

# Changing the Soundtrack of the Anthropocene

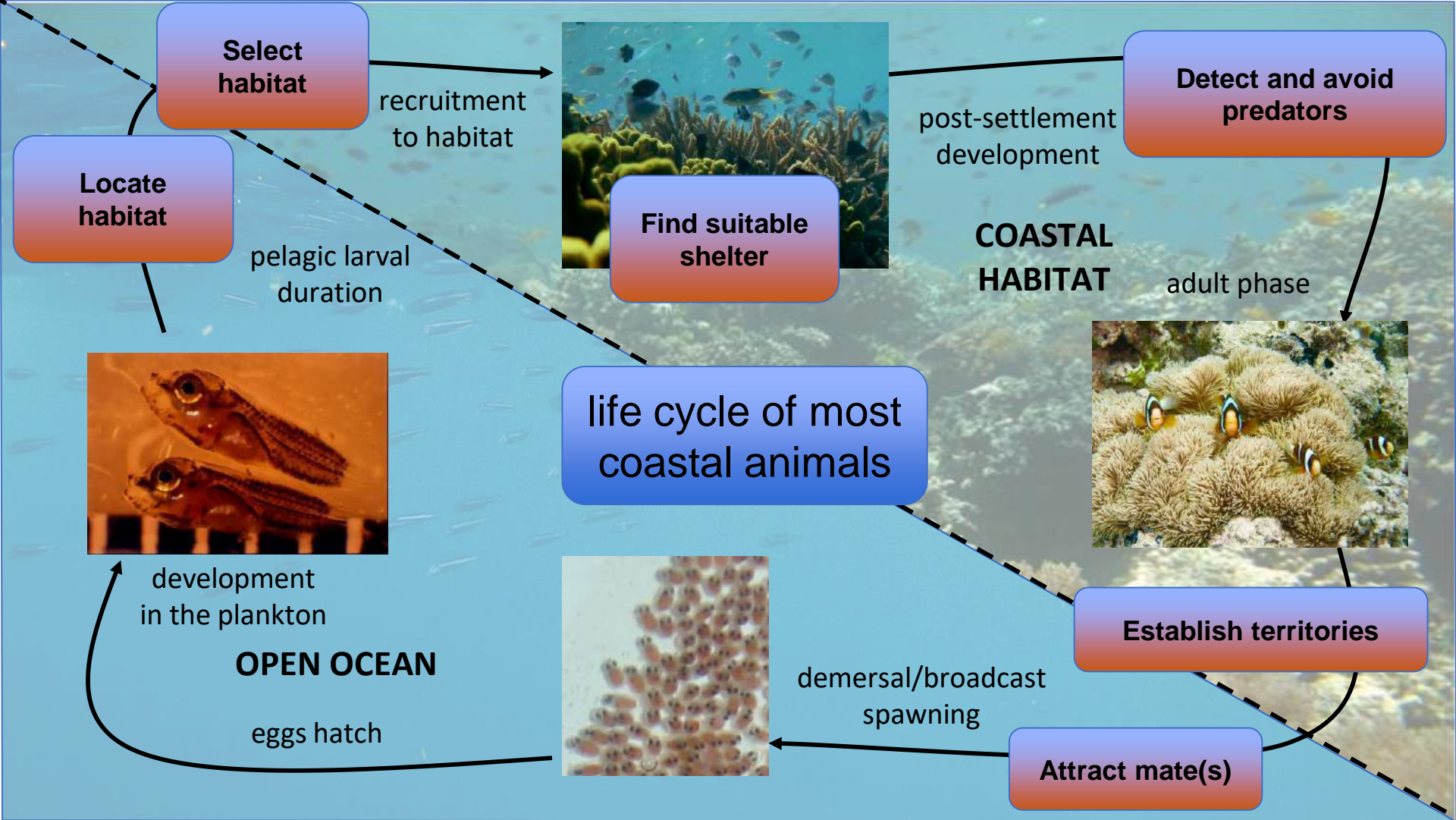
@DrSteveSimpson

Professor of  
Marine Biology  
& Global Change

Roger Munns, Blue Planet II



Credit: Roger Munns, Blue Planet II





# Connectivity: Open vs. closed populations?

SCIENCE • VOL. 278 • 21 NOVEMBER 1997 • www.sciencemag.org

## Connectivity and Management of Caribbean Coral Reefs

Callum M. Roberts

*Ecology*, 66(1), 1985, pp. 54-67  
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## DEMOGRAPHIC THEORY FOR AN OPEN MARINE POPULATION WITH SPACE-LIMITED RECRUITMENT<sup>1</sup>

JONATHAN ROUGHGARDEN, YOH IWASA<sup>2</sup>, AND CHARLES BAXTER  
*Hopkins Marine Station, Department of Biological Sciences, Stanford University,  
Pacific Grove, California 93950 USA*

