


ISLANDS AND GLOBAL CATASTROPHIC/EXISTENTIAL RISK

- 21 October 2022, Centre for the Study of Existential Risk
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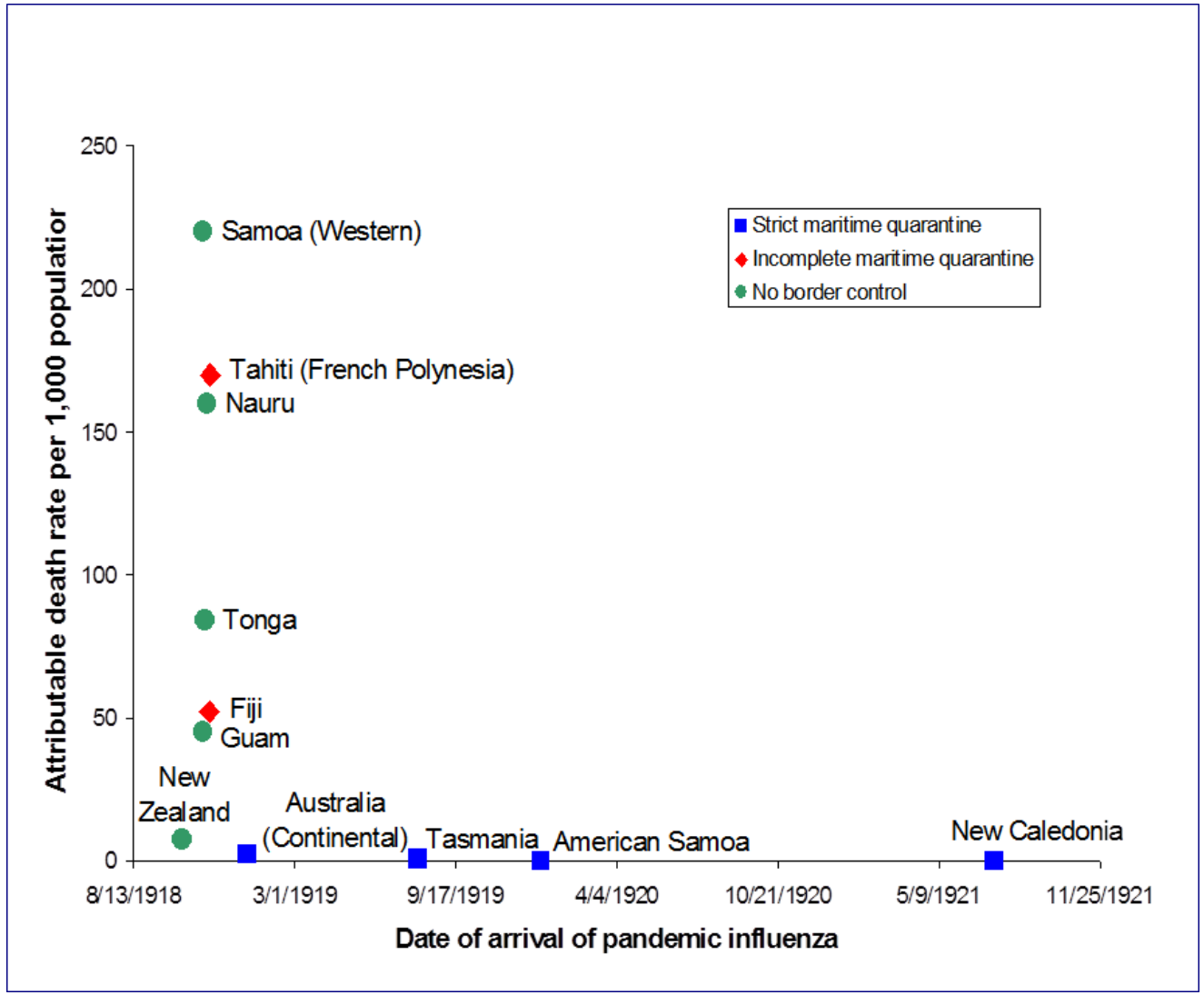
OUTLINE

- Journey to this point
- Why islands?
- Border closure and pandemics (pre-Covid)
- Island refuges (biothreats)
- Island nodes of persisting complexity (ASRS)
- New Zealand Catastrophe Resilience Project

JOURNEY TO THIS POINT

WHY ISLANDS?

