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NINETEENTH REGIONAL TECHNICAL MEETING ON FISHERIES

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ACIAR PROJECTS

(Paper prepared by Australian Centre for International Agricultural Research - ACIAR)

INFORMATION PAPER
FOR
NINETEENTH REGIONAL TECHNICAL MEETING ON FISHERIES
SOUTH PACIFIC COMMISSION

The following Project summaries from Projects funded by the Australian Centre for International Agricultural Research are provided for information.

FISH DRYING IN EAST JAVA

GROWTH AND RECRUITMENT STUDY ON COCONUT CRAB BIRGUS LATRO POPULATION IN VANUATU

PREDICTION AND CONTROL OF SPOILAGE OF FRESH, CURED AND DRIED TROPICAL FISH IN INDONESIA

RESEARCH ON BAITFISH BIOLOGY IN THE SOLOMON ISLANDS, MALDIVES AND PAPUA NEW GUINEA FOR THE TUNA INDUSTRY

THE CULTURE OF THE GIANT CLAM (TRIDACNA SP.) FOR FOOD AND RESTOCKING OF TROPICAL REEFS

Further information on these projects may be obtained from Dr. J.W.Copland, ACIAR, G.P.O. Box 1571, Canberra, A.C.T., 2601, Australia, or the various Project Leaders indicated.

The attention of those countries with interests in giant clam resources, harvesting and mariculture is drawn to the announcement of a Workshop on Giant Clams on the last page of this submission.

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Project 8313

FISH DRYING IN EAST JAVA

Program: Post-harvest Technology
Program Co-ordinator: Dr J.W. Copland

Indonesia harvests a huge fish catch, but loses much of the benefit through post-harvest losses, currently estimated at 30% or more. In East Java, villagers process more than 70% of the catch as dried salted fish, which also undergoes considerable wastage. While the need to reduce the post-harvest losses of these high-protein but unstable foods is urgent, it is vital to implement improved practices in a manner appropriate to the economy of the region and through products that find local acceptance.

This project will characterise and evaluate the current practices, their variations and defects, and involve experimental studies designed to overcome such defects from the time of fish capture to the time of retail sale of dried fishery products from Muncar, East Java. All stages will include an economic evaluation and establishment of cost-benefit analyses for procedures developed to establish solutions. It has a number of related aims: to upgrade the drier-design skills of Indonesian workers; to establish the fundamental knowledge necessary for an appropriate design of fish driers; to define the extent and cause of dried fish wastage and/or economic loss in the system; to define and implement solutions in order to establish in Muncar, model procedures of positive cost-benefit and to encourage their wider adoption throughout East Java; to identify priority areas requiring further basic research; and to recommend such areas for later co-operative study.

In Indonesia, scientists from the Research Institute for Fish Technology (RIFT) will investigate on-board handling and fish landing and classification. Others at the University of Brawijaya (UNIBRAW), in association with staff of Canada's International Development Research Centre, will contribute information on salting and brining and study drying at Muncar. The two groups will combine to evaluate dried products. In each of these areas, the team will define current practices and develop and assess possible variations in usage, with emphasis on development of a five-category sensory grading scale.

Meanwhile, the Australian scientists will undertake fundamental drying studies in Sydney, to establish fish drying curves in terms of air temperature, humidity and velocity, product:air orientation, fatty and non-fatty fish, pretreatment method, fishery form and thickness. They will assess physical, chemical and microbiological aspects of dried products, during and after drying and during storage. Using established fundamentals, they will try to solve problems identified in Muncar and to establish drier designs appropriate to the economics, resources and needs of smaller and less developed fishery centres of East Java.

Scientists from both countries will study the packaging, storage, transport, distribution, marketing and retailing arrangements that apply to the Muncar catch. Again they will define current practices and problem areas, but will emphasise other economic aspects in addition to losses from wastage.

Indonesia's Ministry of Agriculture can provide considerable statistical records, giving basic information on fish catches of East Java and of Muncar in particular, and ambient weather conditions in various areas. This will help in establishing priority ranking in the extension of model Muncar processes to other regions of East Java.

