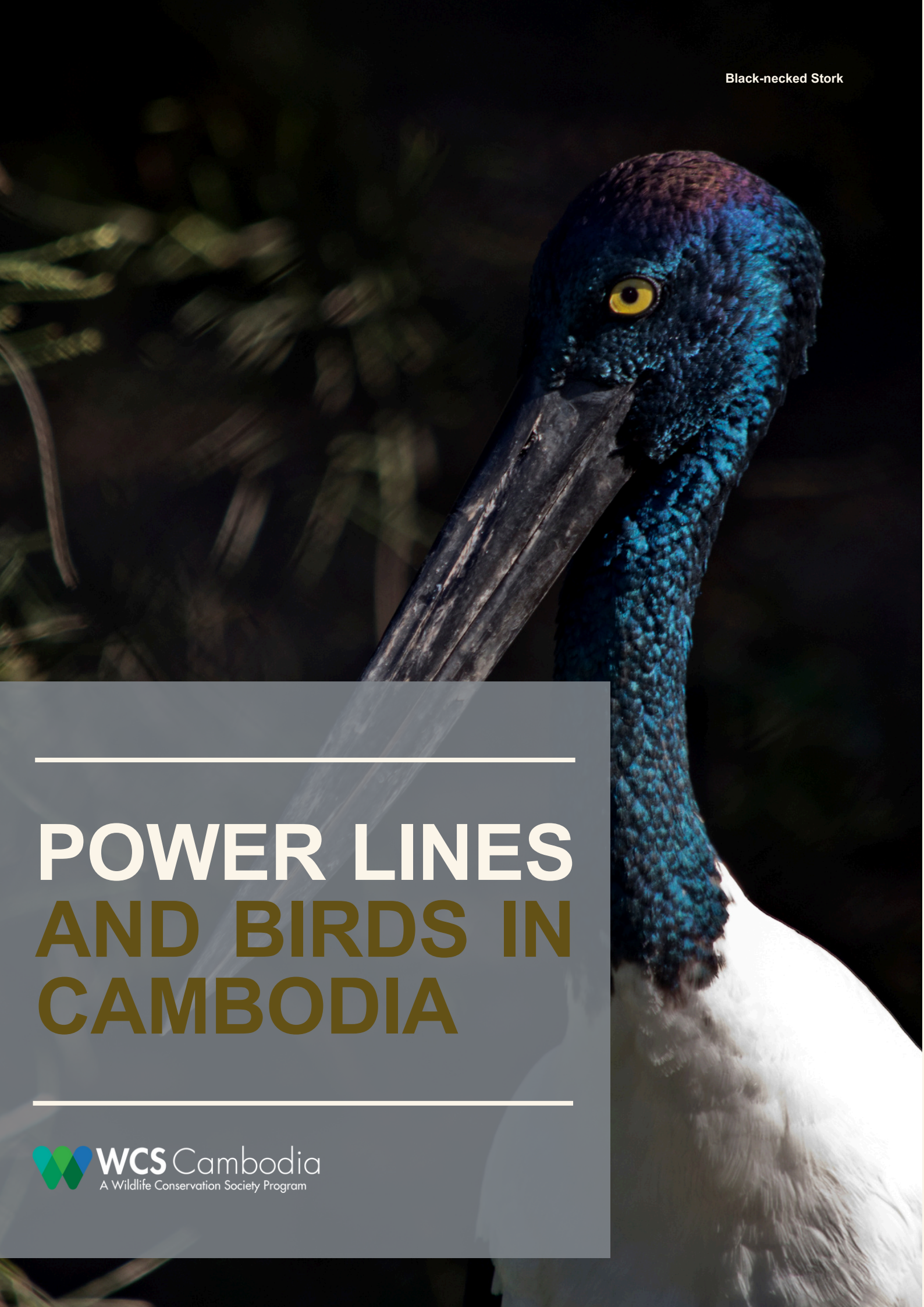


POWER LINES AND BIRDS IN CAMBODIA

WCS Cambodia
A Wildlife Conservation Society Program

The Tonle Sap Great Lake and its Floodplain is a complex landscape with significant biodiversity in the Kingdom of Cambodia. The grasslands within this landscape are the stronghold habitat for the critically endangered Bengal Florican (*Houbaropsis bengalensis*) and other rare species. Of particular concern to such endangered species, is the development of linear infrastructure, such as power lines.

