CRITICAL APPRAISAL

Example of the systematic map Photovoltaic & Biodiversity

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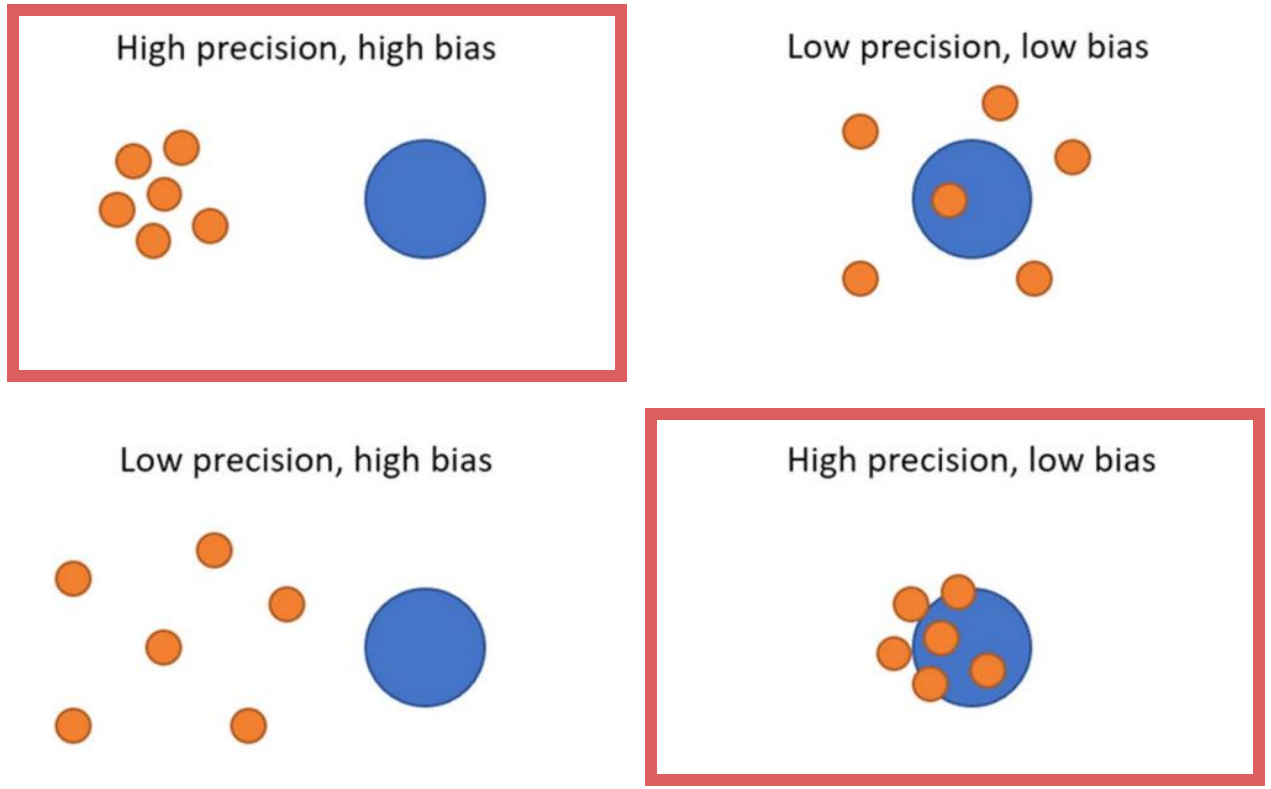
A new critical appraisal recommended by the CEE

Critical appraisal: quantify the extent of **systematic error** in study findings

→ due to **flaws or limitations** in study **design or conduct**

→ To what extent **results deviate** from the true value due to **consistent under/over estimation**



