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ALPBIONET2030

Integrative Alpine wildlife and habitat management for the next generation
Spatial analysis and perspectives of [ecological] connectivity in the wider Alpine areas

ALPBIONET2030 Integrative Alpine wildlife and habitat management for the next generation

By

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EDITORIAL

Towards an ecologically sustainable strategy of nature protection and spatial planning

ALPBIONET2030 identified, analyzed and described the Alpine environmental context of ecological connectivity and wildlife management and addressed an issue that is crucial for sustainability: mediation of human-nature conflicts.

The Alps are a central region of Europe, offering, according to stakeholder groups, widely varying experiences: for some, they represent an obstacle to free mobility, freight and transports, for others they offer a playground for sports and touristic activities. In the minds of many, the Alps also embody a territory of culture, mystery and mountain legends, and this image is bolstered by publicity, which enhances the appeal of this region. Last but not least, the Alps provide living space for locals, and their lives and are subject to the activities of an significant "week-end population" mostly arriving from the important urban agglomerations around the Alps.

The project identified this urban development around the Alps, including its associated infrastructure belt and related economic impacts, which is quite extensive in many areas, as one of the major reasons for ecological connectivity fragmentation isolating the Alps from its periphery and neighbouring mountain ranges.

Although the Alps are exposed to intensive human use that threatens nature conservation and the protection of ecosystems, these activities are nevertheless mostly concentrated in a restricted number of inner Alpine valleys and touristic hot spots. This concentration is, on the one hand, a threat to such intensively used areas exposed to high impacts on nature; on the other hand, it is an opportunity for the conservation of other sites that are not yet fragmented and are still ecologically valuable.

ALPBIONET2030 tried to bring all these aspects together to illustrate the current situation of connectivity and to elaborate, through the maps presented in this Atlas, a concrete foundation for planning a sustainable strategy of land use in the Alpine Space. The project integrated essential factors of such a strategy by defining Strategic Alpine Connectivity Areas (SACA) with a specially dedicated tool (JECAMI 2.0), evaluating wildlife management and human-nature conflict management aspects and generating recommendations. The extent of the project encompassed, for the first time in this thematic field, the whole area of the European Strategy of the Alpine Region (EUSALP).

This Atlas, one of the main outputs of ALPBIONET2030, illustrates, explains and projects Alpine ecological connectivity with all its crucial elements for an audience that includes experts and various stakeholders as well as a broader public. It can and should be used for further policy and spatial planning activities in the Alpine countries by national and regional governments and EU bodies. The maps have been developed to be integrated into long term strategies of the Alpine Space - especially by the Alpine Convention and within the macro-regional strategy of the Alpine Region.
Functioning Alpine ecosystems are still possible – if policy is enacted now for the preservation of the last non-fragmented habitats, responsible planning and, where needed, restoration measures and establishment or enlargement of protected or differently managed areas.

The Alpine Space Programme delivered, through the project ALPBIONET2030, a tool for such a sustainable Alpine environmental policy.

Guido Plassmann
ALPARC (Lead Partner)

Summary

Integrative Alpine wildlife and habitat management for the next generation- Spatial analysis and perspectives regarding [ecological] connectivity in the wider Alpine areas

The ALPBIONET2030 project followed a series of different initiatives and projects completed during the last 10-15 years dealing with the topic of ecological connectivity in the Alps (see publication 'Alpine Nature 2030' from 2016 which summarizes these initiatives).

ALPBIONET2030 investigated for the first time, on a spatially explicit level, where and to what extent the Alpine territory is suitable for ecological connectivity. It carried out a GIS based spatial analysis for the overall area of the European Macro-regional Strategy for the Alps (EUSALP). The methodology applied used different indicators with relevance for ecological connectivity; they are summarized in the so-called Continuum Suitability Index (CSI). Both methodology and results of the analysis can be found under www.jecami.eu .

As a result of the analysis, three different types of Strategic Alpine Connectivity Areas (SACA) were defined: Ecological Conservations Areas (category 1), Ecological Intervention Areas (category 2) and Connectivity Restoration Areas (category 3). The concept behind this categorization is that areas that are still valuable should be protected (Ecological Conservations Areas (category 1), their habitat conditions should be improved and their surface probably expanded. Ecological Intervention Areas (category 2) are those with conditions difficult for wildlife but also with realistic potential for improvement. Connectivity Restoration Areas (category 3) are mainly the large Alpine valleys with high human impact, intensive land use and major barriers, where only specific restoration measures can help to improve the conditions of ecological connectivity. The project's primary output is a map showing both the main barriers to ecological connectivity in the Alps and towards the EUSALP area and the main connectivity areas and ecological corridors through the Alps and towards the neighbouring mountain areas.

A chief result of the JECAMI analysis is the identification of 'white areas' where none of the three defined indicator sets applies – if compared with the land use pattern, these areas belong to the territories intensively used by agriculture. At a regional level, restoration and connectivity measures for valuable habitats are being implemented in those areas. The impact of these measures, however, needs to be expanded in order to develop relevance for Alps-wide ecological connectivity. Biotopes and areas with high ecological value covering surfaces significantly larger than 100 hectares would be necessary to restore elements of connectivity in those areas. Within ALPBIONET2030, different Pilot Working Regions in Slovenia, Italy, France, Austria and Germany were involved to test how the Strategic Alpine Connectivity Areas approach fit for their territory and what perspectives arose from project findings. In addition, interesting examples of regional and local measures for ecological connectivity were carried out.

ALPBIONET2030 aimed to integrate the human as well as the nature and wildlife perspectives. That is why a detailed analysis of the different hunting systems and traditions of the Alpine countries was completed. The results show that species distribution and their treatment by the different regional or national hunting management systems significantly affect ecological connectivity.

A particular focus was set on exploring human – nature conflicts in different settings and constellations – both when human activities impact wildlife needs and vice versa. The perception of nature and wildlife often follows traditional behaviour patterns, and intensive communication and awareness raising is needed to find solutions for successful human – nature co-existence. Overall, the project ALPBIONET2030 creates a reliable scientific basis for integrative Alpine wildlife and habitat management for the next generation.

Résumé

Gestion intégrée des habitats et de la faune sauvage pour les générations à venir - Analyse spatiale et perspectives concernant la connectivité [écologique] dans les Alpes et au-delà

Le projet ALPBIONET2030 fait suite à une série d'initiatives et de projets sur le thème de la connectivité écologique dans les Alpes au cours des 10 à 15 dernières années (voir la publication « Alpine Nature 2030 » de 2016 qui résume ces initiatives).

ALPBIONET2030 a étudié pour la première fois à un niveau spatial explicite où et dans quelle mesure le territoire alpin est compatible avec une connectivité écologique. Dans le cadre du projet a été réalisée une analyse spatiale SIG pour l'ensemble de la zone de la Stratégie macro régionale européenne pour les Alpes (SUERA). La méthodologie appliquée utilise différents indicateurs pertinents pour la connectivité écologique qui sont résumés dans le Continuum Suitability Index (CSI). La méthodologie et les résultats de l'analyse peuvent être consultés sur www.jecami.eu .

L'analyse a permis de définir trois types différents de zones stratégiques de connectivité alpine (SACA) : Zones de conservation écologique (catégorie 1), zones d'intervention écologique (catégorie 2) et zones de restauration de la connectivité (catégorie 3). La réflexion derrière est qu'il faut protéger les zones qui ont encore de la valeur (zones de conservation écologique (catégorie 1), y améliorer les habitats et si possible en étendre la surface. Les zones d'intervention écologique (catégorie 2) sont celles qui présentent des conditions difficiles pour la faune, mais un potentiel d'amélioration réaliste. Les zones de restauration de la connectivité (catégorie 3) sont principalement les grandes vallées alpines à fort impact humain, à occupation intensive des sols et avec des barrières majeures. Dans ces zones seules des mesures de restauration distinctes peuvent contribuer à améliorer les conditions de la connectivité écologique. Le résultat principal du projet est une carte montrant à la fois les principaux obstacles à la connectivité écologique dans les Alpes et vers la zone SUERA et les principales zones de connectivité et corridors écologiques à travers les Alpes et vers les zones de montagne voisines.

L'un des principaux résultats de l'analyse du JECAMI est l'identification de " zones blanches " où aucun des 3 ensembles d'indicateurs définis ne s'applique - concernant les types d'utilisations des sols, ces zones correspondent aux territoires utilisés de manière intensive par l'agriculture. Au niveau régional, des mesures de restauration et de connectivité des habitats à haute valeur écologique sont mises en œuvre dans ces zones. L'impact de ces mesures doit toutefois être étendu afin de développer leur pertinence pour la connectivité écologique à l'échelle des Alpes. A minima des biotopes et des zones de grande valeur écologique d'une superficie nettement supérieure à 100 hectares seraient nécessaires pour rétablir des éléments de connectivité dans ces zones. Au sein d'ALPBIONET2030, différentes régions pilotes de Slovénie, d'Italie, de France, d'Autriche et d'Allemagne ont été impliquées pour tester comment l'approche des zones stratégiques de connectivité alpine s'adapte à leur territoire et quelles perspectives découlent des résultats du projet. En outre, des exemples intéressants de mesures régionales et locales de connectivité écologique ont été réalisés.

ALPBIONET2030 a souhaité intégrer à la fois la perspective humaine et la perspective de la nature et de la faune sauvage. C'est pourquoi une analyse détaillée des différents systèmes et traditions de chasse des pays alpins a été entreprise. Les résultats montrent que la répartition des espèces et leur traitement par les différents systèmes régionaux ou nationaux de gestion de la chasse affectent considérablement la connectivité écologique.

Un accent particulier a été mis sur l'exploration des conflits entre l'homme et la nature dans différents contextes et constellations, à la fois lorsque les activités humaines ont un impact sur les besoins de la faune sauvage et vice versa. La perception de la nature et de la faune suit souvent les modèles de comportement traditionnels et une communication et une sensibilisation intensives sont nécessaires pour trouver des solutions pour une coexistence réussie entre l'homme et la nature. Le projet ALPBIONET2030 constitue une base scientifique fiable pour une gestion intégrée de la faune et de la flore alpine et des habitats pour la prochaine génération.

Zusammenfassung

Integratives alpines Wildtier- und Lebensraummanagement für die nächste Generation - Raumanalyse und Perspektiven der [ökologischen] Vernetzung im erweiterten Alpenraum

Das Projekt ALPBIONET2030 folgt einer Reihe von verschiedenen Initiativen und Projekten der letzten 10-15 Jahre, die sich mit dem Thema ökologische Vernetzung in den Alpen befassen (siehe Publikation "Alpine Nature 2030" von 2016, die diese Initiativen zusammenfasst).

ALPBIONET2030 untersuchte erstmals auf einer räumlich expliziten Ebene, wo und in welchem Umfang einzelne Gebiete der Alpen für ökologische Vernetzung geeignet sind. Im Rahmen des Projekts wurde eine GIS-basierte Raumanalyse für das Gesamtgebiet der Europäischen Makro-Regionalen Strategie für die Alpen (EUSALP) durch. Die angewandte Methodik verwendet verschiedene Indikatoren mit Relevanz für die ökologische Vernetzung, die im sogenannten Continuum Suitability Index (CSI) zusammengefasst sind. Sowohl die Methodik als auch die Ergebnisse der Analyse finden Sie unter www.jecami.eu .

Als Ergebnis der Analyse wurden drei verschiedene Arten von Strategic Alpine Connectivity Areas (SACA) definiert: Ecological Conservations Areas (Kategorie 1), Ecological Intervention Areas (Kategorie 2) und Connectivity Restoration Areas (Kategorie 3). Dahinter steht die Überlegung, dass noch wertvolle Flächen geschützt werden sollten Ecological Conservations Areas (Kategorie 1), die dortigen Lebensraumbedingungen verbessert und ihre Fläche wenn möglich erweitert. Ecological Intervention Areas (Kategorie 2) sind Gebiete mit schwierigen Bedingungen für Wildtiere, aber realistischem Verbesserungspotenzial. Connectivity Restoration Areas (Kategorie 3) sind vor allem die großen Alpentäler mit hoher menschlicher Präsenz, intensiver Landnutzung und bedeutenden Barrieren, bei denen nur spezifische Verbesserungsmaßnahmen dazu beitragen können, die Bedingungen der ökologischen Vernetzung zu verbessern. Das Hauptergebnis des Projekts ist eine Karte, die sowohl die wichtigsten Hindernisse für den ökologischen Verbund in den Alpen und im Grenzbereich zum EUSALP-Gebiet als auch die wichtigsten Verbundgebiete und ökologischen Korridore durch die Alpen und in Richtung der benachbarten Berggebiete darstellt.

Ein Hauptergebnis der JECAMI-Analyse ist das Aufzeigen von "weißen Flächen", bei denen keiner der 3 definierten Indikatorsätze zutrifft - im Vergleich zum Landnutzungsmuster gehören diese Flächen zu den Gebieten, die von der Landwirtschaft intensiv genutzt werden. Auf regionaler Ebene werden in diesen Gebieten Maßnahmen zur Wiederherstellung und Vernetzung wertvoller Lebensräume durchgeführt. Die Auswirkungen dieser Maßnahmen müssen jedoch verstärkt werden, um die Relevanz für die alpenweite ökologische Vernetzung zu entwickeln. Zumindest Biotope und Gebiete mit hohem ökologischem Wert, die deutlich größer als 100 Hektar sind, wären notwendig, um Elemente der Vernetzung in diesen Gebieten wiederherzustellen. Im Rahmen von ALPBIONET2030 wurden verschiedene Pilotarbeitsregionen in Slowenien, Italien, Frankreich, Österreich und Deutschland einbezogen, um zu testen, wie der Ansatz der Strategic Alpine Connectivity Areas für ihr Gebiet geeignet ist und welche Perspektiven sich aus den Projektergebnissen ergeben. Darüber hinaus wurden interessante Ansätze für regionale und lokale Maßnahmen zur ökologischen Vernetzung durchgeführt.

ALPBIONET2030 hatte zum Ziel sowohl die menschliche wie auch die Perspektive der Natur und der Tierwelt zu integrieren. Deshalb wurde eine detaillierte Analyse der verschiedenen Jagdsysteme und -traditionen der Alpenländer durchgeführt. Die Ergebnisse zeigen, dass die Verteilung der Arten und ihre Behandlung durch die verschiedenen regionalen oder nationalen Jagdmanagementsysteme die ökologische Vernetzung erheblich beeinflussen.

Ein besonderer Schwerpunkt lag auf der Erforschung von Mensch-Natur-Konflikten in verschiedenen Umgebungen und Konstellationen - sowohl wenn menschliche Aktivitäten die Bedürfnisse der Tierwelt beeinflussen als auch umgekehrt. Die Wahrnehmung von Natur und Wildtieren folgt oft traditionellen Verhaltensmustern und eine intensive Kommunikation und Bewusstseinsbildung ist notwendig, um Lösungen für eine erfolgreiche Mensch-Natur-Koexistenz zu finden. Insgesamt schafft das Projekt ALPBIONET2030 eine verlässliche wissenschaftliche Grundlage für ein integratives alpines Wild- und Lebensraummanagement für die nächste Generation.

Riepilogo

Gestione integrata della fauna alpina e degli habitat per la prossima generazione - Analisi spaziale e prospettive in materia di connettività [ecologica] nelle aree alpine e oltre

Il progetto ALPBIONET2030 segue una serie di iniziative e progetti degli ultimi 10-15 anni sul tema della connettività ecologica nelle Alpi (si veda la pubblicazione "Alpine Nature 2030" del 2016 che riassume queste iniziative).

ALPBIONET2030 ha indagato per la prima volta ad un livello spaziale specifico, dove e in che misura il territorio alpino è adatto alla connettività ecologica. Ha effettuato un'analisi spaziale basata sul sistema GIS per l'area complessiva della Strategia Macroregionale Europea per le Alpi (EUSALP). La metodologia applicata utilizza diversi indicatori rilevanti per la connettività ecologica, riassunti nel cosiddetto "Continuum Suitability Index" (CSI). Sia la metodologia che i risultati dell'analisi sono disponibili sul sito www.jecami.eu .

Come risultato dell'analisi sono stati definiti tre diversi tipi di" Strategic Alpine Connectivity Areas" (SACA): Aree di conservazione ecologica (categoria 1), Aree di intervento ecologico (categoria 2) e Aree di ripristino della connettività (categoria 3). La riflessione di base è che le aree che sono ancora intatte devono essere protette (Ecological Conservations Areas (categoria 1), le loro condizioni di habitat devono essere migliorate e la loro superficie addirittura estesa. Le aree di intervento ecologico (categoria 2) sono quelle con condizioni difficili per la fauna selvatica, ma con un potenziale di miglioramento realistico. Le Aree di Restauro della Connettività (categoria 3) sono principalmente le grandi valli alpine occupate da insediamenti umani che comportano un uso intensivo del territorio e costituiscono le principali barriere. Qui solo misure di ripristino specifiche possono ripristinare la connettività ecologica.

Il principale risultato del progetto è una mappa che mostra sia le principali barriere alla connettività ecologica nelle Alpi e nell'area EUSALP e le principali aree di connettività e corridoi ecologici attraverso le Alpi e verso le aree montane limitrofe.

Un risultato fondamentale dell'analisi JECAMI è la presenza delle "white areas" dove non è applicabile nessuno dei 3 indicatori definiti - se confrontato con la tendenza di utilizzo del territorio, queste aree corrispondono ai terreni intensamente utilizzati dall'agricoltura. A livello regionale, in queste aree sono in corso di attuazione misure di ripristino e di connettività per gli habitat più importanti. L'impatto di queste misure, tuttavia, deve essere ampliato per diventare rilevante per la connettività ecologica a livello alpino. Almeno i biotopi e le aree ad alto valore ecologico di dimensioni significativamente superiori a 100 ettari dovrebbero essere soggette a interventi di ripristino della connettività. Nell'ambito di ALPBIONET2030 sono state coinvolte diverse regioni di lavoro pilota in Slovenia, Italia, Francia, Austria e Germania per testare come l'approccio "Strategic Alpine Connectivity Areas" si adatta al loro territorio e quali prospettive derivano dai risultati del progetto. Inoltre, sono stati adottate interessanti misure regionali e locali per la connettività ecologica.

ALPBIONET2030 ha voluto integrare la prospettiva umana con quella della fauna selvatica e della natura. Per questo motivo è stata effettuata un'analisi dettagliata delle diverse tradizioni venatorie dei paesi alpini. I risultati mostrano che la distribuzione delle specie e il loro trattamento da parte dei diversi sistemi di caccia regionali o nazionali hanno un impatto significativo sulla connettività ecologica.

Un'attenzione particolare è stata rivolta all'esplorazione dei conflitti uomo-natura in diversi contesti: quando le attività umane hanno un impatto sulle esigenze della fauna selvatica e viceversa. La percezione della natura e della fauna selvatica segue spesso modelli di tradizionali, per questo è necessaria un'intensa campagna di comunicazione e sensibilizzazione per trovare soluzioni per una positiva coesistenza uomo-natura. Nel complesso, il progetto ALPBIONET2030 crea una base scientifica affidabile per una gestione integrata della fauna e degli habitat alpini per la generazione futura.

Povzetek

Celostno upravljanje alpskih prosto živečih živali in habitatov za prihodnje generacije – Prostorska analiza in perspektive za (ekološko) povezljivost na širših alpskih območjih

Projekt ALPBIONET2030 je sledil nizu različnih pobud in projektov, ki so v zadnjih 10–15 letih obravnavali temo ekološke povezljivosti v Alpah (povzetek teh pobud si lahko ogledate v publikaciji »Alpine Nature 2030« iz leta 2016).

Projekt ALPBIONET2030 je prva izrecno prostorska raziskava, ki želi opredeliti, kje in v kolikšni meri ozemlje Alp ustreza kriterijem ekološke povezljivosti. V okviru projekta je bila na podlagi geografskega informacijskega sistema opravljena prostorska analiza celotnega območja evropske Strategije za Alpsko makroregijo (EUSALP). Uporabljena metodologija je upoštevala različne kazalnike, ki so pomembni za ekološko povezljivost in so povzeti v tako imenovanem indeksu ustreznosti kontinuuma (CSI – Continuum Suitability Index). Takó metodologijo kot rezultate analize si je mogoče ogledati na strani www.jecami.eu.

Na podlagi te analize so bile opredeljene tri različne kategorije strateških območij za ekološko povezljivost v Alpah (SACA – Strategic Alpine Connectivity Areas): ekološka ohranitvena območja (kategorija 1), ekološka intervencijska območja (kategorija 2) in območja obnavljanja povezljivosti (kategorija 3). Ta razvrstitev v kategorije temelji na prepričanju, da je treba ekološka ohranitvena območja (kategorija 1), ki so v razmeroma dobrem stanju, zavarovati, izboljšati pogoje v njihovih habitatih in jih po možnosti razširiti. Ekološka intervencijska območja (kategorija 2) so območja z neugodnimi pogoji za prosto živeče živali, a z realističnimi možnostmi za izboljšanje. Območja obnavljanja povezljivosti (kategorija 3) pa so večinoma široke alpske doline z močnim človeškim vplivom, intenzivno rabo tal in velikimi ovirami; v teh območjih je mogoče le z namenskimi obnovitvenimi ukrepi izboljšati pogoje za ekološko povezljivost. Glavni rezultat projekta je zemljevid, ki prikazuje po eni strani glavne ovire za ekološko povezljivost v Alpah in v območju EUSALP, po drugi strani pa tudi glavna področja povezljivosti in ekološke koridorje v Alpah in v smeri sosednjih gorskih območij.

Glavni rezultat analize z orodjem JECAMI je opredelitev »belih območij«, katerim ne ustreza nobeden izmed opredeljenih treh nizov kazalnikov: če jih primerjamo z zemljevidom rabe tal, ugotovimo, da gre za zemljišča z intenzivno kmetijsko rabo. Na regijski ravni so bili v teh območjih izvedeni ukrepi za obnovo povezljivosti in habitatov. Vendar bo treba te ukrepe razširiti, da bodo lahko pomenljivo vplivali na širšo ekološko povezljivost v Alpah. Vsaj v biotopih in območjih z visoko ekološko vrednostjo, ki so večja od 100 hektarjev, bi bilo nujno obnoviti elemente povezljivosti. V okviru projekta ALPBIONET2030 so bile različne pilotne delovne regije v Sloveniji, Italiji, Franciji, Avstriji in Nemčiji vključene v postopek preskušanja, v kolikšni meri pristop Strateških območij za ekološko povezljivost v Alpah ustreza določenemu ozemlju in kakšne perspektive izhajajo iz spoznanj, pridobljenih v projektu. Poleg tega so bili izvedeni zanimivi primeri regijskih in krajevnih ukrepov za ekološko povezljivost.

Projekt ALPBIONET2030 si je prizadeval za usklajevanje človeških potreb z zahtevami, ki jih imajo narava in prosto živeče živali. Iz tega razloga so bili preučeni tudi različni sistemi in tradicije lova v posameznih alpskih državah. Rezultati tega preučevanja kažejo, da razporeditev živalskih vrst in njihovo obravnavanje s strani različnih regijskih ali državnih sistemov lova pomembno vplivajo na ekološko povezljivost.

Posebna pozornost je bila posvečena raziskovanju konfliktov med ljudmi in naravo v različnih okoljih in različnih medsebojnih razmerjih, bodisi ko gre za vpliv človeških dejavnosti na potrebe prosto živečih živali bodisi obratno. Dojemanje narave in prosto živečega živalstva se pogosto ravna po tradicionalnih vedenjskih vzorcih, zato je za iskanje rešitev za uspešno sožitje med ljudmi in naravo potrebno intenzivno obveščanje in ozaveščanje.

S projektom ALPBIONET2030 je bila skratka ustvarjena zanesljiva znanstvena podlaga za celostno upravljanje alpskih prosto živečih živali in habitatov za prihodnje generacije.

INTRODUCTION

The present Atlas compiles a cartographic presentation of the results of the ALPBIONET2030 project. It can be considered as a main achievement of the project to offer - for the area covered by the Alpine Convention but also for the first time for the area concerned by the European Macro-regional Strategy for the Alps (EUSALP) - a concise cartographic representation of various different aspects linked to the thematic of ecological connectivity.

Chapter 1 provides an overview about the involved project partners, the Project Working Regions (PWR) and the protected areas as key elements for ecological connectivity in the Alps.

Chapter 2 presents some insights into ecological space and obstacles in the Alps by analysing several different indicators like environmental protection status, fragmentation or land use types and their impact on ecological connectivity for the alpine and the EUSALP area. The different indicators are summarised in a reviewed Continuum Suitability Index (the CSI is a combined analysis of structural landscape connectivity and landscape permeability), in order to offer support for decision-making processes for policy development and implementation of landscape planning.

Chapter 3 interconnects the innovative approach developed by the project presenting the maps of the 3 different types of Strategic Alpine Connectivity Areas (SACA): Ecological Conservations Areas, Ecological Intervention Areas and Connectivity Restoration Areas. The maps highlight their geographic repartition in the EUSALP territory, their altitudinal distribution as well as the share of the total surface of the concerned area they hold.

Chapter 4 explores the different hunting systems and traditions of the alpine countries underlining the considerable differences that exist at regional and national levels. Species distribution lists and the way they are considered by the different hunting systems in place illustrate how wildlife management by hunting can indeed affect ecological connectivity.

Chapter 5 homes in on some examples of human – nature conflicts that may arise when human activities impact wildlife needs and behaviour or vice versa. It shows as well as the perception of nature and wildlife and potential conflicts that may arise from human – nature co-existence perceived by young people for different alpine regions.

Chapter 6 invites to discover the work realised in the 5 Project Working Regions at regional level, exploring the specific context of the single regions, how the Strategic Alpine Connectivity Areas approach fits for the territory and what perspectives arise from project findings.

Chapter 7 finally concludes with and overview about all 3 SACA types and a digression about the non-SACA areas. In addition, as a result of spatial analysis and expert knowledge inputs, a synopsis of the main barriers to ecological connectivity in the Alps and towards the EUSALP area and main connectivity areas between the Alps and the neighbouring mountain areas is presented.

1. Project Working Regions and Project Partners

Towards integrative wildlife and habitat management for the next generation

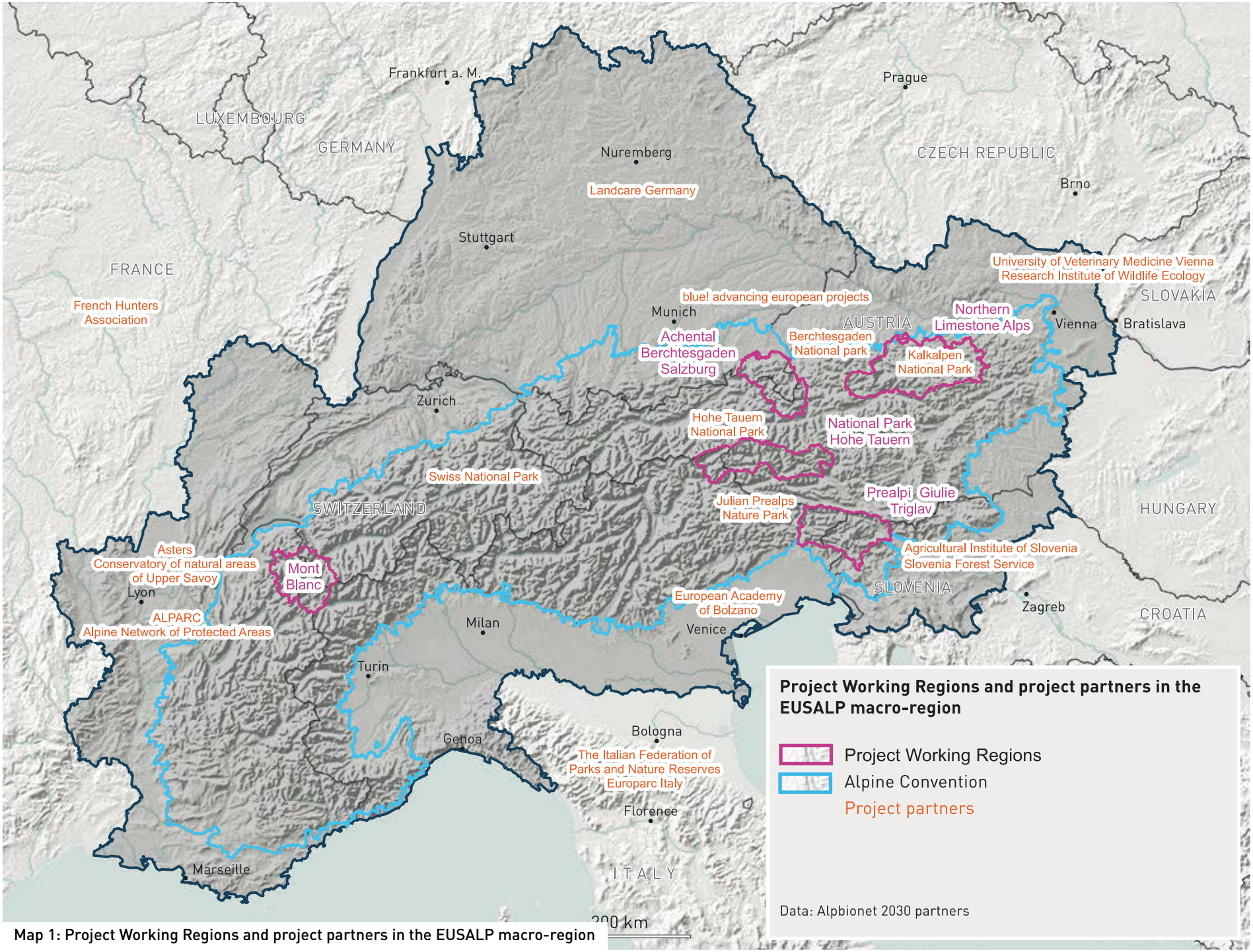
Ecological connectivity is the basis of Alpine and global habitat and species protection. The ALPBIONET2030 project brought together 15 partners from six Alpine countries (Austria, France, Germany, Italy, Slovenia and Switzerland) and a variety of different institutions (research institutions, public administrations, regional, national and international NGOs, federations and protected areas). This variety of institutional partnerships as well as the different sectors from which the project partners originated (land care, agriculture, forestry, nature protection, hunting, planning, and research) ensured an interesting mix of viewpoints on the project's topics and the possibility to address these topics considering the diverse perspectives of the participants.

The concept of ecological connectivity is based on concrete spatial dimensions. Ecological networks need to be implemented on the ground in order to be integrated into the landscape and to ensure functioning ecosystems. In order to achieve this goal step by step, project by project, the project's partnership ensured competences in sound planning (mapping), in interacting with local and regional stakeholders necessary for a successful implementation (mediation concepts) and in concrete implementation with actions in the Project Working Regions (PWR) structured around existing protected areas.