MARITIME QUARANTINE 1918 PANDEMIC



McLeod et al 2008, *EID*

ISLANDS AVOIDED 1918 PANDEMIC ENTIRELY

Boyd et al. 2019, IUHPE

ISLAND CLIMATE MODERATED BY OCEAN

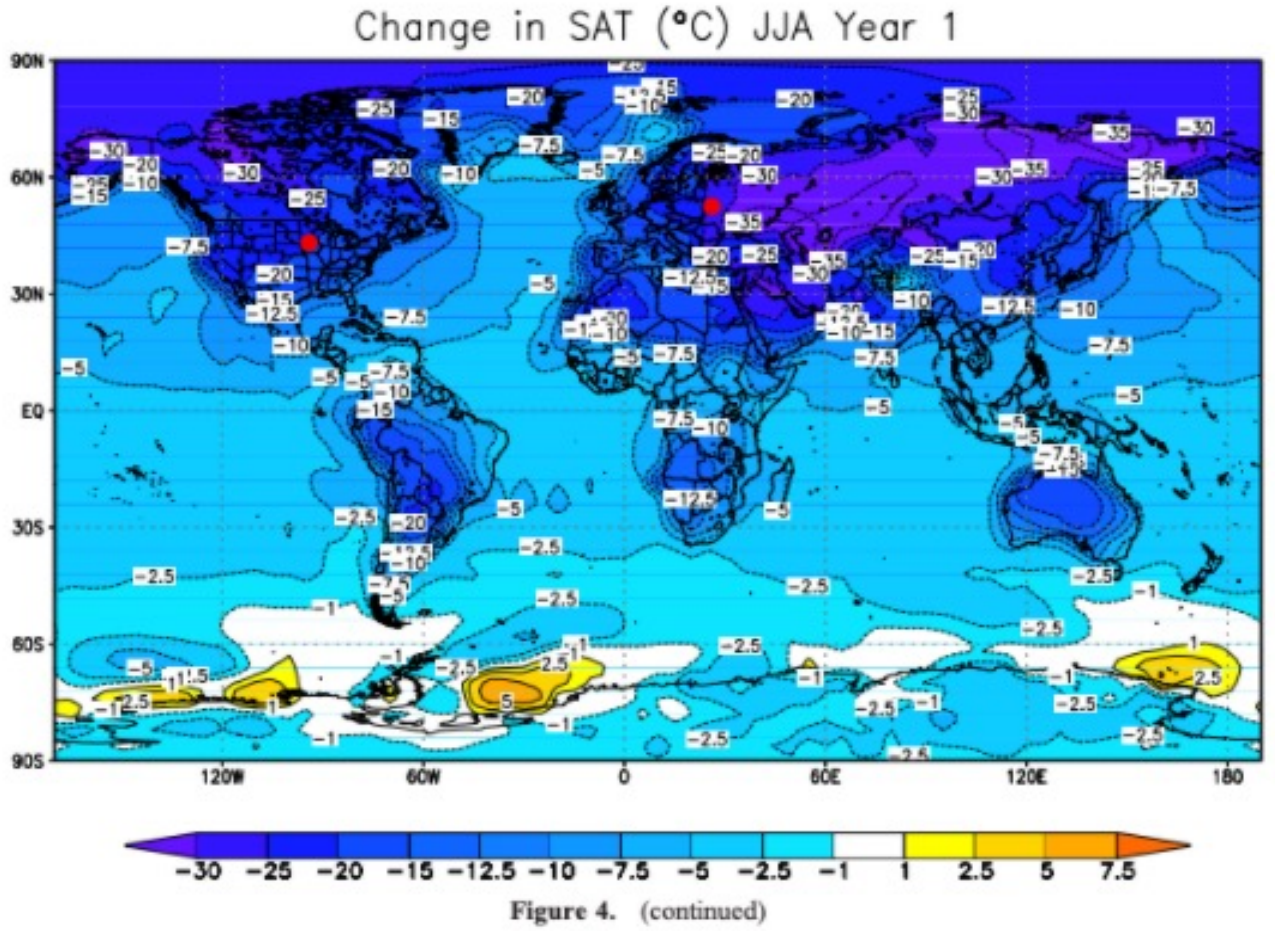


Figure 4. (continued)

Surface air temperature changes for the 150 Tg case averaged for June, July, and August of the year of smoke injection and the next year. Robock et al., 2007

Robock et al J. Geophys. Res., 112, D13107 (permission provided by publisher's (AGU's) policy)

SOUTHERN HEMISPHERE ISLANDS AND TAMBORA ERUPTION 1815 (VEI 7)

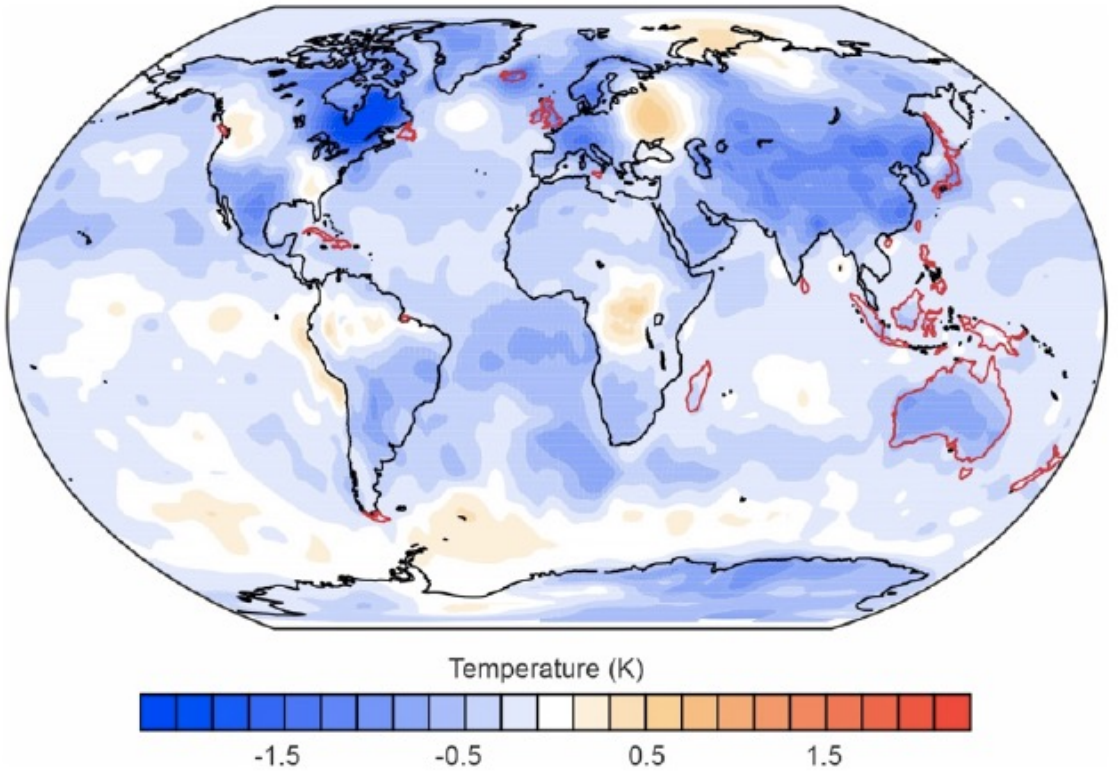


Figure 3

Reconstructed temperature anomalies in 1816 ("the year without a summer") relative to the "non-volcanic" reference period (1779 to 1808) using monthly data from the reconstruction EKF400v2

Wilson et al. 2022, Preprint
https://www.researchsquare.com/article/rs-2124163/v1

SOUTHERN HEMISPHERE ISLANDS AND TAMBORA ERUPTION 1815 (VEI 7)