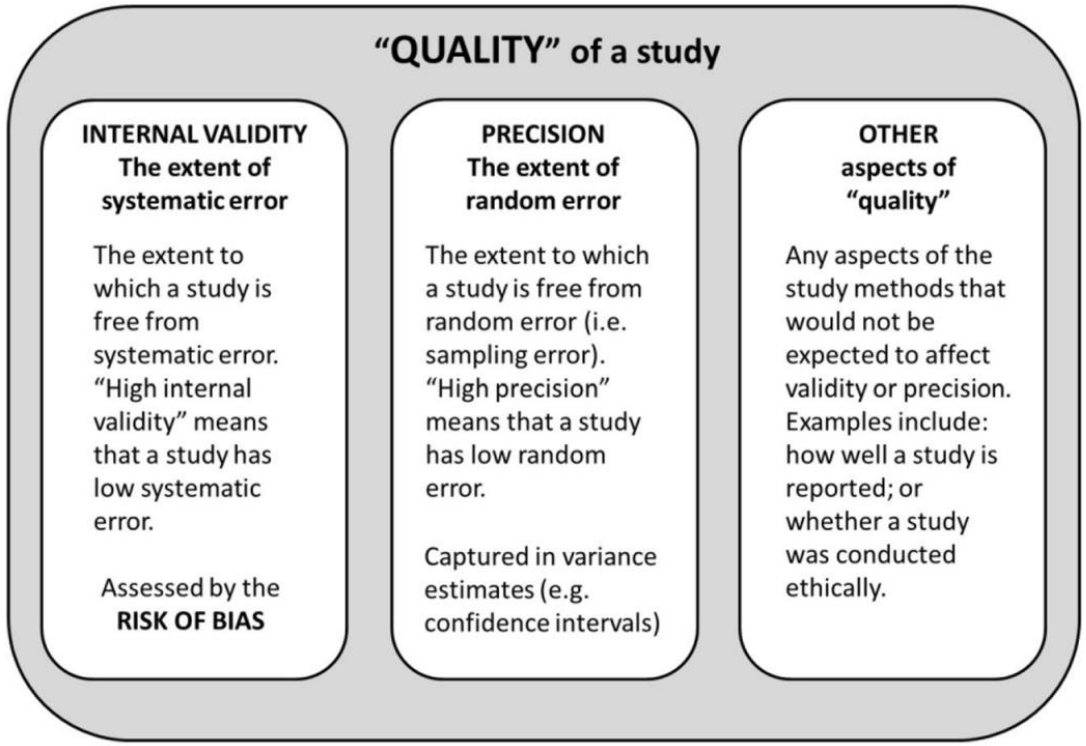
Frampton *et al.* (2022), doi: 10.1186/s13750-022-00264-0

A new critical appraisal recommended by the CEE

Quality of a study = **validity + precision** + other quality constructs

→ **Precision = unpredictable inaccuracy** of estimation **= random error**

→ To reduce random error: ↗ sample size or conduct meta-analysis



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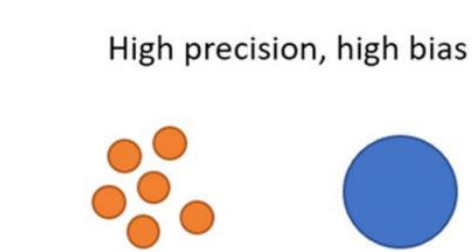

