Enerjisa 9 Wind Power Plant (WPP) Project

Cumulative Collision Risk Assessment

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Definitions and Abbreviations

Abbreviation	Definition
AoI	Area of Influence
BAP	Biodiversity Action Plan
BERN	The Convention on the Conservation of European Wildlife and Natural Habitats
BMP	Biodiversity Management Plan
CAoI	Cumulative AoI
CIA	Cumulative Impact Assessment
CHA	Critical Habitat Assessment
CITES	Convention for the International Trade in Endangered Species of Wild Fauna and Flora
CR	Critically Endangered
CRM	Collision Risk Model
DD	Data Deficient
EBRD	European Bank for Reconstruction and Development
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
EN	Endangered
ESIA	Environmental and Social Impact Assessment
ETL	Energy Transmission Line
EU	European Union
GN	Guidance Notes
IBA	Important Bird Area
IFC	International Finance Cooperation
IUCN	International Union for Conservation of Nature
KBA	Key Biodiversity Area
LC	Least Concern
MoENR	Ministry of Energy and Natural Resources
NT	Near Threatened
PBF	Priority Biodiversity Features
PR	Performance Requirement
PS	Performance Standard
Ramsar	Convention on Wetlands of International Importance Especially as Waterfowl Habitat
T	Turbine
VP	Vantage Point
VEC	Valued Environmental and Social Component
VU	Vulnerable
WPP	Wind Power Plant

Executive summary

Enerjisa Yeka Nine Wind Power Plants (WPPs) project is being implemented by “Enerjisa Üretim” or the “Project Company” as a leading private sector energy producer in Türkiye. The Project Company’s goal is to complete 1,000 MW YEKA-2 project investments by early 2026. Baseline biodiversity studies from 2024 were leveraged to conduct a region-wide Cumulative Collision Risk Assessment for target bird species.

Given limitations and assumptions a total collision risk for target species due to turbine conflict estimate reveals approximately 100 birds each year, while a scenario analysis for 2035 National Energy Plan targets brings the estimation to 200-300 birds each year. Common Buzzard (Buteo buteo), Short-toed Snake Eagle (Circaetus gallicus), Common Kestrel (Falco tinnunculus), Eleonora’s Falcon (Falco eleonorae) and Lesser Kestrel (Falco naumanni) accounted for 90% of those predicted to fatally collide.

While a quantitative estimation for turbine risks was possible, ETL risks are mostly measured and reported qualitatively, and the risks are predicted to be at least equivalent to that of turbine associated risks, but likely more.

Finally, since several important limitations were present and assumptions were made to make an assessment possible, each of those limitations were individually analysed, and found that the quantitative assessment represents the lower end of expected yearly collision risk since almost every limitation, if addressed, would lead to an increase of the estimated risk.

Due to the spatial, temporal and organizational scale and complexity of cumulative risks, management and mitigation would require multilateral contribution and collaboration between public and private sectors, academia and NGOs.

1 Introduction

1.1 Project Background

Enerjisa Yeka Nine Wind Power Plants (WPPs) project is being implemented by “Enerjisa Üretim” or the “Project Company” as a leading private sector energy producer in Türkiye. The total installed capacity of the Project Company’s power generation portfolio is approximately 3,748 MW, of which 9.4% consists of six wind power plants with a total installed capacity of 352.8 MW. The Project Company’s goal is to complete 1,000 MW YEKA-2 project investments by early 2026 and increase their total installed capacity to 5,000 MW. They will focus on flexible and high-efficiency generation units and expanding the utilization of renewable energy resources potential in the upcoming years.

The nine-project package loan has sought funding by a group of development finance institutions and commercial lenders and with partial coverage by the German ECA Euler Hermes Aktiengesellschaft (“EH”). The lenders altogether are defined as “Project Lenders” in this report. The Project Lenders set requirements to manage potential environmental and social risks, and impacts associated with the projects for achieving sustainable outcomes in the financed projects as per their commitments for financing a project.

As a result of the Environmental and Social Impact Assessment (ESIA) study conducted by the Consultant, which includes a Cumulative Impact Assessment (CIA) section describing the Project’s qualitative impacts for the Cumulative Area of Influence (AoI), biodiversity data gaps were identified for the Project’s compliance with the applicable national and international standards as presented in Section 2. Supplementary biodiversity baseline collection methodologies for flora and fauna were subsequently developed by the Consultant and field surveys were conducted in 2024 to address biodiversity data gaps which would (1) enhance the Project biodiversity baseline to provide reliable and robust results, (2) enable revisions of Critical Habitat Assessments (CHA) and Biodiversity Management Plans (BMP), and (3) provide clarifications with regards to implementation of mitigation hierarchy.

1.2 Scope of Study

While the supplementary baseline reports covered each project individually as well as provide an “additive collision risk” overview for the 9 WPPs, the 9 WPP Project’s cumulative collision risks are studied and estimated in this present assessment.

Previously in the ESIA, the Consultant has provided a regional, high-level, qualitative assessment for the Project. In this assessment, the Project’s potential impact on the migratory flyways was considered. Submitted qualitative assessment in ESIA Report for each project’s Chapter 17 was based on Gauld et al (2022) study where collision vulnerability of migratory species is identified which was also restricted by the lack of data for majority of the grids for the regional assessment.

2 Applicable Guidelines and Standards

2.1 National Requirements

The primary framework of the Turkish legislation for environmental legislation is the Environmental Law (Law No: 2872). National laws and regulations regarding protection of the habitats and species are listed in Table 2.1.

Table 2.1 National Legislation on Biodiversity

Legislation (Official Gazette Date/Number - Last Revision Date)	National Strategy Documents
Law on National Parks (11.08.1983/18132 - 09.07.2018) Terrestrial Hunting Law (11.07.2003/25165 - 28.10.2020) Law on Animal Protection (01.07.2004/25509 - 13.12.2010) Regulation on the Protection of Wetlands (04.04.2014/28962 - 23.06.2022) Regulation for Implementing the Convention on International Trade in Endangered Species of Wild Fauna and Flora (27.12.2001/24623 - 20.07.2019) Regulation on Protection of Wildlife and Wildlife Development Areas (08.11.2004/25637) Law on Protection of Cultural and Natural Assets (23.07.1983/18113 - 15.06.2022) Regulation on Collection, Protection and Usage of Plant Genetic Resources (19.07.2012/28358) Law on Fisheries (04.04.1971/ 13799 - 17.02.2021) The Environmental Protection Agency for Special Areas (08.07.2011/ 27988) Environment Law (11.08.1983 / 18132 - 15.06.2022) Forestry Law (08.09.1956 / 9402 - 25.12.2021) Law on Pasture (28.02.1998 / 23272 - 18.01.2019) Law on Coastal Areas Management (17.04.1990 / 20495 - 28.10.2020)	National Plan on on-site Protection of Plant Genetic Diversity (1998) National Environmental Action Plan (1999) National Forestry Program (2004) Climate Change Action Plan (2012) Turkish National Action Plan against Desertification (2015) National Rural Development Strategy (2015) National Biological Diversity Strategy and Action Plan (2019)

