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CANARY ISLAND MARINE BIOLOGICAL EXPEDITION - 1967

PRELIMINARY REPORT

EDITED BY :

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December, 1967.

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Preliminary Report

December, 1967.

Introduction :

The field work of the 1967 expedition has been completed successfully and the team is now involved in the examination of the specimens and data collected. As this aspect of the study will take a considerable time, this short preliminary report has been produced to give a summary of the general results of the expedition. General reports, as well as scientific papers will be prepared and sent to all interested organisations.

Sponsorship :

The expedition received financial support from -

The Royal Geographical Society
The Court of the University of Edinburgh
The Court of the Heriot-Watt University
The Gilchrist Educational Trust
Shell International Petroleum
Arthur Guinness and Son
Sir James Miller Edinburgh Trust.

Dr. Johnston and Mr. Morrison received a research grant from the Carnegie Trust for the Universities of Scotland. Dr. Johnston also received a special research grant from the Royal Society, to enable him to purchase a compressor for his work on marine algae. Several travel grants were obtained by members, including -

F. Archibald received a grant from Ferranti Ltd.

J. Buchanan	-	Buchanan Trust
T. Borthwick	-	Heriot Trust
J.P. Cook	-	Paisley College of Technology
J.H. Duffus	-	Rootes Trust
A. Haxton	-	Heriot Trust
D. Robson	-	Edinburgh Corporation and Edinburgh and Leith
and P. Smith	-	County Scout Council
E. Sprigg	-	Heriot Trust
V. Thambyrajah	-	The British Council

The expedition received considerable material assistance from over 100 companies. The Universities of Warwick and Heriot-Watt, and Paisley College of Technology loaned considerable scientific equipment for use in the expedition research programme. Full acknowledgements of this support will be given in the General Report.

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The scientific programme received the official recognition of the Department of Advancement of Science for UNESCO.

Transport :

The expedition party travelled down to the Canaries in the vessel t.n. 'Begona', of the Spanish Line, calling in at Santander, Coruna, and Vigo. The 'Begona' took members to Las Palmas on Gran Canaria and after a few official problems they were able to sail for Lanzarote in a modern inter-island vessel. Apart from a chaotic arrival on Lanzarote, amidst a Fiesta, the party moved to Arrieta and set up the main base in the old house that had been used on the 1965 expedition. Transport plans on the island included the hire of a microbus for dive visits involving the main party, plus the full-time hire of a car for commuting between the expedition base in Arrieta and the research laboratory set up in the town of Arrecife.

Accommodation :

The main expedition base was set up in Arrieta, a village to the north of the island. On this occasion, however, a research laboratory was established in the school in Arrecife, the main town on Lanzarote. This laboratory was used for the biochemical investigations, while a field laboratory in Arrieta was used for the routine biological work.

The Island:

Lanzarote is a volcanic island with contrasting scenery. Although there has not been an eruption for nearly 200 years, in parts of the Montanas del Fuego (Fire Mountains), a region in the S.W. corner of the island, the ground is so hot that it is possible to cook food quite readily without any other source of heat. For tourist purposes, holes have been cut into the rock and local food dishes, e.g. paella, are cooked in the hot air which rises from the ground. Similarly, if one pushes dry brushwood into cracks in the rock it will burst into flame within a few seconds. Here too are vast flows of black lava, petrified into weird shapes. One of the recent lava flows is over a mile wide and runs into the sea in the area just north of El Golfo. Near to the Montanas del Fuego there are extensive vineyards, the vines being grown in small walled 'craters' which have been cut into the beds of volcanic ash by the inhabitants of the area. By planting the vines in these depressions the inhabitants have protected the plants from the almost perpetual wind which buffets the island. Similarly, one often finds that the fields have been covered by small walls which have been built round individual plants to give them added protection. Other parts of the island are covered in dusty sand ranging in colour from red to black and the fields form a patchwork of colour when viewed from high on the hillside. As the surface soils are of no value for growing crops, the farmer puts down a layer of black volcanic ash over the ground. This cinder bed holds moisture and gives good rooting medium for the crops which are mainly grown in the winter months. The quantity of fruit which is grown on the island is exceedingly impressive for an island with such arid conditions. A considerable quantity

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quantity of the island produce is sold locally, but certain fruits (e.g. the water melon) are exported.

