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Recommendations on the Methodology for Assessing Anthropogenic and Military Impact on the Emerald Network Sites, Preparing Site Restoration Strategies, and Ensuring Effective Management

Conflict and Environment Observatory (CEOBS)

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Conflict and Environment Observatory

CEOBS is a UK charity that provides a voice for our environment - and those who depend upon it - when it faces harm from armed conflicts and military activities.

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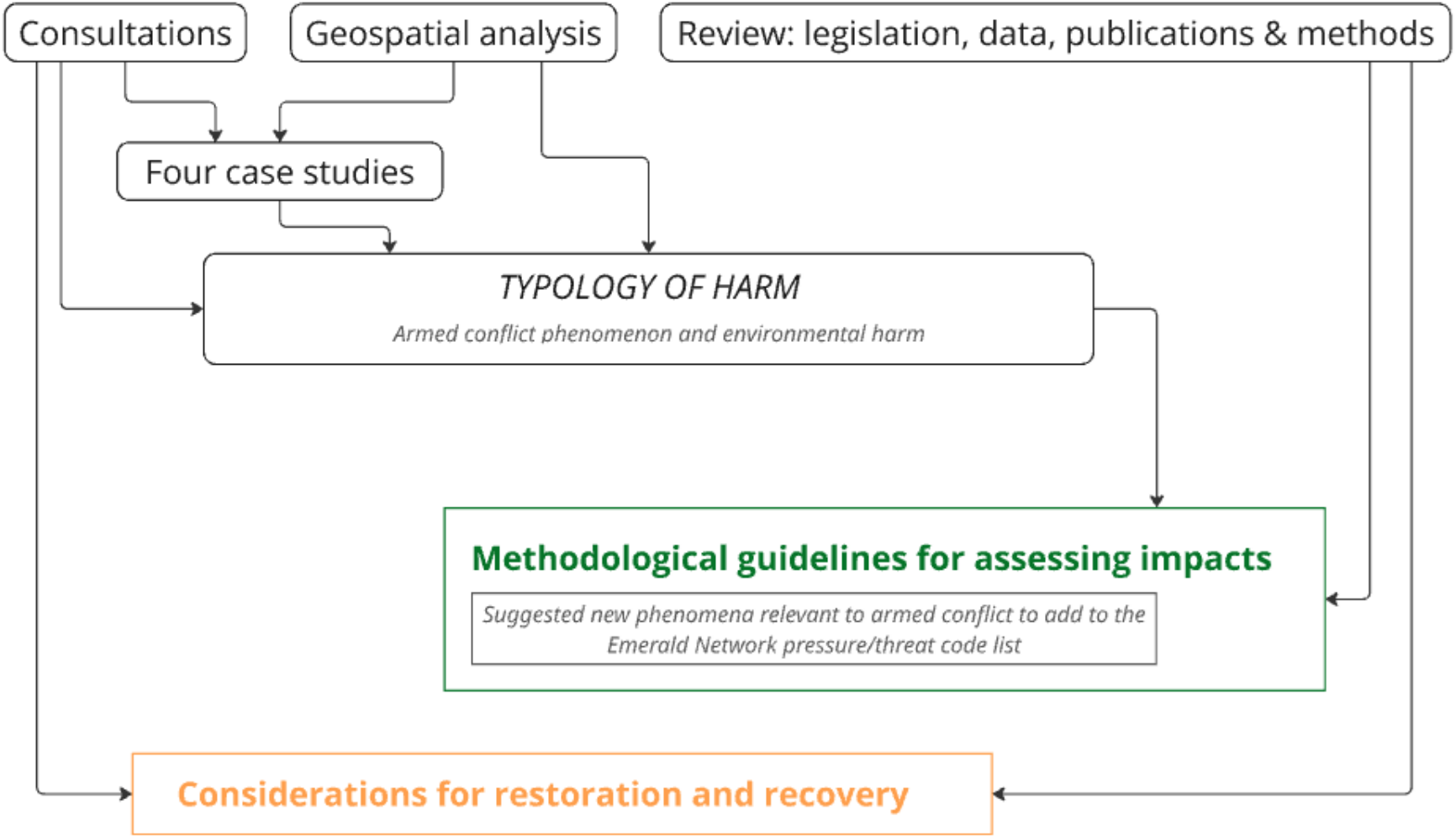
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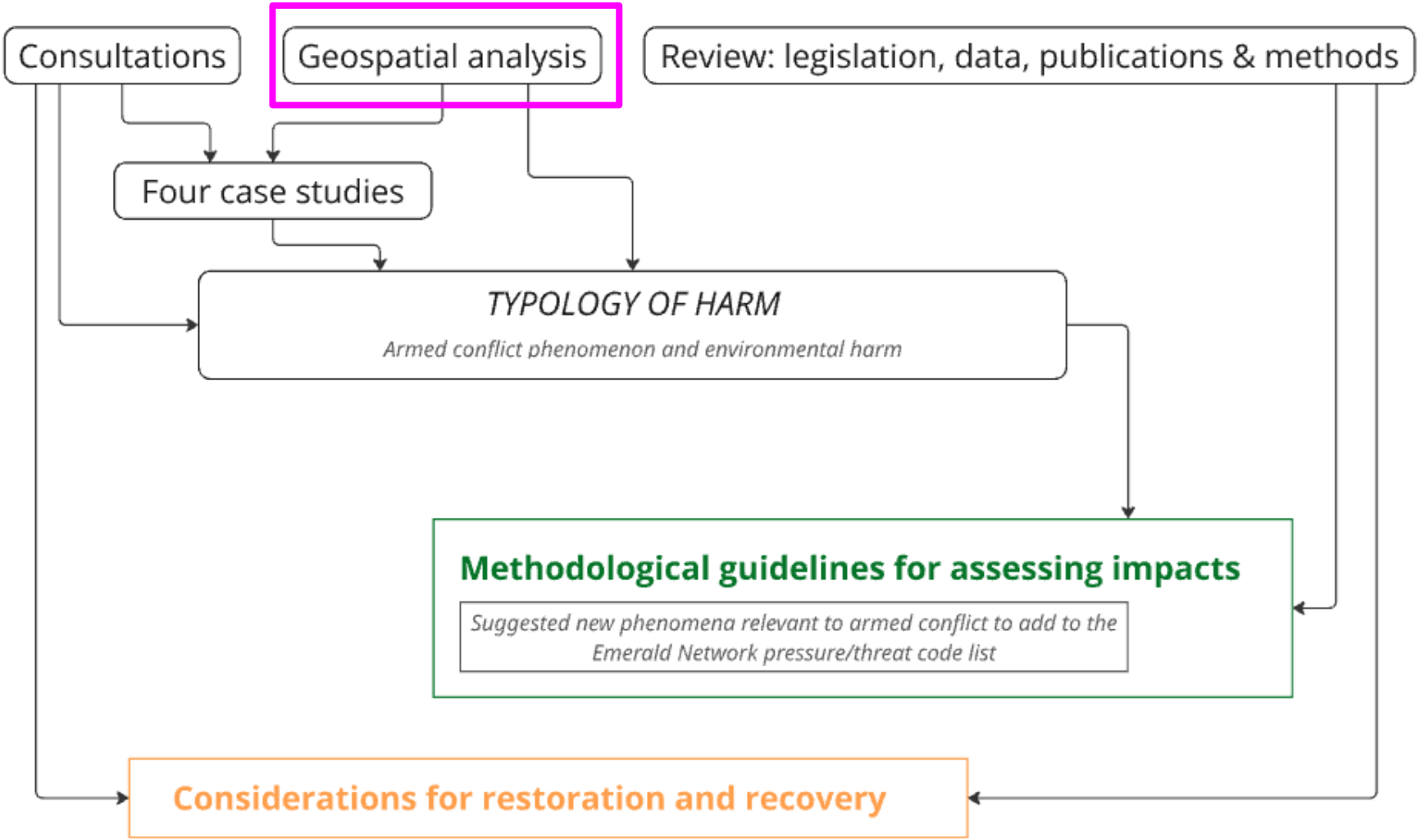
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Summary of Emerald Network sites in Ukraine

Emerald Network polygons from the European Environment Agency (EEA), version 15/02/2024. Habitat classes scraped from online EEA Standard Data Form, version 29/11/2024.
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Topology of harm: Ukraine wide analysis

Indicators obtained from the Standard Data Form for each Emerald site.

