

SPC Fisheries Newsletter No. 38, July-September 1986. I also prepared a summary of the project for the South Pacific Regional Fisheries Development Programme. This summary is being published in the SPC Fisheries Newsletter. The summary is being published in the SPC Fisheries Newsletter. The summary is being published in the SPC Fisheries Newsletter.

A SUMMARY OF THE TOKELAU TROCHUS TRANSPLANT PROJECT.

The summary is being published in the SPC Fisheries Newsletter. The summary is being published in the SPC Fisheries Newsletter. The summary is being published in the SPC Fisheries Newsletter.

Robert D. Gillett, FAO South Pacific Regional Fisheries Development Programme, Suva, Fiji

In May 1985, in conjunction with the Co-ordinator of the UNDP Integrated Atoll Development Project the author prepared a list of potential development projects relating to the marine resources of Fakaofu atoll. One suggestion was that the Tokelau Department of Agriculture and Fisheries consider introducing trochus to Fakaofu. In January 1986, Tokelau authorities indicated that they wished to proceed with such a project. The subsequent trochus introduction was performed in March 1986, funded by the Integrated Atoll Development Project and carried out by staff of the South Pacific Regional Fisheries Development Programme with the help of the Tokelau Department of Agriculture and Fisheries and the Fiji Fisheries Division.

Previous attempts to introduce trochus to various Pacific Islands are listed in Table 1. The transplantation from Palau to Truk was observed for 5 years before it was judged to be a success (McGowan 1958). Based on this and other trochus transplants, McGowan (1958) states that the "introduced animal and their progeny must not be disturbed for a period of at least 5 years". In the Cook Islands about 3 years elapsed before it was evident that the stock transferred to Aitutaki was breeding (Devambe 1960). Eight years later trochus were described as plentiful (Sims 1985). Transplantations from Aitutaki to Palmerston Atoll in 1981 and 1982 resulted in "abundant" quantities by 1984 (Sims, pers. comm.). With the exception of the work done by Sims in the Cook Islands, the technical details of previous trochus transfer operations were not available for the present project.

Extreme caution should be exercised when considering the introduction of an exotic species to an area. The decision to proceed with the Tokelau transplantation was based on discussions with trochus experts, a review of the literature on trochus introductions, and a consideration of historical information.

In the preparatory phase of this project discussions were carried out with 12 people who were knowledgeable about trochus and/or trochus introductions. Included in this group were individuals who have voiced concern in the past over the unrestricted movement of biological material between Pacific Islands. Based primarily on historical experience these authorities did not feel that the transfer of trochus 400 miles eastward of the limit of its natural distribution would be biologically harmful to Tokelau.

