Press Release: Hamburg, XX July 2025

Museum of Nature Hamburg

Connect, Conserve, Restore: How Research Is Protecting Coral Reefs – and Our Future

July 28 marks World Nature Conservation Day – a moment to focus on especially vulnerable habitats, such as coral reefs. These biodiverse ecosystems are not only fascinating but also vital indicators of environmental health. Yet they face severe threats from climate change, ocean warming, deep-sea mining, overfishing, and pollution. In many regions, their survival is uncertain. Two recent studies involving the Leibniz Institute for the Analysis of Biodiversity Change (LIB) in Hamburg show how scientific research can actively help strengthen coral reef resilience and preserve their biodiversity over the long term.

How can the resilience of coral reefs be strengthened?

On one hand, researchers examined coral genetic diversity and found that central reef zones are particularly resilient to environmental change. On the other hand, they explored how coral's microbiome could be combined to better protect itself from climate change.

Identifying and strategically protecting genetic diversity

Published in Evolutionary Applications, one study focuses on the genetic structure of staghorn corals (*Acropora cf. pulchra*) in Micronesia. A research team including Dr Sarah Lemer, molecular biologist at LIB, and collaborators from the University of Guam (UOG), used population genomic methods to analyse corals from five sites across the Mariana Islands, including Guam and Saipan. The main question was how genetically connected these populations are and where potential weak spots or especially resilient groups exist.

The extensive genetic analysis revealed that many populations show extremely high clonality – meaning large reef sections consist of genetically almost identical corals spread by asexual reproduction like fragmentation. This limits genetic diversity and thus adaptability. The researchers also

Stiftung Leibniz-Institut zur Analyse des Biodiversitätswandels
Postanschrift: Adenauerallee 127, 53113 Bonn, Germany

Stiftung des öffentlichen Rechts
Generaldirektion: Prof. B. Misof (Generaldirektor), Adrian Grüter (Kaufm. Geschäftsführer)
Sitz der Stiftung: Adenauerallee 160 in Bonn
Vorsitzender des Stiftungsrates: Dr. Michael Wappelhorst

observed a clear "isolation-by-distance" pattern: the greater the geographic distance between populations, the less genetic exchange occurs. This genetic separation can significantly impair coral adaptability.

Yet the study also offers hope. The team identified so-called connectivity hubs – central reef areas where gene flow occurs and diversity accumulates. These hotspots could become focal points for future conservation and restoration.

"Genetic hubs are more than biological curiosities – they are anchors for restorative action," explains Dr Sarah Lemer. "Knowing where genetic diversity is concentrated allows us to target restoration efforts precisely and effectively." From this insight follows a clear recommendation: using genetically diverse corals to repopulate genetically depleted reef areas can strengthen local ecosystem resilience over the long term.

Microbiome fusion: a pioneering concept in coral research

"If corals have the chance to exchange microbial knowledge, a form of collective resistance could arise," says Dr Lemer. "It's a concept that completely rethinks ecological adaptability." Published in One Earth, in collaboration with microbiologist and coral disease experts from the UOG, the second study introduces a less-explored idea: actively influencing the coral microbiome, the community of microbes living on or in each coral, as a potential key to greater resilience.

Specifically, the approach involves experimentally fusing genetically identical coral fragments with different communities of bacteria and other tiny organisms (microbiomes). This could allow different microbiomes to mix, transferring beneficial microbes to less resilient individuals. Though still theoretical, this concept builds on well-documented processes like coral fusion and microbial migration observed elsewhere.

While experimental, this idea expands the view of corals as learning organisms that respond not only genetically but also microbially to changes. It opens new paths for more active, precise reef support. Practical applications are planned and will be further studied in follow-up research.

Key takeaways for World Nature Conservation Day

Together, these studies demonstrate how different but complementary scientific approaches can contribute to biodiversity conservation. Genetic

analyses reveal areas of high or threatened diversity, while experimental methods like microbiome fusion provide practical tools for ecological restoration.

“Conservation is not just an ethical goal – it’s a strategic task that requires data-driven decisions,” says Dr Sarah Lemer. “Our research provides robust foundations to not only preserve biodiversity but actively enhance it.”

World Nature Conservation Day reminds us that protecting nature is not an abstract ideal but a solvable challenge. With clear vision, scientific rigor, and the courage to explore new methods, conservation becomes tangible. The work of Sarah Lemer and the LIB team in collaboration with the UOG exemplifies this. It shows corals as symbols not just of vulnerability but also of hope.

Nevertheless, science is only the first step toward real change. While researchers reveal the extent of human impact and deepen ecosystem understanding, political will and decisive action are essential to implement effective conservation, says Lemer: “We can map damage and model recovery, but without bold political decisions, our findings remain warnings rather than solutions. Science delivers the facts. Now policymakers must act and make ecosystem protection a true priority.”

