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Supplementary Information
This supplementary information has not been peer reviewed

Title: **An assessment of the environmental and socio-economic impacts of alien rabbits and hares**

Appendix S1: Literature review protocol

Following Evans et al. (2016), we carried out an online search using search terms within a search string, in conjunction with the specific alien species' scientific and common name(s). For example, the search string for the Snowshoe hare was: ("introduced species", "invasive species", "invasive alien species", "IAS", "alien", "non-native", "non-indigenous", "pest", "feral" and "exotic") AND ("snowshoe hare" OR "snowshoe rabbit" OR "varying hare" OR "*Lepus americanus*"). We used the same search terms and the following scientific and common names for the other alien species:

- Arctic hare, *Lepus arcticus*
- Black-tailed jackrabbit, jackass hare, narrow-gage mule, *Lepus californicus*
- Cape hare, Arabian hare, desert hare, Sardinian hare, *Lepus capensis*
- Corsican hare, Apennine hare, Italian hare, *Lepus corsicanus*
- Eastern cottontail, Florida cottontail, *Sylvilagus floridanus*
- European hare, brown hare, *Lepus europaeus*
- European rabbit, rabbit, *Oryctolagus cuniculus*
- Iberian hare, Granada hare, *Lepus granatensis*
- Indian hare, black-naped hare, *Lepus nigricollis*
- Mountain hare, alpine hare, blue hare, Irish hare, snow hare, white hare, *Lepus timidus*
- White-tailed jackrabbit, prairie hare, Townsend hare, white jack, *Lepus townsendii*

Databases searched:

- Web of Science (http://apps.webofknowledge.com)
- Google (https://www.google.co.uk)
- Google Scholar (https://scholar.google.co.uk)

Other online resources searched:

- IUCN Red List of Threatened Species (http://www.iucnredlist.org)
- CABI Invasive Species Compendium (http://www.cabi.org/isc)
- Global Invasive Species Database (GISD) of the Invasive Species Specialist Group (ISSG) (http://www.issg.org/database/welcome)

We searched for additional references listed in any articles and data sources found, repeating this process to a point where no new sources of data were identified.

References

Evans T, Kumschick S, Blackburn TM. 2016. Application of the Environmental Impact Classification for Alien Taxa (EICAT) to a global assessment of alien bird impacts. *Diversity and Distributions* **22**:919–931.

Appendix S2: Contingency table test results

Environmental vs socio-economic impacts

Table S1: Contingency table (chi-squared test) showing the actual and expected number of environmental and socio-economic impact records for each alien leporid species. Expected values are displayed in italics. Individual χ^2 values are displayed in (parentheses). Due to small sample sizes, impacts for two alien leporid species (the Black-tailed jackrabbit and Iberian hare) were combined to produce the 'Other species' group.

	Corsican hare	**Eastern cottontail**	**European hare**	**European rabbit**	**Indian hare**	**Mountain hare**	**Snowshoe hare**	**Other species**	**Total**
Environmental impact records	9 *7.04* (0.54)	2 *3.91* (0.93)	12 *14.87* (0.55)	105 *104.84* (< 0.001)	7 *6.26* (0.09)	6 *5.48* (0.05)	9 *7.04* (0.54)	1 *1.56* (0.2)	151
Socio-economic impact records	0 *1.96* (1.96)	3 *1.09* (3.36)	7 *4.13* (1.99)	29 *29.16* (< 0.001)	1 *1.74* (0.32)	1 *1.52* (0.18)	0 *1.96* (1.96)	1 *0.44* (0.73)	42
Total	9	5	19	134	8	7	9	2	193

$\chi^2 = 5.04$, degrees of freedom = 7, $P < 0.001$, estimate = 0.08

Table S2: Contingency table (chi-squared test) showing the actual and expected number of 'weak', 'moderate' and 'severe' environmental and socio-economic impact records. Expected values are displayed in italics. Individual χ^2 values are displayed in (parentheses).

