 190: 4–88.

JĘDRZEJEWSKA, B. AND JĘDRZEJEWSKI W. (1998): Predation in verterbrate communites. The Białowieża Primeval Forest as a case study. Springer-Verlag, Ecological Studies 135. Berlin-Heidelberg-New York.

JĘDRZEJEWSKA, B., OKARMA H., JĘDRZEJEWSKI W., MIŁKOWSKI L. (1994): Effects of exploitation and protection on forest structure, ungulate density and wolf predation in Białowieża Primeval Forest, Poland. Journal of Applied Ecology 31: 664–676.

JĘDRZEJEWSKA, B., JĘDRZEJEWSKI W., BUNEVICH A. N., MIŁKOWSKI L., OKARMA H. (1996): Population dynamics of Wolves *Canis lupus* in Białowieża Primeval Forest (Poland and Belarus) in relation to hunting by humans, 1847-1993. Mammal Review 26: 103–126.

JĘDRZEJEWSKA, B., JĘDRZEJEWSKI, W., BUNEVICH, A.N., MIŁKOWSKI, L. AND OKARMA H. (1997): Factors shaping population densities and increase rates of ungulates in Białowieża Primeval Forest (Poland and Belarus) in the 19th and 20th centuries. Acta Theriologica 42: 399–451.

JĘDRZEJEWSKI, W., SCHMIDT K. (2001): Strategia ochrony wilków i rysi w północno-wschodniej Polsce. Zakład Badania Ssaków PAN, Białowieża.

JĘDRZEJEWSKI, W., JĘDRZEJEWSKA B., SZYMURA L. (1989): Food niche overlaps in a winter community of predators in the Białowieża Primeval Forest, Poland. Acta Theriologica 34: 487–496.

JĘDRZEJEWSKI, W., JĘDRZEJEWSKA B., OKARMA H., RUPRECHT A. L. (1992): Wolf predation and snow cover as mortality factors in the ungulate community of the Białowieża National Park, Poland. Oecologia 90: 27–36.

JĘDRZEJEWSKI, W., JĘDRZEJEWSKA B., OKARMA H., SCHMIDT K., ZUB K., MUSIANI M. (2000): Prey selection and predation by wolves in Białowieża Primeval Forest, Poland. Journal of Mammalogy 81: 197–212.

JĘDRZEJEWSKI, W., SCHMIDT K., THEUERKAUF J., JĘDRZEJEWSKA B., OKARMA H. (2001): Daily movements and territory use by radio-collared wolves (*Canis lupus*) in Białowieża Primeval Forest in Poland. Canadian Journal of Zoology 79: 1993–2004.

JĘDRZEJEWSKI, W., NOWAK S., SCHMIDT K., JĘDRZEJEWSKA B. (2002a): Wilk i ryś w Polsce – wyniki inwentaryzacji w 2001 roku. Kosmos 51: 491–499.

JĘDRZEJEWSKI, W., SCHMIDT K., THEUERKAUF J., JĘDRZEJEWSKA B., SELVA N., ZUB K., SZYMURA L. (2002b): Kill rates and predation by wolves on ungulate populations in Białowieża Primeval Forest (Poland). Ecology 83: 1341–1356.

JĘDRZEJEWSKI, W. AND BERESZYŃSKI A. (2004a): Wilk *Canis lupus*. In: ADAMSKI P., BARTEL L., BERESZYŃSKI A., KEPEL A., WITKOWSKI Z. (Eds.). Gatunki zwierząt (z wyjątkiem ptaków). Poradniki ochrony siedlisk i gatunków Natura 2000 – podręcznik metodyczny. Ministerstwo Środowiska, Warszawa. Vol. 6: 386–394.

JĘDRZEJEWSKI, W., NIEDZIAŁKOWSKA M., NOWAK S., JĘDRZEJEWSKA B. (2004b): Habitat variables associated with wolf (*Canis lupus*) distribution and abundance in northern Poland. Diversity and Distributions 10: 225–233.

JĘDRZEJEWSKI, W., SCHMIDT K., JĘDRZEJEWSKA B., THEUERKAUF J., KOWALCZYK R., ZUB K. (2004c): The process of a wolf pack splitting in Białowieża Primeval Forest, Poland. Acta Theriologica 49: 275–280.

JĘDRZEJEWSKI W., NOWAK S., KUREK R., MYSŁAJEK R. W., STACHURA K. (2004d). Zwierzęta a drogi. Metody ograniczania negatywnego wpływu dróg na populacje dzikich zwierząt. Wydanie I. Zakład Badania Ssaków Polskiej Akademii Nauk, Białowieża: 84 pp.

JĘDRZEJEWSKI, W., BRANICKI W., VEIT C., MEĐUGORAC I., PILOT M., BUNEVICH A., JĘDRZEJEWSKA B., SCHMIDT K., THEUERKAUF J., OKARMA H., GULA R., SZYMURA L., FÖRSTER M. (2005a): Genetic diversity and relatedness within packs in an intensely hunted population of wolves *Canis lupus*. Acta Theriologica 50: 3–22.

JĘDRZEJEWSKI, W., NIEDZIAŁKOWSKA M., MYSŁAJEK R. W., NOWAK S., JĘDRZEJEWSKA B. (2005b): Habitat selection by wolves *Canis lupus* in the uplands and mountains of southern Poland. Acta Theriologica 50: 417–428.

JĘDRZEJEWSKI, W., NOWAK S., STACHURA K., SKIERCZYŃSKI M., MYSŁAJEK R. W., NIEDZIAŁKOWSKI K., JĘDRZEJEWSKA B., WÓJCIK J. M., ZALEWSKA H., PILOT M. (2005c): Projekt korytarzy ekologicznych łączących Europejską sieć Natura 2000 w Polsce. Unpublished manuscript prepared for Ministry of Environment within programme Phare PL0105.02. Mammal Research Institute, Polish Academy of Sciences, Białowieża.

JĘDRZEJEWSKI, W., SCHMIDT K., THEUERKAUF J., JĘDRZEJEWSKA B., KOWALCZYK R. (2007): Territory size of wolves *Canis lupus*: linking local (Białowieża Primeval Forest, Poland) and Holarctic-scale patterns. Ecography 30: 66–76.

JĘDRZEJEWSKI, W., JĘDRZEJEWSKA B., ZAWADZKA B., BOROWIK T., NOWAK S., MYSŁAJEK R. W. (2008): Habitat suitability model for Polish wolves based on long-term national census. Animal Conservation 11: 377–390.

JĘDRZEJEWSKI, W., NOWAK S., KUREK R., MYSŁAJEK R. W., STACHURA K., ZAWADZKA B., PCHAŁEK M. (2009): Animals and roads. Methods of mitigating the negative impact of roads on wildlife. Mammal Research Institute Polish Academy of Sciences, Białowieża.

JĘDRZEJEWSKI, W., BOROWIK T., NOWAK S. (2010A): WILK CANIS LUPUS. W: MAKOMSKA-JUCHIEWICZ M. (Ed.). Monitoring gatunków zwierząt. Przewodnik metodyczny. Część I. Główny Inspektorat Ochrony Środowiska, Warszawa: 297–318.

JĘDRZEJEWSKI, W., JĘDRZEJEWSKA B., ANDERSONE-LILLEY A., BALČIAUSKAS L., MÄNNIL P., OZOLINŠ J., SIDOROVICH V. E., BAGRADE G., KÜBARSEPP M., ORNICĀNS A., NOWAK S., PUPILA A., ŽUNNA A. (2010b): Synthesizing wolf ecology and management in Eastern Europe: similarities and contrasts with North America. W: MUSIANI M., BOITANI L., PAQUET P. C. (Eds.). The world of wolves. New perspectives on ecology, behaviour and management. University of Calgary Press, Calgary: 207–233.

KACZENSKY, P. (1996): Large Carnivore – Livestock Conflicts in Europe. Carnivores and sheep farming in Norway (3). NINA Oppdragsmelding.

KACZENSKY, P. (Eds.). (2006): Medienpäsenz- und Akzeptanzstudie "Wölfe in Deutschland". Endbericht im Rahmen des F+E-Vorhabens „Fachkonzept für ein Wolfsmanagement in Deutschland“. Universität Freiburg, Deutschland.

KACZENSKY, P., KLUTH, G., KNAUER, F., RAUER, G., REIHNARDT, I. AND U. WOTSCHIKOWSKY (2009): Monitoring von Großraubtieren in Deutschland. BfN-Skripten 251.

KAMLER, J. F., JĘDRZEJEWSKA B., JĘDRZEJEWSKI W. (2007): Factors affecting daily ranges of red deer *Cervus elaphus* in Białowieża Primeval Forest, Poland. Acta Theriologica 52: 113–118.