An invitation to experience this message visually is the special exhibition “Corals – A Play of Colour in Art and Science” at the International Maritime Museum Hamburg, open until August 10, 2025. Visitors can explore artistic works, including a giant crocheted reef, and see real corals from the Museum of Nature Hamburg. Alongside their beauty, the exhibition highlights their threats and the urgent need to protect them.

Original publication:

D. Rios, H. Torrado, S. Lemer, C. Drury, D. Burdick, L. Raymundo, D. J. Combosch: “Population Genomics for Coral Reef Restoration—A Case Study of Staghorn Corals in Micronesia”, Evolutionary Applications, Volume 18, Issue 6 June 2025: https://doi.org/10.1111/eva.70115

C. J. Anthony, S. Lemer, L. J. Raymundo, H. Rouzé: "Restoration innovation: Fusing microbial memories to engineer coral resilience", One Earth, Volume 8, Issue March 21, 2025: https://doi.org/10.1016/j.oneear.2025.101193

Scientific Contact:
Dr Sarah Lemer
Scientific head of Molecular lab
Leibniz Institute for the Analysis of Biodiversity Change
Museum of Nature Hamburg
+49 40 238317 631
s.lemer@leibniz-lib.de

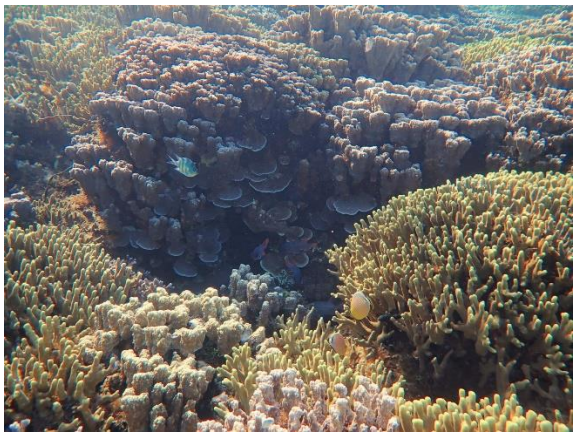
Press Contact:
Mareen Gerisch
Head of Communications and Press, Hamburg
Leibniz Institute for the Analysis of Biodiversity Change
Museum of Nature Hamburg
+49 40 238317 908
m.gerisch@leibniz-lib.de

About the LIB
The LIB is dedicated to researching biodiversity and its changes, the results of which are disseminated to the wider society in an educational manner. In order to better understand the current mass extinction of flora and fauna, researchers are looking for connections and causes of – often – man-made changes. The goal is to develop solutions for the preservation of ecosystems and species in order to maintain the basis of current life.

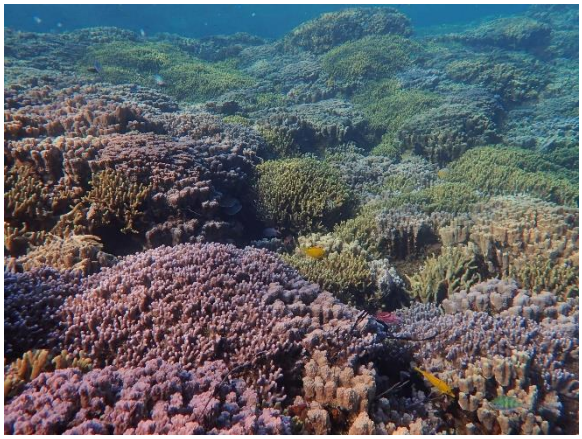
About the Leibniz-Association
The Leibniz Association combines 96 independent research institutes. Their focus ranges from the natural, engineering, and environmental sciences to the humanities and the business, space, and social sciences. The Leibniz institutes focus on relevant social, economic, and ecological issues. They perform knowledge-oriented and applied research (also among the cross-disciplinary Leibniz research alliances), are or support scientific infrastructures, and offer research-based services.

Caption: The staghorn coral (*Acropora cf. pulchra*), subject of the genetic diversity study.
Copyright: © David Combosch

Caption: The staghorn coral (*Acropora cf. pulchra*), subject of the genetic diversity study.
Copyright: © David Combosch



Caption: Image of an intact and healthy coral reef in Guam – a rare glimpse into one of nature's most vibrant yet vulnerable ecosystems.
Copyright: © LIB, S. Lemer



Caption: Image of an intact and healthy coral reef in Guam – a rare glimpse into one of nature's most vibrant yet vulnerable ecosystems.
Copyright: © LIB, S. Lemer