	Environmental impact records	**Socio-economic impact records**	**Total**
Number of 'weak' impact records	38 *58.69* (7.29)	37 *16.32* (26.2)	75
Number of 'moderate' impact records	99 *79.02* (5.05)	2 *21.98* (18.16)	101
Number of 'severe' impact records	14 *13.3* (0.04)	3 *3.7* (0.13)	17
Total	151	42	193

$\chi^2 = 38.73$, degrees of freedom = 2, $P < 0.001$, estimate = 0.44

Table S3: Contingency table (chi-squared test) showing the actual and expected number of environmental and socio-economic impact records as distributed by broad geographic location. Expected values are displayed in italics. Individual χ^2 values are displayed in (parentheses).

	Oceania	**Europe**	**Islands**	**North America**	**South America**	**Total**
Environmental impact records	50 *53.2* (0.19)	7 *10.95* (1.43)	88 *71.98* (3.57)	1 *5.48* (3.66)	5 *9.39* (2.05)	151
Socio-economic impact records	18 *14.8* (0.69)	7 *3.05* (5.13)	4 *20.02* (12.82)	6 *1.52* (13.16)	7 *2.61* (7.38)	42
Total	68	14	92	7	12	193

$\chi^2 = 48.97$, degrees of freedom = 4, $P < 0.001$, estimate = 0.32

Environmental impacts

Table S4: Contingency table (chi-squared test) showing the actual and expected number of 'weak', 'moderate' and 'severe' environmental impact records as distributed by alien leporid species. Expected values are displayed in italics. Individual χ^2 values are displayed in (parentheses). Due to small sample sizes, impacts for two alien leporid species (the Eastern cottontail and Iberian hare) were combined to produce the 'Other species' group.

	Corsican hare	**European hare**	**European rabbit**	**Indian hare**	**Mountain hare**	**Snowshoe hare**	**Other species**	**Total**
Number of 'weak' impact records	9 *2.26* (20.03)	6 *3.02* (2.94)	9 *26.42* (11.49)	7 1.76 (15.58)	6 1.51 (13.35)	0 *2.26* (2.26)	1 *0.75* (0.08)	38
Number of 'moderate' impact records	0 *5.9* (5.9)	6 *7.87* (0.44)	82 *68.84* (2.52)	0 *4.59* (4.59)	0 *3.93* (3.93)	9 *5.9* (1.63)	2 *1.97* (< 0.001)	99
Number of 'severe' impact records	0 *0.83* (0.83)	0 *1.11* (1.11)	14 *9.74* (1.87)	0 0.65 (0.65)	0 0.56 (0.56)	0 *0.83* (0.83)	0 *0.28* (0.28)	14
Total	9	12	105	7	6	9	3	151

$\chi^2 = 104.67$, degrees of freedom = 12, $P < 0.001$, estimate = 0.39

Table S5: Contingency table (chi-squared test) showing the actual and expected number of 'weak', 'moderate' and 'severe' environmental impact records as distributed by family of affected native plants. Expected values are displayed in italics. Individual χ^2 values are displayed in (parentheses). Due to small sample sizes, impact records associated with 35 plant families were grouped together to form the 'Other plant families' category for this test. Impact records for species from unidentified plant families were excluded for this test.

	Grass (*Poaceae*) family	**Other plant families**	**Total**
Number of 'weak' impact records	12 *8.04* (1.95)	18 *21.96* (0.71)	30
Number of 'moderate' impact records	14 *16.62* (0.41)	48 *45.38* (0.15)	62
Number of 'severe' impact records	0 *1.34* (1.34)	5 *3.67* (0.49)	5
Total	26	71	97

$\chi^2 = 3.97$, degrees of freedom = 2, $P = 0.063$, estimate = 0.2

Table S6: Contingency table (chi-squared test) showing the actual and expected number of 'weak', 'moderate' and 'severe' environmental impact records as distributed by class of affected native animals. Expected values are displayed in italics. Individual χ^2 values are displayed in (parentheses). Due to small sample sizes, impacts for three classes of native animal (chilopods, insects and reptiles) were combined to produce the 'Other classes' group.

