# Supplementary material

Can cognitive ability give invasive species the means to succeed? A review of the evidence

Birgit Szabo, Isabel Damas-Moreira and Martin J. Whiting. Frontiers in Ecology and Evolution

Correspond to: Martin J. Whiting, Department of Biological Sciences, Macquarie University, NSW, 2109, Australia; email: martin.whiting@mq.edu.au

## Details on the literature compilation

**11/11/19**

Search in **Scopus**.

Search term: TITLE-ABS-KEY(invasi\* OR invad\* OR establish\* OR introdu\*) AND (cogni\* OR learning OR flexi\* OR innovat\*) AND (fitness OR surviv\* OR reprod\*) AND (animal\*) AND NOT (educat\* OR child\* OR physic\* OR gluco\*) AND ( EXCLUDE ( SUBJAREA,"COMP" ) OR EXCLUDE ( SUBJAREA,"ENGI" ) ) AND ( EXCLUDE ( SUBJAREA,"MEDI" ) OR EXCLUDE ( SUBJAREA,"BIOC" ) )

Results: 8,254

Only the first 2000 results can be viewed in scopus (sorted by relevance).

RIS file downloaded to be loaded into EndNote

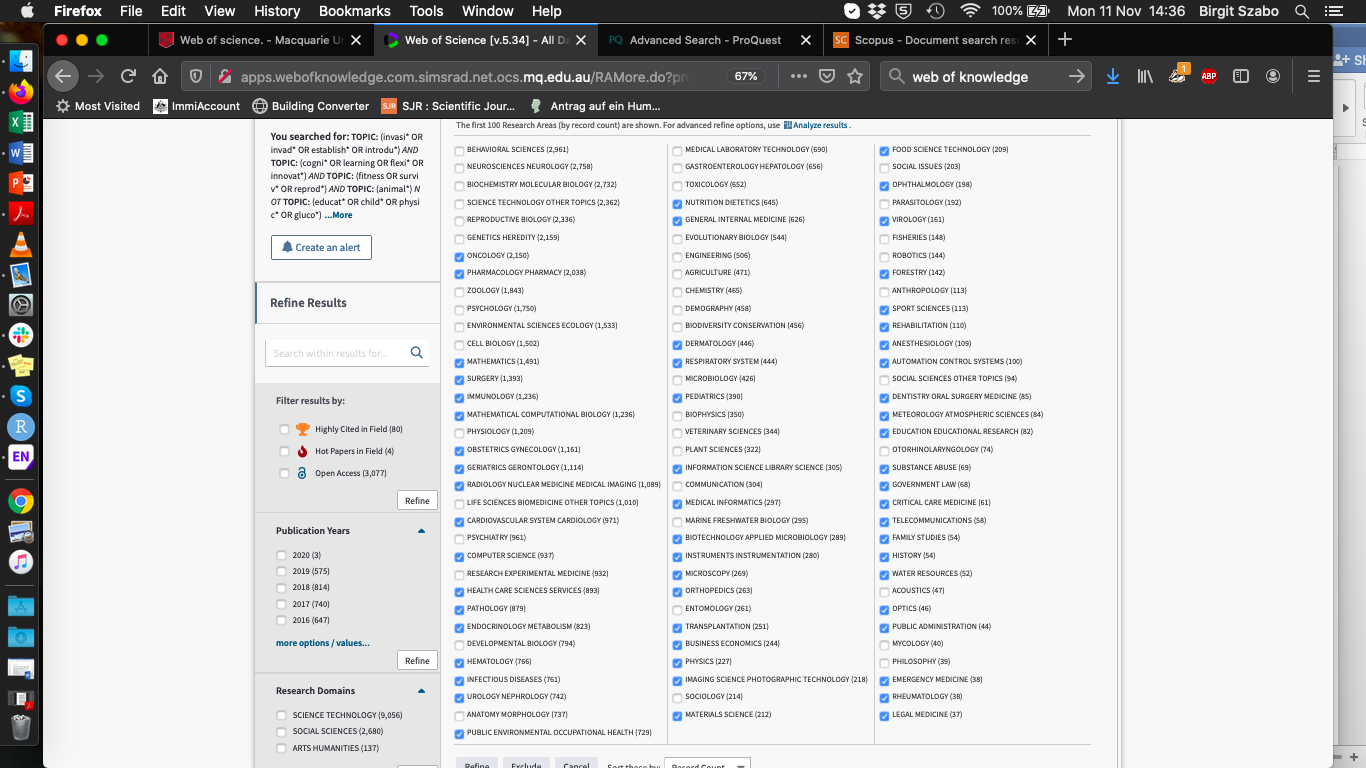
Search in **Web of Science**.