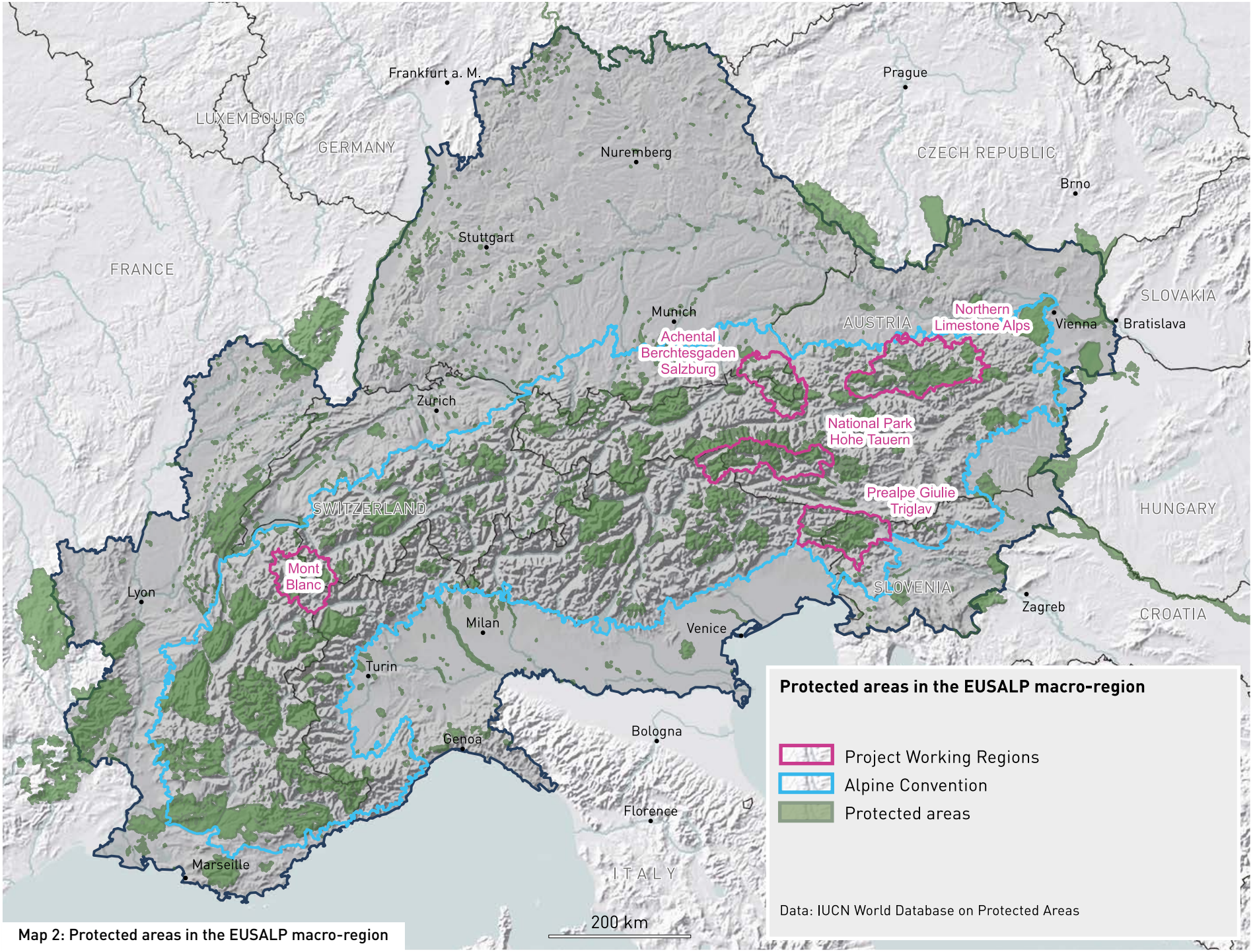
The protected areas of the Alpine Arc (map n°2) are the backbone of ecological connectivity in the Alps. Currently, more than 1000 large protected areas (>100ha) of different categories exist in the Alps. The objectives of each protected area and therefore the actions taken in favor of nature conservation depend on the protected area's categorization and can differ significantly according to whether it is a national park, a nature park or a protected landscape park. In the Alps, stronger protection categories are generally located at higher altitudes. Regardless of their categories and their specific objectives, every protected area can represent an important spatial piece of the puzzle in an Alpine ecological network and contribute to it through different actions.

The role of protected areas in building up an ecological network, especially in the Alpine context, has been described in detail by Plassmann et al. 2016. The mapping of the Strategic Alpine Connectivity Areas (SACAs) in the ALPBIONET2030 project confirmed the importance of protected areas in this context. Indeed, 80% of the Alpine "Ecological Conservation Areas" (see map n°11), the biodiversity hotspots of an ecological network, are located in existing protected areas. This highlights the importance of the protected areas for ecological connectivity in this mountain range, even if the main aim of a large number of these areas is not exclusively or even primarily nature protection but rather a sustainable regional development. The managers of these areas are therefore given a specific role as facilitators to integrate ecological connectivity aspects in a regional development and landscape vision.

The Project Working Regions of this project have been laboratories to test methods of stakeholder involvement, to imagine wider, transboundary wildlife management strategies, to analyze the impact of various (leisure) practices on wildlife such as outdoor sports (mountain biking, paragliding, ski mountaineering), forestry or hunting. They were also study areas to verify the trans-Alpine mapping approach and to connect the project's findings with local expertise within the frame of various field visits.



Map 1: Project Working Regions and project partners in the EUSALP macro-region



Map 2: Protected areas in the EUSALP macro-region

2. Novel insights into ecological space and obstacles in the Alps

Why is ecological connectivity important?
Globally a massive decline of species richness has been documented (Böhm et al. 2013, Estes et al. 2011, Schipper et al. 2008) highlighting a worldwide biodiversity loss far exceeding the background extinction rate (e.g. Pimm et al. 2014). There is mounting evidence that biodiversity loss alters the functioning of ecosystems (e.g. Risch et al. 2018) and thereby impacts human beings by compromising critical ecosystem services, such as the pollination of food crops or the provisioning of fresh and clean air. In order to combat the extinction crisis, the United Nations (UN) sustainable development goals aim to conserve 17% of the terrestrial and 10% of the marine areas (AICHI Target n°11), while representatives of the 'Half Earth approach' (Dinerstein et al. 2012, Noss et al. 2012, Wilson, 2016) claim that 50% of the earth needs to be conserved to sustain human livelihood.

While large, functional and well-managed protected areas are extremely important for conserving biodiversity, it is essential to recognize that vast amounts of biodiversity and ecosystem attributes exist in and depend on landscapes outside of the present-day protected area domain. The simple size of a protected area is, more often than not, a poor criterion when evaluating its value in conserving biodiversity, protecting intact ecosystems and conserving species. No protected area is in itself large enough to fulfil essential conservation goals. In order to achieve these goals, protection will necessarily have to extend into the complex, patchy multi-use matrix that stretches between the protected area islands (e.g. Boscolo and Metzger 2011, Shanahan et al. 2011).

"No protected area is in itself large enough to fulfil essential conservation goals."

The European Alps

Mountain ranges, like the European Alps, are unique habitats exhibiting high species richness. It makes them important to global biodiversity conservation (Kohler et al. 2009, Körner and Spehn 2002). Nature conservation in the European Alps tends to take place mainly where there are few conflicts of interest and not necessarily at the most favorable locations from a conservation perspective. For this reason, we tried to assess the entire landscape of the EUSALP macro-region with regard to its suitability to contribute towards protecting and maintaining functioning ecosystems. In our analytic approach, anthropogenic factors deemed relevant to the alteration of ecosystems are assessed and the landscape is considered as an ecological continuum.

"Nature conservation [...] may mainly take place where there are few conflicts of interest..."

The continuum suitability indices

With the continuum suitability indices (CSI) we aim to a) support the decision-making process for policy development and implementation of landscape planning; and b) provide an overview of ecological space and obstacles in the EUSALP macro region. The CSI are defined as a set of spatially explicit indicators that determine ecological connectivity.

They are:

- Environmental protection (ENV)
- Fragmentation by transportation infrastructure (FRA)
- Land use (LAN)
- Population pressure (POP)
- Altitude and topography (TOP)

The CSI were defined based on the collation of scientific literature and the results of expert workshops. The individual indicators complement each other by not including different influencing factors more than once. Each indicator is described in a spatially explicit manner using a GIS. The spatial analysis results are then valued from 0 to 10 depending on the suitability as an ecological continuum. In the valuation process, 0 means poor suitability as an ecological continuum and 10 indicates high suitability. The individual indicators are presented in chapter 2.1 to 2.6 and provide the basis for the SACA approach (chapter 3).

2.1 Environmental protection status

Key strategic element for conservation

In all ecoregions across the world, environmentally protected areas (PA) are key strategic elements for nature conservation (Laurance et al. 2012, Ostermann, 1998, Saunders et al. 2002) because of the vast amount of biodiversity which exists in them. The effectiveness of the PAs is determined by the effectiveness of their management (Jones et al. 2018), their spatial distribution (Le Saout et al. 2013, Schoville et al. 2018) and the surrounding matrix (Häkkilä et al. 2017). Although the PAs total area has roughly doubled since the Earth Summit in Rio in 1992, the human pressure on PAs has also increased. Nowadays, some 30% of PA land is affected by intense human pressure (Jones et al. 2018).

"Some 30% of protected areas land is affected by intense human pressure"

Furthermore, PAs in the European Alps may come under increasing pressure if they are not sufficiently legally secured. Threats arise from a variety of competing interests, such as the infrastructure construction for renewable energy production and touristic projects. New PA projects are often opposed by particular interest groups, and at lower elevations the establishment of large PAs is almost never discussed.

Legal protection status

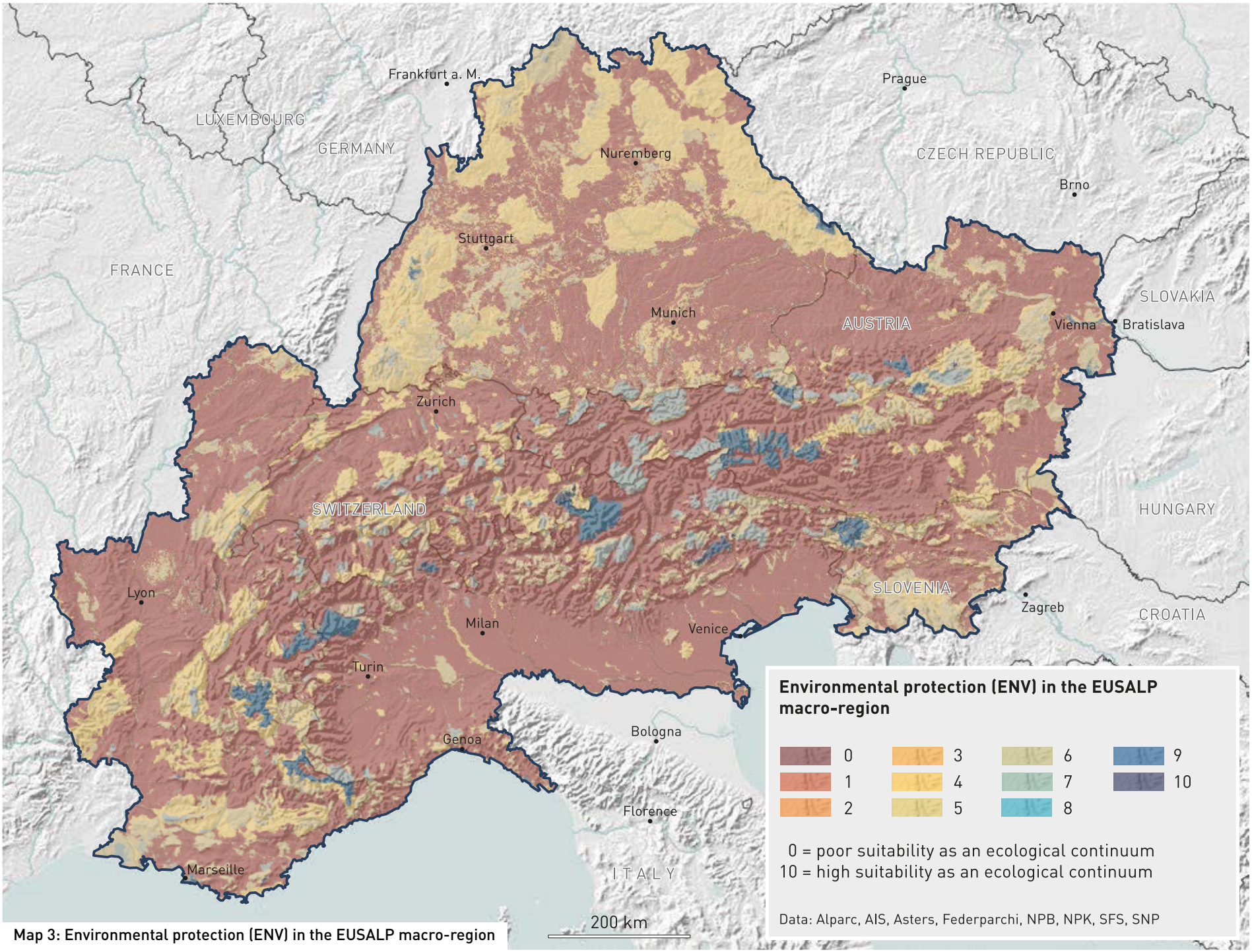
Here environmental protection is considered as the positive attitude towards nature protection expressed as the legal protection status of the different PAs. The assumption is made that the stricter the regulations the more effective the management. The management is used as a proxy for the effectiveness of the administration. National and regional PAs were composed and classified according to their legal protection status from PAs with a strict conservation status without economic use (value 10) to PAs without legal restraints where the management serves the sustainable development of natural ecosystems (value 5). All other areas which are not covered by any PA were classified 0.

Protected areas in the EUSALP region

The analysis (see Map 2) reveals that most large PAs with a high legal protection status are located within the Alps, while outside the Alps smaller scale PAs and PAs with a less strict conservation status predominate. The perimeter of the Alpine Convention encompasses some 4% of PAs that are valued 9 and higher, while in the complete EUSALP region just under 2% is covered by PAs with a strict conservation status. With the PA types taken into account, 37% of the Alpine Convention perimeter and 35% of the EUSALP perimeter are covered by PAs respectively of which roughly half exhibit a low legal protection status (Alpine Convention 37% and EUSALP 48% of PAs).

Conclusions and recommendations

Although the proportion of the PA area relative to the total area seems to be comparatively high, it is still not sufficient to sustain functioning ecosystems. For instance, the distribution of PAs at the Swiss-Austrian border is considered inadequate to support genetic connectivity for vascular plants (Schoville et al. 2018). In a more general view, the suggestion that half of the Earth needs to be protected in order to sustain human livelihood (Dinerstein et al. 2017, Noss et al. 2012, Wilson 2016) is far beyond our current reach. Even the more moderate Aichi Target n°11 to conserve at least 17 percent of the earth's terrestrial area is not fulfilled in all regions because additional PA types (which don't count as conserved area for Aichi Target n°11) were included in our analysis. Based on the analysis results, the following recommendations can be drawn for the improvement of the ecological situation: (1) close gaps in the PA network, mainly in areas at lower elevations and (2) increase proportion of PAs with strict legal protection status.



Map 3: Environmental protection (ENV) in the EUSALP macro-region

2.2 Fragmentation by transportation infrastructure

Landscape is increasingly fragmented by a variety of anthropogenic structures, such as industrial areas, settlements and transportation infrastructure. These constructions result in habitat loss in terms of space (each fragmenting feature uses space) and the breaking-apart and isolation of areas by linear structures, such as roads or railways. Based on island biogeography (Simberloff and Abele 1976), areas rich in biodiversity need to be of a minimum size in order to maintain their species richness. Small disconnected areas that do not allow for movement lose their biodiversity within a short time. The degree of degradation depends on the isolation of the individual areas and their size (Saunders et al. 1991). Small areas are particularly affected over time by decreasing key ecosystem functions (Haddad et al. 2015).

"Areas rich in biodiversity need to be of a minimum size in order to maintain their species richness"

Fragmentation indicator

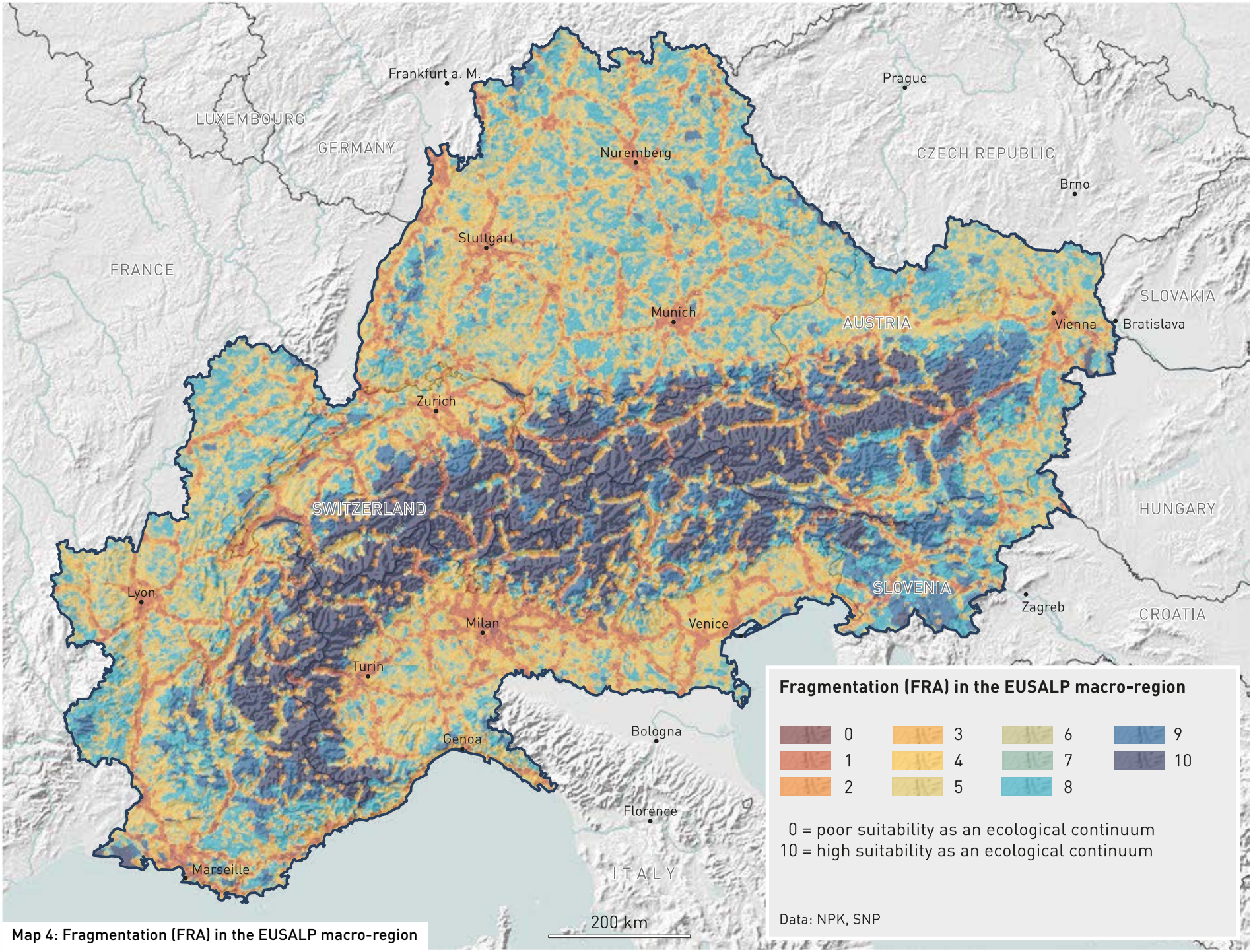
While the loss of space is implicitly included in the land use indicator, the fragmentation indicator accounts for the isolation and breaking-apart of areas by transportation infrastructure. For this purpose, the effective mesh density (Jaeger 2000) - a widely used measure for fragmentation - was applied using the cross-boundary concept proposed by Moser et al. (2007) and assigning a higher importance to motor- and highways. The effective mesh densities were then valued from 0, which means highly fragmented, to 10, which means very low fragmentation and therefore good conditions for an ecological continuum.

Fragmentation in the EUSALP region

The analysis (see Map 4) reveals that the remaining comparatively unfragmented areas are located in the Alps, while there are some less fragmented areas in the Black forest and Jura regions. The lowlands of Switzerland as well as the Po plane in Northern Italy are highly fragmented, while within the Alps the largest valleys are considerably fragmented. Taking into account that high-altitude areas may themselves represent a natural barrier for many species, the situation is overvalued by the fragmentation indicator.

Recommendations

Based on the analysis results the following recommendations for the improvement of the ecological situation may be drawn: reduction of fragmentation at lower elevated areas and in the large Alpine valleys.



Map 4: Fragmentation (FRA) in the EUSALP macro-region

2.3 Land use

Land use in the Alps

Altering natural landscapes for human needs or transforming the use of landscapes directly influences biodiversity and consequentially the functioning of ecosystems (de Baan et al. 2013, Foley et al. 2005, Metzger et al. 2006, Teixeira et al. 2016). In contrast to other ecoregions in the world, the EUSALP macro-region contains almost no area which has not either been used or transformed in the Anthropocene. However, the degree of transformation and the naturalness of the specific landscapes varies considerably. Globally, urbanization is one of the major threats to native species, reducing biodiversity and altering ecosystems (McKinney 2002). In the EUSALP region, land is still being transformed into settlements or sealed for other purposes. In Switzerland, for example, approximately 0.75 square meters are sealed per second (based on the evaluation of the spatial statistics).

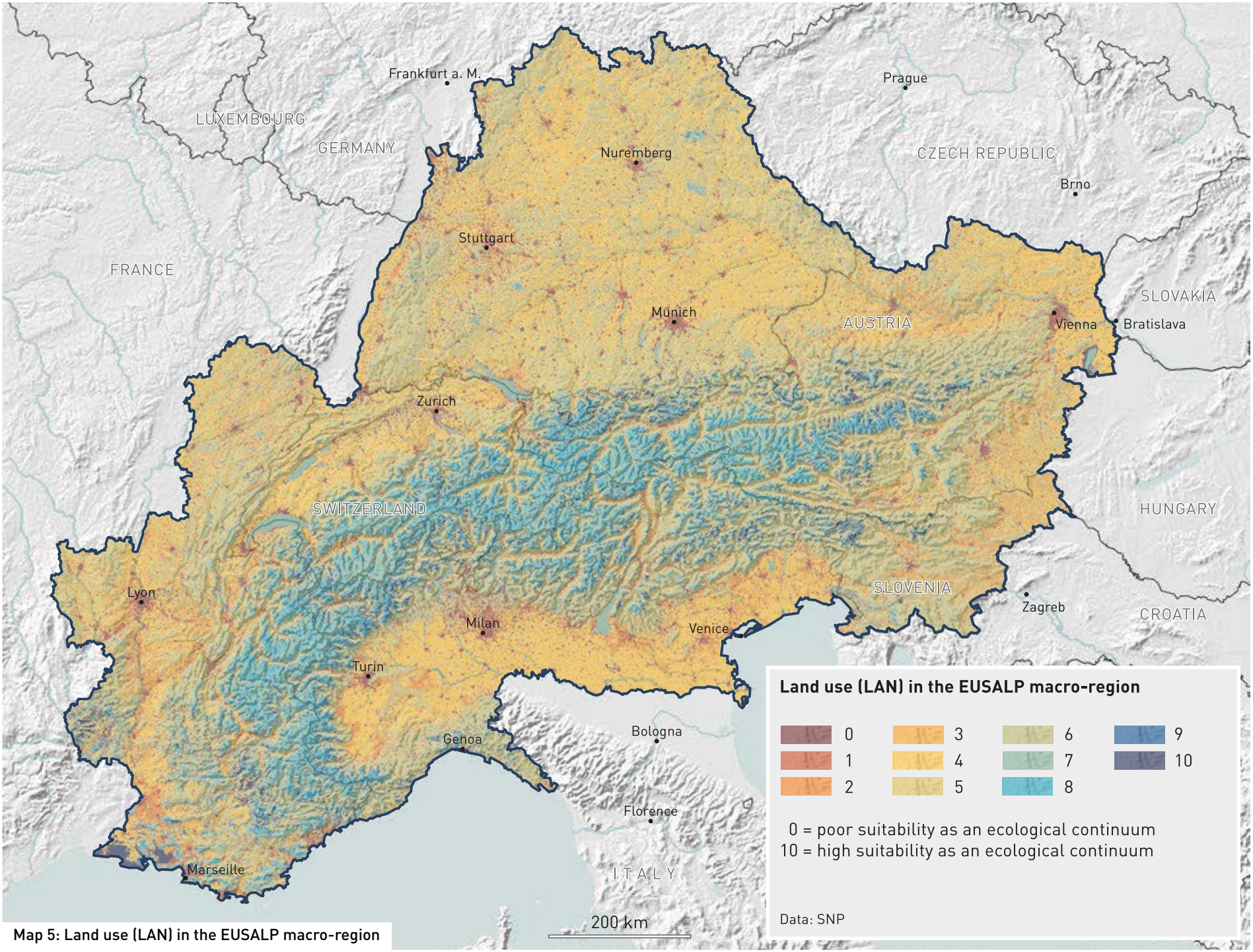
Ecological connectivity and biodiversity in agricultural and forested landscapes depend on land use intensity and on the type of management practices (Yung et al. 2005). Intensive agriculture reduces biodiversity (Tsiafouli et al. 2015, Tuck et al. 2014), while unproductive or extensive agriculture may have the opposite effect. In forested areas, plantations of monocultures reduce the abundance of native species (e.g. Hartley 2002), and the type of forest management methods affects biodiversity (e.g. Bernes et al. 2015). Especially the abandonment of intervention or the near to nature management of forests could have positive effects (Mölder et al. 2019, Paillet et al. 2010), while clear-cut leads to mainly negative effects.

Land use indicator

The aim of the land use indicator is to represent the sum-effect of these interactions on the ecosystem. Based on collation of the results of a literature review combined with the results of expert workshops, a classification scheme for land use and land cover data was elaborated and applied.

Land use in the EUSALP region

The analysis results (see Map 5) reveal that land use is most suitable at mid-elevated areas in the Alps and in the Jura and Black forest regions. The lowest values are found in settled areas at lower elevation within and outside the Alps. This supports the conclusion that ecologically suitable land use types are mainly located where there are few conflicts of use.



Map 5: Land use (LAN) in the EUSALP macro-region

2.4 Land use in the Rhaetian Triangle

The Rhaetian triangle is a pilot region of the Alpine Convention where, in 2007, the Interreg council Terra Raetica was established in order to strengthen collaboration across the national borders. The trinational area consists of predominantly high elevation areas at the bordering region of Switzerland, Austria and Italy.

Tourism

The region is comparatively sparsely populated but with large seasonal variation due to tourism. The region encompasses winter tourism destinations of different importance and with different intensities of use. It includes destinations with little infrastructure (e.g. Val Müstair), destinations such as Scuol (see picture 1, Map 6), and destinations with a vast amount of infrastructure in concert with large modifications of the natural environment and e.g. intense production of technical snow (e.g. Samnaun, Fiss-Ladis). In summer, it varies from installations that resemble fun parks to more sustainable forms of tourism in the national and natural parks of the area.

Agriculture

Agricultural land is present at the valley floor as well as on the Alpine meadows. It includes organic farming with extensively used meadows but also intense monocultural fruit orchards where herbicides, fungicides and insecticides are widely used (see picture 2, Map 6). The agricultural land use types vary as much their ecological impact does (see section Land use in the Alps). While some extensively used or unproductive areas can be ecologically valuable areas, intensively used orchards may represent insurmountable barriers.

Forestry

The Rhaetian Triangle encompasses a relevant proportion of protective forest, which is defined as forest that serves as protection against natural hazards such as avalanches or rock fall, (Lower Engadine and Val Müstair: 59% according to AWN (2018) and 64% of the forest area in Tirol according to Land Tirol (2000)). Protective forests are prioritized and are not combinable with natural forest reserves but only with other forms of nature protection –offering potential for biodiversity in forests. In the Tirolian part of the Rhaetian Triangle, clear-cutting of forests is permitted, which leads to mainly negative ecological effects, in particular those caused by the harvesting methods.

Settlements

Alongside tourism, hotels and secondary homes were built in the region (54% secondary homes in the Swiss part according to ARE (2018)). Secondary homes require the same infrastructure (water, electricity, access road etc.) as permanently inhabited apartments or houses but are typically only used a few weeks or months per year. In addition to the settled area, the road network was upgraded extensively to accommodate an increase in road-traffic (an increase of approximately 30% in road traffic at Ofenpass during the last 20 years according to TBA (2019)). Similar to urbanization processes, negative effects at the ecosystem level can be expected (for further consideration see section Intro and Land use in the Alps).

Nature conservation

The area encompasses 12 large-scale protected areas (PA) (see Map 2). The UNESCO Biosphere reserves, national and nature parks (e.g. National Park Stelvio, Swiss National Park, Nature Park Adamello Brenta) differ in their objectives and their management, but they all endorse functioning ecosystems. On a smaller scale, contractual nature conservation in agricultural and forested landscapes is promoted by local and national stakeholders leading to spatially restricted improvements that may serve to close or decrease gaps in the PA network (see section ENV). Good examples are e.g. the municipality of Mals deciding not to use synthetic fungicides, herbicides and insecticides in their fruit orchards anymore.

Conclusions and recommendations

The sum-effects of the outlined influencing factors lead to the conclusion that, although the region is in comparatively good condition from an ecosystems point of view, 1) there are many interests of use competing, and consequently pressure on natural areas exists, and 2) the current situation would benefit from improvements – especially in the valley floors but also in areas at higher elevation with more or less intense touristic use.