	Birds	**Mammals**	**Other classes**	**Total**
Number of 'weak' impact records	2 *3.5* (0.64)	4 *2.69* (0.64)	1 *0.81* (0.05)	7
Number of 'moderate' impact records	16 *18* (0.22)	15 *13.85* (0.1)	5 *4.15* (0.17)	36
Number of 'severe' impact records	8 *4.5* (2.72)	1 *3.46* (1.75)	0 *1.04* (1.04)	9
Total	26	20	6	52

$\chi^2 = 8.68$, degrees of freedom = 4, $P = 0.059$, estimate = 0.29

Table S7: Contingency table (chi-squared test) showing the actual and expected number of 'weak', 'moderate' and 'severe' environmental impact records as distributed by animal and plant kingdom. Expected values are displayed in italics. Individual χ^2 values are displayed in (parentheses).

	Animal kingdom	**Plant kingdom**	**Total**
Number of 'weak' impact records	7 *13.09* (2.83)	31 *24.91* (1.49)	38
Number of 'moderate' impact records	36 *34.09* (0.11)	63 *64.91* (0.06)	99
Number of 'severe' impact records	9 *4.82* (3.62)	5 *9.18* (1.9)	14
Total	52	99	151

$\chi^2 = 9.04$, degrees of freedom = 2, $P = 0.007$, estimate = 0.24

Table S8: Contingency table (chi-squared test) showing the actual and expected number of 'weak', 'moderate' and 'severe' environmental impact records as distributed by broad geographic location. Expected values are displayed in italics. Individual χ^2 values are displayed in (parentheses). Due to small sample sizes, impacts for North and South America were combined to produce the 'Americas' group.

	Oceania	**Europe**	**Islands**	**Americas**	**Total**
Number of 'weak' impact records	8 *12.58* (1.67)	1 *1.76* (0.33)	27 *22.15* (1.06)	2 *1.51* (0.16)	38
Number of 'moderate' impact records	38 *32.78* (0.83)	6 *4.59* (0.43)	51 *57.7* (0.78)	4 *3.93* (0.001)	99
Number of 'severe' impact records	4 *4.64* (0.09)	0 *0.65* (0.65)	10 *8.16* (0.42)	0 *0.56* (0.56)	14
Total	50	7	88	6	151

$\chi^2 = 9.06$, degrees of freedom = 6, $P = 0.096$, estimate = 0.15

Table S9: Contingency table (chi-squared test) showing the actual and expected number of 'weak', 'moderate' and 'severe' environmental impact records as distributed by EICAT impact mechanism. Expected values are displayed in italics. Individual χ^2 values are displayed in (parentheses).

	Competition	**Grazing / herbivory / browsing**	**Indirect**	**Other mechanisms**	**Total**
Number of 'weak' impact records	3 *2.26* (0.24)	31 *24.16* (1.94)	3 *10.57* (5.42)	1 *1.01* (< 0.001)	38
Number of 'moderate' impact records	5 *5.9* (0.14)	60 *62.94* (0.14)	31 *27.54* (0.44)	3 *2.62* (0.05)	99
Number of 'severe' impact records	1 *0.83* (0.03)	5 *8.9* (1.71)	8 *3.89* (4.33)	0 *0.37* (0.37)	14
Total	9	96	42	4	151

$\chi^2 = 21.1$, degrees of freedom = 6, $P = 0.002$, estimate = 0.23

Table S10: Contingency table (chi-squared test) showing the actual and expected number of environmental impact records for each alien leporid species as distributed by EICAT impact mechanism. Expected values are displayed in italics. Individual χ^2 values are displayed in (parentheses). Due to small sample sizes, impacts for two impact mechanisms (transmission of diseases and hybridisation) were combined to produce the 'Other mechanisms' group, and impacts for two alien leporid species (the Eastern cottontail and Iberian hare) were combined to produce the 'Other species' group.

	Corsican hare	**European hare**	**European rabbit**	**Indian hare**	**Mountain hare**	**Snowshoe hare**	**Other species**	**Total**
Competition	0 *0.54* (0.54)	4 *0.72* (15.09)	4 *6.26* (0.81)	0 *0.42* (0.42)	0 *0.36* (0.36)	0 *0.54* (0.54)	1 *0.18* (3.77)	9
Grazing	9 *5.72* (1.88)	5 *7.63* (0.91)	60 *66.76* (0.68)	7 *4.45* (1.46)	6 *3.81* (1.25)	9 *5.72* (1.88)	0 *1.91* (1.91)	96
Indirect	0 *2.5* (2.5)	0 *3.34* (3.34)	41 *29.21* (4.76)	0 *1.95* (1.95)	0 *1.67* (1.67)	0 *2.5* (2.5)	1 *0.83* (0.03)	42
Other mechanisms	0 *0.24* (0.24)	3 *0.32* (22.63)	0 *2.78* (2.78)	0 *0.19* (0.19)	0 *0.16* (0.16)	0 *0.24* (0.24)	1 *0.08* (10.66)	4
Total	9	12	105	7	6	9	3	151