A method to identify if each site:

- Was occupied before 24 February 2022
- Was occupied as of 30 November 2024
- The number of days under occupation February 2022 - November 2024
- Was non-occupied, but was within 10 km of between February 2022 - November 2024 (and the number of days)

So we could investigate indicators as a function of conflict status

Topology of harm: Ukraine wide analysis

Out of 538 approved and proposed Emerald sites, nearly half (47%) – 250 sites – were either occupied (219) or located within 10 km of the frontline (31).

This indicates a disproportionate impact on Emerald sites, given that the Russian Federation occupied approximately ~20% of Ukraine's territory.

Habitats

Code	Name	# total EN sites containing species	EN sites occupied at any point since Feb. '22		
			# count	% percent	cumulative days
E1.2	Perennial calcareous grassland and basic steppes	244	115	47	99,932
G1.7	Thermophilous deciduous woodland	139	72	52	48,873
E3.4	Moist or wet eutrophic and mesotrophic grassland	222	65	29	23,277
E5.4	Moist or wet tall-herb and fern fringes and meadows	159	62	39	22,191
F3.247	Ponto-Sarmatic deciduous thickets	146	62	42	50,262
F9.1	Riverine scrub	177	60	34	15,935
D5.2	Beds of large sedges normally without free-standing water	181	59	33	15,273
G1.21	Riverine Fraxinus - Alnus woodland, wet at high but not at low water	117	57	49	17,317
C1.222	Floating Hydrocharis morsus-ranae rafts	156	51	33	11,126
C2.33	Mesotrophic vegetation of slow-flowing streams	143	50	35	12,919
E2.2	Low and medium altitude hay meadows	161	50	31	16,689
G1.11	Riverine Salix woodland	130	47	36	14,618
H2.6	Calcareous and ultra-basic screes of warm exposures	59	45	76	40,938
C1.224	Floating Utricularia australis and Utricularia vulgaris colonies	125	44	35	5,303
E1.9	Open non-Mediterranean dry acid and neutral grassland, including inland dune grassland	93	44	47	11,023
X18	Wooded steppe	83	42	51	35,796
C3.51	Euro-Siberian dwarf annual amphibious swards	94	38	40	13,143
G1.A1	Quercus - Fraxinus - Carpinus betulus woodland on eutrophic and mesotrophic soils	149	38	26	17,574
G1.22	Mixed Quercus - Ulmus - Fraxinus woodland of great rivers	62	37	60	15,835
A5	Sublittoral sediment	39	35	90	36,424

Resolution 6 species

Code	Name	# total EN sites containing species	EN sites occupied at any point since Feb. '22		
			# count	% percent	cumulative days
Plants					
6733	Paeonia tenuifolia	52	46	88	46,503
4067	Echium russicum	61	45	74	17,486
4095	Stipa zalesskii	39	37	95	36,950
1477	Pulsatilla patens	77	29	38	9,274
1805	Jurinea cyanoides	61	28	46	8,526
Invertebrates					
1083	Lucanus cervus	246	95	39	51,289
1060	Lycaena dispar	221	76	34	36,298
4028	Catopta thrips	106	52	49	47,154
1088	Cerambyx cerdo	125	50	40	23,807
1078	Callimorpha quadripunctaria	126	49	39	39,938
Fish					
1149	Cobitis taenia	204	75	37	27,259
1134	Rhodeus sericeus amarus	175	58	33	22,195
1145	Misgurnus fossilis	163	54	33	21,347
1130	Aspius aspius	101	38	38	16,764
2484	Eudontomyzon mariae	53	28	53	10,323

Code	Name	# total EN sites containing species	EN sites occupied at any point since Feb. '22		
			# count	% percent	cumulative days
Amphibians					
1188	Bombina bombina	198	63	32	19,897
1166	Triturus cristatus	157	45	29	7,571
1171	Triturus karelinii	10	10	100	10,440
1993	Triturus dobrogicus	5	1	20	1,044
Reptiles					
1220	Emys orbicularis	235	90	38	47,420
1298	Vipera ursinii	59	48	81	49,223
1279	Elaphe quatuorlineata	27	22	81	22,913
1293	Elaphe situla	13	13	100	13,572
5194	Elaphe sauromates	4	3	75	3,132
Birds					
A338	Lanius collurio	441	168	38	102,116
A081	Circus aeruginosus	342	126	37	82,717
A339	Lanius minor	249	125	50	73,635
A307	Sylvia nisoria	304	125	41	63,863
A224	Caprimulgus europaeus	294	112	38	69,772
Mammals					
1355	Lutra lutra	178	51	29	16,272
1337	Castor fiber	126	41	33	11,882
1352	Canis lupus	121	38	31	19,931
1351	Phocoena phocoena	25	23	92	23,896
2633	Mustela eversmanii	32	19	59	17,640

Rare species

Name	# EN sites	Name	# EN sites	Name	# EN sites
Achillea glaberrima	1	Acipenser sturio	2	Stipa syreistschikowii	6
Alburnus mento	1	Gortyna borelii lunata	2	Steveniella satyrioides	7
Alosa fallax	1	Lepidium turczaninowii	2	Crambe koktebelica	8
Alosa immaculata	1	Rhynchocypris percnurus	2	Aegypius monachus	9
Branta leucopsis	1	Astragalus setosulus	3	Mesosa myops	9
Centaurea pseudoleucolepis	1	Brassica sylvestris ssp. taurica	3	Vormela peregusna	9
Cyclamen kuznetzovii	1	Cygnus columbianus bewickii	3	Triturus karelinii	10
Dictyota dichotoma	1	Desmana moschata	3	Onosma polyphylla	11
Euphydryas maturna	1	Najas flexilis	3	Himantoglossum caprinum	12
Phengaris nausithous	1	Serratula tanaitica	4	Elaphe situla	13
Porphyrio porphyrio	1	Lagoseris purpurea	5	Allium regelianum	16
Pulsatilla pratensis ssp. hungarica	1	Oxyura leucocephala	6	Phalacrocorax aristotelis desmarestii	16

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Topology of harm: Ukraine wide analysis

Geospatial analysis, indicators for each site:

- Number of landscape fires and indication if anomalous [satellite - NASA VIIRS]
- Area of forest disturbance [satellite - European Forest Disturbance Atlas]
- Number of conflict incidents [OSINT - Geo Confirmed]
- Russian/Belarussian military earthworks [OSINT - Brady Africk 2025]
- Military positions [OSINT - Project Owl]