2.2 International Requirements

International agreements, conventions, and protocols regarding protection of the habitats and species are listed below:

- The Convention for the Protection of the Mediterranean Sea Against Pollution (Barcelona Convention) (1981)
- The Convention on the Conservation of European Wildlife and Natural Habitats (BERN) (1984)
- United Nations Framework Convention on Climate Change (1994)
- The Convention on Wetlands of International Importance especially as Waterfowl Habitat (RAMSAR) (1994)
- The UN Convention on Biological Diversity (1997) and Cartagena Protocol on Biosafety (2004)
- Kyoto Protocol (2009)
- The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (1996)
- Paris Agreement (2016)

2.3 Project Standards

The Project Company intends to develop the Project in alignment with the applicable international and national standards, and the policy and requirements of the Lenders (i.e., EP IV, IFC and EBRD standards).

The international lender standards concerning biodiversity for the Project are represented by the IFC Performance Standards (PS6) and related Guidance Note (6), EBRD Performance Requirements (PR6) and Guidance Note (6) as well as Equator Principles IV (EP IV).

The impact assessment and critical habitat assessment are carried out in accordance with the following international requirements:

- IFC Performance Standards on Environmental and Social Sustainability,
- EBRD's Environmental and Social Policy and Performance Requirements
- International Union for Conservation of Nature (IUCN) Red List of Threatened Species
- The Birds Directive (2009/147/EC)
- The Habitats Directive (92/43/EEC10)

Post-construction Bird and Bat Fatality Monitoring for Onshore Wind Energy Facilities in Emerging Market Countries - Good Practice Handbook (2023)

The IFC PS6 objectives can be listed as:

- To protect and conserve biodiversity,
- To maintain the benefits from ecosystem services,

To promote the sustainable management of living natural resources through the adoption of practices that integrates conservation needs and development priorities.

Similarly, the EBRD PR6 objectives are as defined below:

- Protect and conserve biodiversity using a precautionary approach,
- Adopt the mitigation hierarchy in the design and implementation of projects with the aim of achieving no net loss, and where appropriate, a net gain of biodiversity,
- Maintain ecosystem services, and

Promote good international practice in the sustainable management and use of living natural resources.

3 Methodology

3.1 Scoping

For Cumulative AoI (CAoI) of the 9 WPPs, considering that medium and large bodied bird species and their migratory activity over minor routes was determined as the Valued Environmental and Social Component (VECs) for biodiversity elements, the AoI was defined as encompassing much of Western Anatolia, and includes the provincial boundaries of Denizli, Aydın, Manisa, İzmir, Balıkesir and Çanakkale, covering a land area of approximately 70,000km^2 (little under the land area of Czech Republic). This CAoI effectively accounts for both minor routes along the Aegean coast and also across the Dardanelles, and potential others such as the inner Balıkesir route. The CAoI considered for the assessment is shown on Figure 3.1.

For the other drivers present within the CAoI, other WPPs in operation and associated ETLs are considered as part of the cumulative impact drivers. A summary of other environmental drivers is presented on Table 3.1

Table 3.1: Summary of other WPPs in the CAoI.

Province	Number of WPPs	Total Installed Capacity (MW)
Aydın	12	439
Balıkesir	32	1.404
Çanakkale	26	1.042
Denizli	1	66
İzmir	58	1.813
Manisa	10	712
CAoI Total	**139**	**5.476**
*Enerjisa YEKA-2	9	1.000

Western Anatolian region in Turkiye is characterized by high level of wind energy development, both in operation and also in construction and pre-license stages, along with the overhead infrastructure associated with energy transmission and distribution. Much of the existing overhead infrastructure is older, pole and pylon designs are not eco-friendly, and cabling is not insulated. Figure 3.2 shows the state of development in the region in January 2021.

Total installed capacity went from 9 GW to 12 GW in Turkiye between 2020 and 2024 (33% increase), while the 2035 target for total installed capacity according to National Energy Plan[1] is 30 GW, suggesting a 150% increase in total installed capacity in 10 years.

For the CAoI, which has a total installed capacity of 5.476 MW representing 46% of the total installed capacity of Turkiye, the YEKA-2 investment's 1000 MW brings the total installed power up to 6.476 MW representing 55% of the national total installed capacity. Since the region is far from reaching its theoretical wind potential, and due to its proximity to strategic areas with increasing energy demands, and the potential for an alliance for supporting European energy security, it is safe to assume these provinces will play an important role in reaching the 2035

[1] Ministry of Energy and Natural Resources. 2022.

targets. For the 30 GW total installed target, between 12-18 GW (40-60%) can be reasonably presumed to be developed in the CAoI by 2035.

On the other hand, due to the increasing need for energy security, National EIA processes and permitting, including biodiversity assessments, are now expedited by state agencies to bring facilities online faster. Expedited permitting are likely to significantly decrease the amount of Project specific biodiversity data collected for each project along the flyway, since biodiversity studies take longer to accomplish during permitting, increasing uncertainties regarding biodiversity risks and therefore increasing potential unmitigated and unmanaged wildlife conflict.