Search term: TOPIC: (invasi\* OR invad\* OR establish\* OR introdu\*) *AND* TOPIC: (cogni\* OR learning OR flexi\* OR innovat\*) *AND* TOPIC: (fitness OR surviv\* OR reprod\*) *AND* TOPIC: (animal\*) *NOT* TOPIC: (educat\* OR child\* OR physic\* OR gluco\*)

Timespan: All years. Databases:  WOS, BCI, CCC, INSPEC, KJD, MEDLINE, RSCI, SCIELO, ZOOREC.

Search language=Auto

Refine Results – Research Areas (ticked = excluded):



Results: 1,228

RIS file downloaded to be loaded into EndNote

Search in **Web of Science**.

Search term: noft(invasi\* OR invad\* OR establish\* OR introdu\*) AND noft(cogni\* OR learning OR flexi\* OR innovat\*) AND not(fitness OR surviv\* OR reprod\*) AND noft(animal\*) NOT noft(educat\* OR child\* OR physic\* OR gluco\*) NOT (humans AND cell survival)

Search anywhere except full text, publication date – all dates, source types, document types and languages

Exclude subjects human and cell survival

Results: 1,509

RIS file downloaded to be loaded into EndNote

**12/11/19**

4737 records imported to EndNote; 801 duplicates removed using EndNote; 3936 records after automatic removal of duplicates

**13/11/19, 14/11/19, 15/11/19**

Select publications by title (list sorted alphabetically by first author)

Title should include any mention of a cognitive ability such as learning, cognitive or behavioural flexibility, memory, inhibition, etc. To ensure no publications are missed, studies on behaviour (which might encompass some cognitive ability) were included as well (removed in next step if abstract reveals that they don’t fit the topic); should mention either that this ability has a fitness or adaptive value (or increases reproductive success), that it was tested in an invasive species or a species that successfully invaded the urban habitat. This will result in the most general list of publications.

While titles were checked, 91 duplicates removed by hand;

3845 records remaining (without duplicates)

**61** publications selected by title.

Full text download using EndNote or Macquarie University Library search.

**18/11/19, 19/11/19, 20/11/19**

**First forward search** in Articles selected by title using Scopus.

40 additional publications found and a full text was downloaded.

**21/11/19, 22/11/19**

Select articles using the abstract.

Inclusion criteria:

1. Must describe a cognitive ability
2. Must mention either being tested in an invasive species, comparing performance between invasive and native species or comparing performance between individuals from the source population and invasive population

Here we exclude studies that look exclusively at behaviour that is not related to cognitive ability.

**27** Publications selected by abstract.

**First backward search** in these 27 articles based on abstract.

11 articles selected by title.

**25/11/19**

A **second forward search** did not result in any additional articles.

After full text download, four articles were selected based on their abstract and we conducted a **second backward search** resulting in one additional article.

A **final forward search** did not result in any additional publications fitting our search criteria. The last article was not selected based on abstract.

Overall, **31** publications were selected to be relevant for full text screening.

**13/12/19**

During full text screening we decided to divide the 31 studies selected by abstract into three groups: (1) studies that compared cognitive performance between species or populations, (2) big comparative studies involving brain size and (3) studies on the cognitive ability of a single species.

We decided to do an additional search for cognitive studies focusing on the invasive species from studies included in (1).

We used each species common or scientific name and the term ‚cognition‘ to search in Scopus. We used the same selection criteria to select studies based on title and abstract, but only included studies testing wild animals to exclude changes in cognition due to prolonged breeding in captivity. Only those studies not selected during the initial search were included.

* Delicate skink, search term: TITLE-ABS-KEY(Lampropholis AND delicata) AND (cognition)

Result: initial search = 6, title = 4, wild animal = 4, selected (new) = 1

* Indian myna, search term: TITLE-ABS-KEY(myna) AND (cognition)

Result: initial search = 21, title = 13, wild animal = 10, selected (new) = 5

* grey squirrel, search term: TITLE-ABS-KEY(Sciurus AND carolinensis) AND (cognition)

Result: initial search = 20, title = 7, wild animal = 2, selected (new) = 0

* green crab, search term TITLE-ABS-KEY(Carcinus AND maenas) AND (cognition)

Result: initial search = 10, title = 7, wild animal = 2, selected (new) = 1

* *Orconectes rusticus*, search term TITLE-ABS-KEY(Orconectes AND rusticus) AND (cognition)

Result: initial search = 7, title = 4, wild animal = 4, selected (new) = 3

* *Procambarus clarkia*, search term: TITLE-ABS-KEY(Procambarus AND clarkia) AND (cognition)

Result: initial search = 15, title = 1, wild animal = 0, selected (new) = 0

* *Drosophila subobscura*, search term: TITLE-ABS-KEY(Drosophila AND subobscura) AND (cognition)

Result: initial search = 1, title = 1, wild animal = 1, selected (new) = 0

In total we found 10 additional studies of which one was another comparative study which was then included in the final sample. This literature search resulted in 17 comparative studies and 22 supporting literature (single species studies).