



REGIONAL SEAS

J. C. Pernetta and H. I. Manner (eds.):

***The ecosystems of
small islands in the Southwest Pacific
(The sixth expedition of the SS "Callisto")***

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EDITORS' FOREWORD

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In mid 1987 the Association of South Pacific Environmental Institutions was asked to consider whether or not the account of the results of the Sixth voyage of the Callisto to various Islands of the South West Pacific was suitable for publication through the United Nations Environment Programme as a contribution to the knowledge of the area covered by the South Pacific Regional Environment Programme.

A preliminary examination of the manuscript indicated that the materials were indeed suitable and valuable but that considerable editorial and scientific review were required prior to the manuscript reaching publishable standard. The Association of South Pacific Environmental Institutions agreed in late 1987 to undertake the task of reviewing, editing and in some areas rewriting the materials for publication and the work was initiated at UNEP's request in 1988.

Each chapter was reviewed for scientific content as originally translated, by a specialist in the field. Each was then subsequently edited either by the reviewer or by the editors or in some instances by both. Both editors considered and reviewed every chapter at each stage of editing. Much of the terminology contained in the original manuscript was archaic and not used in the modern ecological and geographic literature published in English. The editors have therefore attempted where possible to use more modern equivalents, although in some instances the absence of a direct equivalent has led to the original term being retained.

The following people made substantive contributions to the editing and reviewing of various sections: From the University of the South Pacific, Dr P. Nunn, geomorphology; Professor J. Morrison, soils; from the University of Guam, Professor L. Raulerson, botanical biogeography; and Dr I. Schreiner, leaf beetles. Professor F. Kilmer of the University of Guam and Professor P. Hughes of the University of Papua New Guinea provided advice and assistance in a number of areas. One of us (JCP) took overall responsibility for reviewing the animal sections and one (HIM) responsibility for the botanical/geographical sections. Any errors arising from the editing process remain however the responsibility of the overall editors. We are also grateful to Dean David Gillespie, Mss. Rosa Muna, Carmen Santos, and Thelma Sarmiento of the University of Guam's Graduate School and Research for their support, and to Dr. Lu Eldredge of the Pacific Science Association for help with the references. In Moscow, I (HIM) am very appreciative of the warm hospitality of Drs. Vadim Skulkin and Timofei Zatspein, Alexey Sankovsky and Nadezda Drozdova, and Professor Yuri Puzachenko.

The document is an important contribution to the literature of the South Pacific region and represents a significant breakthrough in scientific communication. Numerous expeditions have been undertaken to the Pacific by both Russian and other research vessels and frequently the results are published in languages which cannot be widely read in the region itself. This report, originally written in Russian is now available in English and as such is more accessible to the people living and working in the region. A number of the approaches and views expressed in this document provide interesting and novel insights into the nature and functioning of the environments of the region and may serve as a stimulus to further work on the islands of the world's largest ocean.

John C. Pernetta & Harley I. Manner
Guam, August 1991

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AUTHORS' PREFACE

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BACKGROUND TO THE ORGANIZATION AND IMPLEMENTATION OF THE SIXTH EXPEDITION OF THE SS "CALLISTO"

A working meeting of the All Union Co-ordinating Group of Project 7 "Island ecosystems and their rational use", a project in the UNESCO "Man and Biosphere" (MAB) Program was held in Vladivostok in May 1978. Following discussion and amplification of the many program documents the meeting identified a number of scientific problems, in particular the need for research on islands in the equatorial/tropical regions of the world.

The agreed need for such research was based on the following points:

1. A basic understanding of the organization, interaction and functioning of biotic and abiotic systems is impossible without a thorough knowledge of equatorial-tropical examples. Any model or hypothesis based solely on research on temperate islands would be incomplete if it failed to incorporate and also explain data from tropical systems.
2. An understanding of the problems of island ecosystems is of great importance as a basis for developing ideas concerning the effects of time and space upon the structure and functioning of the biotic and abiotic components of the environment. The concept of an "island" can be expanded and applied to restricted areas or communities ("habitat" islands) *sensu* MacArthur & Wilson (1967), having different characteristics from those of the surrounding environment(s). Such areas or territories exist on continental land masses, frequently being the direct result of anthropogenic activity. Rational use and sustainable development of such areas involve close examination and control of economic as well as environmental problems. Within the tropics one finds a variety of islands, illustrating different environmental conditions which thus provide promising experimental systems for research.
3. Many islands in the Pacific have been well studied, however the data have been collected by scientists from different disciplines and schools of thought. It is therefore often difficult to interpret such data without personal experience of the environment in question, and on the islands concerned. The Soviet school of geography and ecology uses approaches which differ from those of scientists elsewhere; approaches developed on the basis of large and complex expeditions to remote and extensive territories which resulted in the development of new ideas concerning the relationships between environmental components. It was anticipated that the participation of Soviet geographers in an expedition of this kind would throw new light on the functioning of island ecosystems.
4. Finally, similar research work carried out by geographers participating in the sixth expedition of the SS "Dmitriy Mendeleev" in 1971 had resulted in the identification of some promising avenues for further research.

Recognizing these points the Pacific Institute of Geography of the Far-East Scientific Center of the USSR Academy of Sciences laid plans between November 1976 and March 1977 for a specialized island expedition undertaken within the framework of Project 7 of the National Man and Biosphere Program. The leading Soviet scientific research institutions involved in ecological and geographic studies of ecosystems, environments and their components took part in the planning and implementation of this expedition.

A large number of experts were invited to assist in designing the preliminary program, the scientific workplan and the itinerary of the expedition. Numerous alternative hypotheses concerning the structure and functioning of island ecosystems were considered and discussed, and different

approaches were ultimately integrated to provide an optimal program. The research was to center on the structure and functioning of particular island systems at different scales of investigation.

Based on available current theories and general concepts, it was postulated that the structural and functional interaction of the systems to be studied would be determined by the following factors:

1. Island size.
2. Island age.
3. Geological structure.
4. Evolutionary history.
5. Remoteness from the colonizing source.
6. Patterns of rainfall and relative humidity regimes.
7. Temperature regime.
8. Anthropogenic effects.

Considering all possible combinations of the factors listed above and using a latin square approach, it was determined that the expedition would have had to investigate a minimum of 28 islands, a task which was impossible to accomplish during one expedition. In addition it is well known that not all possible combinations of the above factors actually occur in nature; therefore in compiling the expedition itinerary the following additional points were taken into account:

1. The relative importance of each of the factors listed above.
2. The selection of islands to cover as much of the matrix of possible conditions as was practicable.

In this way small islands with an area of less than 50 square kilometers were identified as the main objective for investigation. This selection was made because it was actually possible within a three to five day visit to identify the basic patterns of the island's ecosystems and because such small islands have been little studied previously. Some basic parameters for the islands visited are presented in Table 1, and a map of the cruise route is presented in Figure 1.

Taking into account the difficulties of arranging visits to these islands the original intention was to have several replicates of each "type" of island. During the expedition it was possible to investigate a group of islands which largely corresponded to those categories identified in the preliminary plan. Large islands were studied by means of available literature and through personal investigations by expedition members during their excursions to these islands.

The small islands selected were of two basic types; volcanic and atolls. One island composed of metamorphic rocks was also investigated. Geologically all of the islands belong to the oceanic and transitional zones of the Pacific, and the majority are at the same distance from potential sources of colonizers. In general all of the islands were similar in terms of their rainfall patterns though they differed in their temperature regime and geological age. The expedition examined the islands' structural characteristics, while the functional interrelationships between the various elements were studied as secondary objectives. It proved possible to investigate three aspects of each island: its landscape; the geological facies; and the biological community. This approach provided on the one hand, a relatively complete description of the island in question and on the other, a good correlation between the materials under study.

Table 1. Location and morphometry of the islands visited by the Callisto.