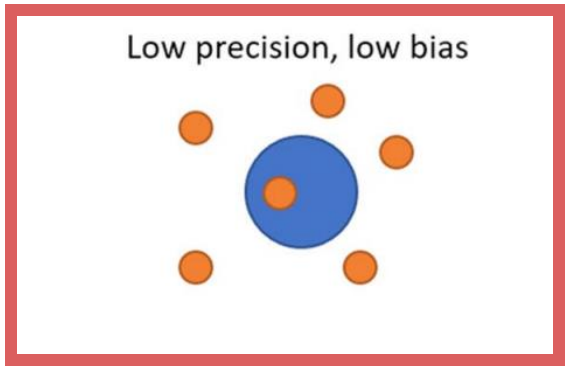

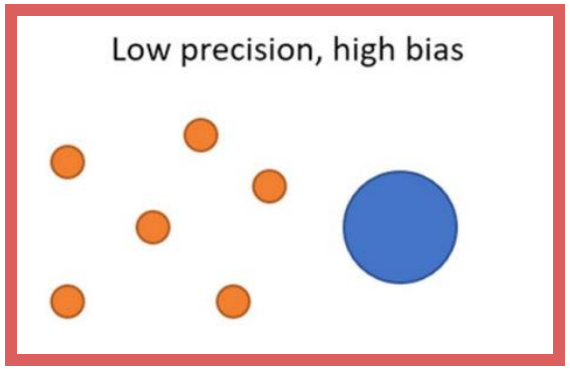

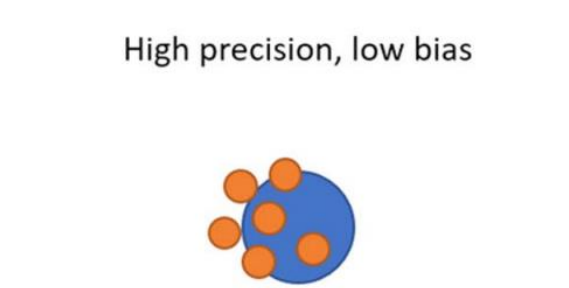

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A new critical appraisal recommended by the CEE

Studies are **critically appraised** based on **2 different types of validity**

1 Internal validity

→ The extent to which the study's **methods** can provide an **unbiased result**

→ **Assessed** thanks to several **RISKS OF BIAS** criteria

2 External validity

→ The extent of **systematic error in applying the results** of a study to **answer a precise review question**

→ **Generalisability**, **applicability**, directness

The different types of risks of bias

Different types of **risks of bias** to estimate the **likelihood of systematic error**

→ **Examine study design/methods** : Were adequate steps taken in order to **avoid systematic error?**

Confounding

Detection

Other…

Attrition

Outcome reporting

Post-exposure selection

Outcome assessment

Misclassified comparison

Performance

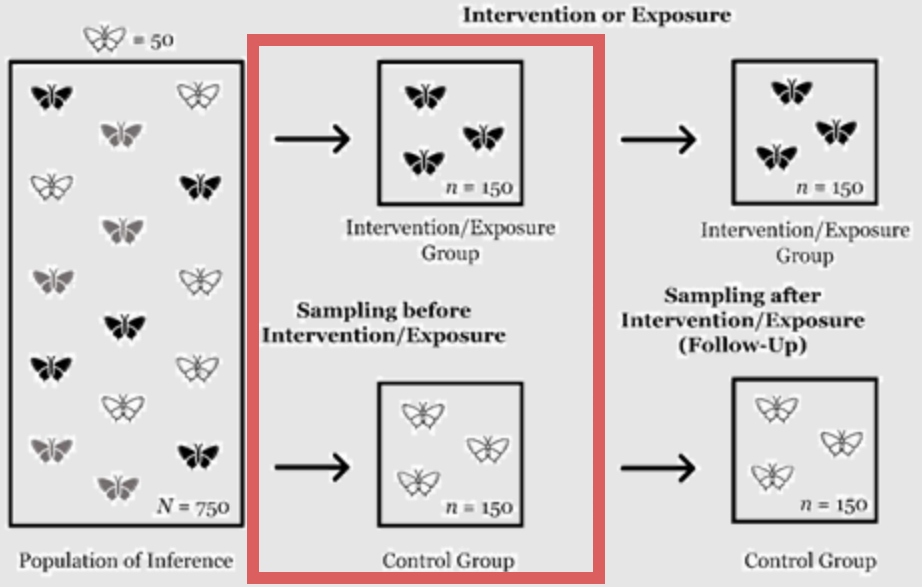
For **observational** studies
→ Study system is **observed**, without any manipulation

For **experimental** studies
→ Study system is **controlled** to reduce the effects of unintended variables

Risk of confounding biases

Bias due to **uncontrolled variables** influencing both the exposure and outcome

- **Different characteristics of studied population** between comparator and exposure groups
- Controlled by **exchangeability** between groups and by **randomisation**