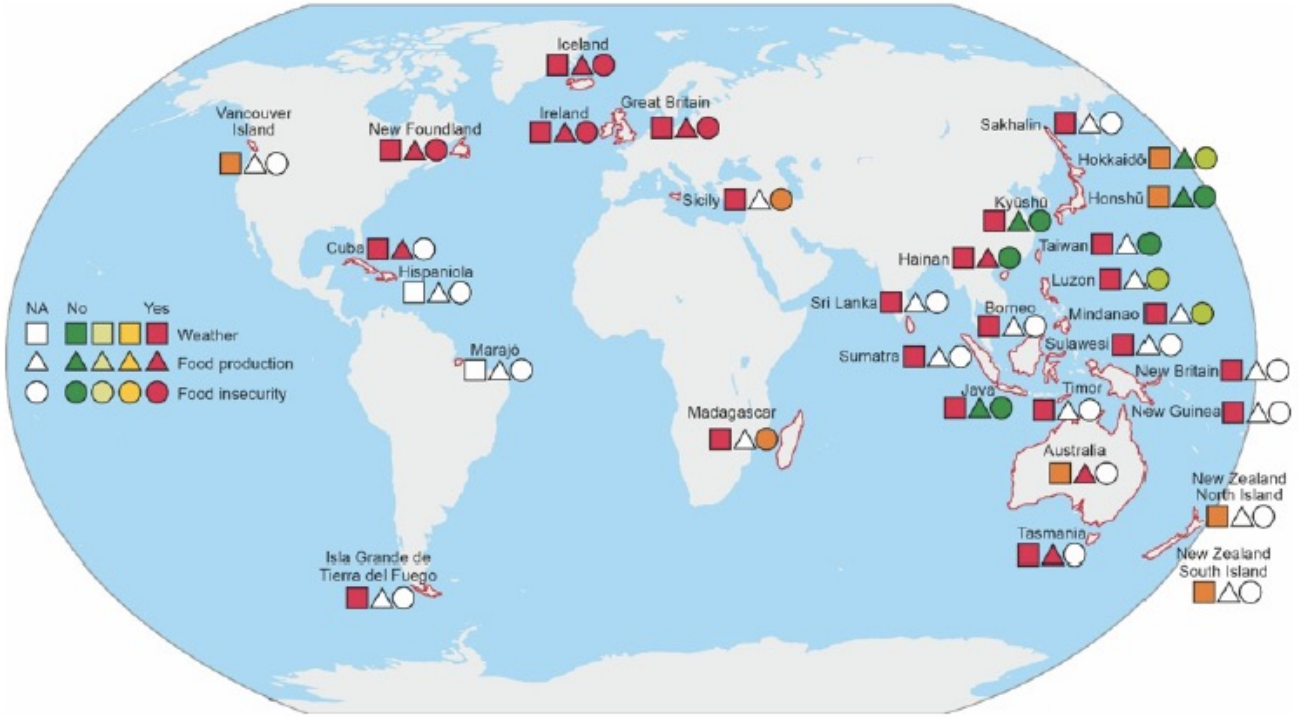


Figure 1

Summarised evidence for impacts from the Tambora eruption on 31 islands in the 1815-1817 period (see Table 1 and Table S2 for additional details)

Wilson et al. 2022, Preprint
https://www.researchsquare.com/article/rs-2124163/v1

BORDER CLOSURE AND PANDEMICS (PRE-COVID)

RESEARCH ARTICLE

Protecting an island nation from extreme pandemic threats: Proof-of-concept around border closure as an intervention

Matt Boyd[1], Michael G. Baker[2], Osman D. Mansoor[3], Giorgi Kvizhinadze[2], Nick Wilson[2]*

1 Adapt Research Ltd, Wellington, New Zealand, **2** Department of Public Health, University of Otago, Wellington, New Zealand, **3** 39 Mortimer Tce, Wellington, New Zealand

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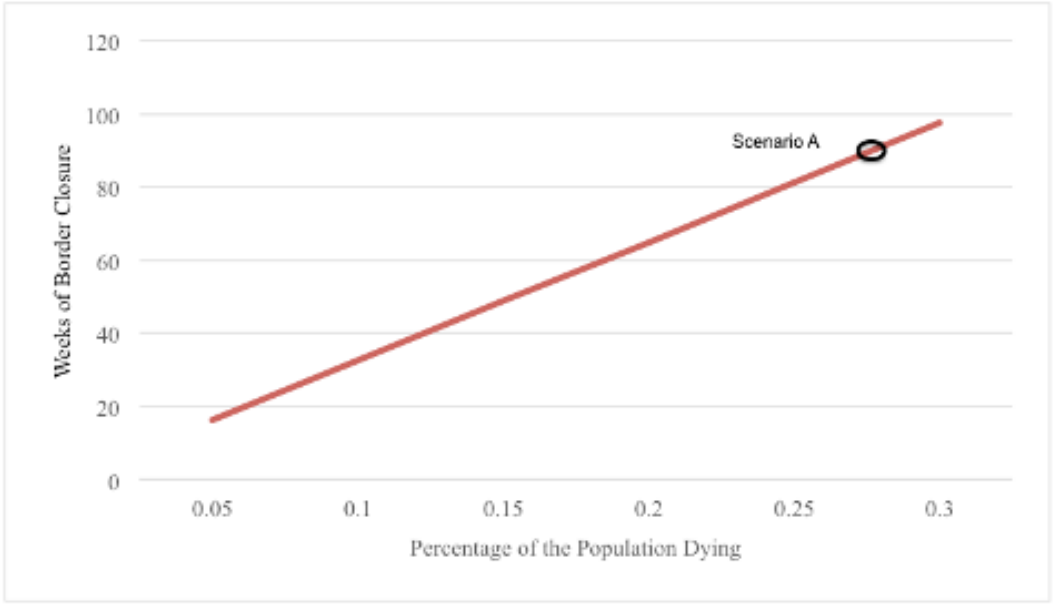


Economic evaluation of border closure for a generic severe pandemic threat using New Zealand Treasury methods