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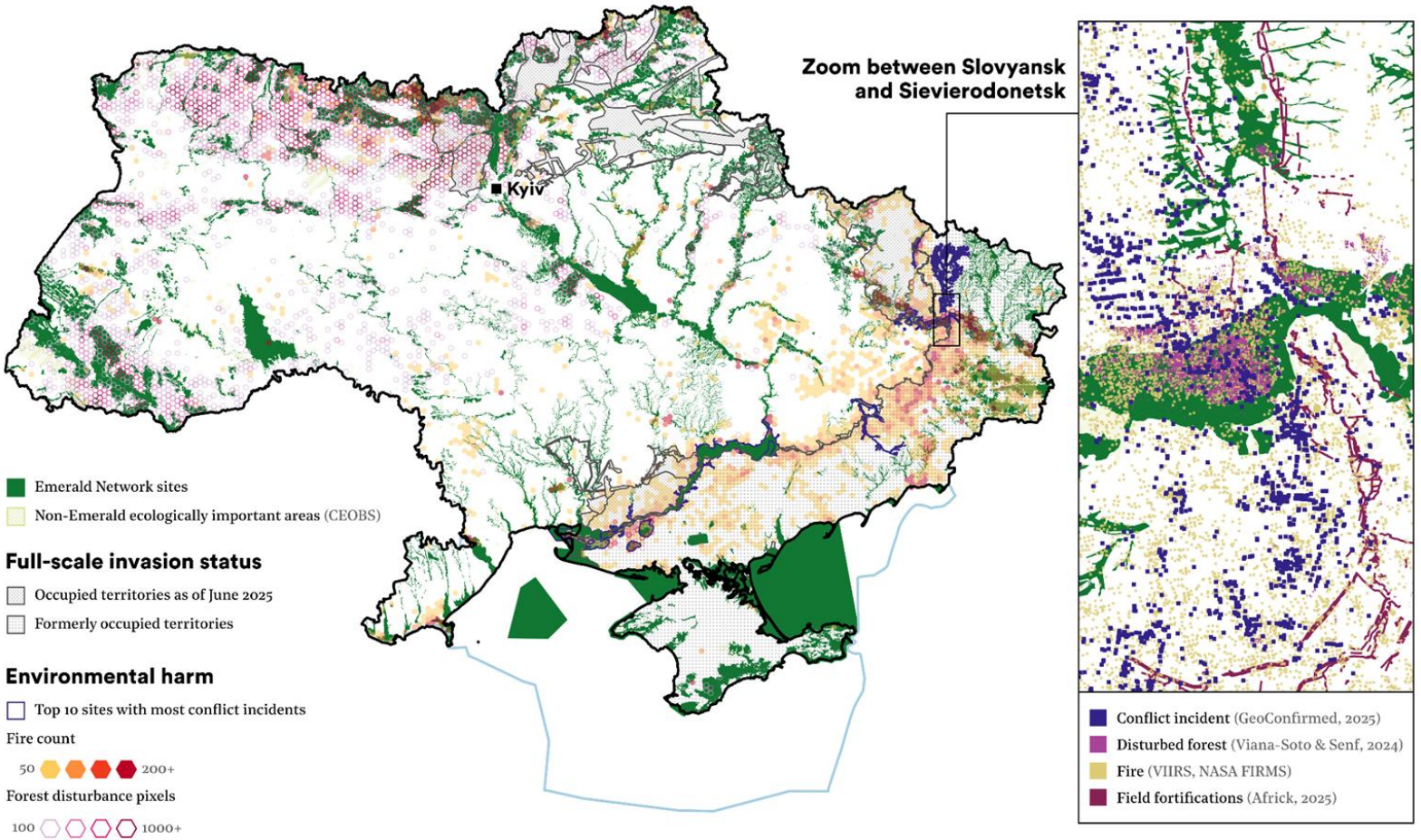
Armed conflict phenomena risking harm to Emerald Network sites



Emerald Network polygons: European Environment Agency (EEA), version 15/02/2024. Fire data: VIIRS from NOAA-20 JPSS-1 (VJ114IMGDL) processed by LANCE / FIRMS.
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Topology of harm: Ukraine wide analysis

- 35,778 fires detected in occupied/front-line EN sites compared to only 6,098 fires in all other sites.
- This fire activity was classified as anomalous in 69% of cases (172 sites).
- 43,262 ha of disturbed forest in occupied/front-line EN sites compared to 29,490 ha in those sites that have not.
- 940 conflict incidents in sites that have been occupied or within 10 km of front-lines, compared to only 10 outside. Earthworks (fortifications, trenches, bunkers etc) visible in 33 sites.

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Geospatial analysis: Fire

Code	Name	Designation	Primary Habitat Type	
Fire occurrence (Feb. '22- Dec. '24)				# days
UA0000315	Siverskyi Donets river valley in Luhansk oblast	No designation	Riverine Fraxinus - Alnus woodland, wet at high but not at low water	3,348
UA0000317	Siverskyi Donets river valley in Kharkiv oblast - 2	No designation	Riverine Fraxinus - Alnus woodland, wet at high but not at low water	2,646
UA0000046	Chornobylskyi Biosphere Reserve	Biosphere Reserve	Moist or wet eutrophic and mesotrophic grassland	2,445
UA0000069	Kreminski Lisy	No designation	Sarmatic steppe Pinus sylvestris forests	1,766
UA0000438	Steppes of the Donetsk ridge	No designation	Perennial calcareous grassland and basic steppes	1,586
UA0000215	Kinburnska Kosa	Regional Landscape Park	Open non-Mediterranean dry acid and neutral grassland, including inland dune grassland	1,542
UA0000029	Sviati Hory	National Nature Park	Sarmatic steppe Pinus sylvestris forests	1,500
UA0000107	Oleshkivski Pisky	National Nature Park	Inland Sand Dunes	1,169
UA0000440	Naholna river basin	No designation	Perennial calcareous grassland and basic steppes	1,084
UA0000441	Steppes of the Great Kamianka river basin	No designation	Perennial calcareous grassland and basic steppes	897