Konno, Livoreil & Pullin (2021), CEECAT version 0.3 (Prototype)

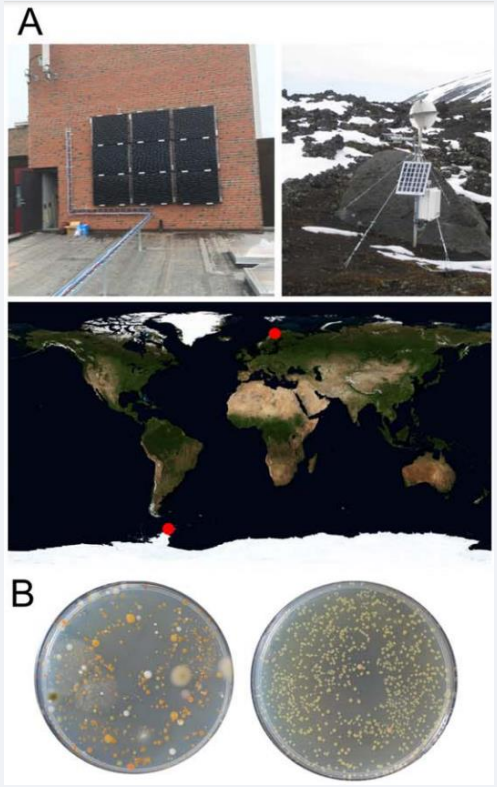
→ Are there **potential confounding factors** influencing the exposure and/or the outcome? (e.g. **different ecosystems** between sites, **additional uncontrolled exposures** such as light, chemical or noise pollution)

Risk of confounding biases

One example:

High | Low | Unclear

- **Tanner et al. (2018):** Study of microorganisms found on PV panels



→ Comparison of microorganism communities in several locations: Artic, Antarctica

*"Two **vertical** panels attached to the wall (98 x 69 cm) and **three inclined** panels (50-60°) next to each other. All of the panels had a **southwards** orientation" & "Panels were sized from 45 x 40 cm to 45 x 80 cm, were **totally vertical** or very **slightly inclined**, displayed a **northwards** orientation"*

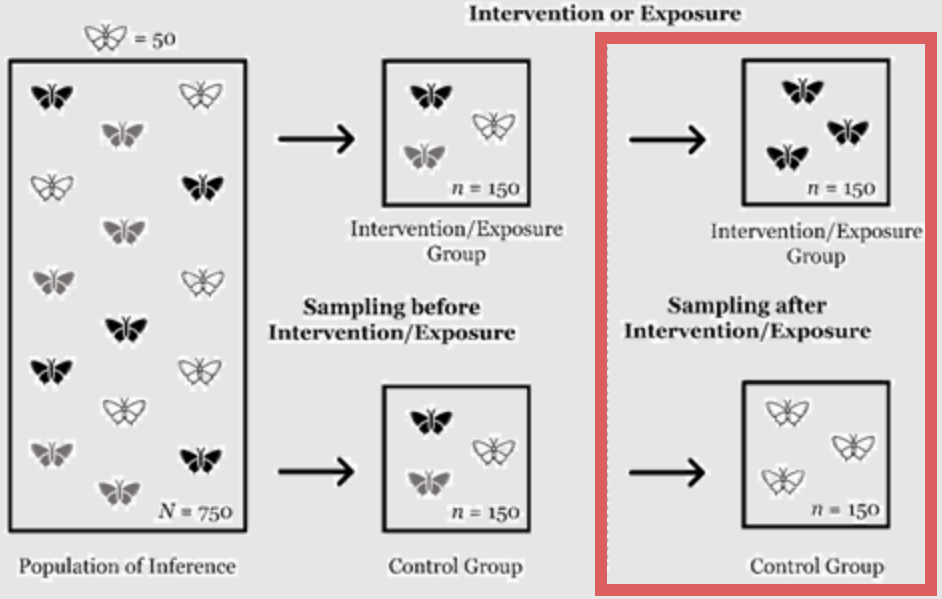
► **High**

Two exposures: **location** and **type of PV** panels

Risk of post-exposure selection biases

Bias due to **systematic differences in selection of subjects/areas after exposure**

- **Selection** of subjects **related to both exposure and outcome**
- Ensured **exchangeability** between selected subjects
- **Blinding** to selection



Konno, Livoreil & Pullin (2021), CEECAT version 0.3 (Prototype)

→ Are exposure and comparator groups **randomly or systematically selected** and **exchangeability** can be assumed after the exposure?

