Appendix 1: details about quantitative literature analysis

We conducted two searches using the Web of Science (WoS) (https://apps.webofknowledge.com). **A)** On 2 March 2016 we searched the Web of Science Core Collection, using the search string (In TOPIC): ("non-native*" OR "non native*" OR exotic* OR alien*OR allochthonous* OR nonindigenous* OR "non-indigenous*" OR introduced* OR invasive* OR naturali?ed* OR "biological invasion*" OR bioinvasion*) AND ((boom AND bust) OR "crash*" OR "die-off*" OR "die off*" OR "reckless invader*" OR "collapse*" OR overshoot*)). Timespan: All years. Indexes: SCI-EXPANDED, SSCI, A&HCI, ESCI.

This initial search was refined by**: [excluding] RESEARCH AREAS**: (ENGINEERING OR METALLURGY METALLURGICAL ENGINEERING OR UROLOGY NEPHROLOGY OR PHYSICS OR ONCOLOGY OR TRANSPLANTATION OR GEOCHEMISTRY GEOPHYSICS OR ARCHAEOLOGY OR ASTRONOMY ASTROPHYSICS OR CELL BIOLOGY OR PATHOLOGY OR MATERIALS SCIENCE OR MINING MINERAL PROCESSING OR CHEMISTRY OR METEOROLOGY ATMOSPHERIC SCIENCES OR MATHEMATICAL METHODS IN SOCIAL SCIENCES OR SURGERY OR ENERGY FUELS OR MECHANICS OR RESEARCH EXPERIMENTAL MEDICINE OR IMMUNOLOGY OR COMPUTER SCIENCE OR TRANSPORTATION OR EMERGENCY MEDICINE OR THERMODYNAMICS OR PHARMACOLOGY PHARMACY OR SPECTROSCOPY OR OTORHINOLARYNGOLOGY OR OBSTETRICS GYNECOLOGY OR BIOCHEMISTRY MOLECULAR BIOLOGY OR HEALTH CARE SCIENCES SERVICES OR NEUROSCIENCES NEUROLOGY OR PEDIATRICS OR GASTROENTEROLOGY HEPATOLOGY OR PUBLIC ENVIRONMENTAL OCCUPATIONAL HEALTH OR INSTRUMENTS INSTRUMENTATION OR GENERAL INTERNAL MEDICINE OR BIOTECHNOLOGY APPLIED MICROBIOLOGY OR

BUSINESS ECONOMICS OR ROBOTICS OR ORTHOPEDICS OR OPHTHALMOLOGY OR CARDIOVASCULAR SYSTEM CARDIOLOGY OR LEGAL MEDICINE OR SOCIAL SCIENCES OTHER TOPICS OR INTERNATIONAL RELATIONS OR ELECTROCHEMISTRY OR OPTICS OR RADIOLOGY NUCLEAR MEDICINE MEDICAL IMAGING OR ACOUSTICS OR PSYCHIATRY OR CONSTRUCTION BUILDING TECHNOLOGY OR PSYCHOLOGY OR POLYMER SCIENCE OR NUCLEAR SCIENCE TECHNOLOGY OR HEMATOLOGY OR RESPIRATORY SYSTEM OR DEVELOPMENTAL BIOLOGY OR ANESTHESIOLOGY OR TELECOMMUNICATIONS OR AUDIOLOGY SPEECH LANGUAGE PATHOLOGY OR BIOPHYSICS OR ENDOCRINOLOGY METABOLISM OR AUTOMATION CONTROL SYSTEMS OR SPORT SCIENCES OR DENTISTRY ORAL SURGERY MEDICINE OR GOVERNMENT LAW) **AND [excluding] WEB OF SCIENCE CATEGORIES**: (TROPICAL MEDICINE OR LITERATURE OR EDUCATION EDUCATIONAL RESEARCH OR MICROSCOPY OR DERMATOLOGY OR CRIMINOLOGY PENOLOGY OR COMMUNICATION OR HUMANITIES MULTIDISCIPLINARY OR GERONTOLOGY OR ANATOMY MORPHOLOGY OR GERIATRICS GERONTOLOGY OR SOCIOLOGY OR RHEUMATOLOGY OR REHABILITATION OR NUTRITION DIETETICS OR SUBSTANCE ABUSE OR MUSIC OR MINERALOGY OR PUBLIC ADMINISTRATION OR MEDIEVAL RENAISSANCE STUDIES OR MEDICAL LABORATORY TECHNOLOGY OR LINGUISTICS OR HISTORY OR LANGUAGE LINGUISTICS OR ETHNIC STUDIES OR GEOLOGY OR CULTURAL STUDIES OR LOGIC OR ARCHITECTURE) **AND [excluding] SOURCE TITLES**: (JOURNAL OF VOLCANOLOGY AND GEOTHERMAL RESEARCH OR PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY A