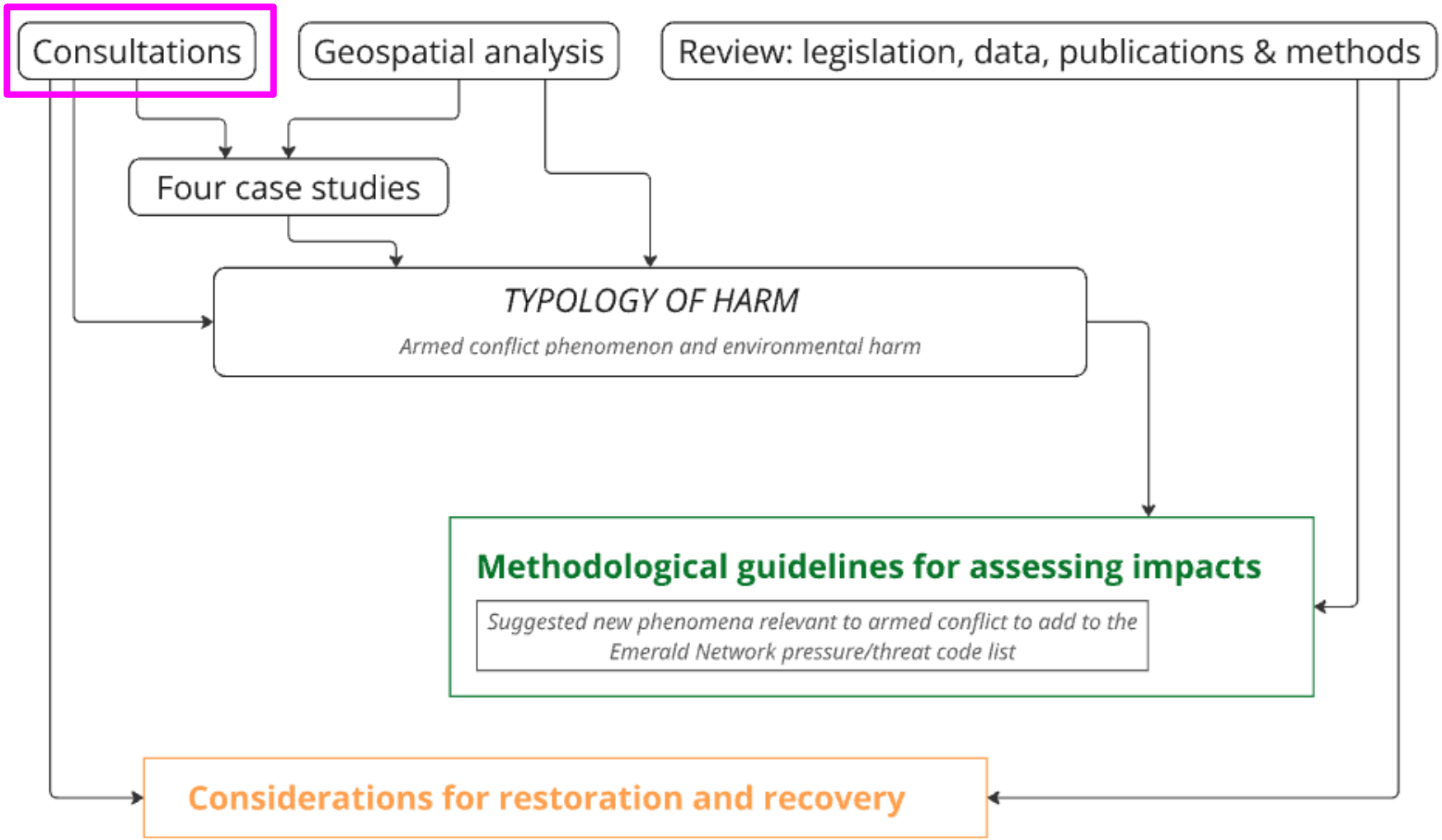
Geospatial analysis: Forest disturbance

Code	Name	Designation	Primary Habitat Type	
Forest loss (2022 and 2023)				Ha
UA0000046	Chornobylskyi Biosphere Reserve	Biosphere Reserve	Humid grassland, Mesophile grassland	10,702
UA0000315	Siverskyi Donets river valley in Luhansk oblast	No designation	Riverine Fraxinus - Alnus woodland, wet at high but not at low water	4,778
UA0000317	Siverskyi Donets river valley in Kharkiv oblast - 2	No designation	Riverine Fraxinus - Alnus woodland, wet at high but not at low water	3,950
UA0000069	Kreminski Lisy	No designation	Sarmatic steppe Pinus sylvestris forests	3,601
UA0000090	Ovrutskyi	Nature Reserve	Moist or wet eutrophic and mesotrophic grassland	2,833
UA0000029	Sviati Hory	National Nature Park	Sarmatic steppe Pinus sylvestris forests	1,556
UA0000047	Mizhrichynskyi Regional Landscape Park	Regional Landscape Park	Moist or wet eutrophic and mesotrophic grassland	1,393
UA0000481	Hrezlianskiy	No designation	Low and medium altitude hay meadows	1,243
UA0000172	Drevlianskyi Nature Reserve	Nature Reserve	Moist or wet eutrophic and mesotrophic grassland	983
UA0000107	Oleshkivski Pisky	National Nature Park	Inland Sand Dunes	925

Geospatial analysis: Conflict incidents

Code	Name	Designation	Primary Habitat Type	
Conflict incidents (Feb. '22- Dec. '24)				Incident count
UA0000069	Kreminski Lisy	No designation	Sarmatic steppe Pinus sylvestris forests	176
UA0000192	Lower Dnipro	National Nature Park	Riverine Salix woodland	143
UA0000447	Zaporizhian Cossacks secret waterway	No designation	Perennial calcareous grassland and basic steppes	116
UA0000403	Krasna river valley	No designation	Perennial calcareous grassland and basic steppes	88
UA0000107	Oleshkivski Pisky	National Nature Park	Inland Sand Dunes	49
UA0000465	Oskol	No designation	Perennial calcareous grassland and basic steppes	34
UA0000215	Kinburnska Kosa	Regional Landscape Park	Open non-Mediterranean dry acid and neutral grassland, including inland dune grassland	31
UA0000106	Kakhovske Reservoir	UA12 - Reservoir	Perennial calcareous grassland and basic steppes	22
UA0000029	Sviati Hory	National Nature Park	Sarmatic steppe Pinus sylvestris forests	21
UA0000097	Biloberezhzhia Sviatoslava National Nature Park	National Nature Park	Littoral sand and muddy sand	16

Topology of harm: Geospatial analysis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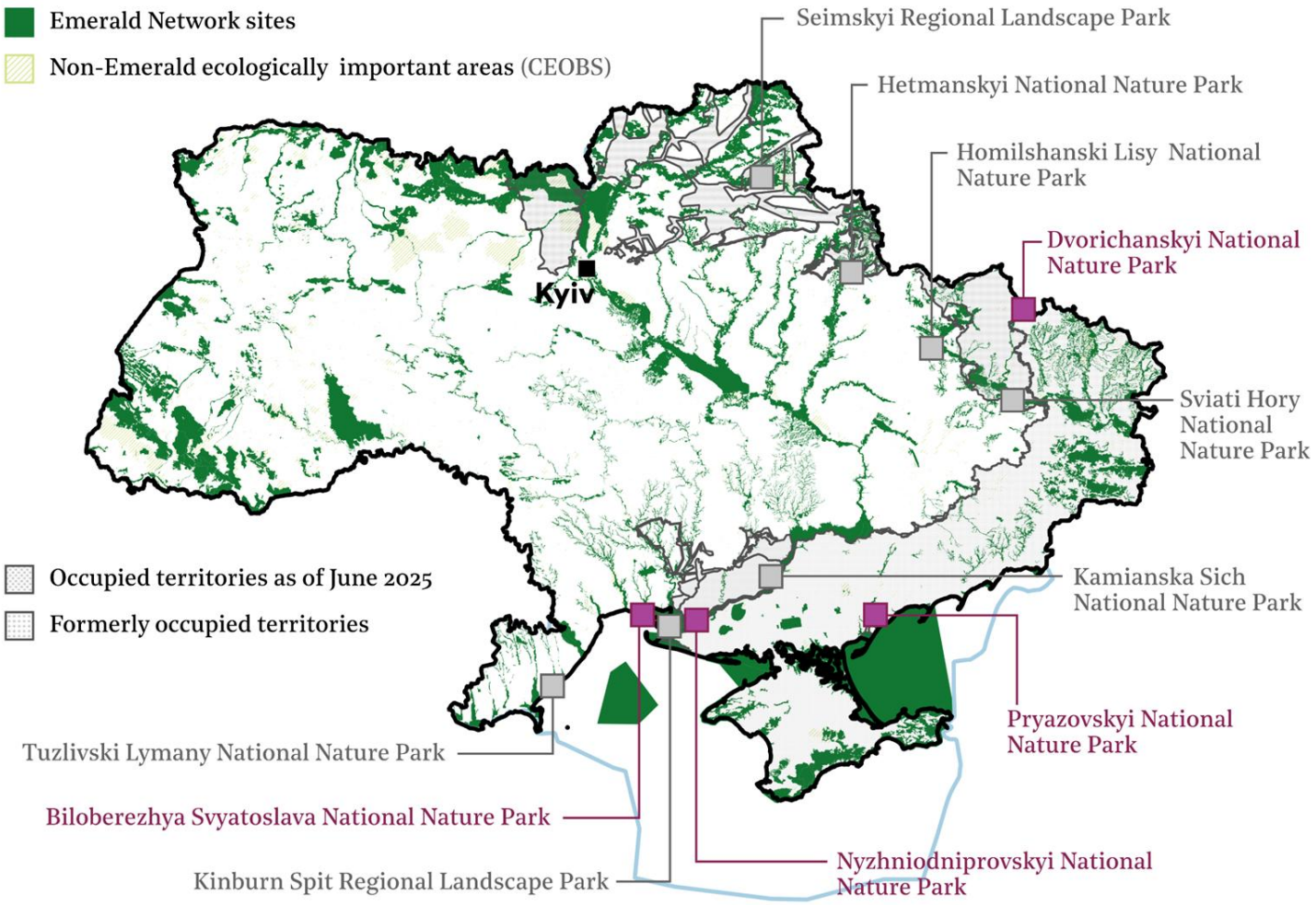
Case study and consultation Emerald Network sites



