@PelegOhad
#ITRS2023

MARINE PROTECTION ENHANCES KELP FOREST STABILITY

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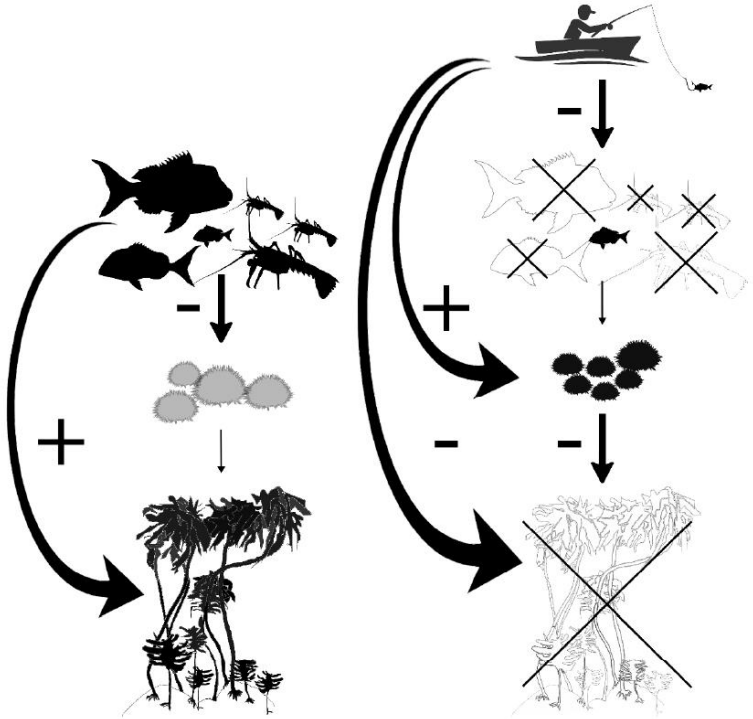
FUTURE-PROOFING KELP FORESTS

- Kelp forests dominate shallow temperate reefs
- Decline in many regions
- Manage, conserve and restore
- Outcomes and benefits need to persist

TROPHIC CASCADES AND ECOSYSTEM PHASE SHIFTS

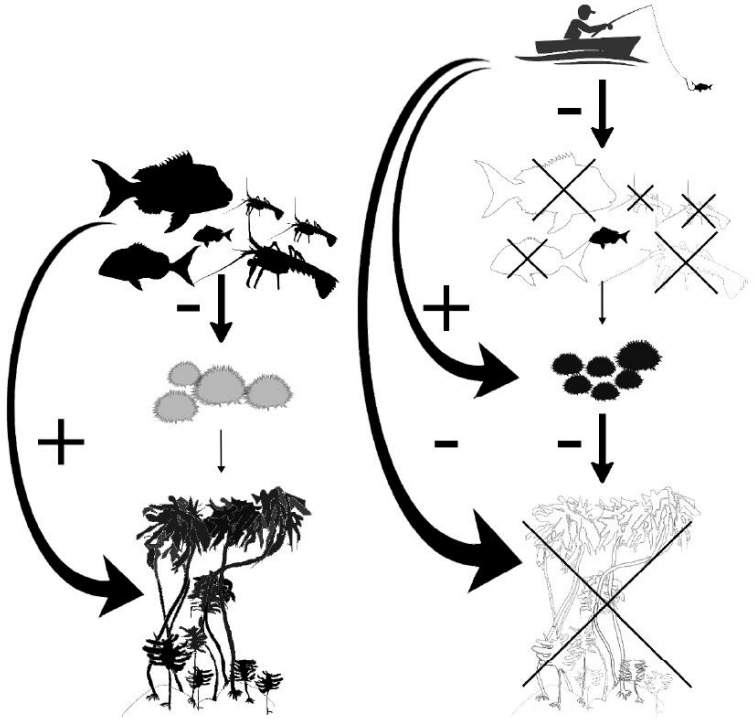
- Fishing can disrupt predatory interactions driving trophic cascades and phase-shifts
- Alternate stable states



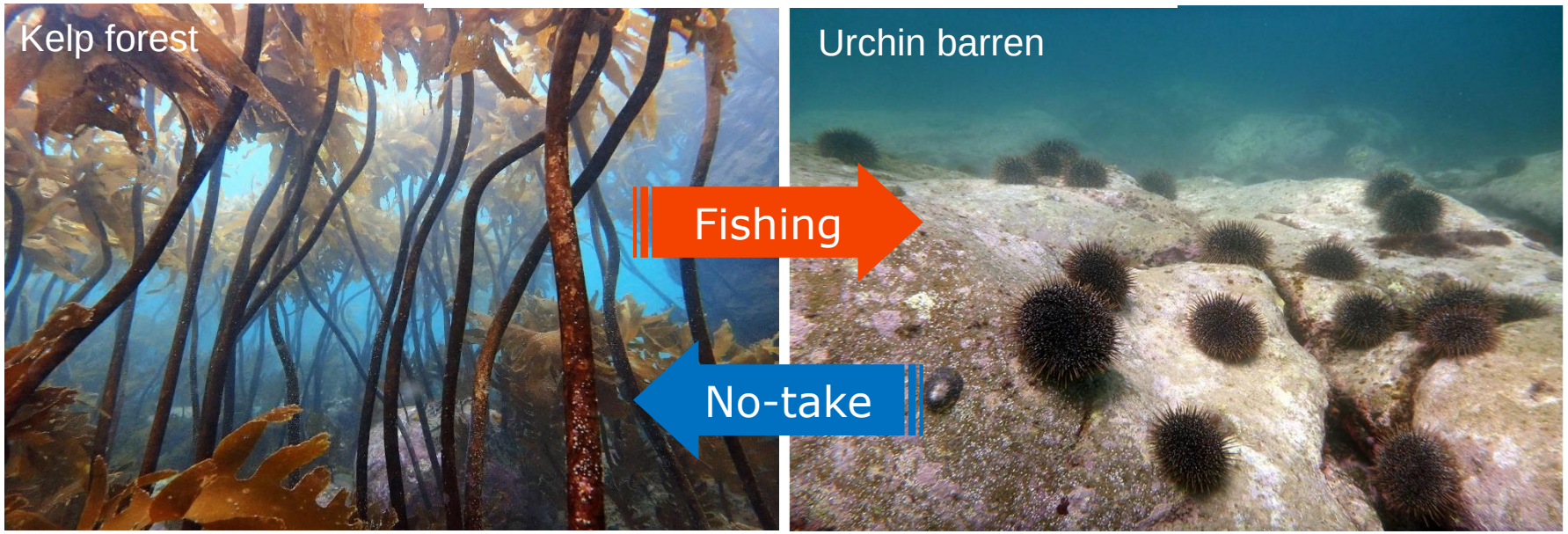
Fishing

PROTECTION, REVERSE SHIFTS AND ECOSYSTEM STABILITY

- No-take protection can reverse these shifts

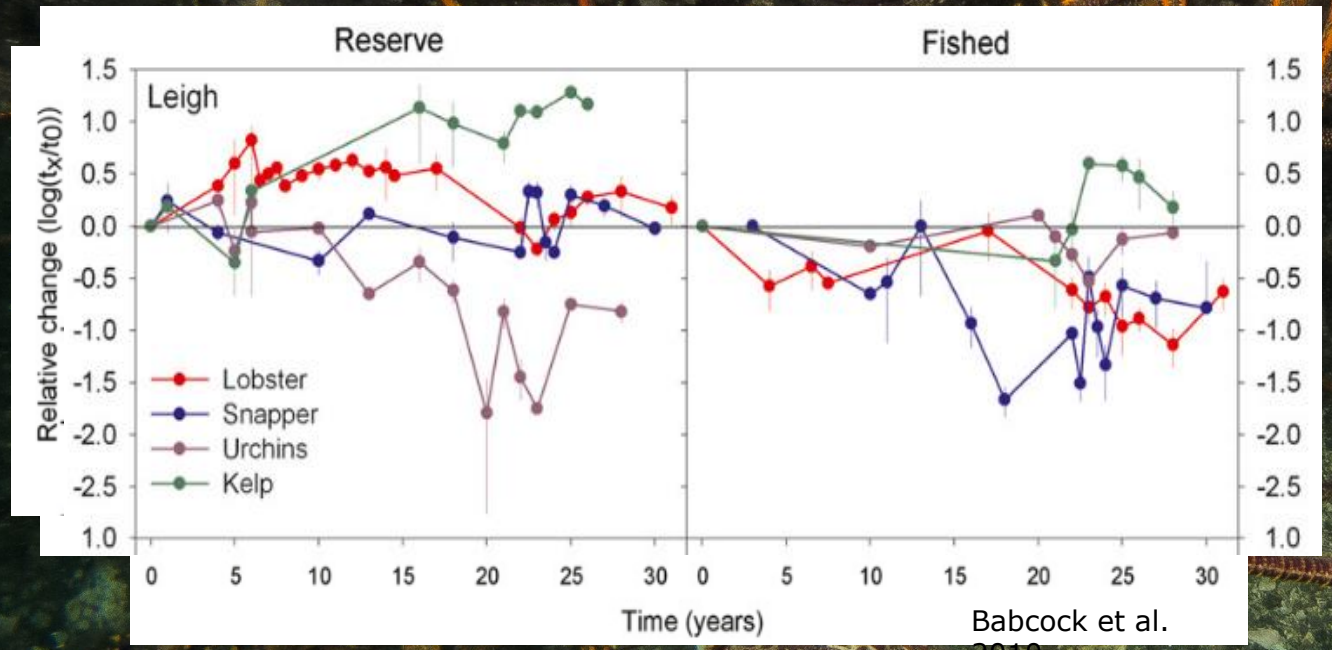


What is the role of protection in ecosystem stability?



