

## MSc/PhD opportunity – a global study on microplastics in exchange with Germany

### ***Are micro-sized plastic particles a new stressor for marine benthic filter feeders? A comparative study on the effects of microplastics and natural seston components***

We welcome applications from MSc/PhD students to participate in an international exchange programme (GAME) run by the GEOMAR | Helmholtz Centre for Ocean Research in Kiel, Germany. Since 2002, GAME has conducted parallel research projects on current ecological issues at different locations around the world. International and German students that work in pairs and are supervised by scientists from GAME's partner institutes in conducting the research. See the attached pamphlet and project description for GAME 2019.

This year's GAME project starts in March 2019, when all international and German students gather at GEOMAR for 1 month to jointly design their global study with assistance of GEOMAR scientists (Dr. Mark Lenz & Prof. Martin Wahl). From there, pairs of students conduct parallel experiments in various countries around the world for 6 months (Apr-Sep 2019), one of them being South Africa to which this call refers. After completion of the experiments, all GAME students spend 3 further months (Oct-Dec 2019) at GEOMAR to analyse data and write up their theses. The GAME programme thus takes 10 months in total and could either form part of an MSc/PhD dissertation or get developed into a full MSc project. The student can be registered at any South African university, but will be based in Cape Town for the duration of the GAME experiment.

GAME funds all project running costs, plus traveling expenses for two trips to Germany and a stipend to support a total of 4 months of living expenses in Kiel. Living expenses for the time in South Africa (during 6 months of the experimental period) will need to be covered by the student (or from external bursaries).

Closing date for expressions of interest is 31 January 2019. Please submit a cover letter and comprehensive CV with contact details and two referees to Dr. Maya Pfaff: [mpfaff@environment.gov.za](mailto:mpfaff@environment.gov.za) or [maya.pfaff@gmail.com](mailto:maya.pfaff@gmail.com)



## **GAME 2019: Are micro-sized plastic particles a new stressor for marine benthic filter feeders? A comparative study on the effects of microplastics and natural seston components**

### ***Background***

Although the subject gains more and more attention by scientists and the public, the number of experimental studies on the biological effects of microplastics on aquatic organisms is still low (Avio et al. 2017). The results obtained so far indicate that pollution by micro-sized plastic particles can impair the health and the reproduction success of marine and fresh water invertebrates (Foley et al. 2018). The majority of studies that documented these effects focused on marine benthic filter feeders such as oysters and mussels (von Moos et al. 2012, Avio et al. 2015, Rist et al. 2016, Sussarellu et al. 2016). These animals extract particles from the surrounding water and digest the organic fraction for their energy supply. By this, they contribute to the self-cleaning capacity of the oceans and connect pelagic to benthic food webs. By this mode of life, however, they are also particularly prone to ingest microplastics that are suspended in near-bottom waters, since they only prevent large particles from entering their mantle cavity. Due to this, microplastics can reach their gills, which serve as an internal filter system, and can also enter the digestive tract. These interactions have the potential to harm the animals. For instance, mussels and oysters clean their gills from indigestible particles by producing a mucus that removes them from the gills' surface (Garrido et al. 2012). Together with the mucus the particles are then ejected from the mantle cavity as pseudofaeces. This is a common response in many epibenthic bivalve species that is also provoked by sediment particles or other natural seston components. Hence, it is an evolutionary adaptation to environments that experience high particle loads. The production of mucus, however, consumes energy that, as a consequence, cannot be used for other life process. Furthermore, microplastic particles can injure epithelia in the digestive tract and can lead to blockages that hinder further food uptake or digestion.

### ***GAME 2019***

A relevant question in this context is whether there is a general difference in the way microplastics and natural seston components act on filter feeders. It is unclear whether microplastics are an entirely new stressor for filter feeders or whether their effects are comparable to those of, for instance, sediment particles. If the latter is the case, microplastics would constitute a further seston component and would be a type of pollution that mussels and oysters are adapted to. So far, we have no empirical knowledge about this and the GAME project of 2019 aims at closing this gap. In a global study, the effects of a monospecific plastic material, i.e. PVC in the size range of 1 to 100  $\mu\text{m}$ , on various filter feeding invertebrates will be compared to those of a natural reference seston material that has the same size (e.g. sand grains or diatom shells). For this, we will employ methods that we established during the GAME projects in 2013, 2014 and 2016 (Brennecke et al. 2016, Rist et al. 2016) and which have been recently refined within a PhD project at GEOMAR. At up to 8 study sites worldwide, exposure experiments will be conducted that will last 8 to 12 weeks. Potential test organisms are mussel species such as *Mytilus chilensis*, *Mytilus edulis*, *Mytilus trossulus*, *Perna perna*

and *Perna viridis*. These test organisms will be exposed to various concentrations of either the PVC particles or one or more reference materials (Rist et al. 2016). The materials that will be used for the experiments will be the same at all sites. During the experiment, several response variables will be obtained that will provide information about the health status of the test animals. The global comparison of the results will allow to conclude whether there is a general difference in the mode of action exhibited by micro-sized plastic particles and natural seston. This information is relevant for assessing the relevance of microplastics as a new pollution in aquatic systems.

