

Connectivity: Open vs. closed populations?

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Connectivity and Management of Caribbean Coral Reefs

Callum M. Roberts



Ecology, 66(1), 1985, pp. 54-67 © 1985 by the Ecological Society of America

> DEMOGRAPHIC THEORY FOR AN OPEN MARINE POPULATION WITH SPACE-LIMITED RECRUITMENT¹

> > JONATHAN ROUGHGARDEN, YOH IWASA², AND CHARLES BANTER Hopkins Marine Station, Department of Biological Sciences, Stanford University, Practic Grove, Catifornia 9396 USA

Annu. Rev. Ecol. Syst. 1996, 27:477-500

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RECRUITMENT AND THE LOCAL DYNAMICS OF OPEN MARINE POPULATIONS

M. J. Caley¹, M. H. Carr², M. A. Hixon³, T. P. Hughes¹, G. P. Jones¹, and B. A. Menge³

Connectivity

Open Populations

Source ≠ Sink



***** NATURE | VOL 402 | 16 DECEMBER 1999 | www.nature.com *******

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

Stephen E. Swearer*, Jennifer E. Caselle*, David W. Lea† & Robert R. Warner*

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BEHAVIOUR OF PELAGIC AND SETTLEMENT-STAGE LARVAE?

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Coral Reef Fish Larvae Settle Close to Home

Gooffier P. Jores, ** Serge Planes,* and Simon R. Thoroots* 'Gentre for Coral Real Biodirectly School of Marine Biology and Aquacultus [11-15], the only unebpixocal approach is to mark farses at their birth site and locate them when they recruit to the adult population [16-18]. Most marins organisms produce large numbers of extensity small pelagic far-

Self-recruitment in a coral reef fish population

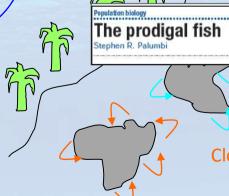
G. P. Jones, M. J. Milicich, M. J. Emslie & C. Lunow