LEIGH MARINE RESERVE

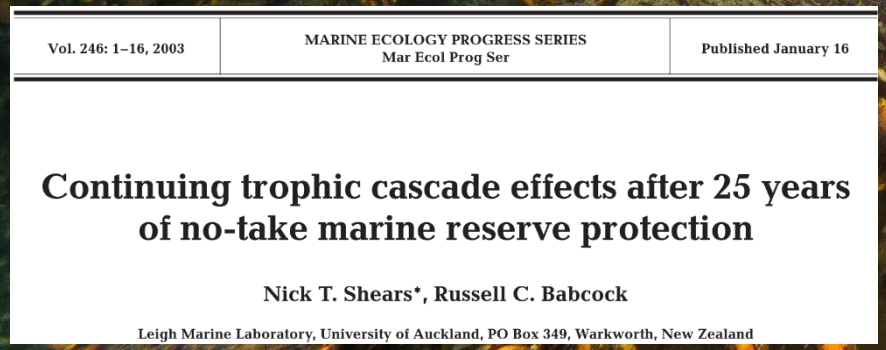
(no-take; est. 1977)



Babcock et al. 2010

Protection effects timeline:

- Direct effects
- 25 yrs: Urchin barrens → Algal forests / turfs
- Indirect effects lag:
  -Size specific predation
  -Time for predators to reach impactful size
  -*Sea urchin density*



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Continuing trophic cascade effects after 25 years of no-take marine reserve protection

Nick T. Shears*, Russell C. Babcock

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Questions:

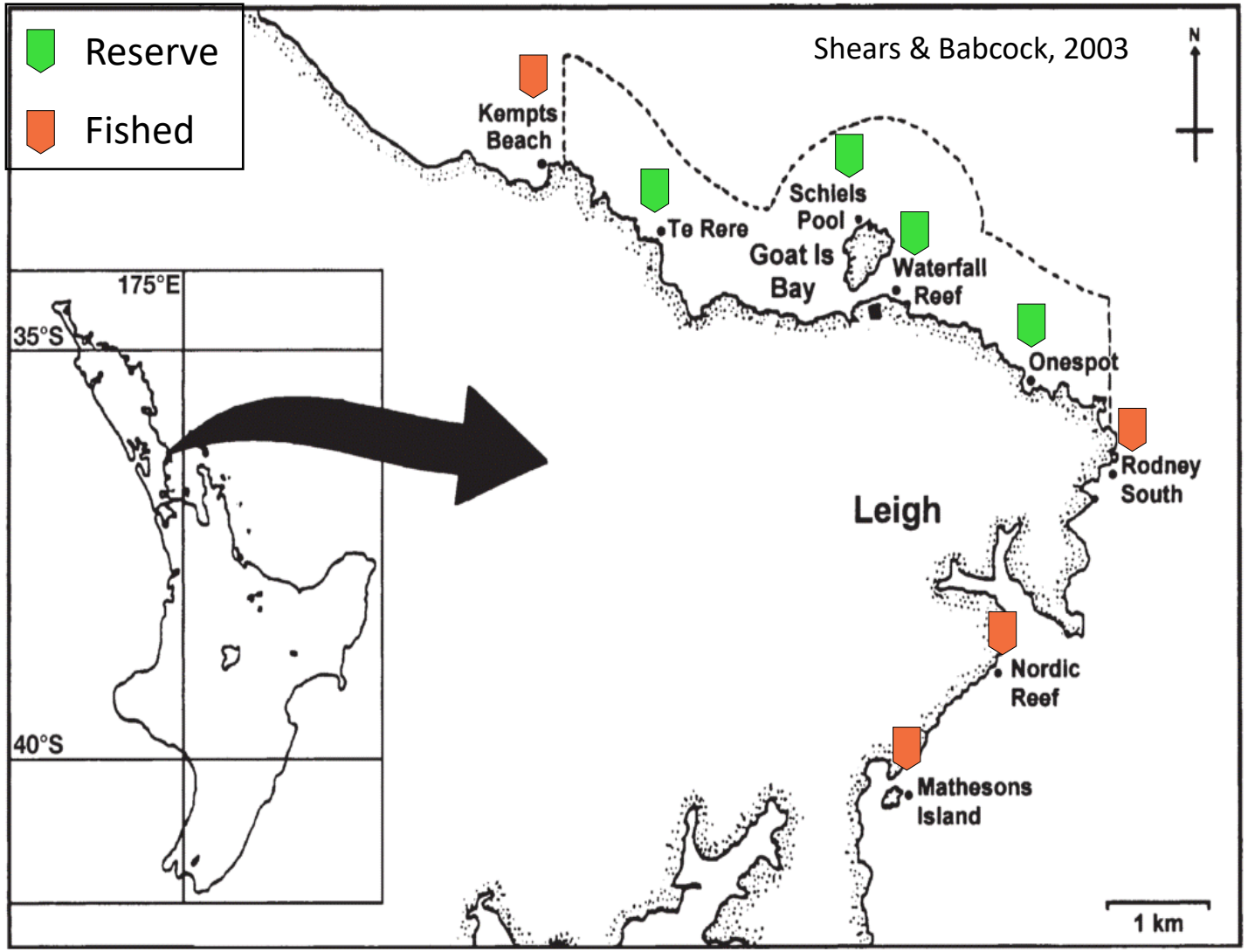
How has protection affected ecosystem stability?

Are turfs a stable or a transient state?

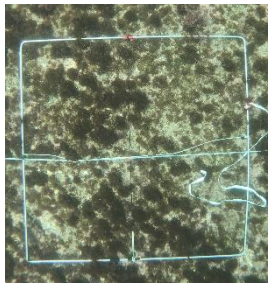
Photo: Paul Caiger

20 YEARS OF BENTHIC COMMUNITY MONITORING

(1999-2019)

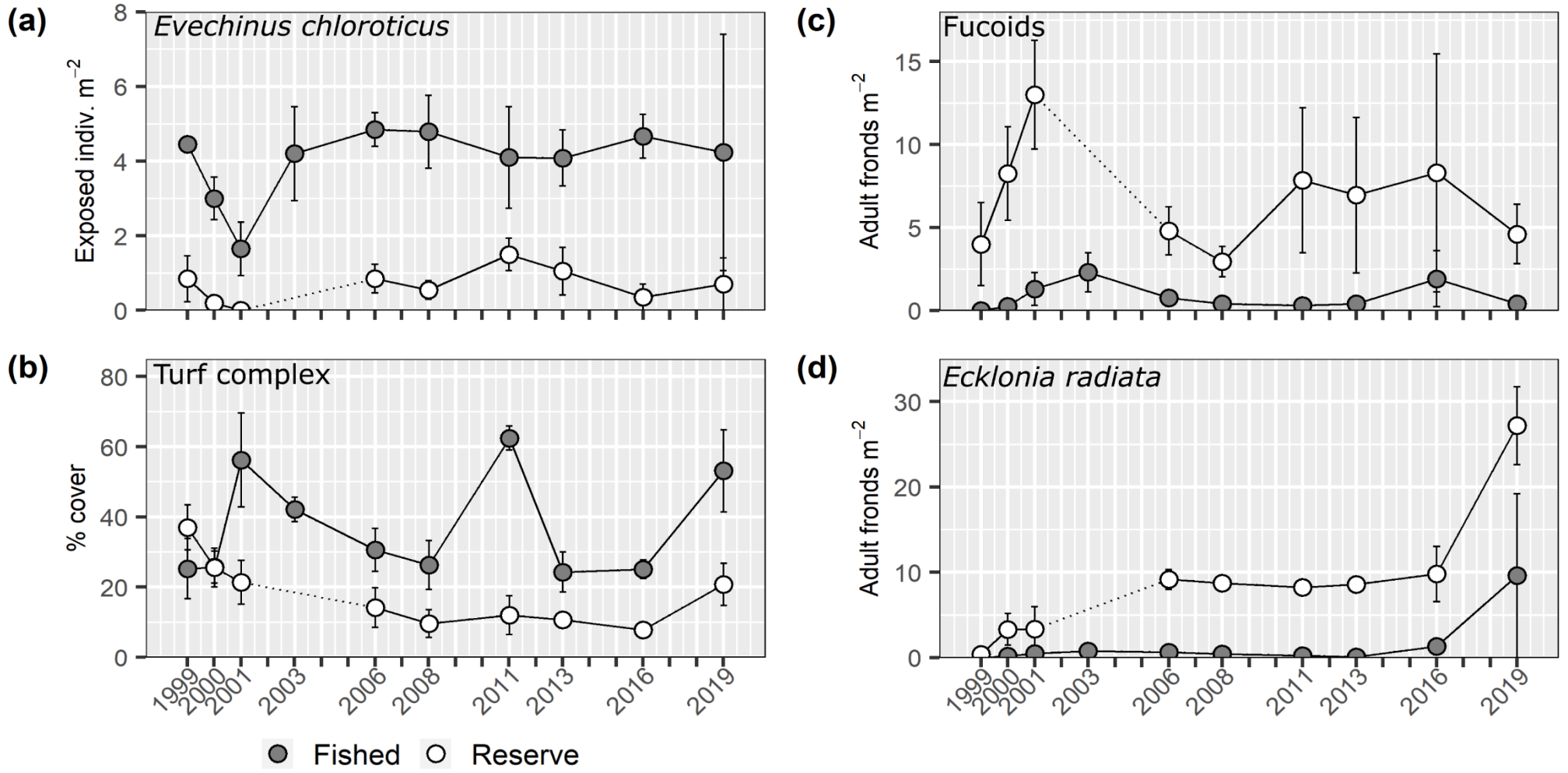


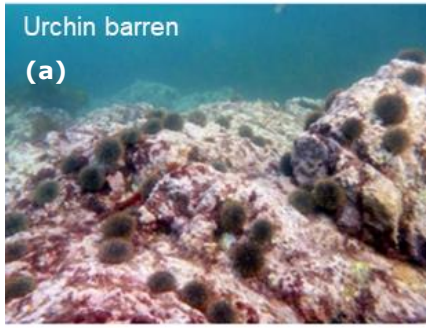
At a depth of 4-6 m, where urchins are most abundant, and where the contrast between reserve and fished sites is most profound

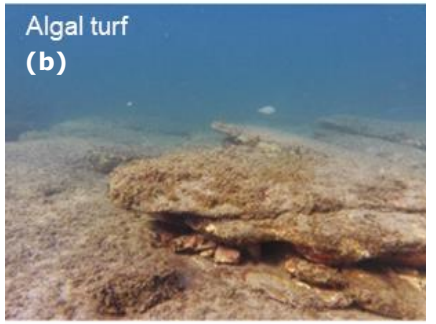


TEMPORAL VARIATION IN HABITAT DEFINING SPECIES

(FOLLOWING 25 YEARS OF PROTECTION)