*Annu. Rev. Ecol. Syst.* 1996. 27:477-500  
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## RECRUITMENT AND THE LOCAL DYNAMICS OF OPEN MARINE POPULATIONS

M. J. Caley<sup>1</sup>, M. H. Carr<sup>2</sup>, M. A. Hixon<sup>3</sup>, T. P. Hughes<sup>1</sup>, G. P. Jones<sup>1</sup>, and B. A. Menge<sup>3</sup>



## Larval retention and recruitment in an island population of a coral-reef fish

Stephen E. Swearer<sup>\*</sup>, Jennifer E. Caselle<sup>\*</sup>, David W. Lou<sup>†</sup>  
& Robert R. Warner<sup>\*</sup>

<sup>\*</sup> Department of Ecology, Evolution and Marine Biology and Marine Science Institute, <sup>†</sup> Department of Geological Sciences, University of California, Santa Barbara, California 93106, USA

*Current Biology* Vol. 10, 1058-1061, July 25, 2000 ©2000 Elsevier Ltd. All rights reserved. DOI: 10.1006/cub.2000.0603

## Coral Reef Fish Larvae Settle Close to Home

Geoffrey F. Jones,<sup>1,2</sup> Sean Phlips,<sup>2</sup>  
and Steven B. Thorpe<sup>2</sup>  
<sup>1</sup>Center for Coral Reef Studies,  
School of Marine Biology and Aquaculture,  
James Cook University

D1-D3, the only anecdotal approach is to mark larvae at their birth site and locate them when they recruit to the adult population (15-18). Most marine organisms produce large numbers of extremely small pelagic larvae that are subject to advection, diffusion, and as-

## BEHAVIOUR OF PELAGIC AND SETTLEMENT-STAGE LARVAE?

## Population biology The prodigal fish Stephen R. Palumbi

## Self-recruitment in a coral reef fish population

G. P. Jones, M. J. Millicich, M. J. Emslie & C. Lunow

School of Marine Biology and Aquaculture, James Cook University, Townsville, 4811 Queensland, Australia

Connectivity

Open Populations

Source  $\neq$  Sink

Retention

Closed Populations

Source = Sink

Une  
prodigieuse  
révélation...

# LE MONDE DU SILENCE

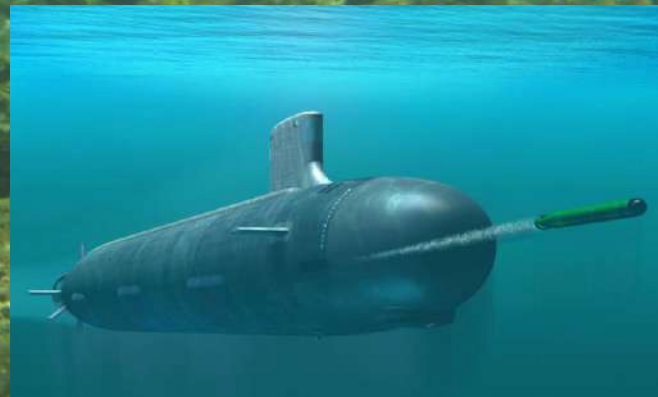
UN GRAND FILM EN EASTMANCOLOR  
DE J.Y. COUSTEAU ET LOUIS MALLE  
Avec FREDERIC DUMAS, ALBERT FALCO, LES PIONNIERS  
ET L'EQUIPAGE DE LA CALYPSO

STYLÉ PAR PHOTOLABORANT - TITRAGES DE COHEN  
MONTÉ ET MISE EN SCÈNE PAR J.Y. COUSTEAU  
MONTAGE SONORAL ALBERT FALCO - MONTAGE VISUEL COUSTEAU

COUSTEAU FILMS - FILMAD - F.S.J.Y.C.

