# Application Information

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| Amount Requested: | $ $14,903 |
| Matching Funds: | $0 |
| Project Title: | Protecting habitats from pollutants to improve aqu |
| Project Abstract: | Emerging pollutants, notably plastic debris and chemical contaminants, affect the environment and marine resources in Indonesia. Waste infrastructure is lacking, and waste is directly discharged into coastal environments resulting in infections/diseases of aquaculture and wildlife resources. Our activities are focused on pollution and its threat to marine resources (e.g. coral reefs, tropical/ornamental fish, seaweeds) in the Spermonde–Sulawesi region, all vital ecologically and economically. Our goal is to help restore polluted environments and conserve alternative livelihoods to practices harmful to biodiversity (e.g. destructive fishing), through research, outreach, and education by collaboration with academia (Hasanuddin), industry (Mars), and education (K-12 students). |

## Protecting Habitats from Pollutants to Improve Aquaculture and Livelihoods in Indonesia

**Activity Description**

The proposed activities are based on the marine science collaboration initiated by Dr. Susan Williams between UC Davis and the Indonesian Hasanuddin Faculty of Marine Science & Fisheries (UNHAS, http://fikp.unhas.ac.id). As a product of Dr. Williams' Seed Grant in 2012, the Office of Research established a Working Agreement of Cooperation between UC Davis and UNHAS beginning in 10/21/2012 for a 4–year period. Building on the work initiated by Dr. Williams, the purpose of this collaboration is to engage in research and education regarding the role of pollutants to restore marine resources on small islands along the coast of Sulawesi, Indonesia (see supporting letter). The Mitra Bahari partnership of government, university, business, and non-governmental organizations have been leading multi–restoration efforts on these islands altered by destructive fishing, anthropogenic pollutants (e.g. urban runoff and marine debris), and climate change.

The focus of our activities is pollutants notably **plastic debris and chemical contaminants including pathogens/diseases**. Pollutants are a major threat to the health of aquatic organisms and their environment. Our goal is to help restore the environment impacted by pollutants and to support the production of sustainable aquatic resources in the Sulawesi, Indonesia. There is no infrastructure for waste on the small islands of Indonesia and thus household waste and wastewater laden with plastic debris and various chemicals are discharged directly into the environment. Contaminants deteriorate water quality and impair the health of ecologically (corals, seagrass) and economically important aquatic organisms (i.e. seafood) including ornamental fishes and seaweeds (used as raw material for food production, pharmaceuticals, and cosmetics) as alternative livelihoods to destructive fishing. Polluted water causes outbreaks of infectious diseases, resulting in chronic infections or mass mortality of aquaculture and wildlife resources. Our goals include a collaboration with UNHAS Faculty of Marine Science for community engagement through an outreach program with K-12 students from the Spermonde Islands (off the Sulawesi coast) in the Coral Triangle. This region supports the most diverse coral reef organisms worldwide. At the center of the Coral Triangle is UNHAS, the only major university outside of Java, Indonesia with a broad marine science program and research station. Collaborating with UNHAS will allow us to establish our research and outreach goals.

Our short-term goals are to travel to Indonesia to establish working relationships with UNHAS and Mars (http://www.marssustainablesolutions.com/), visit the research facilities of UNHAS, conduct preliminary sampling of plastic debris, and other suspect pollutant–exposed or diseased organisms or seaweed, and develop feasible research plans for future proposals. We have recently hosted Dr. Alexander Rantetondok from UNHAS as part of Dr. Williams' outreach activities in the Spermonde Islands, building the initial foundation for this collaboration between our research programs. The expertise of UNHAS faculty is in line with our research directions: Dr. Rantetondok works on immunology and disease of fish and shrimp culture (see supporting letter) and Dr. Gunarto Latama on seaweed culture and associated environmental issues. Regarding business and logistics, we propose to partner with Mars through Noel Janetski (see supporting letter) and Dr. Saipul Rapi. Once we establish a foundation for collaboration, our long-term goals are to: 1) engage in collaborative research efforts and outreach activities to protect and restore habitats in the Sulawesi archipelago impacted by pollutants, 2) create baseline information and publish manuscripts on pollutants and effects in habitats and aquatic resources in this region, 3) develop an outreach and education program for K-12 schools in cooperation with UNHAS faculty and their students to advance current knowledge on pollutants including marine debris, and 4) foster long-term collaborative research on the broader effects of pollutants on local aquatic resources and livelihoods (e.g. seaweed, shrimp, and ornamental fish culture).

