Australian Government

NATIONAL ENVIRONMENTAL PROTECTION AGENCY



Australian Collision Risk Framework

Offshore survey guide

This guide describes survey methods for bird and bat baseline surveys undertaken during pre-construction site investigations and environmental impact assessments for offshore wind energy developments.

It provides guidance on survey design and data collection to support quantitative and qualitative collision likelihood assessments. The guide links offshore survey methods to the collision risk criteria and data requirements identified in the Australian Collision Risk Framework (ACRF).

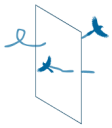
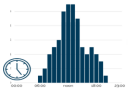
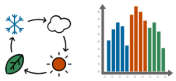
The guide includes a checklist for designing fit-for-purpose survey programs and collecting data suitable for collision likelihood assessment using a collision risk model (CRM), collision likelihood score (CLS) or hybrid assessment pathway.

This guide is advisory and is not mandatory. Different approaches may be appropriate where supported by new scientific information, site-specific considerations or emerging best practice. Any departure from this guidance should be clearly documented and justified.

What data are needed?

Robust collision likelihood assessment requires site-specific information on birds' and bats' exposure to collision risk, including the duration and timing 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.

Risk criterion	Quantitative (CRM) data	Qualitative (CLS) data
Flight activity 	Site-based measurement of movements with identification to species Survey data including duration and area searched accounting for detectability	Presence / absence of species records from multi-season site surveys Historical and regional records Species distribution maps.
Flight height 	Site-based measurement of flight heights, with sufficient resolution to characterise the relevant flight-height distribution. Published data on flight height distributions may be used where appropriate and sufficiently representative.	Published information on flight height classes, informed by species-specific flight foraging strategy (e.g. diving, aerial) where relevant
Spatial use within site 	Flight paths derived from, or directly collected through, site-based surveys Spatial activity may be modelled using justified ecological assumptions (e.g. uniform distribution of activity or activity centred on keystone feature)	Quality and extent of suitable foraging areas or other activity attractors onsite. Distance to keystone features (e.g. breeding colonies)
Daily activity 	Proportion of the day active, based on site-based and/ or published data, including nocturnal activity where relevant	Species activity type (e.g. diurnal, nocturnal or crepuscular) and other relevant information on daily activity patterns
Seasonal activity 	Site-based records representative of the relevant annual cycle and periods of potentially elevated activity, including migration or other seasonal movements where applicable	Recorded seasonal activity from public observation repositories, regional information and other relevant sources

Method suitability

Table 2 provides an overview of the applicability of common data collection methods for generating evidence for the risk criteria relevant to collision likelihood assessment. Methods may be used individually or in combination, depending on the species, site and assessment pathway.

The table is a general guide only. The suitability of a method will depend on **site conditions, study design and data quality.** Survey designers should consider the requirements of the species and sites when selecting methods. Further information on survey methods and collision likelihood assessment pathways is provided in the *Glossary and more information* section.

Table 2 - Quick guide to the applicability of different survey methods as data inputs for collision likelihood assessment.

Method	Applicable to	Flight rate and density	Flight height	Spatial use patterns	Daily activity	Seasonal patterns	Potential application
Visual (boat transect)	Diurnal species	+	+	+*	+	+	Quantitative
Acoustic	Birds and echolocating bats	? Relative	~	~	?	?	Limited use - constrained by deployment difficulty
Radar	All species	~ No species ID	?	?	?	?	Limited to date but evidence base increasing
Telemetry	All species	~	+*	?	+	?	Limited use – focussed on individuals
Digital aerial	All species	+*	+*	+	+	+	Quantitative but may need to be teamed other methods

Key: + **Robust** - can provide a quantitative measure of the input, subject to method-specific limitations and error.

? **Limited** - may provide relevant information, but limitations in accuracy, scale, species identification or ability to provide an absolute measure may prevent a robust estimate.

~ **Not suitable** - Does not provide a valid measure of the relevant input.

* Subject to survey design and method-specific limitations.

Primary survey types

For diurnal birds, **boat-based transect surveys** and **digital aerial surveys** are currently the most widely applicable methods for collecting site-based information on bird abundance, distribution and movements.

Both methods can also provide information from areas beyond the proposed turbine envelope. These data may be useful for assessing macro-avoidance (avoidance of the site as a whole) and displacement, where macro-avoidance restricts access to important habitats or other key environmental features. Emerging studies provide evidence of macro-avoidance and its potential ecological effects, which should be considered when planning offshore wind developments in Australian waters.

Weather considerations

Boat-based and aerial surveys are constrained by weather conditions and must be conducted in low to moderate wind conditions. However, birds and bats may remain active during conditions in which these surveys cannot be reliably undertaken. For example, boat-based surveys may not be feasible at wind speeds above approximately 25-30 knots, while birds may continue to fly during these conditions. As a result, site-based surveys may not capture activity across the full range of conditions in which collision risk may occur.

A combination of survey methods may therefore be appropriate where weather-related gaps are likely to affect the assessment. For example, telemetry can provide information on animal movements across a wider range of weather conditions than boat-based or aerial surveys. Telemetry is unlikely to provide sufficient sample sizes to characterise collision risk on its own in most circumstances, but can complement other survey methods by providing information for conditions that cannot be adequately sampled using conventional visual surveys.

Survey design checklist

This checklist supports the selection of appropriate survey methods and consideration of key aspects of survey design before data collection begins. It is intended to help prioritise survey objectives in the context of the proposed site and assessment pathway. Not all checklist items will be feasible or relevant at every site, and survey designers should apply practical judgement when determining the appropriate survey approach.

The checklist is provided for proponents' consideration and is not a mandatory requirement of the Commonwealth environmental assessment process.