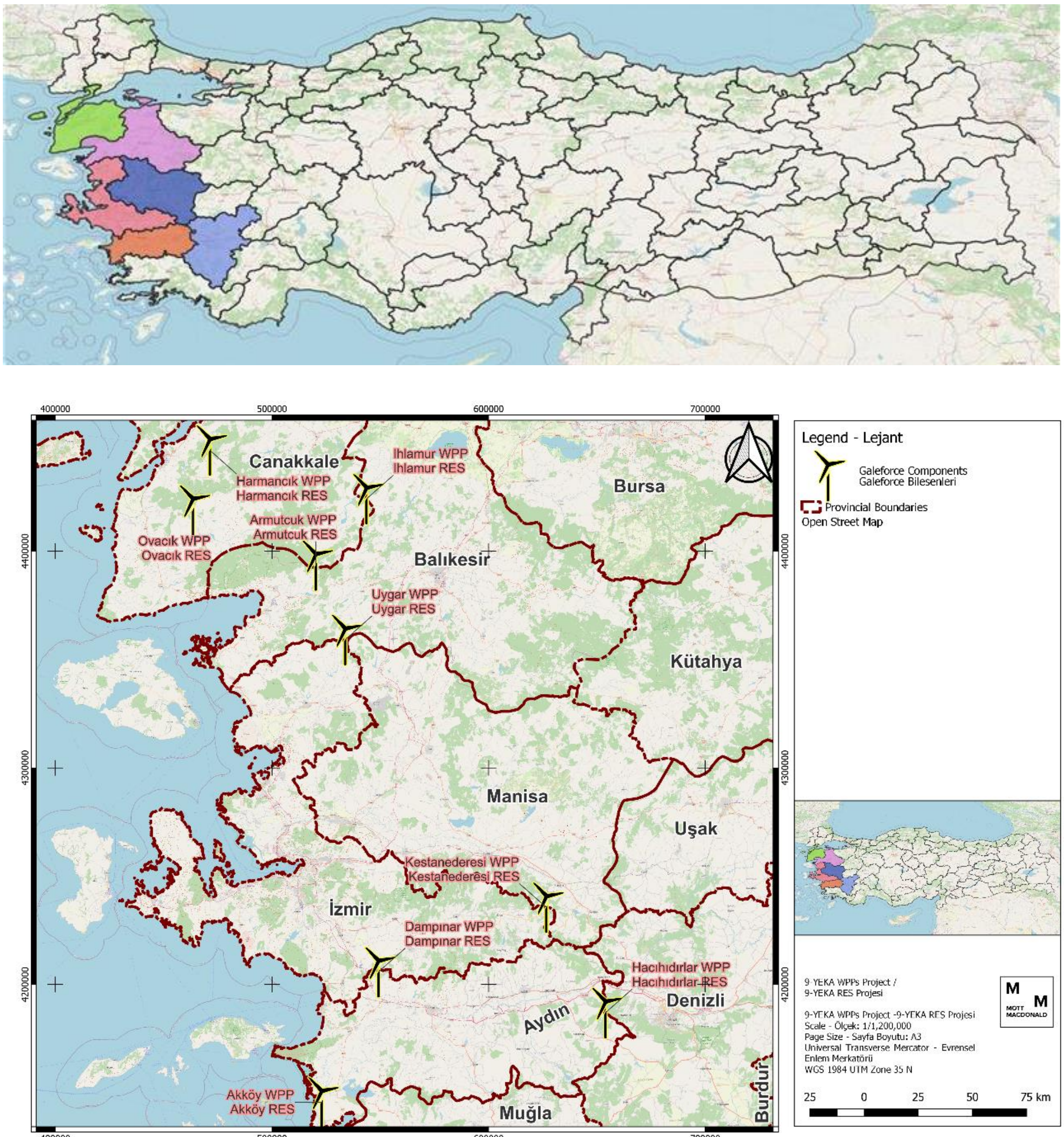

Figure 3.1: Project AoI for the cumulative collision risk assessment.

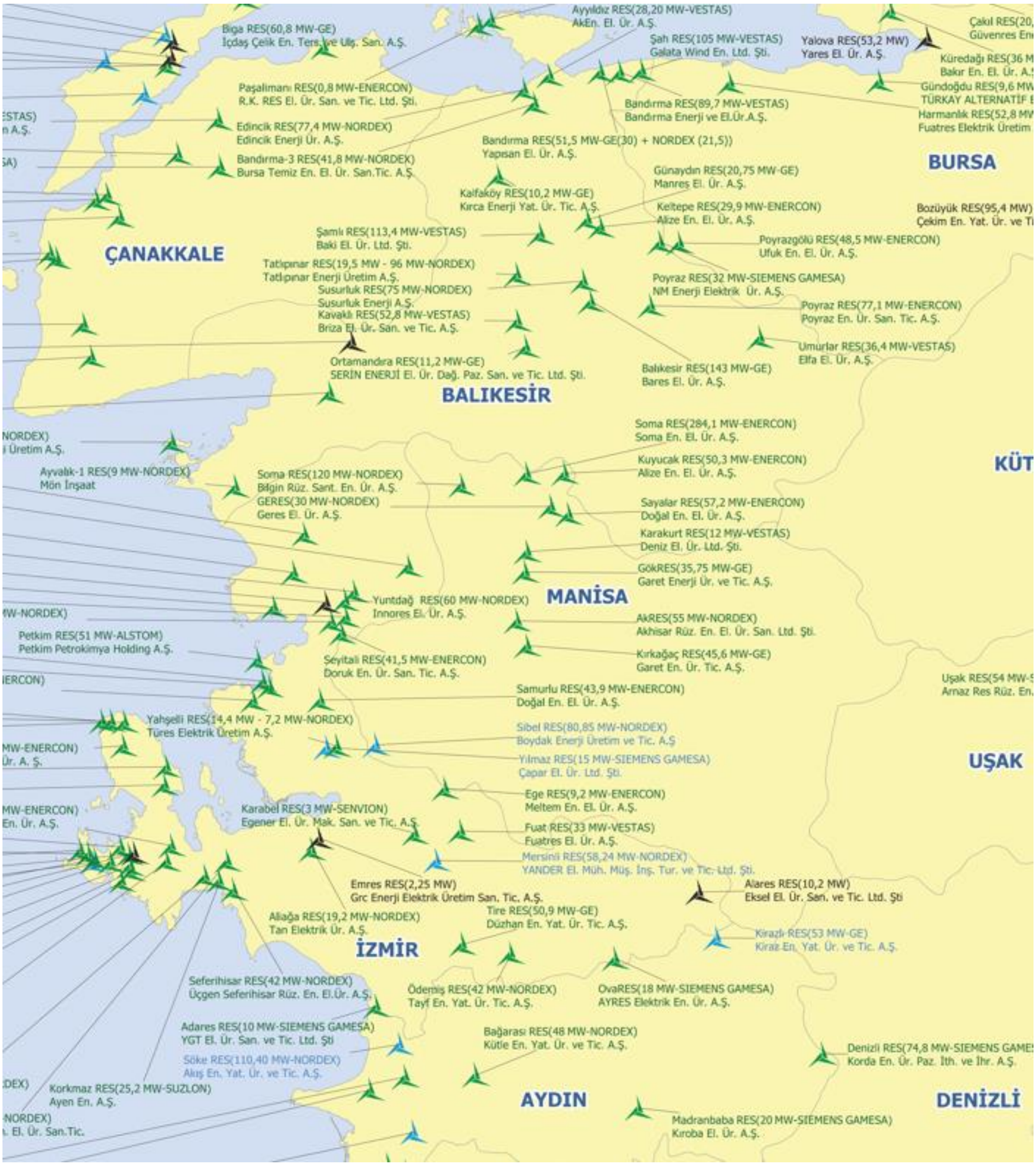

Figure 3.2. WPPs in operation (green), in construction (blue) and licensed (black) in Western Anatolia (as of January 2021).[2]

[2] Turkish Wind Energy Association (TWEA) (2021). Turkish Wind Power Plant Atlas January 2021.

