Australian Government
Department of Climate Change, Energy, the Environment and Water

Australian Collision Risk Framework

DRAFT Offshore survey guide

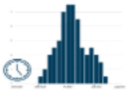
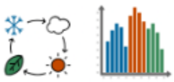
This guide describes survey methods for bird and bat baseline surveys undertaken during pre-construction site investigations and impact assessments. It outlines survey design considerations for collecting quantitative and/or qualitative data for input into collision risk assessment. The guide links offshore survey methods to the collision assessment risk criteria and collision likelihood inputs that are defined in the Australian Collision Risk Framework (ACRF). t provides a checklist to help ensure survey designs are suitable to collect fit-for-purpose data suitable for collision risk assessment, though a collision risk model or collision likelihood score.

What data are needed?

Robust collision risk prediction requires site-specific data on birds' and bats' exposure to collision, including the duration of that exposure (Table 1). These data are combined with published information on species' morphology, flight behaviour and propensity to avoid collision to inform a Collision Risk Model (CRM) or a Collision Likelihood Score (CLS).

Table 1: Summary of risk metrics and data inputs needed from site studies. Red are primary quantitative metrics and black are supporting, qualitative evidence.

Risk metric	**Data inputs** (red/purple - primary quantitative metric and black are supporting, qualitative evidence)
 Rate and density of flights on-site (flight flux)	**Measurement of movements per area in a fixed time via formal surveys identified to species** • Presence / absence of species in multi-season site survey • Historical and regional records • Species distribution maps
 Distribution of flight heights	**Direct site measurement of flight heights** • Flight purpose (e.g. foraging vs migrating) • Flight dynamic (e.g. dynamic soaring or surface shearing) • Dominant wind speeds and directions • Published flight height distributions or classifications
 Spatial use patterns within site	**Direct flight path recording or spatial analysis of observation distribution** **Ecological model (e.g. 'flat' distribution of activity)** • Quality and extent of suitable habitat onsite • Distance to keystone features (e.g. roost sites, nest sites)

 Daily activity	• **Site-based records** • **Literature values** • Species activity type (diurnal, nocturnal etc)
 Seasonal patterns	• **Site-based records representative of the whole period of on-site activity** • Recorded seasonal activity from public observation repositories

Method suitability

Table 2 provides an overview of the applicability of common data collection methods for generating evidence to support each risk metric required for a collision risk assessment. Some methods may be used in combination, depending on the species considered. The table is intended as a general guide only. The suitability of any method will depend on **site conditions, study design and data quality standards.** Survey designers should evaluate the specific requirements of the species and sites under consideration. Further details on survey methods and collision risk assessment types are provided in the *Glossary and more information* section below.

Table 2: Quick guide to applicability of different survey methods to the inputs needed for collision risk assessment.

Method	Applicable	Flight Flux	Height	Spatial	Daily	Seasonal	Model type
Visual (boat transect)	Diurnal species	+	+	+ Species and field method dependent	+	+	Quantitative
Acoustic	Birds and echolocating bats	? Relative	~ Limited	~ limited at scale	+	+	Limited use
Radar	All species	? No species ID	? No species ID	? No species ID	? No species ID	? No species ID	Limited use
Telemetry	All species	~	+	? Limited	? Limited	? Limited	Limited use
Digital aerial	All species	? Species level observations not available for all species	+ Species and field method dependent	+	+	+	Quantitative but may need to be teamed with boat

Key: *+ = Yes, method can provide a robust measure with a degree of error | ? = Limited/Relative Data, Limited refers to the method possibly providing the input but unlikely to yield a robust measure, Relative refers to the method providing the relevant input but not on an absolute scale | ~ = No, the method does not provide a valid way to estimate the relevant input.*

Primary survey types

Currently the most common and broadly applicable method for diurnal birds remains **transect-based searches via boats** and **digital aerial surveys**. These methods have the advantage of also surveying buffer zones outside the turbine envelope which might be useful baseline data to measure macro-avoidance (avoidance of the site as a whole) and displacement (macro-avoidance that restricts access to key environments). A number of studies are emerging that present evidence of macro-avoidance and the potential impacts should be considered when planning sites in Australian waters.

Weather considerations

For a number of the supplied survey methods, high quality collision risk input data is dependent on favourable weather conditions. However, and to differing extents, bird and bat species are still active in unfavourable conditions. With ecologists unable to survey in these unfavourable conditions, an understanding of a species' collision risk is limited and will not be fully understood without the combination of other technology not hampered by weather. For example, boat-based surveys cannot be conducted when wind speeds exceed 25-30 knots, but birds may still be flying in these conditions and risk cannot be estimated. This is where a combined survey approach may be needed such as telemetry. Telemetry data can be collected in all weather conditions and while sample size is not likely to be sufficient to inform collision risk on its own, telemetry can provide data across conditions not possible for boat-based surveys.

