



EKLIPSE

Knowledge & Learning Mechanism
on Biodiversity & Ecosystem Services

WEB CONFERENCE

The impacts of artificial Electromagnetic Radiation on wildlife

Taxonomic Session on Invertebrates

Thomas Tscheulin, University of the Aegean
Adam J. Vanbergen, CEH (Edinburgh)
Wed, 24th January 2018





I. INTRODUCTION: SCOPE AND METHODOLOGY

Literature

- Identification of recent (> 2000), scientific, peer-reviewed research studies and reviews
- Scope of the studies
 - restricted to wildlife (no human health, only limited number on domestic animals)
 - EMR range: only artificial / anthropogenic radiations (light excluded)
- Out of 147 identified publications, 97 were used for the analyses

Multidisciplinary Steering Group

Biological/ecological experts (4)

- Plants
- Invertebrates
- Vertebrates

Technical experts (2)

- Identification of 15 categories of radiations types



INTERACTIVE WEB CONFERENCE

The impacts of artificial Electromagnetic Radiation on wildlife (flora and fauna)





EKLIPSE

Knowledge & Learning Mechanism
on Biodiversity & Ecosystem Services

INTRODUCTION

Analytical grid (1)

For all the publications, the experts identified and analysed:

- taxonomic group(s)
 - Vertebrates
 - Invertebrates
 - Plants
- EMR range/types → → →
- conditions (lab / field / both)

Non-specific magnetic fields	Static magnetic field
	Extremely low frequencies (< 1 kHz)
Non-specific electric fields	Static electric field
	Extremely low frequencies (< 1 kHz)
Non-specific radiofrequencies	Between 1 kHz - 6 GHz
Non-specific microwaves	Between 6 GHz - 300 GHz
Non-specific infrared	Between 300 GHz - 430 Thz
Application-specific exposure	Power lines magnetic field (50 or 60 Hz)
	Power lines electric field (50 or 60 Hz)
	Analog broadcasting-like signals (TV, radio)
	Digital broadcasting-like signals (TV, radio)
	2G base station-like signals (GSM)
	3G base station-like signals (UMTS)
	4G base station-like signals
Radar-like signals	



INTERACTIVE WEB CONFERENCE

The impacts of artificial Electromagnetic Radiation on wildlife (flora and fauna)





Analytical grid (2)

- Quality assessment of the studies in terms of:
technical aspects & biological/ecological aspects
 - 0 - bad/insufficient quality
 - 1 - minimum quality
 - 2 – normal/medium quality
 - 3 - excellent quality
- Extraction of **main findings** and **knowledge gaps**



INTERACTIVE WEB CONFERENCE

The impacts of artificial Electromagnetic Radiation on wildlife (flora and fauna)



EKLIPSE

Knowledge & Learning Mechanism
on Biodiversity & Ecosystem Services

Invertebrates

39 publications on invertebrates. Technical aspects. An overview:

Number of studies technically assessed	Number of studies considered technically irrelevant or bad quality	Number of studies in category 1 minimum quality	Number of studies in category 2 normal quality, some gaps	Number of studies in category 3 excellent quality
26/39	7	2	5	12



INTERACTIVE WEB CONFERENCE

The impacts of artificial Electromagnetic Radiation on wildlife (flora and fauna)





EKLIPSE

Knowledge & Learning Mechanism
on Biodiversity & Ecosystem Services

Invertebrates

39 publications on invertebrates. Biological aspects. An overview:

Number of studies assessed	Number of studies considered irrelevant or bad quality	Number of studies in category 1 Minimum quality	Number of studies in category 2 Normal quality, some gaps	Number of studies in category 3 Excellent quality
39/39	3	10	17	9



INTERACTIVE WEB CONFERENCE

The impacts of artificial Electromagnetic Radiation on wildlife (flora and fauna)





Invertebrates

39 publications on invertebrates. An overview:

General assessment:

- most studies dealt with model insects (e.g. honeybee and *Drosophila* spp.)
- all studies had a very limited scope
- mostly lab-based studies (only 3 field studies)
- only some dealt with anthropogenic EMR
- lack of ecological/community studies
- the majority of laboratory studies focused on physiological or developmental responses to short-term or acute exposure to experimental sources of EMR
- just one study which examined effects on invertebrates of long-term or chronic exposure to sources of anthropogenic EMR.