KARBOWIAK, G., HAPUNIK, J. AND MINIUK, M. (2008): The case of babesiosis in farmed wolf (*Canis lupus* L). Wiadomości Parazytologiczne 54: 243.

KICZYŃSKA, A., WEIGLE A. (2003): Jak zapewnić spójność sieci Natura 2000, czyli o korytarzach ekologicznych. In: Makomaska-Juchiewicz M., Tworek S. (Eds). Ekologiczna sieć NATURA 2000 – problem czy szansa. Instytut Ochrony Przyrody PAN, Kraków: 169–182.

KLAROWSKI, R. (1973): Wilkowi grozi wymarcie. Chrońmy Przyrodę Ojczystą 6: 66–70.

KLEMM, C. (1996): Compensation for damage caused by wild animals. Nature and Environment, No. 84. Council of Europe Publishing.

KLOCH A., BEDNARSKA M., BAJER A. (2005): Intestinal macro- and microparasites of wolves (*Canis lupus* L.) from north-eastern Poland recovered by coprological study. Annals of Agricultural and Environmental Medicine 12: 237–245.

KNAUER, F. (2010): Habitatbewertung für Wolf, Braunbär und Luchs. Kapitel in: Grundlagen für Managementkonzepte für die Rückkehr von Großraubtieren – Rahmenplan Wolf. Endbericht.

KOJOLA, I., ASPI, J., HAKALA, A., HEIKKINEN, S., ILMONI, C., AND S. RONKAINEN (2006): Dispersal in an expanding wolf population in Finland. Journal of Mammalogy, 87(2): 281-286.

KOJOLA, I., KAARTINEN, S., HAKALA, A., HEIKKINEN , S. AND H. M. VOIPIO (2009): Dispersal Behavior and the Connectivity Between Wolf Populations in Northern Europe. Journal of Wildlife Management. 73 (3): 309-313.

KOJOLA, I. (2011): Successes and drawbacks in re-colonization of wolves in Finland. Paper presented at the Wolf Symposium in Vålådalen, 11. – 13. May 2011.

KOSSAK, S. (1998): Zachowanie łowieckie wilków polujących na bydło i owce. Prace IBL nr 844. Warszawa.

KOWALSKI, Z. (1953a): Ogłaszam alarm wilczy. Łowiec Polski 1: 4–5.

KOWALSKI, Z. (1953b): Wilk i jego zwalczanie. PWRiL, Warszawa.

KREEGER, T.J. (2003): The internal wolf: physiology, pathology, and pharmacology. In: Mech and Boitani Ed. Wolves. Behavior, Ecology and Conservation.

KUREK, R. (2002): Populacja wilka (*Canis lupus* L.) i rysia (*Lynx lynx* L.) w zachodniej Polsce w latach 1900-2001. Zasięg, rozmieszczenie, perspektywy rozwoju populacji. Towarzystwo Ekologiczne „Ziemia Przede Wszystkim", Poznań.

LCIE (2010): Position statement from the Large Carnivore Initiative for Europe on the 2010 Swedish wolf hunt.

LEŚNIEWICZ, K. AND PERZANOWSKI K. (1989): The winter diet of wolves in Bieszczady. Mountains. Acta Theriologica 34: 373–380.

LIBERG, O. (2002): Genetic aspects of viability in small populations with special emphasis on the Scandinavian wolf population. Report from an international expert workshop at Färna Herrgard, Sweden 1st – 3rd May 2002. 63pp.

LIBERG, O., ANDRÉN, H., PEDERSEN, H.C., SAND, H., SEJBERG, D., WABAKKEN, P., AKESSON, M AND S. BENSCH (2005): Severe inbreeding depression in wild wolf (*Canis lupus*) population. Biological Letter 1: 17-20.

LIBERG, O., ARONSON, Å., BRAINERD, S. M., KARLSSON, J., PEDERSEN, H.-C., SAND, H. AND P. WABAKKEN (2010): The Recolonizing Scandinavian Wolf Population: Research and Management in Two Countries. In: The world of wolves. New Perspectives on Ecology, Behaviour and Management. University of Calgary Press. 398pp.

LIBERG, O., CHAPRON, G., WABAKKEN, P., PEDERSEN, H. C., THOMPSON HOBBS, N. AND H. SAND (2011): Shoot, shovel and shut up: cryptic poaching slows restoration of a large carnivore in Europe. Proc. R. Soc. B. doi:10.1098/rspb.2011.1275. Published online.

LIFE 04NAT/IT/000144 – COEX. 2008. Improving Coexistence of Large Carnivores and Agriculture in S-Europe. Final technical report of activities.

LINNELL, J. D. C. (2005): Spatial aspects of managing natural resources and conserving biodiversity - Integrating the global and the local. Norwegian Institute for Nature Research Rapport 62: 1-42

LINNELL J., V. SALVATORI AND L. BOITANI (2008): Guidelines for population level management plans for large carnivores in Europe. A Large Carnivore Initiative for Europe report prepared for the European Commission (contract 070501/2005/424162/MAR/B2).

LIRO, A. (Ed.) (1998): Strategia wdrażania krajowej sieci ekologicznej Econet-Polska. Fundacja IUCN Poland, Warszawa.

LIRO, A., Głowacka I., Jakubowski W., Kaftan J., Matuszkiewicz A. J., Szacki J. (1995): Koncepcja krajowej sieci ekologicznej Econet-Polska. Fundacja IUCN Poland, Warszawa.

LOUIS, H. W. AND D. MEYER-RAVENSTEIN (2009): Übernahme des Wolfes in das sächsische Jagdrecht. Gemeinsames Rechtsgutachten. 56pp.

MARBOUTIN, E. (2008): Monitoring the Alpine wolf population: mapping wolf occurrence. KORA Bericht Nr. 41e.

MARBOUTIN, E., PRUSZEK, M., CALENGE, C. AND C. DUCHAMP (2010): On the effects of grid size and shape when mapping the distribution range of a recolonising wolf (Canis lupus) population. Eur J Wildl Res. JrnlID 10344_ArtID 453_Proof# 1 - 04/10/2010

MARBOUTIN, E. (2011): The French paradox: fewer wolves than elsewhere – more problems to solve? Paper presented at the Wolf Symposium in Vålådalen, 11. – 13. May. 2011.

MARESCOT, L., PRADEL, R., DUCHAMP, C., CUBAYNES, S., MARBOUTIN, E., CHOQUET, R., MIQUEL, C., AND O. GIMENEZ (2011): Capture–recapture population growth rate as a robust tool against detection heterogeneity for population management. Ecological Applications, 21(8), 2898–2907 pp.

MARUCCO, F., D. H. PLETSCHER, L. BOITANI, M. K. SCHWARTZ, K. L. PILGRIM, AND J.-D. LEBRETON (2009): Wolf survival and population trend using noninvasive capture–recapture techniques in the Western Alps. Journal of Applied Ecology 46: 1003–1010.

MARUCCO, F. (2011): Il Lupo nelle Alpi e ARGEALP Workshop sulla gestione del lupo nelle Alpi Il Progetto Lupo Piemonte. 11 – 13 maggio 2011. Innsbruck (Tirolo/Austria)

MECH, D. L. AND L. BOITANI (2003): Wolf social ecology. In Wolves: Behavior, Ecology and Conservation. The University of Chicago Press, Chicago and London. 448 pp.

MIŁOSZ-CIELMA, M., ŁAWRESZUK, D. AND JEDRZEJEWSKI, W. (2009): Korytarze ekologiczne w planach zagospodarowania przestrzennego województw – przegląd koncepcji, metod i stanu zaawansowania prac. In: Jędrzejewski, W. and Ławreszuk, D. (Eds.). Ochrona łączności ekologicznej w Polsce. Zakład Badania Ssaków PAN, Białowieża: 126–134.

MINISTERIUM FÜR LANDWIRTSCHAFT, UMWELT UND VERBRAUCHERSCHUTZ MECKLENBURG VORPOMMERN (2010): Managementplan für den Wolf in Mecklenburg-Vorpommern.

MINISTERIUMN FÜR LANDWIRTSCHAFT UND UMWELT DES LANDES SACHSEN-ANHALT (2008): Leitlinie Wolf. Grundsätze zum Umgang mit Wölfen. Handlungsempfehlungen und Managementmaßnahmen für Sachsen-Anhalt. 19 S.

MINISTRY OF NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION OF THE REPUBLIC OF BELARUS (2009): Wolf Population in the Republic of Belarus. MANAGEMENT PLAN. Approved Decision by the board of the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus. No. 06/22.

MINISTERE DE L'ECOLOGIE ET DU DEVELOPPEMENT DURABLE AND MINISTERE DE L'AGRICULTURE, DE L'ALIMENTATION, DE LA PECHE ET DES AFFAIRES RURALES (2004): Plan d'action sur le loup 2004 -2008 /MEDD-MAAPAR/ 08 novembre 2004.