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# A ocean of noise



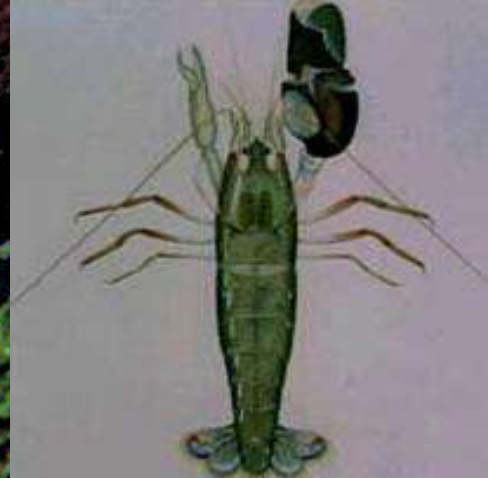






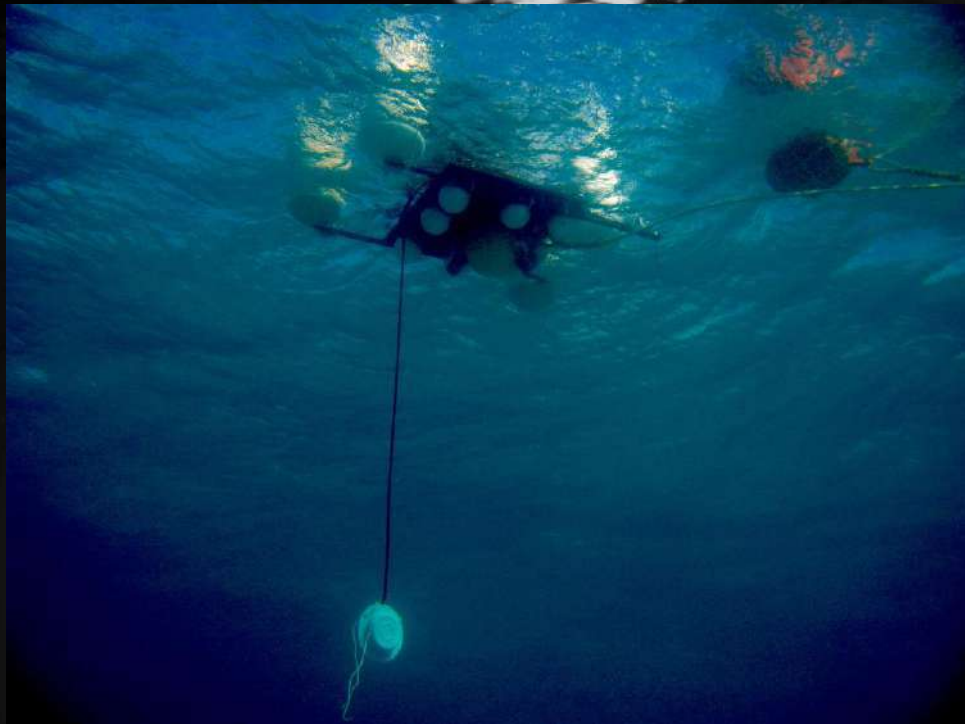








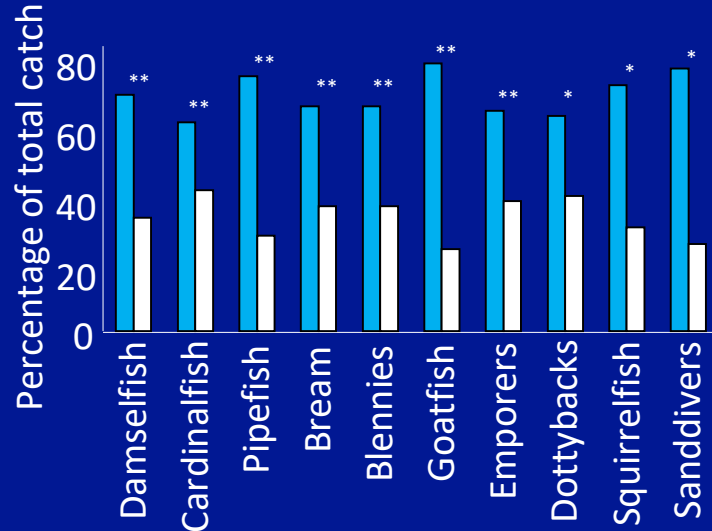






# Coral reef fish larvae can hear their way home

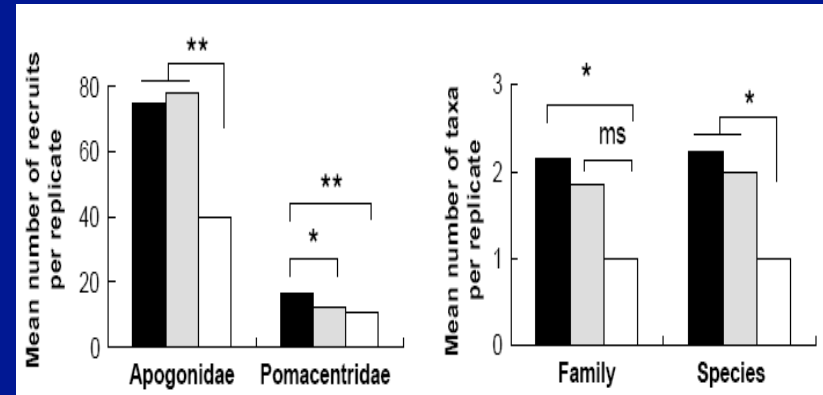
Vol. 276: 263–268, 2004	MARINE ECOLOGY PROGRESS SERIES Mar Ecol Prog Ser	Published August 2
<b>Attraction of settlement-stage coral reef fishes to reef noise</b> S. D. Simpson <sup>1,5,*</sup> , M. G. Meekan <sup>2</sup> , R. D. McCauley <sup>3</sup> , A. Jeffis <sup>4</sup>		