Features of this project include additional training in Australia for Indonesian participants and the scientific contacts and collaboration in Indonesia with the IDRC of Canada. Moreover, the examination of the socio-economic factors involved in dry fish preservation and marketing will provide a valuable base line to evaluate further areas of research. The project complements ACIAR Project 8304 on fish spoilage in Indonesia; together they will make a substantial contribution to preventing post-harvest loss of fish.

Project Leaders: Prof. R.A. Edwards, School of Food Technology, University of New South Wales, Kensington, NSW; Mr Sofyan Ilyas, Research Institute for Fish Technology, Agency for Agricultural Research and Development, Jakarta, Indonesia; Ir. J.A. Sumardi, Department of Food Science and Technology, University of Brawijaya, Malang, East Java, Indonesia.

Collaborators: International Development and Research Centre, PO Box 8500, Ottawa, Canada, KIG 3H9; Ministry of Agriculture, Jakarta, Indonesia.

Related ACIAR Project: 8304 - Prediction and Control of Spoilage of Fresh, Cured and Dried Tropical Fish in Indonesia.

Estimated Expenditure: $340,946/3 years

Date of Approval: July 1983

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Project No. 8381

GROWTH AND RECRUITMENT STUDY ON COCONUT CRAB *BIRGUS LATRO* POPULATION IN VANUATU

Program: Animal and Fish Production
Program Co-ordinator: Dr J.W. Copland

Coconut crabs are prized items, both in the diet of island people of the Indo-Pacific region and as restaurant delicacies. They are the largest of all terrestrial crabs, weighing as much as 4 kg, and the cause of their declining numbers may be exploitation by ever- increasing human populations.

A management regime is needed to establish balance between natural population size and desirable harvesting procedures. A record of growth rates, and a comprehensive understanding of the larval stages of the crab's life cycle are essential for devising an efficient management program. Any attempts to farm the crab will rely on this information.

This project is a response to a request from the Ministry of Agriculture, Forestry and Fisheries, Vanuatu. The results may have relevance for other small Indo-Pacific island nations whose populations of coconut crabs face similar threat.

Based at Luganville, Espiritu Santo, Vanuatu, the research program will centre on field operations. The Australian team, with local field assistants, will attempt to measure growth rates by a system of "mark and recapture" using transmitter or freeze branded tags which are designed to survive repeated moultings.

Vanuatu, a nation of scattered islands, has a range of human population densities. Stocks of coconut crabs will, therefore, be subject to differing exploitation levels, depending on their location. A survey carried out by the Port Vila-based staff of the Fisheries Department will gather information from the local fish market. Knowing the numbers, size and sex of the crabs on sale, and the details of their place of capture, will provide a picture of stock patterns in different parts of Vanuatu.

Project staff will observe crab populations in several locations, assessing population size and structure. The sex, length and weight of each crab encountered will be recorded, along with appropriate environmental data and habitat characteristics. Village people will be questioned to get some idea of the harvesting pressure in each region.

Attention will be given to stages in the life cycle of the crab. Microscopic examination of the "glaucothoe" larva and observations of its behaviour will attempt to establish differences between it and the larvae of closely related

species, especially *Coenebita* sp. Like the hermit crab, the glaucothoe larva of the coconut crab enters a small snail shell before coming ashore to complete its life cycle.

A concurrent rearing program is also proposed. By cultivating larvae in an aquarium/terrarium situation, patterns of shell and microhabitat selection, and changes of behaviour during the transition from water to land can be conveniently observed.

Juvenile coconut crabs are easily distinguishable from other species, and observations of the ecology and general behaviour will be an integral part of other field work in the program. Records of individual moultings and growth rates must rely on the tagging system working as predicted. Juvenile crabs are too small for radio transmitter tags, and should the technique of freeze branding prove inadequate, research workers will resort to maintaining juvenile specimens in individual pens, where the identity of each occupant can be assured.