Island	Proximity To Nearest Landmass (km)	Area (km ²)	Size L x W (km)	Height (m)	Slope Steepness ° Inclination
Bagaman	205 to New Guinea	8	5 x 2.5	219	0 - 10; 30 - 50
Pio	22 to San Cristobal	2.5	2.6 x 1.4	34	0 - 2; 15 - 32
Norfolk	780 to New Zealand	34.1	9.5 x 5.7	318	2 - 10; 15 - 25
Raoul	1000 to New Zealand	29.2	10.5 x 6.7	516	30 - 50; 50 - 90
Niuafo'ou	425 to Samoa	18	8.5 x 8	260	2 - 7; 15 - 30; 50
Suvarrow	832 to Samoa	0.4	15.5 x 17.5	4	
Pukapuka	645 to Samoa	3.8	9 x 4.5	5.5	

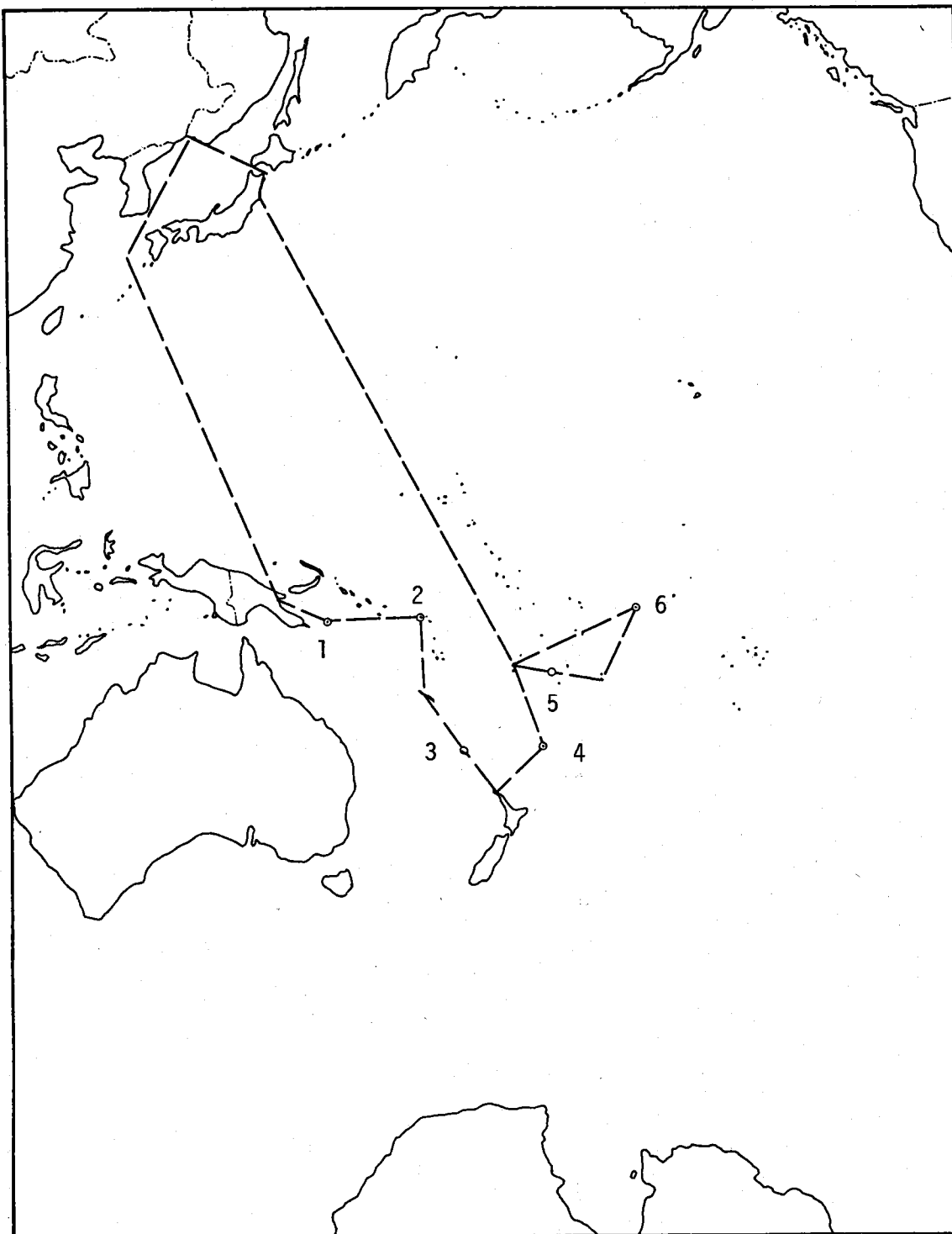


Figure 1. Route of the sixth voyage of the SS Callisto. Islands visited are indicated as follows: 1, Bagaman Island, Louisiade Archipelago; 2, Pio, Solomon Islands; 3, Norfolk Island; 4, Raoul Island, Kermadec Archipelago; Niufo'ou Island, Tonga; 6, Pukapuka Island, Cook Islands; Suvarrow Atoll, Cook Islands.