We are researchers from the Aquatic Health Program in the School of Veterinary Medicine at UC Davis (http://www.vetmed.ucdavis.edu/aquatic_health/index.cfm). The main goal of our program is to provide ecological monitoring of aquatic habitats and wildlife by conducting broad research investigations to promote the health and function of aquatic ecosystems for all species. By using integrative investigative tools, we address the impact of environmental stressors on the health of aquatic organisms. We evaluate multiple stressors ranging from chemical contaminants such as endocrine disrupting chemicals (EDCs) and pesticides to physicochemical factors, climate change, pathogens/diseases, algal blooms, plastic debris, and their effects to organisms at all levels of biological organization. Building the foundation here will enable us to establish long–term collaborations through the development of programs for research, outreach, and education. Our long–term goals will be fulfilled through collaborative writing of research, outreach, and education components for future proposals to conduct various research projects through a framework designed to monitor the health of aquatic organisms and their habitats. A brief description of the proposed projects is outlined below:

**1) Chemical contaminants and plastic debris** — we aim to develop collaborative research regarding the chemical contaminants associated with, and the fate of, plastic debris in the Sulawesi region to extend our current projects measuring the fate of plastic debris and contaminants in aquatic habitats and foodwebs. The Aquatic Health Program has been conducting research on measuring the fate of marine debris and associated chemicals in organisms since 2009 led by Dr. Chelsea M. Rochman (www.chelsearochman.com). This research is funded by multiple funding sources including the United States Environmental Protection Agency (EPA), a National Science Foundation Graduate Research Fellowship, and the National Oceanic and Atmospheric Administration (NOAA) Marine Debris Program. We also collaborate with private organizations (e.g. 5Gyres, Project Kaisei), government agencies (e.g. US EPA, NOAA) and academic experts on marine debris research (e.g. NCEAS) who continue to help make our research relevant and effective. Together with collaborators from UNHAS, we plan to advance our current research program by developing new proposals to measure priority chemical contaminants associated with plastic debris currently recovered in this region. In addition, we would like to measure the availability of plastic debris as a vector for these contaminants in fish and potentially humans that consume seafood. For example, fish that are caught for food by local fisherman can be examined for plastic debris in their gut content. Chemical contaminants associated with plastic debris in this region can then be measured from plastic debris found in gut contents and flesh of these fish that is consumed as a protein source.

Our proposed outreach component will build upon the Marine STEM (Science, Technology, Engineering, Mathematics) K-12 outreach programs previously initiated by Dr. Susan Williams from Bodega Marine Lab at UC Davis with UNHAS faculty. The current marine debris K-12 curriculum has been implemented, and debris is sampled and quantified to educate regarding recycling, and ecological (entanglement) effects. We would like to extend this curriculum to include aspects related to wildlife and human health. With the support of Mars and collaboration with Dr. Williams and UNHAS, we plan to supplement this outreach program to include information on the ecotoxicological aspects of plastic debris and chemical contaminants, including the source of local pollutants and how they may affect the health of wildlife and humans. We currently have developed an outreach curriculum that we have successfully presented in schools and youth conferences across the state of California. We continue to disseminate this curriculum in Northern California schools and will soon extend this curriculum online where students can interact internationally with marine debris researchers throughout the school year. We look forward to adapting this program to the students of Spermonde Islands and potentially to the mainland in the region. The curriculum highlights the sources and fate of our waste (including chemicals and plastic

debris) and the effects of these contaminants to wildlife and humans. We also aim to use education to implement possible solutions, such as implementing the use of reusable water bottles that can be refilled with water decontaminated by solar cookers, ultimately reducing the quantity of plastic marine debris and providing access to clean drinking water.

**2) Endocrine or hormone disrupting chemicals (EDCs)** — these emerging pollutants are synthetic chemicals found in many household and pharmaceutical products (e.g. birth control, hormone replacement, anti-inflammatory medications) associated with specific diseases and disorders in humans. When released into the environment, EDCs cause physiological and behavioral abnormalities in fish and other aquatic organisms and impair the development of sex differentiation and reproduction. Their environmental impacts can be severe in the absence of an effective wastewater treatment process especially in remote regions.