TABLE 1: PACIFIC ISLANDS TROCHUS INTRODUCTIONS

Date	Areas	Details	Source
Before 1927	Palau to Truk Palau to Ponape	Unsuccessful attempt	McGowan 1957
1927-1931	Palau to Truk	Total of 6 724 shells transferred in bait wells of skipjack boats; 5 years elapsed before judged successful. First harvest 1939, greatest annual harvest (1952) 230 tons	McGowan 1957 McGowan 1958
1937	Palau to Phoenix Is.	No details of transfer available; 1986 status unknown to Kiribati officials	Bour et al 1982 Onorio, per. comm.
1939	Palau to Saipan Palau to Ponape	2 974 shells transferred; 6 745 shells transferred; greatest harvest (1951) 180 tons;	McGowan 1957 McGowan 1958
	Palau to Satawal	5 000 shells transferred; success not known	
1939 or 1940	Yap to Ulithi	Very successful	McGowan 1957 McGowan 1958 McCoy, per. comm.
1939	Palau and Yap to various sites in Caroline Islands	Japanese Govt. and private companies transferred shells to many islands including Ngulu, Ngatik, Mokil, Pulawat. Transfers to Sorol, Woleai, Ifaluk, Kapingamarangi, and Nukuoro not successful	McGowan 1957
1939	Palau to Jaluit	Shells transferred to other atolls of the Marshalls including Majuro and Ailinglaplap; transfer to Ebon not successful	McGowan 1957 Bour et al 1982
1940s or early 1950s	Ponape to Kosrae	Unsuccessful operation	McGowan 1958
Early 1950s	Saipan to Guam	Shells transplanted by two fishermen; very successful	Smith, per. comm.
1957	Fiji (Viti Levu) to Aitutaki	2 transfers; one in sea water, other damp in crates (40 shells). seaplane used; trochus population plentiful in 1965. First harvest 1981 (200 tonnes).	Van Pel 1957 Devambeze 1960 Sims 1984 Powell, per. comm.
1957	Vanuatu to Tahiti	1 200 shells shipped in circulatory water tanks. 40 survived the 15 day trip	Yen 1985 Yen per. comm.
1958	Fiji to American Samoa	No details available	Bour et al 1982
1958	New Caledonia to Tahiti	40 shells transferred by aircraft in damp sacks. First harvest 1971; greatest annual harvest (1973) 261 tonnes	Van pel 1957 Anon. 1972 Powell 1960
1959	Ponape to Kosrae	500 live trochus released at 13 locations	Gawel 1982
1963	Guam to Hawaii	1967 survey showed trochus surviving, but no indication of reproduction observed	Kanayama 1967
1963	Tahiti to Moorea	No details available	Anon. 1972
1964	Tahiti to Raiatea	No details available	Anon. 1972
?	Tahiti to Tuamotu and Austral Is.	No details available	Anon. 1972
1981-1983	Aitutaki to Southern Cook Islands	Palmerston Is, 3 000 shells transferred, abundant, at date of report. Manuae, 500 shells, status unknown; Mitiaro, 300 shells, rare/extinct; Atiu, 300 shells, rare/extinct; Mangaia, 300 shells, rare; Rarotonga, 200 shells, rare/extinct	Sims 1984
1982	Aitutaki to Rakahanga and Manihiki	Shells carried on deck in wet sacks. Unsuccessful; all dead before arrival	Sims 1985
1984	Yap to Outer Islands Yap	12 attempts including air drops; 2 were successful; more planned for 1986	Gawel 1986

.... (continued)

TABLE 1: PACIFIC ISLANDS TROCHUS INTRODUCTIONS (CONTINUED)

Date	Areas	Details	Source
1985	Aitutaki to Northern Cook Islands	Penrhyn, 439 shells, carried 6 days in bait tanks; Manihiki, 398 shells, carried 9 days in bait tank; Rakahanga, 693 shells, carried 10 days in bait tank; Pukapuka, all dead, carried 13 days in bait tank	Sims 1985
1985	Fiji (Viti Levu) to Funafuti	181 shells transferred in 3 air shipments; successful; larger transfer planned	Parkinson 1984 Pita 1985 Adams, per. comm. Batty, per. comm.
1986	Aitutaki to Northern Cook Islands	1 200 trochus shipped using flooded skiff on domestic vessel. Very good survival rate	Dashwood, per. comm.
1986	Fiji (Viti Levu) to Tokelau	1029 shells transferred; 584 sent by ship via Western Samoa; 161 flown to Western Samoa to join original shipment; 284 subsequently air-dropped from military aircraft after direct flight Suva-Tokelau.	Present report

Parkinson (1984) discusses the concern over the effect that a trochus introduction would have on the indigenous fauna and environment. On the basis of habitat, diet, and other factors, he concludes that a trochus introduction would "not be detrimental if carried out". It was reported by McGowan (1958) that in the 1920s the scientist, Asano, "after several years of research" decided to proceed with a transplantation of trochus from Palau to Truk. McGowan himself, after studying trochus for two and a half years in Micronesia, concluded that attempts should be made to introduce trochus to areas where it does not exist (McGowan 1958).

Table 1 lists approximately 40 trochus introductions including transfers to the north, south, east, and west of Tokelau. Negative repercussions of these introductions have not been noted with the possible exception of the suggestion by Sims (1984) that on Aitutaki trochus may compete with the green snail, *Turbo setosus*. This snail species, however, is not utilised by Fakaofu residents (Tolou, pers. comm.). Discussions with local residents and fisheries officials in other trochus recipient countries of the Federated States of Micronesia, French Polynesia, Guam and Tuvalu failed to uncover additional detrimental effects. On the contrary, local enthusiasm for secondary trochus transplants within the recipient country, in some case decades after the original operation, gave support to the project to transfer trochus to Tokelau.