3.2 Data Collection

3.2.1 Desktop Study

A desktop review of the study area comprises a major component of the present assessment. The desktop component was performed perusing the following:

- Relevant publicly available peer-reviewed literature
- White and grey literature, including unpublished technical reports
- Public biodiversity databases
  - eBird[3],
  - European Breeding Bird Atlas[4]
  - iNaturalist[5],
  - Trakus[6],
  - Movebank[7]
- Satellite imagery and maps
- Opinions of local biodiversity experts (formal / informal)
- Internationally recognized areas
  - KBAs/IBAs
- IUCN Red List
- Nationally threatened species
- BERN convention and appendices
- EU Habitats Directive
  - Annex I habitats
  - Annex II/IV species

3.2.2 Field Surveys

Both the 9 WPP supplementary baseline survey bird components in 2024, and the WPP studies added to the dataset from the region from unpublished technical reports follow NatureScot Vantage Point (VP) and Collision Risk Modelling (CRM) methodologies. Unpublished studies were also designed and conducted following the same national and international standards, including project standard alignment with IFC PS6 and EBRD PR6, and adherence to NatureScot guidelines.

VP observations are conducted from a fixed location, and the point selection is carried out to ensure that all birds flying through the WPP turbine swept areas can be detected. At least 36 hours of observations are required for each season target bird species are active, however modelling power increases with expanded survey effort especially on major migratory routes or regions where rare target species are sporadically active, in which case at least 72 hours per VP proves to be much more scientifically robust.

Observations are timed to match target species activity which is between 09:00 - 17:00 for medium and large soaring migrants, however daylight variability depending on date and location

[3] URL: Ebird.org Last accessed: 28 March 2025
[4] URL: ebba2.info Last accessed: 28 March 2025
[5] URL: Inaturalist.org Last accessed: 28 March 2025
[6] URL: Trakus.org Last accessed: 28 March 2025
[7] URL: movebank.org Last accessed: 28 March 2025

is considered. The observer scans the area each 5 minutes at a maximum of 180-degree angle. When a bird "contact" occurs, details of the contact are recorded including its flight route on a map. Height levels are determined specifically for each project and vary depending on turbine specifications, and are recorded as (a) below rotor, (b) at rotor height, (c) above rotor height.

Collision risk is calculated according to the "Approach 1: Regular Flights through a Wind Farm" and "Approach 2: Birds using the Wind Farm Airspace" as detailed by NatureScot. Modelling details are further elaborated in each of the Enerjisa 9 WPP Supplementary Baseline Survey Final Reports Collision Risk sections.

3.3 Assessment Approach

First the data tables detailing the Project specific CRA data (2024 baseline) and the 2024 additive collision risk results for the 9 WPPs, demonstrating risk per species, season, subproject and province, was supplemented with other CRA available to the Consultant from the WPPs in the Cumulative Area of Influence (AoI), which were anonymized and obscured to observe data privacy.

Collision risk per unit of installed power in the CAoI was calculated, which was then calculated for the total installed power in the CAoI, thereby obtaining a very rough prediction of collision risks posed specifically by operational wind turbines on avifauna in the region. Installed power was preferred over turbine count since it would correlate better with total turbine swept area compared to total turbine count.

Finally, the findings will also be related back to a qualitative discussion of ETL risks with a reasonable attempt at providing a possible numerical range for ETL infrastructure.

3.4 Limitations

The main limitations regarding a quantitative Cumulative Collision Risk for the Project are that (1) Wind Power Plants (WPPs) in Türkiye either do not carry out collision risk assessments or mortality studies, or do not carry those up to IFI standards, or if conducted, do not publicly disclose such studies, and this leads to (2) a lack of credible publications on mortality risks for WPPs in Türkiye which the quantitative cumulative assessment for Project Galeforce would have benefitted from in terms of data points.

Furthermore, (3) a regional level Cumulative CRA requires an understanding of how the WPPs in the region might potentially synergize, publications on which are not available from the region either. (4) Due to the vast geographical extent of the Project Galeforce, the variety of terrain and habitats, etc., gathering the data needed for a quantitative cumulative assessment is a high effort and long-term task. This level of coordination and data collection is often undertaken at a regional or national level by state agencies who have access to cross-cutting data and resources.

(5) A cumulative risk assessment of the 9 WPPs would need to include rates associated with Energy Transmission Line (ETL) collision mortality since those are considered project associated facilities, the quantitative data for which is also scarce from the region, and modelling methods, such as those associated with turbine mortality, are not well established in literature. Sufficient ETL mortality / collision risk data is not available for the region. For this, the existing qualitative approach as demonstrated in the ESIA, which leverages the Gauld et al (2022) study where collision vulnerability of migratory species is categorically presented for the region, remains the viable approach.

Finally, (6) all unpublished WPP collision risk data incorporated into the present study was obscured and anonymized in order to observe data privacy. Comparable studies from Balıkesir region (accounting for Uygar WPP) are not available which will introduce uncertainty in the assessment. The assessment will not be able to account for winter season. Though activity is significantly diminished in winter it is not non-existent for those subprojects in the lowlands such as Akköy WPP.

4 Analysis and Results

4.1 Baseline Additive Collision Risk

An overview of baseline collision risk estimation at each of the 9 projects broken down by resident or migrant status, covering spring, summer and autumn seasons based on 2024 studies are shown in Table 4.1. The results demonstrate that baseline risk over the study period was driven mainly by resident activity as opposed to migratory movement over the minor pathways.

It is important to note that none of the 2024 surveys account for winter periods. Though activity in winter is expected to be significantly diminished, it is not expected to be non-existent either. Projects located in high altitudes, with extensive precipitation and high winds over the winter are not expected to host significant activity over the winter (e.g. Kestanederesi, potentially) while those projects in lowlands and near important wetlands may indeed receive activity (such as Ihlamur, with anecdotal findings, and Akköy, near a well-known protected wetland for wintering bird species). Therefore, the data from the three seasons was not extrapolated to cover winter (such as substituting an average or a minimum value or applying a coefficient to represent “winter” data) since the effect of winter on collision risk is mixed across the projects.

The table features additional lines to account for the potential effect of the discontinued surveys in Hacıhıdırlar WPP which resulted in missed seasons for autumn and summer. The line 8 WPP without Hacıhıdırlar calculates the %migrant and collision per turbine per year values without the project. The line 8 WPP with extrapolated Hacıhıdırlar is obtained by assuming the same collision risk values in summer and autumn as the spring results for the project.