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

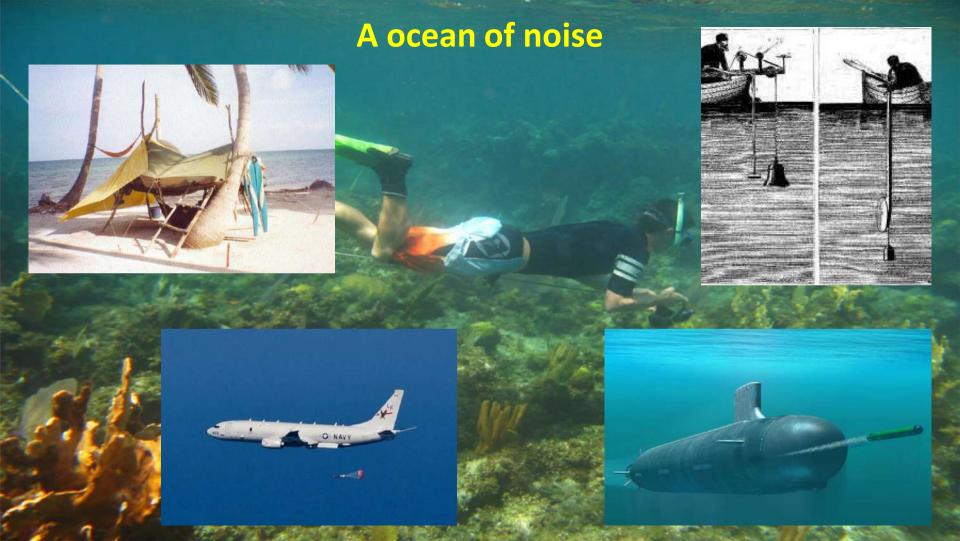
Retention

Closed Populations

Source = Sink



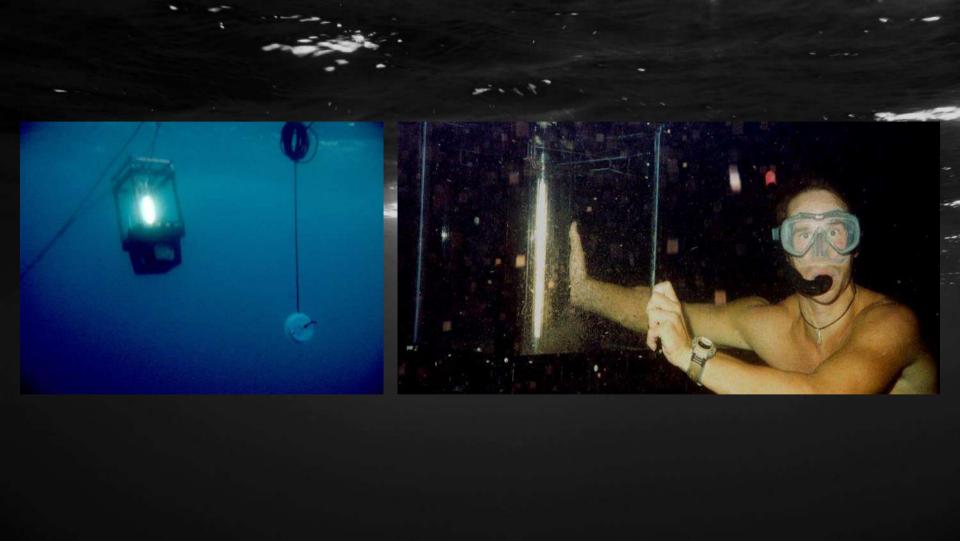






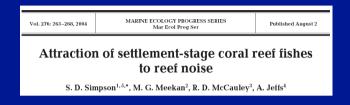








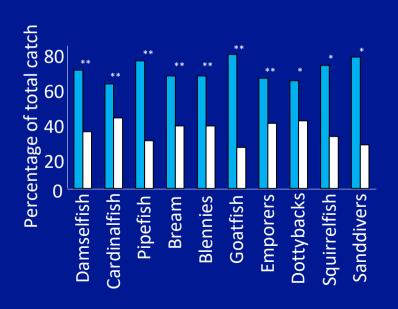
Coral reef fish larvae can hear their way home

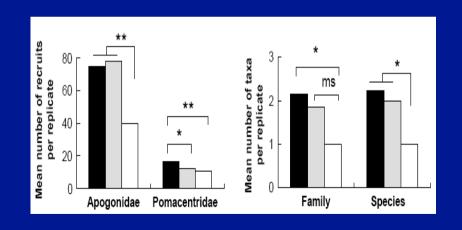


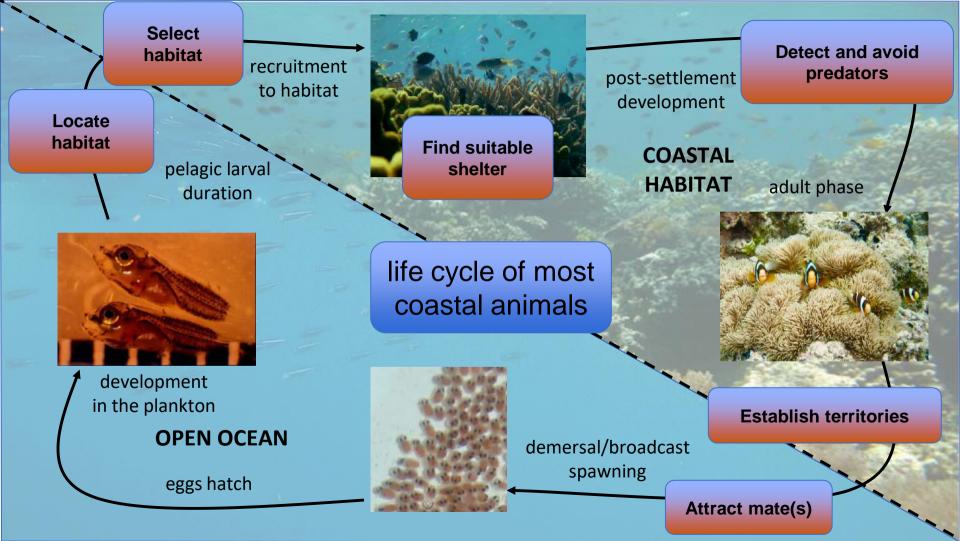
www.sciencemag.org SCIENCE VOL 308 8 APRIL 2005

Homeward Sound

Stephen D. Simpson, ** Mark Meekan, ** John Montgomery, **
Rob McCauley, ** Andrew Jeffs**