Plans for the actual trochus transportation were formulated anticipating major difficulties. It can be seen that many of the previous transplantations listed in Table 1 ended in failure. Furthermore, the Tokelau operation was viewed as being logistically more difficult than any operation attempted to date. There is no aircraft service to Tokelau, and

the only direct shipping service is to Apia, where trochus do not occur. This would necessitate a long period of shipboard transit for the trochus during which they would be subjected to the additional trauma associated with large salinity fluctuations in harbours.

Considering the above difficulties, and the paucity of detailed technical information on previous trochus transplants, it was thought that a 'buckshot' approach to the Tokelau project would be best. Accordingly, it was planned that the trochus would be transported using a variety of techniques to minimise the risk of a major disaster. Another advantage of this approach is that it would give additional insight into trochus mortality which could be useful for future trochus transplants in other Pacific Island countries.

Two sites in Fiji were chosen for the trochus collection operation. Nukubuco Passage and Namuka Passage are located respectively two nautical miles southeast and six miles west of Suva point. The areas were selected more for their proximity to the main wharf at Suva than for the abundance of trochus. Diving was carried out during four expeditions; the first was a two-day trip by seven divers using the M/V Sasalu ni Waitui (11 GRT) and an eight metre skiff both belonging to the Fiji Fisheries Division. Subsequently, eight to fourteen divers made three day-trips using only the skiff. During the first diving trip, 584 trochus were collected (7 trochus per man-diving-hour) and during the latter trips, 161, 160 and 124 trochus were collected (5, 4, and 3 trochus per man-diving-hour).



(Photo: R.D. Gillett 1986 Apia - Tokelau)

Figure 1: Trochus shells in wet tanks on route to Tokelau.

The first indication that the 1958 Cook Island trochus transplant was a success came from length frequency information (Devambezi 1960). Accordingly, all shells collected in the present operation were measured twice. Only those larger than 8cm were retained as adult trochus.

The M/V "Wairua", a passenger/cargo vessel of 617 tonnes is routinely chartered by the Tokelau Administration to provide ship transport to Tokelau. Based in Fiji, the "Wairua" normally departs Suva prior to the contract period, arrives in Apia, embarks passengers and cargo, and then proceeds to Tokelau. With the cooperation of the vessel owners, the vessel schedule was altered to allow a convenient connection with the aircraft service between Fiji and Apia.

In March, six different methods of transporting the trochus were utilised simultaneously. Four of the methods utilized ship transport exclusively while two involved a combination of air and shipping service.

1) The aluminium skiff of the "Wairua" was vigorously cleaned by a work gang for several hours, placed on deck, and flooded by the ship's fire hose. The water flow of about 25 litres per minute, continuous throughout the entire voyage, was drained by both a plug at the base of the transom and by flow over the gunwales. One group of trochus was placed in the skiff during the voyage.

2) A second group of trochus was carried in four shallow wooden boxes (100cm x 100cm x 20cm), lined with thick plastic shower curtain material and flooded with water using the ship's fire hose at a flow rate somewhat reduced from No.1 above. Water flowed out over the top edges.

3) As there was some concern over the effect that the ship's bronze plumbing system would have on the trochus, a third group of animals were placed on 3 plastic trays (60cm x 60cm, perforated on the bottom with 0.5cm diameter holes). The 3 trays were placed in a specially constructed box. Each tray was covered with a burlap sack and, although referred to as 'dry', was soaked at least once per hour by water obtained by plastic bucket directly from the sea (not from the ship's plumbing).

4) Recognizing that the new plywood used to construct the above box may contain preservatives toxic to trochus, one tray of trochus (identical to those above) was kept on deck separately.

5) Because of the long ship transit period, (five and half days from Suva to Fakaofu,) three plastic trays of trochus were sent by aircraft to Apia. These trochus were collected 3 to 4 days after those which departed Suva aboard the "Wairua". Upon arrival in Apia they were placed in the flooded skiff of the "Wairua" with the other trochus. One hour thereafter the "Wairua" departed Apia for Fakaofu.

6) Aquarium fish are routinely shipped from Fiji to North America and Europe, after being placed in plastic bags (33 x 22 cm) containing seawater and oxygen. Using the same technology, one group of trochus was airfreighted along with No.5 above to the Wairua in Apia and was liberated from the plastic bags just prior to placement on the reef at Fakaofu.