### **Literature**

Avio, C.G., Gorbi, S., Milan, M., Benedetti, M., Fattorini, D., d'Errico, G., Pauletto, M., Bargelloni, L., Regoli, F. (2015) Pollutants bioavailability and toxicological risk from microplastics to marine mussels. *Environmental Pollution* 198: 211-222

Avio, C.G., Gorbi, S., Regoli, F. (2017) Plastics and microplastics in the oceans: From emerging pollutants to emerged threat. *Marine Environmental Research* 128: 2-11

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Foley, C.J., Feiner, Z.S., Malinich, T.D., Höök, T.O. (2018) A meta-analysis of the effects of exposure to microplastics on fish and aquatic invertebrates. *Science of the Total Environment* 631-632: 550-559

Garrido, M.V., Chaparro, O.R., Thompson, R.J., Garrido, O., Navarro, J.M. (2012) Particles sorting and formation and elimination of pseudofaeces in the bivalve *Mulina edulis* (siphonate) and *Mytilus chilensis* (asiphonate). *Marine Biology* 159: 987-1000

Lusher, A.L., Welden, N.A., Sobral, P., Cole, M. (2017) Sampling, isolating and identifying microplastics ingested by fish and invertebrates. *Analytical Methods* 9, 1346-1360.

Rist, S.E., Assidqi, K., Zamani, N.P., Appel, D., Perschke, M., Huhn, M., Lenz, M. (2016) Suspended micro-sized PVC particles impair the performance and decrease survival in the Asian green mussel *Perna viridis*. *Marine Pollution Bulletin* 111: 213-220

Sussarellu, R., Suquet, M., Thomas, Y., Lambert, C., Fabioux, C., Eve, M., Pernet, J. (2016). Oyster reproduction is affected by exposure to polystyrene microplastics, *Proceeding of the National Academy of Science*, 113(9), 2430–2435.

Van Cauwenberghe, L., Claessens, M., Vandegehuchte, M.B., Janssen, C.R. (2015b) Microplastics are taken up by mussels (*Mytilus edulis*) and lugworms (*Arenicola marina*) living in natural habitats. *Environmental Pollution* 199, 10-17.

Von Moos, N. (2012). Uptake and effects of microplastics on cells and tissue of the blue mussel *Mytilus edulis*. *Environmental Science and Technology*, 46, 11327 - 11335.