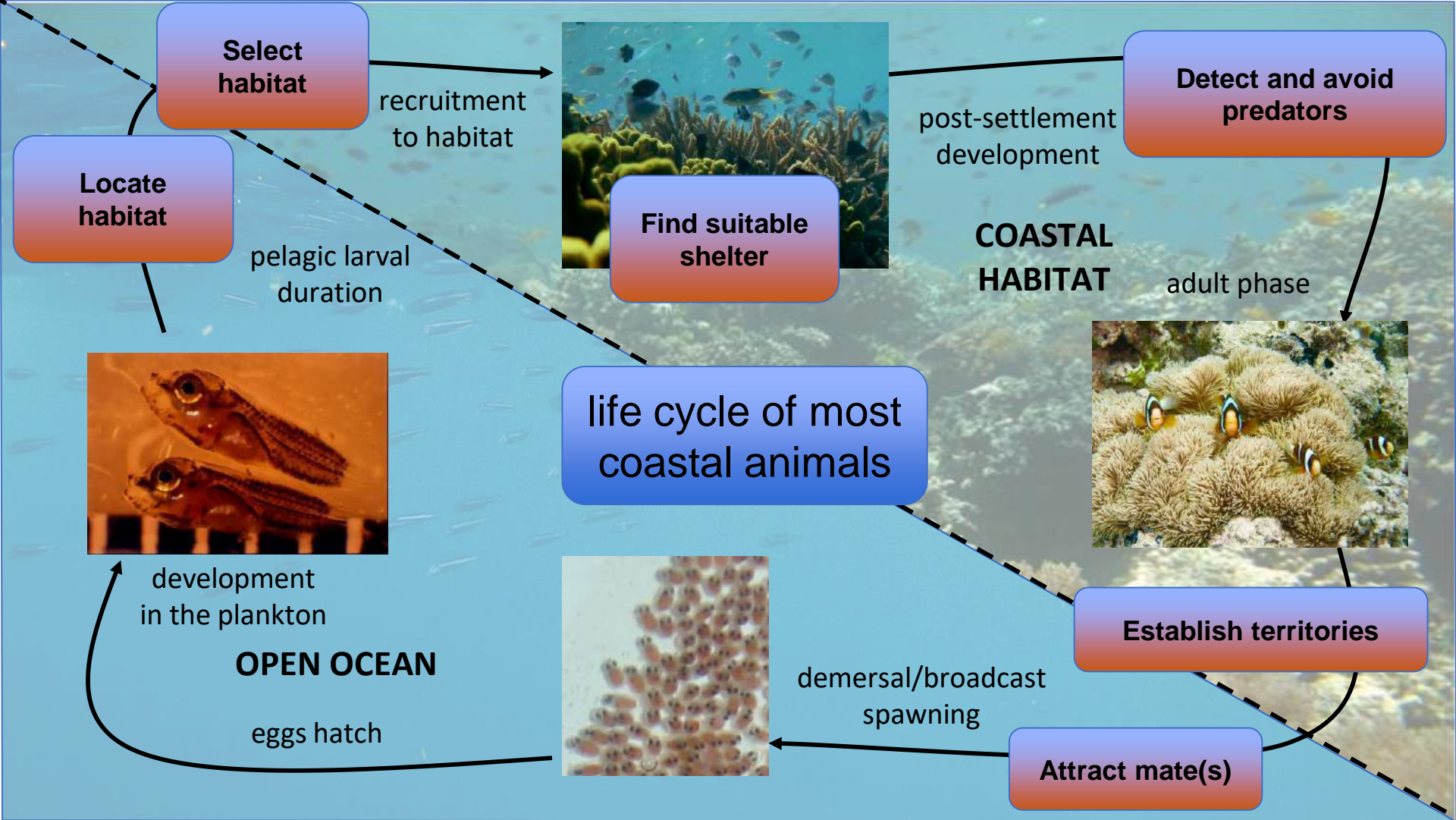


www.sciencemag.org SCIENCE VOL 308 8 APRIL 2005

## Homeward Sound

Stephen D. Simpson,<sup>1\*</sup> Mark Meekan,<sup>2</sup> John Montgomery,<sup>3</sup>  
Rob McCauley,<sup>4</sup> Andrew Jeffs<sup>5</sup>