A study of ways to improve marketing of the crabs will test the preservation and food quality of crabs which have been cooked and frozen prior to shipment to the markets. The research team also hopes to improve the survival rate of crabs caught by traditional methods and taken live to market.

A taxonomic survey of coconut crabs in other areas, using preserved material forwarded to the University of Queensland, will correlate and link biological data collected at Vanuatu with data about the coconut crab populations of other Indo-Pacific countries. The studies in Vanuatu will thus be relevant to the whole region.

Project Leaders: (a) In Australia: Dr I.W. Brown, Queensland Department of Primary Industries, Southern Fisheries Research Centre, PO Box 76, Deception Bay, Qld 4508; Dr D.R. Fielder, University of Queensland, St Lucia, Qld 4067,(b) In Vanuatu: Mr J. Crossland, Director of Fisheries, Department of Fisheries, Ministry of Land & Natural Resources, PO Box 22, Vila, Vanuatu

Commissioned Organisation: Queensland Department of Primary Industries

Collaboration in Australia: Zoology Department, University of Queensland; Queensland Institute of Technology

Developing Country Collaboration: Fisheries Department, MAFF, Vanuatu

Date of Approval: September 1984

Budget:	1984/85	89,500
	1985/86	117,000
	1986/87	100,000
	1987/88	67,000
	Total	373,500

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Project No. 8304

PREDICTION AND CONTROL OF SPOILAGE OF FRESH, CURED AND DRIED TROPICAL FISH IN INDONESIA

Program: Post-harvest Technology
Program Co-ordinator: Dr J.W. Copland

Spoilage of cured and dried fish results from the development of halotolerant and osmotolerant bacteria and fungi. Information about the occurrence and ecology of both groups remains fragmentary. In particular, information is required on the effects of various time-temperature-water activity combinations, to determine conditions under which fish may be safely dried and stored and to allow prediction of the remaining shelf life. Similarly, little is known about the mechanisms of spoilage of fresh tropical fish. Topics of interest include the mechanisms in iced fish and, especially, mesophilic spoilage. The latter occurs between 25° and 40°C, so the fish-handling practices in tropical countries give mesophiles ample scope: some fishermen carry no ice and hold the catch at ambient temperatures for some hours; later, transport in unrefrigerated containers may add to the problem.

This project will draw on expertise in Australia, Indonesia and the Philippines to conduct co-ordinated research into the processes causing tropical fish to spoil before they can be eaten. Fundamental research into the spoilage processes will include: identification and behaviour of the spoilage micro-organisms; fungal food spoilage, water relations and mycotoxins; biochemical aspects; rancidity in fresh and dried fish; fish species- and habitat-dependent effects; and the role of insects.

Much of the research on cured and dried fish will be carried out in Australia. Dry fish is relatively stable, and no major changes in mould microflora have occurred in the samples sent from Indonesian fish-processing yards and markets, on a regular basis, to Hobart and Sydney for analysis.

Scientists in Hobart measure the time-temperature-water activity tolerances of various bacteria (principally the red obligate halophiles) known to cause spoilage in dried fish. They are using a Malthus Microbiological Growth Analyser, a relatively new instrument in such research, to detect microbial growth by measuring changes in conductance of growth media. It enables more rapid collection of accurate data than traditional methods, and particularly suits such measurements at low water activities. Members of the team at CSIRO, Ryde, will conduct the studies on fungal food spoilage, fungal water relations and mycotoxins.

The two microbiological studies will provide the data needed to calculate the drying rates and storage conditions necessary to prevent bacterial and mould spoilage. The University of Tasmania's Department of Mechanical Engineering will undertake the mathematical modelling and analysis required.

Entomological studies at the same university will include the observation of sequences of infestation and the interrelation of insect and microbial spoilage.

Indonesian scientists in the various disciplines will co-ordinate their research with that of their Australian counterparts, but will place greater emphasis on fresh fish. This work will cover: the comparative spoilage rates of different fish species, including identification of the spoilage micro-organisms; a study of the effects of chilling; organoleptic and chemical tests; development of a marketable product from the trawl 'by-catch' (which is currently discarded); and the writing of 'good practice' codes for fresh-fish handling and distribution.