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# GLOBAL

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# APPROACH BY

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# MODULAR

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# EXPERIMENTS

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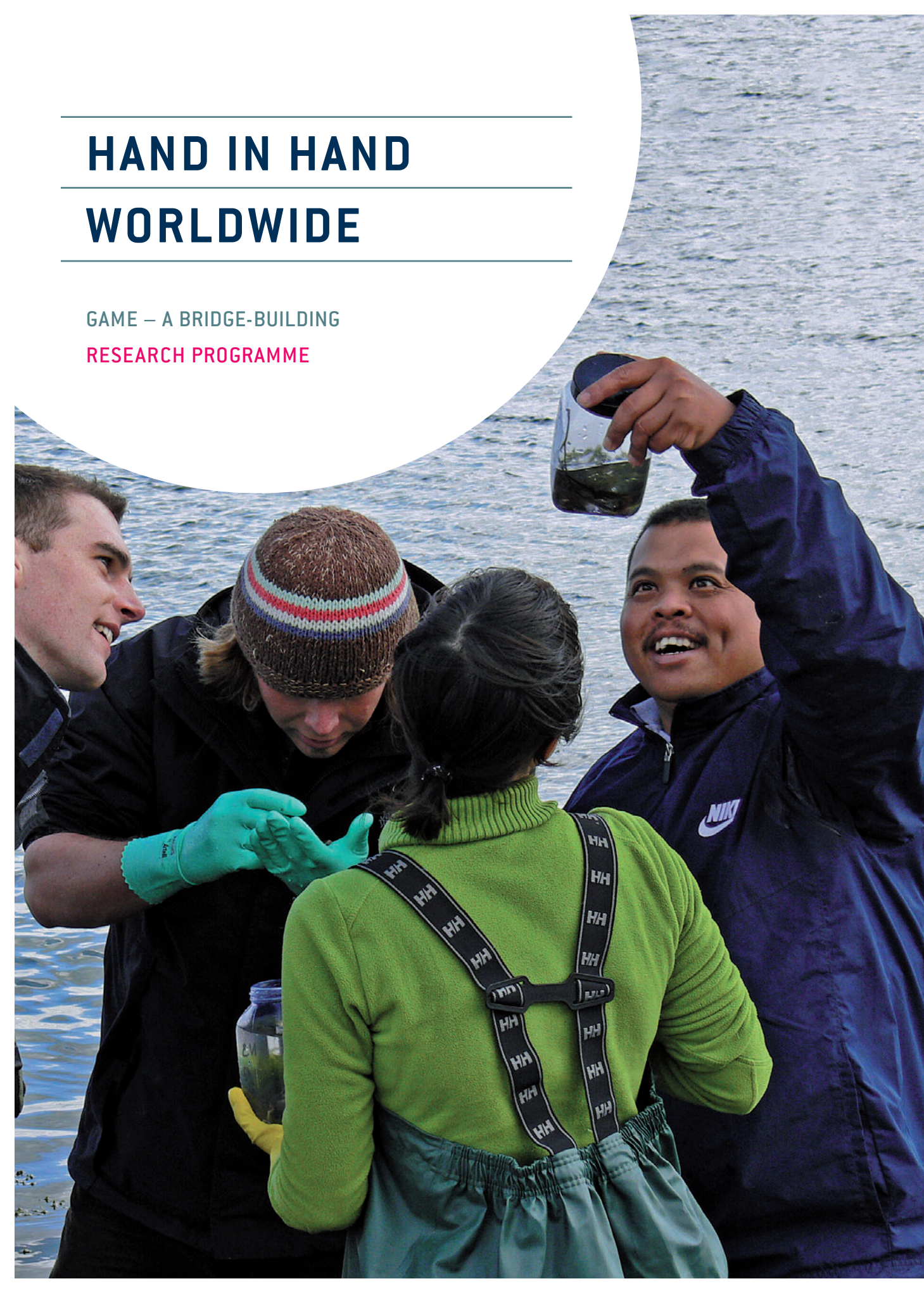
**A WORLDWIDE PROGRAMME  
STUDYING GLOBAL CHANGE**

GAME supports and links  
young marine scientists.



# HAND IN HAND WORLDWIDE

GAME – A BRIDGE-BUILDING  
RESEARCH PROGRAMME



## ? WHAT IS GAME?

GEOMAR | Helmholtz Centre for Ocean Research Kiel is one of the world's leading institutes in the field of marine science. It aims to study the oceans in their entirety and for this purpose the institute combines research in physics, chemistry, biology and geology under one roof. In 2002, Professor Martin Wahl initiated a special programme in the field of marine biology, establishing a new and innovative scientific approach:

**GAME – a programme for the worldwide implementation of identical experiments across geographical and climatic boundaries.**

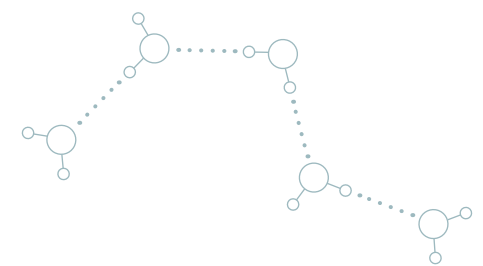
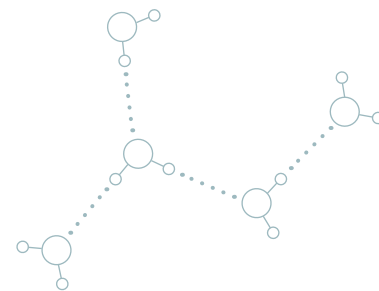
GAME-research projects study the effects of global change on habitats in coastal waters.

GAME is in an international training programme that combines applied research with training for young scientists. Every year, parallel research projects on current ecological issues are organised at different locations around the world. The research is carried out by students working in bi-national pairs and supervised by scientists from GAME's partner institutes.

The unique GAME projects enable generalizable insights into urgent ecological issues. At the same time GAME links GEOMAR with numerous partner institutes worldwide and creates a global network for the sustainable exchange of scientific knowledge. GAME currently cooperates with 33 marine research institutes on five continents.