To the north of the island, the seascape rivals the landscape as one looks out from the cliffs bordering the Rio Strait to the white sands of Graciosa and the more distant islands. Even underground there are scenes of remarkable beauty. The Cuevas de Los Verdes is a series of huge caves which runs underground for over seven kilometres and in places is made up of galleries at four different levels. In the early history of the island, the inhabitants used to hide in these caves from invaders. A section of the cave formation has now been opened up to tourists. The natural architecture of the caves has been enhanced by carefully chosen lighting and it leaves one with the impression of majesty resembling that left by a great Gothic cathedral. One section of the cave is used for concerts and the acoustic effect is excellent.

Tourism is a rapidly growing industry on the island and will presumably become the major source of island income. Over the two year period since the first expedition (1965) there have been several introductions including the completion of a very impressive night club in the cave of Jameos del Agua, the completion of a new luxury hotel called 'Los Fariones' near Playa Quemada, the introduction of many tourist facilities in the main town of Arrecife, and the building of improved roads in several parts of the island. At present further projects are underway, such as the building of several new hotels in Arrecife, including a multistorey luxury hotel to the southern end of the town. Many more tourists are reaching the island from Las Palmas and cruise ships are cal ling at Arrecife itself, e.g. the cruise vessels of the Fred Olsen Line. With the safe prediction of further trade and tourism the commercial wharf in Arrecife is being extended to cope with larger vessels. Further trends include the 'urbanisation' plans already started, i.e. the construction of holiday villas, bungalows, etc. near the more popular beaches, e.g. Playa Blanca. Many foreign people are buying land, especially Germans and Swedes, e.g. a large group of bungalows has been built at Arrieta by a Swede, near the location of our 1965 and 1967 expedition base.

There is no doubt that prosperity will come to the island, but with the influx of tourists much of the island character and charm will be lost. This is known by the local inhabitants but necessity forces them to accept the trend. It means, of course, that those of us who seek coasts unaffected by tourists must find new ground. Fortunately, for this one need not leave the Canaries because many of the smaller islets are uninhabited and some have never 'seen' a scientist!

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Even yet the greater part of the population gains its livelihood from the sea. An industry which presents a very impressive sight is that of salt production from sea water. Windmills pump up the water into huge pans where it is left to evaporate in the strong sun. The fishing industry has been increased in importance over recent years by the building of several large fish processing and ice-making factories around the main town of Arrecife. The island authorities have also helped the industry by building new houses for the fishermen. The fisheries formed part of the expedition study programme and are discussed later in this report. One of the latest introductions to the island, and probably the most important step in increasing its prosperity, was the building of a salt-water desalination plant near Arrecife. This plant was built by an American firm and produces about 30 litres of fresh water per second. The unit is coupled to a power plant producing electricity for the island.

Scientific Investigations :

The major part of the research programme was devoted to a study of the marine benthic ecology of the area. This work could be divided into three main sections.

1. An investigation of the ecological distribution and primary production of benthic marine algae was carried out by Dr. Johnston, assisted by J. P. Cook.

2. A biochemical and ecological study of selected marine benthic molluscs was undertaken, particular attention being given to attempts to establish a correlation between digestive capability and ecological distribution. This work was led by Dr. Duffus, assisted by Dr. Thompson.

3. A general survey of the marine flora and fauna of the benthos was undertaken, this being a continuation of the large-scale survey undertaken in 1965. This work was supervised by K. MacLachlan.

Several other projects were undertaken, including a study of the island fisheries by D. McKinlay (reported in this publication), and a photogrammetric survey by I.A. Morrison. The techniques developed by Mr. Morrison were employed in the algal survey by Dr. Johnston, with the assistance of G.S. Evans.

It is, unfortunately, important to mention that the 'timetable' for the research programme had to be re-arranged drastically when the new compressor for charging diving tanks broke down and required a complete replacement unit to be sent down from Britain. This meant that for several weeks the underwater studies had to be carried out/...