MUSIANI M., OKARMA H. AND JĘDRZEJEWSKI W. (1998): Speed and actual distances travelled by radiocollared wolves in Białowieża Primeval Forest (Poland). Acta Theriologica 43(4): 409–416.

MUSZYŃSKA, M. (1996): Comparison of spring and summer diet of wolf and red fox in the Bieszczady Mountains. Journal of Wildlife Research 1 (2): 182–185.

MYSŁAJEK, R. W. (2009): Ochrona zwierząt hodowlanych przed wilkami. In: Demianowicz J. (Ed.). Wilk. Żubr. Bóbr. Kampania na rzecz ograniczania szkód. Fundacja Zielone Płuca Polski, Białystok: 35–66.

MYSŁAJEK, R. W. AND NOWAK S. (1998): Wolf protection in the Polish part of the Carpathians - an example of the activities of the Association for Nature "WOLF". Proceedings of the International Scientific-Practical Conference "Issues of sustainable development in the Carpathian Region", 13-15 October 1998, Ukraine, Rakhiv. Vol. 2: 106–111.

NOWAK, S. (1996): Dzikie jest piękne - kampania na rzecz objęcia ochroną gatunkową rysia i wilka w całej Polsce. Biuletyn Informacyjny X Ogólnopolskiego Spotkania Ruchów Ekologicznych Kolumna '96: 110–111.

NOWAK, S. (1999): Nie taki wilk liczny, jak go szacują? Łowiec Polski 7: 22–23.

NOWAK, S. AND JĘDRZEJEWSKI W. (2008): Ecology, behavior, and population genetics of wolves (*Canis lupus*) in Poland. Journal of Veterinary Behavior: Clinical Applications and Research 4 (2): 67.

NOWAK, S. AND MYSŁAJEK R. W. (1999): Problemy ochrony wilka *Canis lupus* w Polsce. Przegląd Przyrodniczy 10, 3-4: 163–172.

NOWAK, S. AND MYSŁAJEK R. W. (1999): Ochrona zwierząt hodowlanych przed wilkami. Stowarzyszenie dla Natury „Wilk", Godziszka.

NOWAK, S. AND MYSŁAJEK R. W. (2000): Tropem wilka. Stowarzyszenie dla Natury „Wilk", Godziszka.

NOWAK, S. AND MYSŁAJEK R. W. (2002): Uprzedzić konflikty – kompleksowy program ochrony wilka *Canis lupus* w Karpatach Zachodnich. Przegląd Przyrodniczy 13, 4: 169–180.

NOWAK, S. AND MYSŁAJEK R. W. (2005): Livestock Guarding Dogs in the western part of the Polish Carpathians. Carnivores Damage Prevention News 8: 13–17.

NOWAK, S. AND MYSŁAJEK R. W. (2006): Poradnik ochrony zwierząt hodowlanych przed wilkami. Stowarzyszenie dla Natury Wilk, Twardorzeczka.

NOWAK, S. AND MYSŁAJEK R. W. (2010): Existing experiences and background information from Poland. In: Heller K., Spangenberg A. (Eds.). TEWN Manual. Recommendations for the reduction of habitat fragmentation caused by transport infrastructure development. EuroNatur, Radolfzell: 65–68.

NOWAK, S. AND MYSŁAJEK R. W. (2011): Wilki na zachód od Wisły. Stowarzyszenie dla Natury „Wilk", Godziszka.

NOWAK, S., MYSŁAJEK R. W., JĘDRZEJEWSKA B. (2005a): Patterns of wolf *Canis lupus* predation on wild and domestic ungulates in the Western Carpathian Mountains (S Poland). Acta Theriologica 50: 263–276.

NOWAK, S., MYSŁAJEK R., OKARMA H., ŚMIETANA W. (2005b): Analiza dotychczasowych rodzajów i rozmiaru szkód wyrządzanych przez wilki (*Canis lupus*) oraz stosowanych metod rozwiązywania sytuacji konfliktowych. Instytut Ochrony Przyrody PAN, Kraków. Unpublished Report for Ministry of Environment

NOWAK, S., JĘDRZEJEWSKI W., SCHMIDT K., THEUERKAUF J., MYSŁAJEK R. W., JĘDRZEJEWSKA B. (2007): Howling activity of free-ranging wolves (*Canis lupus*) in the Białowieża Primeval Forest and the Western Beskidy Mountains (Poland). Journal of Ethology 25: 231–237.

NOWAK, S., MYSŁAJEK R. W., JĘDRZEJEWSKA B. (2008): Density and demography of wolf, *Canis lupus* population in the western-most part of the Polish Carpathian Mountains, 1996-2003. Folia Zoologica 57: 392–402.

NOWAK, S., MYSŁAJEK R. W., HUBER Đ., KUSAK J., MIŁOSZ-CIELMA M. (2010): Guidelines for proper implementation of mitigation measures. In: Heller K., Spangenberg A. (Eds.). TEWN Manual. Recommendations for the reduction of habitat fragmentation caused by transport infrastructure development. EuroNatur, Radolfzell: 18–57.

NOWAK, S., MYSŁAJEK R. W., SCHWADERER G. (2010): Importance of wildlife networks. In: Heller K., Spangenberg A. (Eds.). TEWN Manual. Recommendations for the reduction of habitat fragmentation caused by transport infrastructure development. EuroNatur, Radolfzell: 12–15.

NOWAK, S., MYSŁAJEK R. W., KŁOSIŃSKA A., GABRYŚ G. (2011): Diet and prey selection of wolves (*Canis lupus*) recolonising Western and Central Poland. Mammal Biology 76: 709–715.

OKARMA, H., KOTEJA P. (1987): Basal metabolic rate in the gray wolf in Poland. Journal of Wildlife Management: 51: 800–801.

OKARMA, H. (1984): The physical condition of red deer falling a prey to the wolf and lynx and harvested in the Carpathian Mountains. Acta Theriologica 29: 283–290.

OKARMA, H. (1989): Distribution and number of wolves in Poland. Acta Theriologica 34: 497–503.

OKARMA, H. (1991): Marrow Fat Content, Sex and Age of Red Deer Killed by Wolves in Winter in the Carpathian Mountains. Holarctic Ecology 14: 169–172.

OKARMA, H. (1992): Wilk – monografia przyrodniczo-łowiecka. Nakładem Autora, Białowieża.

OKARMA, H. (1993): Status and management of the wolf in Poland. Biological Conservation 66: 153–158.

OKARMA, H. (1995): The trophic ecology of wolves and their predatory role in ungulate communities of forest ecosystems in Europe. Acta Theriologica 40: 335–386.

OKARMA, H. (1997): Wilk. Monografie przyrodnicze 2. Wydawnictwo Lubuskiego Klubu Przyrodników, Świebodzin.

OKARMA, H. AND BUCHALCZYK T. (1993): Craniometrical characteristics of wolves *Canis lupus* from Poland. Acta Theriologica 38: 253–262.

OKARMA, H. AND JĘDRZEJEWSKI W. (1997): Livetrapping wolves with nets. Wildlife Society Bulletin 25: 78–82.

OKARMA, H., GULA R., BREWCZYŃSKI P. (2011): Krajowa strategia ochrony wilka *Canis lupus* warunkująca trwałość populacji gatunku w Polsce. Szkoła Główna Gospodarstwa Wiejskiego, Warszawa.

OKARMA, H., JĘDRZEJEWSKA B., JĘDRZEJEWSKI W., KRASIŃSKI Z. A., MIŁKOWSKI L. (1995): The roles of predation, snow cover, acorn crop and man-related factors on ungulate mortality in Białowieża Primeval Forest, Poland. Acta Theriologica 40: 197–217.

OKARMA, H. (1997): Der Wolf. Ökologie, Verhalten, Schutz. Parey Buchverlag Berlin. 160 pp.

OKARMA, H., JĘDRZEJEWSKI W., JĘDRZEJEWSKA B., NOWAK S., ŚMIETANA W. (1998a): Strategia ochrony i gospodarowania populacją wilka w Polsce. Instytut Ochrony Przyrody PAN, Kraków. Unpublished Report for Ministry of Environment.

OKARMA, H., JĘDRZEJEWSKI W., SCHMIDT K., ŚNIEŻKO S., BUNEVICH A. N., JĘDRZEJEWSKA B. (1998b): Home ranges of wolves in Białowieża Primeval Forest, Poland, compared with other Eurasian populations. Journal of Mammalogy 79: 842–852.

PERZANOWSKI, K. (ED.). (2005): Strategia ochrony i gospodarowania populacją wilka w województwie podkarpackim. Unpublished Report.