Alignment with collision risk assessment

- ☐ Is it clear whether each required data input will be used **quantitatively or qualitatively**?
- ☐ Has **each relevant data input** (e.g. flight rate and density, flight height, spatial use and temporal patterns) been addressed by **one or more survey methods**?
- ☐ Are **all relevant bird and bat species** adequately covered by the selected methods?
- ☐ Have **complementary survey methods** been considered where a combination of methods would better inform the assessment?

Spatial coverage

- ☐ Have key breeding sites, migration corridors, and foraging areas or routes been identified?
- ☐ Have survey locations and transects been selected using an appropriate spatial design (e.g. **random, systematic or stratified**)?
- ☐ Have **extended transects** within and beyond the turbine envelope, or an appropriate buffer, been considered to support assessment of post-construction changes in use or avoidance?

Temporal coverage

- ☐ Do the selected data sources capture relevant **daily variation in activity**, including nocturnal activity where applicable?
- ☐ Are **diurnal and nocturnal activity patterns** of relevant species adequately considered?
- ☐ Do the methods capture **baseline activity** across relevant **seasonal and migratory periods**, including multiple years where appropriate? (Shi et al. 2026)
- ☐ Are **survey duration, frequency, and timing** sufficient to capture periods of peak activity (e.g. migration events)?
- ☐ Has **observer fatigue** been considered and addressed in the survey design?

Appropriate survey methods

- ☐ Have all relevant species identified during Stage 1 Site identification been considered in the survey design?
- ☐ Are the selected methods capable of detecting relevant:
  - diurnal species;
  - nocturnal species; and

- cryptic or low-detectability species

☐ Are the selected methods appropriate to the **scale, complexity, and risk profile** of the project?

☐ Have the limitations of each selected method, including species detectability and weather constraints, been considered?

Quality standards

☐ Are survey methods sufficiently **standardised and repeatable**, particularly where data may be used to support post-construction comparisons?

☐ Have potential **detection biases** been identified and addressed or documented (e.g. distance correction and availability bias)?

☐ Have data handling, storage and management procedures been defined, including:

- standardised data templates;
- secure data storage; and
- 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 survey methods**, effort and limitations?

☐ Is survey effort, including temporal and spatial coverage, clearly documented to support interpretation of flight activity and, where applicable, **estimates of flight rate or density**?

☐ 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 based on ranked risk criteria. The CLS combines species activity, flight height, seasonal exposure, and collision history to assign a transparent collision likelihood rating. CLS is appropriate when data are insufficient to support a collision risk model (CRM), during early project stages, or where collision likelihood is clearly very low or very high.

Collision risk assessment (CRA)
A structured process for assessing the likelihood and consequences of bird and bat collisions with wind turbines. A CRA is used to identify species potentially at risk, inform application of the mitigation hierarchy and support environmental impact assessment and regulatory decision-making for onshore and offshore wind energy developments.

Collision risk model (CRM)
A **quantitative model** that uses numerical survey and other data to estimate the number of bird or bat collisions that may occur over a specified period. A CRM is most appropriate where flight rate or density, flight height and other relevant exposure parameters can be measured or reliably modelled. Where practicable, uncertainty associated with model inputs and outputs should be quantified.

Species
For readability, in this document, 'species' refers to both species and subspecies of relevant birds and bats.

Offshore survey methods

Method	Description	Considerations
Visual Surveys	Observers record bird movements directly, usually from vessels using transect-based surveys.	– Quantitative CRM requires movements recorded across defined area and time. – Detection probability should be considered, including effective strip width where applicable. – Height estimation should provide sufficient resolution to characterise the relevant flight height distribution. – Surveys may be limited by adverse weather and sea conditions. – Cryptic, nocturnal, or poorly detectable species may be under-recorded. – Height validation studies may be required where reliable flight-height estimates cannot be obtained directly. – Vessel presence may influence bird behaviour, including attraction or avoidance. – The size of offshore survey areas may constrain spatial and temporal coverage.
Acoustic Monitoring	Detectors record vocalisations of birds and echolocating bats. Offshore, detectors may be placed on floating or other suitable structures.	– Marine and vessel noise can affect detection. – Detection range and deployment locations may be limited. – Data generally provides relative measure of an activity rather than an absolute measure of abundance or flight rate. – Species or species complexes may be difficult to distinguish.

Method	Description	Considerations
		– Individual identification is generally not possible. – Deployment duration should be sufficient to capture relevant seasonal and migratory activity.
Radar	Radar uses radio waves to detect bird and bat movements continuously, including during darkness and under many weather conditions.	– Species identification may be limited. – Device placement and installation infrastructure may constrain coverage. – Performance can be affected by rain, sea state, wave clutter and other environmental conditions. – Offshore installation and maintenance may be challenging.
Telemetry	Birds or bats are fitted with tracking devices to collect information on movements, flight behaviour and habitat use.	–Sample sizes are typically small and may not be representative of the wider population. – Sampling interval and device settings critical. – Species size constraints for ethical and technical reasons.
Digital Aerial Surveys	Aircraft-mounted still or video cameras capture imagery that can be used to estimate bird abundance, distribution and, where methods permit, movements.	– Quantitative CRM requires movements to be linked to a defined area and time. – Useful in difficult-to-access large areas. – Species identification may be limited; best combined with other methods (visual, acoustic) for species apportioning.

References

Shi X, Holden W, Simmonds JS, Clarke RH, Chapman JW, Liu Y, Fuller RA and Kerswell A (2026) 'Mistimed surveys lead to underestimated migratory bird impacts from wind farms', *Journal of Applied Ecology*, 63(4):e70386.

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Contributors

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