$\chi^2 = 76.2$, degrees of freedom = 18, $P < 0.001$, estimate = 0.31

Table S11: Contingency table (chi-squared test) showing the actual and expected number of environmental impact records for each native animal class as distributed by EICAT impact mechanism. Expected values are displayed in italics. Individual χ^2 values are displayed in (parentheses). Due to small sample sizes, impacts for two impact mechanisms (transmission of diseases and hybridisation) were combined to produce the 'Other mechanisms' group, and impacts for three classes of native animal (chilopods, insects and reptiles) were combined to produce the 'Other classes' group.

	Birds	**Mammals**	**Other classes**	**Total**
Competition	1 *4.5* (2.72)	8 *3.46* (5.95)	0 *1.04* (1.04)	9
Indirect	25 *19.5* (1.55)	8 *15* (3.27)	6 *4.5* (0.5)	39
Other mechanisms	0 *2* (2)	4 *1.54* (3.94)	0 *0.46* (0.46)	4
Total	26	20	6	52

$\chi^2 = 25.28$, degrees of freedom = 4, $P < 0.001$, estimate = 0.49

Table S12: Contingency table (chi-squared test) showing the actual and expected number of environmental impact records associated with each EICAT impact mechanism as distributed by broad geographic location. Expected values are displayed in italics. Individual χ^2 values are displayed in (parentheses). Due to small sample sizes, impacts for North and South America were combined to produce the 'Americas' group, and impacts for two impact mechanisms (transmission of diseases and hybridisation) were combined to produce the 'Other mechanisms' group.

	Oceania	**Europe**	**Islands**	**Americas**	**Total**
Competition	3 *2.98* (< 0.001)	2 *0.42* (6)	1 *5.25* (3.44)	3 *0.36* (19.52)	9
Grazing	30 *31.79* (0.1)	0 *4.45* (4.45)	63 *55.95* (0.89)	3 *3.81* (0.17)	96
Indirect	17 *13.91* (0.69)	1 *1.95* (0.46)	24 *24.48* (0.009)	0 *1.67* (1.67)	42
Other mechanisms	0 *1.32* (1.32)	4 *0.19* (78.47)	0 *2.33* (2.33)	0 *0.16* (0.16)	4
Total	50	7	88	6	151

$\chi^2 = 38.33$, degrees of freedom = 9, $P < 0.001$, estimate = 0.29

Socio-economic impacts

Table S13: Contingency table (chi-squared test) showing the actual and expected number of 'weak' and 'moderate' or 'severe' socio-economic impact records as distributed by alien leporid species. Expected values are displayed in italics. Individual χ^2 values are displayed in (parentheses). Due to small sample sizes, impacts for three alien leporid species (the Black-tailed jackrabbit, Indian hare and Mountain hare) were combined to produce the 'Other species' group, and 'moderate' and 'severe' impact records were combined.

	Eastern cottontail	**European hare**	**European rabbit**	**Other species**	**Total**
Number of 'weak' impact records	3 *2.64* (0.05)	7 *6.17* (0.11)	25 *25.55* (0.01)	2 *2.64* (0.16)	37
Number of 'moderate' or 'severe' impact records	0 *0.36* (0.36)	0 *0.83* (0.83)	4 *3.45* (0.09)	1 *0.36* (1.16)	5
Total	3	7	23	3	42

$\chi^2 = 1.39$, degrees of freedom = 3, $P = 0.624$, estimate = 0.13

Table S14: Contingency table (chi-squared test) showing the actual and expected number of 'weak', and 'moderate' or 'severe' socio-economic impact records as distributed by broad geographic location. Expected values are displayed in italics. Individual χ^2 values are displayed in (parentheses). Due to small sample sizes 'moderate' and 'severe' impact records were combined.