Topology of harm: Consultations

- Following literature reviews, legal analysis, satellite and OSINT observations;
- 11 key affected protected areas;
- 6 questionnaires returned;
- 27 questions covering direct damage, indirect damage, assessment of priorities and needs, pre-war pressures and impacts;
- Multiple choice and open-ended questions;
- Valuable data and insights.

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Topology of harm: Consultations

Key military impacts identified by the staff:

- Artillery and missile shelling;
- Air and drone strikes;
- Combat operations involving heavy military equipment;
- Construction of fortifications;
- Military waste;
- Noise and disturbance;
- Damage to soils and cratering;
- ERW/UXO contamination;
- Ecosystem fires;
- Destruction of habitats and rare plant communities;
- Geomorphological damage;
- Illegal logging;
- Loss of property and records;
- Dangers to park staff;
- Loss of tourism activity.

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Topology of harm: Consultations

ERW/UXO contamination:

- 11,894.5 in Sviati Hory NNP (only some firebreaks and roads cleared)
- 11,673.2 in Hetmanskyi NNP;
- 15,000 ha of Dnipro-Buh Estuary;
- Sea and underwater mines;
- Injuries to staff, loss of vehicles;

Ecosystem fires:

- 6,000 ha in Svyati Hory;
- 9,223 ha in Biloberezhya Svyatoslava;
- 10,000 ha in the Lower Dnipro NNP;
- 1,527 ha in Dvorichanskyi RLP;
- Firefighting complicated because of fighting and explosives;

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Topology of harm: Consultations

Damage assessment:

- Damage assessments are coordinated with the law enforcement and prosecutor's offices;
- Only a fraction of the area covered;
- Satellite assessments do not provide exhaustive information on habitat and plant community damage;
- Soil and water sampling are rare - mostly within academic cooperation projects (Hetmanskyi NNP);
- Drone surveys are limited.

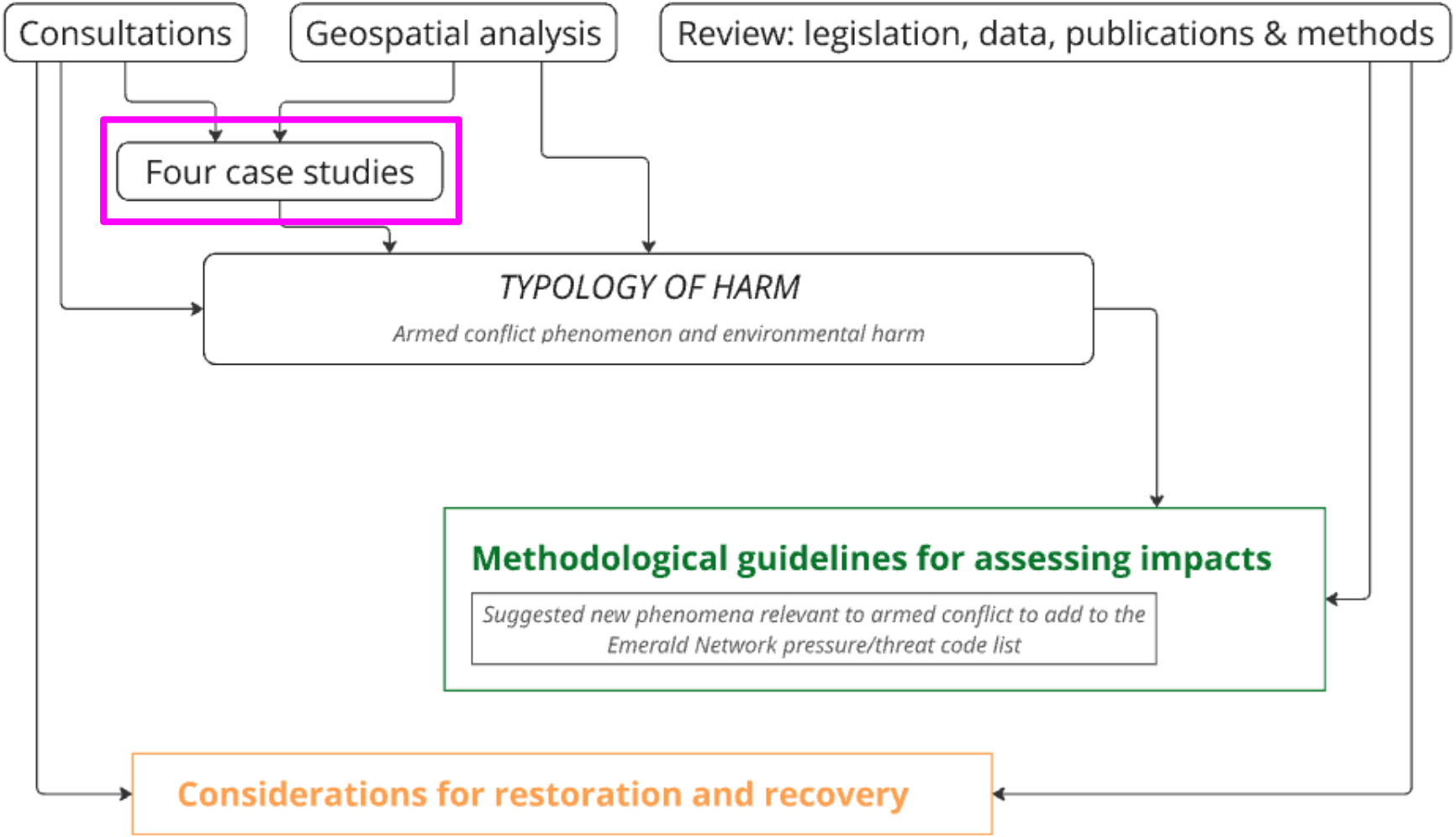
Topology of harm: Consultations

Resource needs:

- Non-technical survey, mine clearance and physical access;
- Satellite images;
- Laboratory capacities;
- Equipment and vehicles;
- Involvement of a sufficient number of specialists and researchers

Staff needs:

- Financial needs;
- Social support;
- Housing and adequate living conditions;
- Personal protective equipment;
- Physical safety;
- Training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Damage adjacent to Nyzhniodniprovskyi NNP

Significant habitat damage and soil, water and air pollution adjacent to EN site UA0000192

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Topology of harm: Lower Dnipro case study

Events related to the armed conflict:

- Artillery shelling
- Mining
- Construction of fortifications
- Movement of heavy military equipment
- Looting
- Persecution and eviction of local residents

Damage to the natural environment:

- Damage to soil and vegetation cover
- Fires
- Contamination with EO
- Pollution with military waste, damaged and destroyed equipment
- Noise pollution
- Soil erosion