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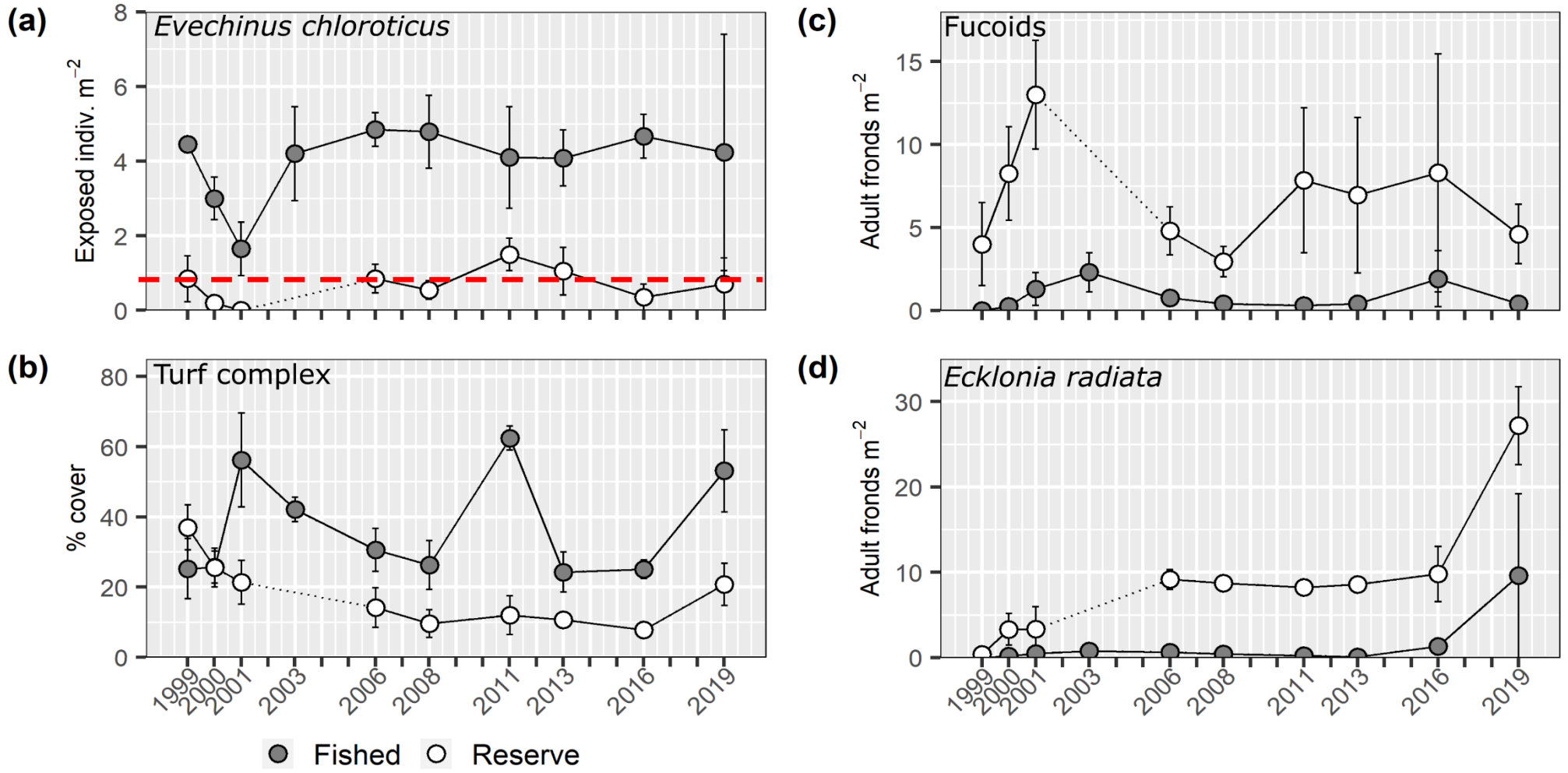

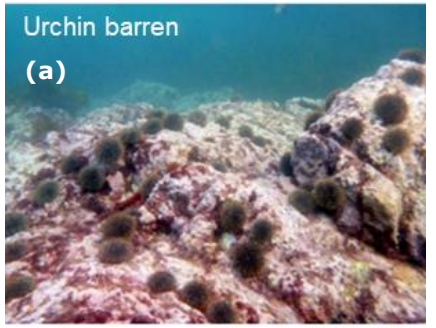

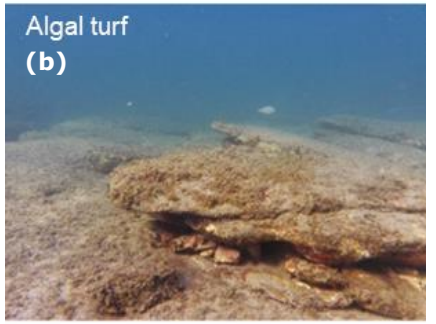

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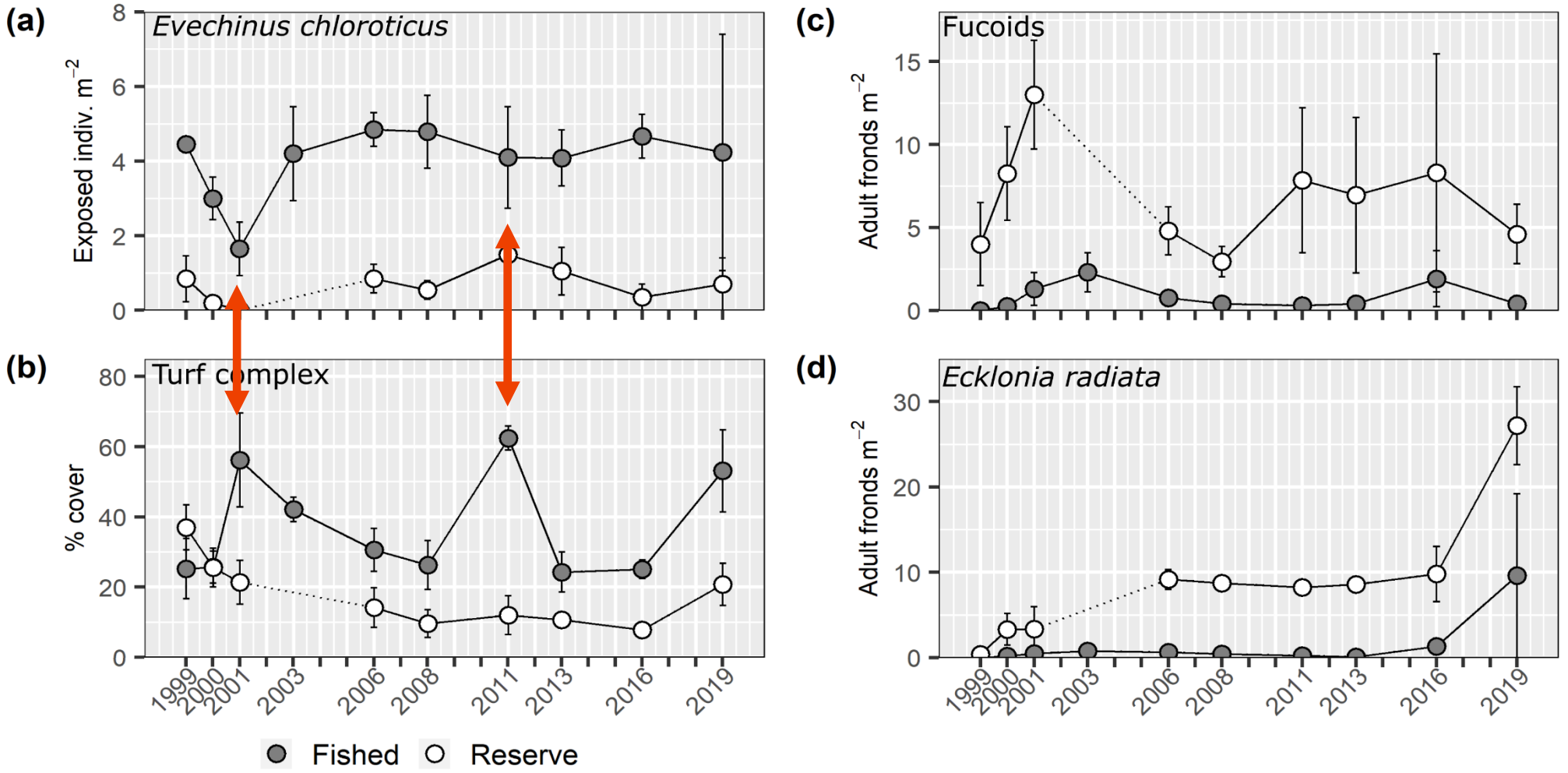