Roger Munns, Blue Planet II

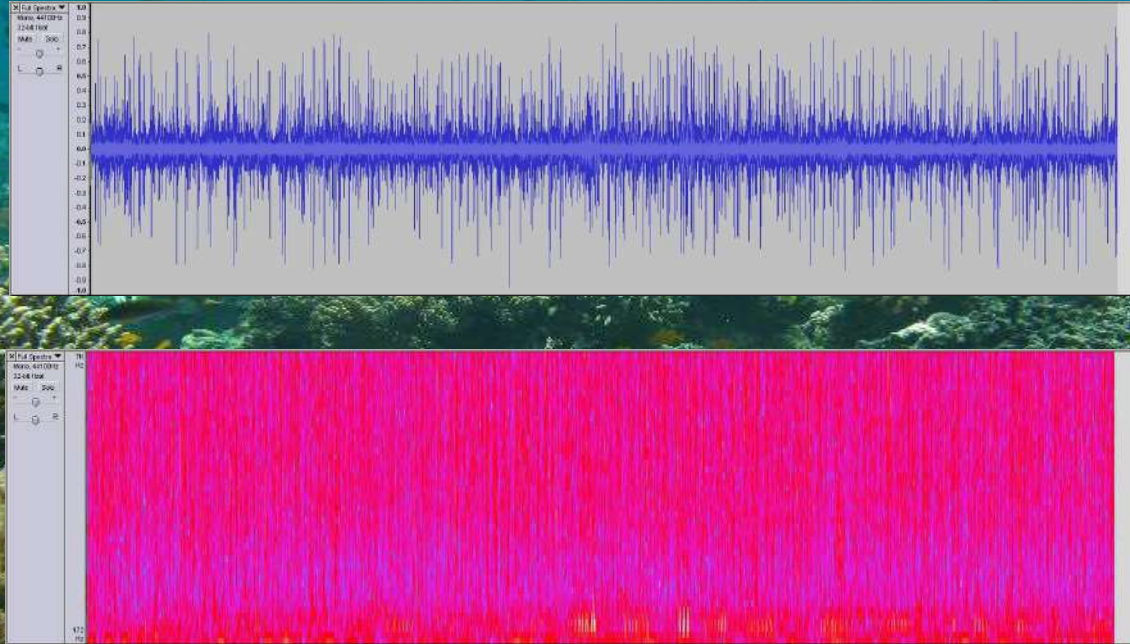
Credit: Roger Munns, Blue Planet II



**Reefs sound different, and baby fish can select the best habitat  
So can crabs, lobsters, clams, oysters and even corals!**

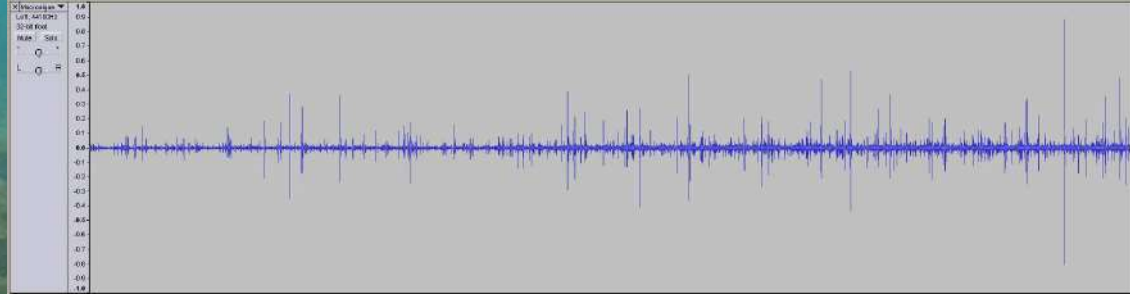


# Balicasag: Marine Protected Area





Nearby overfished reef



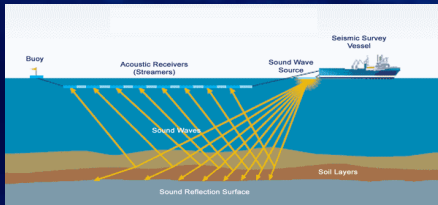
**We can HEAR  
the HEALTH of the ocean**