This network is growing.

» GAME stands for  
**GLOBAL  
APPROACH BY  
MODULAR  
EXPERIMENTS**



»



*The GAME programme promotes its participants' intercultural competence, making an important contribution to open, unprejudiced and interested engagement with other cultures in order to learn, work and research together*

Kerstin Bockhorn, GAME participant from Germany, now employed as an Environmental Scientist with the municipal Office for Nature and Resource Conservation in Hamburg

# NETWORKS FOR THE OCEANS

A PROGRAMME FOR THE FUTURE THAT NEEDS **PARTNERS**



## WAYS IN WHICH YOU CAN SUPPORT US

### With a partnership

you can enable GAME to continue its successful international cooperation and to pursue and develop excellent teaching within the programme (teaching, student supervision, network expansion, publicity). You decide the amount of your contribution to support GAME.

### With a sponsorship

you give an individual student the opportunity to participate in an exchange as part of the GAME project. With a fixed sum you can fund a scholarship for one student (travel costs, equipment, books, media).

We are happy to send detailed information on request.



## WHAT ARE THE AIMS OF GAME?

GAME's primary aim is to study the effects of global change on the earth's coastal habitats. Furthermore, GAME works to develop and expand the multinational transfer of knowledge, in particular between industrialized and newly industrializing countries, as well as creating lasting and sustainable networks for marine research. At the same time GAME supports young scientists and in intensive teaching modules trains them in scientific core skills, such as the communication of research findings in the form of scientific articles and talks.

GAME needs support for this work.

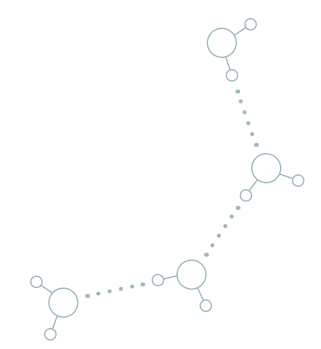
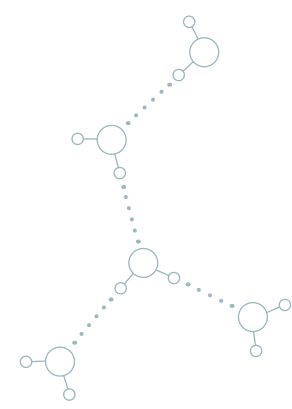
We are looking for businesses, individuals and foundations willing to become involved as partners or sponsors for future projects:

- You would like to support sustainable marine research?
- You would like to support young scientists?
- You would like to be part of a cultural and scientific competence network?

GAME provides opportunities – for its partners and sponsors:

### Your benefits as a partner or sponsor

- > Personal, exclusive invitations to GAME events
- > Personal contact and opportunities for communication with scientists and institutions
- > You can experience research "close up"
- > Your name will be mentioned in GAME publicity
- > You will be linked with an international research network



# GLOBAL THINKING MODULAR RESEARCH

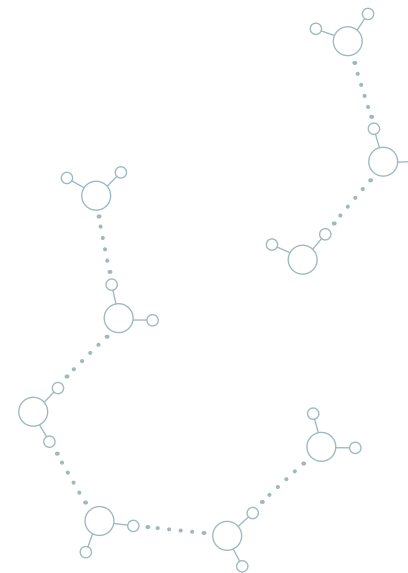
IN A WORLDWIDE **NETWORK** FOR  
SCIENTIFIC EXCHANGE



## HOW DOES GAME WORK?

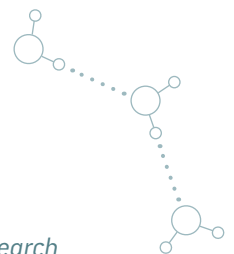
Currently 18 scholarships are awarded annually, divided equally between German and foreign students who are writing their final thesis in the framework of a research project

- > Every GAME project begins in Kiel.
- > Every year in March all participants meet here and develop the methodological approach for their new research project in a month-long preparatory course, together with scientists from GEOMAR.
- > The participants form bi-national teams consisting of one German and one local student and perform the experiments at one of our partner institutes from April on.
- > At the beginning of September the German students return to Kiel, where they evaluate their data and write their final theses with the support of GEOMAR scientists.
- > Subsequently the foreign students return to participate in the global evaluation of the experimental results.
- > This is followed by a phase with intensive training modules on delivering scientific lectures and preparing publications.
- > In the last phase of each project the participants present their findings in the form of lectures at universities and marine science institutes in northern Germany, and prepare articles for scientific journals.