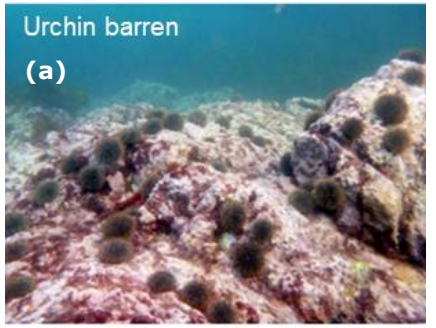

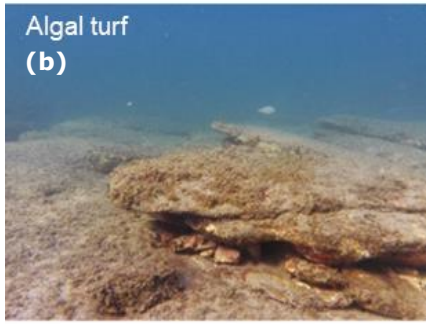

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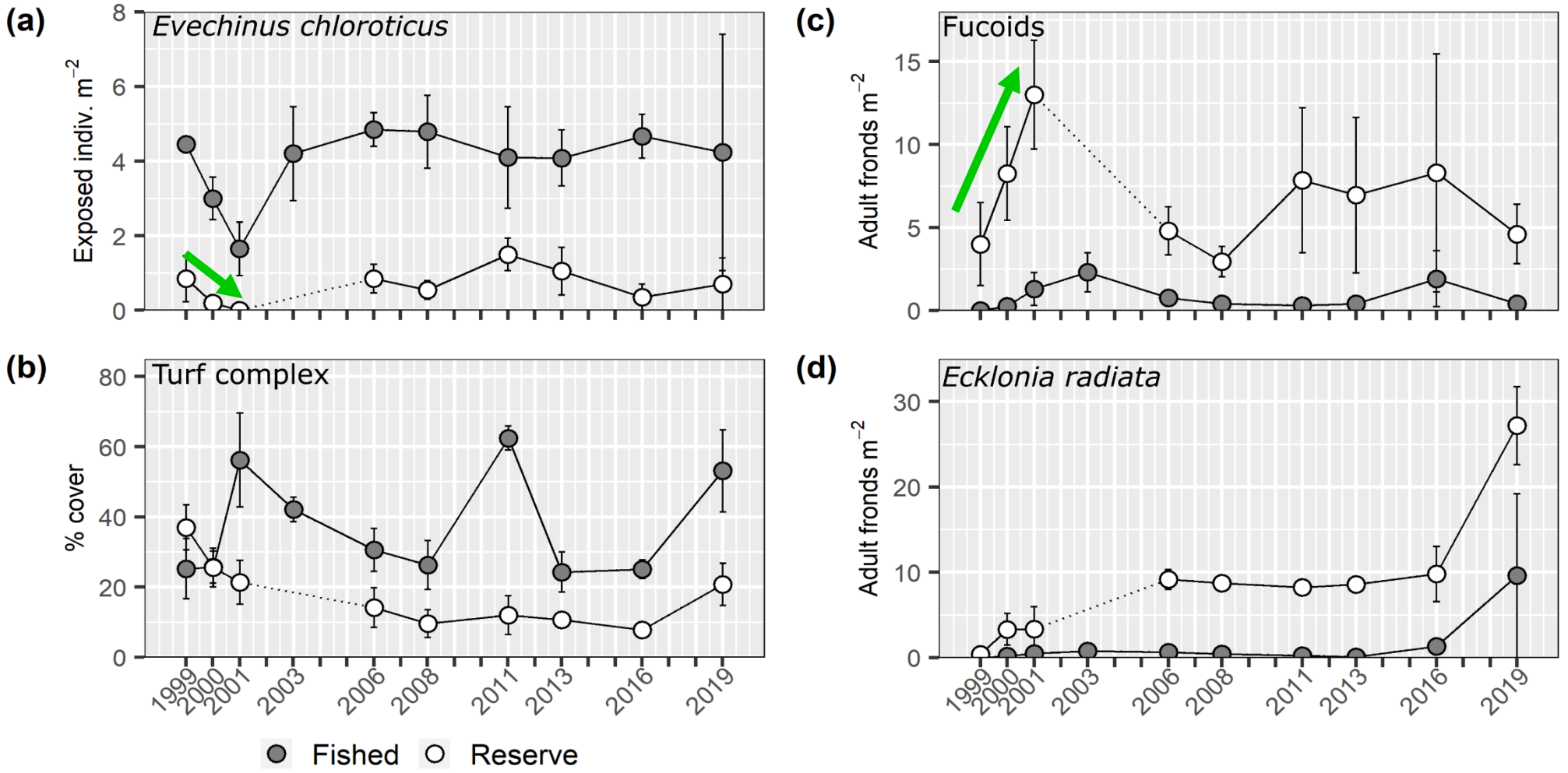

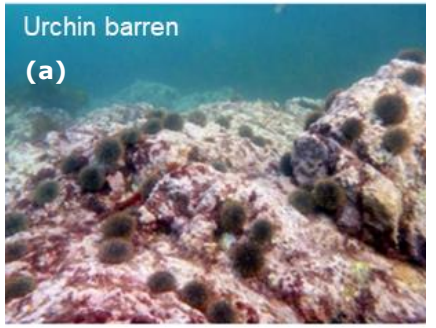

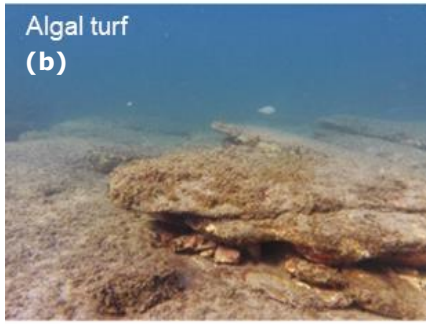

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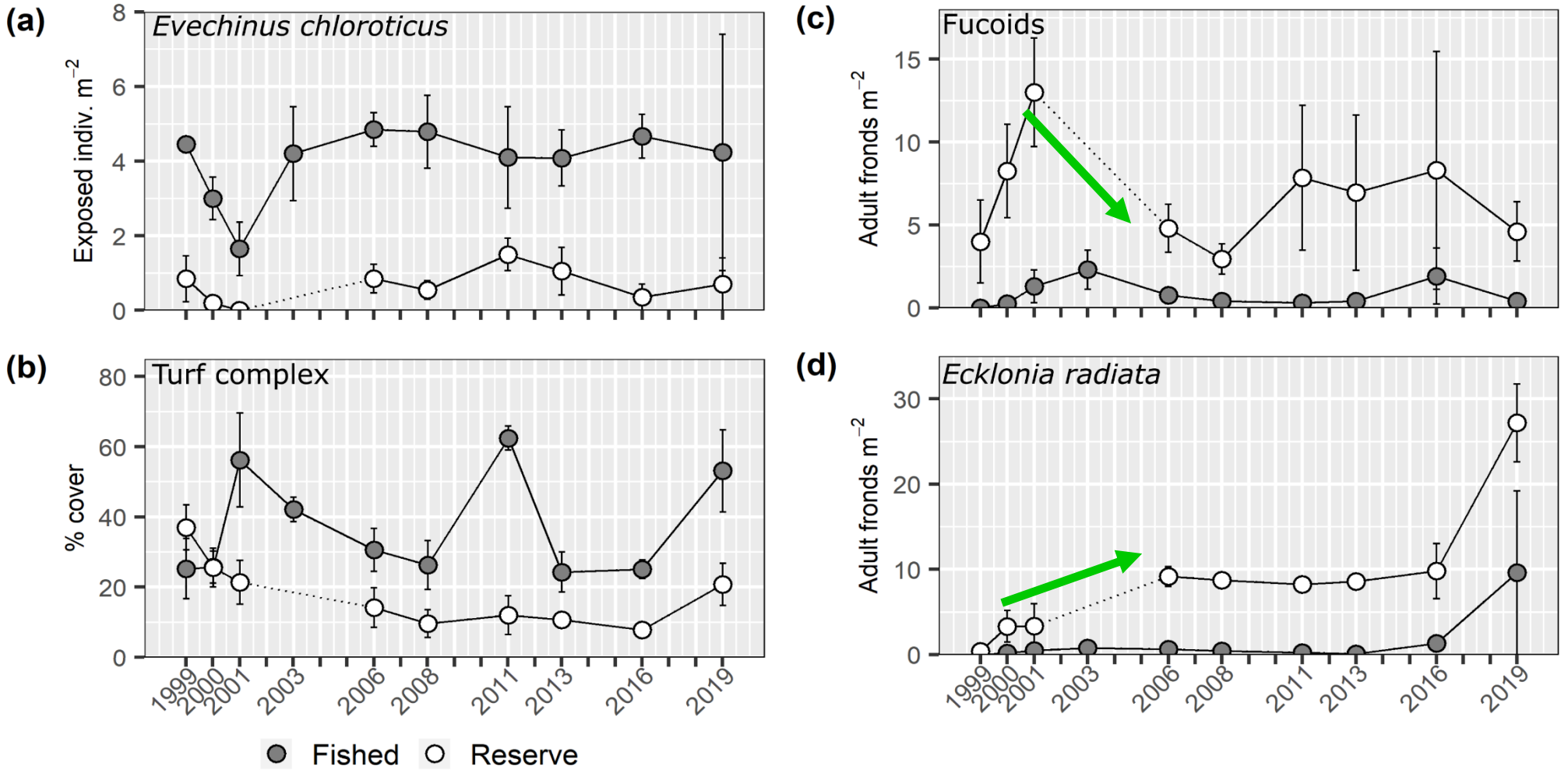