**Overfishing is Changing the Soundtrack of the Anthropocene**



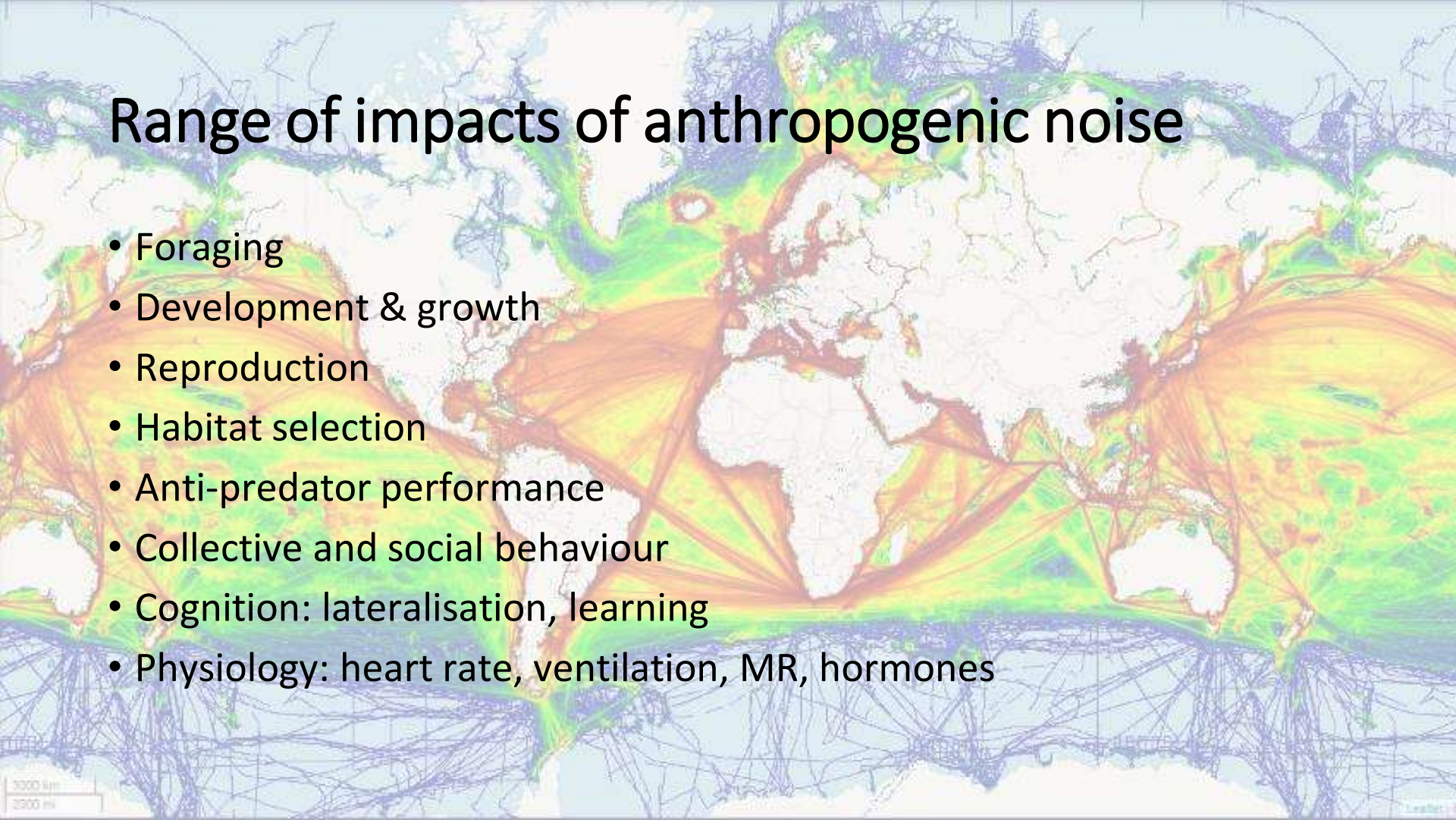
# Heavy Metal in a Sea of Tranquillity

- Shipping – >50,000 ships transport 90% of world trade at sea
- Oil & Gas – seismic surveys audible for 1000s km
- Offshore construction – rapid growth of marine renewable energies
- Recreation – 15 million motorboats in USA, ¼ million on Great Barrier Reef



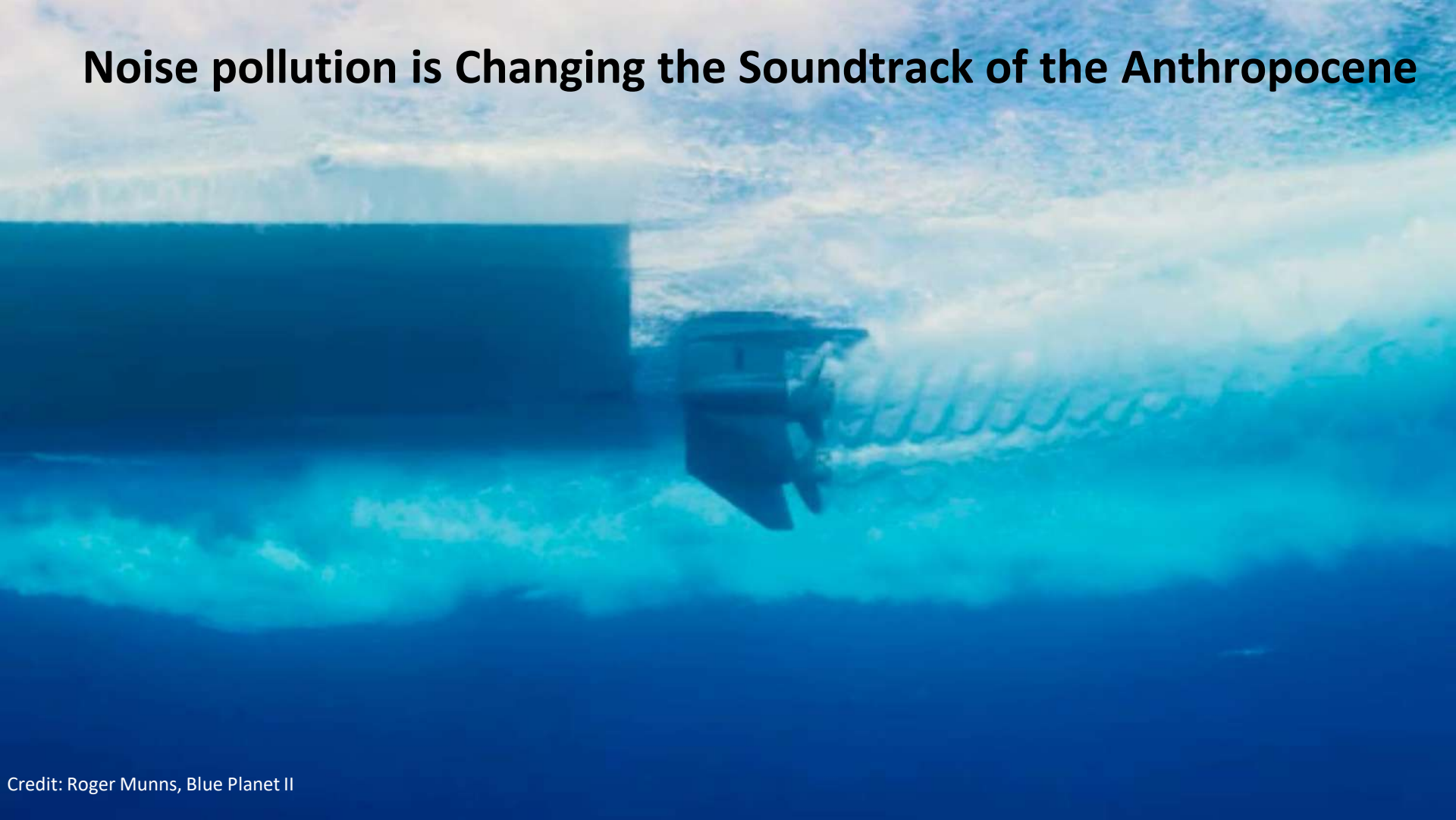
# Range of impacts of anthropogenic noise