A dead Pond Heron from collision with a power line in Cambodia (WCS staff)

THE DANGERS FOR BIRDS

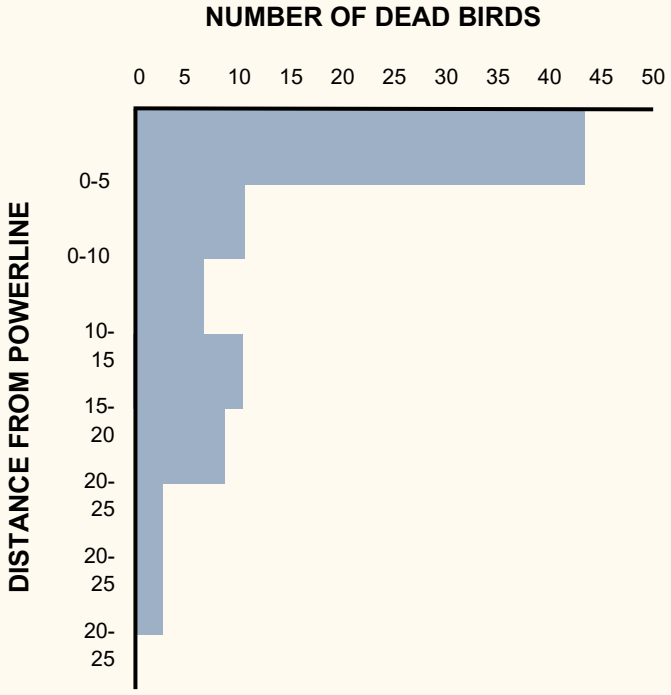
Power lines pose several dangers to birds: collisions, electrocutions, and habitat disruption.

- **Collisions:** Colliding with electric line infrastructure is a key risk for flying birds. **Collisions result in broken wings, broken necks and legs, and head injuries; and sometimes the bird does not die immediately after impact.** Strong, fast-flying birds with limited forward vision are at higher risk of colliding with power lines, especially during low-light conditions. Both transmission and distribution lines pose threats; however, **the highest, thinnest wire on transmission lines - the earth wire / ground wire - is a major collision point**.

- **Electrocutions:** Less common than collisions but still impactful – **electrocutions result from birds making contact with two conductors, touching a conductor and an earthed metallic structure, or the bird can be indirectly electrocuted.** Large species (e.g. raptors or storks) that perch or nest on powerlines and pylons are at risk of electrocution.

- **Habitat Disruption:** Transmission lines can fragment or degrade bird habitat. **This can displace birds, reduce nesting sites, and make them more vulnerable to predators.**

A dead Bengal Florican from collision with a power line in Cambodia (WCS staff)



Histogram showing distance (metres) of bird carcasses relative to the power line. Only species of a mass greater than 500g are included.

ANALYSIS OF BIRD CARCASSES PROXIMATE TO POWER LINES IN CAMBODIA, 2022

The figure to the left illustrates the number of dead birds at different distances from power lines in Kampong Thom, Cambodia.

This analysis included an assessment of 140 bird carcasses, constituting at least 30 species. Mortalities included highly threatened bird species, such as Bengal Floricans, Spot-billed Pelicans and Painted Storks.

More birds were found closer to the power line than further from it, indicating a strong positive influence of the power line on the distribution of bird carcasses in the landscape. These threats can have population-level effects on vulnerable bird species.

Mahood, 2022

THREATENED BIRDS

In the Tonle Sap Stronghold, endangered and rare species can be threatened by such infrastructure developments.