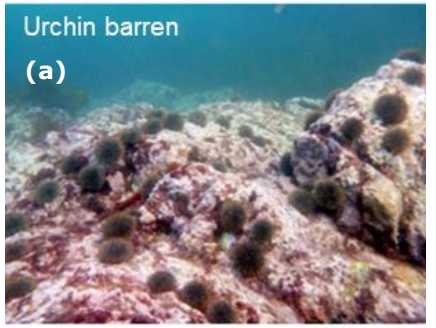

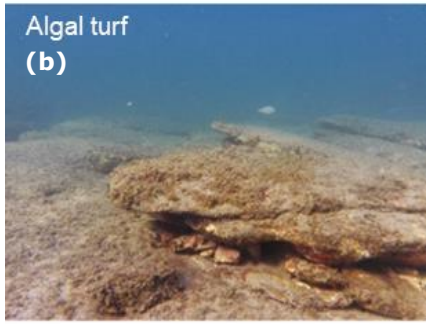

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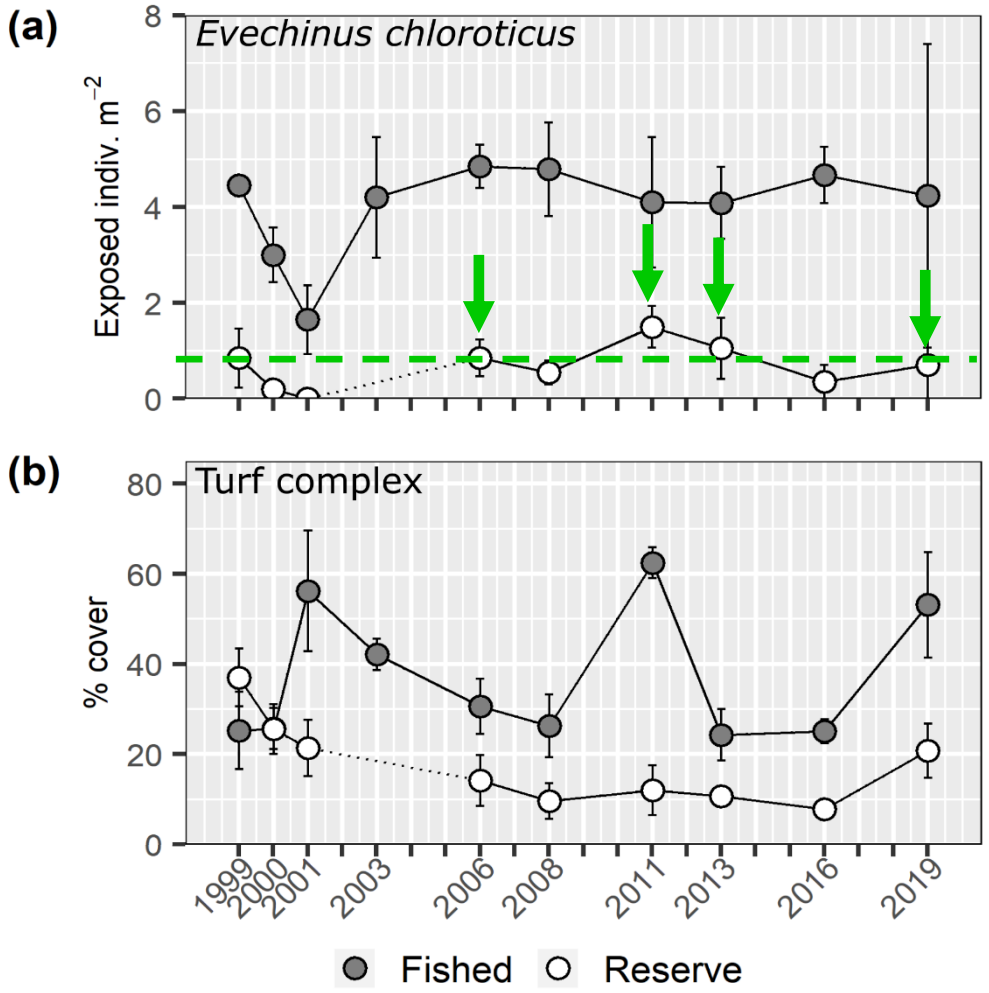
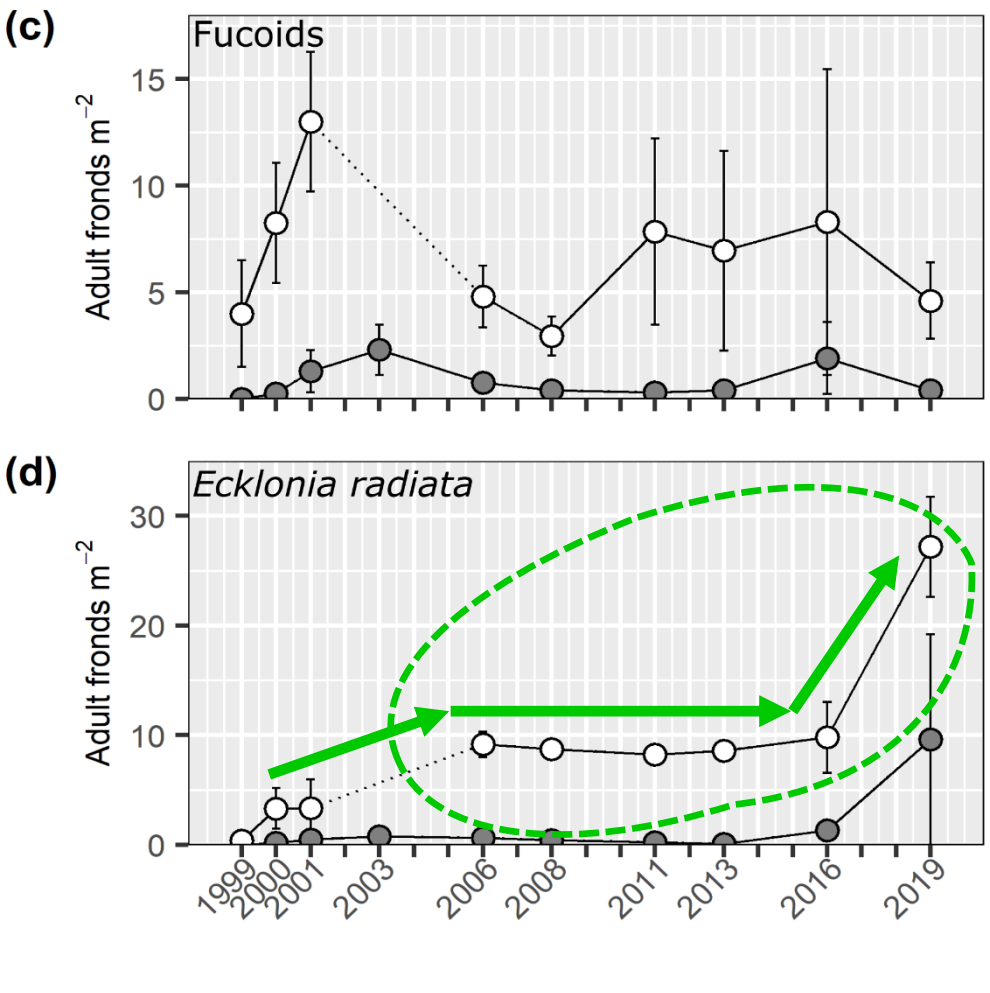
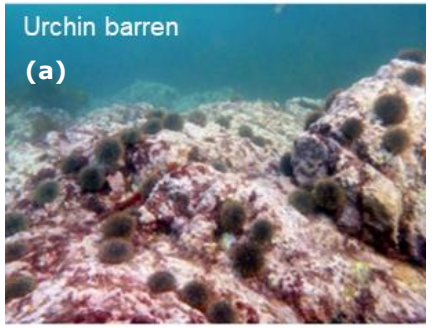
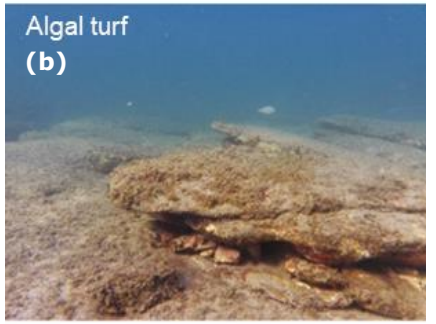




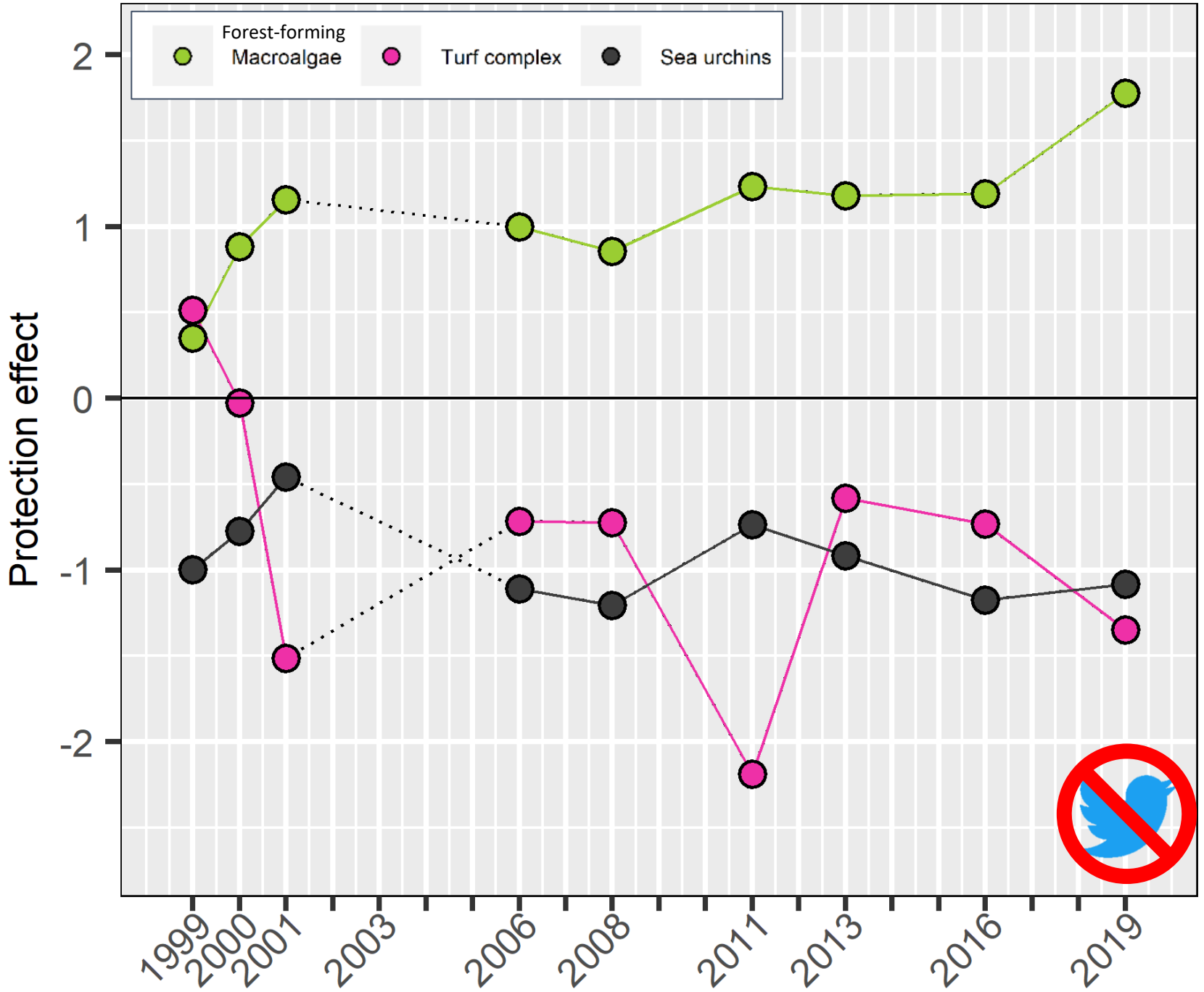




PROTECTION EFFECT

(FOLLOWING 25 YEARS OF PROTECTION)

- Consistent net negative effect on exposed sea urchins
- Net negative effect on turf complex after 2000—succession?
- Consistent net positive effect on forest-forming macroalgae, with a large increase 1999–2001
- Mirroring effects of forest-forming macroalgae and turf complex