PILOT, M., JĘDRZEJEWSKI W., BRANICKI W., SIDOROVICH V. E., JĘDRZEJEWSKA B., STACHURA K., FUNK S. M. (2006) Ecological factors influence population genetic structure of European grey wolves. Molecular Ecology 15: 4533 – 4553.

PILOT, M., BRANICKI W., JĘDRZEJEWSKI W., GOSZCZYŃSKI J., JĘDRZEJEWSKA B., DYKYY I., SHKVYRYA M., TSINGARSKA E. (2010): Phylogeographic history of grey wolves in Europe. BMC Evolutionary Biology 104: 1–11.

PIRÓG, A. (2011): Helmintofauna wilka *Canis lupus* L. z północno-zachodniej Polski. Uniwersytet Przyrodniczy we Wrocławiu, Wydział Biologii i Hodowli Zwierząt, Wrocław. Unpublished Master Thesis.

POPIOŁEK, M., SZCZĘSNA J., NOWAK S., MYSŁAJEK R. W. (2007): Helminth infections in faecal samples of wolves *Canis lupus* L. from the western Beskidy Mountains in southern Poland. Journal of Helminthology 81: 339 – 344.

POULLE, M.-L., LEQUETTE, B. AND T. DAHIER (1999): La recolonisation des Alps pa le Loup de 1992 à 1999. Bulletin Mensuel de la Office Natiuonal de la Chasse. 242: 4 - 13.

Projektteam Rahmenplan: KACZENSKY, P., KLUTH, G., KNAUER, F., RAUER, G., REIHNARDT, I. AND U. WOTSCHIKOWSKY (2010): Bewertung von Problemindividuum bei Bär, Wolf und Luchs und Empfehlungen zum Umgang. Kapitel des Endberichtes des F+E-Vorhabens „Grundlagen für Managementkonzepte für die Rückkehr von Großraubtieren – Rahmenplan Wolf“ (FKZ 3507 86040).

PROMBERGER, C. AND D. HOFER (1994): Ein Managementplan für Wölfe in Brandenburg. Wildbiologische Gesellschaft München.

PUCEK, Z. AND RACZYŃSKI, J. (1983): Atlas rozmieszczenia ssaków w Polsce. PWN, Warszawa.

REIG S. AND JĘDRZEJEWSKI W. (1988): Winter and early spring food of some carnivores in the Białowieża National Park, eastern Poland. Acta Theriologica 33: 57 – 65.

REINHARDT, I. AND G. KLUTH (2007): Leben mit Wölfen. Leitfaden für den Umgang mit einer konfliktträchtigen Tierart. BfN-Skripten 201.

REINHARDT, I., RAUER, J., KLUTH, G., KACZENSKY, P., KNAUER, F. AND U. WOTSCHIKOWSKY (2010): Synopse und Bewertung existierender Präventions- und Kompensationsmodelle. 55 pp. Kapitel 3 aus: Projektteam Rahmenplan Wolf. 2010. Grundlagen für Managementkonzepte für die Rückkehr von Großraubtieren – Rahmenplan Wolf. Final Report.

REINHARDT, I. AND G. KLUTH (2011): Pilotstudie zur Abwanderung und zur Ausbreitung von Wölfen in Deutschland. Final Report, F+E Vorhaben (FKZ 806 86 080).

REINHARDT, I., RAUER, J., KLUTH, G., KACZENSKY, P., KNAUER, F. AND U. WOTSCHIKOWSKY (2012): Livestock protection methods applicable for Germany – a Country newly recolonized by wolves. Hystrix, It. J. Mamm. (2012). online first.

RÖCKEL, D. (1999): Die abenteuerliche Geschichte des letzten Wolfes vom Odenwald and Letzte Wölfe in Deutschlands Regionen. Rhein-Neckar Zeitung GmbH, Heidelberg. 127 pp.

RZEBIK-KOWALSKA, B. (1972): Badania nad pokarmem ssaków drapieżnych w Polsce. Acta zoologica cracoviensia 17 (19): 415 – 506.

SÄCHSISCHES STAATSMINISTERIUM FÜR UMWELT UND LANDWIRTSCHAFT (2009): Managementplan für den Wolf in Sachsen.

SADKOWSKA-TODYS, M. AND KUCHARCZYK B. (2009): Wścieklizna w Polsce w 2007 roku. Przegląd Epidemiologiczny 63: 257–261.

SALWA, A., ANUSZ, K., WELZ, M., WOZIKOWSKI, R., ZALESKA, M. AND KITA J. (2011): Analiza sytuacji epizootiologicznej u zwierząt gospodarskich i wolno żyjących w Bieszczadach w związku wystąpieniem gruźlicy bydlęcej u żubrów (*Bison bonasus*). European Bison Conservation Newsletter 4: 71–80.

SALVATORI, V. AND J. LINNELL (2005): Report on the conservation status and threats for wolf (*Canis lupus*) in Europe. Councel of Europe. PVS/Inf (2005) 16.

SAND H, LIBERG O, ARONSON Å, FORSLUND P, PEDERSEN HC, WABAKKEN P, BRAINERD S, BENSCH S, KARLSSON J OCH P AHLQVIST (2010): Den Skandinaviska Vargen en sammanställning av kunskapsläget 1998 – 2010 från det skandinaviska vargforskningsprojektet SKANDULV, Grimsö forskningsstation, SLU. Rapport till Direktoratet for Naturforvaltning, Trondheim, Norge.

SCHMIDT, K., JĘDRZEJEWSKI W., THEUERKAUF J., KOWALCZYK R., OKARMA H., JĘDRZEJEWSKA B. (2008): Reproductive behaviour of wild-living wolves in Białowieża Primeval Forest (Poland). Journal of Ethology 26: 69 – 78.

SCHMIDT, K., JĘDRZEJEWSKI W., OKARMA H., KOWALCZYK R. (2009): Spatial interactions between grey wolves and Eurasian lynx in Białowieża Primeval Forest, Poland. Ecological Research 24: 207 – 214.

SELVA, N., JĘDRZEJEWSKA B., JĘDRZEJEWSKI W., WAJRAK A. (2005): Factors affecting carcass use by a guild of scavengers in European temperate woodland. Canadian Journal of Zoology 83: 1590 – 1601.

SEWERNIAK, P. (2010): Wolves in Toruń Basin. Ecological Questions 13: 47 - 53.

SHINE, C. (2005): Legal Report on the possible need to amend Appendix II of the Convention for the wolf. Convention on the Conservation of European Wildlife and Natural Habitats. Standing Committee. T-PVS/Inf (2005) 18.

SOŁTYS, A. (1964): Helmintofauna wilków (*Canis lupus* L.). Wiadomości Parazytologiczne 10 (1): 59 – 62.

SUMIŃSKI, P. (1970): Jeszcze raz w obronie wilka. Chrońmy Przyrodę Ojczystą 5: 59 – 61.

SUMIŃSKI, P. (1975): Morphologische Unterscheidungsmerkmale zwischen Wolfs (*Canis lupus* L.) und Hundeschadel (*Canis familiaris* L.). Zeitschrift für Jagdwissenschaft 21: 227 – 232.

SUMIŃSKI, P. (1975a): The wolf in Poland. Proceedings of the 1st Meeting of Wolf Specialist and of the 1st International Conference on the Conservation of the Wolf, Stockholm, September 1973. IUCN, Morges: 44 – 52.

SUMIŃSKI, P. AND FILIPIAK W. (1977): Beitrag zur Nahrungsunterschung des Wolfes (*Canis lupus* L.). Zeitschrift für Jagdwissenschaft 23: 1 – 5.

SZAFRAŃSKA, E., WASIELEWSKI O., BERESZYŃSKI A. (2010): A faecal analysis of helminth infections in wild and captive wolves, *Canis lupus* L., in Poland. Journal of Helminthology 84: 415 – 419.

SZCZĘSNA-STAŚKIEWICZ (2009): Helmintofauna wilka *Canis lupus* L. w Polsce. Uniwersytet Przyrodniczy we Wrocławiu, Wydział Biologii i Hodowli Zwierząt, Wrocław. Unpublished Doctoral Thesis.

ŚWIĘTORZECKI, B. (1926): Wilk. Myśliwska Spółka Wydawnicza, Warszawa.

ŚMIETANA, W. (1995): Plan ochrony wilka w województwie krośnieńskim. Suche Rzeki. Unpublished Report.

ŚMIETANA, W. (2005): Selectivity of wolf predation on red deer in the Bieszczady Mountains, Poland. Acta Theriologica 50: 277 – 288.

ŚMIETANA, W. (2006a): Pasterski pies stróżujący, Wychowanie i szkolenie owczarka podhalańskiego. WWF Polska, Warszawa.

ŚMIETANA, W. (2006b): Use of tatra Shepherd Dog in the Bieszczady Mountains and the Bieszczady Foothills, Poland. Carnivore Damage Protection News 8: 10 – 11.