Risk of post-exposure selection biases

One example:

High | Low | **Unclear**

- **Guerin (2017):** report of USSE construction risks on people, fauna, flora…

→ Report on the conduct of fauna and flora management during the construction of an USSE

*"Fauna survey methods employed included habitat **assessment**, microbat **surveys**, anabat **analysis**, nocturnal **surveys**, targeted **surveys**, weekly, monthly HSE **inspections**, and **inspections** of relocated habitats and trenches"*

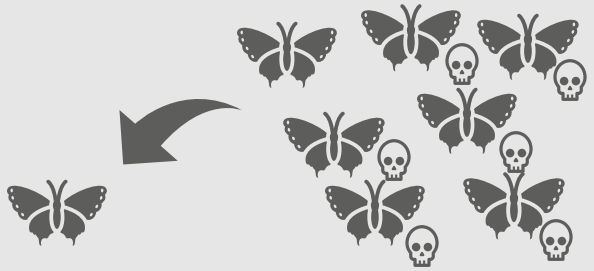
► **Unclear**

Survey methods **not sufficiently described**

Risk of attrition biases

Bias due to **missing data**

- **Significant imbalance of missing data** between exposure and comparator
- **Sufficient loss** of data potentially **significantly affecting the effect estimate**

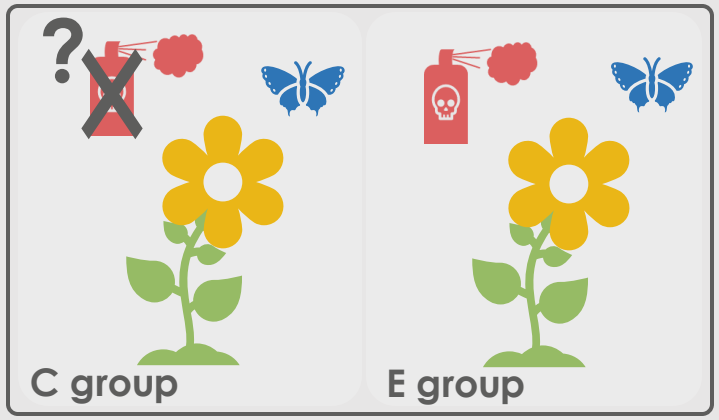


→ Were there any **differences in missing data** between exposure and comparator groups during the **study** or the **analysis?**

Risk of misclassified comparison biases

Bias due to **mismeasurements of exposure/comparator**

- Only for **observational studies**
- **Accurate and precise definitions** of E and C groups
- No-exposure group without <u>any</u> influence from exposure



→ Are exposure and comparator groups **sufficiently well defined**?

Risk of misclassified comparison biases

One example:

High | Low | Unclear

- **Wit & Biesmeijer (2019):** Study of seed mixes used to rehabilitate USSE

→ Comparison of different type of seed mixes (**exposed**) and in a **control** area

*"The study was set-up as a randomized block design. The area was **divided into five blocks** based on soil type, in which the clusters (A - G) were organized in such a way that they randomly contained each of the **five seed mixes including a control plot** with a total of six plots per cluster"*

► **High**

nature of control plot **not sufficiently specified**

Risk of performance biases

Bias due to **deviation/alteration of planned exposure**

- Only for **experimental studies**
- Presence of unplanned **co-exposure(s)**
- **Failure to implement** planned exposure (also cross-contamination)
- **Lack of adherence** of subjects to exposure
- **Blinding** to hypothesis/comparison