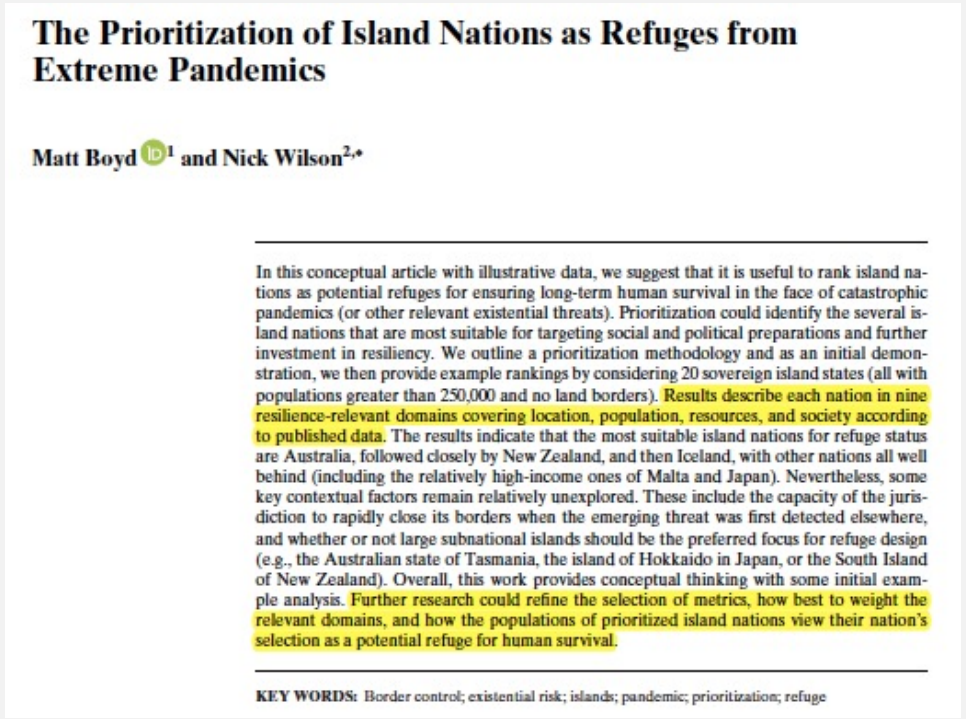
Matt Boyd,[1] Osman D. Mansoor,[2] Michael G. Baker,[3] Nick Wilson[3]

ECONOMIC CASE FOR BORDER CLOSURE IN SEVERE PANDEMICS

Boyd et al 2017, *PLOS ONE*; Boyd et al 2018, *ANZJPH*

ISLANDS REFUGES (BIOTHREATS)

IDENTIFICATION AND PRIORITIZATION OF ISLAND REFUGES

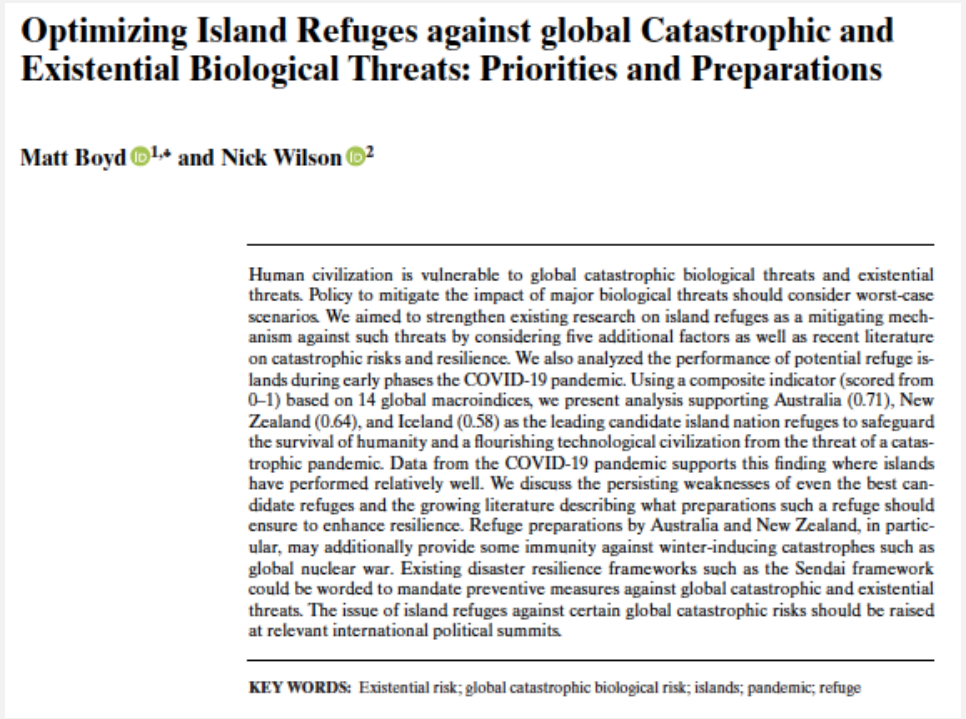


The Prioritization of Island Nations as Refuges from Extreme Pandemics

Matt Boyd [1] and Nick Wilson [2,*]

In this conceptual article with illustrative data, we suggest that it is useful to rank island nations as potential refuges for ensuring long-term human survival in the face of catastrophic pandemics (or other relevant existential threats). Prioritization could identify the several island nations that are most suitable for targeting social and political preparations and further investment in resiliency. We outline a prioritization methodology and as an initial demonstration, we then provide example rankings by considering 20 sovereign island states (all with populations greater than 250,000 and no land borders). Results describe each nation in nine resilience-relevant domains covering location, population, resources, and society according to published data. The results indicate that the most suitable island nations for refuge status are Australia, followed closely by New Zealand, and then Iceland, with other nations all well behind (including the relatively high-income ones of Malta and Japan). Nevertheless, some key contextual factors remain relatively unexplored. These include the capacity of the jurisdiction to rapidly close its borders when the emerging threat was first detected elsewhere, and whether or not large subnational islands should be the preferred focus for refuge design (e.g., the Australian state of Tasmania, the island of Hokkaido in Japan, or the South Island of New Zealand). Overall, this work provides conceptual thinking with some initial example analysis. Further research could refine the selection of metrics, how best to weight the relevant domains, and how the populations of prioritized island nations view their nation's selection as a potential refuge for human survival.