	Oceania	**Europe**	**Islands**	**North America**	**South America**	**Total**
Number of 'weak' impact records	15 *15.86* (0.05)	7 *6.17* (0.11)	2 *3.52* (0.66)	6 *5.29* (0.1)	7 *6.17* (0.11)	37
Number of 'moderate' or 'severe' impact records	3 *2.14* (0.34)	0 *0.83* (0.83)	2 *0.48* (4.88)	0 *0.71* (0.71)	0 *0.83* (0.83)	5
Total	18	7	4	6	7	42

$\chi^2 = 5.63$, degrees of freedom = 4, $P = 0.176$, estimate = 0.23

Table S15: Contingency table (chi-squared test) showing the actual and expected number of 'weak', and 'moderate' or 'severe' socio-economic impact records as distributed by SEICAT impact mechanism. Expected values are displayed in italics. Individual χ^2 values are displayed in (parentheses). Due to small sample sizes, impact records for four SEICAT impact mechanisms (impacts to health and safety, material assets, the tourism industry and recreation) were combined to form the 'Other mechanisms' group, and 'moderate' and 'severe' impact records were combined.

	Agriculture / horticulture / forestry	**Other mechanisms**	**Total**
Number of 'weak' impact records	29 *28.19* (0.02)	8 *8.81* (0.07)	37
Number of 'moderate' or 'severe' impact records	3 *3.81* (0.17)	2 *1.19* (0.55)	5
Total	32	10	42

$\chi^2 = 0.6$, degrees of freedom = 1, $P = 0.577$, estimate = 0.12

Table S16: Contingency table (chi-squared test) showing the actual and expected number of socio-economic impact records for each alien leporid species as distributed by SEICAT impact mechanism. Expected values are displayed in italics. Individual χ^2 values are displayed in (parentheses). Due to small sample sizes, impacts for impacts for three alien leporid species (the Black-tailed jackrabbit, Indian hare and Mountain hare) were combined to produce the 'Other species' group, and four SEICAT impact mechanisms (impacts to health and safety, material assets, the tourism industry and recreation) were combined to form the 'Other mechanisms' group.

	Eastern cottontail	**European hare**	**European rabbit**	**Other species**	**Total**
Agriculture / horticulture / forestry	2 *2.29* (0.04)	7 *5.33* (0.52)	22 *22.1* (< 0.001)	1 *2.29* (0.72)	32
Other mechanisms	1 *0.71* (0.11)	0 *1.67* (1.67)	7 *6.9* (0.001)	2 *0.71* (2.31)	10
Total	3	7	29	3	42

$\chi^2 = 2.37$, degrees of freedom = 3, $P = 0.298$, estimate = 0.17

Table S17: Contingency table (chi-squared test) showing the actual and expected number of socio-economic impact records associated with each SEICAT impact mechanism as distributed by broad geographic location. Expected values are displayed in italics. Individual χ^2 values are displayed in (parentheses). Due to small sample sizes impact records for four SEICAT impact mechanisms (impacts to health and safety, material assets, the tourism industry and recreation) were combined to form the 'Other mechanisms' group.

	Oceania	**Europe**	**Islands**	**North America**	**South America**	**Total**
Agriculture / horticulture / forestry	15 *13.71* (0.12)	5 *5.33* (0.02)	2 *3.05* (0.36)	3 *4.57* (0.54)	7 *5.33* (0.52)	32
Other mechanisms	3 *4.29* (0.39)	2 *1.67* (0.07)	2 *0.95* (1.15)	3 *1.43* (1.73)	0 *1.67* (1.67)	10
Total	18	7	4	6	7	42