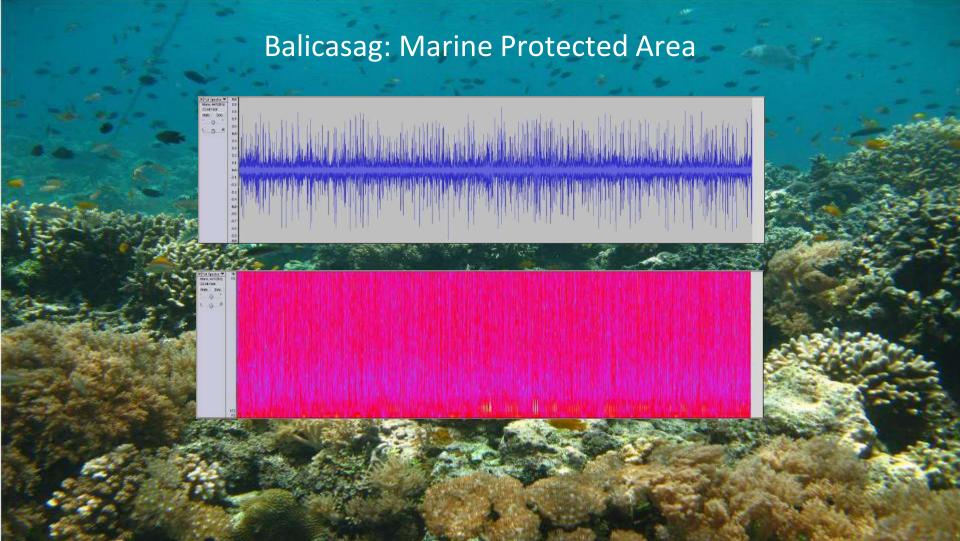








Reefs sound different, and baby fish can select the best habitat So can crabs, lobsters, clams, oysters and even corals!



Nearby overfished reef





We can HEAR the HEALTH of the ocean

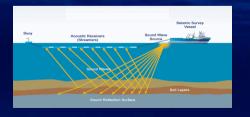
Overfishing is Changing the Soundtrack of the Anthropocene

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





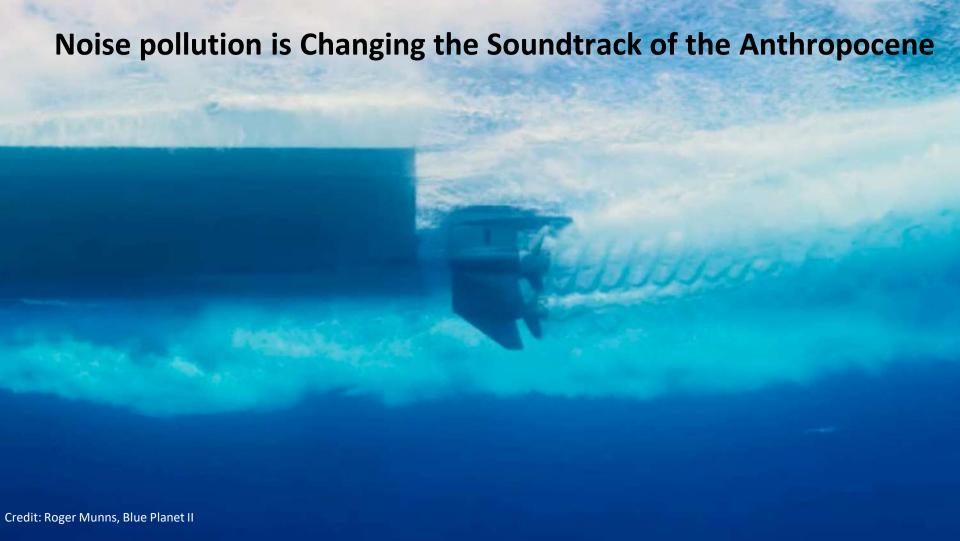






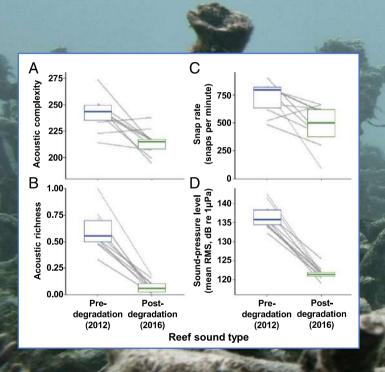
Range of impacts of anthropogenic noise

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





Warming Seas are Changing the Soundtrack of the Anthropocene



Great Barrier Reef, 2017

Gordon et al. 2018 Proc Nat Acad Sci

EcoGrief? How to respond to our experiences?