ŚMIETANA, W. (2010): Zabezpieczanie zwierząt gospodarskich przed atakami wilków przy użyciu ogrodzeń elektrycznych. Instytut Ochrony Przyrody PAN, Kraków.

ŚMIETANA, W. AND KLIMEK A. (1993): Diet of wolves in the Bieszczady Mountains, Poland. Acta Theriologica 38: 245 – 251.

ŚMIETANA, W. AND WAJDA J. (1997): Wolf number changes in Bieszczady National Park, Poland. Acta Theriologica 42: 241 – 252.

SOLBERG, K.H., BELLEMAIN, E., DRAGESET, O.-M., TABERLET. P. AND J. E. SWENSON (2006): An evaluation of field and non-invasive genetic methods to estimate brown bear (Ursus arctos) population size. Biol. Conserv. 128:158–168.

THEUERKAUF, J. (2009): What drives wolves: fear or hunger? Humans, diet, climate and wolf activity patterns. Ethology 115: 649 – 657.

THEUERKAUF, J. AND JĘDRZEJEWSKI W. (2002): Accuracy of radiotelemetry to estimate wolf activity and locations. Journal of Wildlife Management 66: 859 – 864.

THEUERKAUF, J. AND ROUYS S. (2008): Habitat selection by ungulates in relation to predation risk by wolves and humans in the Białowieża Forest, Poland. Forest Ecology and Management 256: 1325 – 1332.

THEUERKAUF, J., JĘDRZEJEWSKI W., SCHMIDT K., GULA R. (2003a): Spatiotemporal segregation of wolves from humans in the Białowieża Forest (Poland). Journal of Wildlife Management 67: 706 – 716.

THEUERKAUF, J., JĘDRZEJEWSKI W., SCHMIDT K., OKARMA H., RUCZYŃSKI I., ŚNIEŻKO S., GULA R., (2003b): Daily patterns and duration of wolf activity in the Białowieża Forest, Poland. Journal of Mammalogy 84: 243 – 253.

THEUERKAUF, J., ROUYS S., JĘDRZEJEWSKI W. (2003c): Selection of den, rendezvous, and resting sites by wolves in the Białowieża Forest, Poland. Canadian Journal of Zoology 81: 163 - 167.

THEUERKAUF, J., GULA R., PIRGA B., TSUNODA H., EGGERMANN J., BRZEZOWSKA B., ROUYS S., RADLER S. (2007): Human impact on wolf activity in the Bieszczady Mountains, SE Poland. Annales Zoologici Fennici 44: 225 – 231.

TSUNODA, H., GULA R., THEUERKAUF J., ROUYS S., RADLER S., PIRGA B., EGGERMANN J., BRZEZOWSKA B. (2009): How does parental role influence the activity and movements of breeding wolves? Journal of Ethology 27: 185 – 189.

VALIÈRE, N., FUMAGALLI, L., GIELLY, L., MIQUEL, C., LEQUETTE, B., POULLE, M.-L., WEBER, J.-M., ARLETTAZ, R. AND P. TABERLET (2003): Long-distance wolf recolonization of France and Switzerland inferred from non-invasive genetic sampling over a period of 10 years. Animal Conservation. 6: 83 – 92.

VONHOLDT, B. M., POLLINGER J. P., LOHMUELLER K. E., HAN E., PARKER H. G., QUIGNON P., DEGENHARDT J. D., BOYKO A. R., EARL D. A., AUTON A., REYNOLDS A., BRYC K., BRISBIN A., KNOWLES J. C., MOSHER D. S., SPADY T. C., ELKAHLOUN A., GEFFEN E., PILOT M., JĘDRZEJEWSKI W., GRECO C., RANDI E., BANNASCH D. (2010): Genome-wide SNP and haplotype analyses reveal a rich history underlying dog domestication. Nature 464: 898 – 902.

WABAKKEN, P., H. SAND, O. LIBERG UND A. BJÄRVALL (2001): The recovery, distribution and population dynamics of wolves on the Scandinavian Peninsula, 1978 – 1998. Can. J. Zool. 79: 710 – 725.

WABAKKEN P., ARONSON, Å., STRØMSETH, T. H., SAND, H., MAARTMANN, E., SVENSSON, L., FLAGSTAD, Ø., HEDMARK, E., LIBERG, O. AND I. KOJOLA (2010): Ulv i Skandinavia Statusrapport for vinteren 2009-2010. Høgskolen i Hedmark Oppdragsrapport nr. 4 – 2010. 60pp.

WAGNER, C. (2008): Zur Nahrungsökologie des Wolfes Canis lupus L. 1758 in Deutschland. Diplomarbeit. 114pp.

WAWRZYNIAK, P., JĘDRZEJEWSKI W., JĘDRZEJEWSKA B., BOROWIK T. (2010): Ungulates and their management in Poland. In: Apollonio M., Andersen R., Puttman R. (Eds). European ungulates and their management in 21st century. Cambridge University Press, Cambridge: 223 – 242.

WIERZBOWSKA, I. (2011): Wilk. Fundacja Wspierania Inicjatyw Ekologicznych, Kraków.

WOLSAN, M., BIENIEK M., BUCHALCZYK T. (1992): The history of distributional and numerical changes of the wolf Canis lupus L. in Poland. In: Bobek B., Perzanowski K., Regelin W. L. (Eds.). Global trends in wildlife management. Trans. 18th IUGB Congress, Krakow 1987. Wydawnictwo Świat Press, Krakow–Warszawa: 375 – 380.

WOTSCHIKOWSKY, U. (2006): Wölfe, Jagd und Wald in der Oberlausitz. Endbericht. Vauna. 46pp.

ZIMEN, E. AND L. BOITANI (1975): Number and distribution of wolves in Italy. Zeit. Säugetierk. 40: 102 – 112.

ZUB, K., J. THEUERKAUF, W. JĘDRZEJEWSKI, B. JĘDRZEJEWSKA, K. SCHMIDT AND R KOWALCZYK (2003): Wolf pack territory marking in the Białowieża Primeval Forest (Poland). Behaviour 140: 635 – 648.

Appendix 1. Template for a transboundary management plan from the Guidelines for Population Level Management Plans for Large Carnivores in Europe (Linnell et al. 2008)

The following is a draft template for the topics that a transboundary management plan should contain. There should be three sections, focusing on background information, a formulation of measurable, time specific and spatial explicit objectives and targets, and a set of actions that are needed to achieve these objectives.

Title	*Explanatory notes*
1.Background	This section summarises the background information about the specific population and its metapopulation context. It is intended to serve as a reference for justifying the objectives and associated actions that come later in the document, and to increase the transparency, credibility and robustness of the overall plan. Outlining the similarities and differences in circumstances between different management units is important. It will include the following sub-sections.
1.1 Population definition	Describes the geographic limits of the population, where possible separating between (1) the distribution of the reproductive portion of the population, (2) the total area of regular occurrence of resident individuals and (3) the areas where individuals, such as dispersers, occasionally occur. If the distribution of animals within a population is clumped, then these population segments need to be described.
1.2 Management units	Describes the existing management units – such as national, state or county borders, wildlife management unit borders, or protected area borders that overlay this distribution.
1.3 Population description	Describes the history, status, trend, and ecology of the population. If any data are available on demographic parameters (reproduction or mortality) they should be gathered and presented. Likewise, as detailed as possible time series data on population trends and eventual human harvest should be gathered on as fine a spatial scale as possible. Special emphasis should be placed on describing the survey / monitoring / census methods that have been used such that the quality of the data can be evaluated.
1.4 Habitat description	Describes the quality of the habitat within the geographic limits of the populations and in surrounding areas where expansion is possible. Presents data on anthropogenic (human population, infrastructure, agriculture, landuse) and biological (forest cover, prey distribution) parameters.
1.5 Continental context	Describes the existing and potential connections to neighbouring populations within the metapopulation. Evaluates

	the importance of this population inside the European context – both in terms of numbers and connectivity.
1.6 Current management	
1.6.1 Legal status and management regime	Describes the current management practices within each of the management units.
1.6.2 Damage and conflicts	Summarises data on the different conflicts that occur and on ways in which these have been mitigated.
1.6.3 Obstacles to conservation	Identifies the major threats, limiting factors and obstacles to successful conservation in the region. A SWOT or DSPIR method could be used to structure this debate.
1.6.4 Conservation status	Summarise the conservation status of the population and any conservation measures that have been taken recently to improve this status.
2. Definition of goals and objectives	This section develops both the overall vision and the temporally- and spatially-specific, measurable, objectives and targets that the plan seeks to reach. It contains the following sub-sections.
2.1 Statement of overall vision	Develops a common overall vision for large carnivore conservation in the region[1]. It could also include statements about large carnivore conservation and should relate to other conservation and social economic objectives for the same region.
2.2 Measurable objectives	This is the section where specific and measurable objectives are developed within the frames of the overall vision. These objectives should be impact-orientated (represent desired end points), measurable, time-limited, specific and credible. These objectives should be based on the best available science, be tailored to the specific species and region, include both short-term and long-term objectives, and make uncertainties transparent (Tear *et al*. 2005).
2.2.1 Favourable reference population	Develops a common understanding of what the threshold favourable reference population value will be for this population.
2.2.2 Favourable reference range	Develops a common understanding of what the threshold favourable reference range distribution will be for this population.
2.2.3 Population goals	Explores how far beyond the threshold levels required to satisfy community obligations it is desirable to go for this population.
2.2.4 Success criteria	Develops a set of measurable parameters, such as population size or trend, harvest rates, damage levels, poaching levels,