Australian scientists from the Royal Melbourne Institute of Technology provide advice on microbiological, chemical and sensory analysis of stored fish in Jakarta, and will undertake spoilage studies at the Institute. They will also maintain liaison with the group in the Philippines, which will study mesophilic spoilage, the effects of delayed icing on spoilage of fresh fish and the identification of the spoilage microflora.

Planned workshops during and at the completion of the project will facilitate dissemination of the results, which, together with those of the complementary ACIAR Project No. 8313 on fish drying, should make a substantial contribution to preventing post-harvest loss of fish.

Project Leaders: Dr Peter Doe, c/o Department of Civil and Mechanical Engineering, University of Tasmania, GPO Box 252C, Hobart, Tas., 7001; Mr. Sofyan Ilyas, Research Institute for Fish Technology, Jakarta, Indonesia.

Collaborators: Department of Agricultural Science, University of Tasmania, Hobart, Tas.; CSIRO Division of Food Research, Hobart, Tas., and Ryde, NSW; Department of Food Technology, Royal Melbourne Institute of Technology, Melbourne, Vic.; Universitas Brawijaya, Malang, Indonesia; University of the Philippines, College of Fisheries, Philippines; Indo-Pacific Fisheries Commission Working Party on Fish Technology and Marketing, c/o Mr D.G. James, FAO, via delle Terme di Caracalla, 00100, Rome, Italy.

Related ACIAR Project: 8313 - Fish Drying in East Java, Phase 1.

Estimated Expenditure: $458,300/3 years

Date of Approval: July 1983

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Project No 8543

RESEARCH ON BAITFISH BIOLOGY IN THE SOLOMON ISLANDS, MALDIVES AND PAPUA NEW GUINEA FOR THE TUNA INDUSTRY

Program: Fisheries
Program Coordinator: Dr J W Copland

Tuna fishing is a vital source of food, employment and export earning in both Solomon Islands and Maldives. Most of the tuna is caught using the traditional pole-and-line method, a technique that relies on baitfish - small fish which are thrown live into the sea to attract tuna schools within fishing range of the boat.

The long-term viability of pole-and-line fleets in both countries depends upon the assured availability of baitfish. Sampling of baitfish commenced in Solomon Islands in 1982, but a more coordinated effort is needed to understand baitfish biology and to determine the impact of baitfish extraction on the reef fish populations.

Tuna fishing in the Maldives involves a large proportion of the population. Tuna consumption per capita is the highest in the world, and tuna meat is the main source of protein. The country also wishes to boost its tuna exports, and a key component in this effort is the baitfish supply. There is evidence of local overfishing of baitfish and habitat destruction through coral mining. The biological status of the baitfish stocks needs to be established before an effective management plan can be devised. Traditional fishing practices also need examining.

The main objective of this project is to collect and analyse biological information on the important baitfish species in both Solomon Islands and the Maldives. These data will enable better management and conservation of the resource for both the traditional owners and the commercial tuna fisheries. Researchers will link up with similar work on baitfish in Papua New Guinea which has continued for some years.

Scientists will make a taxonomic evaluation of the baitfish population, and analyse species composition of baitfish catches throughout the year, recording weight and numbers of each species contributing to the total catch.

They will determine the population dynamics of the major baitfish species at several sites in Solomon Islands, Maldives and Papua New Guinea, and study the recruitment patterns of the baitfish species at each site. In addition they will establish the importance of baitfish in the food chain leading to the reef fish.

Other factors that the scientists will examine include: diet and feeding habits, and the influence of zooplankton species composition and distribution on the diets and abundance of baitfish; physio-chemical factors such as temperature, turbidity and currents. They will seek to improve technical and management aspects at each site, and determine the impact of existing fishing intensities on baitfish populations. Data collected will enable assessment and prediction of changes in populations resulting from varying degrees of exploitation.