KEY WORDS: Border control; existential risk; islands; pandemic; prioritization; refuge



Optimizing Island Refuges against global Catastrophic and Existential Biological Threats: Priorities and Preparations

Matt Boyd [1,*] and Nick Wilson [2]

Human civilization is vulnerable to global catastrophic biological threats and existential threats. Policy to mitigate the impact of major biological threats should consider worst-case scenarios. We aimed to strengthen existing research on island refuges as a mitigating mechanism against such threats by considering five additional factors as well as recent literature on catastrophic risks and resilience. We also analyzed the performance of potential refuge islands during early phases the COVID-19 pandemic. Using a composite indicator (scored from 0–1) based on 14 global macroindices, we present analysis supporting Australia (0.71), New Zealand (0.64), and Iceland (0.58) as the leading candidate island nation refuges to safeguard the survival of humanity and a flourishing technological civilization from the threat of a catastrophic pandemic. Data from the COVID-19 pandemic supports this finding where islands have performed relatively well. We discuss the persisting weaknesses of even the best candidate refuges and the growing literature describing what preparations such a refuge should ensure to enhance resilience. Refuge preparations by Australia and New Zealand, in particular, may additionally provide some immunity against winter-inducing catastrophes such as global nuclear war. Existing disaster resilience frameworks such as the Sendai framework could be worded to mandate preventive measures against global catastrophic and existential threats. The issue of island refuges against certain global catastrophic risks should be raised at relevant international political summits.

KEY WORDS: Existential risk; global catastrophic biological risk; islands; pandemic; refuge

Boyd & Wilson 2019 and 2021, *Risk Analysis*

FIVE FACTORS FOR REFUGE SUCCESS

People	Access	Resource security	Health Security	Hazards
• Population size • Secondary school completions (resilience) • Social capital index (health, equality, crime, freedom, and satisfaction) • Political stability and absence of violence	• Distance from neighbours • International arrivals • Military capability (armed forces personnel)	• Food Production kcal/capita • Energy self-sufficiency • GDP per capita	• Global Health Security Index • Covid-19 deaths per million	• World risk index (excludes volcano) • Climate vulnerability

Boyd & Wilson 2021, *Risk Analysis*

RESULTS & INTERPRETATION

Table VI. Composite Indicator Scores When Each Factor was Weighted in Turn to Determine 50% of the Overall Score (Island Nations are Listed in the Same Order as in Tables III and IV for Comparison)

	Factor weighted to 50% of Overall Composite Indicator Score (Three Highest Scores for Each Analysis in Bold)				
Island Nation	People	Access	Health Security	Resource Security	Hazards
Australia	**0.75**	**0.51**	**0.80**	**0.79**	**0.69**
New Zealand	**0.69**	**0.57**	**0.71**	**0.59**	0.65
Iceland	0.61	**0.50**	0.50	**0.56**	**0.75**
Japan	**0.67**	0.46	**0.65**	0.43	0.51
Cuba	0.57	0.44	0.55	0.38	0.67
Sri Lanka	0.57	0.49	0.59	0.35	0.51
Trinidad and Tobago	0.50	0.40	0.55	0.40	0.59
Malta	0.51	0.38	0.46	0.35	**0.69**
Jamaica	0.53	0.40	0.55	0.32	0.62
Bahamas, The	0.48	0.40	0.38	0.34	0.66
Comoros	0.44	0.43	0.49	0.31	0.62
Madagascar	0.45	0.41	0.56	0.32	0.45
Mauritius	0.48	0.36	0.51	0.32	0.56
Philippines	0.50	0.38	0.50	0.32	0.40
Fiji	0.45	0.42	0.52	0.31	0.43
Barbados	0.40	0.34	0.38	0.30	0.64
Maldives	0.39	0.36	0.36	0.26	0.60
Solomon Islands	0.38	0.38	0.49	0.31	0.40
Cabo Verde	0.40	0.38	0.30	0.25	0.57
Vanuatu	0.37	0.40	0.49	0.30	0.29

The four factors not weighted to 50% in each analysis each comprised an equal 12.5% of the total score.
Factor composition from individual variables is as follows: People (population size, social capital, political stability, and education), accessibility (distance, visitors, military), health security (GHSI scores, COVID-19 deaths), resources (GDP per capita, food, energy), and hazards (natural hazard risk, climate vulnerability).

Boyd & Wilson 2021, *Risk Analysis*

RESULTS & INTERPRETATION (ACCORDING TO *THE SUN*)

Tech > Science

EXIT STRATEGY Scientists rank safest spots to flee to if apocalyptic outbreak begins to wipe out humanity

Charlotte Edwards, Digital Technology and Science Reporter

15:19, 2 Oct 2019 | **Updated**: 16:06, 20 Mar 2020

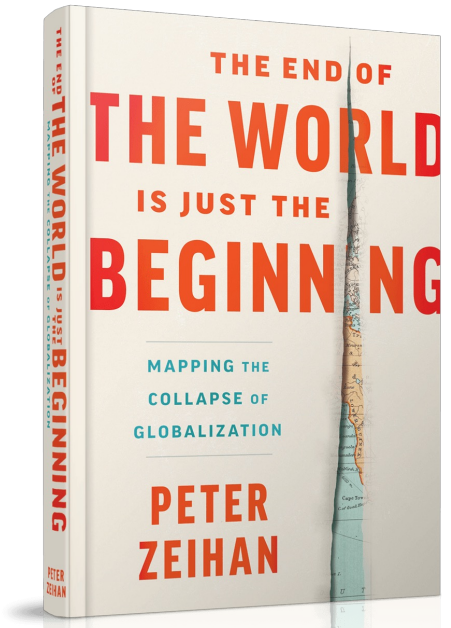
RECOMMENDATIONS

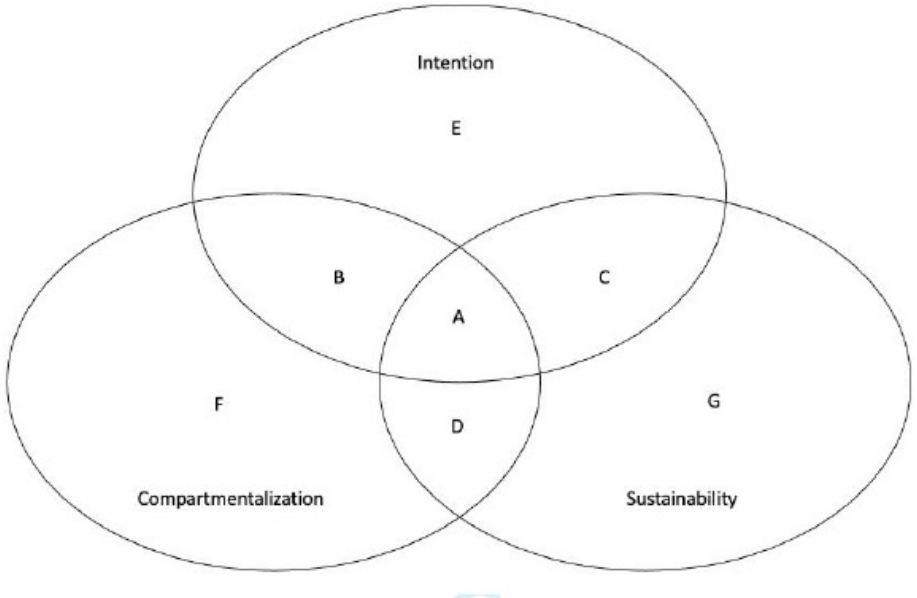
- Early warning system & criteria for closure, rapid decision-making
- Food assessment & security
- Energy assessment & security
- Essential services resilience (water, electricity, wastewater, redundancy)
- Health security (especially ability to detect, isolate cases)
- Psychological preparation & communication
- Identify legal barriers, national emergency laws
- Develop a Preparation Framework (may overlap with other risks see below 'Resilience Projects for Major Scenarios')