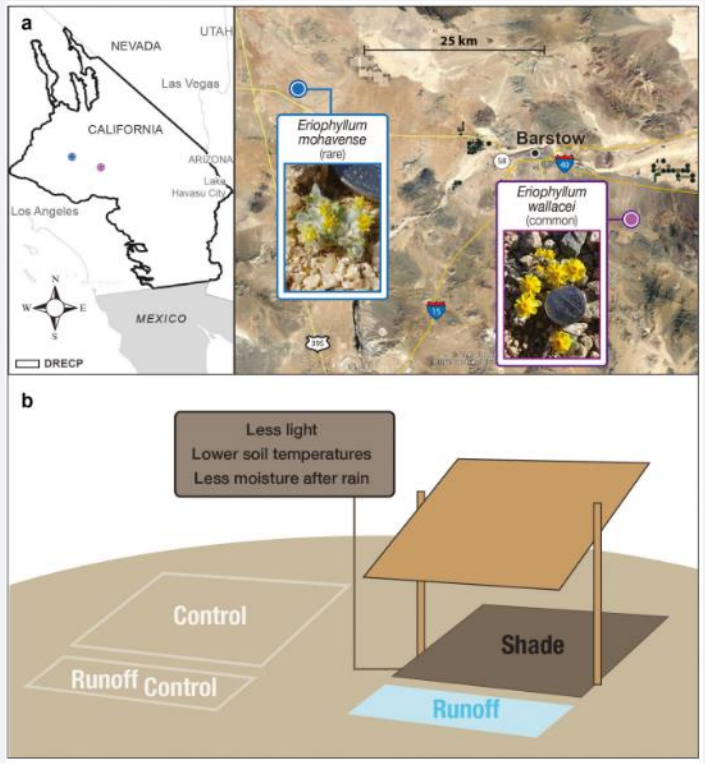
→ Was the **exposure altered during the experiment and thus differed** between exposure and comparator groups?

Risk of performance biases

One example:

High | Low | Unclear

- **Tanner et al. (2020):** study of plant communities in the Mojave desert, California



→ Comparison of plant communities under (**exposed**) and in open areas (**control**) from 2012 to 2018

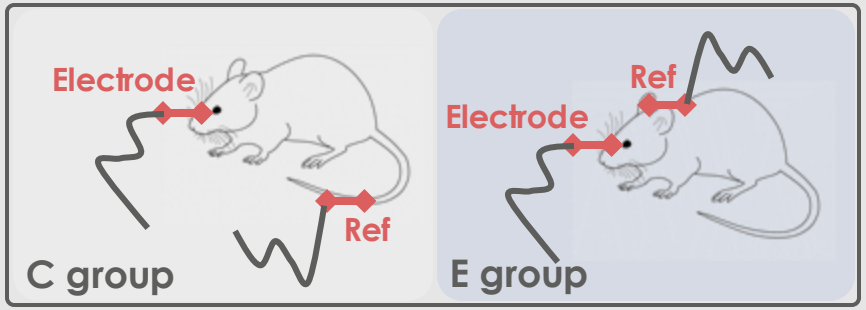
*"In **summer of 2016**, we covered panels with **clear plastic sheeting** (4-mm Coroplast, Corrugated Plastics.net, Hillsborough, New Jersey, USA) to improve rainfall runoff."*

► **High**
change of exposure halfway through experiment

Risk of detection biases

Bias due to **systematic differences in measurements** of outcomes

- **Different methods** between exposure and comparator groups
- **Different calibration methods**
- **Different instruments**
- **Blinding** of investigator to E and C groups



→ Are they **differences in how outcomes were measured** between the exposure and comparator groups?