In general, although any bird species may collide with a power line, in Cambodia:

- **Bustards**, including Bengal Floricans, are highly susceptible to power line collisions due to their field of vision and limited maneuverability
- **Cranes and storks** also face risks, for similar reasons
- **Other species**, such as raptors, adjutants, and pelicans, are at increased collision risk due to their heavy weight and/or reduced maneuverability; they are also at risk of electrocution when perching or nesting on pylons
- **In other Cambodian landscapes**, crucial species at threat from collisions with transmission lines include Giant Ibis (*Thaumatibis gigantea*).

Key globally threatened birds are listed below, organized by their IUCN Status (Critically Endangered, Endangered, Vulnerable, or Near Threatened) and their risk of mortality as it relates to power lines is indicated as high, medium or low.

Bengal Florican (*Houbaropsis bengalensis*) - CR

Masked Finfoot (*Heliopais personatus*) - CR

White-shouldered Ibis (*Pseudibis davisoni*) - CR

Yellow-breasted Bunting (*Emberiza aureola*) - CR

Milky Stork (*Mycteria cinerea*) - EN

Sarus Crane (*Grus antigone*) - VU

Gray-headed Fish Eagle (*Haliaeetus ichthyaetus*) - NT

Painted Stork (*Mycteria leucocephala*) - NT

Spot-billed Pelican (*Pelecanus philippensis*) - NT

Lesser Adjutant (*Leptoptilos javanicus*) - NT

Greater Adjutant (*Leptoptilos dubius*) - NT

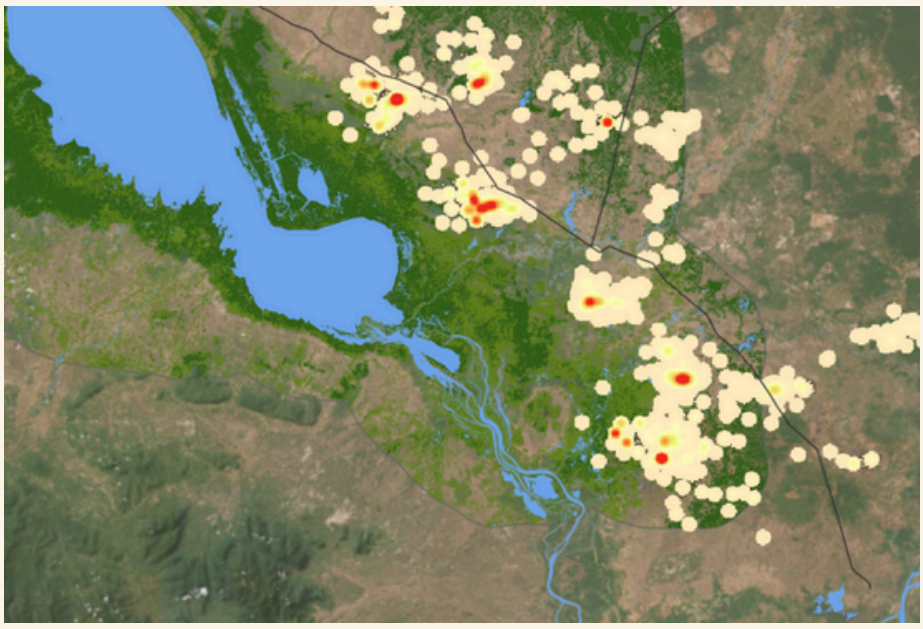
Chinese Grassbird (*Graminicola striatus*) - NT

SPECIES MORTALITY RISK FROM POWER LINES

- HIGH
- MEDIUM
- LOW

COLLISION RISKS: FLORICANS AND POWER LINES

Dead Bengal Floricans next to power lines



BENGAL FLORICANS

Floricans are at risk of extinction and are prone to power line collisions.

The heatmap on the left illustrates Florican telemetry sightings near transmission lines.

This area holds Southeast Asia's largest remaining population for the species. This telemetry data shows that the birds migrate across multiple high-voltage lines, highlighting the urgent need to address this threat.