$\chi^2 = 5.32$, degrees of freedom = 4, $P = 0.23$, estimate = 0.23

Appendix S3

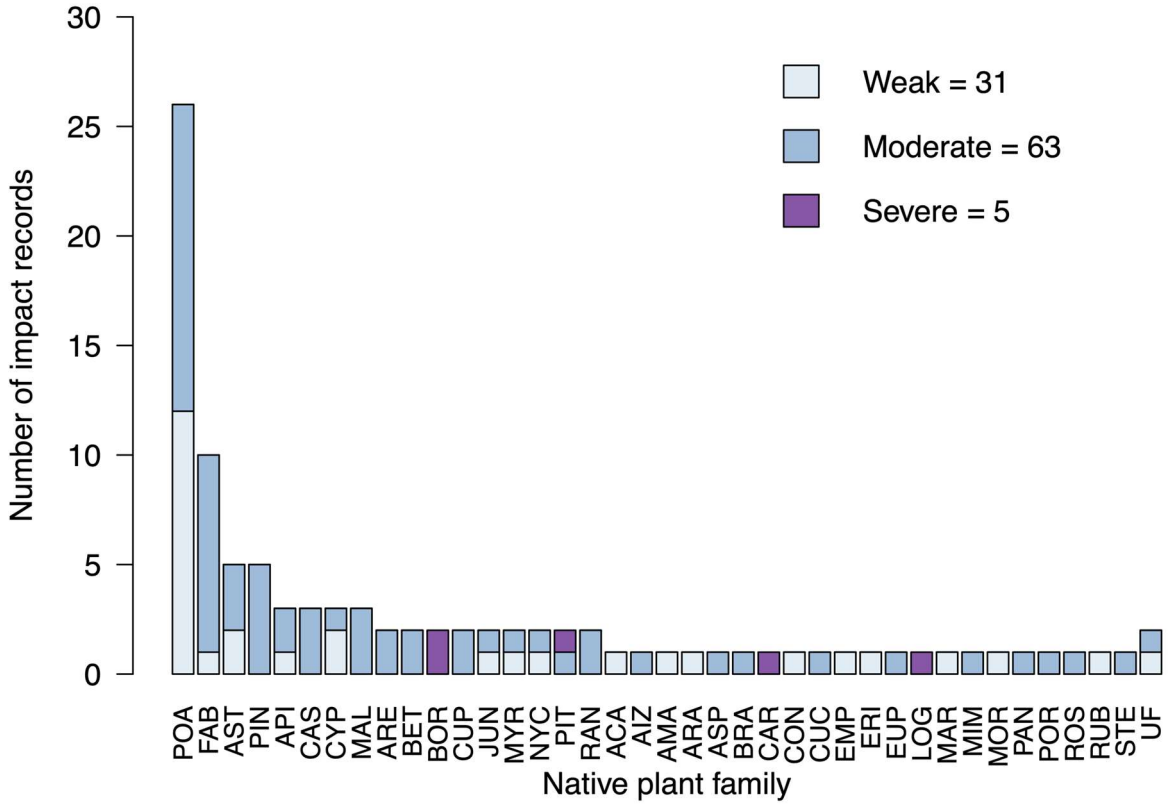

Figure S1: The number and severity of impact records as categorised by native plant family sustaining impacts. Native plant family: ACA = *Acanthaceae*; AIZ = *Aizoaceae*; AMA = *Amaranthaceae*; API = *Apiaceae*; ARA = *Araliaceae*; ARE = *Arecaceae*; ASP = *Asphodelaceae*; AST = *Asteraceae*; BET = *Betulaceae*; BOR = *Boraginaceae*; BRA = *Brassicaceae*; CAR = *Caryophyllaceae*; CAS = *Casuarinaceae*; CON = *Convolvulaceae*; CUC = *Cucurbitaceae*; CUP = *Cupressaceae*; CYP = *Cyperaceae*; EMP = *Empetraceae*; ERI = *Ericaceae*; EUP = *Euphorbiaceae*; FAB = *Fabaceae*; JUN = *Juncaceae*; LOG = *Loganiaceae*; MAL = *Malvaceae*; MAR = *Marattiaceae*; MIM = *Mimosaceae*; MOR = *Moraceae*; MYR = *Myrtaceae*; NYC = *Nyctaginaceae*; PAN = *Pandanaceae*; PIN = *Pinaceae*; PIT = *Pittosporaceae*; POA = *Poaceae*; POR = *Portulacaceae*; RAN = *Ranunculaceae*; ROS = *Rosaceae*; RUB = *Rubiaceae*; STE = *Sterculiaceae*; UF = Unidentified family. Impact severity categories: Weak = impacts categorised as MC or MN under EICAT; Moderate = impacts categorised as MO; Severe = impacts categorised as MR or MV.