ACKNOWLEDGEMENTS

Y. G. PUZACHENKO

The event which resulted in this monograph, the first voyage of the scientific research ship "Callisto", was unique. This voyage was devoted to the task of studying the ecology of the small islands in the Pacific Ocean. This attempt was initiated by A. P. Kapica, the head of the Soviet Far East Scientific Center. Until that time, the Russian scientific ships worked only in the open seas, and changing this tradition was difficult to overcome.

There were many obstacles which we had to overcome, making this monograph, indeed, a minor miracle. To begin, the presence of Soviet ships in the Pacific has never been taken lightly. The majority of the Pacific island governments consider them as spy ships, making their ports of call an adventure. Our technical equipment was not very new or reliable. In fact, our most complex instruments were radar and a depth sounder which, however, didn't work during most of the expedition, particularly when the ship was close to landfall.

Few of us had any idea of the islands of the Pacific. All the islands that we eventually visited were selected using inappropriately scaled maps with obsolete and often erroneous navigational information, while we were still in Russia. Despite the poor information, but perhaps overshadowed by our romantic imaginations of these islands, we selected the islands of our expedition, several months before our voyage. To our surprise, our choices proved to be very appropriate.

The 1970s was the period of detente and the establishment of a new world order. Russian visitors to the Pacific islands were unique and attracted a lot of local attention. We would like to note that in most cases, we were accepted with great warmth and were given everything that we needed to accomplish our work. We therefore, thank the administrations of the islands we visited, the local scientific organizations and all the people who helped us. We will treasure the memories about these people for the rest of our lives. Without their unselfish assistance, we could not have solved the smallest of our problems. Of course, there were some variations to the rule. On Papua New Guinea (Vauvau Station), we were met by the representatives of the Australian intelligence service. Fortunately, alcohol worked well to ease tensions and allay their suspicions. Perhaps, for fear of their lives, the women of Niuafu'ou island preferred that their husbands stayed on land. A day after our arrival there, our main duty was to reduce the number of parties and festivals both on and off the ship.

We acknowledge with thanks, the crew of the "Callisto", who helped us, not only during the landings, but with our scientific work as well. The male sailors cleared the transect pathways of vegetation, while the female sailors wrote our notes of the islands' vegetation. For all of the expedition members, these were without doubt, the happiest days of our lives.

With this voyage, scientific expeditions into the Pacific became a tradition. The 12th and last voyage of the "Callisto" was made in 1978 to the islands of Tonga and Western Samoa. These were followed by special expeditions to the Seychelle and Vietnamese islands. While many of the research materials have been published in Russian, few have been published in English. Because of its significance, we believed that it was necessary to make this monograph available to the English reader. Fortunately, UNEP supported this idea and this monograph is the result.

There were still many other problems. The first problem concerned the translation. Unfortunately, each language is very specific and many widely used scientific words have slightly (or completely) different meanings in different languages. Although our interpreters were specialists in the different areas of science, they were sometimes confused by the peculiarities of scientific terminology. The situation was complicated by the "island" character of Soviet geography; some of our specific scientific terms have no equivalence abroad. We thank our interpreters for their efforts, achieved under trying circumstances, and our English speaking editors who did a great job to make this

monograph available to the wider scientific reader.

However, the process of translation and editing has been pretty long, with the text traveling a lot across the Pacific. Finally, the text found its last "father" - Professor Harley I. Manner of the University of Guam. Professor Manner agreed to undertake the most difficult part of the work and finalize the monograph. During this final state, we realized that Guam is fairly distant from Moscow, and the airline and other connections between these two places are far from perfect. The organization of two meetings between the Russian and English editors has taken two years to accomplish as desires did not coincide with the opportunities.

Finally, we hope that our work can present new information and ideas about the ecology of the small islands of the Pacific Ocean. These islands are important models for the question of biodiversity preservation. We hope that our work will attract other scientists and applied specialists to working in these often neglected islands.

For the authors of this monograph, I thank everyone who took any part in it. I send my best wishes to all of them.

Professor Y. G. Puzachenko
Moscow, July 28, 1991

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