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Community Type	Locality (where examined)
Cystoseira abies-marina	La Santa; Jameos del Agua; Famara
Cystoseira fimbriata - Padina pavonia	Los Charcos
Padina pavonia - Halopteris scoparia	nearly every locality round island, especially east coast, e.g. Arrieta
Padina pavonia	Playa Blanca; Papagayo
Cladostephus verticillatus - Halopteris	Arrieta
Cymopolia barbata	Arrieta
Galaxaura spp.	Jameos del Agua
Caulerpa prolifera	Arrecife, south (shallow and deep)
Zostera marina - Caulerpa prolifera	Arrecife south ; Los Charcos
Zostera marina *	Playa Quemada; Rio Strait; Arrieta
Lithophyllum spp.	every locality
Stipopodium zonale	Jameos del Agua
Dasycladus vermicularis	Arrieta
Caulerpa racemosa and Webbiana - Halimeda tuna	Arrecife south

(* - Zostera is an angiosperm but is listed because it is a marine species)

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The commonest algal community of the island benthos is Padina - Halopteris, which is found at most localities, especially in the more sheltered areas. It is replaced by Cystoseira communities in areas of heavy wave action, e.g. the west coast of the island (La Santa, Famara) and parts of Jameos del Agua and Los Charcos on the east coast. The other communities mentioned are frequent around the island but only the Caulerpa prolifera and Zostera marina communities occupy large areas of the sea bed. They dominate sand habitats and C. prolifera is found to depths in excess of 40 metres.

In the General Report, and in scientific papers, a more detailed description will be given of each community and its representative species. Some mention will be made of the more important animal species associated with these communities. Although precise communities have been listed in this preliminary report, there were occasions where mixing occurred and this will be discussed.

Many of the communities listed above were examined on a quantitative basis, using three survey techniques:-

a) quadrat analysis, using fresh weight and dry weight values as measures of algal 'standing crop';

b) photogrammetric estimation of percentage cover, i.e. quadrat analysis recorded by photographic methods, enabling the field analysis to be rapid and the accurate measurements made from photograph s at a later date;

c) a 10-point method estimating percentage frequency of the various algal species.

Apart from providing an assessment of the quantit ative structure of the major algal communities, this approach enabled survey techniques to be tested and developed, and valuable comparisons made.

Short-term and 24-hour period primary productivity estimations were made for selected algal species. Rates of production of organic material by photosynthesis were calculated from data obtained by the "light-dark bottle" technique, using C^{14} incorporation and oxygen production methods of assay. The algae studied included -

Caulerpa prolifera/...

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Caulerpa prolifera
Caulerpa racemosa
Caulerpa mexicana
Padina pavonia
Codium sp.
Cymopolia barbata
Halopteris scoparia
Cystoseira abies-marina
Cystoseira fimbriata
Pocockiella variegata
Galaxaura sp.
Gelidium sp.
and the angiosperm - Zostera marina

A critical examination of methods was undertaken and several interesting facts ve been obtained. The accuracy of the "light-dark bottle" method will be considered, nd the advantages/disadvantages of the C^{14} and oxygen methods will be assessed. It as found that in determining net daily production, the two techniques gave very similar esults.

The relation between depth and rate of photosynthesis was examined, using both methods, this work being carried out to depths of over 33 metres. Several other physiological factors were examined and will be discussed in the General Report.

An attempt to correlate the digestive capability and ecological distribution of Benthic marine molluscs. by Dr. J.H. Duffus.

It is very difficult to establish the feeding habits of many small marine molluscs with any degree of certainty. Careful investigation may show that each species is to be found in association with a limited range of algae but whether a given mollusc feeds on the alga with which it is associated or on the epiphytes of that alga cannot be readily ascertained from simple observation. Hence it was decided that it would be of value to carry out a direct survey of the distribution of molluscs in a given algal population and simultaneously to investigate the digestive capabilities of these molluscs as indicated by their enzymic potential.

The use of divers for collecting ensured the quantitative nature of the direct survey. Firstly pure stands of each alga were selected, a polythene bag was placed carefully over each algal sample and tied before the sample was cut free. Thus any molluscs washed off the algal fronds would be retained in the bag. Once at the surface, all the contents of the bag were washed into a basin for sorting. When all molluscs had been removed from the algal sample, it was air dried and weighed. The number of molluscs was then calculated per kilogram dry weight.