Seefeld in Tirol
Innsbruck
Imst
Oetz
Landeck
Neustift im Stubaital
Prutz
Ischgl
Sölden
Nauders
Klosters-Serneus
Davos
Scuol
AUSTRIA
SWITZERLAND
Zernez
Mals
Meran
Laas
Brunico
Bressanone
Ortisei
Samedan
Livigno
Bolzano
Bormio
ITALY
St. Moritz
Pieve di Cadore
Cles
Ora
Poschiavo
Grosio
Fraviano
Predazzo
Chiesa in Valmalenco
Tirano
Mezzolombardo
Sondrio
Edolo
Pinzolo
Lavis
Trento
Borgo
Tione di Trento
Breno
Arco
Clusone
Darfo Boario Terme
Riva del Garda
Rovereto
40 km

Land use (LAN) in the Rhaetian Triangle

0	3	6	9
1	4	7	10
2	5	8	

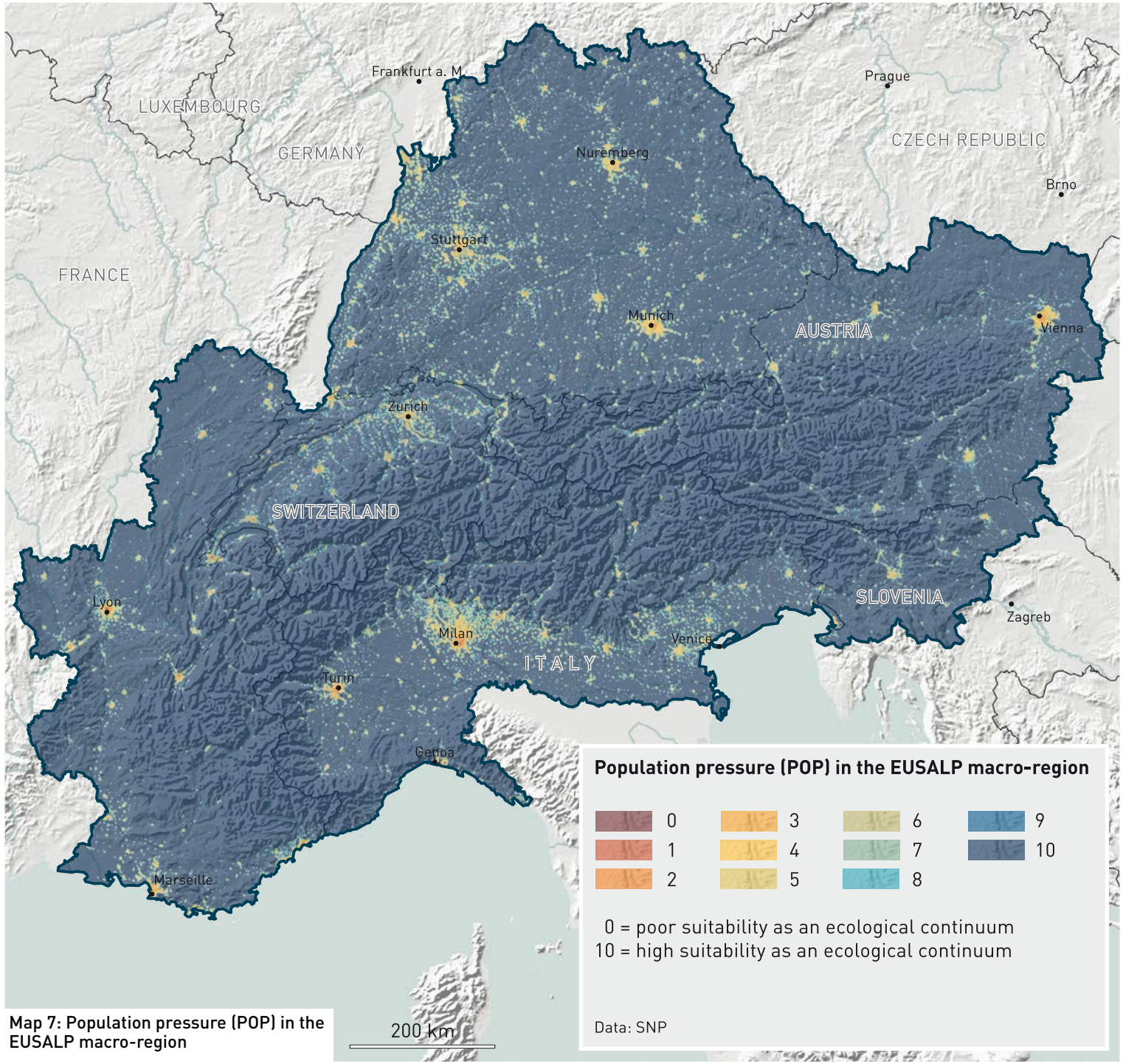
0 = poor suitability as an ecological continuum
10 = high suitability as an ecological continuum

Data: SNP

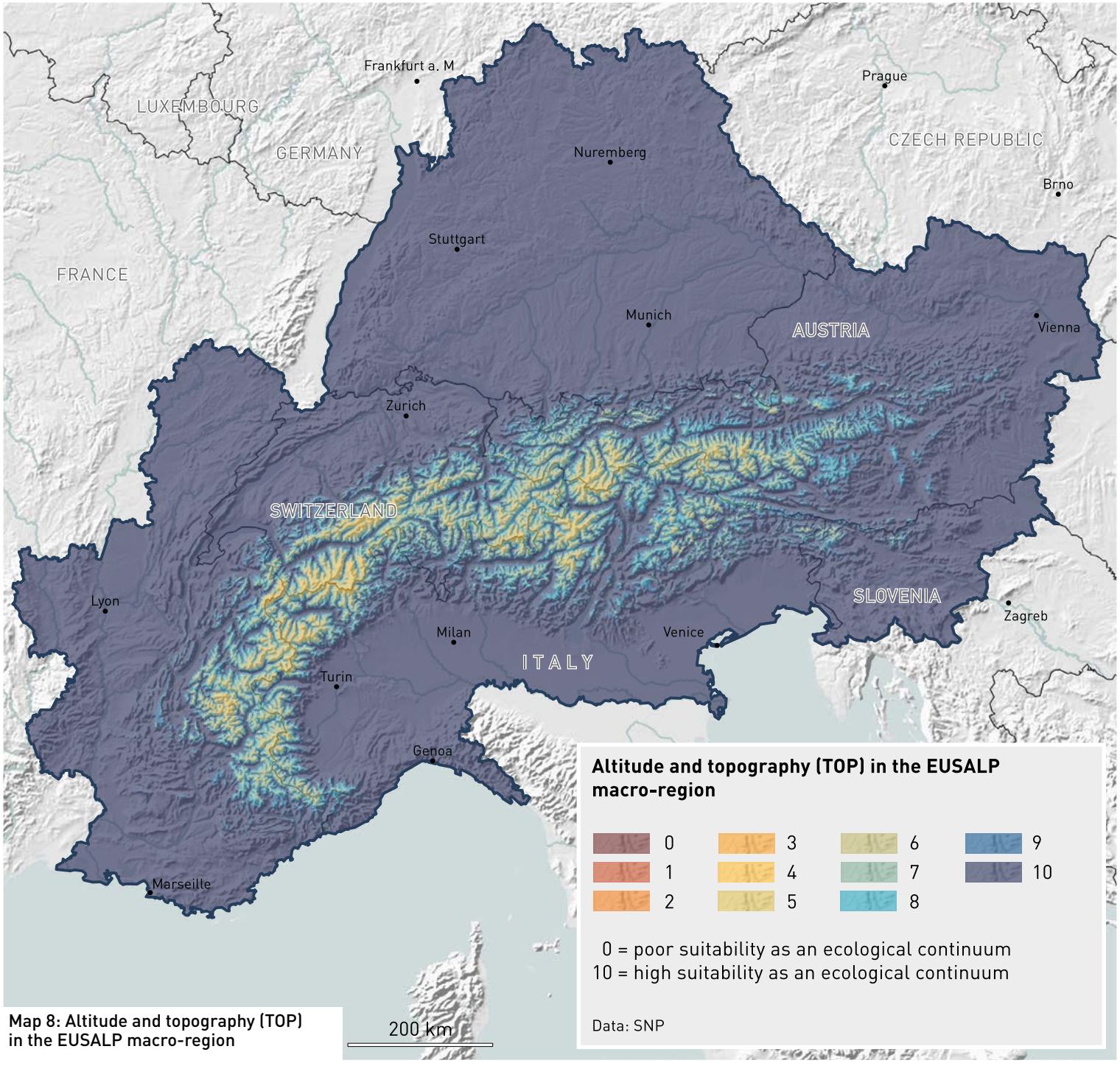
Map 6: Land use (LAN) in the Rhaetian Triangle

2.5 Population pressure in the Alps

Humans are seen as the main drivers of change in the state of ecological systems by the Millennium Ecosystem Assessment (2005), and the threat to biodiversity increases as human population density increases (Luck 2007). In addition to permanent inhabitants, tourism demand plays an important role in human pressure on ecosystems – especially in the Alps, where approximately 1200 million overnights stays are registered annually (based on the evaluation of the Eurostat data [Eurostat 2019] of 2016 for the EUSALP perimeter). With the population indicator, human pressure on ecological connectivity is represented. It is expressed as a classification of population density.



Map 7: Population pressure (POP) in the EUSALP macro-region



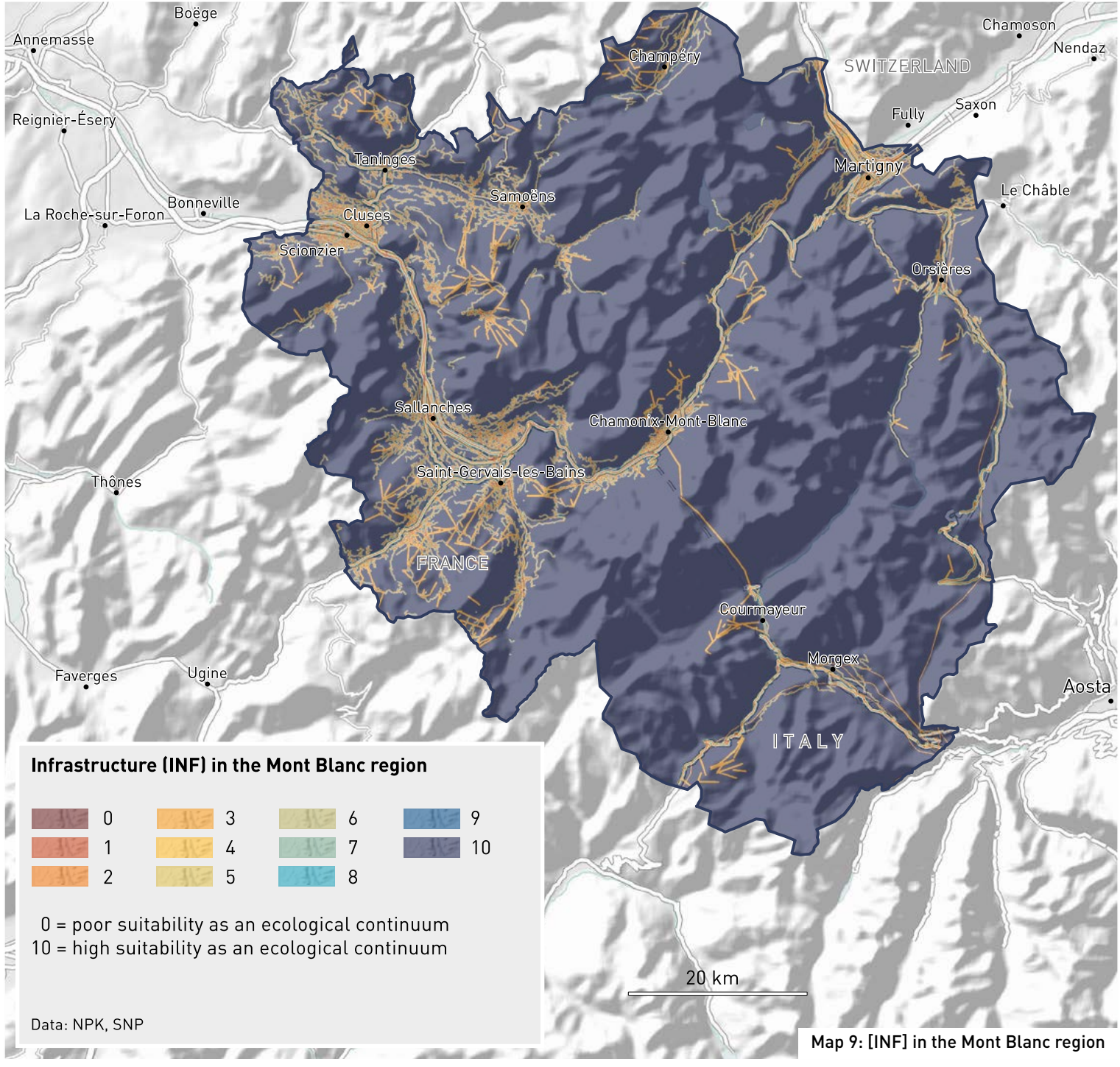
Map 8: Altitude and topography (TOP) in the EUSALP macro-region

2.6 Effects of altitude and topography

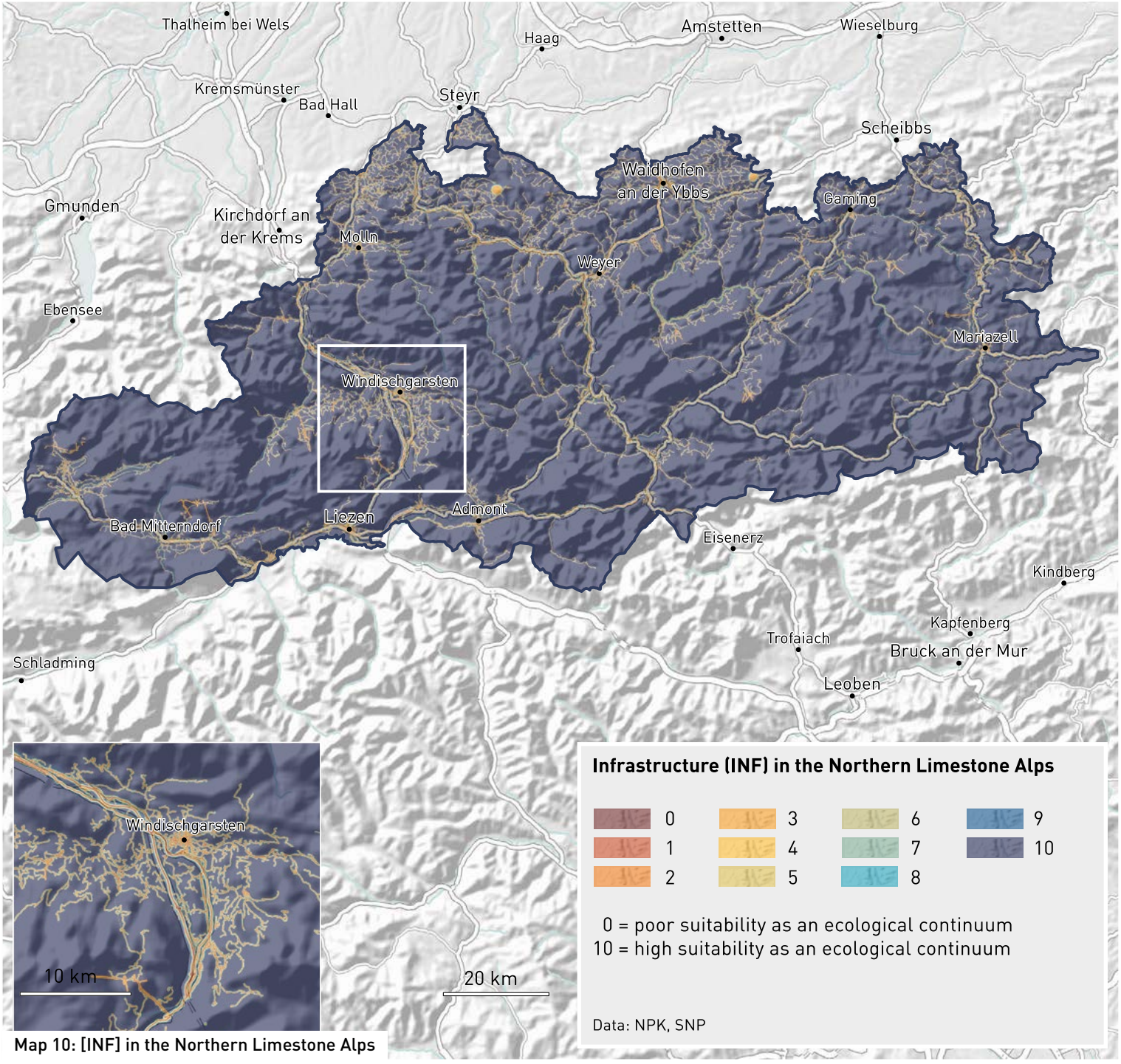
High Alpine areas act as a barrier for many species occurring at lower elevations and steep rock walls may be insurmountable obstacles. In addition, biomass decreases with altitude in the European Alps. Similarly, species richness decreases with altitude (e.g. Meyer and Thaler 1995). The topography indicator accounts for these sum-effects by the combined evaluation of altitude and slope.

2.7 Infrastructure in the Mont Blanc region

Man-made infrastructure elements have major disturbance effects on wildlife populations. These include e.g. road-kill or electrocution by power lines. The aim of the infrastructure indicator is to consider a wide variety of infrastructure elements that have a potential impact on wildlife. Depending on the infrastructure element, different distance classes were determined and weighted. In the Mont Blanc region, a significant amount of touristic infrastructure along with transportation infrastructure is present.



Map 9: [INF] in the Mont Blanc region



Map 10: [INF] in the Northern Limestone Alps

2.8 Infrastructure in the Northern Limestone Alps

Man-made infrastructure elements have major disturbance effects on wildlife populations. These effects include e.g. road-kill or electrocution by power lines. The aim of the infrastructure indicator is to consider a wide variety of infrastructure elements that have a potential impact on wildlife. Depending on the infrastructure element, different distance classes were determined and weighted. In the Northern Limestone Alps, infrastructure (considered in the indicator) consists of transportation infrastructure, touristic infrastructure and power lines.

3. Strategic Alpine Connectivity Areas (SACA) – a EUSALP wide concept for [ecological] connectivity

The fact that ecological connectivity is crucial in order to successfully preserve biodiversity in the long term is well accepted among conservationists. In the Alpine area, initiatives to implement ecological connectivity, as foreseen by the nature protection protocol of the Alpine convention, have a longstanding history (Plassmann et al. 2016). Nevertheless, until now, evidence pinpointing appropriate target sites and measures was lacking.

The Strategic Alpine Connectivity Areas (SACA), approach offers a useful lens through which to view these questions. All Alpine and EUSALP areas have been analyzed with regard to their potential for ecological connectivity (see also chapter 1 CSI) and assigned to one of three categories according to the status of their ecological connectivity and to the type of action required. For the EUSALP area it can now be illustrated, at a pan-Alpine level, where to prioritize conservation action, restoration activities or planning for more important ad-hoc measures.

Based on expert knowledge, the main barriers to ecological connectivity in and around the Alps have been defined based on the Strategic Alpine Connectivity Areas (SACA) analysis. These barriers represent significant obstacles to the movement of flora and fauna. One key finding is the concentration of barriers in the border zone between the Alpine Convention area and the EUSALP area. The isolation of the mountainous region of the Alps from the surroundings is therefore a fact that needs to be considered when discussing ecological connectivity in the European Alpine context.

In addition, main connectivity areas have been identified by the experts. These areas are of particular importance for ecological connectivity at an international level and, when managed appropriately, allow bridging of the interruptions caused by the barriers. They often also represent linkages to neighboring mountain ranges such as the Apennines or the Jura. The connectivity areas will certainly play a central role in the context of climate change induced migrations in the area.

Limitations of the SACA model

The Strategic Alpine Connectivity Areas (SACA) approach offers a model within which to classify areas in the Alps and in the EUSALP territory into three different categories. The model is based on a series of indicators that have been defined by experts and adapted to the geographic area concerned. The indicators used in the model emerged from a former version of the Continuum Suitability Index (CSI) and were discussed and adapted by a large panel of experts during the project lifetime.

The model and the SACA categories were developed to illustrate and clarify the situation of Alpine regions with regard to landscape permeability and the potential for species migration opportunities.

The model assumes, that, in order to efficiently support ecological processes, SACA 1 areas (based on still intact and well-functioning natural areas) need to be larger than 100 ha. Smaller surface areas are presumed to be less efficient as stepping-stones for ecological connectivity within a system of permeable landscapes adapted for species migration.

This definition also indicates one of the limits of the SACA model, which always exists for modelling and categorization. Smaller biotopes exist, but they are not considered in this model. This limits the representation of the reality on the ground. On the other hand, it stresses where efforts are needed to improve the connectivity situation, which is the main goal of this approach.

The SACA model does not replace verification in situ, but it allows identification and localization of different connectivity situations at an Alps-wide scale, as well as the determination of action priorities especially within the so called super SACA's (connectivity areas and corridors).

3.1 Ecological Conservation Areas (ECAs)

Ecological Conservation Areas (ECAs) are the first of the three categories of the Strategic Alpine Connectivity Areas (SACAs). **They are areas that still have considerable space for connectivity with non-fragmented surfaces and where connectivity should be conserved.**

Due to their characteristics, they can be considered as connectivity nodes or central elements in an Alpine ecological network system. They ensure larger continuous natural areas and therefore represent nature hotspots in the Alps. Compared to other regions, the Alps are still rich in fairly intact landscapes. 8% of the surface included in the EUSALP perimeter is considered as Ecological Conservation Areas.

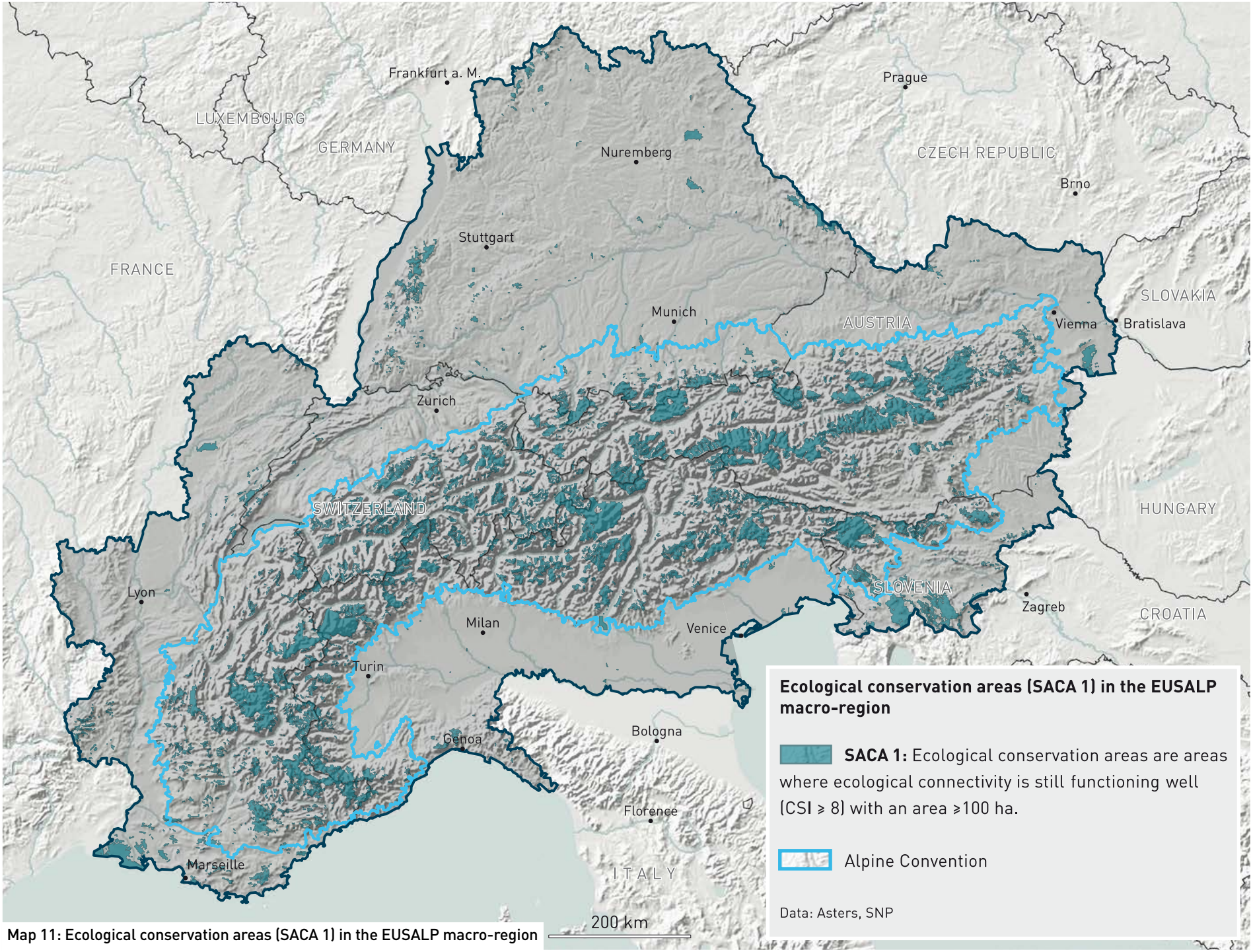
The main objective from an ecological connectivity point of view for the Alps is to **conserve these areas as they are now by preventing degradation that would have a negative impact on the ecological functioning of the area,** such as fragmentation, intensification of land use or further anthropogenic pressure. This means that these areas need a well targeted large-scale conservation policy to prevent such degradation (passive approach) combined with a spatial planning policy recognizing their role as a biodiversity heart for ecological connectivity.

Currently, 61% of the Ecological Conservation Areas are located in existing protected areas (within the perimeter of the Alpine Convention, which means in mountainous regions). 48% of the existing protected areas are totally or partly located in an Ecological Conservation Area. This highlights the importance of protected areas as non-fragmented areas in the Alps and as important areas for nature conservation especially regarding ecological connectivity aspects. But it also shows that **efforts must be undertaken to raise the profile of Ecological Conservation Areas that are not located in protected areas.**

Within the EUSALP perimeter (without the Alpine Convention part), the portion of Ecological Conservation Areas located in protected areas is much lower (27%). Also the number of protected areas addressing ECA is lower (10%).

Directly comparing the proportion of ECAs within the perimeter of the Alpine Convention (15%) to that within the EUSALP perimeter (2%), it clearly appears that the situation in the Alps is much better. As the human pressure on land and the effects of human land use are much higher in the lowlands than in the mountainous areas, this is not very surprising. But it shows the need to consider these aspects in the lowlands surrounding the Alps and the importance of a close analysis of the situation in particular in the frontier area between the Alps and the EUSALP area (see also Map 37).

Building on the project's findings, Ecological Conservation Areas should be safeguarded by intelligent nature conservation and spatial planning polices, and where possible their area should be increased. Connections between Ecological Conservation Areas should be reinforced by adequately addressing the zones located between them.



Map 11: Ecological conservation areas (SACA 1) in the EUSALP macro-region

3.2 Ecological Intervention Areas (EIAs)

Ecological Intervention Areas (EIAs) are the second of the three categories of the Strategic Alpine Connectivity Areas (SACAs). They are areas with a high potential for connectivity in which larger, more or less natural non-fragmented zones could be created, especially by connecting protected areas, Natura 2000 sites or other precious biotopes. Ecological connectivity is currently working to some extent in these areas but would benefit from enhancements.

The Ecological Intervention Areas have been designed as important links between the Ecological Conservation Areas (see Map 12). They have been defined based on the assumption of the electric circuit theory (McRae et al., 2008), stating that landscape composition and pattern can be linked to functional connectivity by translating landscapes and an animals' potential to move within them into current, voltage, and resistance values. The circuit theory approach therefore simulates dispersal and gene flow in wildlife populations at landscape spatial scales by analyzing how current disperses in a given landscape in which resistance values have been attributed to different landscape patterns. ECAs are defined as power sources from which electric power is released into the landscape. A resistance matrix based on the Continuum Suitability Index CSI (see maps chapter 2) defines the resistance of a single landscape to the power flow. Only areas connecting two or more ECAs and located below 2500m were selected as EIA.

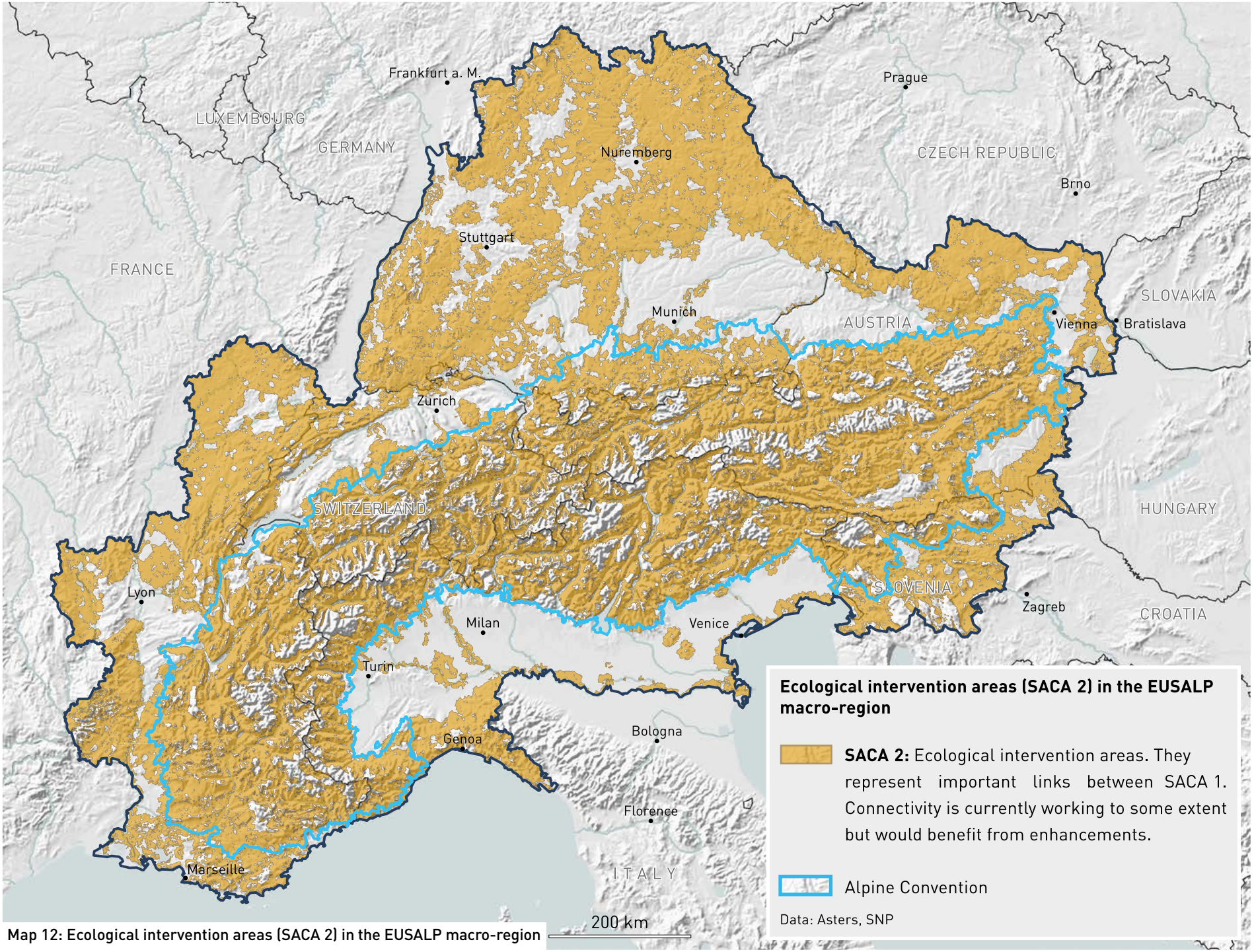
The map shows that 59% of the total EUSALP territory and 65% of the Alpine Convention territory are covered by EIAs. As the number of Ecological Conservation Areas is higher in the Alpine Convention Perimeter, the percentage of EIA is also higher here.