During the above operations personnel familiar with trochus biology selected the precise reef areas most appropriate for the placement of these trochus, and of any future loads. It was therefore possible to take advantage in June of an offer by the New Zealand High Commission and the Royal New Zealand Air Force to airdrop trochus at Fakaofu. Late in May the author was notified that a C130-Hercules aircraft would be made available to fly trochus directly from Suva to Tokelau. Trochus, both on "dry" racks and in aquarium bags, were packed into a padded crate (90 x 90 x 90 cm) which fully loaded weighed 200 kg. The load was dropped using two T7-Alpha parachutes at an altitude of 100 metres while flying at an airspeed of 125 knots. Twenty three men in three boats were awaiting the crate at the drop site.

Both the air and surface shipments were accompanied by the author and other personnel involved in the project. All containers were covered to reduce the detrimental effect of sunshine, rain, and dust contamination. The trochus were regularly inspected. Dead trochus were removed upon detection and measured before being discarded. Salinity was monitored using two hand-held refractometers. In the event of a large decrease in salinity, common in both Apia and Suva harbours after rainstorms, contingency plans were formulated which involved carrying large amounts of oceanic seawater aboard the "Wairua" in plastic bins.



Figure 2: Dropping trochus onto reef by air (NZ Air Force) to waiting group below.

Figure 3: The transport scheme from Fiji to Samoa and Tokelau.