[1] By region we refer to both the internal structure of the population in question and its external connectivity to neighbouring populations.

	that can be used to measure the success of management actions.
2.2.5 Connectivity and expansion	Specifically develops a plan to maintain or enhance the connectivity both within this population and with neighbouring populations. Areas where expansion is to be encouraged or favoured, and corridors crucial for connectivity should be identified.
2.2.6 Spatial aspects of management	The overall objectives developed in the previous sections should be distributed in space between various management units such as countries, states, counties, wildlife management units or protected areas. The relationship between this plan and any protected areas, especially Natura2000 sites, should be considered in detail.
3. Actions	These are specific action points that need to be considered. They focus on the actions that mainly apply to population level management planning – other national actions may also exist but not all need to be repeated. It is not automatic that the actions should be identical in all management units – but they should be coordinated and compatible with each other. Sharp boundaries between widely different actions should be avoided.
3.1 Maintaining range and population size	Outlines concrete actions that will act on the population to ensure that its conservation status is maintained or enhanced (as appropriate). Outlines steps that will be made to maintain or enhance internal connectivity within the population, especially if there are a number of population segments.
3.2 Maintaining and enhancing connectivity	Outlines any specific actions that will be taken to maintain or enhance external connectivity to neighbouring populations. Develops clear land-use plans for crucial corridors. If translocation or reintroduction is to be considered, these need to be described in detail.
3.3 Adapting legislation	Describes any changes in legislation that are needed to bring about the population level management plan. Sharp boundaries between management units with widely different legislations should be avoided.
3.4 Ensuring adequate wild prey base, natural food supply and habitat quality	Describes measures that will be taken to ensure that adequate prey and habitat are available for large carnivores. For bears it is important that forestry maintains food trees and that presence of hunting and forestry practices do not disturb denning bears during winter. For lynx and wolf it is crucial that wild ungulate harvest takes into account the presence of predators when setting quotas.
3.5 Damage control and conflict resolution	Describes how the various conflicts will be mitigated and how this mitigation will be funded. In order to foster a sense of fairness and justice it would be beneficial if the same, or at least similar, incentive measures and levels of support could be

	obtained in all management units sharing a population.
3.6 Coordinating harvest / control of carnivores.	It is crucial that the removal of large carnivores be coordinated between all management units that share a population. A population level limit for the number of individuals that can be removed per year should be set. Development of the logic behind the application of derogations is based on a consistent, but locally relevant, logic. Ensure that evaluation of “no detrimental effect” when applying for derogations is conducted on the population level.
3.7 Enforcement	Reports that enforcement (anti-poaching) is seriously planned and coordinated between management units to ensure that poaching in one unit cannot be passed off as legal harvest in another.
3.8 Cross-border exchange of experience among stakeholders and interest groups	Establishes a forum for stakeholders and interest groups from all management units to meet and discuss large carnivore management related issues together.
3.9 Institutional coordination of management authorities	Establishes a contact forum for all management authorities sharing a population to exchange information and meet periodically.
3.10 Coordination of monitoring and scientific research programs	It is crucial that population monitoring be conducted in a comparable and coordinated manner. Different management units may use some different methods and focus on different parameters, but there must be a minimum of overlap in data collected to permit population level evaluation of population status and trend. Describes how transboundary research cooperation will be stimulated.
3.11 Ensuring sectorial coordination within and between countries.	Establishes a contact forum for coordination between sectorial interests (e.g. environment, tourism, agriculture, forestry, infrastructure) between all management authorities within the relevant region. This forum should ensure that planning of other sectorial activities does not increase conflicts in carnivore range or fragment habitat within carnivore range or in connectivity corridors.

Appendix 2. Natura 2000 sites protecting wolf habitats in Poland

Tab. 1: Natura 2000 sites protecting wolf habitats in different regions of Poland.

Code	Name	Area [km^2]
Carpathian Mountains		
PLH120012	Na Policy	4
PLH120013	Pieniny	23
PLH120001	Babia Góra	34
PLH240023	Beskid Mały	72
PLH120016	Torfowiska Orawsko-Nowotarskie	83
PLH120018	Ostoja Gorczańska	180
PLH180001	Ostoja Magurska	201
PLC120001	Tatry	210
PLH240005	Beskid Śląski	264
PLH180014	Ostoja Jaśliska	293
PLH240006	Beskid Żywiecki	353
PLH180012	Ostoja Przemyska	397
PLH180013	Góry Słonne	461
PLH120019	Ostoja Popradzka	579
PLC180001	Bieszczady	1,115
	Total	**4,268**
Eastern Poland		
PLH060092	Niedzielski Las	3
PLH180048	Bory Bagienne nad Bukową	5
PLH060094	Uroczyska Lasów Adamowskich	11
PLH180026	Moczary	12
PLH280029	Doliny Erozyjne Wysoczyzny Elbląskiej	23
PLH260011	Lasy Skarżyskie	24
PLH200019	Jelonka	25
PLH060107	Ostoja Parczewska	36
PLH060099	Uroczyska Lasów Strzeleckich	36
PLH200018	Czerwony Bór	51
PLH260015	Dolina Czarnej	58
PLH060093	Uroczyska Roztocza Wschodniego	58

PLH060017	Roztocze Środkowe	85
PLH060097	Dolina Dolnej Tanwi	85
PLH060043	Lasy Sobiborskie	97
PLH060013	Ostoja Poleska	102
PLH260040	Lasy Cisowsko-Orłowińskie	104
PLH280049	Niecka Skaliska	114
PLH180017	Horyniec	116
PLH200007	Pojezierze Sejneńskie	136
PLH280005	Puszcza Romincka	148
PLH200004	Ostoja Wigierska	161
PLH180054	Lasy Sieniawskie	180
PLH260010	Lasy Suchedniowskie	191
PLH200010	Ostoja w Dolinie Górnej Narwi	203
PLH140029	Kampinoska Dolina Wisły	207
PLH280016	Ostoja Borecka	253
PLH140035	Puszcza Kozienicka	282
PLH280052	Ostoja Napiwodzko-Ramucka	326
PLH060031	Uroczyska Lasów Janowskich	345
PLH060034	Uroczyska Puszczy Solskiej	347
PLH140011	Ostoja Nadbużańska	460
PLH280048	Ostoja Piska	578
PLC200004	Puszcza Białowieska	631
PLH200005	Ostoja Augustowska	1,071
PLH200008	Dolina Biebrzy	1,212
PLH200006	Ostoja Knyszyńska	1,361
	Total	**9,137**
Western Poland		
PLH220064	Sporysz	5
PLH020090	Dąbrowy Kliczkowskie	6
PLH300006	Jezioro Kubek	10
PLH080007	Buczyna Szprotawsko-Piotrowicka	14
PLH080042	Stara Dąbrowa w Korytach	16
PLH080032	Bory Chrobotkowe Puszczy Noteckiej	23
PLH080036	Jeziora Gościmskie	30

PLH080060	Uroczyska Borów Zasieckich	44
PLH020047	Torfowiska Gór Izerskich	50
PLH080011	Dolina Pliszki	50
PLH020050	Dolina Dolnej Kwisy	60
PLH020015	Wrzosowisko Przemkowskie	67
PLH080008	Buczyny Łagowsko-Sulęcińskie	68
PLH220026	Sandr Brdy	75
PLH020072	Uroczyska Borów Dolnośląskich	80
PLH220078	Nowa Brda	100
PLH020063	Wrzosowiska Świętoszowsko-Ławszowskie	101
PLH320067	Pojezierze Ińskie	102
PLH080037	Lasy Dobrosułowskie	112
PLH080044	Wilki nad Nysą	122
PLH320046	Uroczyska Puszczy Drawskiej	744
	Total	**1,880**
	Whole Poland total:	**15,284**

Appendix 3. Monitoring of wolves in Poland and Germany

For Habitats Directive reporting, information on wolf range and trend of the range, as well as population size and trend is required. The table below summarizes how these parameters are defined and measured, and how monitoring is structured in Poland and Germany, respectively.