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War related fires causing damage along the Kinburn Peninsula

Damage to forest, steppes, wetlands and plantations across several EN sites

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Topology of harm: Kinburn Spit case study

Events related to the armed conflict:

- Artillery shelling
- Mining
- Construction of fortifications
- Movement of heavy military equipment
- Looting
- Persecution and eviction of local residents

Damage to the natural environment:

- Damage to soil and vegetation cover
- Fires
- Contamination with EO
- Pollution with military waste, damaged and destroyed equipment
- Noise pollution
- Soil erosion

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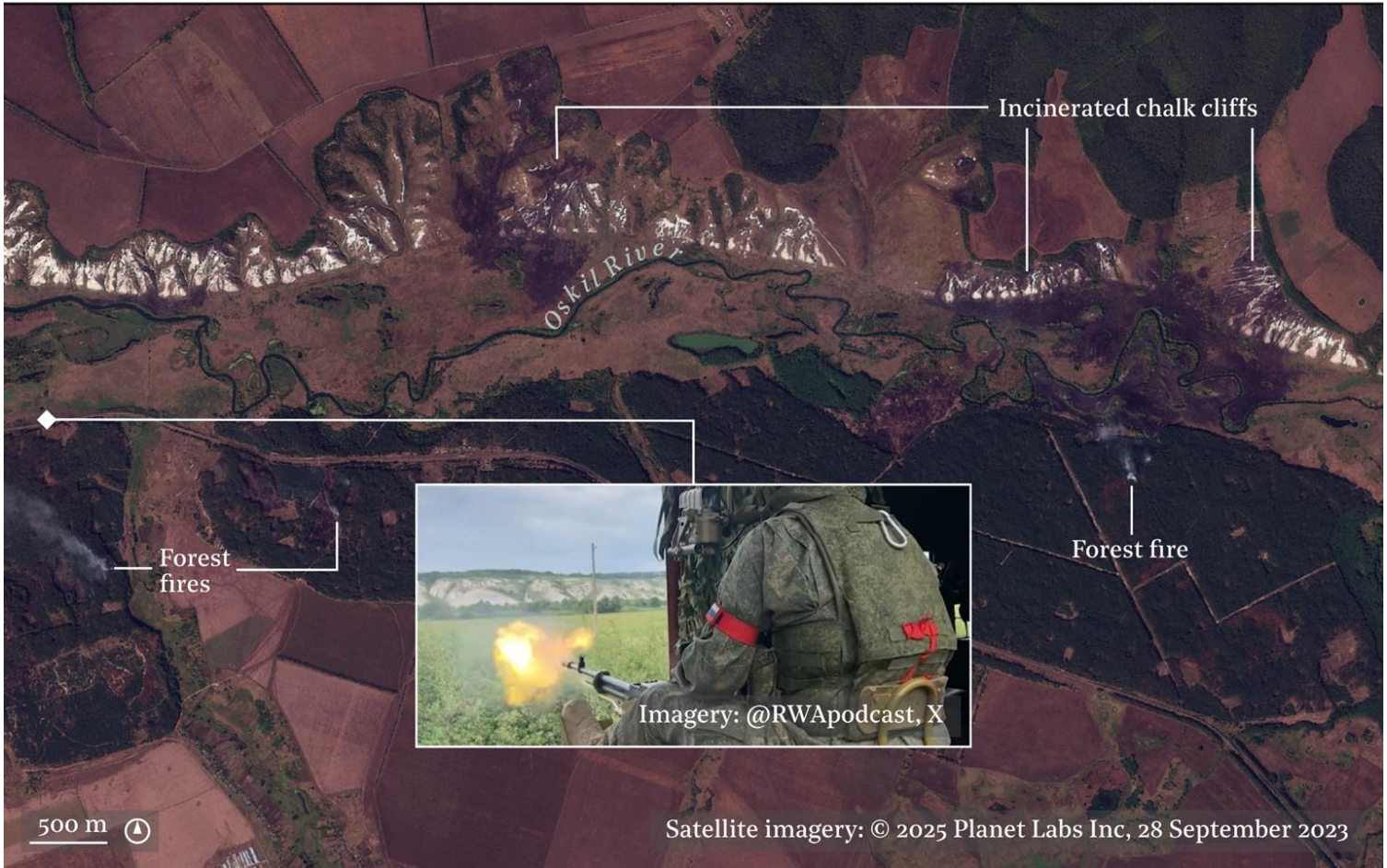
Environmental harm to Dvorichansky National Park

Intentional habitat destruction via fires and fighting in EN site UA0000074



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Topology of harm: Dvorichanskyi case study

Events related to the armed conflict:

- Shelling and airstrikes
- Low-altitude helicopter flights
- Abandoned, damaged, and destroyed military equipment
- Mining
- Construction of fortifications
- Persecution of park administration staff
- Deployment of heavy military equipment and air defense systems

Damage to the natural environment:

- Air, soil, and water pollution
- Formation of craters, damage to soil and vegetation cover
- Contamination with EO
- Illegal logging
- Noise pollution
- Fires

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Military activity adjacent to Pryazovsky National Nature Park

Fortifications, vehicle/aircraft movements and likely training next to EN Site UA0000092

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Topology of harm: Dvorichanskyi case study

Events related to the armed conflict:

- Poaching
- Looting
- Artillery training
- Mining
- Construction of fortifications
- Movement of heavy military equipment
- Low-altitude helicopter flights
- Persecution and eviction of local residents

Damage to the natural environment:

- Damage to soil and vegetation cover
- Fires
- Contamination with EO
- Pollution with military and household waste
- Noise pollution
- Destruction of important biotopes
- Change in the hydrological regime