Table 4.1 Collision risk summary for Project Galeforce and each of its projects as calculated in 2024

Projects	Migrant /yr*	Resident /yr*	Total /yr*	%migrant	Turbine count	Collision/ turbine/ yr*
Akköy	0.05	0.49	0.54	9.26	6	0.09
Armutçuk	0.19	0.43	0.62	30.65	20	0.03
Dampınar	0.06	1.44	1.50	4.00	11	0.14
Hacıhıdırlar**	0.00	0.50	0.50	0.00	15	0.03
Harmancık	0.05	0.06	0.11	45.45	10	0.01
Ihlamur	0.27	2.51	2.78	9.71	18	0.15
Kestanederesi	0.18	5.10	5.28	3.41	28	0.19
Ovacık	0.07	0.16	0.23	30.43	13	0.02
Uygar	0.65	1.76	2.41	26.97	60	0.04
Project Galeforce	1.52	12.45	13.97	10.88	181	0.08
8 WPP (-Hacıhıdırlar)	1.52	11.95	13.47	11.28	166	0.08

*Though denoted year (yr), the survey period consists of spring, summer and autumn, and does not account for winter periods

**Hacıhıdırlar WPP baseline collection was disrupted, and summer and autumn data could not be collected.

The data table summarizing the project specific collision risk estimations from the data is presented in Table 4.2.

Additive collision risk evaluation for Project Galeforce established from the 2024 baseline collection estimated the yearly total target species collision risk at 14 target birds for the study period (spring, summer, autumn). The results indicate that about 11% of the collision risk was driven by migrant activity, while 80% of migrant collision risk was attributed to autumn period movement as opposed to spring migration. This finding is congruent with literature information regarding spring and autumn movement across Anatolia. Whereas spring movement occurs in a more concentrated manner spatially and temporally, autumn movement is usually more dispersed both over autumn period and geographically.

Interestingly, due to the correlation with autumn migrant activity, the project which accounted for the most estimated migrant risk was Uygar, followed by a three-way tie between Armutçuk, Ihlamur and Kestanederesi. Due to the massive area that over which Uygar spreads, its higher proportion in total migrant risk makes sense. Harmancık receiving little migratory activity and accounting for low risk this year was the least expected result, however Harmancık is indeed distinct in the sense that it is the only project where the percentage of migrant risk overall is approximately 50%, while others are lower, meaning risk at Harmancık is moreso driven by migrants than any other project. This is significant due to the year-on-year variations in migratory rates over minor routes, which are not as consistently active each year as the major routes are, however can exhibit bursts of activity over some years. This is one of the reasons long-term monitoring datasets are crucial.

For residents, approximately half of the collision risk is attributed to summer season while spring and autumn are more or less equivalent. In terms of species, Common Buzzard, Short-toed Snake Eagle and Eurasian Kestrel, which are common, abundant, breeding raptors, topped the collision risk estimations and accounted for approximately 65% of the estimated risk for residents. These species are expected to continue to be active post-construction due to the habituation effect, and many of the projects providing adequate habitat for feeding and opportunities for perching. Additionally, Eleanora's Falcon activity will continue to be associated with late-summer and autumn passerine migration movement, since their breeding activity is reliant on the food source represented by migrant passerines in autumn. The species is also an indirect indicator of passerine migration at each project and wherever they are active can be assumed to be significant fly-over and/or rest habitats for songbirds.

Two further considerations are pertinent for the additive collision risk evaluation. (1) Regarding substitution of data for Hacıhıdırlar, if summer and autumn are assumed homogenous with spring, the overall results are not altered much. However, if resident bird species are relatively more active over the summer, or if autumn migratory movement is similarly moderate like with some other projects, this has the potential to have a medium level of influence on the overall picture.

The second consideration is that (2) the baseline does not account for winter activity. As previously mentioned, target species activity in the WPP airspaces are generally expected to be diminished, though not non-existent. For some projects near important wetlands, wintering waterbird and wetland associating raptor activity might be a concern and these are discussed in respective final baseline reports. If winter activity is factored in as about the same as overall spring collision risk (which would indicate the maximum expected risk level), overall target species mortality for Project Galeforce would be contained within the range of 14-17 birds annually.