Ecological Intervention Areas connect Ecological Conservation Areas with one another and represent the dynamic areas of an ecological network facilitating connections between larger core areas. For these areas a careful institution of measures improving ecological connectivity should be planned. The situation of ecological connectivity can be slightly improved by adapted measures, which means that action in these areas is still feasible with a relatively low investment.

Comparing the altitudinal situation of the EIAs with the altitudinal situation of the ECAs (see table), it is obvious and unsurprising that EIAs are located at lower altitudes, altitudes where human pressure on land is higher.

The EIAs represent the largest share of the three categories of the Strategic Alpine Connectivity Areas (77%).

	ECA	**EIA**
Altitude (m asl)	%	%
0-500	7	38
500 - 1000	13	35
1000 - 1500	20	15
1500 - 2000	25	8
2000 - 2500	23	5
2500 - 3000	10	0
3000 - 3500	2	0
3500 - 5000	0	0



Map 12: Ecological intervention areas (SACA 2) in the EUSALP macro-region

3.3 Connectivity Restoration Areas (CRAs)

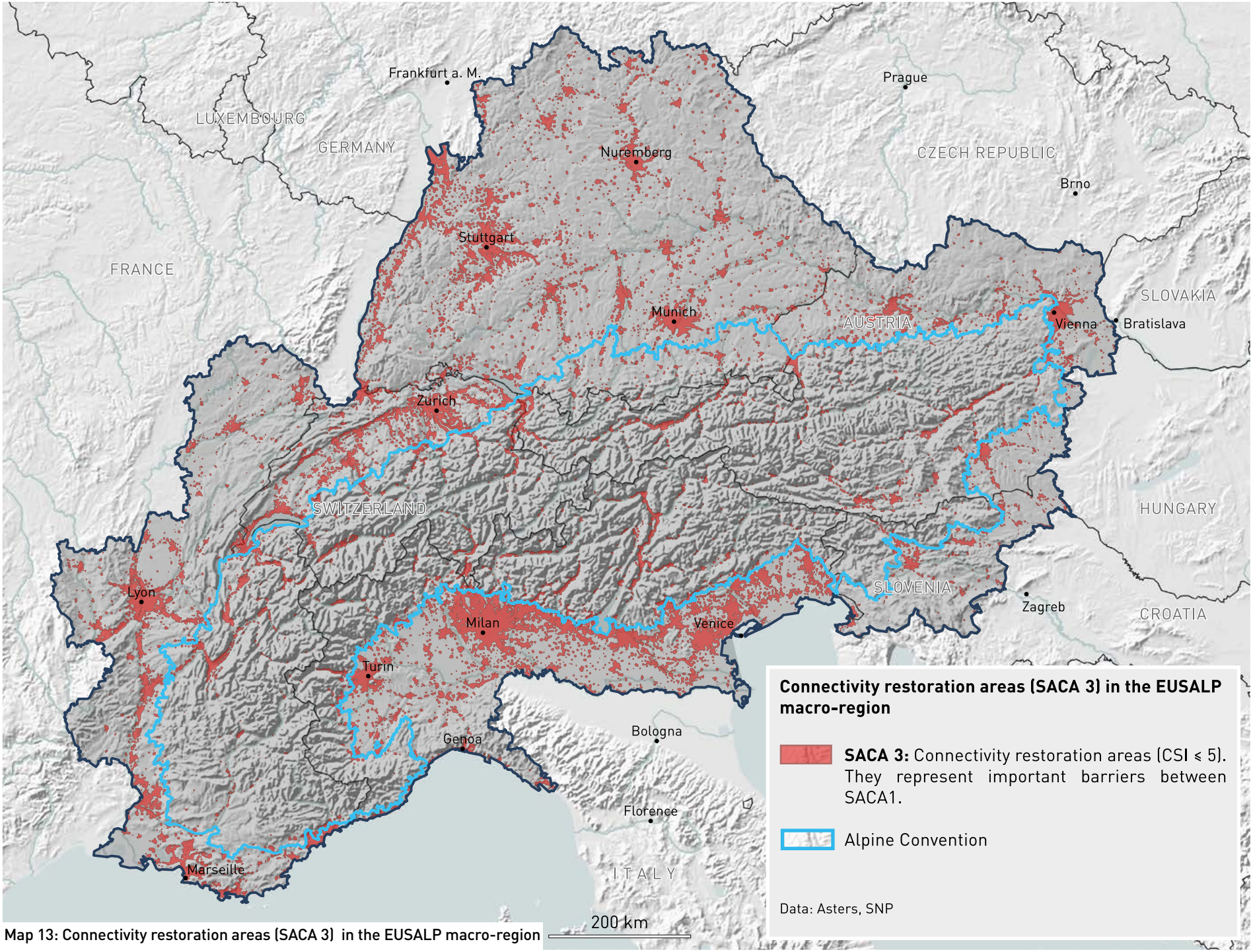
Connectivity Restoration Areas (CRAs) are the third of the three categories of the Strategic Alpine Connectivity Areas (SACAs). They are **areas where fragmentation has already progressed so far that interlinked habitats and a transparent landscape matrix are no longer a realistic option using reasonable, viable interventions**, and solutions would entail extreme financial and political effort. They represent important barriers between Ecological Conservation Areas.

The Connectivity Restoration Areas represent 14% of the EUSALP territory and 4% of the Alpine Convention territory. They are located mainly at lower altitudes (see table) with very high human pressure on the land.

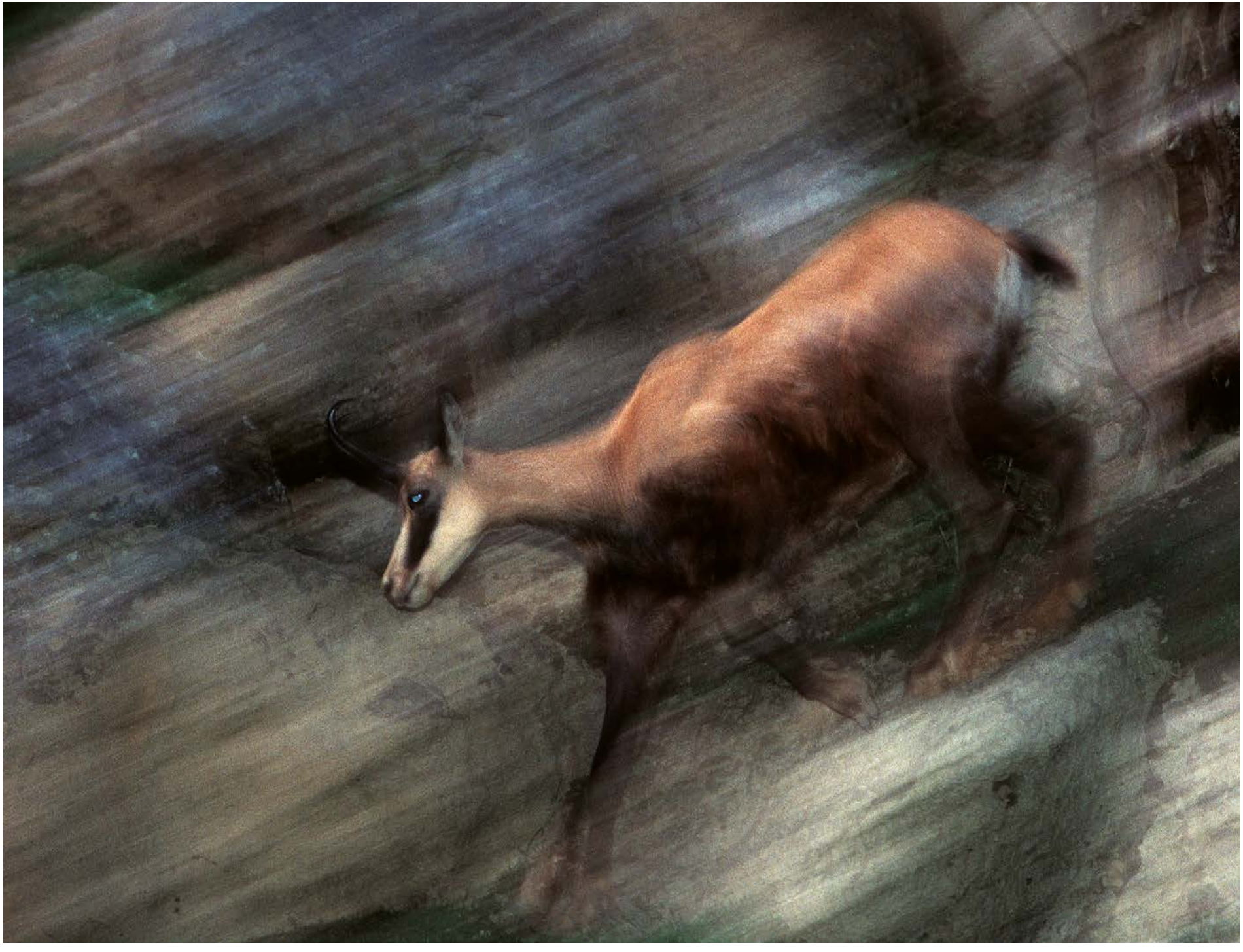
In the Alpine area, they are mainly concentrated in the densely populated and intensively used valley bottom areas. In the territories around the Alps, they are mostly located in the areas of larger agglomerations and cities. Two big belts can be identified in the southern (Po plain) and northern border areas between the Alpine and the EUSALP territory as well as in the lower Rhone valley in the west. They are characterized by landscape fragmentation due to urban sprawl and transport infrastructure as well as river engineering generating important barrier effects and causing loss of natural connectivity between individual populations.

Recommendations for these areas are the implementation of ad hoc measures to improve ecological connectivity (punctuated approach) at very targeted locations in order to mitigate negative barrier impacts.

SACA 3	
Altitude (m asl)	%
0-500	84
500 - 1000	15
1000 - 1500	1
1500 - 2000	0
2000 - 2500	0
2500 - 3000	0
3000 - 3500	0
3500 - 5000	0



Map 13: Connectivity restoration areas (SACA 3) in the EUSALP macro-region



4. Coordinated trans-boundary wildlife management - Hunting in the Alps

More and more stakeholders have joined the 'traditional' land-users (agriculture, forestry and hunting). Agriculture and forestry make growing demands on the cultural landscapes in which they operate. Tourism and recreational activities in nature have also increased immensely over the last decades. Human activities and land usage have a high potential for conflict with the animal residents of these landscapes, whose populations can often stretch across regions and countries and do not adhere to administrative borders.

In every country within the EUSALP perimeter, there is a common understanding that hunting is an important element in managing wildlife in order to lessen or avoid conflicts due to the overabundance of certain wildlife species. Hunting is, therefore, generally seen as a tool in wildlife management, but the hunters themselves have their own definitions and ideas of what hunting is and what (if any) responsibilities they bear.

Hunting is one of the oldest uses of natural resources dating back to the roots of mankind. Animals provided sustenance as well as clothing from hides and pelt, and hunting also played a social role for our ancestors. Many tools, methods and motivations for hunting have changed over the centuries, while some remain the same. There have been many developments since prehistoric hunting, including hunting as a sport of the medieval nobility, progressing to the modern-day hunter using off-road vehicles, high precision rifles and wildlife camera traps. Nevertheless, and perhaps because of the adaptation to modern times, hunting still plays an important role in our cultural landscapes.

The organization of hunting activities is handled differently in each EUSALP country, as it is a product of historical, political and social factors. Some systems overlap more than others. The foundation of all hunting activities is primarily the legislature that defines the framework in which hunters can act. These laws and regulations determine the hunting system, hunting seasons, hunting practices, permissible firearms and ammunitions, etc. The national hunting legislations are, of course, deeply influenced by the various traditions and the history of hunting in the countries. Hunters, like most other interest groups, have an influential lobby. Additionally, European legislations and decrees influence more and more regulations concerning hunting activities and national legislative procedures. These include regulations for the protection of certain species (e.g. Annex II, IV and V species of the Habitat Directive), hygiene regulations for handling and sale of game meat, or the ruling, by the European Court of Human Rights, for landowners in France to prohibit hunting on their property.

Wildlife populations in border areas are sometimes managed by two hunting systems, in terms of monitoring and/or hunting for example, as all countries have their own approach to managing 'their' populations. These management decisions might have impacts on the spatial and temporal behavior of the animals. Differences in hunting season lengths, for example, might push animals into some regions or prevent movement into others. This can lead to difficulties in meeting wildlife management plans / harvest plans and can be detrimental for the hunters in cases where they are liable for wildlife damages.

4.1 Hunting systems

The ways in which wildlife species are managed in the different countries stem from the legal and social developments and how history and traditions have shaped and continue to influence these elements. The feudal systems, land use and land allocation practices sculpted Europe's countries, and the effects are still evident today.

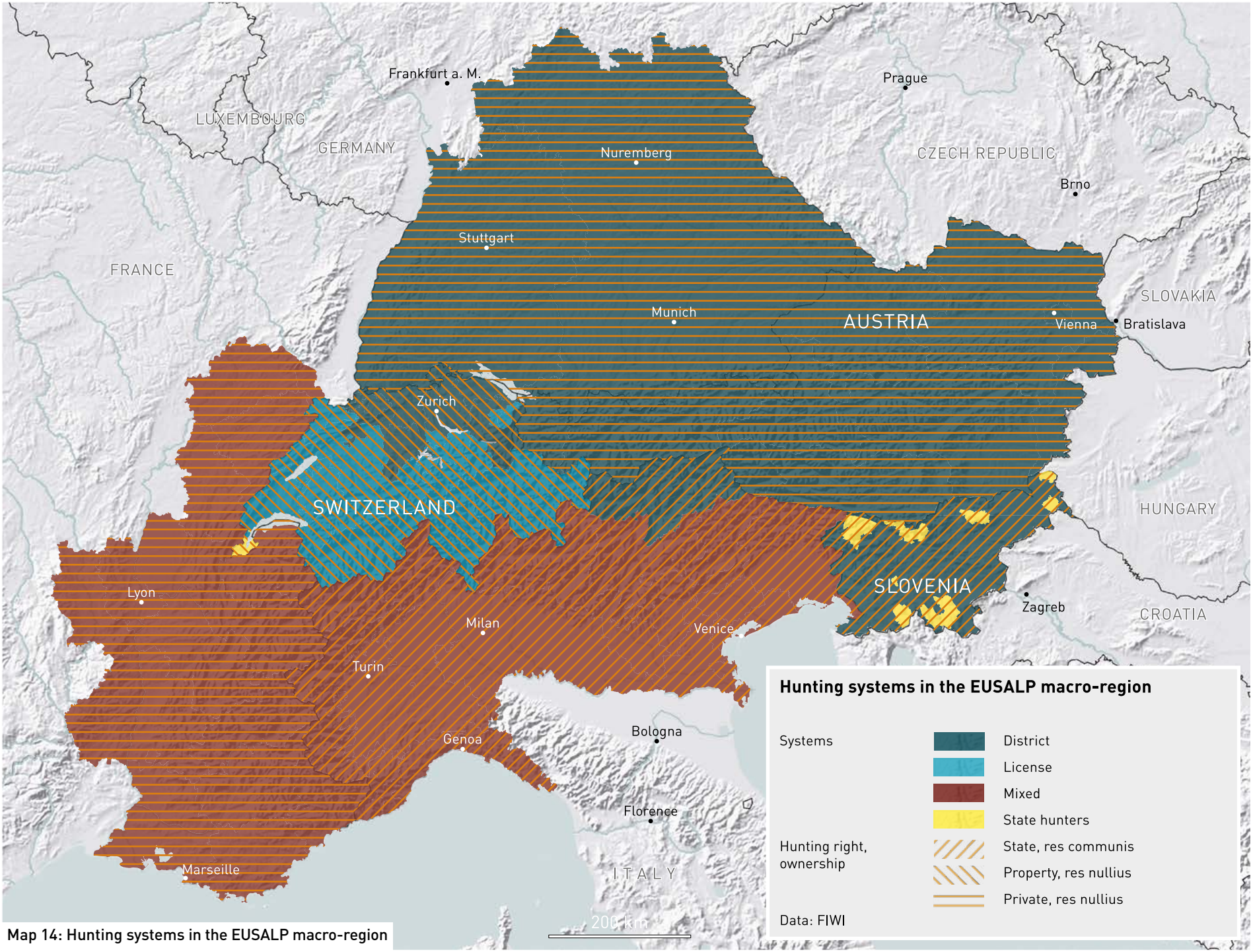
One important aspect to understand and define wildlife management systems within the EUSALP perimeter is the legal status of wildlife, since, in some countries, game animals belong to the people (res communis/communitatis – SI, IT) and in others to 'no one' (res nullius – AT, DE, CH, FR). Another important aspect is the agent to whom the hunting right belongs. This can be the state, which regulates who is permitted to hunt wildlife (CH), or private persons, who, in general, lease a hunting area and are granted the right to hunt wildlife with the property (hunting right is bound to the property – AT, DE) (Putman 2011).

The legal frameworks for the wildlife management systems are set by the respective governments or state authorities and refer to aspects of wildlife management planning, hunting regulations, game meat sale and handling, firearms regulation, etc. Legislation determines and controls hunting seasons, the allocation of shooting quotas, permissible hunting methods, weapons and ammunition use, hunters' training requirements, and, in some countries, it defines the role of the hunter in sustainable land-use management. In many cases, some aspects of wildlife management regulation and control are delegated to state or regional authorities. This is especially the case for hunting seasons, as state or regional characteristics might indicate different requirements adapted to wildlife population levels or wildlife damage situations.

The term 'hunting system' is generally used to differentiate the German coined 'Revier' / district-based hunting system (present in Austria, Germany, Slovenia and nine cantons of Switzerland), from the 'Patent' / licence-based hunting system (present in 16 Swiss cantons). In countries such as Switzerland and Slovenia, regulations and administration are largely managed at a national level (canton level in Switzerland), whereas in countries like Austria, Germany and Italy, wildlife management is also delegated to state and especially to regional authorities (Apollonio et al. 2010; Imesch-Bebie et al. 2010; Reimoser and Reimoser 2010; Wotschikowsky 2010).

Relative to the "district vs. licence-based system"-generalization, the hunting systems for France and Italy have an "in-between" system. In France, for example, even though the hunting right belongs to the property, and thus the owner has the right to allow or forbid hunting, the quota (how many animals are allowed to be hunted) is allocated using animal tags, which are generally used in licence-based hunting systems. In most departments (10 departments), an accredited communal hunting association (Association Communale de Chasse Agréée – ACCA) that manages hunting on a regional level in communes is mandatory. Here every landowner is automatically a member of such an ACCA, and the hunters can use the whole district for hunting (Maillard et al. 2010).

Another wildlife management concept exists, most clearly represented in the Swiss canton of Geneva, where 'hobby' hunting is forbidden, and wildlife management culls are executed by state appointed game wardens. This hunting system is also often present in nature protection areas, for example in many national parks, where hunting is generally forbidden, but for population control purposes hunting (perhaps better termed 'culling') is performed by professional hunters employed by the park administration. Slovenia also has 11 State Wildlife Reserves where such a state managed hunting system is implemented (Adamic and Jerina 2010).



Map 14: Hunting systems in the EUSALP macro-region

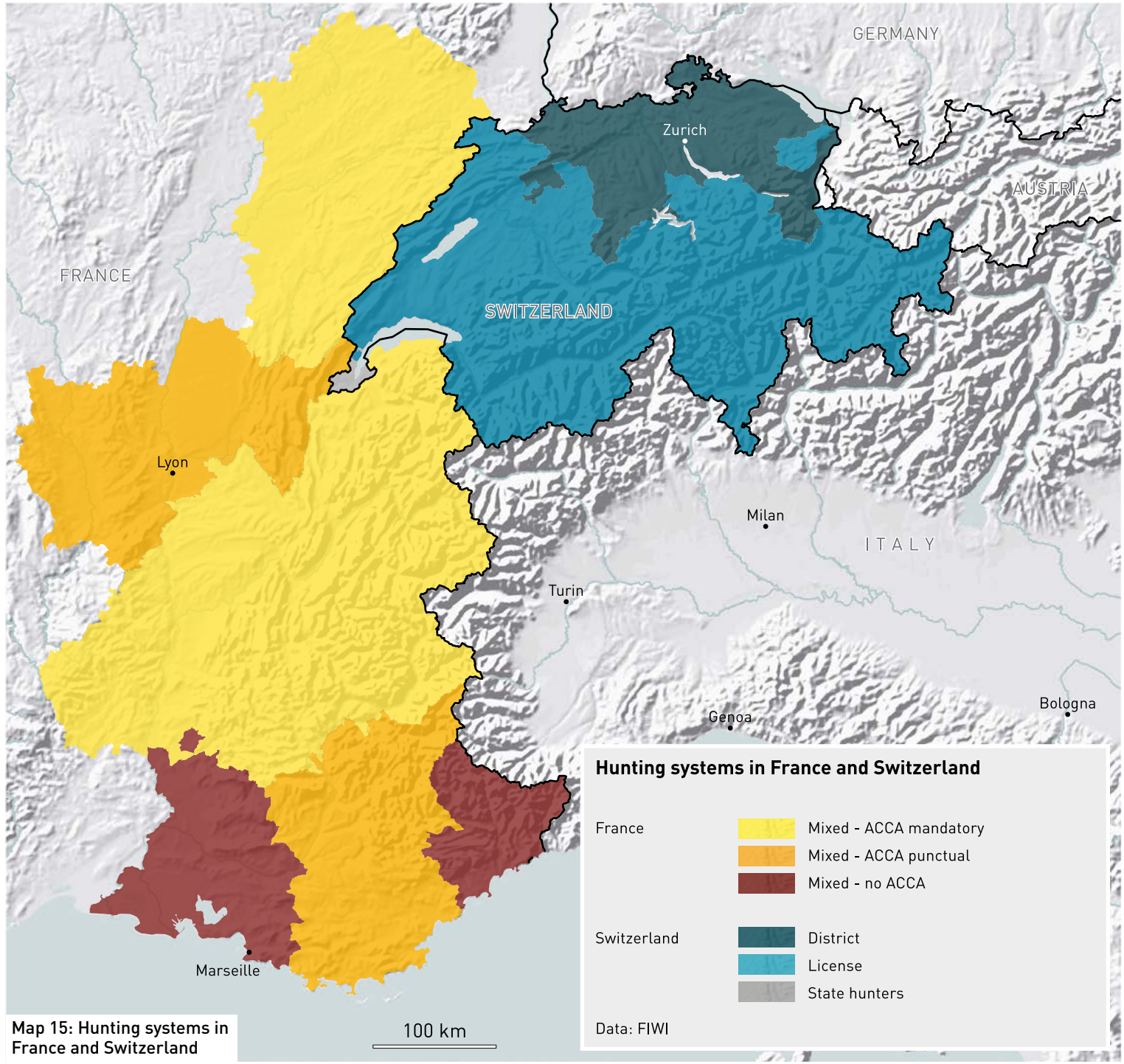
4.2 Hunting systems CH/FR

Switzerland

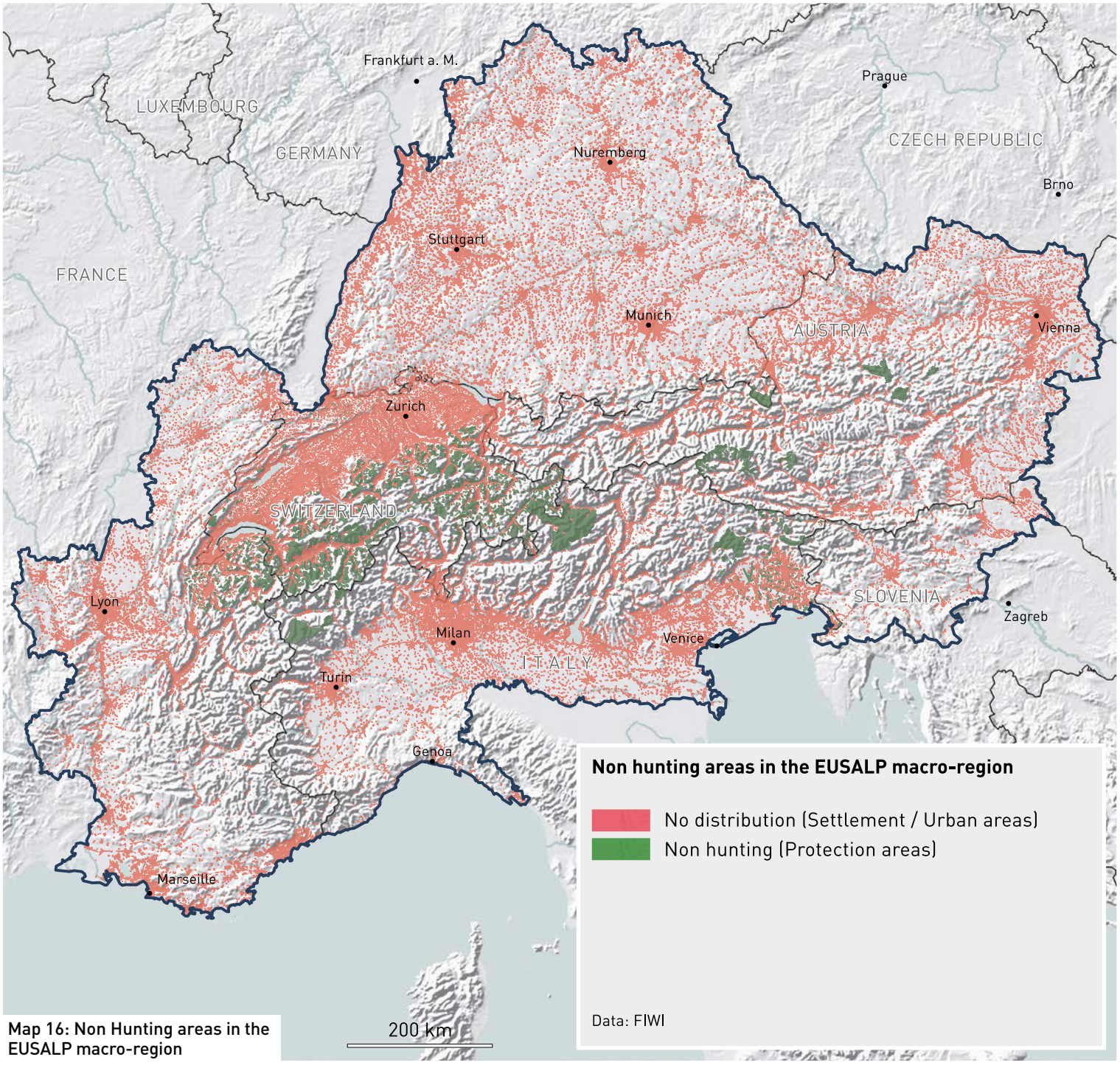
The right to hunt is a sovereign right and controlled by the state or canton. Hunting systems are the traditional "Revier"-/district-based system, the "Patent"-/licence-based system and the state hunting system.

France

The right to hunt is bound to ownership. The hunting system is a mix between a district-based and a licence-based system. In most departments, hunting is organized by hunting associations over large areas, and members can hunt in the whole area. Hunters pay for animal tags or are allocated a specific quota that they are permitted to hunt.



Map 15: Hunting systems in France and Switzerland



Map 16: Non Hunting areas in the EUSALP macro-region

4.3 Non Hunting Areas

In some countries, legislations or regulations designate areas where hunting is prohibited, suspended or restricted. These regulations are either year-round or defined for a limited time period.

Hunting is also generally prohibited within approximately 200 meters of urban areas or settlements (regions differ +/- 50 m).

4.4 Hunting seasons

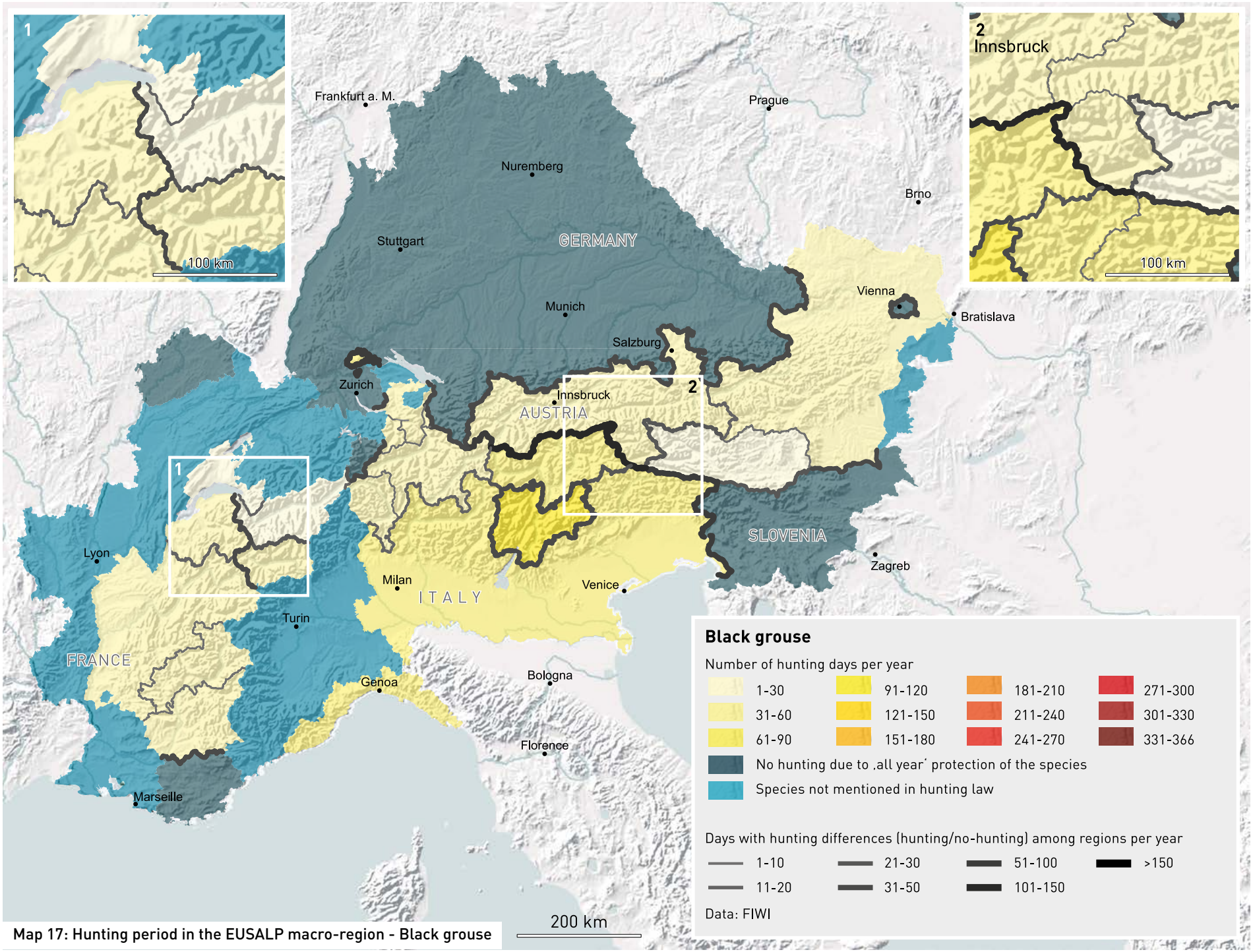
As part of their hunting legislature, each respective responsible administrative level establishes its own hunting seasons for each huntable wildlife species. The seasons often vary greatly between bordering administrative regions, not only in the total sum of hunting days but also in the frequency of how often the hunting seasons differ between these regions (i.e. when hunting is allowed on one side of the border and forbidden on the other side). These differences are some of the most striking discrepancies between hunting systems, as the hunting season lengths in licence-based systems generally last only a few weeks, while they continue for many months in district-based hunting systems.