MATHEMATICAL PHYSICAL AND ENGINEERING SCIENCES OR LINEAR ALGEBRA AND ITS APPLICATIONS OR JOVE JOURNAL OF VISUALIZED EXPERIMENTS OR GEOPHYSICAL RESEARCH LETTERS OR GEOLOGICAL SOCIETY OF AMERICA BULLETIN OR GEOLOGICAL MAGAZINE OR JOURNAL OF THE GEOLOGICAL SOCIETY OR FOOD RESEARCH INTERNATIONAL OR ANNALS OF APPLIED PROBABILITY).

B) On 9 March 2016 we collected the scientific papers available on WoS that were cited by or cited Simberloff & Gibbons (2004). This was done to include potentially important boom-bust papers that might have eluded the first search.

All papers were analyzed in two steps. In the first step, papers with no abstract on WoS were excluded, all abstracts were screened, and papers were divided into eight categories:

Category 1: Total mismatch (non-ecological): Papers on economics, geology, molecular biology, etc. that seem to have no connection to ecology.

Categories 2-3: Ecological, but no clear mention of non-native species: Papers seem to be describing aspects of ecology or ecological research, but there is no mention of non-native species. Papers assigned to Category 2 might still be relevant to the topic of boom-bust dynamics in non-native species (e.g., theoretical papers on population dynamics), whereas papers assigned to Category 3 appeared to be irrelevant to the topic of boom-bust dynamics in non-native species.

Categories 4-8: Mention of non-native species: non-native species are mentioned in some way, not necessarily regarding population dynamics or the boom-bust phenomenon. In **Category 4) Pest control/management**, the papers deal with the eradication or other forms of control of invaders (might also be experimental/laboratory setups), but do not necessarily mention "anthropogenic" boom-bust. In **Category 5) Population changes in non-native species (not**

pest control or management), the papers address population/distribution dynamics of an invader in some way, with no clear connection to direct management/control (not necessarily regarding boom-bust). These papers may address population dynamics of other species as well. Papers in **Category 6) Influence of non-native species on other species** address native species population/distribution dynamics/changes/collapse caused by invaders, without addressing population/distribution changes in invaders (i.e., the invader is just mentioned briefly as the cause). The remaining papers that mention non-native species, and were not classified in the other three groups include theoretical papers or reviews and are divided into **Category 7)**: might be relevant to the topic of boom-bust dynamics in non-native species, and **Category 8)**: irrelevant to the topic of boom-bust dynamics in non-native species.

In the second step, full-text papers from Categories 2, 4, 5 and 7 were obtained and classified further as follows (all full text papers fell into one or more of these): true boom-bust dynamics in non-native species (papers describing original data documenting a boom-bust population dynamics in an alien species or providing original assessments of existing datasets); review/synopsis; model/simulation; experiment; or other. We obtained the information listed in Table A1 for all papers classified as "true boom-bust dynamics in non-native species".