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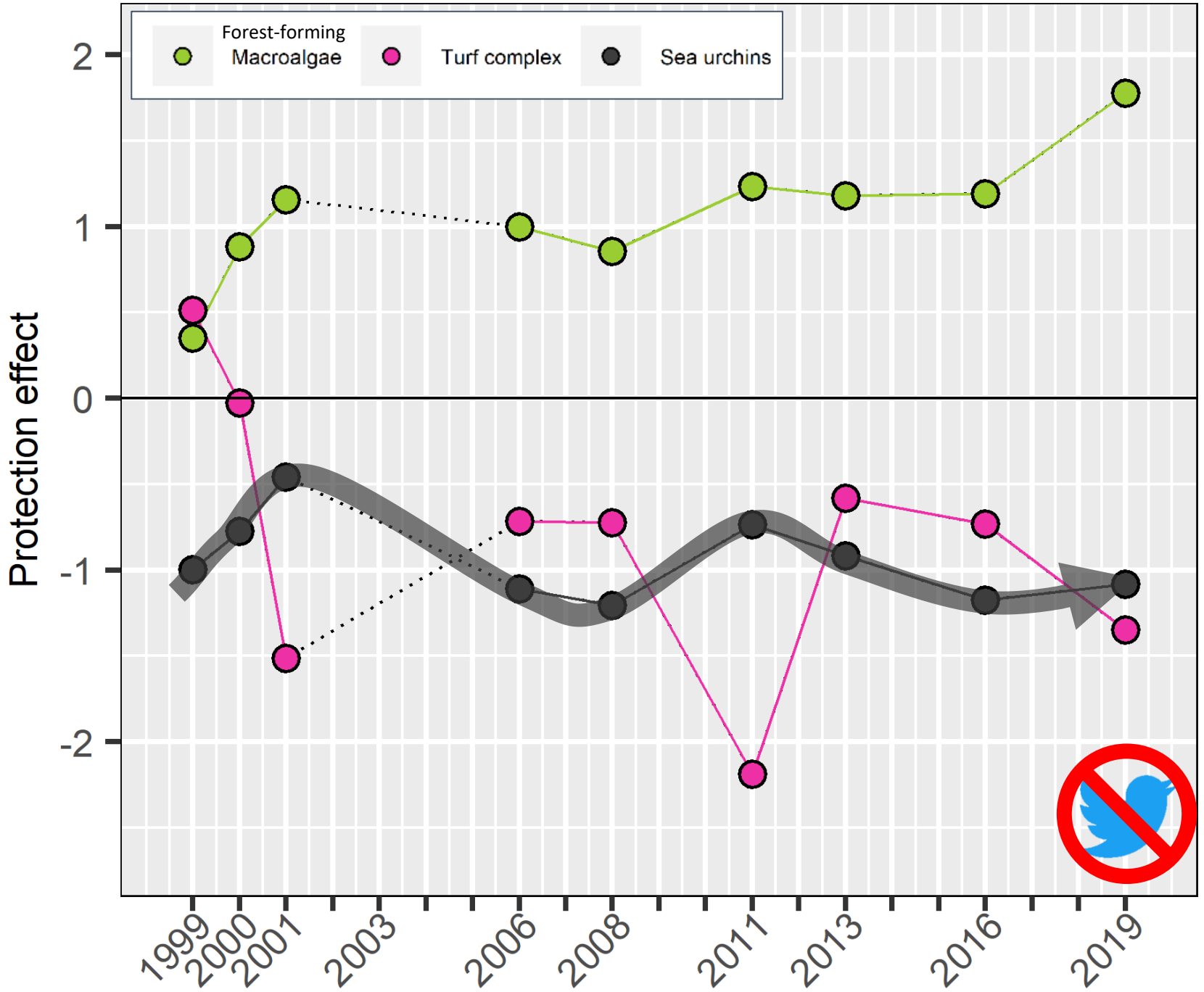

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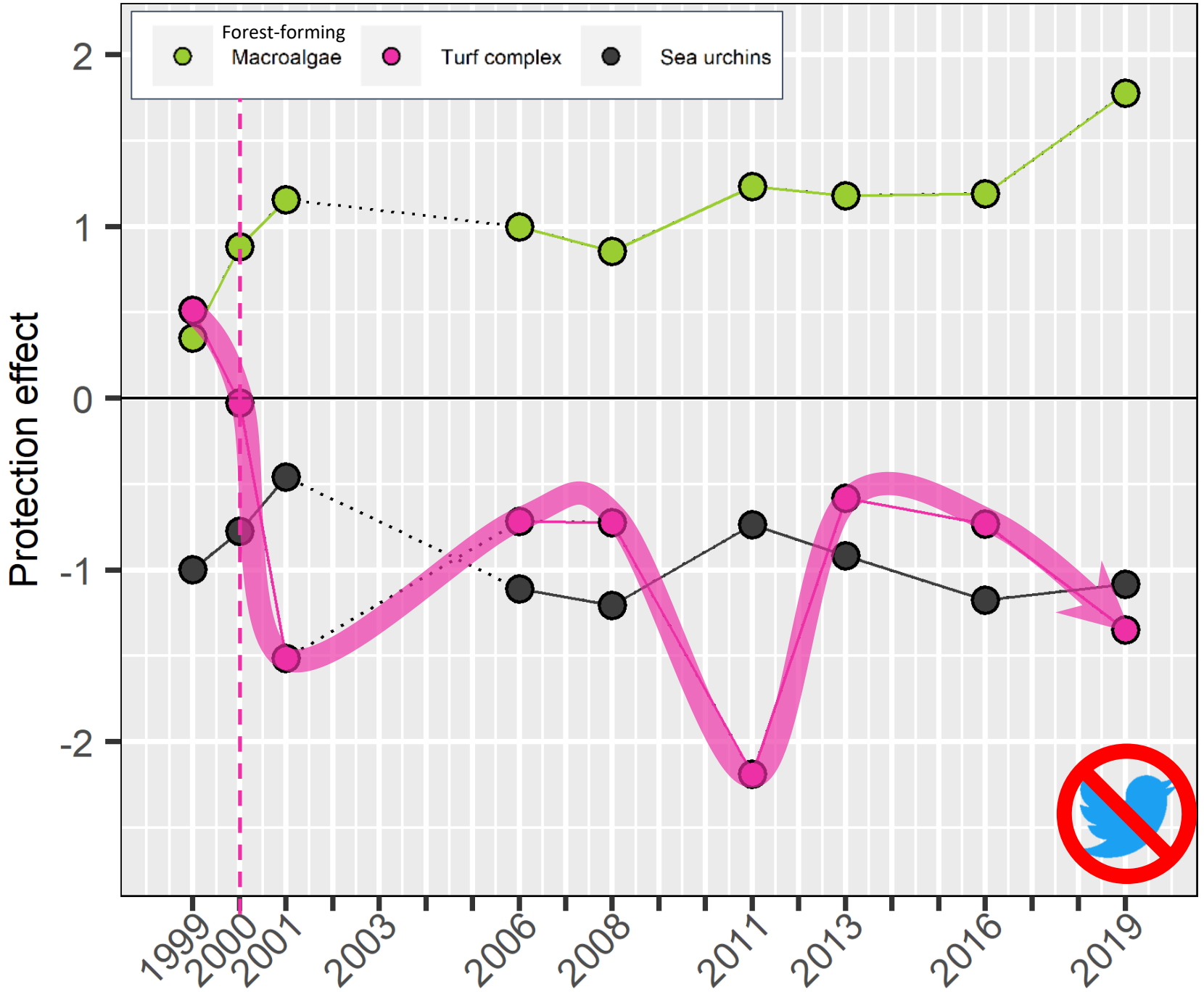

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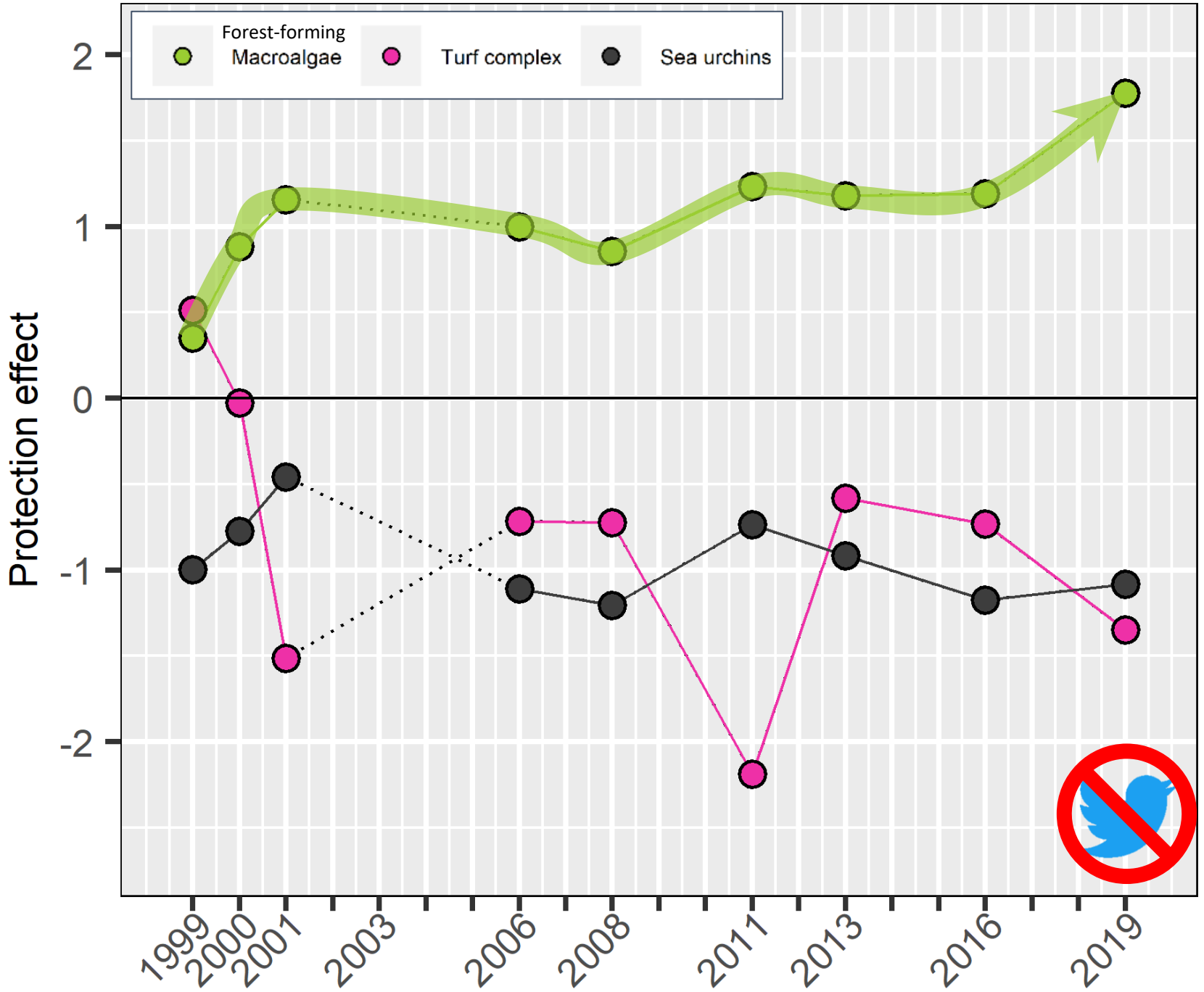