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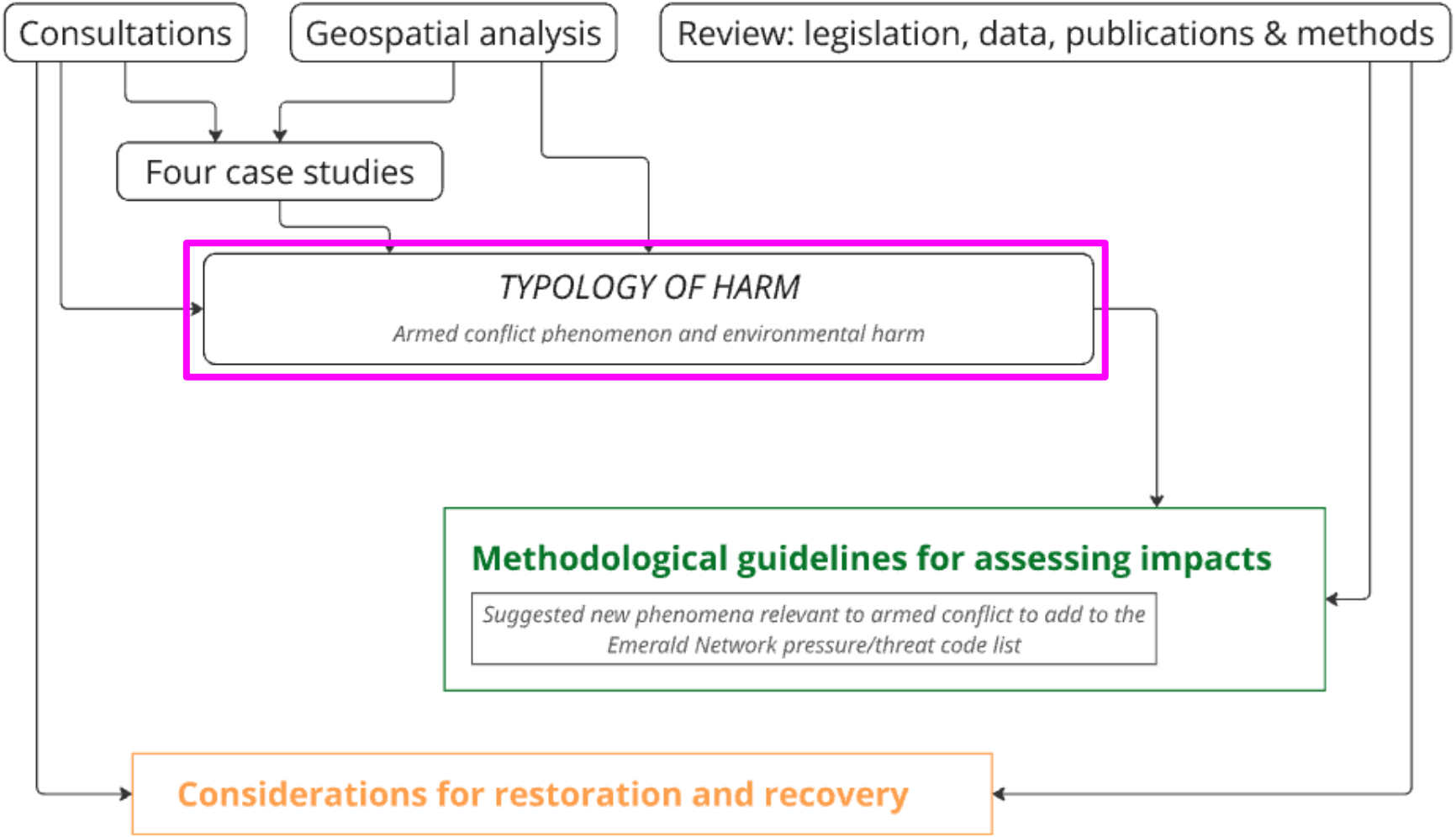
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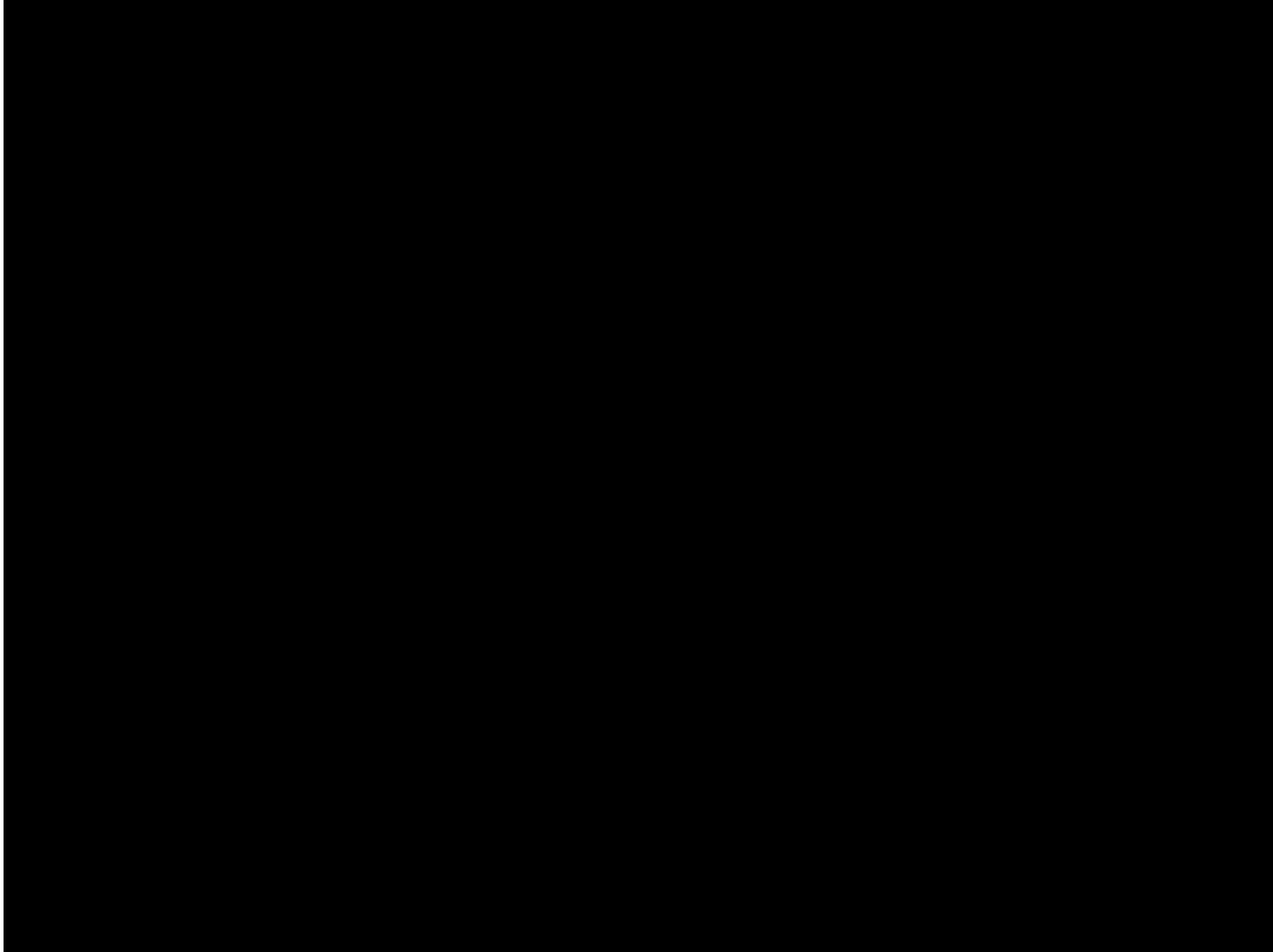
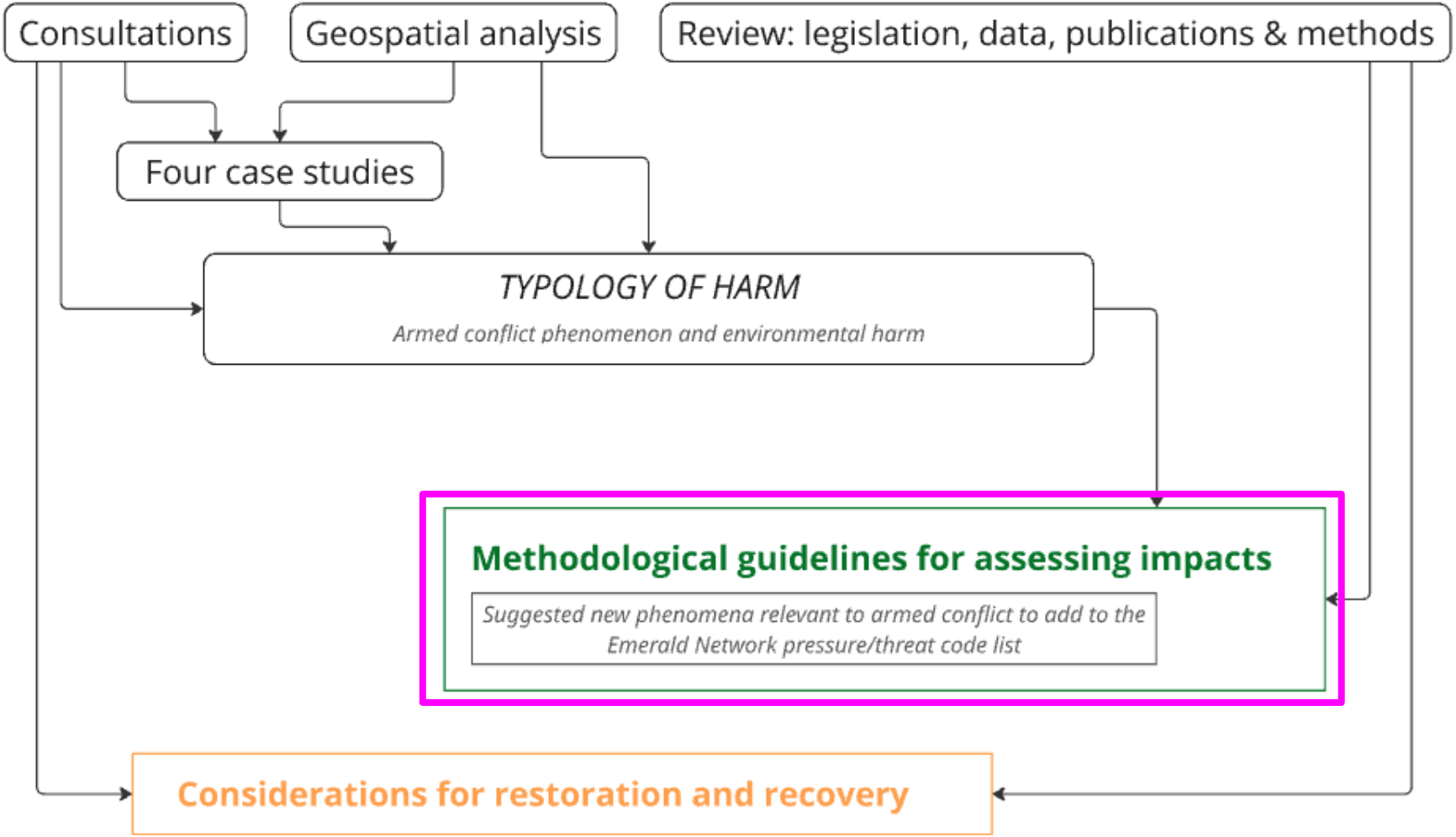
Topology of harm: Bringing findings together