Boyd & Wilson 2021, *Risk Analysis*

SOME PROBLEMS WITH ISOLATED REFUGES

- Misconception that refuge is a biothreat 'lifeboat' (*The Sun*)
- Social/legal/moral issues with refusing citizen entry
- Moral hazard of preparation vs prevention
- Lack of representativeness of humanity
- Technological/industrial self-sufficiency is HARD – an infrastructure of infrastructures
- Isolation of single island may not be optimal for resilience





Article

An Analysis of the Potential for the Formation of 'Nodes of Persisting Complexity'

Nick King and Aled Jones *

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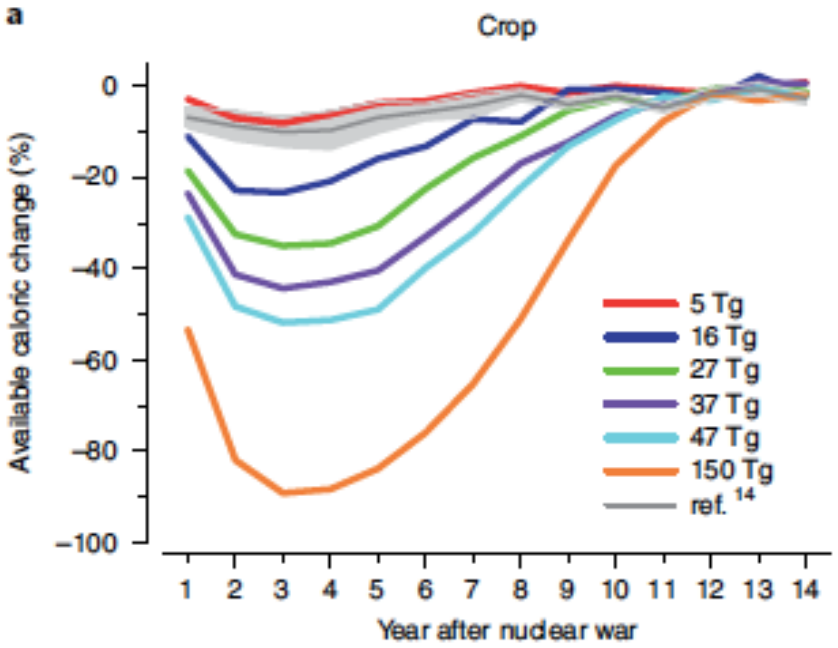
Abstract: Human civilisation has undergone a continuous trajectory of rising sociopolitical complexity since its inception; a trend which has undergone a dramatic recent acceleration. This phenomenon has resulted in increasingly severe perturbation of the Earth System, manifesting recently as global-scale effects such as climate change. These effects create an increased risk of a global 'de-complexification' (collapse) event in which complexity could undergo widespread reversal. 'Nodes of persisting complexity' are geographical locations which may experience lesser effects from 'de-complexification' due to having 'favourable starting conditions' that may allow the retention of a degree of complexity. A shortlist of nations (New Zealand, Iceland, the United Kingdom, Australia and Ireland) were identified and qualitatively analysed in detail to ascertain their potential to form 'nodes of persisting complexity' (New Zealand is identified as having the greatest potential). The analysis outputs are applied to identify insights for enhancing resilience to 'de-complexification'.

ISLAND REFUGES VS NODES OF PERSISTING COMPLEXITY

ISLANDS AND ABRUPT SUNLIGHT REDUCTION SCENARIOS (ASRS)



nature food
ARTICLES
https://doi.org/10.1038/s43016-022-00573-0
Check for updates

OPEN

Global food insecurity and famine from reduced crop, marine fishery and livestock production due to climate disruption from nuclear war soot injection

Lili Xia[1], Alan Robock[1], Kim Scherrer[2,3], Cheryl S. Harrison[4], Benjamin Leon Bodirsky[5,6], Isabelle Weindl[5], Jonas Jägermeyr[5,7,8], Charles G. Bardeen[9], Owen B. Toon[10] and Ryan Heneghan[11]

Atmospheric soot loadings from nuclear weapon detonation would cause disruptions to the Earth's climate, limiting terrestrial and aquatic food production. Here, we use climate, crop and fishery models to estimate the impacts arising from six scenarios of stratospheric soot injection, predicting the total food calories available in each nation post-war after stored food is consumed. In quantifying impacts away from target areas, we demonstrate that soot injections larger than 5 Tg would lead to mass food shortages, and livestock and aquatic food production would be unable to compensate for reduced crop output, in almost all countries. Adaptation measures such as food waste reduction would have limited impact on increasing available calories. We estimate more than 2 billion people could die from nuclear war between India and Pakistan, and more than 5 billion could die from a war between the United States and Russia—underlining the importance of global cooperation in preventing nuclear war.