Ideally, the hunting seasons are defined to avoid important seasonal events in the species' life cycle, such as breeding seasons, birthing seasons and resting periods during winter months, since the presence of hunters in the animals' habitats can certainly have impacts on their spatial and temporal behavior. In reality, hunting seasons often target the aggregation events of most species, as the animals are then the easiest to find. Hunting practices that reinforce the hunted animal's mental connection with the hunter create shy animals, as they adapt to humans as a predator. The surviving individuals then pass their 'experience' to their offspring. As a consequence, the selection pressure on bolder individuals is increased, and the shy individuals are the ones that procreate more successfully. This perpetuates the reproduction of shyer and shyer animals, which makes hunting more and more difficult, resulting in even higher population growth rates (Apollonio et al. 2011).

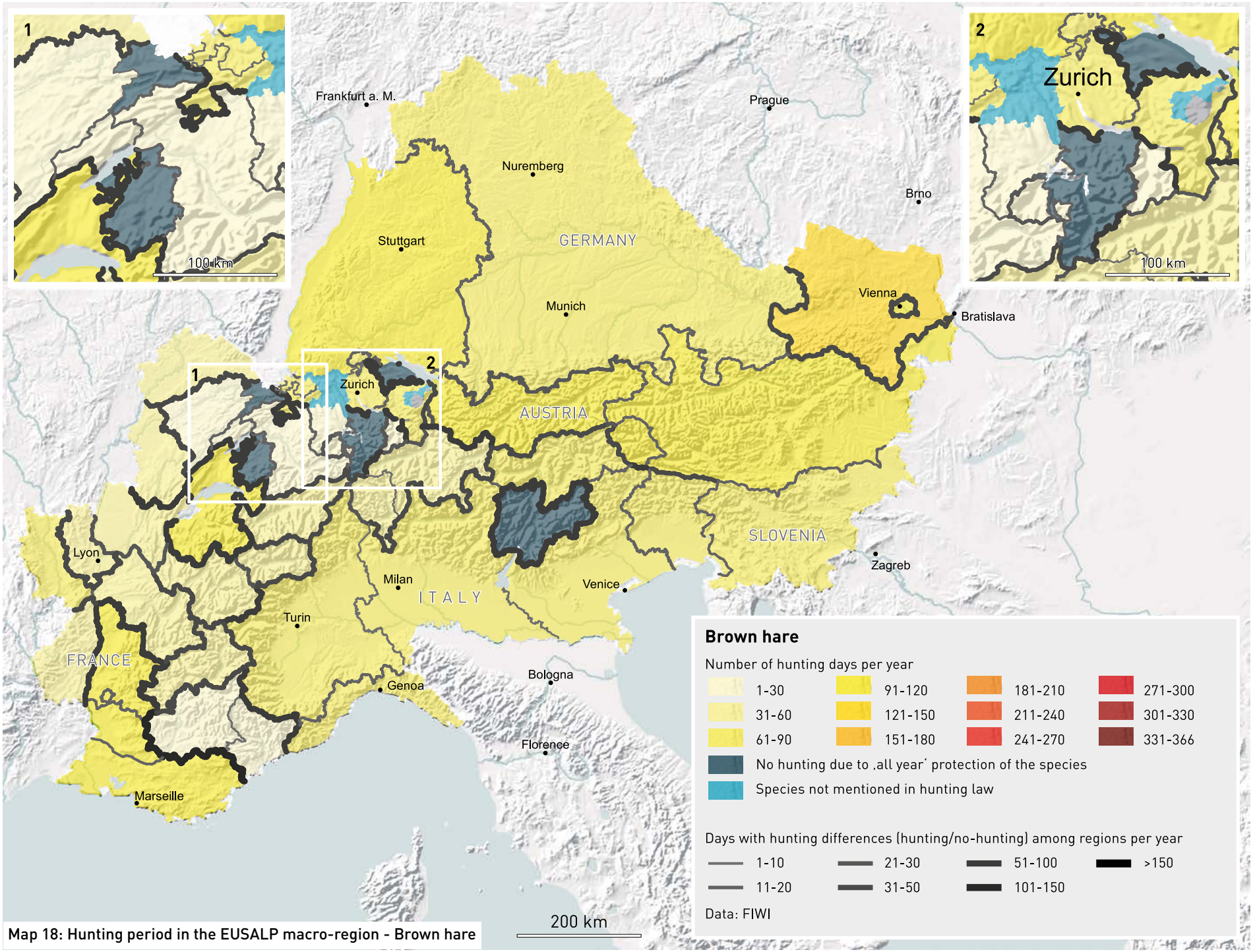
These elusive animals can cause problems for the forest, especially where forests have to function as protection from avalanches, landslides and mudflows. In too many regions, red deer, for example, retreat into these areas in wintertime, as these areas are often difficult for people to access and thus provide a refuge from human disturbances. Rest during wintertime is especially important for ungulate species, as their metabolic rate is reduced. Disruptions during this time can result in life-threatening energy loss when no appropriate food source is available. The protective forests usually do not offer enough quality food and the increased deer population damages the tree stands through bark stripping thus destabilizing the protective function of these forests (Reimoser and Putman 2011).

Species distribution

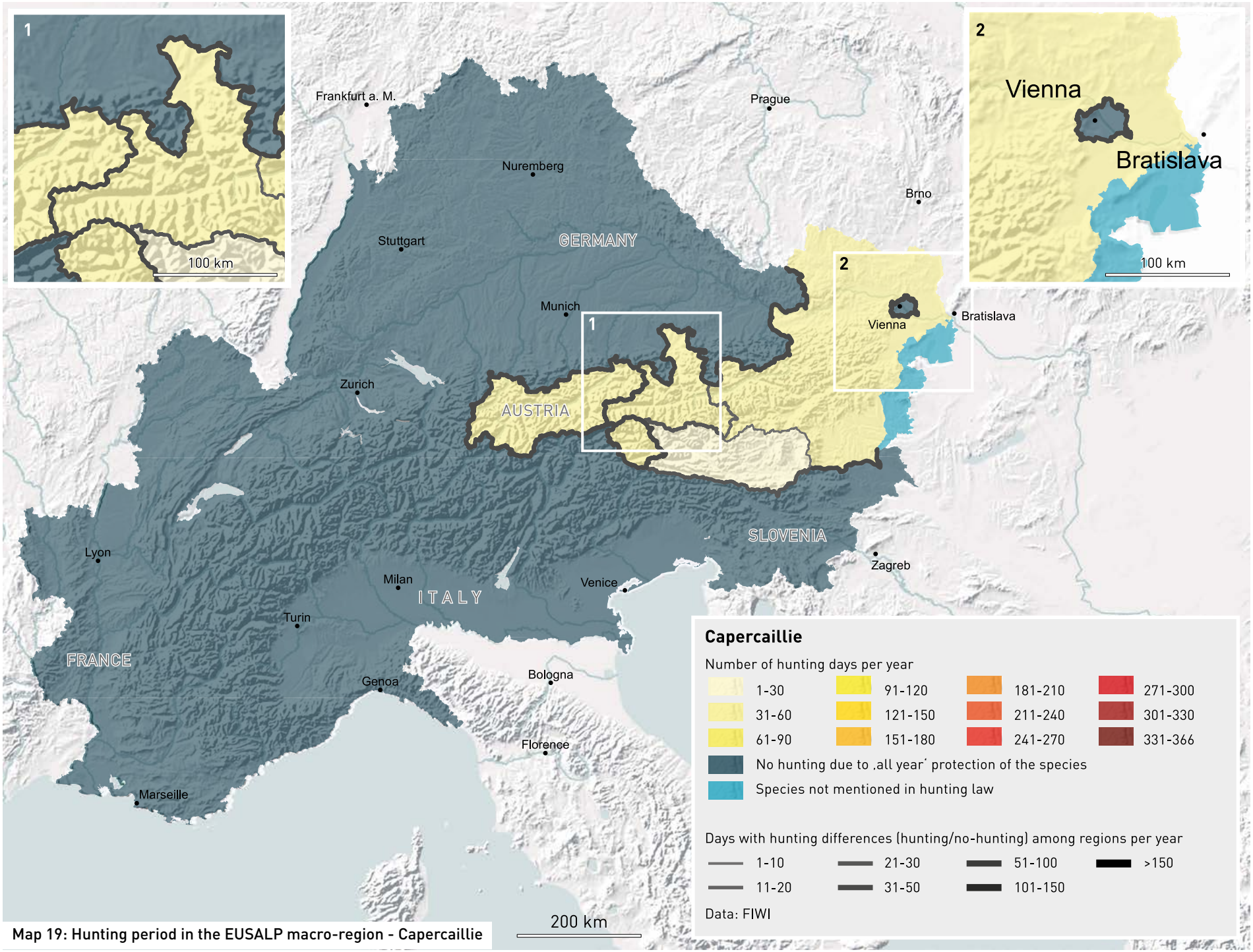
Knowledge about species distributions is vital for planning in wildlife management. The distributions of five ungulate wildlife species were mapped as part of the project. For this, the appropriate hunting administrations and associations were contacted, and the distribution data requested. As there is no consistent methodology and often no legal requirement in the countries for how species distribution is mapped, the available distribution data differed greatly. Depending on the species, the data consisted of distribution data (from monitoring schemes) and habitat data. Additionally, hunting bag data and broad IUCN distribution layers were used to fill in the gaps.



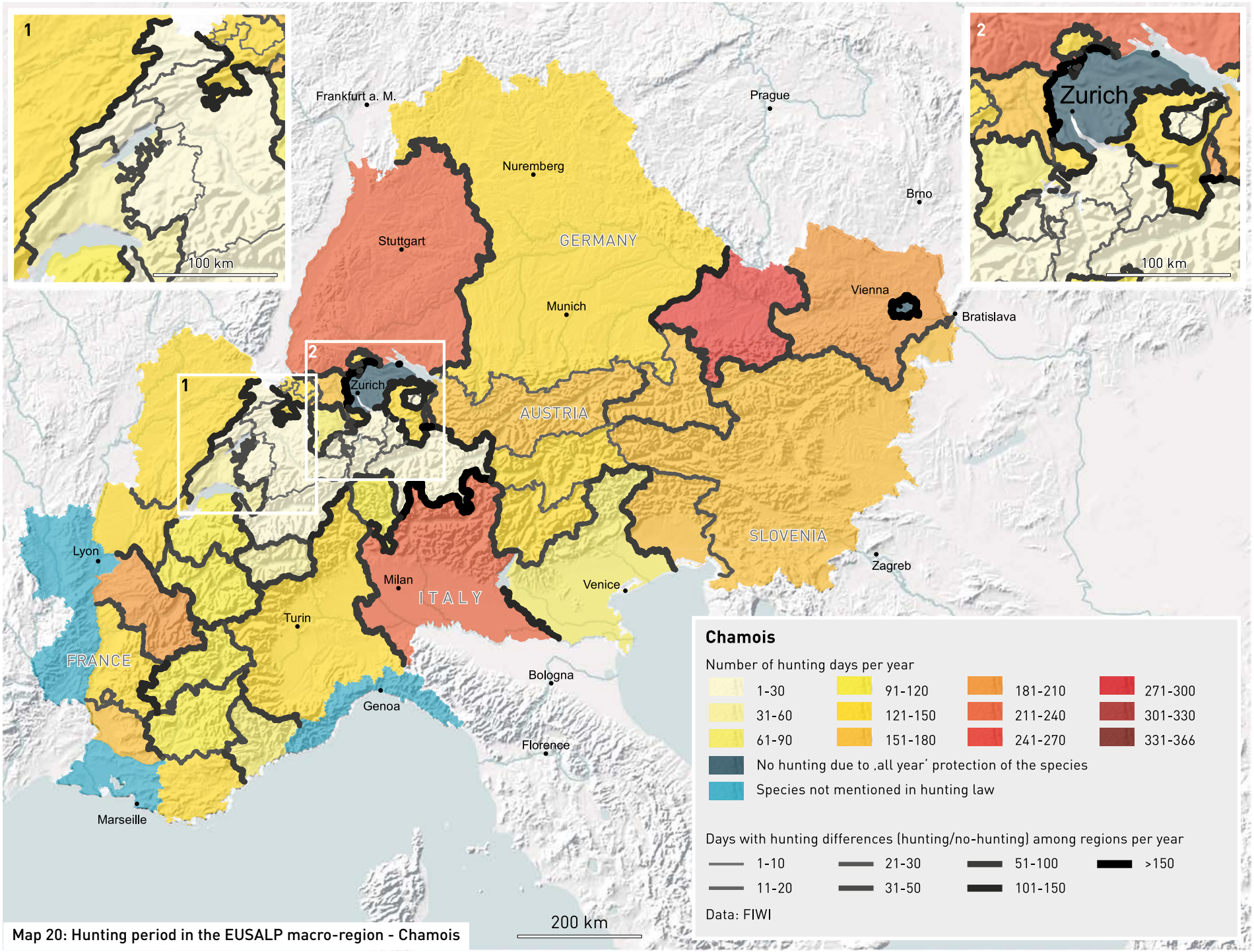
Map 17: Hunting period in the EUSALP macro-region - Black grouse



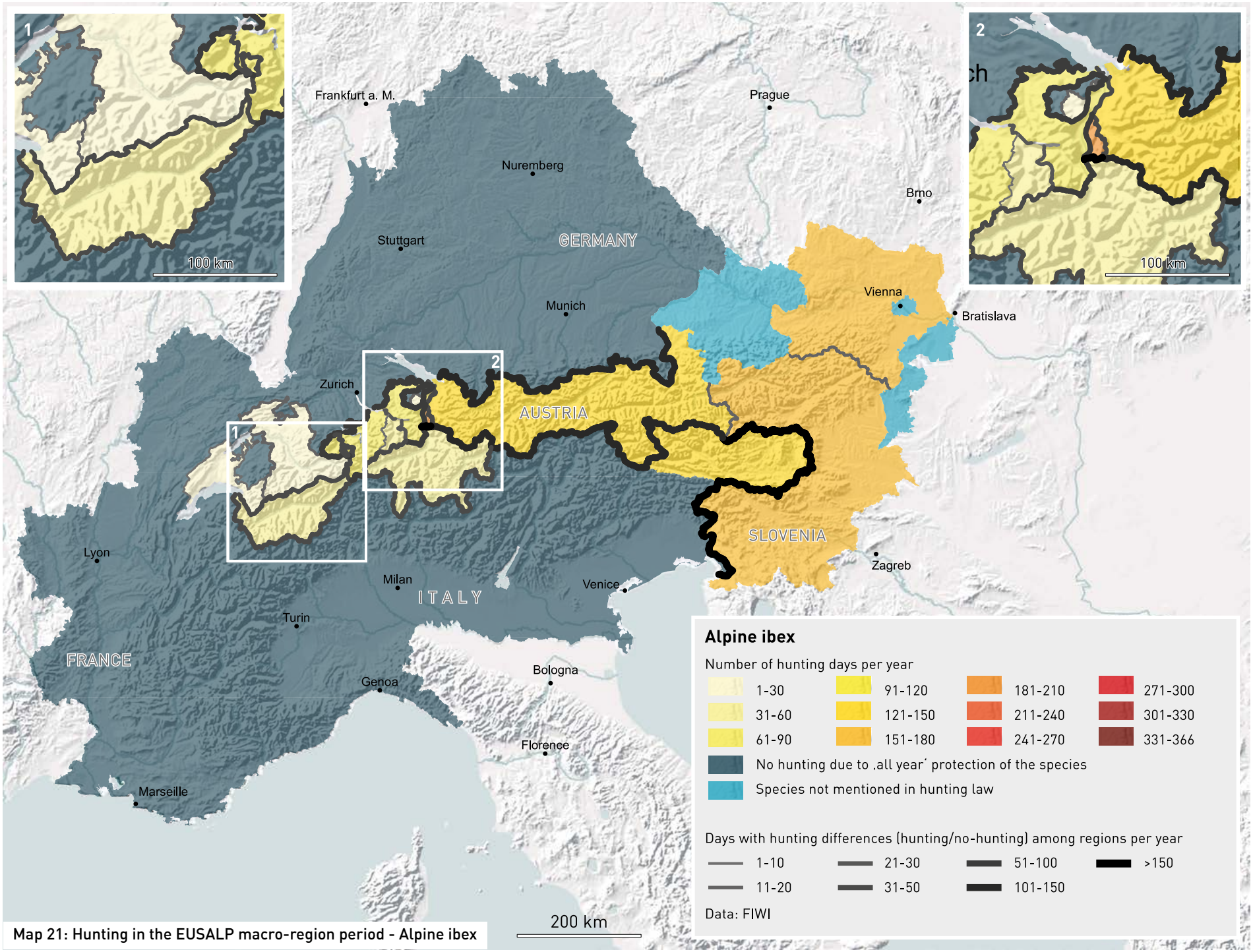
Map 18: Hunting period in the EUSALP macro-region - Brown hare



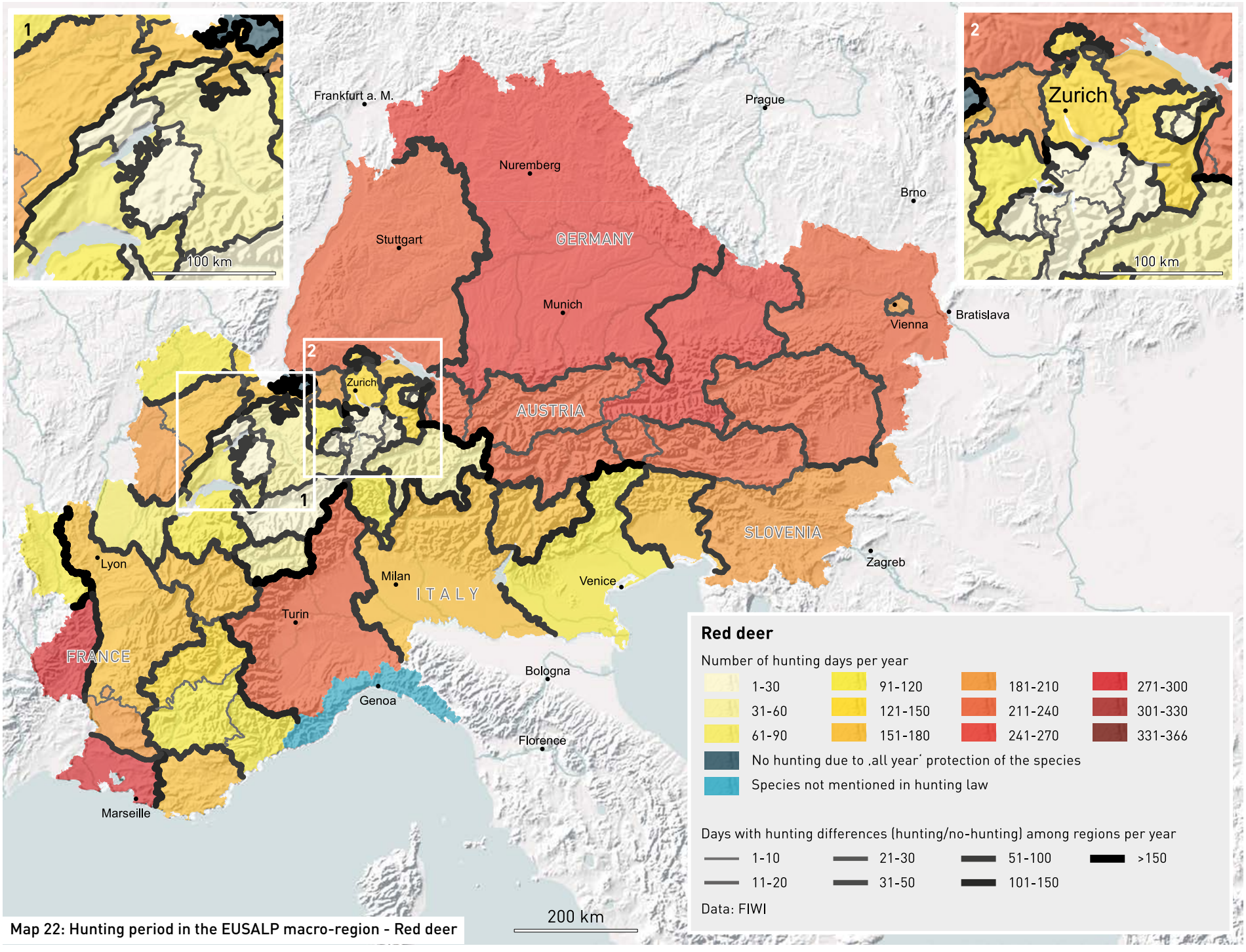
Map 19: Hunting period in the EUSALP macro-region - Capercaillie



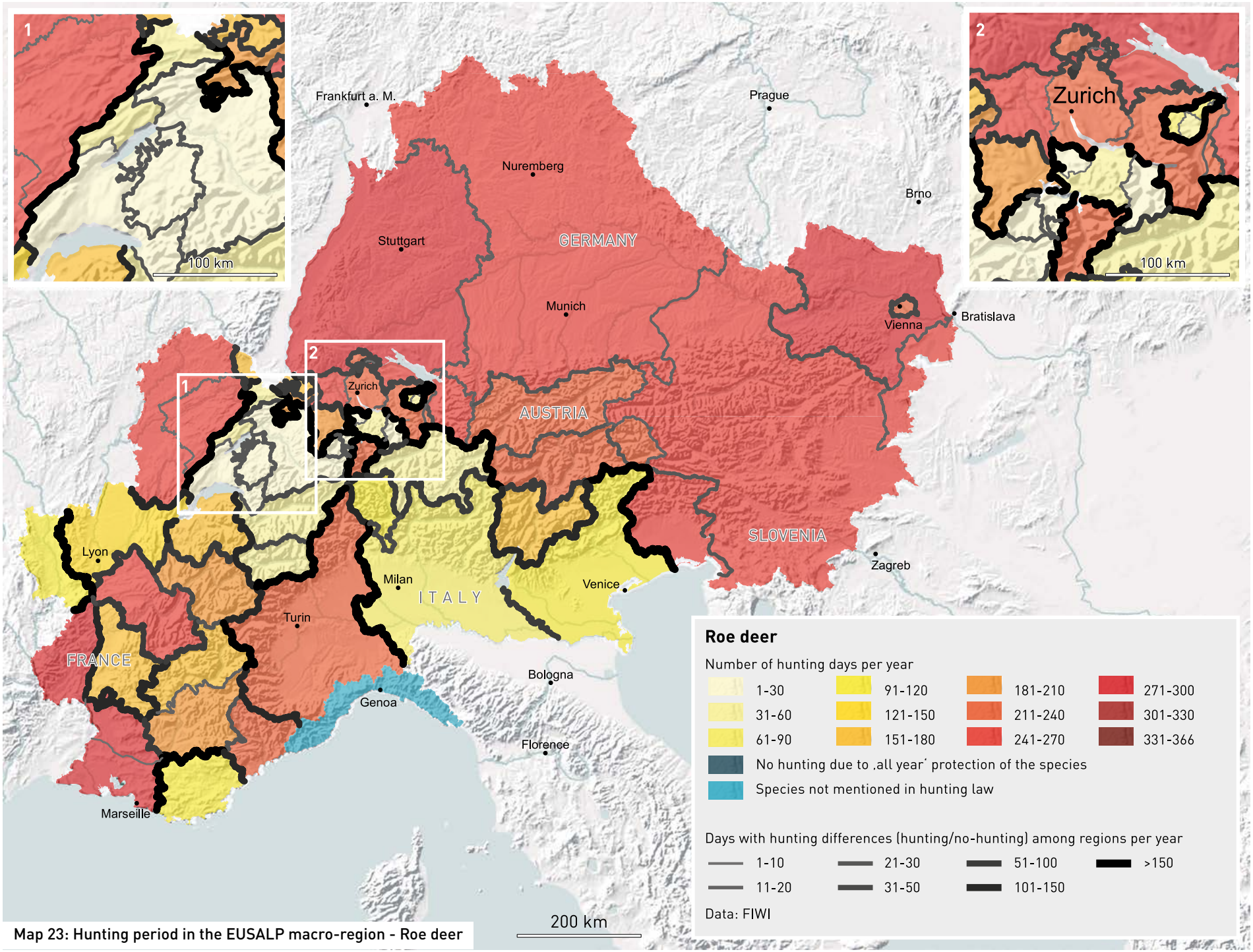
Map 20: Hunting period in the EUSALP macro-region - Chamois



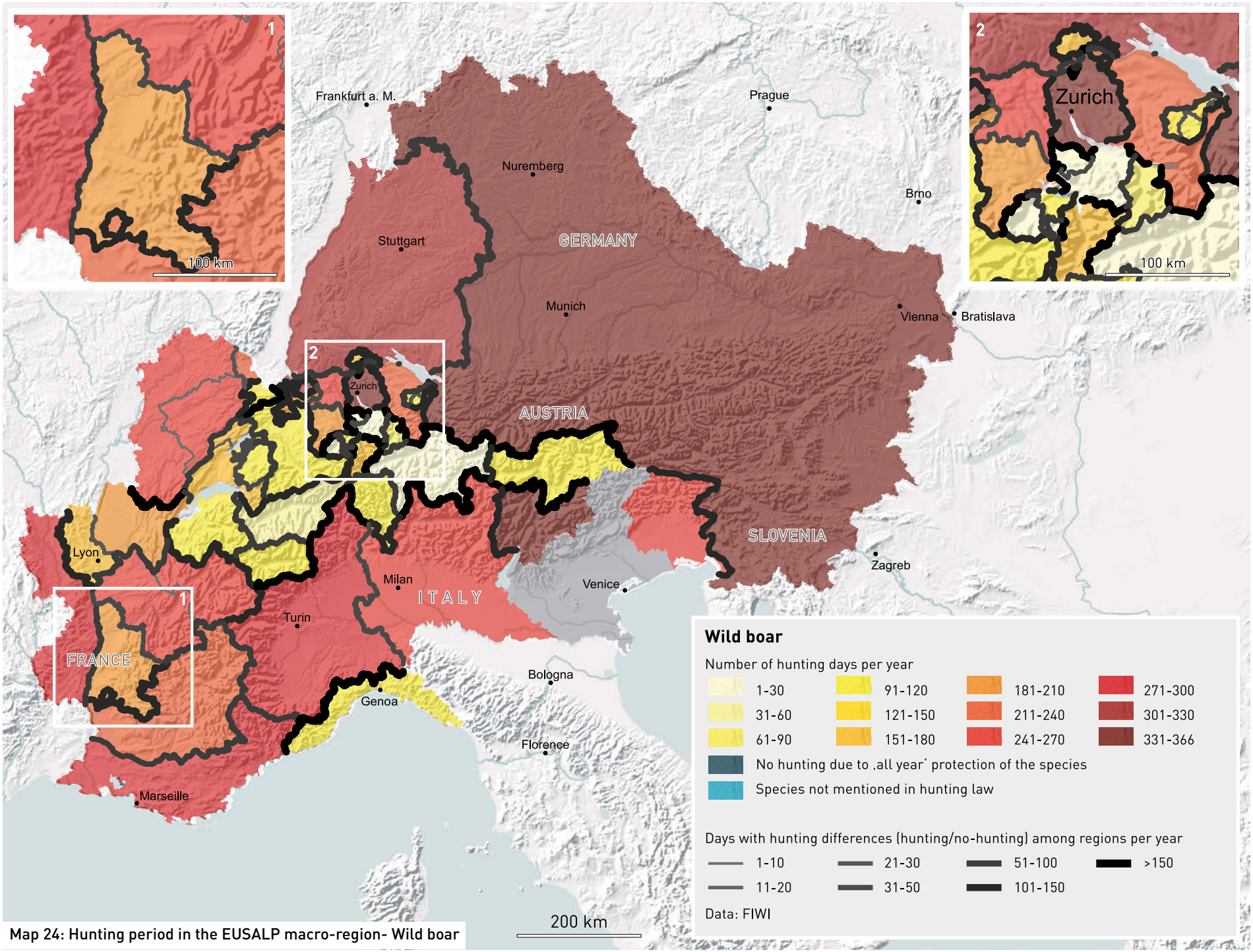
Map 21: Hunting in the EUSALP macro-region period - Alpine ibex