Endocrine disruption studies have been in place at the Aquatic Health Program beginning in 2000 with funding support to Dr. Swee Teh (http://faculty.vetmed.ucdavis.edu/faculty/sjteh/) from the US Environmental Protection Agency, State Water Resources Control Board, the California Department of Fish and Wildlife and Water Resources, and other private water contractors in California. Following an initial investigation of waste in the region, we can build effective research programs geared toward solutions that protect human health and wildlife. Based on obtained information, we will apply for future funding to assess the toxicity and endocrine disruption from marine debris and wastewater sampled from impacted areas in the Makassar and Sulawesi regions. This work will be initiated by Drs. Tomofumi Kurobe (http://www.vetmed.ucdavis.edu/faculty/results.cfm?fid=20699) and Swee Teh.

**3) Pathogens and diseases** — pathogens and diseases are often encountered in intensive aquaculture conditions and highly polluted environments. With our expertise, we aim to examine the pathogens and diseases that occur in farmed or wild finfish and shellfish (shrimp and abalone), ecologically important resources (corals, seagrass), and aquaculture of ornamental fishes (seahorses, clownfish, and mandarin fish), and seaweeds. Although Indonesia has a long history of fish disease problems and research, expertise and laboratory facilities are limited in this country. Moreover, viral diseases are on the rise but expertise on fish virology is lacking.

Since 1999, the Aquatic Health Program has been engaged in ecological monitoring of fish health as part of a broader effort to restore native and exotic fish species in the Sacramento–San Joaquin delta. Various species in the delta are currently listed in threatened or endangered status due to the degradation of its ecosystem. Fish health monitoring projects are funded by the Ecosystem Restoration Program in collaboration with various state agencies including the California Department of Fish & Wildlife, US Bureau of Reclamation, and US Geological Survey. Our goal is to establish fish health in an ecological context using a comprehensive biomarker approach, which utilizes various indices including fish nutrition and condition, pathogens, histopathology, reproductive potential, and enzymatic assays as indicators of contaminant exposure. Taken together, these metrics provide a "Fish Health Index" category of individual fish that we examine. We use tools spanning from conventional to advanced techniques including mathematical modeling to assess the role of pathogens, pollutants, and stressors on fish and ecosystem health. If feasible, relevant methods will be introduced into the research and outreach component of the fish disease studies with UNHAS. Dr. Dolores V. Baxa has an extensive background in fish disease research and will be the lead for the disease component (http://www.vetmed.ucdavis.edu/faculty/results.cfm?fid=18748).

**4) Pollutant effects on culture of marine ornamental fish and seaweeds** — culturing marine ornamental fish as an alternative livelihood to destructive fishing is one of the most lucrative businesses in Indonesia. Economic viability has been proven for seahorse breeding and seaweed farming; both are a major source of income for many Indonesian farmers. In collaboration with Dr. Williams' activities on ornamental species trade, we will design a framework to include pollutant studies in the newly renovated government lab ('Takalar'). Previously used for food fish and seaweed aquaculture research, the Takalar director has begun a collaboration with the Mars research group to culture ornamental fishes. We plan to collaborate with Mars (Noel Janetski/Dr. Saipul Rapi), UNHAS Marine Science faculty (Drs. Alexander Rantetondok, Gunarto Latama, and Hilal Anshary), and with Dr. Susan Williams (UC Davis, Bodega Marine Lab) to examine the role of pollutants during the breeding and grow-out phases of culturing seahorses and other ornamental fishes (clownfish and mandarin fish), seaweeds, and shellfish including abalone cultures in Sulawesi islands.

**Benefits to International Programs**

This collaboration will advance understanding regarding water contaminants particularly on anthropogenic pollutants and diseases affecting aquatic resources that are economically and ecologically important in Indonesia, specifically in the Spermonde Islands. Addressing environmental problems to maintain the health of its natural resources are intricately related in an effort to support sustainable sources of livelihoods. These activities will lay the foundation for outreach components of multidisciplinary proposals from the Aquatic Health Program for future submission to the One Health Program and the Research Investments in the Sciences and Engineering (RISE). These programs aim to address the complex local and global problems governing the health and conservation of animals, humans, and the environment. The focus of our efforts are geared to assess the effect of pollutants by way of core activities, previously initiated by Dr. Williams, designed to protect marine biodiversity (coral reefs, seagrass) and the quest for economically viable alternative livelihoods (ornamental species trade) to destructive fishing practices. We will expand these objectives by establishing a framework to educate and train the community at large on the hazards of pollutants in aquatic habitats and fishery resources through collaborations with UNHAS and Mars.