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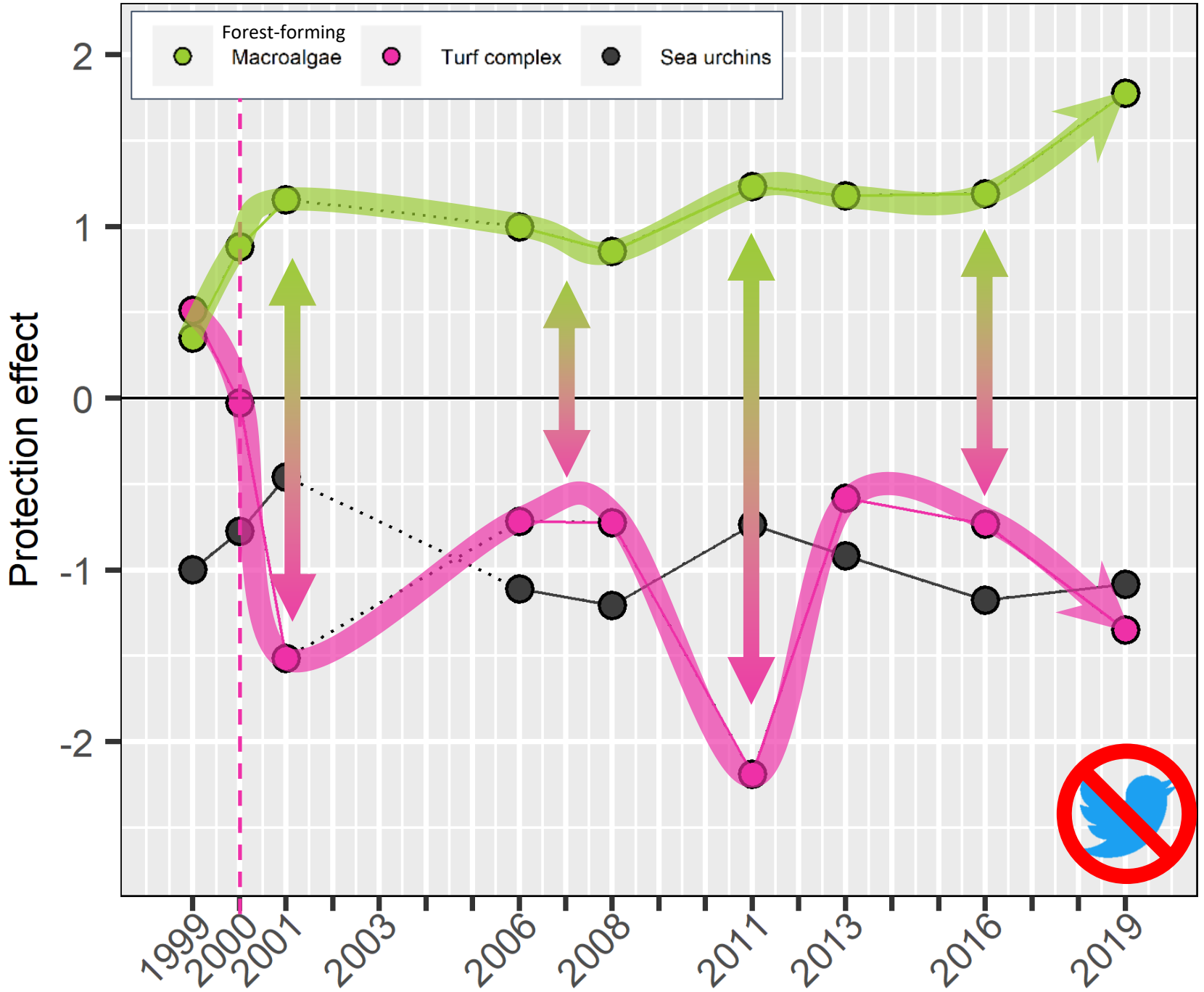
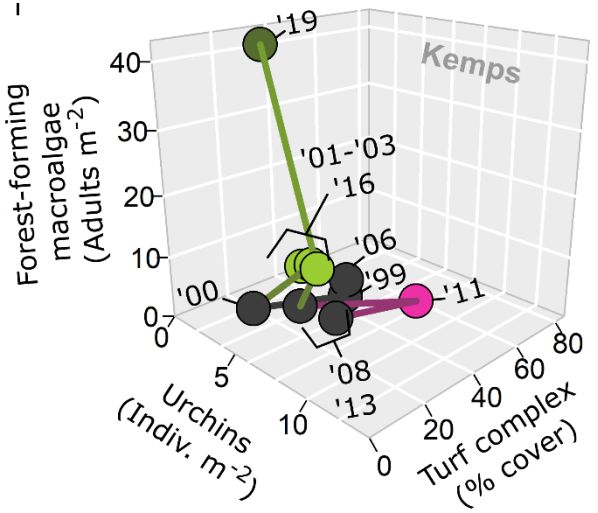
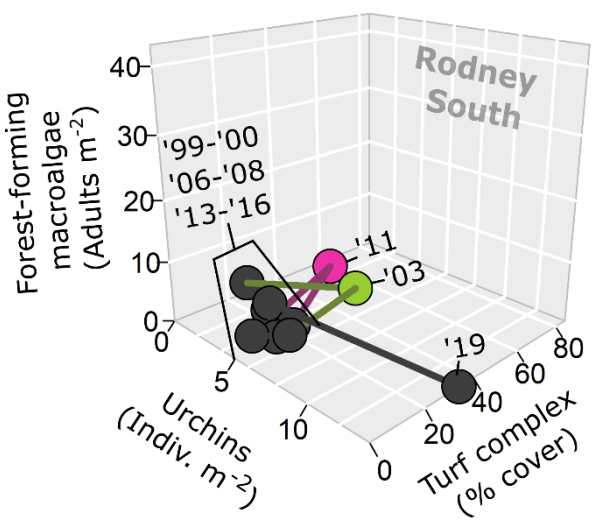
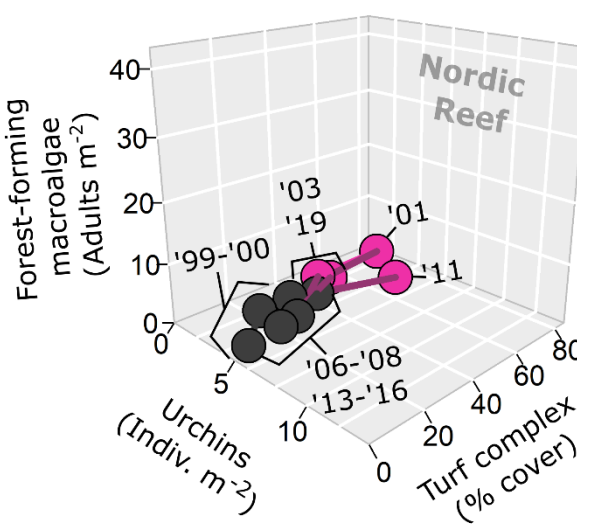
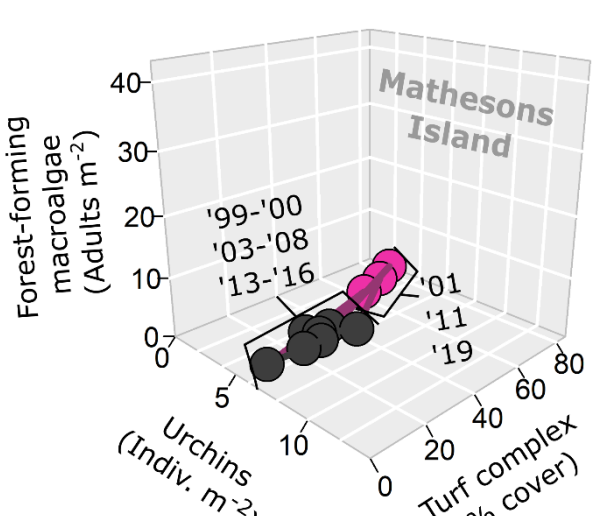


FISHED



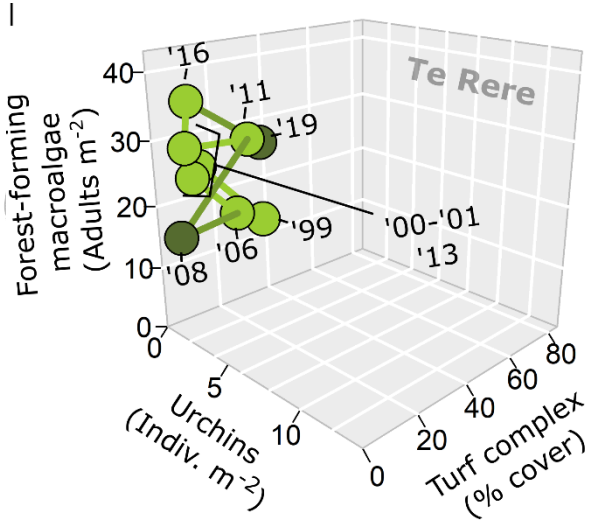


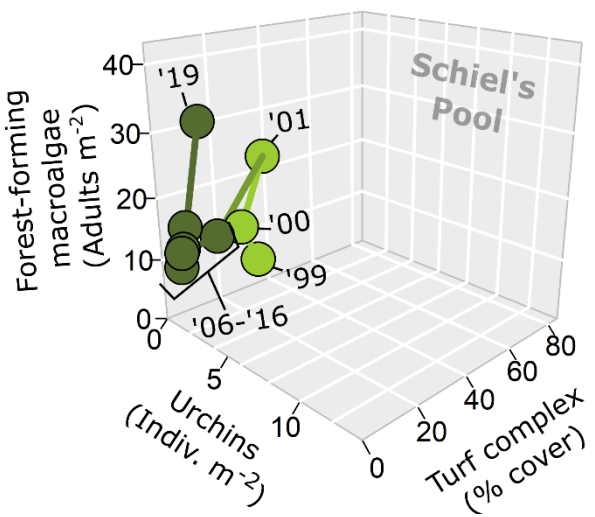


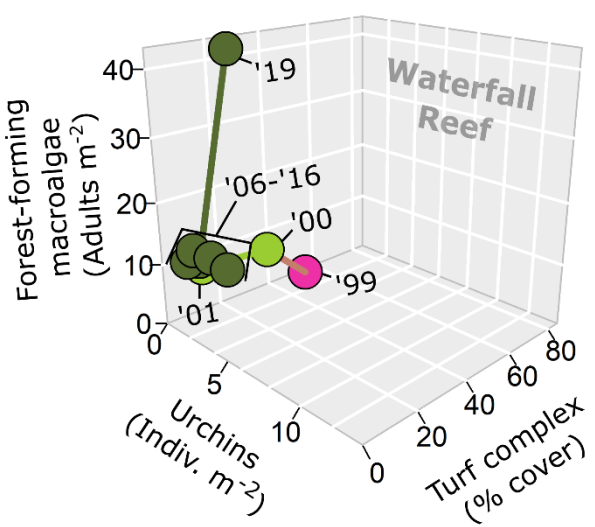


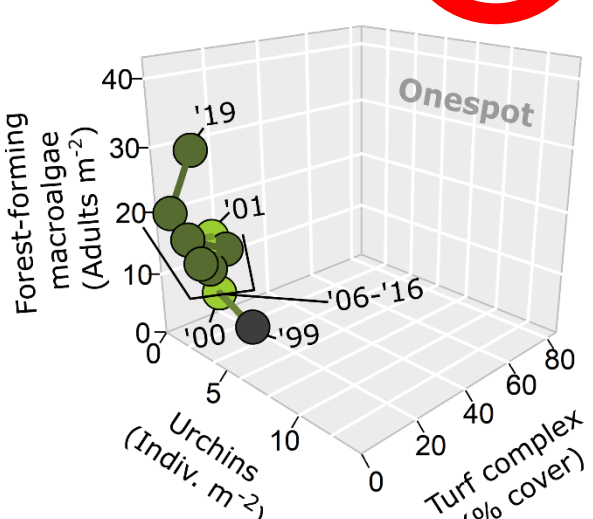
Urchin barrens and occasionally algal turf or mixed algal forest