Fig. A1 summarizes the results of our searches. The first search (A) delivered 3,986 papers before refinement, 663 after refinement, all but one of which had their abstract on WoS. Therefore, 662 abstracts were screened from this search. After the screening of abstracts, 165 papers were selected for full-text analyses. The second search (B) delivered 198 papers. After duplicates (with search A) and papers with no abstract on WoS were removed, 174 papers remained. Screening of abstracts produced 68 papers for full text analysis.

All full text papers that described boom-bust dynamics (papers in the "Yes" category under "B. Describes boom-bust dynamics?") were included in the qualitative synthesis (103 papers). Only studies belonging to the "true boom-bust in non-native species" category were included in the quantitative analysis (56 papers). Continent, ecosystem type, and focal taxa of these papers are given in Table A2.

Papers included in the qualitative synthesis (papers marked with an asterisk were used in the quantitative analysis)

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376

Table A1. Information obtained from full-text papers in the second step of our analysis.

A. Type of population change:
    1. Population change in non-native species
    2. Population change in native species caused by non-native species
    3. Changes in an ecosystem
B. Describes boom-bust dynamics?
    1. Yes
    2. No
C. Criterion for claiming that a boom-bust occurred:
    1. Not given
    2. Narrative ((e.g. “the population declined precipitously” without defining what “precipitously” means)
    3. Quantitative
    4) Quantitative, amount of decline (%)
D. Quantitative - metric used:
    1. Catch-per-unit effort (CPUE)
    2. Volumetric population density (e.g., #cells/mL)
    3. Areal population density (e.g., no./ha)
    4. Population abundance (e.g., number)
    5. % cover
    6. Biomass
    7. Total catch or hunting bag
    8. Range area
E. Taxon of non-native species:
    1. Microbe
    2. Algae
    3. Plant
    4. Crustacean
    5. Insect
    6. Mollusk
    7. Other invertebrate
    8. Fish
    9. Amphibian
    10. Reptile
    11. Bird
    12. Mammal
    13. Other
F. Ecosystem involved:
    1. Terrestrial
    2. Freshwater
    3. Marine
G.a. Influence (mechanism described):
    1. No mechanism given for bust
    2. Mechanism hypothesized
    3. Mechanism demonstrated

G.b. Influence (which mechanism involved):

1. Predator-prey
2. Competition
3. Change in inorganic factors
4. Disease/parasites
5. Genetic
6. Human influence /management
7. Climate change
8. Resource depletion
9. Density dependence
10. Other factors
11. No mechanism given

H. Part of the world:

1. N-America
2. S-America
3. Europe
4. Africa
5. Asia
6. Oceania
7. Antarctica

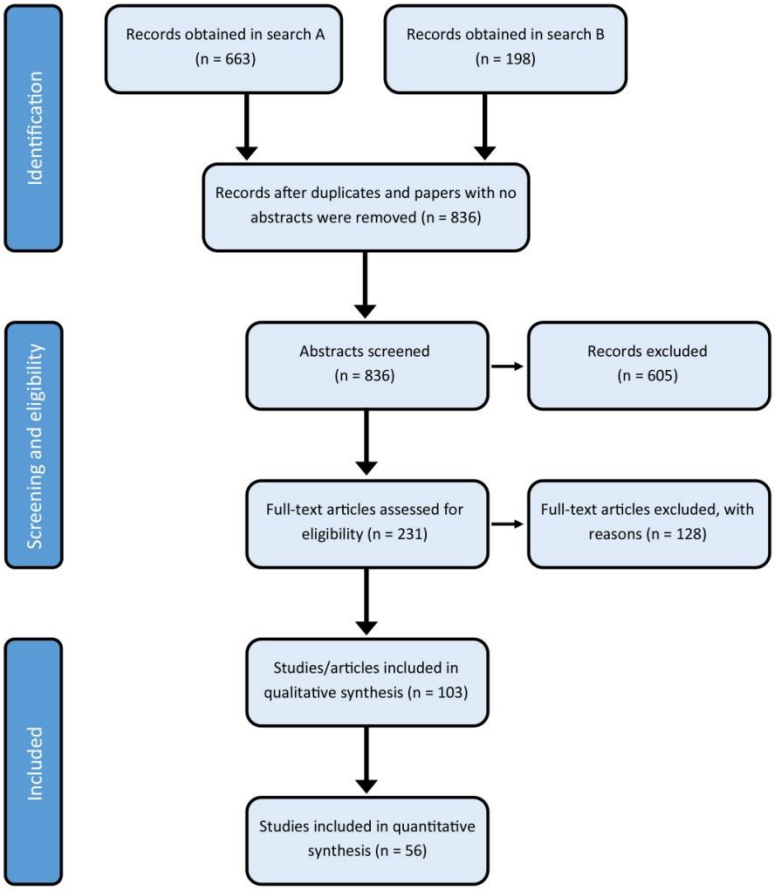
I. Study length (years)