INTERACTIVE WEB CONFERENCE

The impacts of artificial Electromagnetic Radiation on wildlife (flora and fauna)





39 publications on invertebrates. An overview:

Specific problems/criticism:

- very mixed quality (often low replication levels, anecdotal, lack of statistical analysis)
- field-studies suffer from confounding effects
- lab studies often not transferable to real-life situations due to oversimplification
- limited scope (e.g. only short term exposure of selected species)
- unrealistic exposure to EMR (time and space)
- studies not comparable



INTERACTIVE WEB CONFERENCE

The impacts of artificial Electromagnetic Radiation on wildlife (flora and fauna)

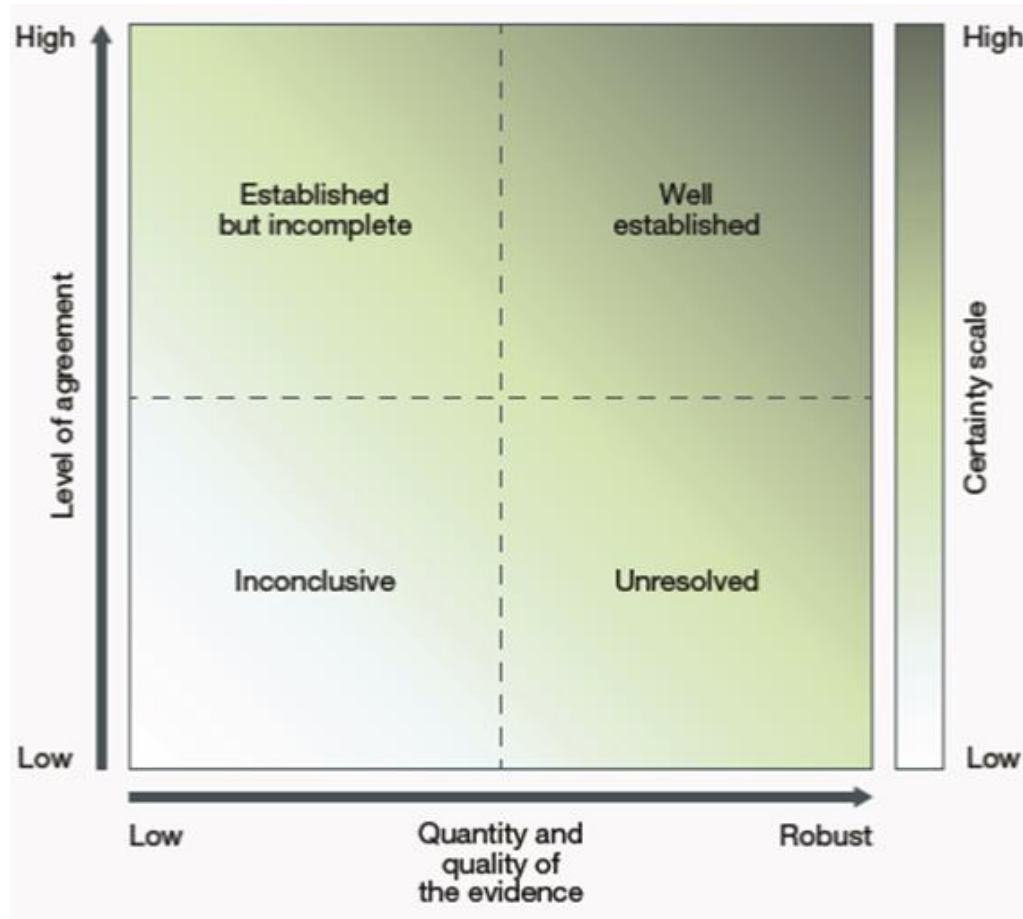




EKLIPSE

Knowledge & Learning Mechanism
on Biodiversity & Ecosystem Services

Invertebrates



INTERACTIVE WEB CONFERENCE

The impacts of artificial Electromagnetic Radiation on wildlife (flora and fauna)





Invertebrates

Key findings:

- EMR is an environmental cue detectable by invertebrate physiological mechanisms governing orientation or movement [established but incomplete].
- EMR from anthropogenic sources (e.g. mobile phones) represent a potential risk to such physiological mechanisms [established but incomplete], but current evidence is limited, both by the number and quality of studies [inconclusive].
- There is some evidence that anthropogenic EMR in laboratory experiments can affect behaviour or reproduction of model insect species such as the fruit fly *Drosophila melanogaster*), although effects are often negligible or inconsistent between studies [unresolved].