RESERVE





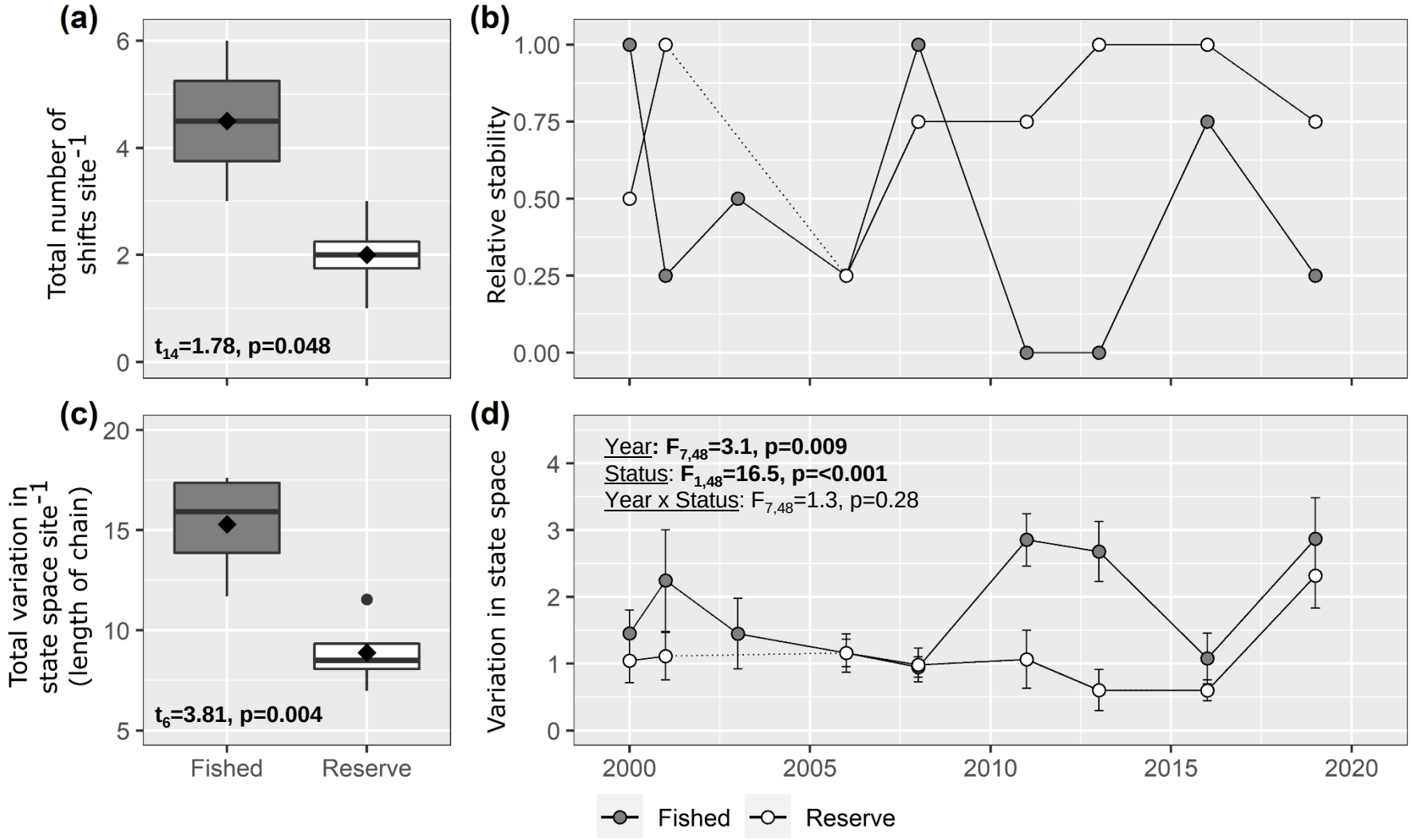




Trajectory to kelp forest

Urchin barren | Algal turf | Mixed algal forest | Kelp forest

ECOSYSTEM STABILITY



Proportion of shifts were significantly higher in the fished area **(χ^2=5.25, p=0.01)**

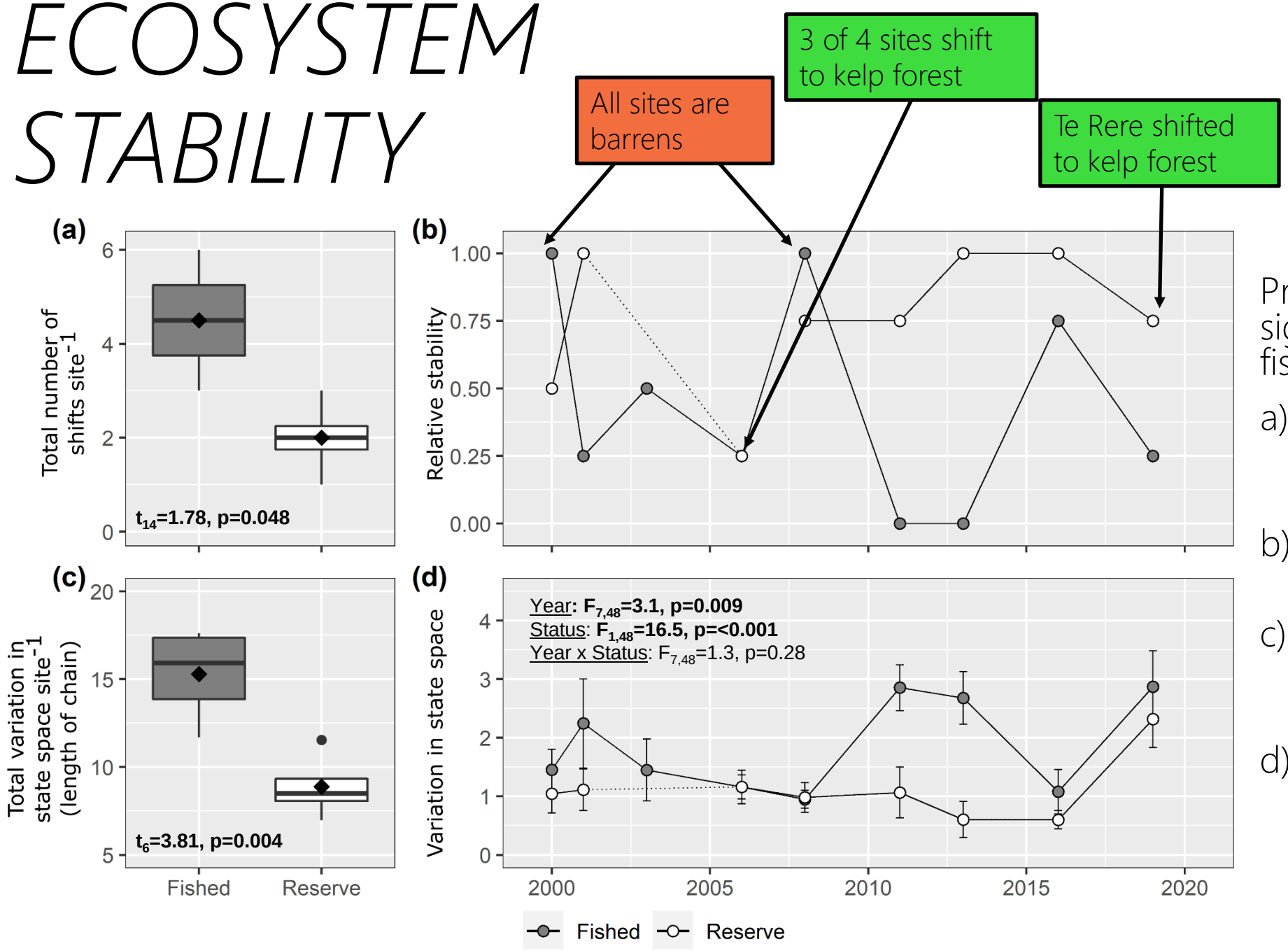
a) mean number of shifts site^{-1} higher in the fished area

b) Temporal relative stability—variable

c) Total variation in state space higher in the fished area

d) Variation in state space between consecutive years varied by protection 'status' and by 'year'

ECOSYSTEM STABILITY



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LONG-TERM NO-TAKE PROTECTION ENHANCES THE STABILITY OF KELP FOREST ECOSYSTEMS

FUTURE-PROOFING KELP FORESTS ECOSYSTEMS:

- Protect TODAY to restore kelp forest ecosystem health by 2050
- Protect larger reef area – ecosystem effect constrained to reserve boundary
- Combine active restoration with marine protection to boost recovery

- Turfs are likely transient states
- Goes beyond the traditional dichotomic kelp vs. urchins

Video by B. Doak @ Onespot, Leigh Marine Reserve, 2019

THANKS!

- IMS staff and students who helped monitoring the reefs throughout the years
- Richard Taylor, Kelsey Miller, Paul Caiger, Arie Spyksma, Celia Balemi, and Benn Hanns
- Auckland Council
- Department of Conservation
- Sustainable Seas (1.1 Ecological responses to cumulative effects)

VICTORIA UNIVERSITY OF WELLINGTON TE HERENGA WAKA

National Science Challenges | SUSTAINABLE SEAS | Ko ngā moana whakauka

Department of Conservation *Te Papa Atawhai*

THE UNIVERSITY OF AUCKLAND NEW ZEALAND

SCIENCE INSTITUTE OF MARINE SCIENCE

Video by B. Doak @ Onespot, Leigh Marine Reserve, 2019

Auckland Council *Te Kaunihera o Tāmaki Makaurau*

A CALL FOR COLLABORATION

- Stability
- Persistence
- Resilience
- Resistance
- Recovery

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KICK-OFF:

Tomorrow (Thu)
11:10 am - morning tea
@ the poster venue

@PelegOhad
#ITRS2023