444 Table A2. Continent, ecosystem type, and focal taxa of scientific papers containing original
445 analyses of boom-bust populations ("true boom-bust in non-native species", *n*=56 for all
446 attributes).

	Number of studies	% of studies
Continent		
North America	25	45
Europe	16	29
Oceania	9	16
Asia	4	7
South America	1	2
Africa	1	2
Antarctica	1	2
Ecosystem type		
Freshwater	28	50
Terrestrial	20	36
Marine	9	16
Focal taxon		
Fish	11	20
Crustaceans	9	16
Insects	8	14
Molluscs	8	14
Plants	7	13
Mammals	5	9
Other invertebrates	5	9
Amphibians	2	4
Algae	1	2

447

448



449

450 Fig. A1. PRISMA flow diagram providing overview of the review protocol. All full-text papers
451 that described boom-bust dynamics (papers in the "Yes" category under "B. Describes boom-
452 bust dynamics?") were included in the qualitative synthesis. Only studies belonging to the "true
453 boom-bust in non-native species" category were included in the quantitative analysis. Papers that
454 covered boom-bust dynamics but were for example reviews or described models or experiments

were included in the qualitative synthesis but excluded from the quantitative analysis in Tables 1 and A1 and Fig. 3.

Appendix 2: details about analyses of simulated populations

We simulated the basic boom-bust-dynamic as logistic population growth from which is subtracted a logistic population bust (N_{bust}) after time t_{bust}. Thus,

$N_t = N_{logistic} - N_{bust}$

where

$$N_{logistic} = \frac{KN_0e^{rt}}{K + N_0(e^{rt} - 1)}$$

and

$$N_{bust} = \frac{K'N_0e^{rt}}{K' + N_0(e^{rt} - 1)}$$

using the following parameters: K=100, N_0=1, r=1, and K'=20, 50, and 90 for various degrees of bust. The bust began at time-step 11 (i.e., after 10 time-steps of logistic growth), so that $t'=t-10$. We ran this out to 60 time-steps.

Observation error was incorporated by adding an error term, ε_t, to each population size, so that $N_{obs} = N_t + \varepsilon_t$, for both the logistic and bust populations, N_{obs} being the observed population size. Each value of ε_t was drawn independently at random from a normal distribution as $\varepsilon_t \sim (0,\sigma)$, where σ is set at 0.1, 0.3 or 1 of N_t. We produced 1000 populations of each type (3 amounts of error, 4 degrees of bust, including no bust), for a total of 12 types of populations, and 12,000 individual simulated population trajectories. Occasionally, these simulations produced negative values for N_{obs}, especially for small populations subject to large observation errors. In such cases, we set N_{obs} to zero, and proceeded with subsequent calculations. Examples of simulated populations are shown in Fig. A2.

We calculated four specific metrics based on the observed decline from the peak observed value. First, we simply calculated the percentage decline from the observed peak (in the

first 30 years) to lowest observed value in the subsequent period of record. We considered periods extending 3, 10, and 30 years after the peak. Second, we calculated the severity of the bust as the percentage decline from the observed peak (again, in the first 30 years) to the *average* value in the 3, 10, or 30 years after the peak. Third, we calculated 3-year running averages of population size, and then repeated both previous estimates of bust severity. Each randomization was run for 1000 trials. Simulations were run in Excel, using the Resampling Stats add-in.