- Foraging
- Development & growth
- Reproduction
- Habitat selection
- Anti-predator performance
- Collective and social behaviour
- Cognition: lateralisation, learning
- Physiology: heart rate, ventilation, MR, hormones





# Noise pollution is Changing the Soundtrack of the Anthropocene



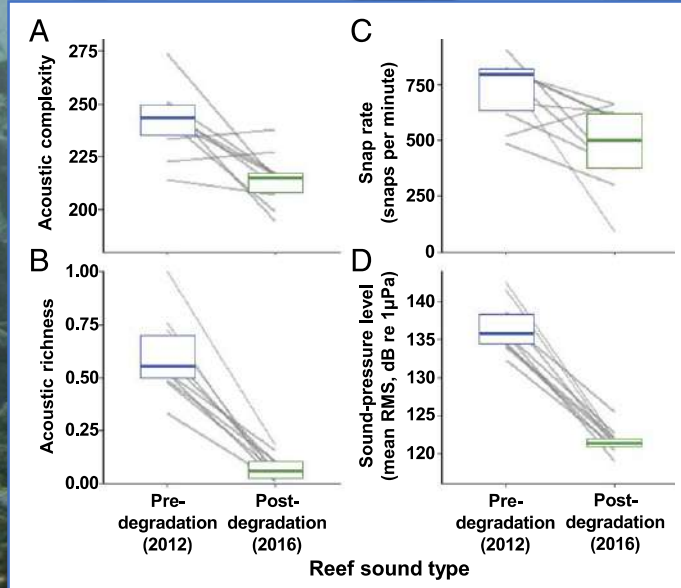
# Great Barrier Reef, 2012





# Warming Seas are Changing the Soundtrack of the Anthropocene

## Great Barrier Reef, 2017



Gordon et al. 2018 Proc Nat Acad Sci

## Grieving environmental scientists need support

of recovering elasticity of mind" (5). Academic institutions must allow environmental scientists to grieve well and thus emerge stronger from traumatic experiences to discover new insights about our rapidly changing world. Much can be learned from other professions in which distressing circumstances are commonplace, such as health care, disaster relief, law enforcement, and the military. In these fields, well-defined organizational structures and active strategies exist for employees to anticipate and manage their emotional distress (5). Effective systems can facilitate both the grieving

## REFERENCES AND NOTES

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**Any advice to others experiencing ecological grief?**  
There's a power and an honor to grief, because it means that we have loved something, and we've had a connection to a place or to a species of the planet. We need to find ways to mark our loss and share our loss, so it's not just ours.

It's an existential sort of crisis. If your world is being liquidated. And I'm partly responsible for this. So there's huge amounts of guilt involved along with the anxiety.

We've been traveling through Maine to hold community dialog sessions to talk about ecological grief. And we're having some great conversations — it's pretty clear that people want to talk about it. Our hope is that we can



An underwater photograph of a coral reef. In the foreground, there is a large, dense patch of branching coral. Several small, colorful fish are swimming around the coral. The background shows more coral structures and a few more fish, all under a clear blue sky.