Benefits from the projects are expected to flow on to other countries of the Pacific and Indian Oceans. Papua New Guinea will benefit by joining the Baitfish Research Network which will assist in analysis of data and translation of findings into an improved management regime.

This baitfish research fits into the research framework currently in progress at the CSIRO Division of Fisheries Research. Australia, Solomon Islands, Papua New Guinea and Maldives all share the same Indo-Pacific marine fish fauna, and the project will thus have widespread scientific relevance on top of the benefits to the tuna fishing industry.

Project Leader: Dr S J M Blaber, CSIRO Division of Fisheries Research, PO Box 120, Cleveland QLD 4163; Mr P V Nichols, Fisheries Division, Ministry of Natural Resources, Honiara, Solomon Islands; Mr Hassan Maniku Maizan, Marine Research Station, Ministry of Fisheries, Male, Republic of Maldives; Mr J Opnai, Fisheries Division, Department of Primary Industry, Port Moresby, Papua New Guinea.

Commissioned Organisation: CSIRO Division of Fisheries Research, PO Box 120, Cleveland QLD 4163.

Collaborators: Fisheries Division, Ministry of Natural Resources, Honiara, Solomon Islands; Marine Research Section, Ministry of Fisheries, Male, Maldives; Fisheries Division, Department of Primary Industry, Port Moresby, Papua New Guinea; ADAB Solomon Islands Fisheries Project.

Estimated Expenditure: $474,000/ 3 years

Date of Approval: 6 June 1986

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Project No. 8332

THE CULTURE OF THE GIANT CLAM (*TRIDACNA* SP.) FOR FOOD AND RESTOCKING OF TROPICAL REEFS

Program: Animal and Fish Production
Program Co-ordinator: Dr J.W. Copland

Giant clams form a significant component of the diets of the people of Oceania and South-East Asia, being completely edible except for the kidney. The adductor muscle is a highly prized food in South-East Asia. However, the combined effects of increasing populations, pollution and habitat destruction and the depredations of poachers have severely reduced stocks of these tridacnid clams throughout their Indo-Pacific distribution. Apart from large size, giant clams are notable for maintaining symbiotic algae in their exposed fleshy mantle tissue, which supply them with photosynthetic products. Thus clams are phototrophic, with similar environmental requirements to plants, and are the only potential farm animals that feed themselves. Some species grow rapidly and current studies suggest that annual production rates of 60 tonnes of clam meat per hectare are considered quite feasible.

If they could be cultivated, tridacnid clams would add substantially to the supply of low-cost, locally produced acceptable protein food, simultaneously providing a high-value exportable product in the form of dried adductor muscle. Research work done to date on the maricultural possibilities of giant clams, although fragmentary and on a small scale, has not revealed any major impediments to commercial-scale cultivation, but further research is necessary. The largest living species, *Tridacna gigas*, grows rapidly to as much as 137 cm, which makes it a prime target for additional research. The known extinction of *T. gigas* and *Hippopus hippopus* in some areas, the threatened status of these and other species elsewhere and the consequent or threatened loss of genetic diversity provide additional justification for substantial research effort.

This project has five main objectives. The scientists will assess tridacnid stocks at various localities in Fiji, Papua New Guinea and the Phillipines, using standardised field assessment procedures. Secondly, they will study natural growth rate of tridacnids and the influence that environmental factors - especially those related to latitude, such as water temperature, sunlight intensity, tides etc. - have on growth. Thirdly, they will investigate the reproductive biology of tridacnids, including gametogenic and spawning cycles and spawning chemistry. A fourth goal is to identify the specific ecological requirements of larvae and juvenile clams in natural and experimental environments. This research will include a study of predation, to determine the extent of protection necessary for juveniles and also for adults. Finally, the scientists will apply the results obtained in the above research to establish the hatchery and rearing techniques for optimum growth and survival rates in large-scale culture of the tridacnid species of greatest commercial importance.