**Specific Benefits of the Collaboration**

- This initial collaboration will increase our understanding on the scale and impact of pollutants in small islands and coastal communities to design programs that support healthy resources for local livelihoods.
- Assessing the availability and feasibility of resources by visiting the community, university, and primary schools in this region will provide us with the knowledge to design future research projects and outreach programs that can facilitate healthy ecosystems and resources.
- Preliminary sampling will allow us to understand the sources, fate, and effects of pollutants in this region and lay the foundation for future research proposals and potential solutions, such as a design for local trash infrastructure that may promote positive cascading effects to the health of aquatic environments and increased opportunities for livelihood resources.
- Collaborations will produce peer-reviewed publications in international journals from our research group with UNHAS faculty, and will broaden the research objectives outlined in the Memorandum of Agreement between UC Davis and UNHAS in 2012.
- Collaborations between business and university support a unique concept of community engagement to protect natural resources through sustainable efforts that aim to restore the environment.

**Proposed Budget and Narrative** — the major expense is for travel to UNHAS for a week for the four researchers of this proposal to assess the resources and facilities and meet with collaborators. Medical costs supplies and immunizations are estimated at $100/person. School supplies for K-12 students for the initial outreach activities and a modest gift to collaborators are requested.

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| Airfare: SFO–Jakarta–Makassar @$1600+$500-domestic x 4 | $7,200 |
| Visas ($25) + Departure tax ($16) x 4 | 164 |
| Ground transportation: airport and hotel shuttles, parking | 500 |
| Baggage fees (airline, shuttle, samples) | 500 |
| Hotel ($100/day + $16 internet access–Makassar) x 4 x 7 days; | 3,248 |
| (In-transit $175) x 4 x 1 day | 700 |
| Meals ($56/person for 9 days) x 4 | 2,016 |
| First aid supplies, school supplies, immunizations | 500 |
| Gift to collaborators | 75 |
| **TOTAL** | **$ 14,903** |

**Documentation of Matching Support** — Mars Symbioscience will provide logistics support (see supporting letter); UNHAS faculty will donate their time to organize K-12 students and islanders, serve as translators of local dialects, and provide access to their marine station. Dr. Susan Williams' on going efforts in the region on marine debris will provide additional manpower and research support (see supporting letter).

**Indication of How the Educational Program or Activity will be Sustained** — The Aquatic Health Program is committed to outreach and education for the purpose of translating research beyond academia so that the science can be applied to a broader scale and targeted users. Our previous and current projects at the Aquatic Health Program are funded by several government (state and federal) agencies and private entities in California. Funding support to the PIs (Baxa and Teh) and researchers (Rochman and Kurobe) for this proposal have been generated either through competitive grants (e.g. Ecosystem Restoration Program, NOAA, Surface Water Ambient Monitoring Program–SWAMP in California) or via direct funding to Dr. Teh (e.g. Interagency Ecological Program–Pelagic Organism Decline, Department of Water Resources, California Department of Fish and Wildlife, US Environmental Protection Agency, State Water Resources Control Board, the California Department of Fish and Wildlife and other private water contractors in California). Funding for outreach activities is an integral component for most of these projects and thus will be sustained as our research proceeds. To supplement our efforts, we aim to develop proposals with UNHAS faculty that will be submitted to the Indonesian Ministry of Education. Multi-disciplinary proposals will be developed at the Aquatic Health Program for funding support from the One Health Program and the Research Investments in the Sciences and Engineering (RISE) Program at UC Davis. Both of these programs highlight the need for broad and integrative outreach components that aim to engage the community regarding the conservation of natural resources and to build scientific capacity worldwide.

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25 October 2013

TO: SEED Grant Committee
RE: Letter of Support for Baxa and Teh Proposal: "Protecting Habitats from Pollutants to Improve Aquaculture and Livelihoods in Indonesia"

Dear Colleagues:

I am delighted to support the proposal of Drs. Baxa and Teh to support an expanded collaboration between UCD and Hasanuddin University (UNHAS) in Sulawesi, Indonesia. Their proposed research and outreach is highly relevant to UCD's mission and programs in Aquatic Health and the One Health Initiative, as well as in support of the MOA between UCD-UNHAS to foster research and education collaborations. In addition, their research is focused on one of the most pressing marine environmental problems- pollution of diverse kinds- that has plagued the planet since Rachel Carson first brought it to notice in *The Silent Spring*. Indonesia is particularly affected by marine pollution.