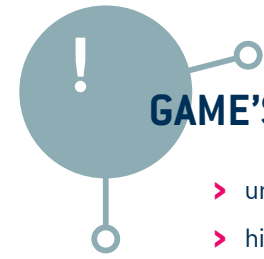
*GAME combines the implementation of an innovative, global research approach with the education of promising young scientists and in this way provides a model for the ideal combination of scientific research and broadly defined academic education.*

Dr. Bernhard Lorentz  
President of Stiftung Mercator



# COMPETENCE THROUGH COOPERATION

GAME SUPPORTS CAREERS – AND HELPS TO SECURE THE FUTURE OF COASTAL REGIONS



## GAME'S STRENGTHS

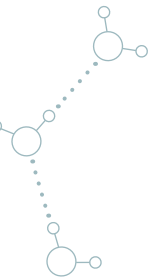
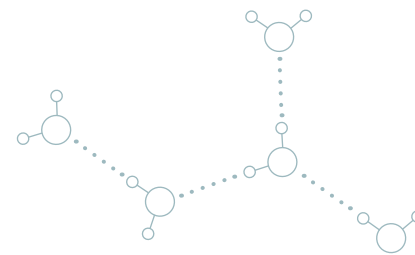
- > unique scientific approach
- > high relevance due to generalizable research results
- > high quality due to small numbers of participants
- > GAME is a global tool that can serve as a model for other disciplines
- > high level of attractiveness through its utilization of the competence and logistics of GEOMAR
- > networking of participants and partner institutes
- > global transfer of knowledge

### GAME promotes

- > understanding of global issues and research approaches
- > intercultural competence and teamwork skills
- > exchange of knowledge, cosmopolitanism and tolerance
- > qualification for scientific work at an international level

### GAME offers

- > an excellent education with intensive and individual supervision
- > efficient training for optimum career prospects
- > research experience abroad before starting a doctoral project
- > training in practical work at difficult research locations



*There is no other way to say it: GAME has changed my life. This global project gave me a rigorous formal training of quantitative analysis of spatial and temporal dynamics in benthic marine communities. I am currently a postdoctoral fellow in Edgewater, Maryland, USA, working with the effects of pollution and latitude on native and invasive species. GAME showed me the right way and gave me the tools I needed for the path I chose.*

Dr. João Canning-Clode, GAME-participant from Madeira / Portugal currently Smithsonian Research Fellow



# THE WORLD POSES QUESTIONS

## THE GAME NETWORK IN FIGURES

Our network currently includes 33 research institutions in 24 countries. We are represented on five continents and thus in all of the large marine areas. So far 129 students have been supervised by GAME. The German participants came from 25 different universities throughout the country. To date, 36 publications based on GAME projects have appeared in international peer-reviewed scientific journals.

## GAME FINDS ANSWERS – IN THE OCEANS

Using the findings from many comparable individual studies, GAME participants draw conclusions that are transferable and universally applicable.

The oceans contain the greatest variety of species on earth, but are much less well researched than terrestrial habitats. They are of tremendous significance as a source of organic and non-organic resources and as a climate buffer.

GAME concentrates on the coastal regions of our planet, as they are of paramount importance for humanity: They store major food resources, provide carbon dioxide sinks and stabilise coastal lines.

Already, more than 50% of the world's population live close to the sea and this percentage is rising continually. For this reason, coastal seas are most affected by global change, as climate warming, rising sea levels, species transfers and intense human use all come together here. This can have far-reaching consequences for the ways in which these ecosystems function.

GAME studies the effects of global change on these habitats of major significance to mankind.

Several projects, for example, have studied factors influencing biodiversity. GAME is also interested in issues in invasion ecology and studies the ways in which environmental changes affect the interrelations between species.

> Information on GAME's research projects is available at [www.geomar.de/go/game](http://www.geomar.de/go/game)



*In the field of marine ecology, GAME provides an example of the genuine and sustainable transfer of technology and knowledge from the "North" to "newly industrializing countries". The programme also raises young German scientists' awareness of the problems and difficulties of the partner countries.*

Nikolaus Gelpke, Marine biologist  
Publisher of the journal MARE and member of the GAME board of trustees



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