At the same time, an investigation by the International Centre for Living Aquatic Resources and Management (ICLARM) will undertake a complementary research program on socio-economic, processing and other technical topics, which will include development of a hatchery and grow-out facility in a representative equatorial Indo-Pacific island environment.

In addition to increasing the protein food supply in Oceania and South-east Asia, extensive clam mariculture would reduce the pressures leading to over-exploitation of coastal fish stocks in Pacific waters. Harnessing the tropical reef, the greatest natural resource of the Pacific Islands, would be a strong incentive to preserve the marine environment and would highlight the benefits of conservation.

Project Leaders: Dr. J.S. Lucas, James Cook University, Townsville, Qld; Dr. J.L. Munro, ICLARM South Pacific Office, Townsville, Qld; Professor A.C. Alcala, Silliman University, Dumaguete City, Philippines; Dr. J. Pernetta, University Papua New Guinea, Papua New Guinea; Professor E. Gomez, University of the Philippines, Quezon City, Philippines; Dr. A. Lewis, Ministry of Primary Industries, Suva, Fiji.

Collaborators: Queensland Department of Primary Industries, Qld; Australian Institute of Marine Science, Townsville; University of Papua new Guinea; Fisheries Division, Ministry of Agriculture and Fisheries, Suva, Fiji; Silliman University, Dumaguete, Philippines; International Center for Living Aquatic Resources and Management (ICLARM); University of the Philippines, Quezon City, Philippines.

Estimated Expenditure: $836,245/3 years.

Duration of Project: June 1984 - June 1987.

PROPOSED INTERNATIONAL WORKSHOP ON GIANT CLAMS

The Australian Centre for International Agricultural Research is proposing to sponsor a Workshop meeting on all aspects of giant clam mariculture and ecology. The timing of the Workshop will be in April 1988 and the likely venue is James Cook University in North Queensland, Australia. It is proposed as an international meeting, with biologists and organisations involved in giant clam research and interested persons from countries throughout the Indo-Pacific range of giant clams invited to participate. Some objectives of the Workshop will be to report the achievements of the 1984-87 program of giant clam research funded by ACIAR, to propagate this information, to review the general state of knowledge of giant clams, to determine the interests of Pacific island countries in giant clam and harvesting, and to identify priorities for research.

Details of the Workshop, when available, will be circulated widely through Dr John Copland, ACIAR, G.P.O. Box 1571, Canberra, A.C.T. 2601, Australia, and Associate Professor John Lucas, Zoology Dept., James Cook University, Townsville, Q. 4811, Australia.

UPDATE ON THE GIANT CLAM MARICULTURE PROJECT

The three year project of giant clam research funded by ACIAR concluded in June 87. Before its conclusion, the project was reviewed by a committee consisting of Dr Joe Baker (Director, Australian Institute of Marine Sciences, Townsville), Professor Clem Tisdell (Professor of Economics, University of Newcastle, New South Wales) and Mr Gerry Heslinga (Director, Micronesian Mariculture Demonstration Center, Palua). The committee was to assess the success of the project in achieving its objectives and to recommend to ACIAR whether the project should be extended and what should be the directions of further research. The committee visited all the collaborating institutions: James Cook University; Fisheries Division, Fiji; University of Papua New Guinea; University of the Philippines Marine Sciences Institute; and Silliman University Marine Laboratory.

If the Review Committee recommends a renewal of the project, and this is accepted by ACIAR, then a further three year program of collaborative research will be developed and initiated later in 1987. In the meantime, ACIAR is providing "bridging" funding to sustain the mariculture operations and maintain staff at the collaborating institutions.

A recent development at James Cook University is the design of several kinds of 30m long protective containers for the ocean-nursery culture of Tridacna gigas in the intertidal zone. More than 70,000 juvenile clams up to 30 months old are now being cultured in this manner in Pioneer Bay, Orpheus Island. Growth rates for this species in intertidal culture are about 10 cm per annum increment in shell length, from 12 months of age, with marked variation between summer and winter in rates of growth. Some slides of these culture method innovations may be shown during the Meeting.