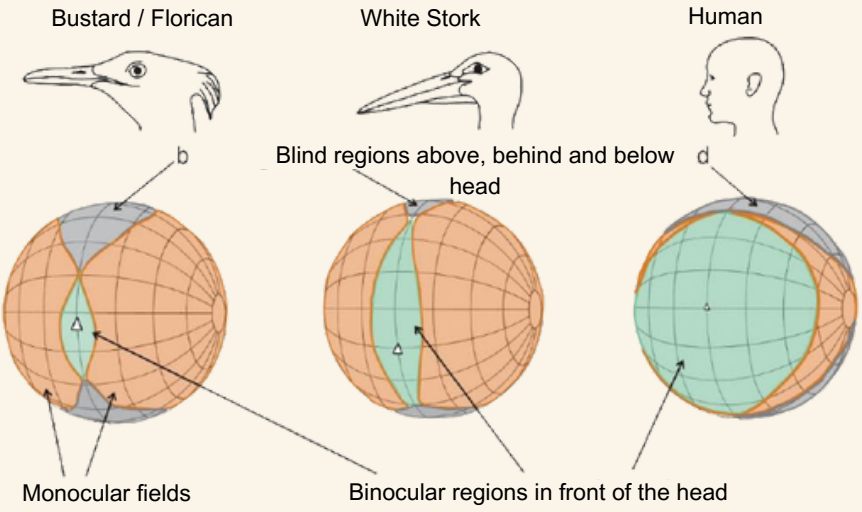
Kessler, M. *2022*

NO FORWARD VISION

The eye placement on a species' head makes a difference in what it can see.

- Imagine a ball around a bird's head: the picture to the right shows what each bird can see on that ball with its binocular field (**green**) and its monocular field (**orange**).
- For example, Bustards (same family as Floricans) **can not see straight ahead when they look down**, but White Storks and humans can.
- For a Florican to see something clearly, **it needs to turn its head and look at something from the side**, instead of looking straight on.

Vision & Birds, Martin, 2022



- **The human field of view is unusual** because we have two eyes that look straight out from our face. Our field of vision lies directly ahead, and we see less details in our periphery vision. In humans, the binocular field is 120 degrees wide.

- **Birds' eyes are generally on the sides of their heads**, not at the front.

- **Some birds** can see all around them. But some species, like larger birds of prey (*Accipitridae*) and bustards (*Otididae*), **can not see directly** above their heads when they look down. So, when they tilt their heads to scan the ground, they're essentially flying blind in the direction they're going. To see something really clearly, a bird has to turn its head and look at it from the side, instead of looking straight on.

- Vision is a complex and multifaceted sense. **Knowledge about bird vision** can guide power line adjustments and guide diverter design and deployment.

Vision & Birds, Martin, 2022

Bengal Florican (ACCB/Chiara Parolin)

BENGAL FLORICANS ARE HIGHLY SUSCEPTIBLE TO COLLISIONS WITH POWER LINES.

Floricans do not have forward facing eyes, as seen from the photo on the left. They are fast/strong fliers and have a relatively heavy mass.

This means that generally they cannot see the powerlines until its too late, are flying too fast to maneuver easily, and weigh too much to make sharp turns easily.

MITIGATION MEASURES

In regions where endangered bird species reside and transmission line construction is planned, **prioritizing bird-friendly solutions** is essential and practical.

If undergrounding or rerouting the line is not possible, the following measures, recommended by the IUCN, NABU and the Audubon Society, should be adopted. These recommendations intend to reduce the risks of **collisions** (below) and **electrocutions** (next page).

High-priority measures to decrease the risks for BIRD COLLISIONS - all measures to be considered at the planning stage

01. **Bury** the power lines and/or **re-route to avoid** critical areas	...to eliminate the risk of collisions
02. **Adjust** the line configuration so that the **ground / earth wire is NOT the highest wire**;	...to reduce the collision risk with the ground/earth wire; instead position the more visible wires at the highest level
03. **Reduce** redundant lines (load share onto new lines),	... to reduce extra navigation hazards for flying birds
04. **Minimize** lines in the air space (opt for single level arrangement of conductor cables)	... to reduce extra navigation hazards for flying birds
05. **Increase** wire visibility: use visual signaling devices* (*esp. for ground /earth wire*), e.g. flight diverters, at a max. distance of 10m.	... to reduce collision risk & increase wire visibility
06. **Reduce** the number of horizontal planes of conductors	... to reduce risk of collision

[*] Diverters must be high contrast, have movement, and be visible at night; Research is ongoing for this topic, however either the diverter type “Firefly”, or balls used for alerting aircraft could be a good option; Diverters must be monitored regularly to detect malfunction or missing diverters

From an economic perspective, bird-friendly solutions also make sense. According to the Avian Power Line Interaction Committee, an estimated 10% - 24% of power cuts in the United States are caused by birds.