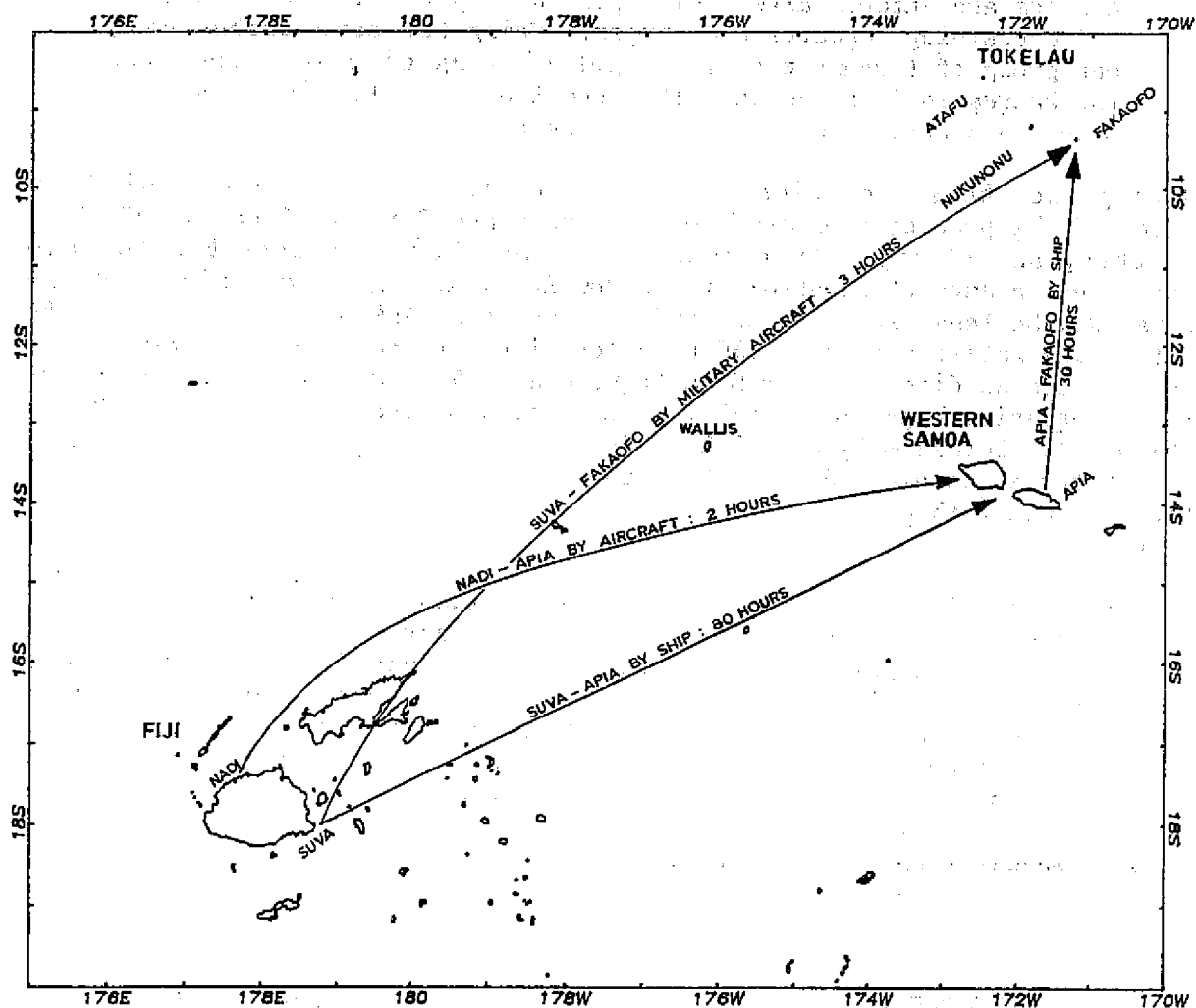


Table 2: Mortality of trochus during transport to Tokelau.

Method	Approximate number of shells	Time held 'dry'	Total time from capture to release	Number dead	Mortality in percentage
Shipboard: Flooded skiff (1)	153	6 hrs	134 to 164 hrs	3*	1.9
Flooded boxes (4)	285	6 hrs	134 to 164 hrs	7*	2.4
'Dry' tray in box (3)	108	133 hrs	None released alive	108	100
'Dry' tray on deck (1)	38	133 hrs	None released alive	38	100
Air/Ship: 'Dry' tray/flooded skiff (3)	140	13 hrs	66 to 69 hrs	0	0
Plastic bags (water & oxygen) (21)	21	4 hrs	66 to 69 hrs	0	0
Air: 'Dry' tray (2)	204	28 hrs	50 to 80 hrs	1	0.4
Plastic bags (water & oxygen) (80)	80	3 hrs	50 to 80 hrs	0	0
Total	1 029			159	15.4

* Some additional mortality may have occurred due to escape and/or poaching.

Figure 3 depicts Tokelau in relation to Western Samoa and Fiji and shows details of the transport utilized between these areas. Table 2 gives details on the trochus mortality during transport to Tokelau. In summary, methods which involved carrying trochus in flowing water were very successful. Only 10 of these animals died and this was possibly due to escape onto lead-based paintwork. The 21 trochus transported "aquarium fish style" survived the 35 hours in the plastic bags without mortality. 93 per cent of the trochus held "dry" in trays survived 72 hours out of water. The remainder of these animals died between 72 and 96 hours.

The site for trochus implantation in Fakaofo, known as Tulua Fatu, was selected considering the presence of typical trochus habitat, distance from the population centre, reef and currents. Trochus were placed on smooth coral areas both on top of the reef flat and deeper in the surf zone in approximately two to three metres of water.