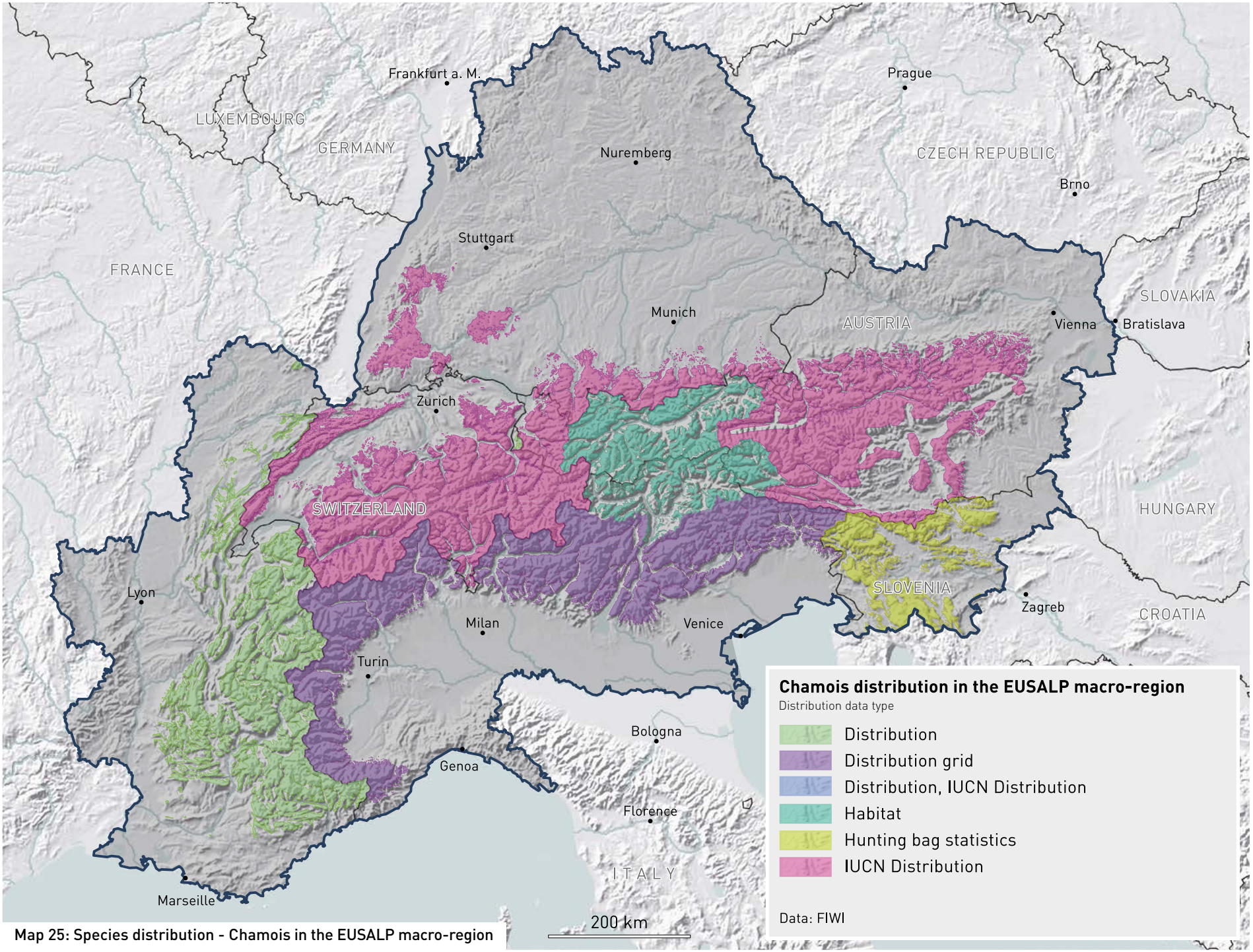
Map 22: Hunting period in the EUSALP macro-region - Red deer



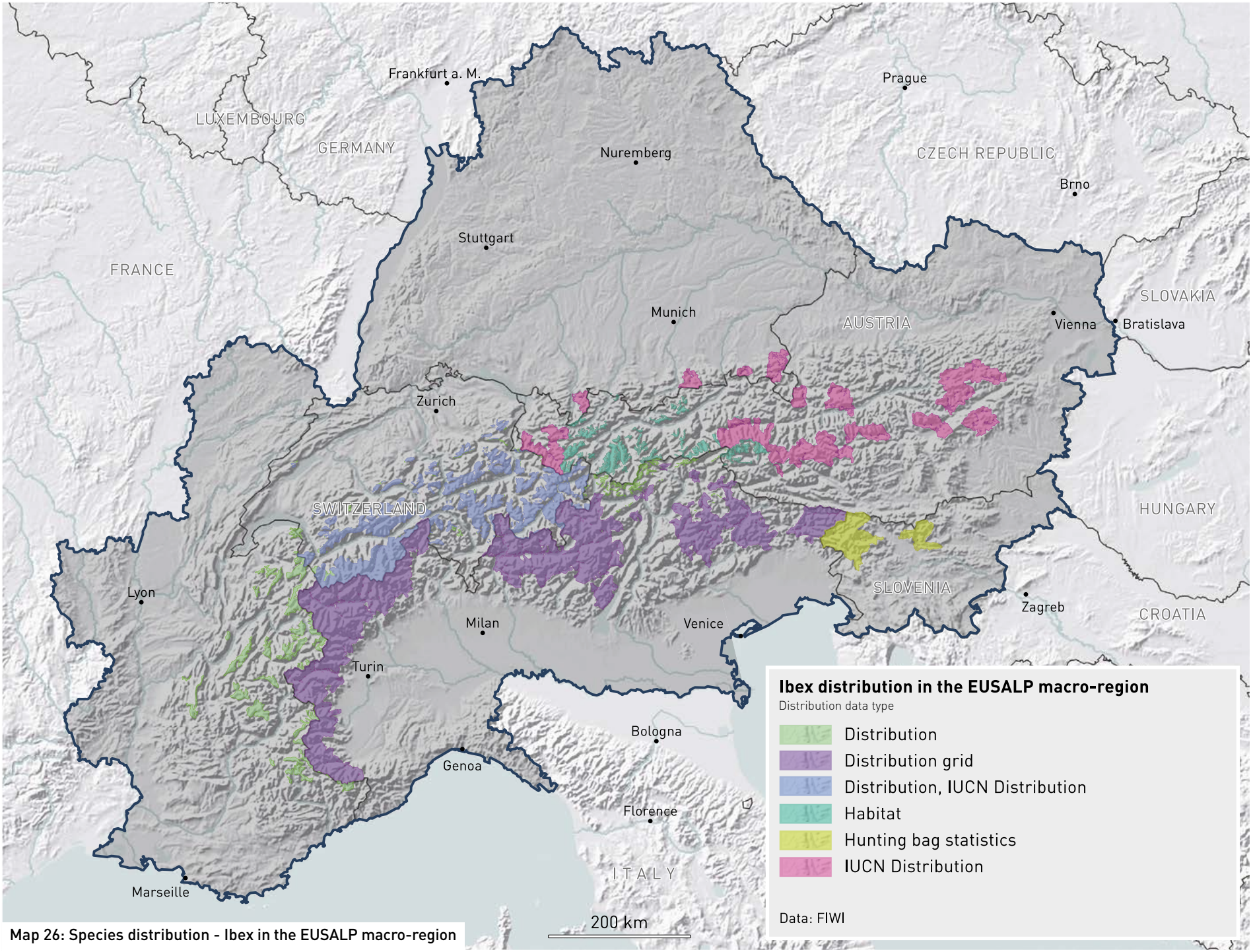
Map 23: Hunting period in the EUSALP macro-region - Roe deer



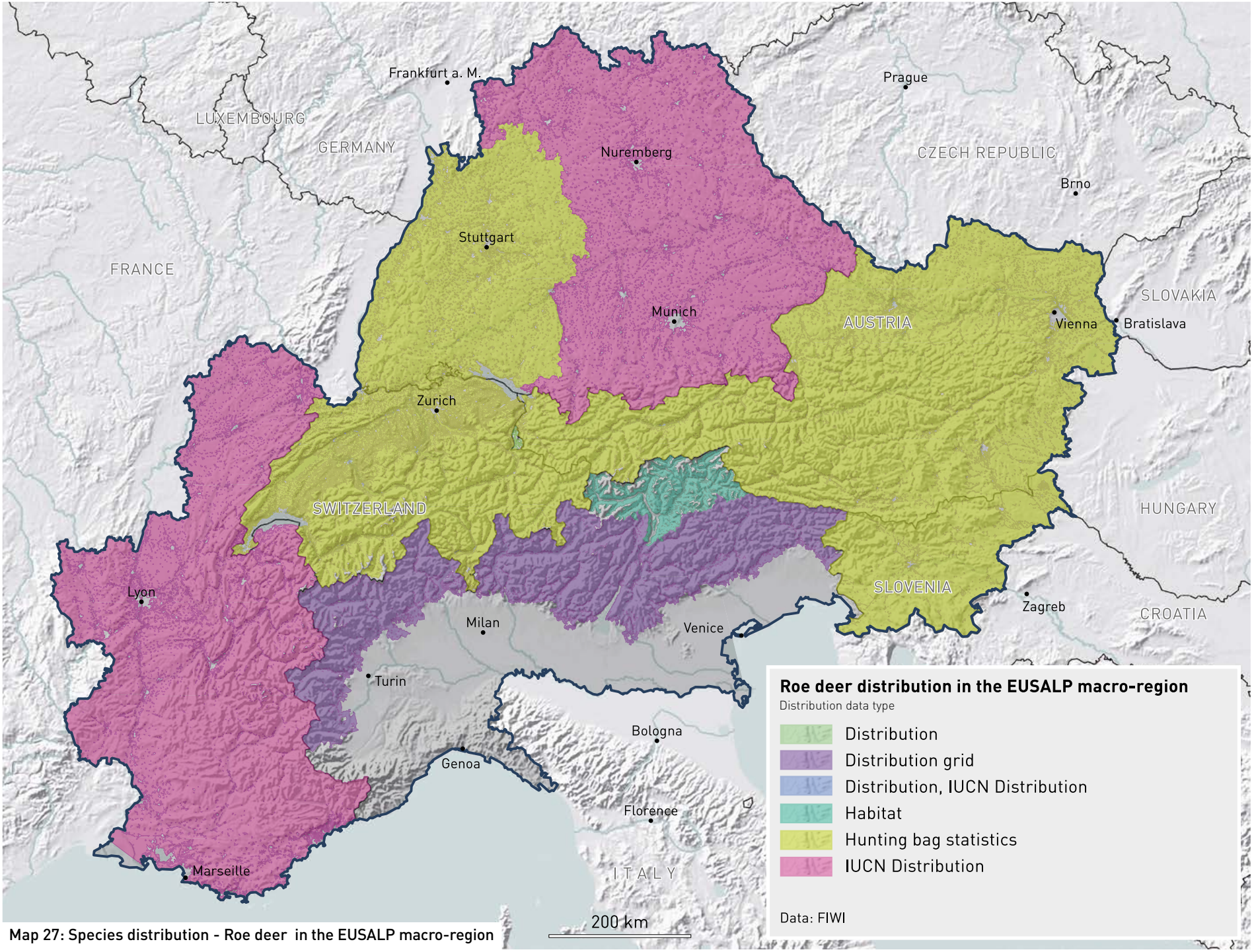
Map 24: Hunting period in the EUSALP macro-region- Wild boar



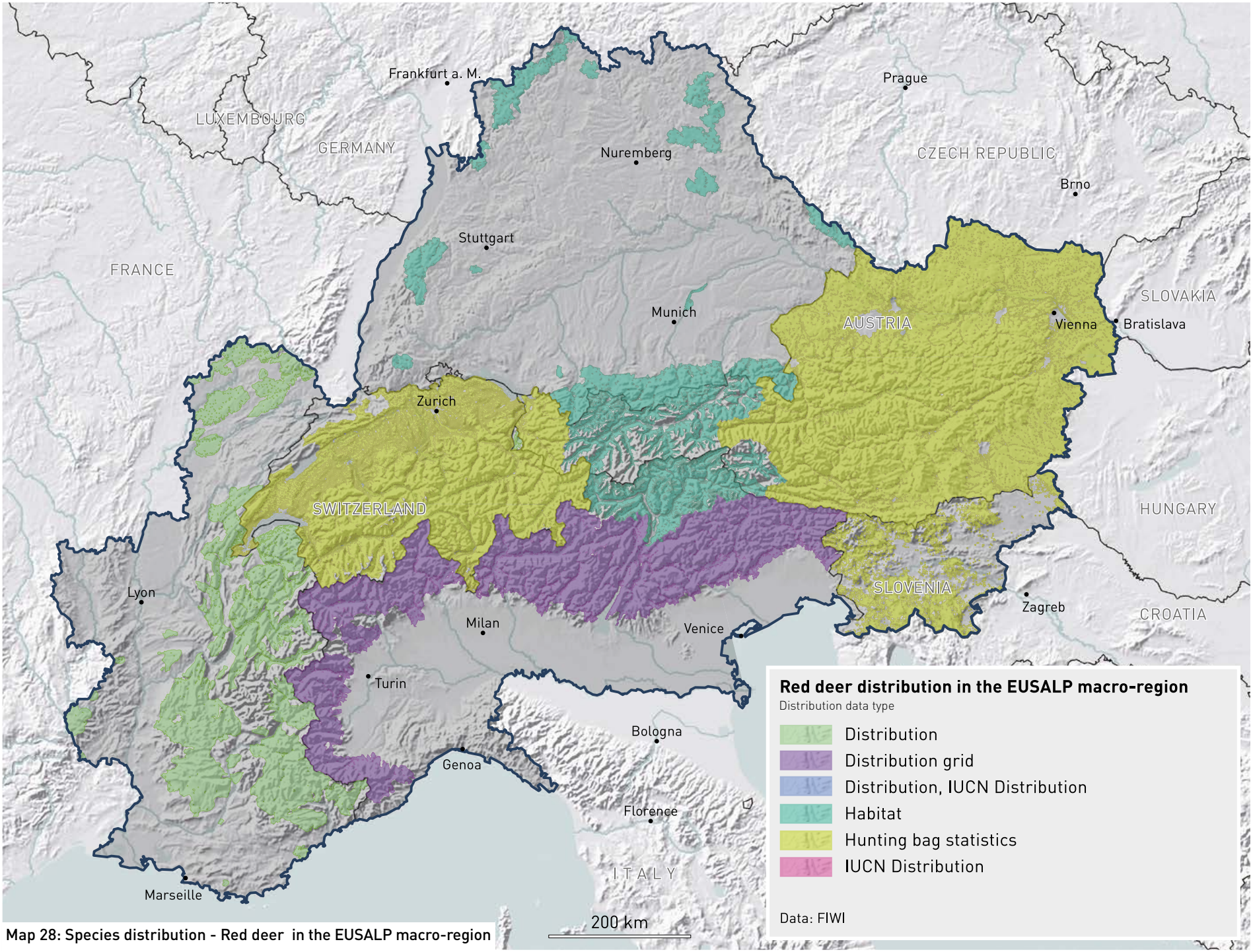
Map 25: Species distribution - Chamois in the EUSALP macro-region



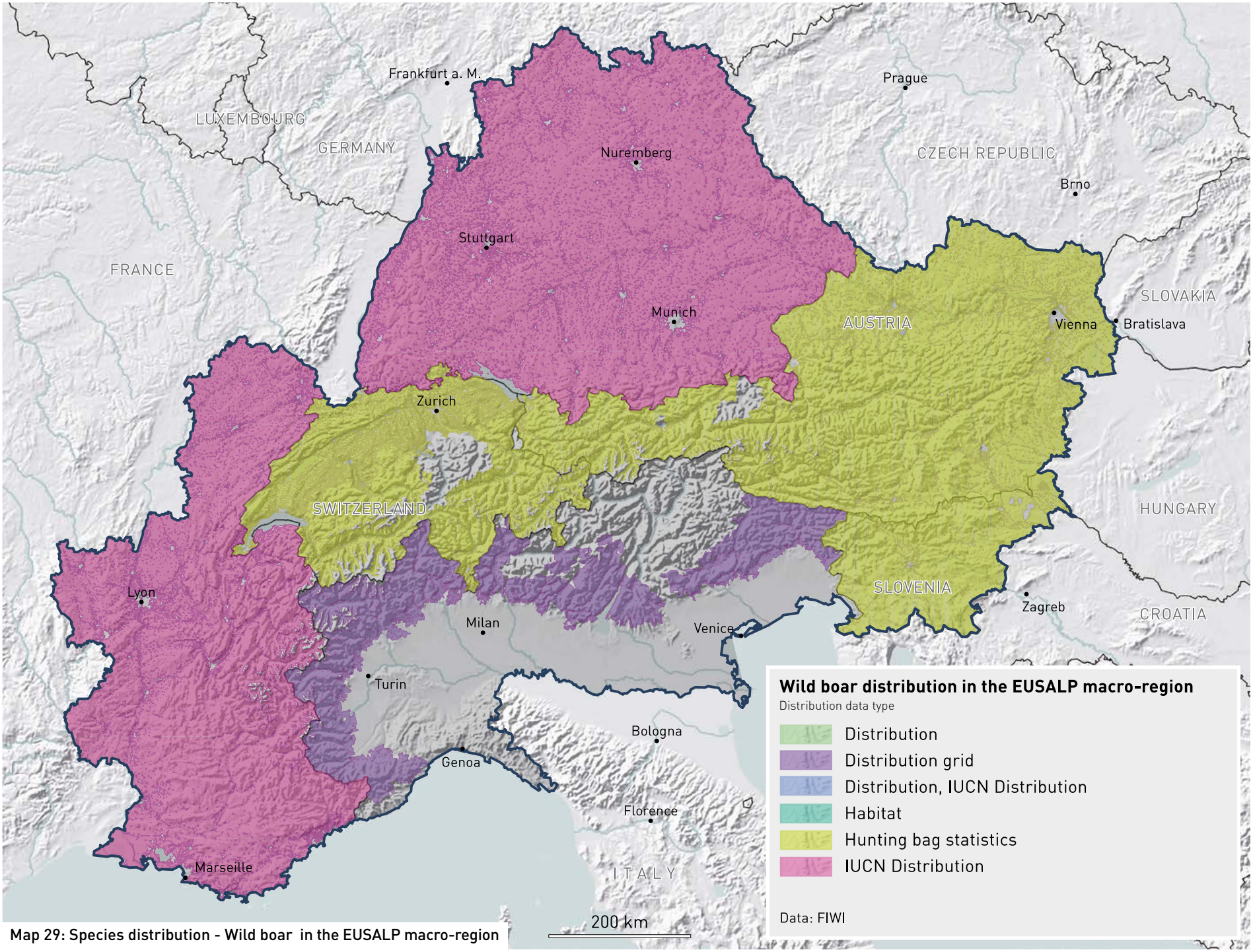
Map 26: Species distribution - Ibex in the EUSALP macro-region



Map 27: Species distribution - Roe deer in the EUSALP macro-region



Map 28: Species distribution - Red deer in the EUSALP macro-region



Map 29: Species distribution - Wild boar in the EUSALP macro-region

5. Humans and nature co-existence for thousands of years in the Alps

In the last decades, conservation policies, demographic trends, ecological and topographic factors have intensified interactions and potential conflicts involving human activities and biodiversity conservation. Therefore, there is an urgent need to manage these interactions efficiently from a social and ecological point of view in order to enhance sustainable cohabitation in the shared space. There is an increasing acknowledgment among specialists that the social dimension of human-nature and wildlife interactions should always be considered when managing conflicts in order to build shared resolution processes with local stakeholders. A positive and constructive dialogue among the different actors for the implementation of ecological connectivity measures is therefore of great importance. This approach strives to consider the diversity of economic sectors and economic interests within a given territory, while also evaluating the cultural assets, the local traditions and the recreational activities, to formulate potential coexistence models.

Ecological connectivity is at the foundation of ecosystem health and species protection. Measures and activities toward its implementation on the ground can provide stakeholders and the greater public with an enlarged view of the landscape and of its functions. Ecological connectivity can highlight the ecological needs of wild species and the barriers that reduce their natural dispersal, highlighting the instruments for protecting natural ecosystems from human activities, improving habitat health and ecological processes.

Public response to wildlife presence is specifically considered as a prominent indicator of the intensity of a conflict and an important working area that must be addressed through mediation and dialogue facilitation approaches. Therefore, the involvement of local stakeholders is a key factor in understanding the intensity of local human-nature conflicts. The two main issues to be considered when analyzing the roots of conflict and potential approaches to its resolution are economic impact and social perception of wildlife. They can be overlapping and often confusing,

A promising strategy intended to emphasize the need to combine multi- and inter-disciplinary methods to achieve a satisfactory and stable level of human-nature coexistence that would fit within the scheme of ecological connectivity management and implementation throughout the Alpine areas.
The following maps and graphs provide an overview of the approach followed in WPT5 and an example of the results obtained through the involvement of local stakeholders and especially of young generations.

5.1 Best practice examples that have been analyzed

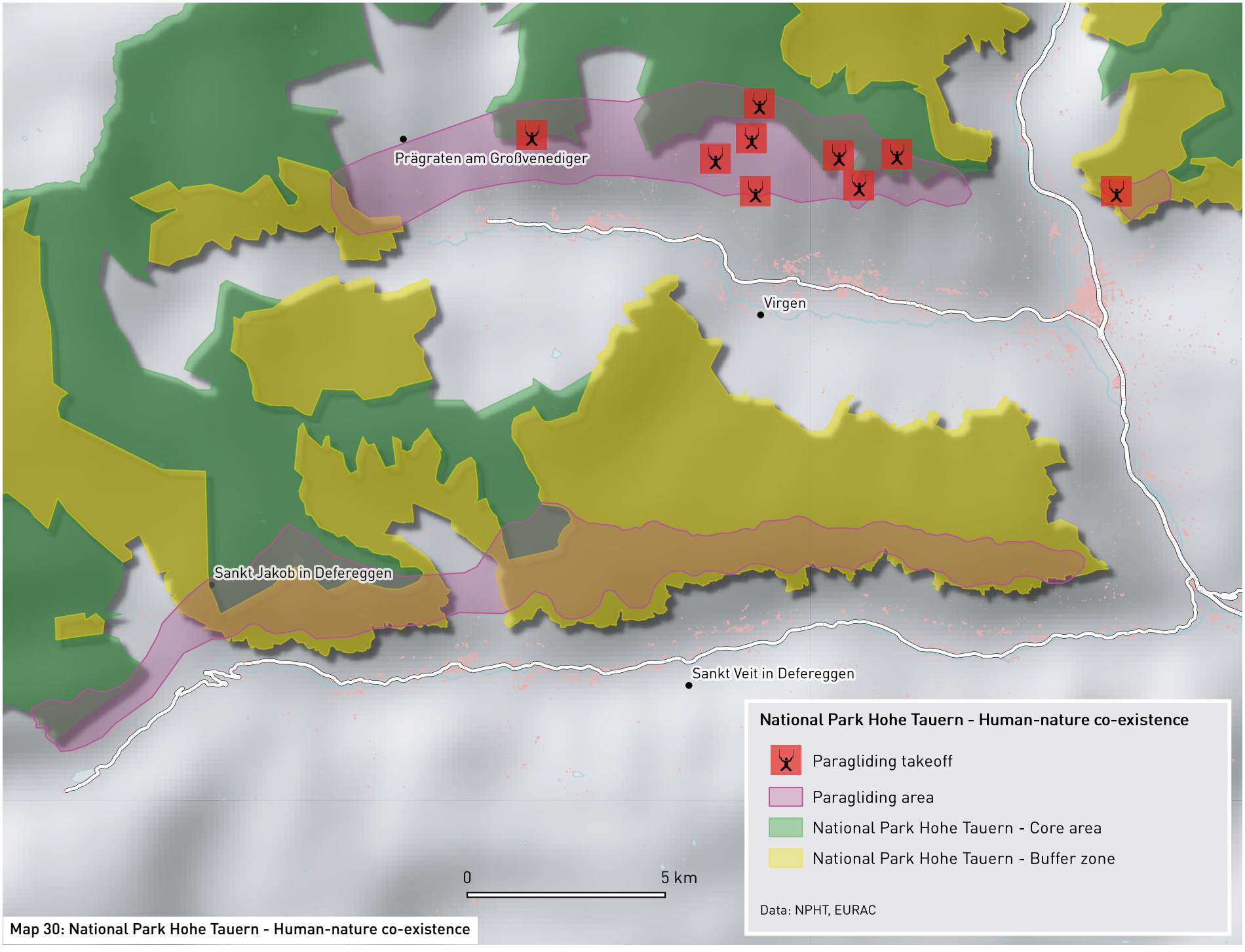
In the Achental-Berchtesgaden-Salzburg area (GER/AT), one of the main touristic attractions relies on the presence of bike routes, which allow tourists to get to know the park amenities in a sustainable way. However, the expansion of new technologies for mountain bikes has broadened opportunities to reach high-value mountain and core areas that were previously inaccessible to most. The Berchtesgaden National Park has defined the accessible bike routes in order to avoid any disturbance to other economic activities and to wildlife, but the use of E-mountain bikes can result in both increasing the traffic and extending the temporal use of mountain wilderness areas. Wildlife is therefore expected to experience more disturbance and behavioural change.

Another example of conflict analysis refers to the transnational area of South Tyrol (IT) / Hohe Tauern (AT). The area is famous for its selection of sports activities, especially paragliding, due to its expanse and wilderness. This central Alpine region attracts a significant number of tourists both from the surroundings and from other countries. The National Park Hohe Tauern's administration, the South Tyrol Provincial Parks' administration and the paragliders' groups have a mutual interest in preserving the attractive natural landscape in the South Tyrol / Hohe Tauern area. In order to better understand the potential disturbance of wildlife in the PWR Hohe Tauern NP (AT) and NP Rieserferner-Ahrn (IT), an analysis with stakeholder-involvement was done. Special requirements and vulnerabilities of protected species were analyzed and mapped (see map 30).

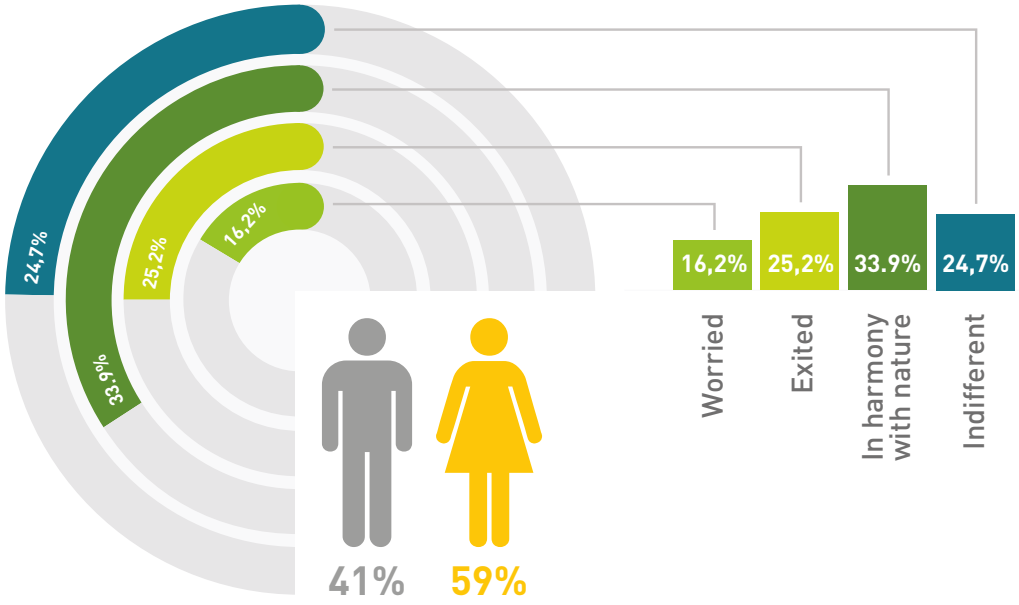
The conflict and interactions analyses also focused on the collection of information about the attitude and knowledge of high school students regarding the presence of wildlife in their area and about their knowledge of current conflicts with nature. We decided to specifically consult high school students because we believe that they should already have their own ideas and opinions about their region, the local natural capital, and the interactions between regional development and nature protection. Moreover, the ALPBIONET2030 project points at developing a vision for the future of the Alps, and current high school students will be the new administrators and wildlife managers in the following 20-30 years.

The survey aimed at collecting, among others, answers about the following questions:

- What is the attitude and knowledge level of high school students concerning large carnivores and ecological connectivity? To what extent are large carnivores accepted?
- What are the main issues regarding the presence of large carnivores in each of the Project Working Regions?
- How does the level of social acceptance compare to the personal attitude towards ecological connectivity-related activities and wildlife presence?
- What experience do they have/have they had with large carnivores?
- What vision for the future of the Alps do they have?



Map 30: National Park Hohe Tauern - Human-nature co-existence



The idea of living in an area in the Alps where wild species (e.g. Wolf, Bear, Lynx, etc.) are returning in their original territories (naturally or through reintroduction) makes you feel:

According to your knowlege and opinion, what do you think „Ecological Connectivity“ means?

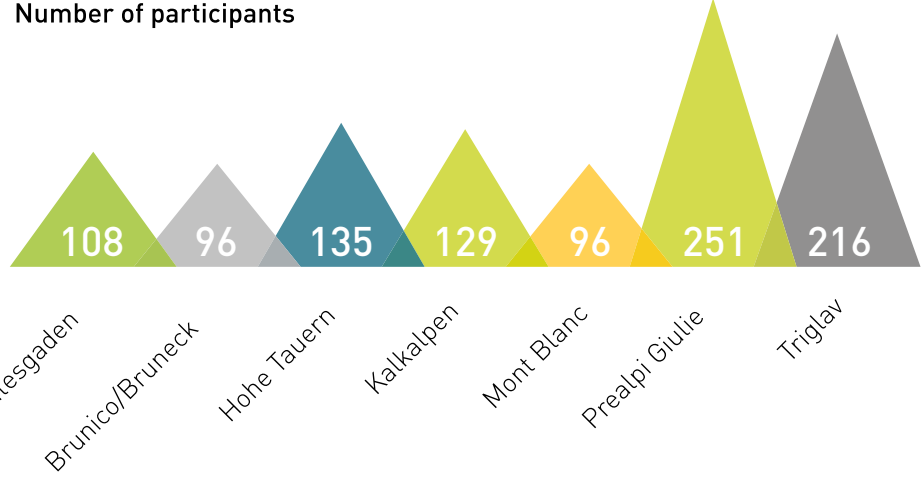
It is when humans have to adapt to wildlife needs and retire from some territories that are important for wildlife survival.

It is a concept which aims at allowing the coexistence of wildlife and humans, developing an integrated network of roads, ecological corridors, urban areas and green areas

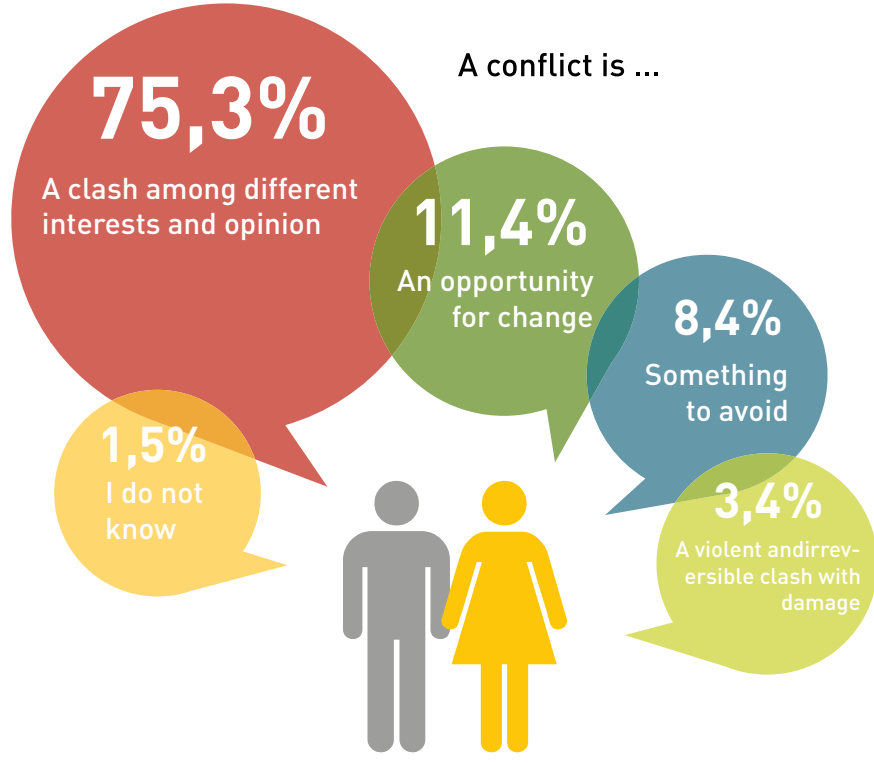
It is when cities and countryside are connected through a network of green paths where people can freely ride and walk

Composition of stundents interviewed

Number of participants



A conflict is ...