CONTINUED...

High / medium priority measures to decrease the risks for BIRD ELECTROCUTIONS - all measures to be considered at the planning stage

01. **Discourage** perching by design	... to reduce electrocution risk
02. **Insulate** all live elements with pre-formed sheaths and coverings	... to reduce electrocution risk
03. **Avoid** perpendicular crossing of lines	... to reduce electrocution risk
04. **Install** elements with a "*critical distance*" - the distance between live elements should be 1.0m -1.5m distance**	(same above); if the distance is too short, this can increase risk of electrocution
05. **Avoid** using upright / pin insulators	... to reduce electrocution risk
06. **Avoid** using jumpers configured above the insulators	(same above); configure the wires below insulators
07. **Reduce** the span of the conductors between pylons	... if the span is too wide, this can increase risk of electrocution
08. **Use** the "staggered" pylon configuration with suspension insulators	... to reduce electrocution risk
09. **Avoid** horizontal configuration with strain insulators / jumpers above insulators, and additional elements	... to reduce electrocution risk; this is the most dangerous configuration for birds
10. **Reduce** additional elements on the pylons (transformers, disconnectors)	... because this is more bird friendly

To prevent bird-related hazards on high-voltage powerlines, ensure that crossarms, insulators, and other components are designed and installed to minimize perching opportunities near energized conductors.

[**] the vertical distance between the point where the bird perches and the nearest live element at a lower level is recommended at 1m distance; the vertical distance between the point where the bird perches and the nearest live element at a higher level is recommended at 1.5m distance; the horizontal distance between the point where the bird perches and the nearest live element is recommended at 1.5m distance; the vertical distance between the bottom of the cross arm and the nearest live element at a higher level is recommended at 1m distance.

MONITORING SUGGESTIONS

In addition to the above measures to mitigate bird deaths and injury from power lines, we recommend a systematic monitoring system working with local communities who are invested in the landscape. This can provide feedback on the effectiveness of the mitigation measures.

WCS can assist and contribute to the following activities:

- Establish points for long-term monitoring of changes in bird mortality
- Conduct weekly searches along the new line to monitor bird deaths
- Develop a team of 4-5 community members who work with WCS to undertake monitoring
- Monitoring will be conducted in habitat of highest value to threatened species
- Survey methodology follows standard protocols for assessing mortality of birds associated with power lines

Funded by the European Union

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KEY READING

- ***Key reading:*** S. Mahood et. al (2022) *Short Communication A new power transmission line causes significant mortality in the largest remaining population of Critically Endangered Bengal floricans Houbaropsis bengalensis* (link) & G. Martin *Vision-Based Design and Deployment Criteria for Power Line Bird Diverters* Birds , 3, 410–422 (link)
- ***Monitoring recommendations:*** Silva JP, Marques AT, Bernardino J et al. (2023) The effects of powerlines on bustards: how best to mitigate, how best to monitor? Bird Conservation International 33, e30. (link)
- ***Birds and power lines in the USA:*** Brooke L Bateman, Gary Moody, Jennifer Fuller, Lotem Taylor, Nat Seavy, Joanna Grand, Jon Belak, Garry George, Chad Wilsey, and Sarah Rose. (2023) Audubon's Birds and Transmission Report: Building the Grid Birds Need. National Audubon Society: New York (link)
- ***Recommended training on birds and transmission lines*****:** IUCN Centre for Mediterranean Cooperation, BIRDS AND POWER LINES, MOOC (Massive Open Online Course) (IUCN)

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