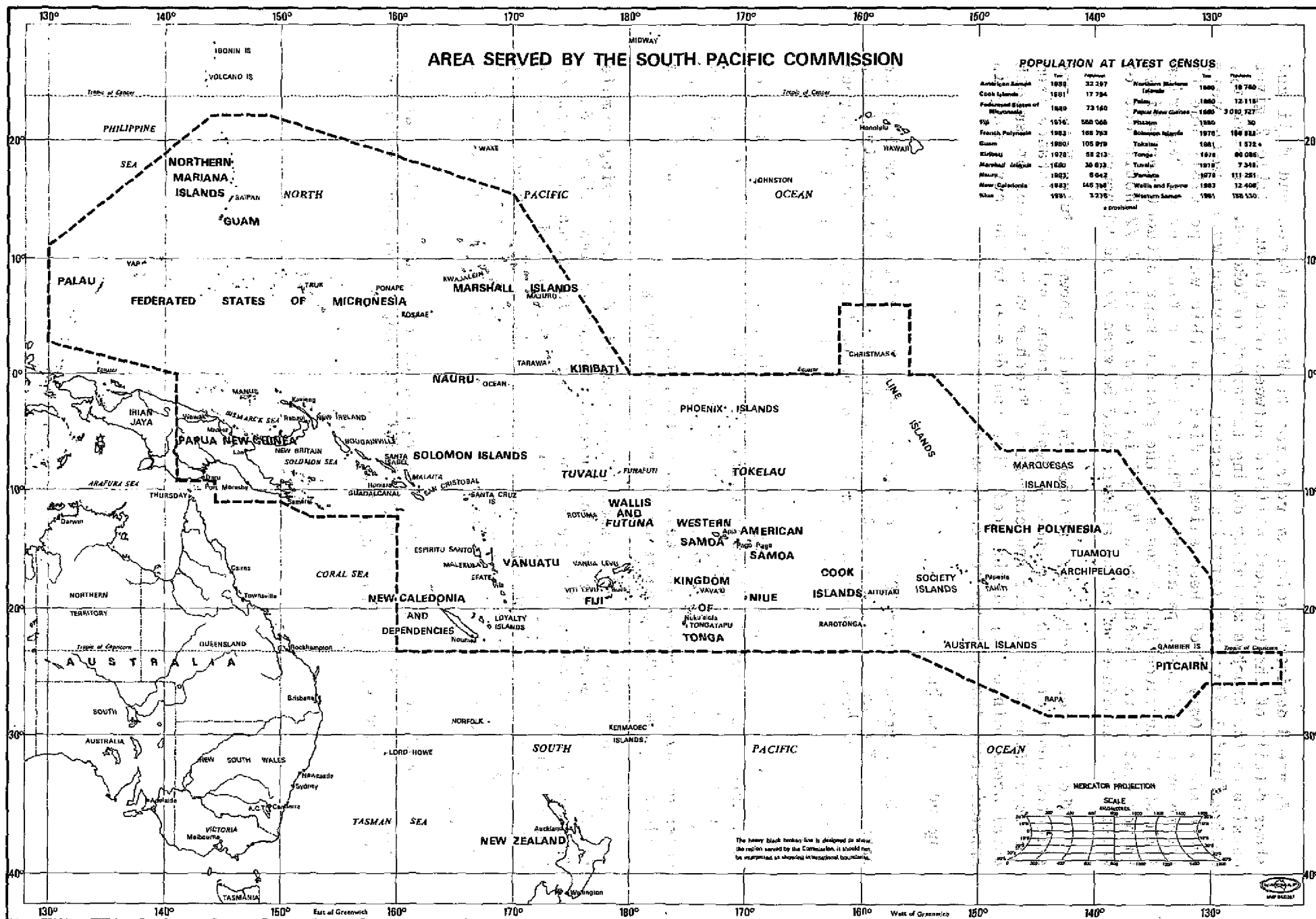
Concluding Remarks

In the project over 800 live trochus were transplanted from Fiji to Fakaofo. The number to survive the journey was in excess of twenty times the amount to survive previous transfers to the Cook Islands and to French Polynesia, both of which resulted in the establishment of trochus fisheries.

Fisheries officials in other Pacific Island countries who are contemplating a similar transplantation should make an independent assessment of the desirability and impact of such a project. They should also be careful not to underestimate the amount of work involved. Several weeks of advance preparation were necessary and for the actual trochus collection, over 195 man hours were expended on diving.

Transportation of trochus aboard non-specialized vessels using simple flooded tanks appears practical for future voyages of less than 6 days. Trochus transport on "dry" trays is not recommended for trips in excess of 2 days. The use of plastic bags and oxygen is promising and has advantages with respect to quarantine regulations when transiting other countries. If the placement site can be selected beforehand, if reliable ground crew are available, and if transport is provided free of charge, parachute dropping is ideal.

A complete report of the transplantation with bibliographic information is available from: South Pacific Regional Fisheries Development Programme, UNDP Private Mail Bag, Suva, Fiji.

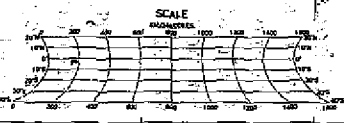


POPULATION AT LATEST CENSUS

Country	Year	Population	Country	Year	Population
American Samoa	1959	32 397	Western Samoa	1960	19 740
Cook Islands	1961	17 794	Palau	1960	12 111
Federated States of Micronesia	1960	73 160	Papua New Guinea	1960	3 010 721
Fiji	1976	560 066	Plains	1960	30
French Polynesia	1963	188 793	Solomon Islands	1976	100 831
Guam	1980	105 979	Takelau	1961	1 872
Kiribati	1978	51 213	Tonga	1978	80 086
Marshall Islands	1980	30 873	Tuvalu	1978	7 341
Nauru	1983	8 642	Vanuatu	1978	111 251
New Caledonia	1983	145 794	Wallis and Futuna	1983	12 408
Niue	1981	3 276	Western Samoa	1981	195 150

a provisional

MERCATOR PROJECTION



The heavy black broken line is designed to show the region served by the Commission; it should not be interpreted as showing international boundaries.