Table 4.2 Additive Collision Risk Assessment summary for the Project Galeforce

Common Name	Projects	Migrant	Resident	Total
Black Kite	Harmancık	0.00	0.00	0.00
Subtotal		0.00	0.00	0.00
Black Stork	Ihlamur	0.00	0.02	0.02
	Uygar	0.01	0.01	0.02
Subtotal		0.01	0.03	0.04
Booted Eagle	Akköy	0.00	0.00	0.00
	Armutçuk	0.00	0.00	0.00
	Harmancık	0.00	0.00	0.00
	Ihlamur	0.01	0.00	0.01
	Kestanederesi	0.00	0.02	0.02
	Ovacık	0.01	0.00	0.01
	Uygar	0.00	0.02	0.02
Subtotal		0.02	0.04	0.06
Common Buzzard	Akköy	0.00	0.01	0.01
	Armutçuk	0.15	0.21	0.36
	Dampınar	0.00	0.19	0.19
	Hacıhıdırlar	0.00	0.40	0.40
	Harmancık	0.02	0.03	0.05
	Ihlamur	0.11	0.50	0.61
	Kestanederesi	0.00	1.00	1.00
	Ovacık	0.02	0.10	0.12
	Uygar	0.25	0.98	1.23
Subtotal		0.55	3.42	3.97
Dalmatian Pelican	Akköy	0.00	0.06	0.06
Subtotal		0.00	0.06	0.06
Eleonora's Falcon	Armutçuk	0.00	0.07	0.07
	Dampınar	0.00	0.48	0.48
	Hacıhıdırlar	0.00	0.04	0.04
	Harmancık	0.00	0.02	0.02
	Ihlamur	0.04	0.65	0.69
	Kestanederesi	0.00	0.35	0.35
	Ovacık	0.00	0.01	0.01
	Uygar	0.00	0.02	0.02
Subtotal		0.04	1.64	1.68
Eurasian Hobby	Ihlamur	0.00	0.06	0.06
	Ovacık	0.00	0.00	0.00
	Uygar	0.01	0.00	0.01
Subtotal		0.01	0.06	0.07
Eurasian Kestrel	Akköy	0.00	0.05	0.05
	Armutçuk	0.00	0.03	0.03
	Dampınar	0.01	0.00	0.01
	Hacıhıdırlar	0.00	0.02	0.02
	Harmancık	0.00	0.00	0.00
	Ihlamur	0.00	0.74	0.74
	Kestanederesi	0.00	1.06	1.06
	Ovacık	0.00	0.01	0.01
	Uygar	0.01	0.10	0.11
Subtotal		0.02	2.01	2.03
Eurasian Marsh-Harrier	Akköy	0.00	0.00	0.00
	Ihlamur	0.01	0.00	0.01
	Kestanederesi	0.03	0.00	0.03
	Ovacık	0.01	0.00	0.01
Subtotal		0.05	0.00	0.05
Eurasian Sparrowhawk	Akköy	0.00	0.04	0.04
	Armutçuk	0.01	0.04	0.05
	Dampınar	0.03	0.03	0.06
	Hacıhıdırlar	0.00	0.02	0.02
	Harmancık	0.02	0.00	0.02
	Ihlamur	0.03	0.02	0.05
	Kestanederesi	0.03	0.00	0.03
	Ovacık	0.02	0.01	0.03
	Uygar	0.30	0.05	0.35
Subtotal		0.44	0.21	0.65
European Honey-buzzard	Armutçuk	0.02	0.04	0.06
	Dampınar	0.01	0.01	0.02
	Harmancık	0.01	0.00	0.01
	Ihlamur	0.01	0.06	0.07
	Kestanederesi	0.11	0.00	0.11
	Uygar	0.04	0.04	0.08
Subtotal		0.20	0.15	0.35
Hen Harrier	Ihlamur	0.01	0.00	0.01
Subtotal		0.01	0.00	0.01
Lesser Kestrel	Kestanederesi	0.00	1.91	1.91
Subtotal		0.00	1.91	1.91
Levant Sparrowhawk	Harmancık	0.00	0.00	0.00
	Uygar	0.02	0.00	0.02
Subtotal		0.02	0.00	0.02
Long-legged Buzzard	Akköy	0.01	0.01	0.02
	Dampınar	0.00	0.00	0.00
	Kestanederesi	0.00	0.28	0.28
Long-legged Buzzard Total		0.01	0.29	0.30
Montagu's Harrier	Akköy	0.00	0.00	0.00
	Dampınar	0.01	0.00	0.01
	Kestanederesi	0.01	0.00	0.01
Subtotal		0.02	0.00	0.02
Peregrine Falcon	Dampınar	0.00	0.00	0.00
	Kestanederesi	0.00	0.04	0.04
Peregrine Falcon Total		0.00	0.04	0.04
Red-footed Falcon	Ihlamur	0.01	0.00	0.01
Red-footed Falcon Total		0.01	0.00	0.01
Short-toed Snake-Eagle	Akköy	0.03	0.15	0.18
	Armutçuk	0.01	0.04	0.05
	Dampınar	0.00	0.73	0.73
	Hacıhıdırlar	0.00	0.02	0.02
	Harmancık	0.00	0.01	0.01
	Ihlamur	0.04	0.46	0.50
	Kestanederesi	0.00	0.44	0.44
	Ovacık	0.01	0.03	0.04
	Uygar	0.00	0.54	0.54
Subtotal		0.09	2.42	2.51
unidentified Falcon	Harmancık	0.00	0.00	0.00
	Uygar	0.01	0.00	0.01
Subtotal		0.01	0.00	0.01
White Stork	Akköy	0.01	0.17	0.18
Subtotal		0.01	0.17	0.18
Total		1.52	12.45	13.97

4.2 Dataset Preparation

The 9 WPP 2024 dataset represents 15% of total installed power in the CAoI assuming the 2026 scenario (all 9 WPPs in operation). Since the current dataset is heavily biased toward the Çanakkale region, 2 additional anonymous WPP collision risk estimations were introduced to the dataset. These collision risk estimations were collected at WPPs within the Cumulative AoI outside of Çanakkale province and using the same methodologies as the 9 WPPs adhering to NatureScot guidelines within the last 5 years.

The modified dataset accounts for 17% of total installed power in the Cumulative AoI assuming the 2026 scenario (all 9 WPPs in operation for 1000 MW installed and 121 MW installed for the additional two WPPs). Final dataset is presented in Table 4.3.

Table 4.3: Baseline collision risk (spring, summer and autumn) for all 11 WPPs in the analysis. CR= Collision Risk (number of birds estimated to fatally collide).

Scientific Name	Total Migrant CR /yr	Total Resident CR /yr	Total CR /yr	Total CR /yr per installed GW
Accipiter brevipes	0.02	0.00	0.02	0.018
Accipiter nisus	0.52	0.24	0.76	0.681
Buteo buteo	0.62	3.80	4.42	3.943
Buteo rufinus	0.01	0.29	0.30	0.268
Ciconia ciconia	0.58	0.17	0.75	0.669
Ciconia nigra	0.11	0.03	0.14	0.125
Circaetus gallicus	0.18	3.29	3.47	3.099
Circus aeruginosus	0.06	0.00	0.06	0.054
Circus cyaneus	0.01	0.00	0.01	0.009
Circus pygargus	0.02	0.00	0.02	0.018
Falco eleonorae	0.08	2.76	2.84	2.533
Falco naumanni	0.00	1.91	1.91	1.707
Falco peregrinus	0.00	0.04	0.04	0.036
Falco subbuteo	0.01	0.07	0.08	0.071
Falco tinnunculus	0.03	2.90	2.93	2.614
Falco vespertinus	0.02	0.00	0.02	0.018
Hieraaetus pennatus	0.03	0.04	0.07	0.062
Milvus migrans	0.00	0.00	0.00	0.000
Pelecanus crispus	0.00	0.06	0.06	0.054
Pernis apivorus	0.23	0.24	0.47	0.418
Total	2.54	15.84	18.38	16.396

4.3 Turbine Collision Risk Estimations

The calculated annual (three season) collision risk for each species per installed capacity was then used to extrapolate total collision risk due to turbine conflict within the Cumulative AoI for each species for which an estimation is available. Estimation for the current installed capacity and future target capacity is presented in Table 4.4. For the Cumulative AoI, the species that accounted for the most collisions were Common Buzzard (*Buteo buteo)* and Short-toed Snake

Eagle (*Circaetus gallicus)*, which is expected since these are both common and widespread raptors in the region, and also abundant as migrants, followed by similar collision risk estimations for three Falco species, Common Kestrel (*Falco tinnunculus*), Eleonoroa's Falcon (*Falco eleonorae)* and Lesser Kestrel (*Falco naumanni)*. Both the activity levels and patterns of Eleonora's Falcon (*Falco eleonorae)* was an unexpected result of 9 WPP baseline surveys and consecutive assessments, especially the findings of the species much far inland than expected in Western Anatolia at this level of activity.

Table 4.4: 9 WPP baseline collision risk for each species.