Edited by Jennifer Sills

Grieving environmental scientists need support

Rates of environmental destruction are greater today than it are pre-sions point in human history $\langle I \rangle$. This loss of valued species, coxystems, and landscapestinggers strong griff responses in people with an emotional attachment to instince $\langle I \rangle$. However, environmental scientifies are presented with few opportunities to address this griff professionally

Environmental selectifus tend to respond to cierradation of the natural world by ignoring, suppressing, or deaying the resulting pulirful emetions while as work (3). The risks that this citalis are profound 'Envirolema' tnamma can substantially compresses selfavoreness, maghanities, and the shillist to think coherently (4). As Charles Darwin put it one "who emulais passive when overwhelmed with grief loses (the) best charse of recovering elasticity or intail?

Academic institutes must allow emiremmental scientists to given veil and thus emerge strenger from trammatic experiences to discover new insights about our rapidly changing world. Much an the learned from other professions in which distressing circumstances are commosplese, such is health care, dissester relief, hav einforcement, and the milliony, it these fields well-defined organizational structures and active strategies octif for employees to anticipate and manage their remational distress (5). Effective systems can deciditate healthy griving processes, ordance psychological recovery, and reduce the risks of long-term mental health impacts, potentially leading to better practice, decision-making, and resilience in future periods of training (2-10), lauprewed psychosocial working environments for scientisms inglight include systematic training of employees, early-intervention deleteling after disturbing intervention deleteling after disturbing

events, social support from celleagues and

managers, and theraposite counseling. The pervisive filisson that scientists must be disparationate observers it dragsrously misquieds. Rather, grief and post-traumatic recovery can strengthen resolve and inspire scientific creativity. To understand and find solutions for our increasingly dramage natural congressions, environmental accientation must be allowed to cry and be supported as they mays forecast.

Timothy A. C. Gordon¹⁴, Andrew N. Radford¹, Stephen D. Simpson²

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Tibetan hot-spring snakes under threat

Endemic to the Theran Placeau, the batespaint said (Pharmania and and a) is a relief species that depards on the heat in peothermal scanes to curvive (f-e). The endy snake species found on the Changtuang Plateau (3), this side surviver of the suborder. September (5) has lived for additions of years (5, 3) in actual caves, shore seams, and crannier (6). These sketcers, along with wednado harboring the snake's diet (tadpoles, toads, frogs, and fish) (7), are consential for the survival of the hot-spring snake in this high, cold, and arth habitati.

The local Tiberans believe that butsuring water can cure many diseases and that the box-spring enales is the natron saint of these waters (e.g., (8)), in recent years, most of the hot springs in the areas where the snakes live have been put to use for commercial ecoloitation (d). Although Thetans do not directly bart analys, their modifications to the natural stone topology and wetland landscape have unwittingly resulted in the loss of the snake's shelters. and food (6). In turn, these local enake populations face extinction (6). The construction of mods and thermoelectric plants is even more devastating for the species (6). It is estimated that a total of 15 billion yuan (equivalent to US\$2.1 billion) will evenually be invested in Tibet for the comprehensive explaination of mothermal resources (9). The hot-soring snake preparative needs halo.

It is possible to protect and restore hat-spring-snake populations without compromising the economic development and well-being of Tibetans. To do so, both the secomment and the public must give more attention and financial support to this speries. Scientists must conduct comprehensive and detailed population resurveys, and natural shelters must be protected or artificial snake dess built. Stillwater wetlands should be restored and frogs and toads reintroduced to the habitats. Finally, it will be crucial to monitor the snake population before, during, and after any construction projects involving geothermal resources.