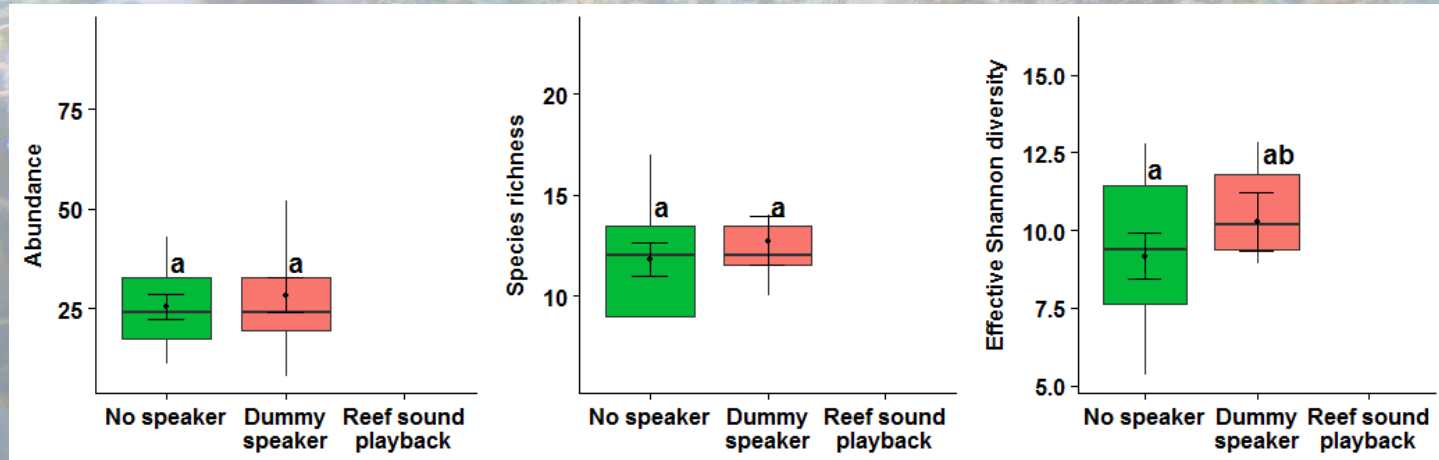
**Turning knowledge into solutions?**

# Noise pollution or acoustic protection?

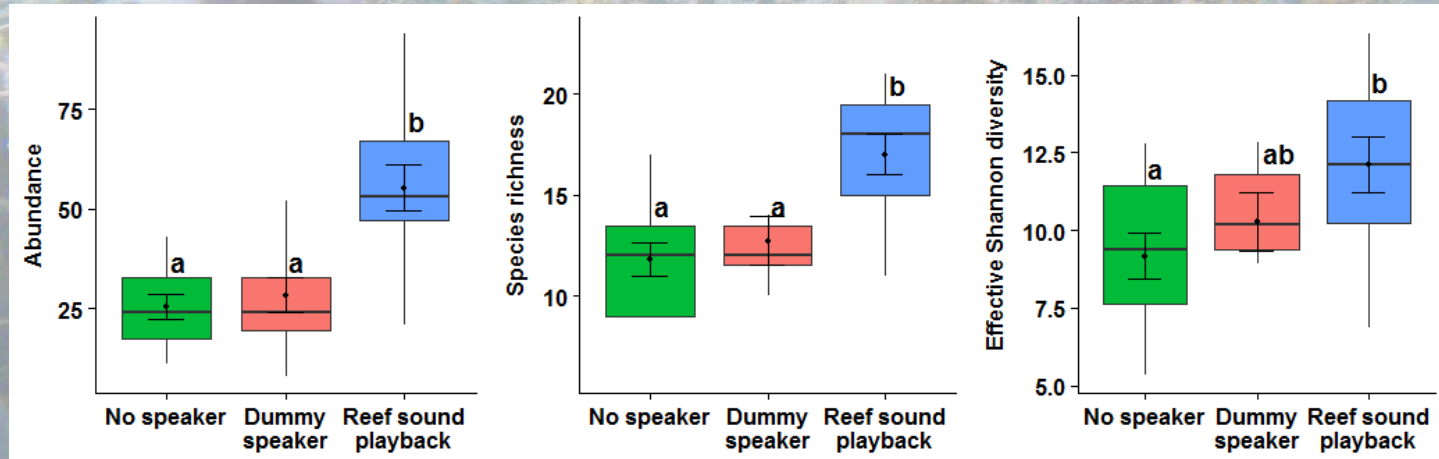




# Could acoustic enrichment accelerate restoration?



# Could acoustic enrichment accelerate restoration?





# We can Change the Soundtrack of the Anthropocene



Technology



Environmental  
Protection



Acoustic Enrichment