Scientific Name	Total CR /yr for 2026 (6.5 GW)	Total CR /yr for 2035 (12 GW scenario)	Total CR /yr for 2035 (18 GW scenario)
Accipiter brevipes	0.12	0.21	0.32
Accipiter nisus	4.43	8.18	12.26
Buteo buteo	25.63	47.31	70.97
Buteo rufinus	1.74	3.21	4.82
Ciconia ciconia	4.35	8.03	12.04
Ciconia nigra	0.81	1.50	2.25
Circaetus gallicus	20.14	37.19	55.78
Circus aeruginosus	0.35	0.64	0.96
Circus cyaneus	0.06	0.11	0.16
Circus pygargus	0.12	0.21	0.32
Falco eleonorae	16.47	30.40	45.60
Falco naumanni	11.10	20.49	30.73
Falco peregrinus	0.23	0.43	0.64
Falco subbuteo	0.46	0.86	1.28
Falco tinnunculus	16.99	31.36	47.05
Falco vespertinus	0.12	0.21	0.32
Hieraaetus pennatus	0.41	0.75	1.12
Milvus migrans	0.00	0.00	0.00
Pelecanus crispus	0.35	0.64	0.96
Pernis apivorus	2.72	5.02	7.53
Total	106.57	196.75	295.13

4.4 ETL Collision Risk

Due to the limitations listed summarized as the quantitative data for ETL risks and mortality being virtually non-existent from the region, and science-based modelling methods, such as those associated with turbine risks, are being not well established in literature, quantitative ETL mortality / collision risk data is not available for the region to carry out the analysis as was done for turbine risks.

To assess ETL risks, first, the existing qualitative approach as demonstrated in the ESIA was reviewed, which leverages the Gauld et al (2022) study where collision vulnerability of migratory species is categorically presented for the region.

The first thing to note is that for each grid (5 x 5 km) where data was available, and vulnerability was categorized, the study consistently identified risks associated with power lines to be much higher than risks associated with turbines for every species reported. As an example, for

Ciconia ciconia, the number of high vulnerability grids for turbine risks was 323 for the studied area, while for power lines the number of high-risk grid cells were 5361 (16-fold more number of high vulnerability cells).

The second thing to note is that despite presenting a high effort review, the study is limited by bird telemetry data availability. In their discussion, the authors note “we acknowledge gaps were present in the available GPS tracking data, particularly within areas such as northern France, northern Spain, Scandinavia, Algeria and Libya. These gaps reflect geographical and seasonal variation in the availability of bird telemetry data (Bouten et al., 2013). As such, our results successfully highlight where sensitivity and vulnerability to collision with EI occurs but cannot indicate where vulnerability does not occur.” While the major migration route across Anatolia is well covered in the study, much of Western Anatolia and consequently the Cumulative AoI is represented by the “no data grids” as seen on Figure 4.1.

However, the study makes it evident that there is a clear correlation, as expected, between a combination of high wind infrastructure development and migration activity and increased vulnerability scores. If further tracking studies were incorporated into this assessment the account for the geographic bias in telemetry data, it would likely reveal a track of moderate (yellow) vulnerability grids where minor route activity occurs, mixed in with high vulnerability grids (red) near Çan, Çanakkale and Gelibolu Peninsula, which at the time of the study was already evident. Furthermore, the more wind infrastructure along this route is developed, the more vulnerability will increase, which is an effect demonstrated along the major route already. The study also remarks that despite not being on a bottleneck, a high proportion of the highest vulnerability grids were in Poland due to the high density of wind infrastructure development in this country.

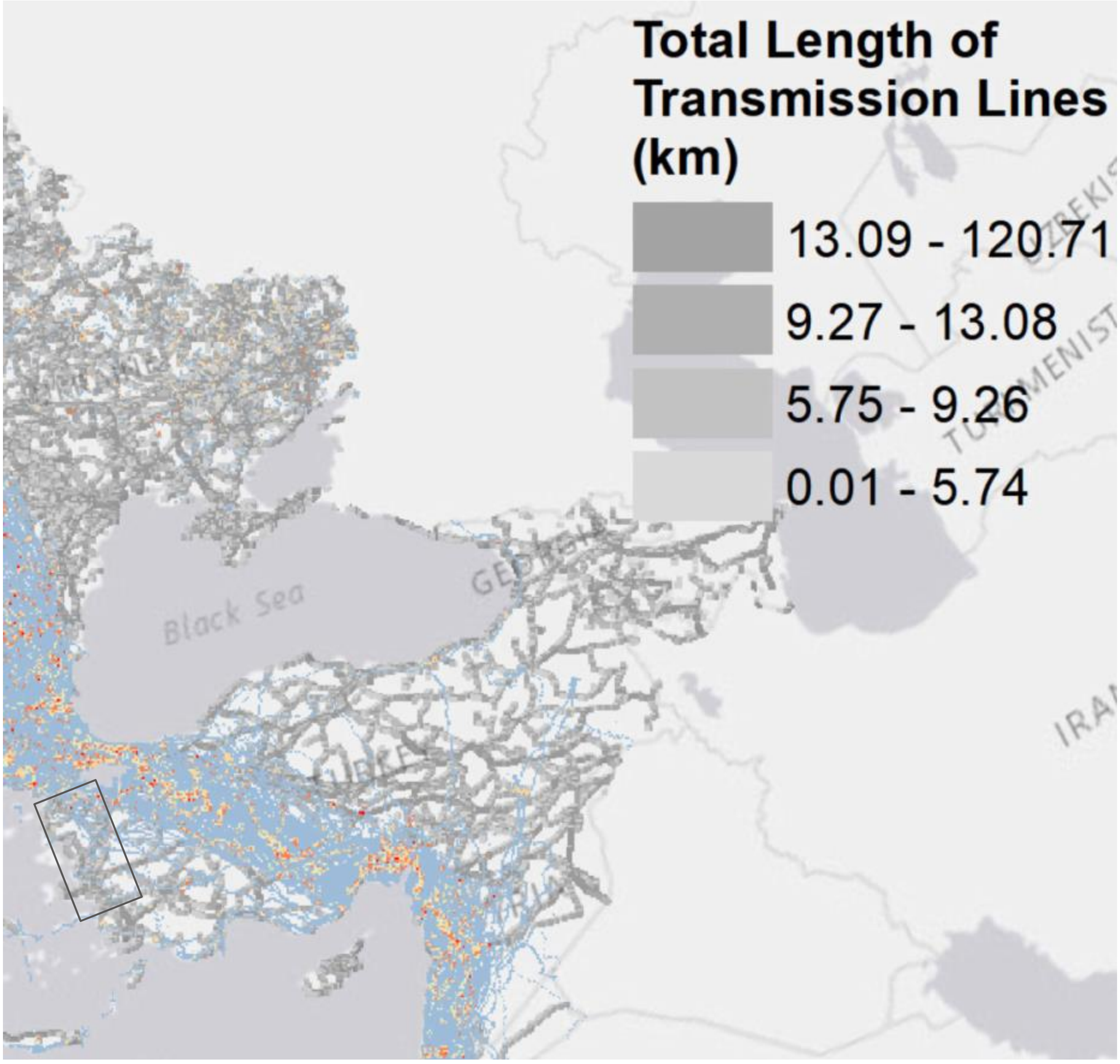

Figure 4.1: Vulnerability associated with power transmission lines (figure from Gauld et al 2022). Project CAoI roughly shown in rectangle.