Risk of detection biases

One example:

High | Low | Unclear

- **DeVault et al. (2014):** Study of bird use of PV installations at airport

Northern Rough-winged Swallow on a PV panel.
Credits: Doris Dumrauf/Alamy

→ Comparison of bird use of PV installations in airport fields with (**exposed**) or without PV panels (**control**)

*"PV arrays were […] similar to their paired airfield sites. Although **vegetation differed** between airfield grasslands and PV arrays"*

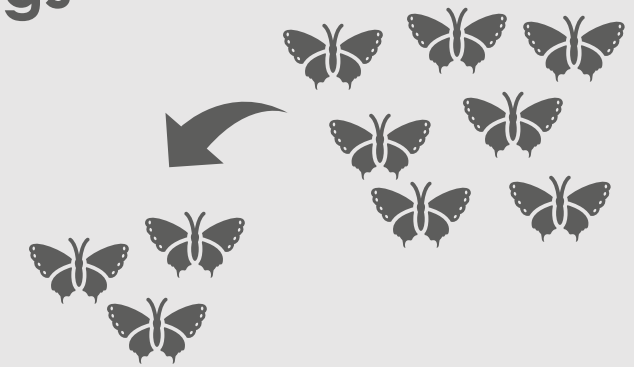
▶ **High**

Potential **different detectability** of birds

Risk of outcome reporting biases

Bias due to **selective disclosure of findings**

- From **multiple measurements**
- From **multiple subpopulations**
- From **multiple analyses**
- May be **suspected if not any non-significant results available**



→ Are reported **findings selectively disclosed?**

Risk of outcome reporting biases

One example:

High | Low | Unclear

- **Vespalcova et al. (2015):** Study of plant community in USSE

USSE in Spain. Credits: Statkraft Spain

→ Comparison of plant communities under (**exposed**) and between PV panels (**control**)

*Abstract: "The observation was carried out on twelve test spots also **under** photovoltaic panels and **between** them"*

▶ **High**

no results provided in main text

Risk of outcome assessment biases

Bias due to **errors in applied statistical analysis**

- **Errors** in applied **descriptive** statistics (n, $\bar{x}$, σ)
- **Errors** in applied **inferential** statistics (null hypothesis)
- **Violation of assumptions** (normality, homoscedasticity)
- **Appropriateness** of applied statistical methods
- **Blinding** to exposure and comparator groups

→ Were **assumptions** for the applied statistical analyses **violated**? (e.g. **normality**, **homoscedasticity**)

Risk of outcome assessment biases

One example:

High | Low | **Unclear**

- **Smith et al. (2020):** Study of Golden Eagle Breeding Response to USSE in California

Golden Eagle *Aquila chrysaetos* (Linnaeus, 1758).
Credits: European Environment Agency

→ Comparison of breeding performances between eagles near (**exposed**) and far from USSE (**control**)

*"We used pooled **variance t-tests** to compare breeding performance metrics for the two groups"*

► **Unclear**
Checking of **assumptions unspecified**

Overall risk of bias

Summary of all results of internal validity assessment

High → If **one** risk of bias criterion rated as **high**

Unclear → If **one** risk of bias criterion rated as **unclear**

Low → If **all** risks of bias criteria rated as **low**

	Confounding	Selection	Attrition	Misclassified comparison	Performance	Detection	Outcome reporting	Outcome assessment	Overall RISK OF BIAS
Tanner et al. (2020)	Low	Low	Low	High	Low	Low	Low	Low	HIGH
Wooster et al. (2022)	Low	Low	Low	Low	Low	Unclear	Low	Low	UNCLEAR

Assessing external validity

External validity: **context suitability**

→ the extent to which the **results** of a research study can be applied to **answer a precise question, without introducing systematic error**

→ Also, **external validity of review question itself** to assess as well

External validity assessment

Study of interest	Review question
Population	Population
Exposure/Intervention	Exposure/Intervention
Comparator	Comparator
Outcome	Outcome

Assessing external validity

Review question: what are the impacts of PV panels on plant growth, abundance and diversity?

One example:

Low | High

- **Tanner et al. (2020):** study of plant communities in the Mojave desert, California

→ Comparison of plant communities under (**exposed**) and in open areas (**control**) from 2012 to 2018

► **Low**

Low generalisability of exposure to simulated panels for real in-situ USSE facilities conditions

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