5.2 Conclusions

This work represents an initial attempt to investigate the main human-nature interactions that affect ecological connectivity in the Alps. The analysis was based on the need to include the human dimension in wildlife management. Meaning that humans and their economic activities and their social values, traditions and culture should be included when wildlife and nature seem to be an obstacle to human development. Conflicts are usually not with nature or wildlife themselves. Conflicts usually involve competing economic interests between different stakeholders' groups. The project aimed at involving local stakeholders from the Project Working Regions in order to understand, directly from them, the main issues regarding their work with high-value ecological assets.

Related to the general project's aim, the inclusion of the social aspects of nature wanted to highlight the importance of awareness regarding our personal relationship with it and with wildlife species. For this reason, it was decided to include in its analysis, not only the most attractive/famous conflicts, such as the large carnivores' depredation of livestock, or animal-vehicle collisions, but also the impact of sport activities in the mountains and the knowledge and awareness of high school students, to make it as comprehensive as possible.

Of course, it is not possible to cover all the potential human-nature interactions that may turn into conflict, but it is important to define an approach to them. Our approach was more of an explorative one rather than a resolution one. Before solving conflicts, we must know what these conflicts entail and how they affect local people. Firstly, it is, of course, important to know how to gain understanding of these conflicts. Secondly, one must explore how local people and stakeholders react to these conflicts and their ideas to resolve or manage them. Thirdly, it is important to inform other people and those from other places about the current conflicts and encourage exchange of experiences and resolution approaches. Finally, the future of the land must be considered. Involve young people, check their knowledge and awareness, and discuss with them the above-defined problems.

ALPBIONET2030 pointed at the future of the Alps: A future where ecological processes and wildlife species could co-exist with humans or better, where humans will learn to co-exist with wildlife species because they have reached an understanding of their value and awareness of the benefits a connected nature could bring to them.

6. Regional challenges and approaches for [ecological] connectivity

Five Project Working Regions (PWR) were defined as pilot sites for project activities. They were led by and geographically structured around the following project partners:

- Kalkalpen National Park: Northern Limestone Alps
- Hohe Tauern National Park (in cooperation with South Tirol Nature Parks): Hohe Tauern National Park
- Berchtesgaden National Park: Achental - Berchtesgaden - Salzburg
- Asters, Conservatory of Natural Areas of Upper Savoy: Mont Blanc
- Prealpi Giulie Nature Park (in cooperation with Triglav National Park): Prealpi Giulie-Triglav

The PWR were a key factor in the success of the ALPBIONET2030 project. In these areas, the approach of the Strategic Alpine Connectivity Areas (SACA) could be verified on site and the pertinence discussed with local stakeholders.

The PWR were also the areas for in-depth study of possible human-wildlife conflicts, case studies and test laboratories for (transboundary) wildlife management strategies and an important means of ground proofing project activities and findings.

The experience gained in the project confirmed previous findings regarding the potential of protected areas to launch processes improving ecological connectivity in their surroundings and the important value they add to this process (see also Plassmann et al. 2016).

6.1 Northern Limestone Alps

The wild heart of Austria

The Pilot Working Region (PWR) "Northern Limestone Alps" is located in the center of Austria where the borders of three Austrian provinces (Upper Austria, Lower Austria and Styria) meet. Due to historical reasons and the fact that the region is relatively far away from the provinces' urban agglomerations, it has remained quite natural and relatively unfragmented. The altitude varies from about 350 m up to more than 2.500 m.

Large Forests

If one thinks about ecological connectivity, some of the most important contributors are the forests. Quite large areas of natural mixed forests are found here. The last remaining primeval forest of Austria and patches of untouched forests are located in Wilderness Area Dürrenstein in the National Park Kalkalpen. The dominant types of forests are beech mixed with fir, spruce, maple, larch and other tree species in different proportions based on site, altitude etc.

Austria's one and only UNESCO world heritage

The outstanding forests in the Northern Limestone Alps were recognized as Austria's one and only UNESCO natural World Heritage Site in 2017 as part of the European world heritage series of ancient beech forests.

Lots of protected area and connectivity activities

Due to the outstanding natural assets, it is not surprising that there are a lot of protected areas established in this region. The protection status ranges from Nature Parks up to a strictly protected wilderness area (IUCN category Ia). Both National Park Kalkalpen (NPK) and National Park Gesäuse (NPG) are PAs in the IUCN category II. Additionally, there are several nature reserves established by the federal laws of the three provinces.

The region has been involved in activities supporting ecological connectivity (EC) in the Alps from the outset. Especially worth mentioning is the cooperation Netzwerk Naturwald (www.netzwerk-naturwald.at). It aimed to protect and to enhance ecological connectivity. The approach and the first steps to establish a functional network of stepping stones beyond provincial borders was visionary and future-orientated and also had a positive impact in the nomination process for UNESCO world heritage of ancient beech forests. Since the award from UNESCO for a natural world heritage recognition, the ecological connectivity between the component parts and beyond have become a national and even international task.

Connectivity on regional, Alp wide and transnational scale

As illustrated in the following map, the proportion of SACA1 areas is quite high, and there are very few areas that have been evaluated as SACA3 areas. The aim is not only to maintain the current and substantial level of ecological connectivity but also to focus on further improvement. For mobile species the connectivity is considered to be very good. The PWR provides a core area for mobile mammals. Also, the existing documentation of wildlife corridors and migration routes show this region as a very important hub of migration routes from north to south and also from east to west as well as in the opposite directions. So, the region is important for connectivity on a regional, an Alp wide, and also a transnational scale.

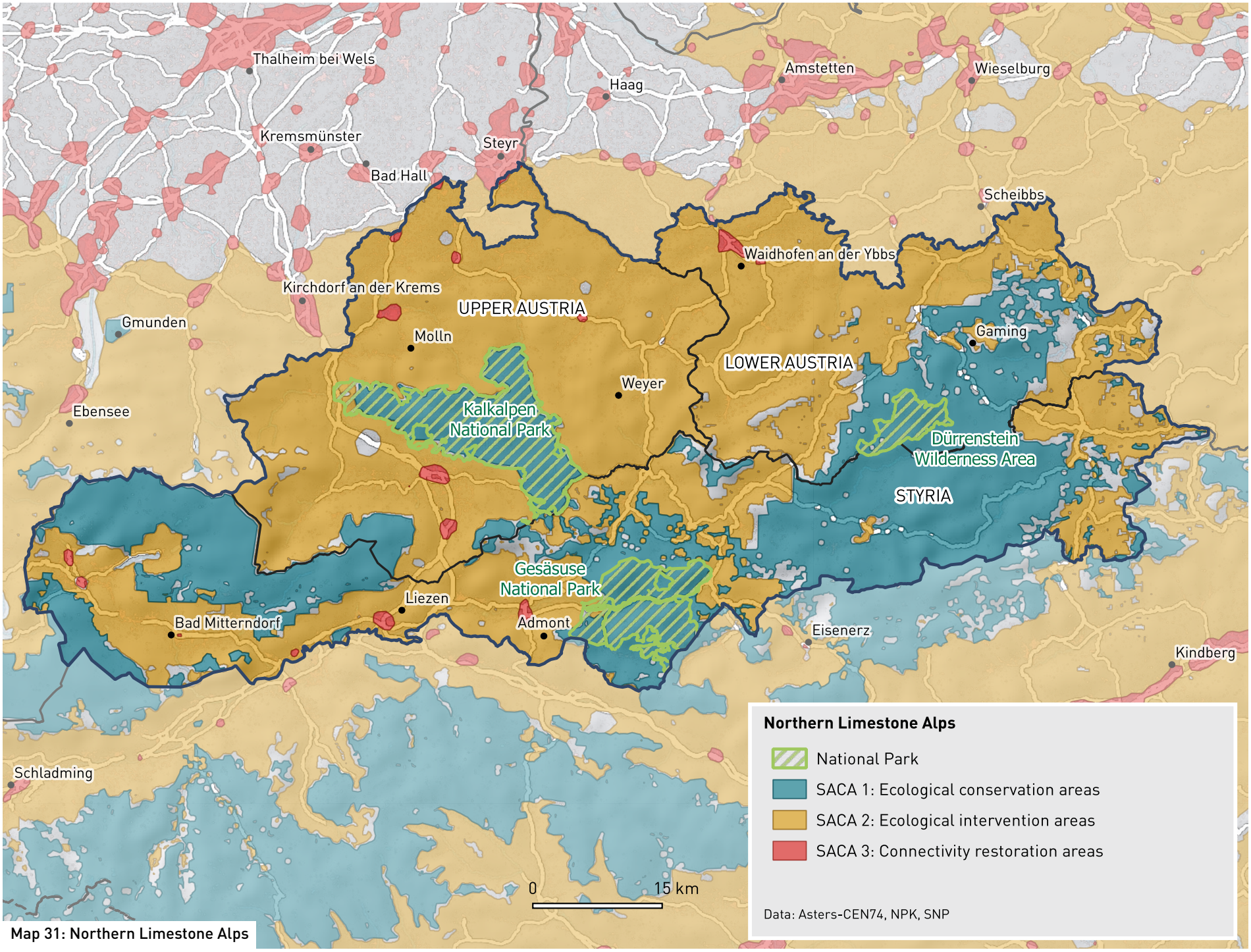
Large carnivores face non-physical barriers

For large carnivores the barriers seem not to be physical obstacles but rather the mindset of certain individuals. So, the reintroduction of the Eurasian Lynx was endangered by cases of poaching. The reintroduction of the brown bear unfortunately failed in the last decades. So, it will take considerable effort to improve this situation.

The main physical barriers appear along highway A9 from Kirchdorf south to Liezen as well as along the river Enns valley. The highway on this route is bridged by many tunnels and overpasses in an attempt to address this issue. The river Enns valley presents less of a barrier, as the traffic is lighter than on the highway, and this route is rarely fenced and also crossed by many tunnels and bridges in the lower Enns valley.

The hub for Ecological Connectivity in the eastern Alps

Summarizing the project results once more highlighted PWR Northern Limestone Alps as a quite outstanding and important region for ecological connectivity. The initial efforts toward working on ecological connectivity at a cross-provincial level should by all means be continued and expanded, as this region is an important hub for ecological connectivity on every scale.



Map 31: Northern Limestone Alps

6.2 Hohe Tauern National Park (in cooperation with Southern Tyrol Nature Parks)

The PWR (project working region) Hohe Tauern Nationalpark (Tyrol and Carinthia; AT) & Naturepark Rieserferner-Ahrn (IT) is situated in the southern part of the main ridge of the eastern Alps of Austria and Italy.

The region is an important transit area contributing to ecological connectivity (EC) within the eastern Alps (BMNT 2018). It provides natural barriers (large glaciers, high mountains) and has a high wilderness-potential and less human impact compared to other regions (WWF Austria, 2016). A long history of reintroduction resettlement projects of extinct species (e.g. bearded vulture) illustrates the need to think beyond the borders of the protected areas.

The region is also a touristic hot-spot. One of the ecological benefits (and touristic highlights) of the region is a high density of protected areas, and human activities like tourism and outdoor sports can trigger conflicts concerning EC.

EC in the PWR – main issues & conflicts

Both cross-border protected areas together with Naturepark Zillertal (Tyrol) create a large area with a high standard of environmental protection and less fragmentation by human beings. Fragmentation within the PWR occurs mainly around settlements, like the cities of Lienz (11.868, 01/2019) and Bruneck (16.580, 12/2017) as well as smaller villages. Additionally, fragmentation may result due to transportation infrastructure in and toward the neighboring areas in the south consisting of main roads in the Möll-, Drau- and Puster valleys ("Bundes-/Landesstraßen"), smaller roads and railway-infrastructure (with only single track). Compared to other EUSALP areas, these roads are less important and less traveled (with nearly no continuous noise protection walls along these corridors). Rivers and floodplain corridors as well as extensively used grassland and low nutrient meadows have important functions as corridors and stepping stones.

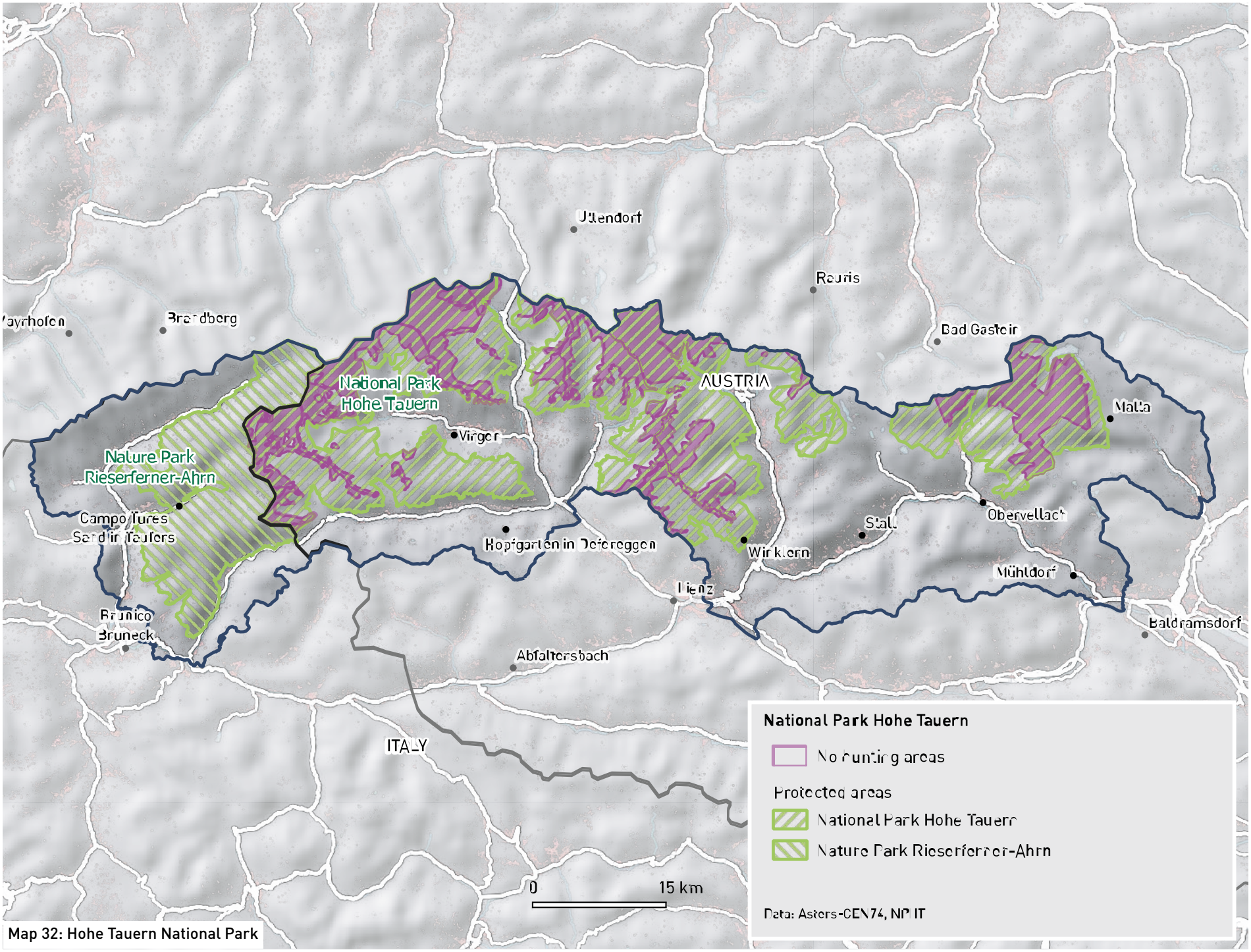
SACAs in the PWR

The majority of SACAs in the PWR are protected areas (SACA 1). The surrounding area (SACA 2) is Alpine (high Alpine) land with Alpine to montane forests and Alpine pastures. Down in the valleys, small cities and villages define SACA 3 areas. These are surrounded by agricultural land, and agriculture is important for the region (with a high amount of extensive use, small-scale family farms).

Perspective

New trends in leisure activities (icefall-climbing, paragliding and, obviously, eBiking) are becoming more popular and allowing increasing numbers of people to use mountainous regions – and also protected areas – to enjoy nature, but they may also disturb nature through conflicts involving human-nature co-existence. Within the scope of ALPBIONET2030, thematic and spatial hot-spots in the PWR have been analyzed (Senitza, 2019) and workshops and trainings with stakeholders and the different target-groups (guides, Alpine clubs, paragliding clubs, bike rentals) have been organized. This should be continued, as direct contact and communication of knowledge seems to be the best channel to achieve awareness. Social media activities should help to reach the target groups in the source-regions (urban areas around the Alps), but special target-group forums and other media should also be included.

Different hunting systems are a major problem for some resettlement projects of extinct species. In the PWR the reintroduction of bearded vultures was compromised by contamination of rotting carcasses with lead ammunition. The connected protected areas provide a large area with no hunting, but, in the areas between, currently only 26,1% use lead-free ammunition (IGF, 2017). Based on a cross-border study in the PWR, discussions with hunters/stakeholders have been organized, politicians were involved and transition-workshops have been held. These efforts should be continued.



Map 32: Hohe Tauern National Park

6.3 Achental-Berchtesgaden-Salzburg

EC in the PWR (main issues, main conflicts)

The ALPBIONET2030 project working region (PWR) Berchtesgaden-Salzburg including the PP National Park Berchtesgaden (NPB) and Landcare Germany (DVL) is situated in the central eastern part of the EUSALP area. It is an important transit hub for ecological connectivity between the pre-Alps and Alpine areas with an excellent diversity of qualitative biotopes and habitats for many specialized species. As the area is not only a hotspot for nature and biodiversity but also for human activities, like tourism, outdoor sports and land use, conflicts concerning EC arise. In ALPBIONET2030, the main conflicts were analyzed and, in concert with experts and stakeholders, local solutions were devised, and first steps to improve EC were taken. The tremendous importance of ecological connectivity in this area makes improvement here a serious priority. This is achieved through close cooperation between NP Berchtesgaden and DVL.

The main challenge is fragmentation created by intensifying demands from tourism and recreation as well as land use for highways (ID 6+8), urban development, and current or even abandoned agricultural activity. As a hotspot for tourism and outdoor sports, NPB analyzed potential conflicts arising from developments like "overtourism" or social media use in protected areas and discussed solution strategies. Growing numbers of visitors in sensitive areas, easier access to remote areas and temporal expansion of usage are all exemplified by technical developments like E-biking. An update of visitor management and adaptation to current developments, such as social media, is needed, as is the prevention of wildlife disturbances in protected areas (ID 12 + 26). Online posting of "hidden" and often ecologically sensitive spots is a relatively new phenomenon. People visit sites like the National Park in order to recreate images that they have seen online. Many people do not know that they are inside a protected area; however, they describe themselves as "naturalists". As a consequence, wildlife disturbance, trash, campfire sites or the creation of new paths beyond the existing trail network can result in destruction and lead to erosion. Exposed trails and photo-spots are dangerous - serious accidents have already taken place. A good on-site communication program and online strategies are essential to inform people in advance and to minimize the effects to EC (ID 9+26).

In addition, pre-existing concepts for the implementation of EC in the surroundings of the NP were also explored in cooperation with the local Landcare Association. Stakeholders from communes and farmers have been involved in these implementation processes.

SACAs in the PWR

The National Park Berchtesgaden, Naturpark Weißbach and the protected area Hagengebirge comprise a well-connected transboundary SACA1 area. There are some patches of SACA3 in urban areas and along the valleys. SACA2 was mainly calculated around the protected areas.

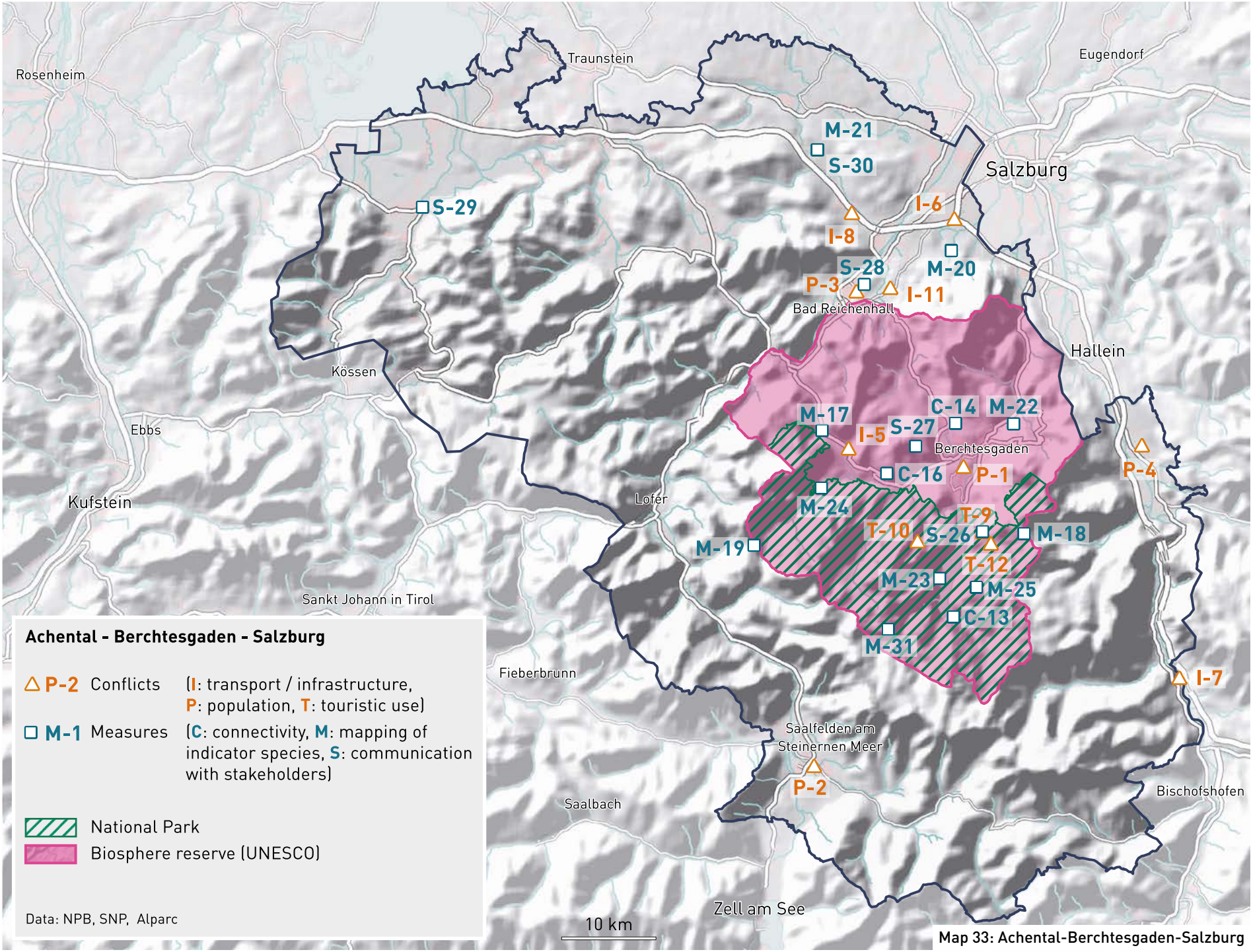
To improve EC, we recommend focusing on existing tools (e.g. the biotope mapping or the landscape structure plan for the Alpenpark Berchtesgaden) combined with macro-scale tools like JECAMI. Linking the landscape structure plan with results from earlier projects (Econnect), sites of cultural landscape with high biodiversity and value for cultural identification, like Alpine pastures and dry grassland, can engender close cooperation between NPB, DVL and its local member Landcare Association BGL.

In order to expand the stepping stone network to connect SACA1 sites like National Park Berchtesgaden with the surrounding SACA2 areas, studies were carried out. Umbrella species for EC, like Hazel Grouse and dragonflies, as well as valuable but rare special grazing sites called "Tratten" (ID: 14-16) were investigated and mapped. The importance of the sites for EC was determined, and basic information for the implementation of measures was created.

To improve EC, discussions were held in the field with experts in nature conservation, landscape planning, pasture management and land care. Furthermore, a cross-border network of experts working on EC was initiated (ID 28).

Perspective (next steps for implementing EC at strategic/practical level)

In ALPBIONET2030, concepts were derived to handle new challenges regarding EC in concert with local actors in the PWR. Regular meetings or management plans (e.g. for Alpine pastures as stepping stones for dry grassland in the National Park surroundings) are important and technical prerequisites for a successful implementation of EC. Moreover, social developments necessitate constant updating.



Achental - Berchtesgaden - Salzburg

△ P-2 Conflicts (I: transport / infrastructure, P: population, T: touristic use)

□ M-1 Measures (C: connectivity, M: mapping of indicator species, S: communication with stakeholders)

National Park

Biosphere reserve (UNESCO)

Data: NPB, SNP, Alparc

Map 33: Achental-Berchtesgaden-Salzburg

6.4 Mont Blanc Region

Ecological connectivity in the Mont Blanc region

The Project Working Region Mont Blanc is composed of valleys and mountain ranges in the northwest of the Alps. Topography is a natural constraint for the mobility of terrestrial species. In the mountains, seasonal attendance and infrastructures of ski resorts are the main threats. In the valleys, the concentration of human activities causes fragmentation of the habitats. Urban pressure increases, and there is an extension of disruption at the foot of the mountain. To increase ecological networks, corridors that cross the valley should be preserved or restored.

SACAs in the Mont Blanc region

The SACAs 1 are mainly protected areas: nature reserves in France (nature protection area), Natura 2000 sites in Italy and District franc in Switzerland. These areas are especially found in sub-Alpine and Alpine zones, from 1500m to 2800m. The fauna is adapted to the altitudinal conditions. Ecosystems here are preserved, and there are few pressures like seasonal attendance. In these areas, fauna population could be threatened because of the situation in the other SACAs.

SACAs 2 are areas relatively well-preserved but with pressures due to tourist activities, such as ski resorts and extension of urbanization. Sloped terrains in mountainside are natural obstacles.

SACAs 3 are located in the three main valleys: the Arve valley (FR), the Rhône valley (CH) and Dora Baltea valley (IT). Land use and population density make conditions difficult for fauna mobility and biodiversity.

Other areas, illustrated in white, are less important for the ecological network of the Alps for two main reasons:

- altitude is too high to be a habitat or a corridor for species. Few terrestrial species can cross this terrain.
- some areas seem less important for fauna mobility. Models showed that fauna preferentially use the surface in SACAs 2.

Approach of SACAs

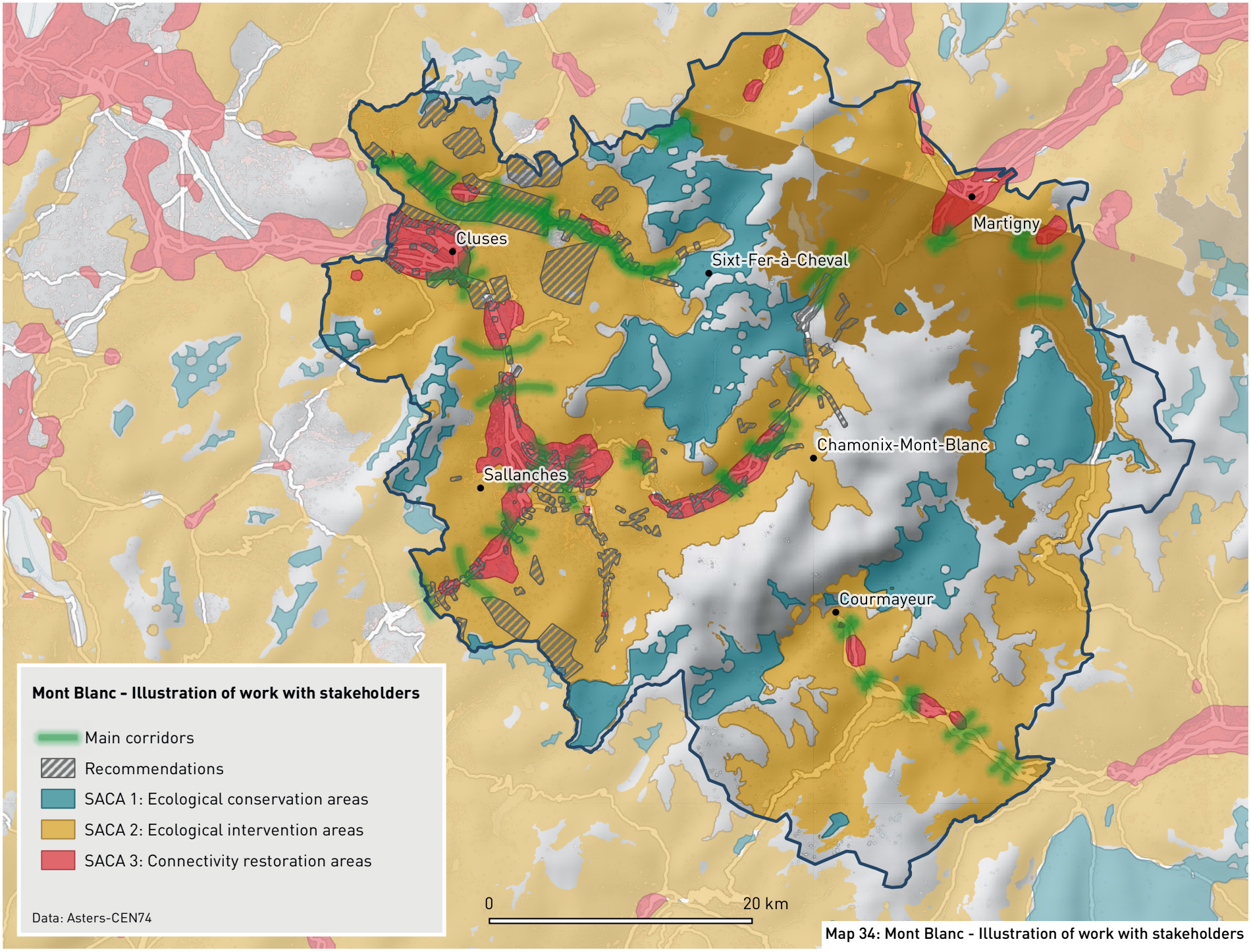
The three kind of SACAs are strategic areas for Alpine connectivity. In the PWR, a considerable proportion of the territory has strategic significance for connectivity. This map of SACAs emphasizes the main hot spots of the Alps, the SACAs 1.These areas should be protected. The SACAs 2, which represent a high surface area, have an importance for the ecological network too. Concrete measures have to be realized to preserve them. Local studies can identify corridors in the SACAs 3 that should be preserved or restored. The Alpbionet project and other studies in each country define some corridors in green on the map. Most of them cross valleys.