FOOD AS MAJOR PROBLEM IN ASRS

NZ FOOD EXPORT CALORIE ANALYSIS

- Nutritional survey data multiplied by population by age
- Weight of food exports converted to kcal
- Wastage adjustments
- Nuclear winter scenarios from 3 sources (Xia 2022, Jagermeyr 2020, Green 1987)
- But climate impact on production just one factor

Table 5: Daily dietary energy provided by major food export categories relative to the daily dietary energy intakes of the current NZ population and after three nuclear winter scenarios

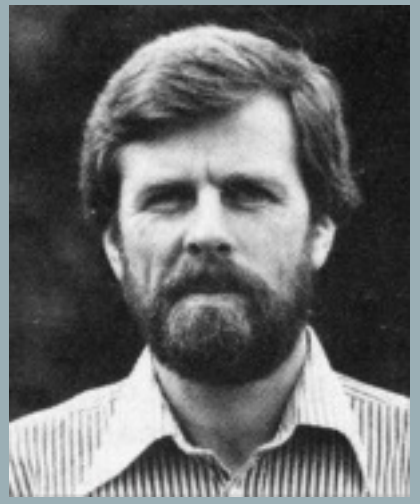
Major food export group (from Table 4)	Weight of annual food exports in tonnes (from Table 4)	Percentage of total NZ population intake (business-as-usual) (%)	Percentage of total NZ population dietary energy intake from diverted food exports after various nuclear winter scenarios (as per Table 2) (%)		
			8% reduction in agriculture	28% reduction in agriculture	61% reduction in agriculture
Dairy products	3,064,118	338%	311%	243%	132%
Meat products	871,672	34.1%	31%	25%	13.3%
Fruit	893,480	8.6%	4%	3%	3.3%
Alcohol	302,417	4.8%	8%	6%	1.9%
Marine food products	246,931	4.6%	3%	2%	1.8%
Vegetables	322,221	2.7%	4%	3%	1.1%
Total	5,700,839	393%	361%	283%	153%
Total kJ available	–	63,658,104	58,565,456	45,833,835	24,826,661
Total kJ per person per day available	–	34,098	31,370 (7498 kcal)	24,551 (5868 kcal)	13,298 (3178 kcal)

Wilson et al 2022, preprint https://www.medrxiv.org/content/10.1101/2022.05.13.22275065v3

ISLANDS & ASRS

- **Hypothesis**: island nations, particularly in the Southern Hemisphere, would typically suffer less from ASRS (aimed to identify which)
- **Method**:
  - Island food threshold analysis
  - Profiles of islands according to resilience factors (based on NZNIS and other literature on nuclear winter and island refuges, see below)
  - More detailed case study of one island (New Zealand)
  - Derive recommendations to match shortcomings highlighted by results

THE NZ NUCLEAR IMPACTS STUDY 1987



Dr Wren Green (Ecologist & Lead Author)

French reparations from the bombing of the Rainbow Warrior funded the study

DERIVED FACTORS RELEVANT TO ISLAND SUCCESS IN ASRS

Energy self-sufficiency	Food energy per capita surplus (in severe ASRS conditions)	Communication, transport, & water infrastructure resilience	Access to regional trading partners
Manufacturing capability	Social cohesion	Social capital	Political stability/risk
Defence	Population size	Education	Health security

Boyd & Wilson 2022, preprint
https://www.researchsquare.com/article/rs-1927222/v1

Indicator	Australia	New Zealand	Indonesia	Iceland	The Philippines	Mauritius	Vanuatu	Solomon Islands
Food kcal/capita/day (150 Tg)	**16,069**	3,741	1,658	4,139	1,180	1,795	2,834	2,898
Total energy self-sufficiency [a]	**320%**	76%	184%	88%	49%	16%	NA	NA
Communication	87	91	54	**99**	47	65	26	12
Infrastructure quality 0–7	4.70 (39th)	4.76 (34th)	4.13 (68th)	**5.60 (17th)**	2.96 (113th)	4.49 (50th)	NA	NA
Access to trade	See text	See text	See text	See text	See text	See text	See text	See text
Manufacturing capability	0.042	0.0079	**0.052**	0.00057	0.025	0.0007	NA	NA
Social cohesion	2.5	1.8	6.7	**1.0**	8.2	2.9	NA	6.4
Social capital score	54.1 (31st)	56.0 (20th)	46.1 (74th)	**64.1 (1st)**	41.8 (103rd)	47.3 (69th)	36.4 (144th)	41.9 (100th)
Political stability	0.85	**1.49**	-0.50	1.39	-0.79	0.89	0.90	0.64
Defence spend (per capita)	**$27,536m ($1,072)**	$3,011m ($592)	$9,396m ($34)	$0m ($0) [b]	$3,733m ($34)	$18m ($14)	NA (NA)	NA (NA)
Education	**80.0**	75.1	38.1	74.1	30.5	43.6	NA	NA
Health security	**71.1**	62.5	50.4	48.5	45.7	39.7	25.9	23.3
Average ranking	**2.1 (1st)**	2.5 (2nd)	4.4 (4th)	2.7 (3rd)	5.8 (6th)	4.7 (5th)	6.0 (7th)	6.2 (8th)

ISLANDS & ASRS: RESULTS

Boyd & Wilson 2022, preprint
https://www.researchsquare.com/article/rs-1927222/v1

NEW ZEALAND CASE STUDY

Most isolated temperate land mass in the world, highly susceptible to cessation of long-haul shipping

No diesel/refined fuels - 100% dependent on trade

Sparse distributed population and transportation of food almost exclusively by road

Only 1.2% of vehicles in New Zealand are electric

Dairy milk bulk of calories, milking at scale uses electricity/diesel

Industrial inputs unavailable, including commodities such as valves, lubricating oils, tyre rubber, many chemicals and their precursors (eg, fertilizer), electronics, semiconductors

Sophisticated manufacturing lacking

Operational data (eg finance) stored offshore

Interisland shipping vulnerable (diesel, breakdowns – needing international expertise/parts)

These and many other problems could lead to rationing, hyperinflation, social breakdown

"Infrastructure of infrastructures" - complex adaptive ecological system, embedded in a complex natural adaptive ecological system

Boyd & Wilson 2022, preprint
https://www.researchsquare.com/article/rs-1927222/v1

MANY PATHS TO COLLAPSE WITHOUT SIGNIFICANT RESILIENCE BUILDING

"[i]t is hard to see why [New Zealand] wouldn't make it through with most of their technology (and institutions) intact" (Ord, 2020)

Yet, there are a number of paths to societal collapse in ASRS, many of which were identified in the 1980s NZ Nuclear Impacts Study

"[f]undamental disruptions to New Zealand society would occur in the absence of direct targets or climatic change" (Green, 1989)