My own SEED grant awarded this year led to the MOA and building a marine debris K-12 outreach program in the Spermonde Islands of Sulawesi in collaboration with UNHAS faculty and students. My SEED grant led to a successful USAID PEER proposal (one of only 53), with travel funds for myself and students committed by NSF, so I will continue work I started with my SEED grant. I, and the students I have taken to Indonesia with me, are very excited to think we would be joined by Drs. Baxa and Teh and their lab group. In addition to the research and community outreach collaboration and companionship they would offer, their participation will greatly help everyone with dealing with the logistical and cultural challenges we face on each trip.

The research and outreach planned by Baxa and Teh will add a significant new and complimentary component to the research and outreach: marine food web contamination by plastics and other pollutants. Drs. Baxa and Teh have been phenomenally receptive campus colleagues for Indonesian research and hosted Professor Alexander Rantetondok on his recent visit to UCD. Drs. Baxa and Teh not only gave generously of their time but also provided critical funding for a shortfall in the travel grant 'Prof Alex' was given by the Indonesian Ministry of Education.

I am committed to helping them in any way possible and have already introduced them to the Mars Symbioscience team that is my partner and provides the match for my SEED grant. Mars has already pledged to help Dolly and Swee.

Finally, I have attached a photo from our SEED-PEER site to highlight the issue of marine debris in Indonesia, to emphasize visually the significant difference a UCD team and UNHAS collaboration can make to the people in the Spermonde Islands.

With my best regards,

Susan L Williams

Susan L. Williams, Ph.D.
Professor, Ecology & Evolution
Director Emeritus, Bodega Marine Laboratory
Campus Contact: MOA UCD-UNHAS

MARS

PT. Mars Symbioscience Indonesia
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To:
**SEED Grant Proposals Committee,**
UC Davis-University
Outreach & International Programs

RE: Support for the proposal from the Aquatic Health Program in the School of Veterinary Medicine at UC Davis to investigate "**Protecting Habitats from Pollutants to Improve Aquaculture and Livelihoods in Indonesia.**"

This is a letter of support for the Aquatic Health Program in the School of Veterinary Medicine at UC Davis proposal to work with the Universitas Hasanuddin and the Konsorsium Mitra Bahari to investigate Protecting Habitats from Pollutants to Improve Aquaculture and Livelihoods in Indonesia.

Mars has an ongoing engagement with the University California, Davis and Bodega Bay Marine research Laboratory supporting local logistics, management and communications, local transport and boat charter, equipment rental and consumables for collaborative projects on seaweed rehabilitation. We have also engaged and support ongoing work to evaluate and identify solutions in the areas of marine trash and engagement of the younger generation in the process to better understand the issues facing the marine environment going forward.
We very much welcome the engagement of the Aquatic Health Program in the School of Veterinary Medicine at UC Davis and are pleased to offer the same kind of ongoing support to facilitate local logistics, communications and engagement of local institutions and peoples.

Makassar, 30 October 2013

PT Mars Symbioscience Indonesia

**Ruud Engbers**
**President Director**

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**KEMENTRIAN PENDIDIKAN DAN KEBUDAYAAN**
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27 October 2013

TO: SEED Grant Committee
RE: Letter of Support for Baxa and Teh Proposal: "Protecting Habitats from Pollutants to Improve Aquaculture and Livelihoods in Indonesia"

Dear SEED Grant Committee,

I am grateful for the opportunity to support the proposal of Drs. Baxa and Teh for the Seed Grant application. This funding will allow them and their colleagues to travel to Hasanuddin University (UNHAS) in Sulawesi, Indonesia. Visiting the UNHAS marine station, faculty, and students will advance our research collaboration and establish outreach programs regarding the effects of plastic debris, wastes, and wastewater. The collaboration will examine these pollutants that endanger the coastal environments and aquatic resources in the Sulawesi region.

My recent visit to UC Davis through the current MOA between UNHAS and UC Davis, and co–hosted by Drs. Baxa, Teh, and Williams, gave me a broad perspective on the breadth of aquatic health research topics that are highly relevant in my laboratory at UNHAS Fish Diseases and Parasites. This Seed funding will allow Drs. Baxa and Teh and their colleagues to share their expertise on vital environmental and aquaculture problems associated with pollutants in the Sulawesi–Spermonde region.

Thank you and best wishes,

Dr. Alexander Rantetondok
Professor and Head of Fish Diseases and Parasites
Faculty of Marine Science and Fisheries
Hasanuddin University