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For the enzyme studies, the molluscs were extracted with water. Only live molluscs were used and the extractions were carried out as soon as possible after sorting. The extracts were assayed for ∝-amylase, laminarinase, agarase, cellulase, acid phosphatase and acid esterase activities. Activities were expressed as enzyme units per unit fresh weight but, without knowledge of the stability of the enzymes concerned the results can be considered as having only qualitative value.

Fourteen species of algae were investigated. Broadly they could be divided into two groups - those on which Tricolia pulla was dominant and those on which Bittium reticulatum was dominant (Table). In the former case, dominance was often shared with Rissoa spp, particularly Rissoa costulata. In the latter case it was often shared with Calliostoma exasperata. Enzyme studies also showed this relationship between the species. Tricolia pulla and the Rissoa spp. showed marked ∝-amylase and laminarinase activity. Bittium reticulatum and Calliostoma exasperata showed slight amylase activity and no laminarinase activity. How this biochemical distinction is related to algal preference is at present under consideration.

Algal Species Showing Tricolia pulla or Bittium reticulatum Dominance.

Tricolia pulla	Bittium reticulatum
Cystoseira abies-marina	Caulerpa prolifera
Cystoseira fimbriata	Caulerpa racemosa
Clado stephus verticillatus	Codium sp.
Galaxaura spp.	Codium Bursa
Halopteris scoparia	
Liagora spp.	
Pockockiella variegata	
Gelidum sp.	
Padina pavonia	

As well as the molluscs mentioned above, another fifteen species were analysed in the same way with respect to their digestive potential. The results are being compared with information available in the literature concerning their feeding habits.

From many of the species studied acetone powders have been prepared and these should enable more detailed studies to be made of selected enzymes.

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A Survey of the Fisheries of the Canary Islands - A Preliminary Report by D.A. McKinlay, M.A.

It is the purpose of this report to outline the nature and extent of a fisheries survey carried out in the Canary Islands, and, in particular, on the island of Lanzarote, as a part of the 1967 Canary Island Biological Expedition, and to indicate progress made since towards the compilation of a full report on this topic.

The fishing industry is vital to the economy of the Canary Islands. The study of this industry assumes greater importance in the light of the ever increasing danger of over-exploitation on this, one of the world's most important fishing grounds. This topic is to be discussed at a symposium, organized by the International Council for the Exploration of the Sea, to be held at Tenerife in the Canary Islands in March, 1968.

Typically, towards the Equator, the volume of individual species of fish decreases and the variety of fish increases. The Canary Islands offer, therefore, one of the best combinations of extensive commercial fishing and a vast variety of interesting non-commercial fish.

The aims of the fisheries study were twofold. Firstly, it was desirable to obtain further information on an activity which forms an integral part of the economy of Lanzarote and the other islands in the archipelago.

An attempt was made to obtain information about fish caught, fishing methods, landings (cath statistics) and the influence of the fishing industry on the island economy and the way of life of the inhabitants.

Throughout this part of the survey, methods applicable to any natural resource assessment have been used. The 'common property' nature of this resource, together with the very varied nature of the islands' fisheries have added to both the interest and the difficulty of this study.

The second aim was to integrate this work with the scientific studies being carried out by the other members of the Expedition. It must be emphasized at this point that, in accordance with all major international organizations in this field, the products of the sea, /...

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sea, often grouped under the single heading "fisheries", include molluscs, crustaceans and aquatic plants as well as fish. Molluscs and crustaceans form an important part of the total fisheries' product of the Canary Islands and, for this reason, shall be included in all future discussion.

The nature of the resource under consideration limited the degree to which field observations could be carried out. Therefore, although the landing, processing, and marketing of fish were all examined, the first two stages of the fishing process - namely the locating and catching of the fish - could not be observed. This obvious disadvantage has been compensated for, in part, by use of 'second-hand' information from interview and from available literature.

On the island of Lanzarote, harbour activities and organisation were observed at Arrecife - the main port for the island - and, on a much smaller scale, at Arrieta, where the Expedition was based, Orzola - a small village to the north of the island, and at other small villages around the coast. Observations were also made during a trip to the small island of Graciosa where fishing is the mainstay in the economy of the small community.