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Methodological guidelines

1. Establish a pre-war baseline.

2. Compile a chronology of conflict-related events.

3. Determine access constraints.

Methodological guidelines

4. Assess the resources and methods for assessing military impacts.

5. Identify damage using remote sensing.

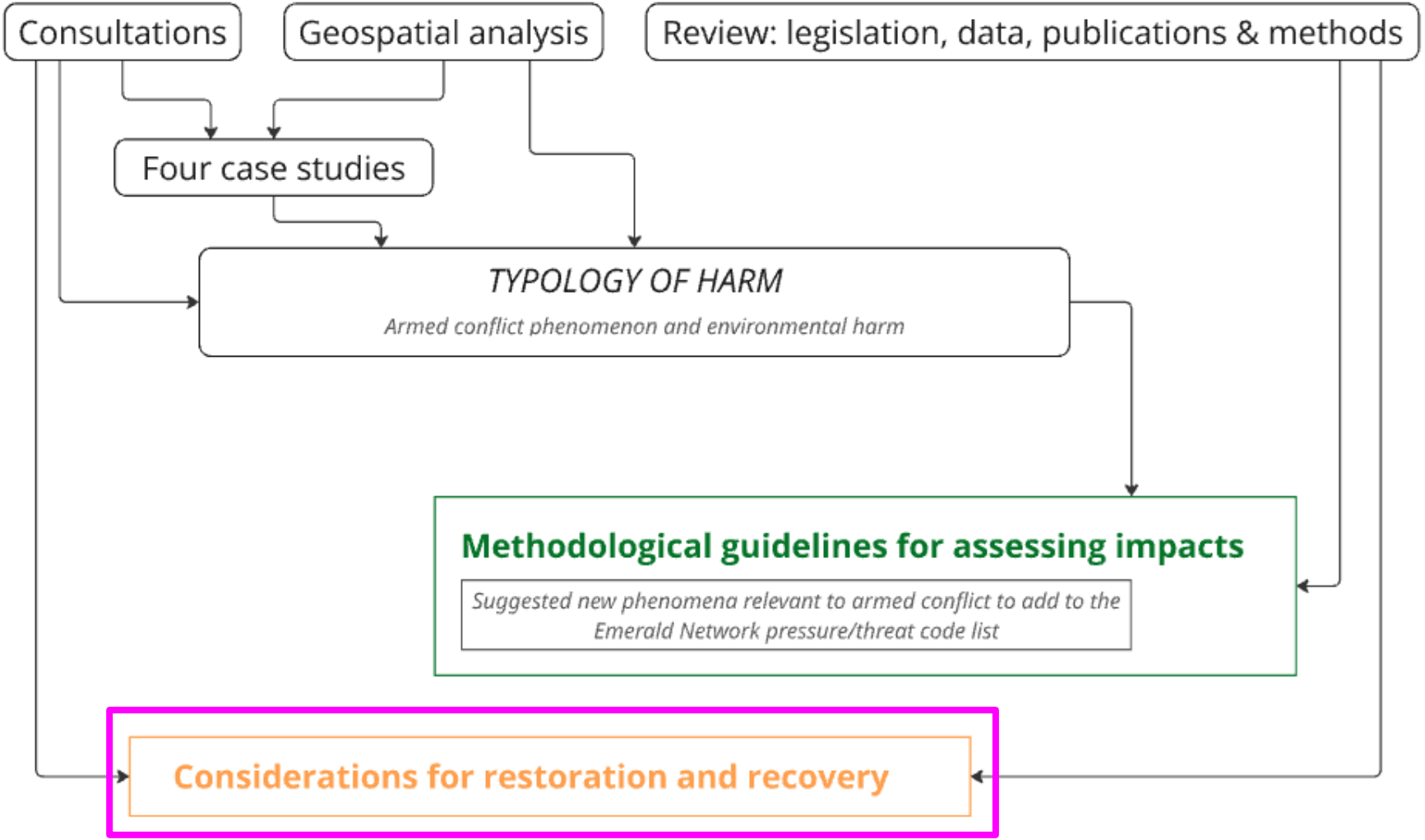
6. Plan and conduct field research.

Methodological guidelines

7. Identify and assess indirect and delayed impacts.

8. Systematically report change.

9. Communicate the findings.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Recommendations - Mine action

Cooperate with relevant stakeholders involved to develop a tailored mine clearance strategy applicable to different habitat types and EO contamination patterns within Emerald sites.

Recommendations - Landscape fires

Develop a fire management policy for areas of conservation significance and enhance the capacity of Emerald site personnel to use fire forecasting and alert systems more effectively.

Recommendations - Ecosystem restoration

During ecosystem restoration, **ensure policy coherence** with local, national and thematic plans, and with international obligations on nature, climate and pollution.

Recommendations - Pollution monitoring and control

Identify best practices for pollution control in sensitive habitats, and the resources to implement them; the cheapest and least ecologically harmful options may be nature-based solutions.

Recommendations - Biodiversity monitoring systems

Review wartime biodiversity data losses and monitoring gaps, transition to cloud-based data storage, allocate management plan resources to data, and ensure collection and storage measures are coordinated nationally.

Recommendations: Scientific and technical cooperation

Management strategies should **allocate resources to cooperation programmes**, international stakeholders should continue to support Ukrainian entities and Ukraine's participation in EU funding programmes such as Horizon and LIFE should be increased.

MOVING FORWARD TOGETHER

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