Tab. 1: Comparision of wolf monitoring in Germany and Poland. Note that the monitoring standards in Germany are currently under revision.

	Germany	**Poland**
Area of occurrence (area of occupancy)		
scale	10 x 10 km EU grid	wolf inventory: forest complex with n elipses elipse = mean wolf pack territory (250km^2) n = number of resident packs in the forest for reporting to EU – 10x10 km EU grid
time scale	yearly	wolf inventory - yearly
area occupied if	1 C2 or 3 C2 / per grid cell	wolf inventory: at least one resident pack is present (a pack which marks the area with scats or in which reproduction is confirmed) for reporting to EU – signs of wolf presence (with geo coordinates) in a grid cell (data from the wolf inventory)
size of the area of occupancy	Refers to the number of grid cells occupied	for reporting to EU – sum of grid cells with the wolf presence (data from the wolf inventory)
Range		
scale	MCP around occupied grid cells. (see figure 2 and 3 for details).	for reporting to EU – sum of grid cells within forest complexes occupied by wolf packs (data from the wolf inventory)
time scale	Every six years for EU reporting.	Every six years for EU reporting
	Every six years for the Habitats Directive report, the range and the trend of the range are calculated. Cells count as occupied for the range if they have been occupied both in the report year and the previous year, or if reproduction was confirmed in the last year of the report period. The **trend** is described as the difference between, or the quotient of, the range size in year 0 and the range size in year 6 (year 0 is the last year of the previous report period).	For reporting to EU - the range and the trend of the range are calculated. The grid cells are considered as occupied by wolves, if wolf pack presence was confirmed in the last 2 years of the reporting period (data from the wolf inventory). The trend – similar to Germany
Population size		
population size	Pop. size is expressed as an index of number of packs + scent marking pairs; (total number of individuals is not assessed)	Wolf Inventory 1. mean number of resident packs (and a range min-max) and 2. mean number of individuals recorded in those packs (and a range min-max) in Poland

		for reporting to UE: min-max number of individuals from the last year of the wolf inventory
time scale	yearly (for every Land) The Laender data are compiled at a yearly monitoring meeting for a national report (see monitoring structures). Every six years, the **trend of population size** is calculated (and reported to the EU).	Yearly (for whole country). Wolf census: Data provided by forest service, NP service, volunteers are analysed at the end of the year in MRI. Since 2010 no pack and wolf numbers are available, only a population range (see for details in "Explanations for Poland" below). Official numbers: estimations of wolf numbers are provided yearly by RDEP to GDEP,
definition of pack	a group of more than two wolves that live in a territory and that have been confirmed by C1 or C2 data	a group of two or more adult wolves that mark the territory with scats
definition of reproducing pack	two or more wolves with confirmed reproduction	a group of two or more adult wolves that mark the territory with scats and breed regularly
confirmation of reproduction	with 1 C1 or 2 C2; for each known pack / scent marking pair, an attempt is made to confirm reproduction every year	reproduction should be confirmed by: mating evidence, pup sighting, or pup tracks and play sites, or a den, or female with evidence of lactation , or pups howling
confirmation of a single territorial wolf	With C1 or several C2. Over a longer time period (several months) only one individual can be confirmed.	single wolves are not regarded as "territorial" from a long-term perspective; thus, they are not considered as evidence for wolf range increase
differentiation between neighboring territories	Reproduction confirmed at the same time or reproduction confirmed > 10km apart or pack territory is known by telemetry 2 centers of activity (accumulation of tracks / scats)) at the same time more than 10km apart	reproduction confirmed at the same time in two distant locations (at least 8-10 km apart) or 2 centres of activity (accumulation of scats) at the same time in distant locations (at least 8-10 km apart)
Methods		
methods used	Presence sign survey (search for wolf signs and documentation of indications with photos and field protocol according to a monitoring manual) camera traps / video documentation, especially to confirm reproduction Genetic analysis Snow tracking Howling survey (only, if presumed reproduction cannot be confirmed using other methods)	Methods of Wolf Inventory were developed by MRI and AfN Wolf and are available on the MRI web site and in the manual "Monitoring of animal species" of the Inspectorate of Environmental Protection. 1. 1 or 2 snow tracks of wolves along defined transects in winter (simultaneously on the same day in well-defined forest complex within the wolf range). Information on tracking (with geo coordinates or numbers of forest compartment) on forms and maps are sent to MRI 2. Year round collection of evidence of wolf presence (tracks, scats, scent marking, sightings, dens, howling, remains of wild prey, damage to livestock) in the whole of Poland.

		Information on special forms are sent to MRI 3. Checking and collecting information from outside the wolf range (western Poland) is done by professionals (wolf biologists) 4. Computing data from forms to database is conducted in MRI. Next - preparing GIS layers from database - analyses of layers using knowledge of wolf ecology from scentific projects on wolves in Poland - defining locations of wolf pack territories as elipses of 250 km^2 size around den sites or centres of wolves activity in early summer - estimating wolf pack numbers and individuals number
Monitoring structure and organization		
structure	Monitoring responsibility rests with the Laender. In accordance with the federalist form of government in Germany, current monitoring structures differ widely. To assure consistent interpretation of monitoring data, monitoring standards for LCs in Germany have been developed and were accepted by the Laender. Data evaluation and interpretation is done by persons experienced in wolf monitoring. This assessment is done according to a monitoring manual where criteria are defined that must be fulfilled for each sign (e.g. track, scat, kill) in order to record a sign as confirmed indication. This approach requires detailed documentation (measurements, field protocol, and photographs) for each wolf sign designated as confirmed indication of wolf presence. Experienced persons are supported by specially trained persons. All wolf indications collected by trained persons have to be documented according to the monitoring manual to enable experienced persons to assess them.. If the Laender do not have their own experienced persons yet (since wolves only recently returned to Germany) it is highly recommended that they “share” the experienced persons available in other Laender. Every year, each of the Laender has to assess the area of occurrence and population size.	General Inspectorate of Environmental Protection (GIEP) is responsible for HD species monitoring in Poland. But no wolf monitoring system/structure as yet defined (see “Explanations for Poland” below the table). Only the structure of the Wolf Inventory is available. Wolf Inventory co-ordinators: the Mammal Research Institute (MRI) and the Association for Nature Wolf (AfN Wolf) In each defined forest complex (surrounded by distinctiive barriers) within the permanent wolf range the local co-ordinator of the wolf inventory is appointed (experienced forester). The co-ordinator is responsible for the tracking organisation and sending collected data to MRI Outside the permanent wolf range, an active wolf survey is conducted in all defined suitable habitats by wolf specialists from AfN Wolf and then volunteers and foresters are trained to collect and provide data in future Final results of analyses done in MRI (annual reports from wolf surveys with maps of wolf packs distributions/wolf territories, their numbers and population numbers) are sent to the Ministry of the Environment and General Directorate for Environmental Conservation.

	Once a year, the experienced persons from the different Laender meet to evaluate and assess the Laender data together in order to obtain a unique picture for Germany of populations sizes and areas of occurrence.	

Details of wolf monitoring in Germany

In the following, we define the SCALP criteria required for standardised monitoring of large carnivores in Germany. Based on the original SCALP criteria, they have been adapted for the situation in Germany and also for two additional species – wolf and bear.

A few preconditions apply:

In each region with large carnivores, at least one experienced person must be available to evaluate field data.

"Experienced" in this regard means having extensive field experience with the large-carnivore species concerned.

All observation must be checked for genuineness (i.e. the possibility of intentional deception must be ruled out).

The letter "C" stands for "category". The numbers 1, 2 and 3 below have nothing to do with the observer's qualifications; they are used to denote the level of verification for an observation.

C1: Hard evidence = Hard fact, i.e. evidence that unambiguously confirms the presence of a large carnivore (live capture, find of a dead animal, genetic proof, photo, telemetric location).

C2: Confirmed observation = Indirect signs like tracks, scats and kills confirmed by an *experienced* person as being caused by an LC. The experienced person can either confirm the signs himself in the field, or based on a documentation by a third party.

C3: Unconfirmed record = All observations not confirmed by an experienced person or observations, which by their nature cannot be confirmed. Examples including sightings by experienced persons; all signs that are too old, unclear, or are incompletely documented; signs that are too small in number to provide a clear picture (for example single track of a canide); indications which, for other reasons, do not suffice to provide confirmation; and all indications that cannot be checked thoroughly. Category C3 can be divided into the sub-categories "likely" and "unlikely".

False: false report = indication for which a large carnivore can be ruled out as the cause, or is highly unlikely to be the cause.