ISLANDS & ASRS: SUGGESTIONS FOR NEXT STEPS

Note: a comprehensive list of suggested actions corresponding to the ASRS resilience factors for islands (as above) can be found in the Supplementary Material of our pre-print: 220627SUPPLEMENTARYFILEIslandsasrefugefromASRSplaintext28June.docx

- NZ should repeat key aspects of the Nuclear Impacts Study and follow through to policy considerations (National ASRS Strategy & Plan)
- Other islands should conduct bottom-up caloric supply calculations under ASRS conditions
- Repeat ASRS profiling as above for other food rich nations (eg South America)
- ASRS should be included in National Risk Assessments
- Policies that will 'never be an option' should still be evaluated
- Assess business as usual co-benefits of resilience options
- Consider the similar challenges between isolated refuges (voluntary) for biothreats and isolation (imposed) by ASRS

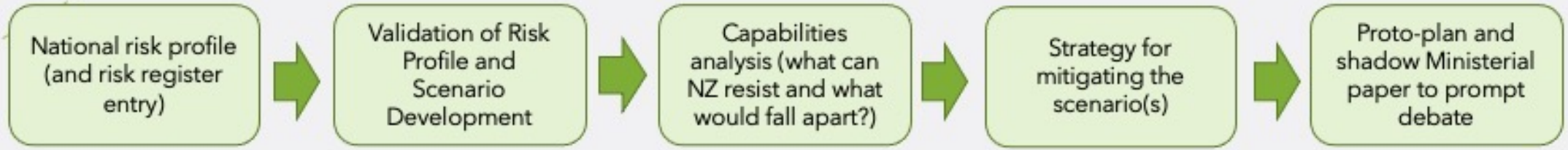
AOTEAROA NZ CATASTROPHE RESILIENCE PROJECT

Nov 2022 – Oct 2023

Preliminary Project Plan

Project Investigators:
- Dr Matt Boyd
- Prof Nick Wilson
- Dr Ben Payne

External advice



National risk assessment methodology (based on Norwegian/Dutch process)

Workshop with diverse experts:
- Revise the risk profile
- Develop scenarios
- Determine information needs

Survey across sectors (responses prompted by scenario)

Targeted interviews of key knowledge holders

Response to knowledge previously elicited by NZ Nuclear Impacts Study

Summary presentations then Roundtable discussion among diverse experts/sectors to elicit interventions

Delphi process to prioritize interventions

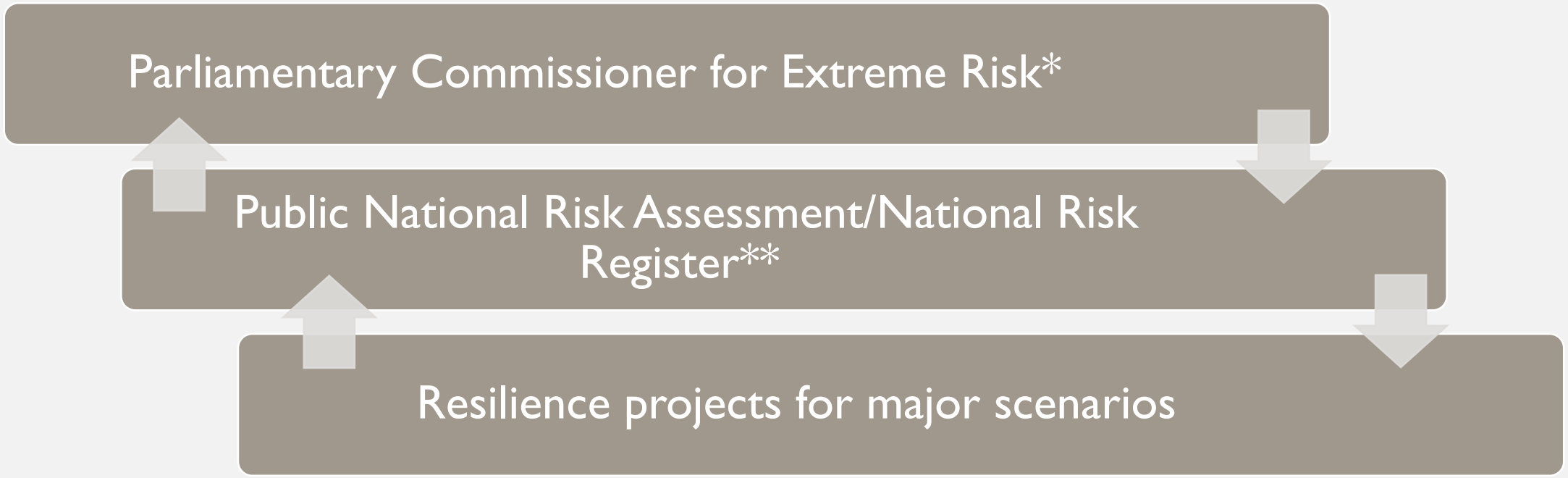
Shadow National Catastrophe Resilience Plan outline & summary of findings & recommendations

Media/public engagement

Steps toward National Catastrophe Resilience Conference

STRUCTURAL APPROACH TO CATASTROPHE/EXISTENTIAL RISK

> … any entity tasked with improving New Zealand's resilience to extreme risk must be anticipatory, central/aggregating, coordinating, apolitical, transparent, adaptive and accountable …



TAKEAWAYS

There are reasons to think that islands might be less impacted by some GCRs/x-risks (biothreats, ASRS)

In some scenarios, some islands might offer the best chance of sustaining nodes of industrial/institutional complexity

However, island societies are complex adaptive systems embedded in complex adaptive ecological systems, and may be prone to state transitions

Such transitions might be triggered by shocks to critical system variables such as trade, energy, food, transportation, manufacturing, social cohesion

There is great uncertainty around the nature and impacts of these threats and they should be included in islands' national risk analyses

Islands that are good candidates to resist GCRs/x-risks should conduct detailed analyses of their resilience to such scenarios and plan accordingly

MANY THANKS TO

- Professor Nick Wilson (co-author on all papers)
- Michael Cassidy, Lara Mani, Stefan Brönnimann, Veronika Valler (co-authors on Tambora paper)
- Marnie Prickett (co-author NZ food exports paper)
- Centre for Effective Altruism Long-term Future Fund
- The Regranting Program of the FTX Future Fund