Survey Design Checklist

This checklist is intended to support the selection of appropriate survey methods and ensure all key aspects of the survey program have been considered prior to data collection.

Alignment with Collision Risk Assessment Inputs

- Is it clear whether each collision risk input will be informed **quantitatively or qualitatively**?
- Has **each collision metric input** (e.g. flux, height, spatial use, temporal variation) been captured by **one or more survey methods**?
- Are **all relevant bird and bat species** adequately covered by the selected methods?
- Have **multiple survey methods** been considered or employed together to better inform CRM inputs where appropriate?

Spatial Coverage

- Have **key roosts, movement corridors, flyways, and dispersal routes** been identified?
- Are survey locations/transects selected using an appropriate spatial design (e.g. **random, systematic, stratified**)?
- Have **extended transects** (within and outside turbine envelope) been considered to support post-construction avoidance comparisons?

Temporal Coverage

- Do the selected data sources capture **daily variation in activity** (e.g. across a 24-hour period)?
- Are **diurnal and nocturnal activity patterns** of all relevant species captured?
- Do the methods capture **seasonal and migratory patterns**, including across multiple years where required?
- Are **survey duration, frequency, and timing** sufficient to capture peak activity periods (e.g. migration events)?
- Has **observer fatigue** been considered and addressed in the survey design?

Appropriate Survey Methods

- Have all **relevant species** been identified during **Stage 1 Site identification**?
- Are the selected methods capable of detecting:
    - Diurnal species

    - Nocturnal species
    - Cryptic or low-detectability species
- Are survey methods appropriate for the **scale, complexity, and risk profile** of the project?

Quality Standards

- Are survey methods **designed to be repeatable**, particularly to support post-construction comparisons?
- Have potential **detection biases** been identified and addressed or documented (e.g. distance correction, availability bias)?
- Have **data handling, storage, and management procedures** been defined, including:
    - Standardised data templates
    - Secure data storage
    - Quality assurance and version control processes

Surveyor Competency

- Are survey personnel **appropriately experienced** with the relevant taxa and survey methods?
- Do survey personnel have access to **appropriate and calibrated equipment**?
- Have **standard operating procedures (SOPs)** been developed and implemented?
- Have survey personnel been trained in **key measurement and recording protocols** to ensure consistency across surveys?

Documentation of Survey Methods and Results

- Will survey reports include **detailed descriptions of methods**, survey effort, and limitations?
- Is survey effort (time and spatial coverage) clearly documented to support **estimates of flight flux activity**?
- Do reports provide sufficient methodological detail to allow **independent evaluation** of results and conclusions?

Glossary and more information

Collision Likelihood Score (CLS)

A structured, **qualitative assessment** of collision likelihood risk using ranked criteria. CLS combines species activity, flight height, seasonal exposure, and collision history to generate transparent risk ratings. CLS is appropriate when data are insufficient for a CRM, during early project stages, or when collision risk is clearly very low or very high.

Collision Risk Assessment (CRA)

A multi-step process that assesses the likelihood and consequence of wind turbine collisions for bird and bat species. The CRA is designed to identify species at risk, inform the mitigation hierarchy and to support regulatory approval of onshore and offshore wind farm developments.

Collision Risk Model (CRM)

A **quantitative model** that uses numerical survey data to estimate the long-term average number of bird or bat collisions per year. CRM works best when flight activity (flights per area per time) can be measured or reliably modelled and should ideally include uncertainty (confidence intervals).

Offshore Survey Methods

Survey Type	Description	Considerations
Visual Surveys	Observers record bird activity directly, usually using boat-based transects.	- Quantitative CRM requires flights recorded across defined area and time - Apply distance correction for detectability - Height estimation must resolve species distributions; avoid coarse bins - Avoid field truncation - Limited in adverse weather - Cryptic, nocturnal, or migratory species may be missed - Height validation studies may be necessary
Acoustic Monitoring	Detectors record calls of birds and bats (full-spectrum or zero-crossing for bats). Offshore, detectors may be placed on floating devices.	- Sea noise can affect detectors - Limited detection range - Provides relative activity only - Species complexes may be difficult to distinguish - Individual identification often not possible - Deployment duration should capture seasonal/migratory events
Radar	Uses radio waves to detect bird and bat movements continuously, independent of daylight, and largely weather independent.	- Species identification may be limited - Device placement constraints - Affected by weather and marine noise (waves) - Limited installation structures offshore
Telemetry	Birds are captured and fitted with GPS or radio transmitters to track flight and habitat use.	- Typically small sample sizes; not population-representative - Ping interval selection critical - Species size constraints for ethical and technical reasons
Digital Aerial Surveys	Aircraft-mounted still or video cameras capture high-resolution imagery to estimate populations and distributions.	- Quantitative CRM requires movements recorded across defined area and time - Useful in difficult-to-access areas - Species identification may be limited; best combined with other methods (visual, acoustic, thermal) for species apportioning

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