INTERACTIVE WEB CONFERENCE

The impacts of artificial Electromagnetic Radiation on wildlife (flora and fauna)





Invertebrates

Key findings:

- Currently evidence for effects of EMR on the diversity or abundance of invertebrates is very limited. Few ecological studies exist, but where they do report EMR effects are negligible, contrasting, or cannot be separated from other environmental factors (e.g. land-use) [inconclusive].
- The majority of experimental and field studies suffered from poor scientific method (e.g. zero or under-replicated, lack of covariate measurements), field-unrealistic exposures to EMR sources, or underreporting of scientific or technical details making evaluation difficult.



INTERACTIVE WEB CONFERENCE

The impacts of artificial Electromagnetic Radiation on wildlife (flora and fauna)

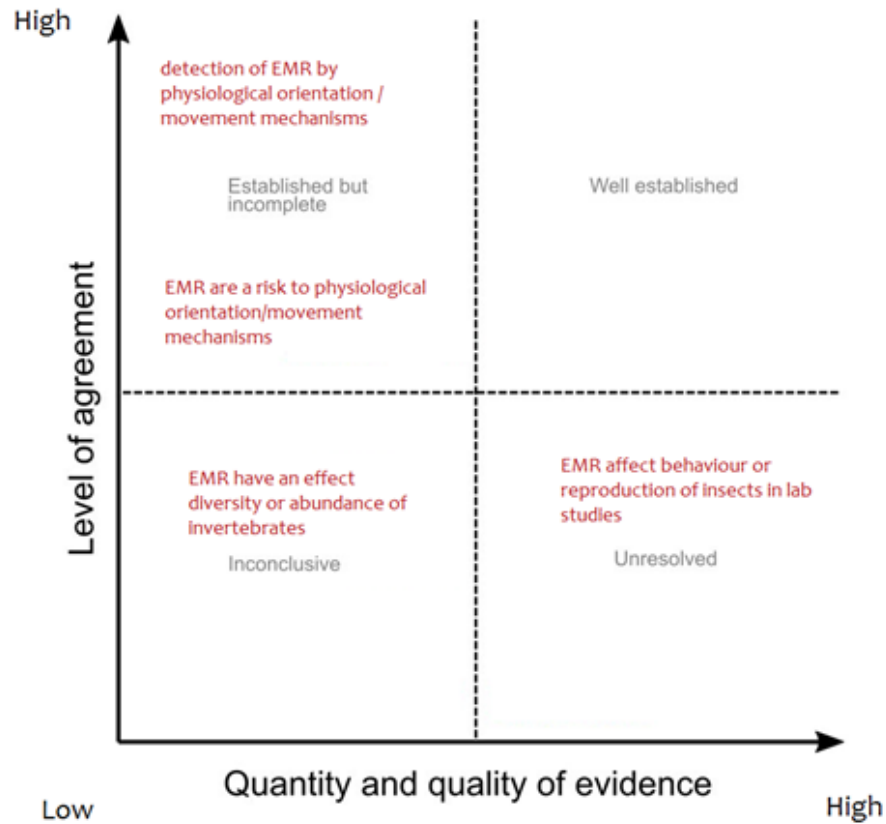




EKLIPSE

Knowledge & Learning Mechanism
on Biodiversity & Ecosystem Services

Invertebrates



INTERACTIVE WEB CONFERENCE

The impacts of artificial Electromagnetic Radiation on wildlife (flora and fauna)





EKLIPSE

Knowledge & Learning Mechanism
on Biodiversity & Ecosystem Services

Invertebrates

Knowledge gaps

- More field-ecological studies measuring the effects of EMR:
 - on community responses, long-term and pre- and post-exposure
 - over a wide geographical extent and in different natural and anthropogenic systems
 - interdisciplinary collaborations
 - based on testable hypotheses (avoiding speculative ad-hoc approaches)
 - with field-realistic exposure
- More studies assessing chronic effects
- Comparable data
- Experiments examining the potential interplay between EMR exposure and a) foraging ecology and b) other stressors affecting nutritional ecology



INTERACTIVE WEB CONFERENCE

The impacts of artificial Electromagnetic Radiation on wildlife (flora and fauna)