Perspective

Models developed by the Alpbionet project and the map of SACAs improve the knowledge of ecological connectivity in this region. Many measures can come out of this project. Each region should use this map to inform spatial planning. Organizations and companies should take ecological connectivity into account in all human activities in the SACAs 1, 2 and 3, including new infrastructures, urbanization, and public works.

Concrete measures have been proposed within the Alpbionet project in the area which hatched on the map. Four kinds of measures are listed: planning measures, works, studies and communication. These measures must improve ecological connectivity for terrestrial, aquatic or aerial species. They are prioritized on a scale from 1 to 3.

In Italy, a local study will complete this map. Specific actions should be described. In Switzerland, the third Rhone modification will improve the connectivity situation in the SACA 3 of Martigny region. A study is ongoing to propose measures for habitats and for species. This map is the first transnational map of ecological connectivity in this area. One of the recommendations is to continue the exchange between the three countries, in order to adopt compatible strategies.



Map 34: Mont Blanc - Illustration of work with stakeholders

6.5 Prealpi Giulie Nature Park (in cooperation with Triglav National Park)

The transhumance and conflict intensity map

Human-wildlife conflicts can negatively affect ecological connectivity. It is therefore important to work at the local level in order to identify the primary sources of conflict, to recognize which stakeholders are involved, and to understand their needs, their concerns and what role they can play in the decision-making process. The main aim is to find shared solutions suitable to each territory. On the Italian side of the Pilot Working Region Julian Prealps Nature Park –Triglav National Park, one of the main issues is the presence of large transhumant flocks, even though livestock grazing plays a key ecological, economical and landscape role.

In this case, the conflicts concern different naturalistic topics (e.g. predation by large carnivores, trampling of floristic species, destruction of corncrake broods, transmission of parasites between sheep and wild animals, etc.) and socio-economic issues (relationships with private landowners of pastures, interference with the hunters' activity, etc.). Therefore, a concrete tool was elaborated to manage and prevent the highlighted conflicts.

Public and private institutions provided useful data, and further information came from the questionnaires submitted to residents and tourists. The method employed to elaborate the map included multiple steps. First, important definitions were generated within working areas by collecting two different types of data concerning:

- routes traversed by the two main flocks and their relative staging points within and close to the park territory;
- places where factors could generate conflicts and where some conflicts are certainly present. The factors and conflicts were:
  - presence of the brown bear (Ursus arctos arctos), considered only as a potential element responsible for sheep predation;
  - presence of corncrake (Crex crex), since this species needs the pastures also used by the flocks for its reproduction;
  - depredation events, considered as an indicator of places where flocks are more vulnerable to losses.;
  - conflict with tourist activities, as hikers and bikers are intolerant of dirty road surfaces and damaged paths;
  - touristic shelters made unavailable for trekkers because shepherds occupy them for long periods;
  - conflicts with herb-pickers and garlic farmers (the same pastures and grazing areas are dedicated to grow garlic and to harvest medicinal herbs);
  - concerns about hunting activities near the park borders;
  - management of damage by other wild animals;
  - more farmers in the same place: sometimes more farmers (with different kinds of livestock) need to use a pasture simultaneously;
  - donkey grazing and touristic related activities.

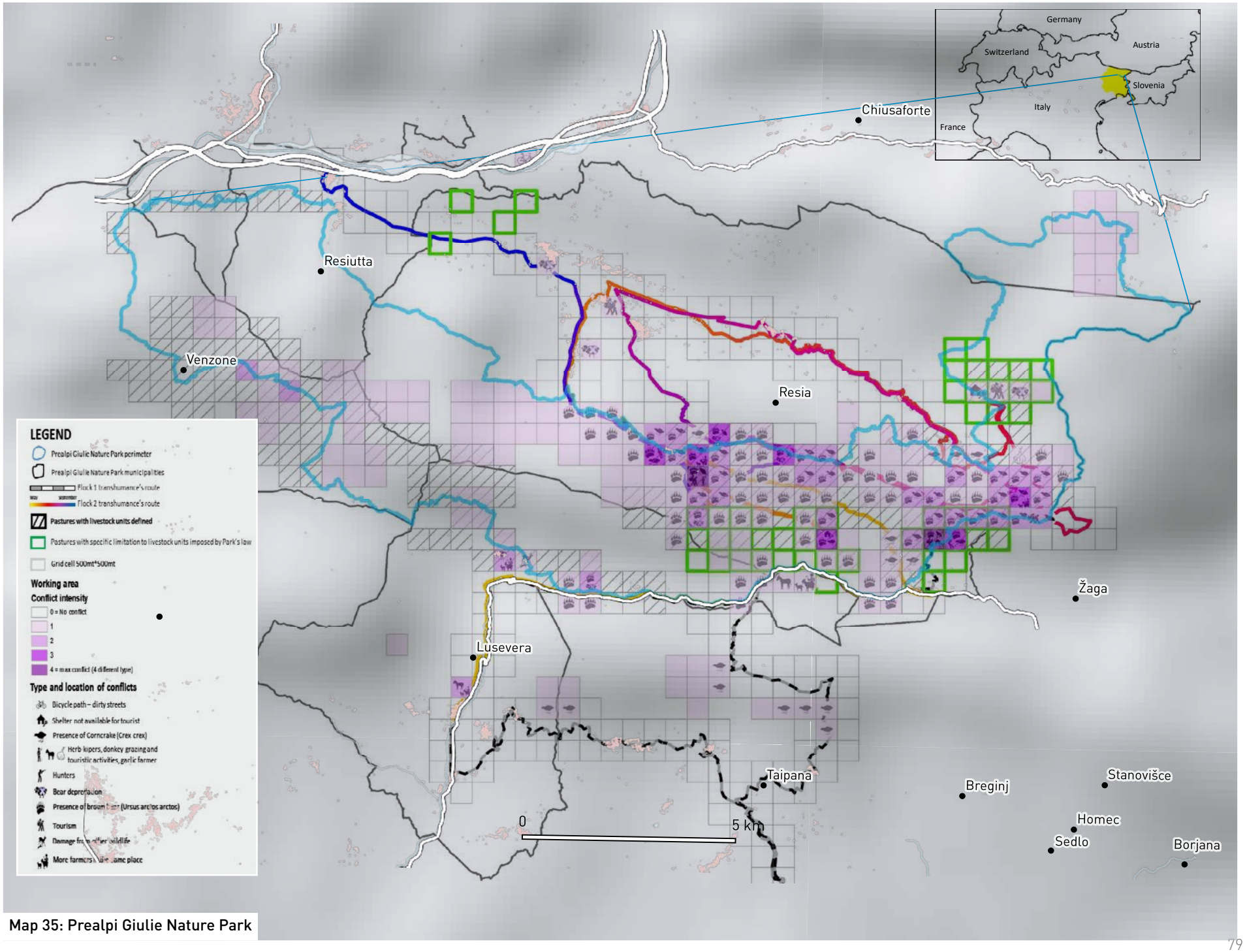
All this information was then geo-referenced and made available as point or line data. Afterwards, these data were elaborated using an open source GIS software: each point and line was attributed to a reference unit represented by a grid cell (500m x 500m). In this way every conflict was defined by a specific and comparable layer. In order to create a concrete conflict and intensity map, a value from 0 to 1 was assigned to each grid cell. The value 0 meant no conflict, and 1 meant presence of conflict. Thanks to spatial overlapping, an intensity scale of conflict was obtained given by the sum of the existing conflicts in the same area. After this calculation, the scale intensity obtained ranged from 0 to 4, where 0 meant no conflict and 4 was equal to the sum of 4 different conflicts.

Finally, to every cell of the working area two other types of data were added: the presence of pastures with calculated livestock units, and whether there was any specific limitation to livestock units imposed by park management plan.

The output map, named "Transhumance and conflict-intensity map", allows the identification of the "hot spot" conflict areas in and around the park and clearly defines type and number of conflicts. Therefore, for example, it makes it possible to:

- correctly direct efforts and resources to apply mitigation measures;
- know where and when to concentrate the monitoring actions for particular species;
- know where and when to develop field activities for the greater public in order to improve awareness of "human-nature conflicts".

The proposed model is easy to update but is only a starting point, and improvements will be necessary. An aspect to investigate further concerns how much every type of conflict really affects the scale intensity, and to assess how difficult it is to solve the conflict.



Map 35: Prealpi Giulie Nature Park

7. The ´Super-SACA´ approach - very important areas for [ecological] connectivity in the Alps

7.1 Strategic Alpine Connectivity Areas

Strategic Alpine Connectivity Areas

This map displays all three of the different types of Strategic Alpine Connectivity Areas at once. The map clearly illustrates that the Ecological Intervention Areas (EIA) constitute the largest percentage of the Strategic Alpine Connectivity Areas. The EIA act as linkages between Ecological Conservation Areas (ECA) as well as buffer zones.

Looking at the Alpine and EUSALP picture, it appears that the ECA, mostly located in the higher Alpine areas, are, to a large extent, already benefiting from an existing protection measure (some category of protected area) and therefore need commitment to long term preservation of this status without any degradation of ecological functioning.

Connectivity Restoration Areas (CRA), located in the lower altitudes, are concentrated at the border area between the mountain zone and the lower lands surrounding the Alps. Here, interventions to improve ecological connectivity require participation of a larger number of stakeholders as well as significant financial investment. As these areas are often located in densely urbanized areas or areas with intensive land use, actions must also be closely coordinated with the spatial planning sector.

Since the EIA represent the greatest surface area and are geographically distributed over the different altitudes and areas of the Alps and the EUSALP, they are the focus of this approach. Their relative abundance also illustrates the high potential both in and around the Alps for ecological connectivity improvement by implementing the corresponding actions. Large parts of the landscape would benefit from a coherent initiative of ecological network building.

7.2 White areas

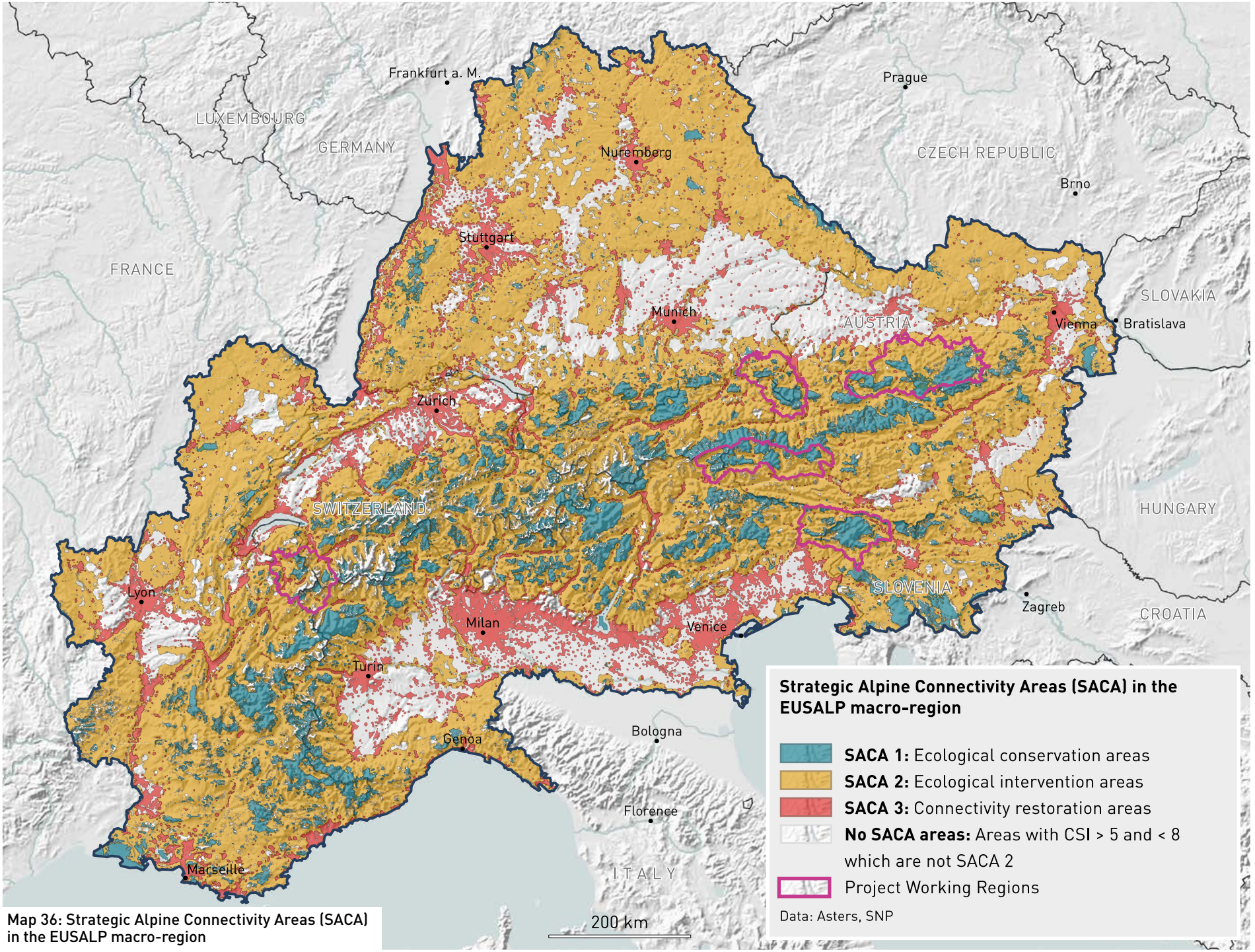
A non expected result of the analysis of connectivity and a main finding of the project

Map number 17 shows the three categories of Strategic Alpine Connectivity Areas. All Strategic Alpine Connectivity Areas together cover 77% of the EUSALP territory (84% of the territory of the Alpine Convention). Therefore, 23% of the area is not covered by any of the three SACA categories.

Areas with CSI values between 5 and 8 would normally fall into the category of the Ecological Intervention Areas (SACA 2). Based on their individual geographic context, they have, nevertheless, been excluded from this category because of their location in areas where interventions concerning improvement of ecological connectivity would not make much sense according to the criteria defined by the project (lakes, high altitudes above 2500m asl). They have also been excluded from this category if they do not act as connecting elements between two Ecological Conservation Areas. This is the case if distances between two ECAs are too great to ensure connectivity between them.

It is noticeable that the areas not considered in the Strategic Alpine Connectivity Areas categories are mostly located on the border between the EUSALP territory and the territory of the Alpine Convention. The intensive land use observed in this zone explains the absence of protected areas and, according to our findings, therefore also the absence of Ecological Conservation Areas that could be connected. The main land use type leading to these results is agriculture, which is practiced in an intensive way in the concerned zones.

Improvement of the permeability of the landscape matrix and creation of larger protected areas in these zones could certainly improve the situation and would lead to a classification in the Ecological Intervention Areas category.



Map 36: Strategic Alpine Connectivity Areas (SACA) in the EUSALP macro-region

7.3 Main barriers in, from and to the Alps

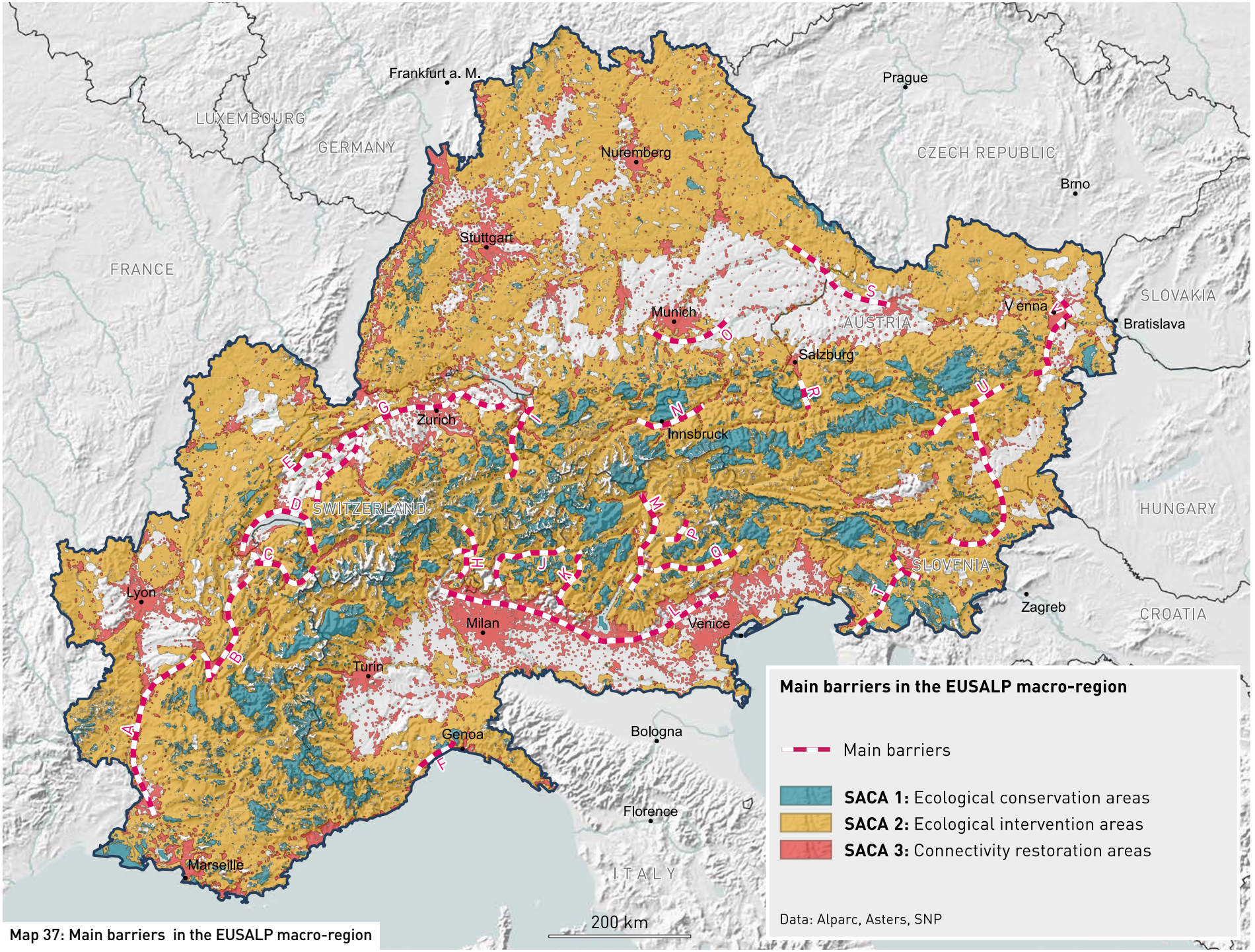
The Alps: Surrounded by an important infrastructure and activity belt isolating Alpine nature and species

Some forms of land use and their intensity have negative effects on ecological connectivity. This map highlights important barriers to ecological connectivity for the Alps due to high impact land use, important infrastructure and human activities. The barriers have been identified based on an exhaustive analysis of data, expert knowledge and verification "in situ".

The most important barriers are located around the Alps mainly in the transition zone between the Alps and the EUSALP territory (Alpine Macro-Region). They are characterized by a significant concentration of urban and economic infrastructure generating high transport and energy flows.These peri-Alpine barriers are situated in upper Italy (Po flat plane); the southern French Rhône valley up to lake Geneva by way of some intensively used pre-Alpine valleys (e.g. the French Isere valley); the central Swiss region between the Jura and the Alps; the urban belt south of Munich (DE) with a very high transport flow to and from the Alps and a large discontinuous sector of agglomerations, infrastructure and intensive traffic between Vienna (AT) in the North and Maribor (SI) in the South continued by a barrier of transport infrastructure between Ljubljana (SI) and Trieste (IT).

A series of inner-Alpine valleys have been identified as inner Alpine barriers due to a combination of varied factors such as high traffic of people and merchandise, important settlements linking all economic activities, intensive agriculture, canalization of riverine systems, monocultures, and heavy infrastructure, such as highways and railways protected by fences and energy lines concentrated in some important valley floors. Such inner-Alpine valleys include: the Isere valley between Grenoble and Albertville (FR); parts of the Arve Valley (FR) between Annemasse and Sallanches; the lower Rhône Valley (Valais, CH); the Rhine Valley between Chur and Bregenz (CH, AT); parts of the Inn valley (AT); the area around Lake Como, parts of the Adige, Adda, Camonica, Brenta and Fiemme valleys (IT); the northern Salzach valley and parts of the Mürztal (AT).

Nevertheless, most of these inner Alpine barriers still have hybrid areas allowing for migration of some species. It is essential that those areas are conserved to avoid isolating even more Alpine nature and species.



Map 37: Main barriers in the EUSALP macro-region

7.4 Overcoming main barriers

Super SACAs in the Alps: Connectivity areas and ecological macro corridors– identifying solutions to ensure ecological connectivity to and from the Alps

Ecological connectivity is no longer ensured in many parts of the Alps, especially in the large belt area around the Alpine arc. To protect biodiversity and enable enough gene exchange and migratory movements of species, it is crucial to concentrate on measures in areas where connectivity is the most needed and where implementation is feasible. Transalpine ecological macro corridors and strategic connectivity areas are hot spots of connectivity allowing species to overcome barriers by improving landscape permeability through adequate measures and strategies.

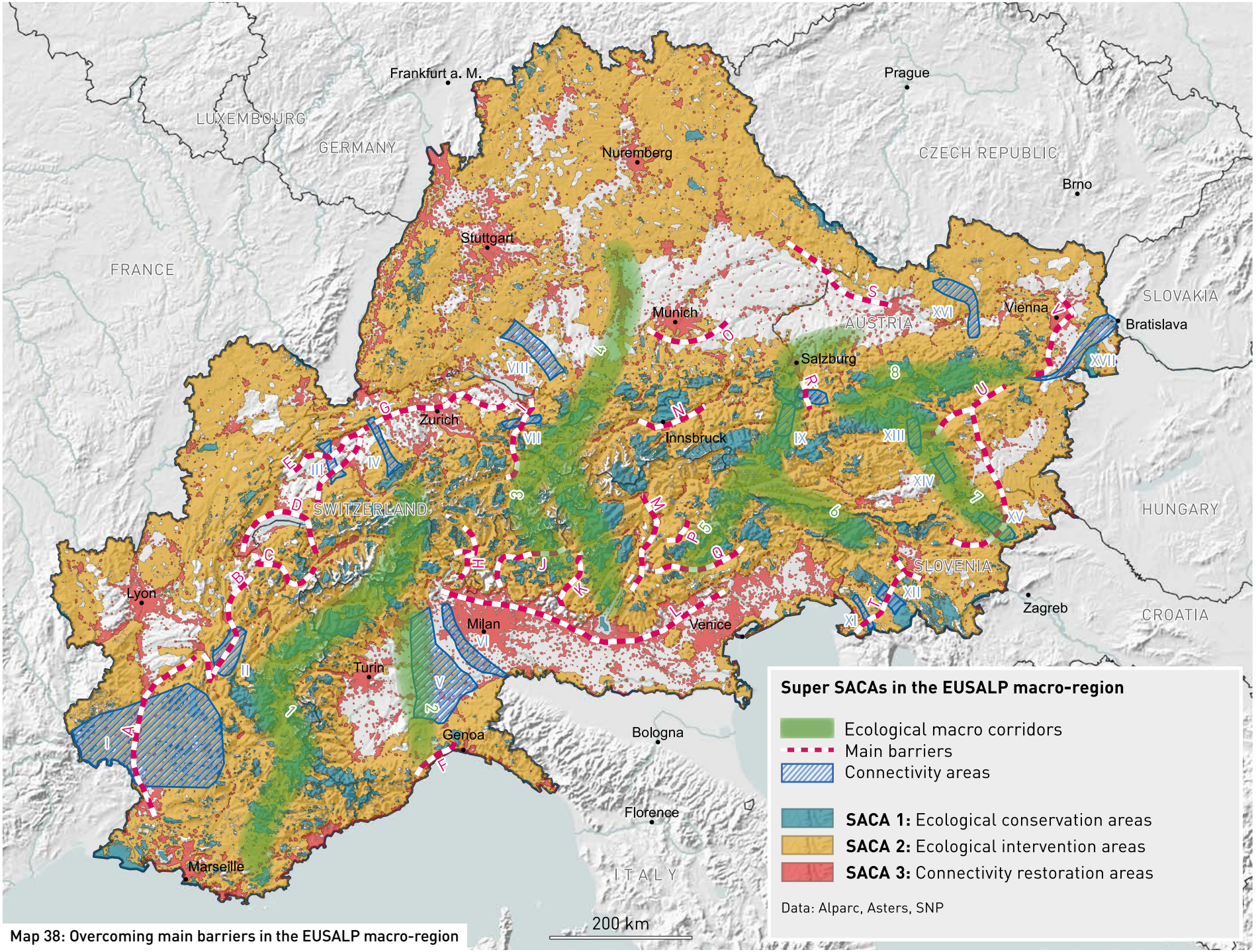
The main features of Alpine ecological connectivity (barriers, ecological macro corridors and connectivity areas) are summarized on the map "**Super SACA**", which illustrates the high priority areas for action to ensure ecological connectivity for generations to come. Adapted measures need to be taken in these areas.

Identification of these areas reflects the output of a complex data analysis of several indicators such as land use. It also relies on the classification of the Alps into three SACA types as well as expert knowledge from the different Alpine countries and ALPBIONET2030 project partners.

Connectivity areas are strategic regions, where protection, planning and specific ad-hoc measures are necessary to avoid isolation of Alpine biodiversity at the Alpine periphery (EUSALP) and to allow the conservation of large-scale wildlife corridors reaching neighbouring mountain massifs of the Alps. Connectivity areas represent pathways through identified obstacles or bridging areas where SACA 1 areas (made of "biotopes" and "stepping stones" of an ecological network) are missing or are insufficient in number.

Ecological macro corridors functionally ensure long distance links between habitats and less fragmentated regions by providing both north-south and east-west ecological connectivity in (and through) the Alps. North-south "corridors" are highly significant for species migration and constitute an important "green-infrastructure" and an adaptation strategy addressing climate change. It is of high ecological interest to conserve these areas along the macro corridors, which are often composed of protected areas. It is essential to understand that these macro corridors and the areas surrounding them are part of the last non-fragmented sectors of the Alps covering numerous SACA 1 areas.

Some of the connectivity areas (e.g. I, III, IV, V, XII, XVII) and the macro corridors (e.g. 2, 4, 7) have a very high importance not only for the Alps and the EUSALP area but also for larger parts of Europe by interconnecting European mountain massifs or different biogeographical regions. Defining "Super SACA", the map provides the first concrete indication of where to prioritize action. This does not, however, represent an exhaustive list.



Map 38: Overcoming main barriers in the EUSALP macro-region

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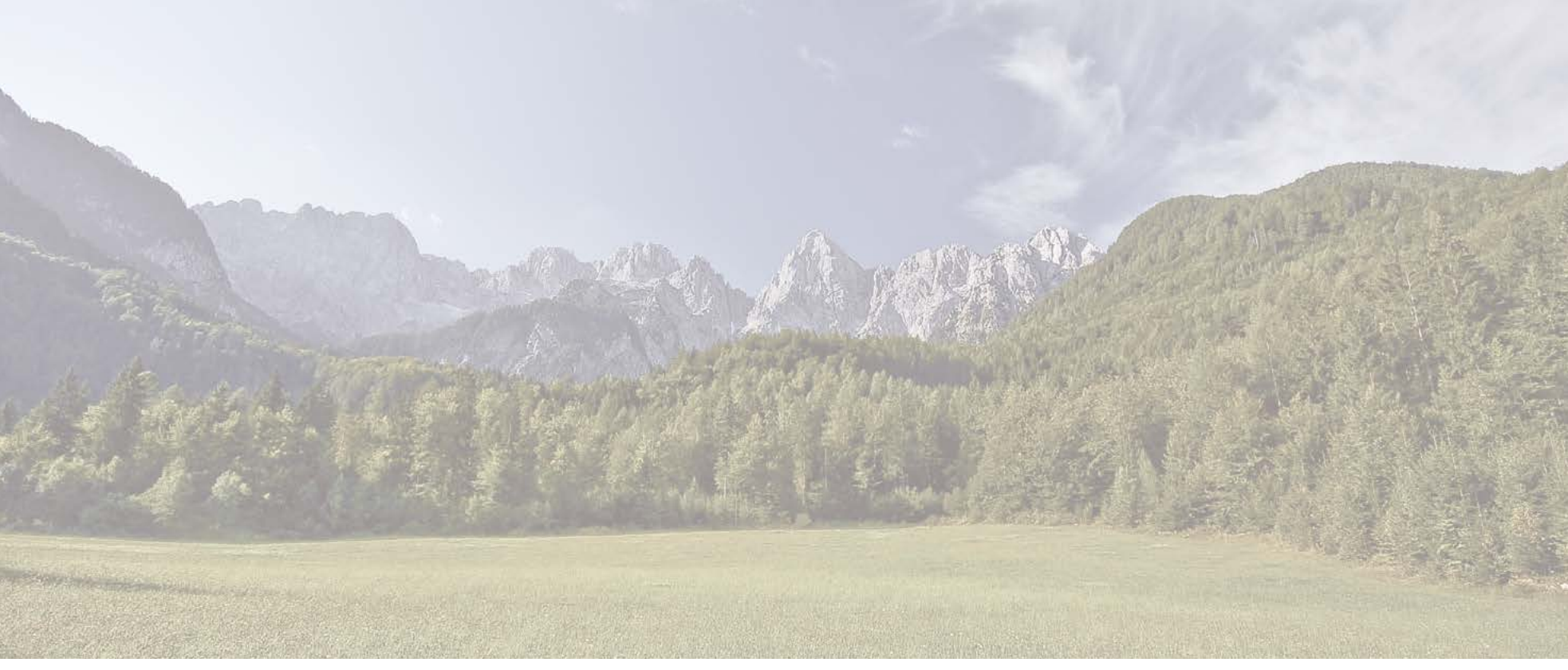

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