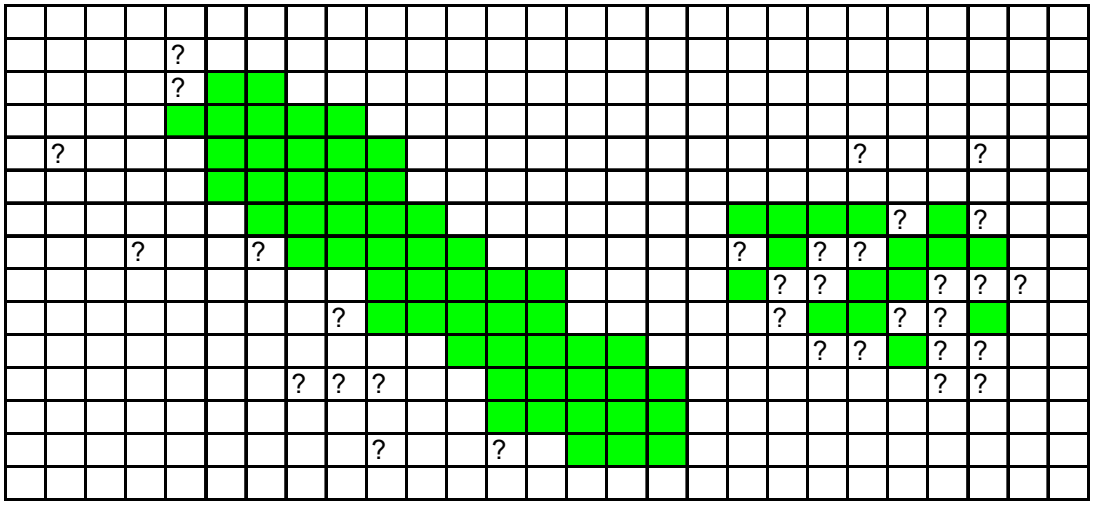

Fig. 1: Example for estimation of occurrence (green). For each occupied (green) cell, at least one C1 confirmation, or three C2 indications was/were obtained. Left: continuous distribution with possible extension to the west. The western extension is speculative, since it has no C1 confirmation and too few C2 indications. Right: distribution with gaps. The gaps could be real, i.e. gaps in the actual occurrence, or they could be the result of inadequate monitoring.

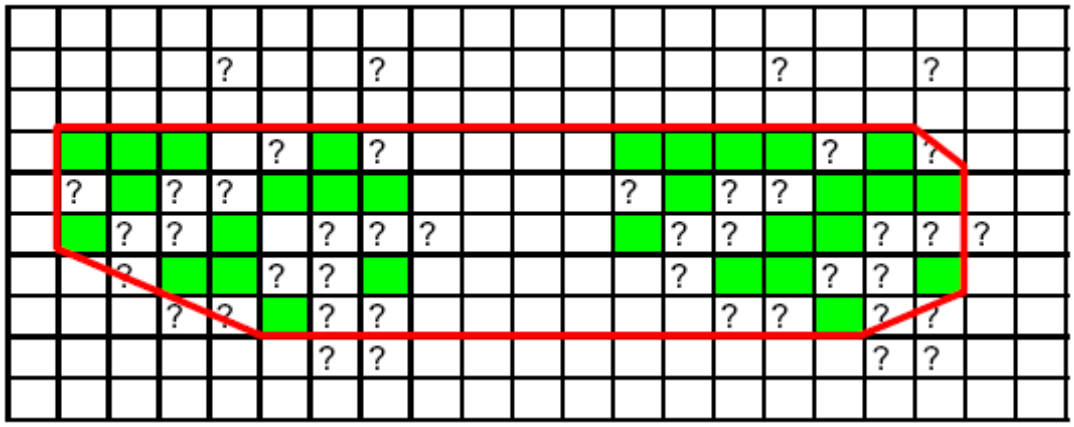

Fig. 2: Two areas separated by fewer than five cells form a range.

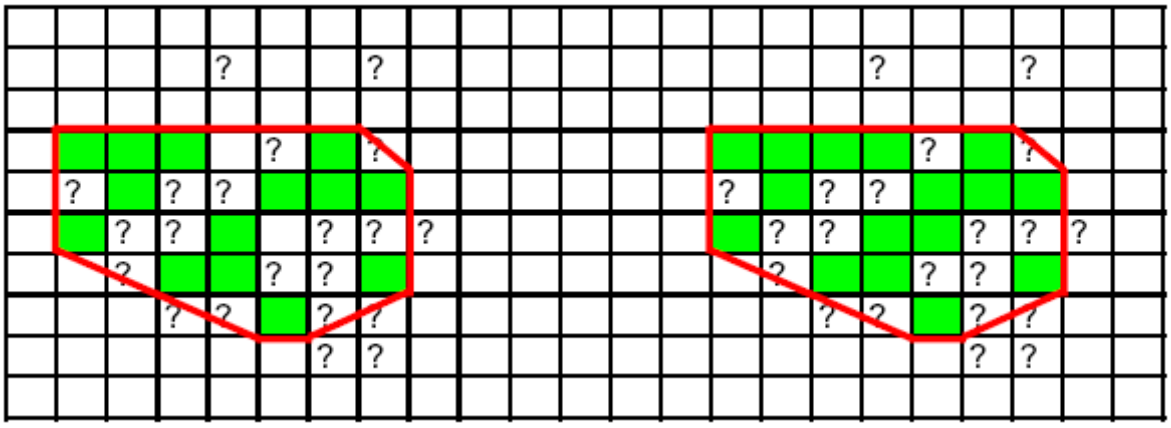

Fig. 3: Two areas separated by five or more cells form two ranges.

Tab. 2: *Parameters, recommended methods and accuracy needed to estimate area of occurrence and population size for* wolves *in Germany*. Note that the monitoring standards in Germany are currently under revision.

Parameter	Method	Precision and scope of required data
Area of occurrence	Presence sign survey	One C1 confirmation, or three independent C2 indications, or ten C2 indications of the same type, per 10 x 10 km cell and year
Number of packs Number of scent marking pairs Number of individual territorial wolves	Presence sign survey, snow tracking, genetic analysis, howling survey, video / foto documentation	Occurrence of a pack, a scent marking pair or a territorial individual must be confirmed via C1 or C2 indications.
Pack size	Presence sign survey(focus on tracks), snow tracking , genetic analysis, howling survey, video / foto documentation	The minimum figure for pack size must be confirmed via C1 or C2 indications, in late fall / winter.
Reproduction	Search for presence signs (focus on pup tracks), snow tracking , genetic analysis, howling survey, video documentation of rendezvous sites, camera traps	Successful reproduction has to be confirmed via C1 or two C2 indications.

Description of the Wolf Monitoring system in Poland

Under the the Nature Conservation Act, the General Inspectorate of Environmental Protection (GIEP) is responsible for HD species monitoring in Poland. However, a final structure has not been defined for the wolf monitoring system yet.

In 2007, to report to the EU, the GIEP commissioned the Institute of Nature Conservation of the Polish Academy of Sciences (INC) in Krakow with preparation of a report on the conservation status of HD species.The INC devolved responsibioity of development of the report on wolf conservation status to the Mammal Research Institute PAS in Białowieża. Thus, the report was based on results of the Wolf Inventory.

The Wolf census has been carried out in all forest districts and national parks in Poland since 2000. By agreement with the State Forest Service, the census was launched as a joint initiative of the Mammal Research Institute PAS in Białowieża (MRI) and the Association for Nature “Wolf” (AfN “Wolf”). The project was accepted by the Polish Ministry of the Environment in 2001. The census was not financed by the national budget, but by the State Forest Service, the Euronatur and IFAW foundations and with funds from MRI and AfN “Wolf”. Data on wolf presence are collected year round, and at the end of each year a report from the census is prepared and sent to involved institutions, the National State Forest Service, the Ministry of the Environment and the General Directorate of Environmental Protection, and presented on a website http://www.zbs.bialowieza.pl/artykul/553.html.

Since 2010 as some forest divisions have not provided sufficient data, there is not possible to estimate numbers of packs and individuals for whole Poland and only the range of the wolf population is defined yearly.

General instructions on preparing reports for the EU on the conservation status of HD species and habitats were published by the General Inspectorate for Environmental Protection (GIEP) in 2006 www.gios.gov.pl/siedliska/pdf/wskazowki.pdf. Instructions are

based on EU and national guideliness and reports, and describe the main indicators, give advice on how to prepare and evaluate information on species and habitats and how to fill in forms.

GIEP has also published a guidebook “Monitoring of animal species” (Makomaska-Juchiewicz 2010) in which methods are presented on wolf population monitoring and indicators of population status and habitat status (within Natura 2000 sites). The main methods and structure are based on the Wolf Inventory system. Main indicators for population status are: population density (n of individuals/100 km^2) and number of packs/100 km^2. Indicators for wolf habitat quality are: forest cover, fragmentation of forests, food biomass (kg/km^2), road density, and isolation of habitats.