In Arrecife, five fish processing plants were visited and various processes of conservation observed and photographed. These processes included drying, salting, canning and deep-freezing. These plants which employ 800-900 people are of considerable important in the economy of the island. In addition to employing a significant percentage of the working population of Lanzarote they provide a continuing outlet for fish caught by local crews, they increase the standard of living by paying steady wages and giving stable, though slightly seasonal, employment, and they utilise other local products such as salt. The 'invisible' benefits to the island are also important; these include the social amenities and essential services which accompany industrialisation and a better economic atmosphere for the inflow of capital from private and government sources, with a possible spiral effect as existing factories expand and subsidiary industries are set up.

The main importance of the fisheries in Lanzarote would seem, therefore, to be as a growth industry, or at least as a stabilising point in an expanding economy much dependent on tourism.

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The smaller villages such as Arrieta where the fish caught are consumed by the villagers themselves on a subsistence rather than on a profit-motivation basis will, in all probability, be drowned by the incoming flood of tourists and the accompanying architectural catastrophes.

Where possible, during brief visits to other islands, photographs were taken of general fishery activities and observations made. Only a small proportion of fish landed in these islands are caught on the insular fishing grounds. The main hauls are made on the so-called 'Saharan Banks' - the zone directly influenced by the favourable conditions of the Canary Current.

While in Las Palmas a brief observation of the 'shape of things to come' in the fishing industry was obtained. Large stern trawlers, and stern freezer-trawlers, showed that fishing in this area has become a well organized, high-capital industry.

Whereas the first part of the survey was concerned with geographical and socio-economic considerations, the second was more involved with biological factors. It must be emphasized that, although during the general underwater survey work, fish were observed and photographed, the work of this fisheries survey did not involve underwater observations. It had been planned to investigate fish feeding habits by underwater observation and gut analysis but the member who was to be responsible for this work had to withdraw from the expedition team. It is hoped, however, that photographs, and notes made by the marine biologists will prove useful in co-ordinating the fisheries'studies with the other results.

Throughout this second part of the study, work has been done mainly from published sources, and relevant information on several species has been filed. The final report will include sections on food-chains, fish migrations, plankton productivity and other biological factors which have a direct bearing on the fisheries of the area.

In both parts of the survey, the method of 'observation - analysis - interpretation' has been applied. Observed characteristics have been correlated by use of statistical, and other published material. Analysis is being carried out both qualitatively (by assessing the general nature and characteristics of the fisheries of the area), and quantitatively (by statistical analysis of figures issued locally, nationally and internationally). Statistics on three different levels are, therefore, being used, to give a clearer picture of the fisheries both as a separate entity and as part of a broader unit. Statistical tables with graphs, maps and analyses, will be included in the main report.

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While interpretation of available information is continually being carried out as work on this project progresses, final conclusions cannot be stated in this report.

To say that this survey has progressed smoothly and efficiently would be wrong. Both on Lanzarote and in Edinburgh there have been setbacks due to delays in obtaining information, difficulties of translation and of comparing different statistical sources etc.

Already, however, much useful information on the fish and fisheries of this area has been unearthed; a comprehensive index and classification of species has been compiled and additions are constantly being made to this; a bibliography consisting of works both in Spanish and English, has been built up, and, probably most important, contacts have been made with many individuals and authorities. A full list of these persons to whom we are indebted will be included in the main report. In the meantime, however, our very sincere thanks go to all those who have extended the hand of friendship and assistance to us and helped to make our work both enjoyable and fruitful.

General Remarks:

The findings of the 1967 expedition have added greatly to the work carried out in 1965. A considerable percentage of the 1967 programme was quantitative and physiological in nature and was established on the solid but qualitative findings of the 1965 expedition. Studies of the 1965 specimens and data are still being undertaken and because of the continual cross-reference that will occur between 1965 and 1967 data it has been proposed that, after the completion of the 1967 General Report, all work will come under the title of the Canary Island Biological Survey. This will enable later studies to be included under the same programme title.

Acknowledgements:

We would like to offer our sincerest thanks to all the organisations and individuals that assisted our expedition. Apart from all the organisations that assisted with the supply of stores, equipment and finance, innumerable persons helped with the organisation of the project. We will give full details of all that support in our 1967 Expedition General Report.

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December, 1967.

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