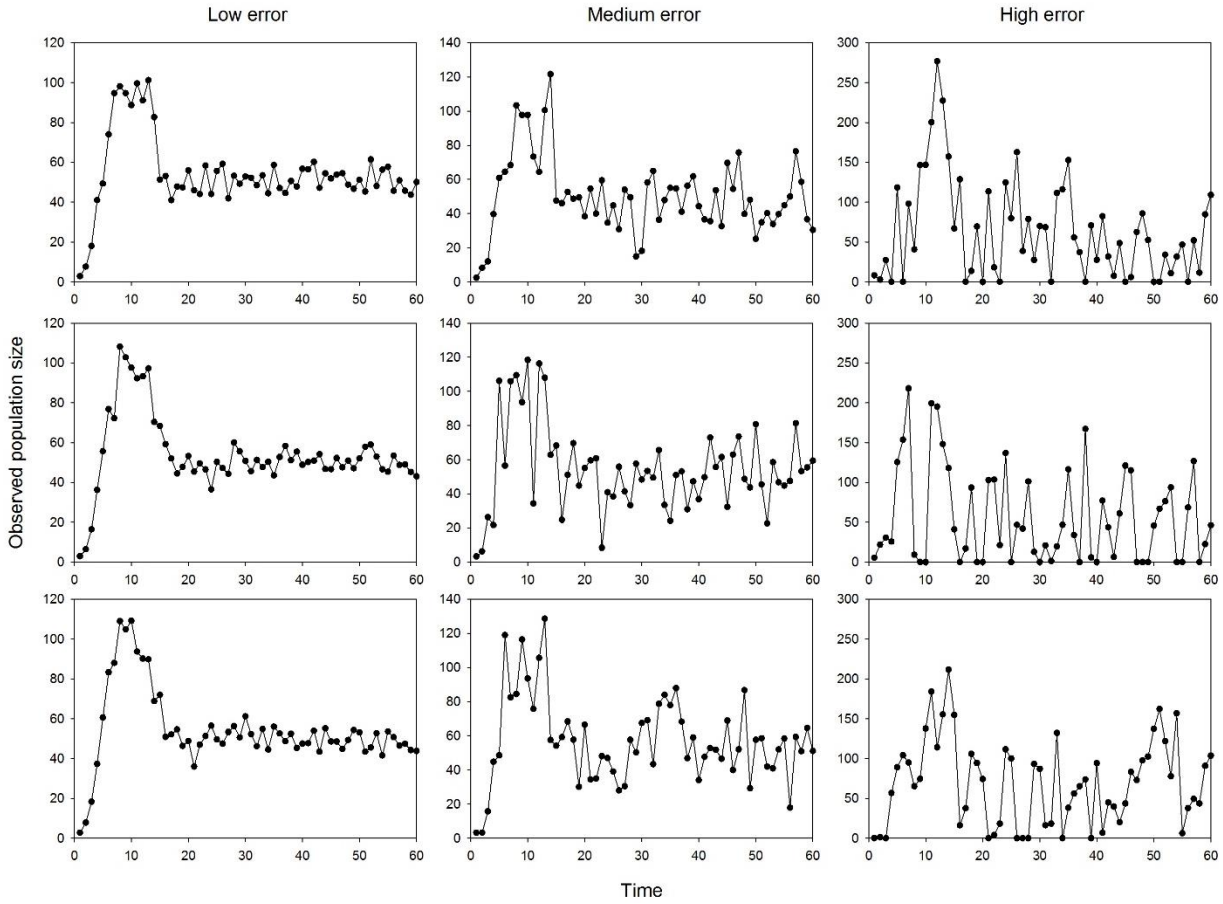


Fig. A2. Examples of simulated populations. Shown here are three examples (out of 1000 simulations that were run for each scenario) for each of the low, medium, and high error populations with a 50% bust.