Anecdotally, mortality data findings from another WPP not included in this assessment (on the major route and outside of the CAoI) is congruent with the finding that transmission lines may be the more fatal component, though this observation was not scientifically measured. Despite lower routine ground carcass search frequencies at transmission lines (once per month vs once per week for turbines), an equivalent number of raw carcass findings were made as under the turbines for large-bodied bird species. Since a statistical mortality estimation could not be made, there is no quantitative data to argue for higher mortality associations with transmission lines. However, with the double effect of both collision for risk height birds, and electrocution for species which are bound to find the poles and pylons increasingly more attractive for perching and nesting due to increased habitat loss, deforestation and ground predation pressures from feral and stray dogs across the CAoI, it is certainly possible.

5 Discussion and Conclusions

Enerjisa 9 WPP baseline VP bird studies and consecutive CRA from 2024 provided robust and reliable data for a region-wide Cumulative Collision Risk Assessment. The project alone constituted 15% of the installed capacity in the region (assuming all 9 WPPs in operation). The project data was supplemented with studies conducted from within the CAoI and aligned with the same standards and using the same methodology to provide more data points for underrepresented sections of the area, bringing the total represented capacity at 17%.

Based on the data limitations and assumptions made which were detailed in the previous sections, deriving a quantitative assessment for turbine risks was possible. For the CAoI, assuming all 9 WPPs are operational, yearly (spring, summer, autumn) total collision risk for target species due to turbine conflict was assessed as 107 birds.

With the National Energy Plan targets for wind energy development, the region was predicted to account for 40-60% of total installed targets by 2035, which was reflected in two 10-year scenarios for the CAoI, 12GW and 18GW total installed. Yearly (spring, summer, autumn) total collision risk for target species due to turbine conflict was assessed as between 196-295 birds by 2035. Five species, *Buteo buteo, Circaetus gallicus, Falco tinnunculus, Falco eleonorae and Falco naumanni* accounted for the vast majority (approx. 90%) of the annual collision risk estimations.

While a quantitative estimation for turbine risks was possible, ETL risks are mostly measured and reported categorically, that is, if they are measured and reported at all. Based on scientific literature that evaluated collision vulnerability of target species to turbines and power lines, two rough conclusions can be made. The Cumulative AoI is more likely to feature high risk areas due to power line development relative to turbine development, and density of infrastructure development and migration activity are both independent drivers of risk, which can only mean the two factors also synergize and the risk may sum up to more than the parts.

Since the CAoI already features a mixture of vulnerability grids, it would be reasonable to assess that for each unit area that ETL is developed, risks are at least equivalent to that of turbine associated risks, but possibly more due to increased attraction and habituation effects near ETLs.

Finally, since several important limitations were present and assumptions were made to make an assessment possible, a discussion of these limitations and assumptions, and how they are likely to drive the quantitative assessment is necessary.

This assessment does not evaluate the winter season at all, which means what is intended to be an annual risk estimation is already missing a season. However, risk for each season is not proportionate, and though it is possible to assume winter activity is generally lower, it is not possible to say by how much without comparable studies conducted in the winter season. While for the mountainous parts of the CAoI (such as Kestanederesi) the activity target species activity is expected to be diminished to near zero levels, for the lowland parts of the CAoI (such as Ihlamur) the activity is expected to resume though at lower rates, while for some other significant parts of the CAoI such as coastal and inland wetlands (like Akköy), activity may increase due to species returning to their wintering ranges.

- Inclusion of winter season would clearly increase the annual risk estimations, though the contribution of this season is expected to be lower though each of the remaining seasons.

This assessment cannot evaluate what species are known to be in the CAoI from literature but were not captured in the VP surveys due to (1) missing winters, (2) species rarity, (3) migratory route activity variability over years. If winters were accounted for, and if total capacity represented for the assessment was closer to 50-60%, it is likely that most species in the CAoI, including wintering waterfowl, would be accounted for.

- Higher total installed capacity representation would clearly increase the annual risk estimations by accounting for species not captured in the studies of current 17% total installed capacity represented, though as exemplified by some of the lower risk species in this assessment, their contribution would likely change the composition of the 10% of total risk outside of the top five species.

While the Gauld et al (2022) study categorically accounts for synergy, synergistic effects between WPPs and ETLs in the CAoI is not currently understood. Presence of multiple components in proximity to each other may deter, disturb, attract, confuse or exhaust species is novel interactions. Synergistic effects would be accounted for if a high enough majority of WPP and ETL could collect data.

- Synergistic interactions between each driver in the CAoI would likely increase estimated collision risk.

This evaluation is made mainly from data from projects during pre-operation phase, which does not properly account for disturbance and barrier effects like operation phase studies. Continued wind development in the region will inevitably contribute to disturbance and barrier effects, as the presence of fast-moving components, land use changes and other anthropogenic disturbance sources will deter and prevent bird species from the region in general.

- Barrier and disturbance effects are likely to lower estimated collision risk.

Paradoxically, wind development can lead to habituation and attraction effects, which are also definitely not accounted for in pre-operation studies. In habituation effects, some species become tolerant of the WPPs and start co-existing. In attraction, due to new habitat creation, increased foraging, perching or nesting opportunities, bird species begin favouring the WPPs.

- Habituation and attraction effects are likely to increase estimated collision risk.

A final point to consider is that a new, understudied theory between ornithologists in Turkiye is that due to extreme habitat loss along the major migratory route in İstanbul section, which is a critical bottleneck, and high levels of habitat loss in Marmara region in general, the migratory preferences may be slowly shifting over to the Dardanelles which may currently offer better passage due to better stop-over habitat availability.

- If minor routes in Western Anatolia become more prominent over the operation lifespan of 9 WPPs due to the major route becoming too hazardous, this can increase the estimations over the operation lifetime.

Therefore, it is quite likely that the quantitative assessment presented in this assessment represents a best-case scenario than a worst case one. Management and mitigation of CAoI level effects likely require multilateral contribution from FIs, project companies, NGOs, academia, and government agencies and is considered much beyond the scope of a single project company such as Enerjisa Üretim AŞ and would need to be incorporated from the initial stages of development, such as policy making, and planning stages for projects.