Song Huang 124 and Lifang Pong

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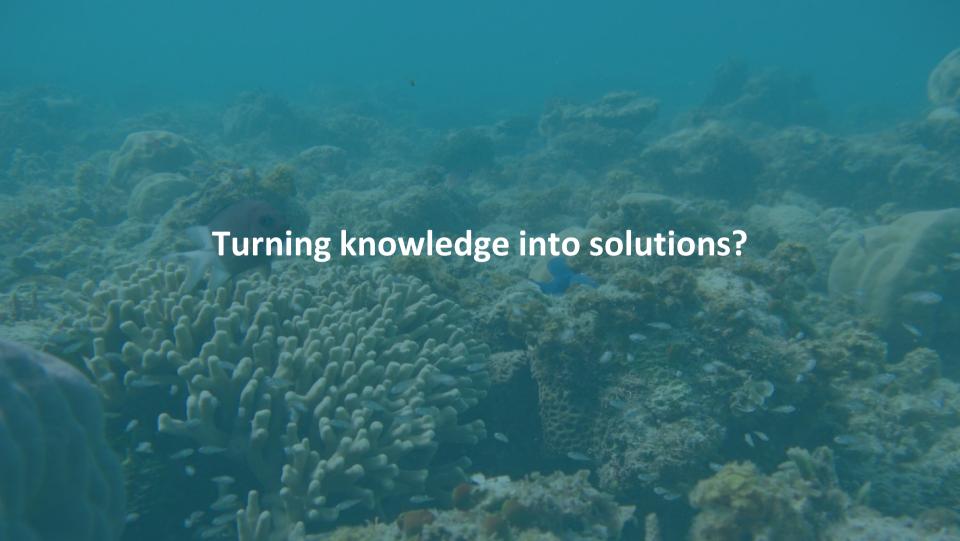
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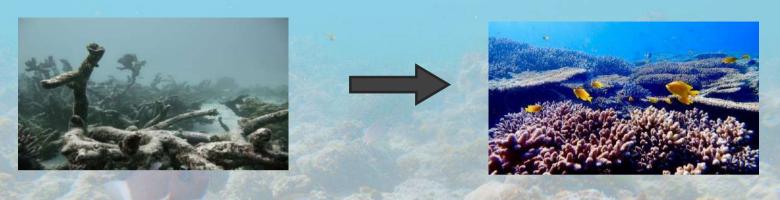
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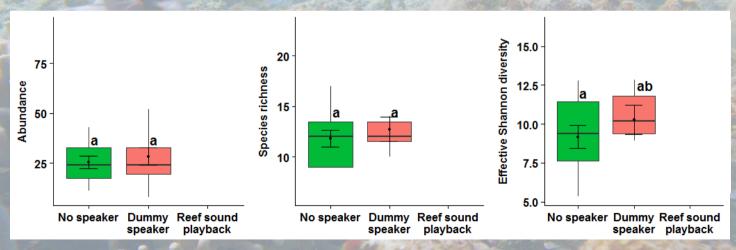
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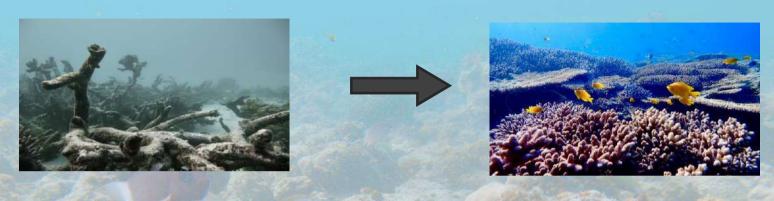
Could acoustic enrichment accelerate restoration?

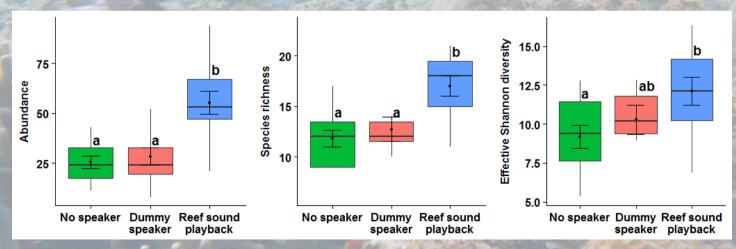




Gordon et al. 2019 Nature Communications

Could acoustic enrichment accelerate restoration?





Gordon et al. 2019 Nature Communications

We can Change the Soundtrack of the Anthropocene



Technology



Environmental Protection



Acoustic Enrichment

