Swain Reefs.
Conservation and Use.

Great Barrier Reef Committee.

THE GREAT BARRIER REEF

SWAIN REEFS
CONSERVATION AND USE

A report to the GBRMPA

by

The Great Barrier Reef Committee
A society promoting scientific
study of the Great Barrier Reef

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The Authority accepted the report specified above, of the Great Barrier Reef Committee as fulfilling the requirements of its contract with the Authority. The Authority decided not to adopt the recommendations contained in the report.

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The Authority agreed to have Mr Kenchington inform the Council of the Great Barrier Reef Committee that the Authority would wish to distribute the scientific information consultance reports with the recommendations removed. (MPA 28, 20-21 February 1980)

Name of Project Officer: Richard Kenchington

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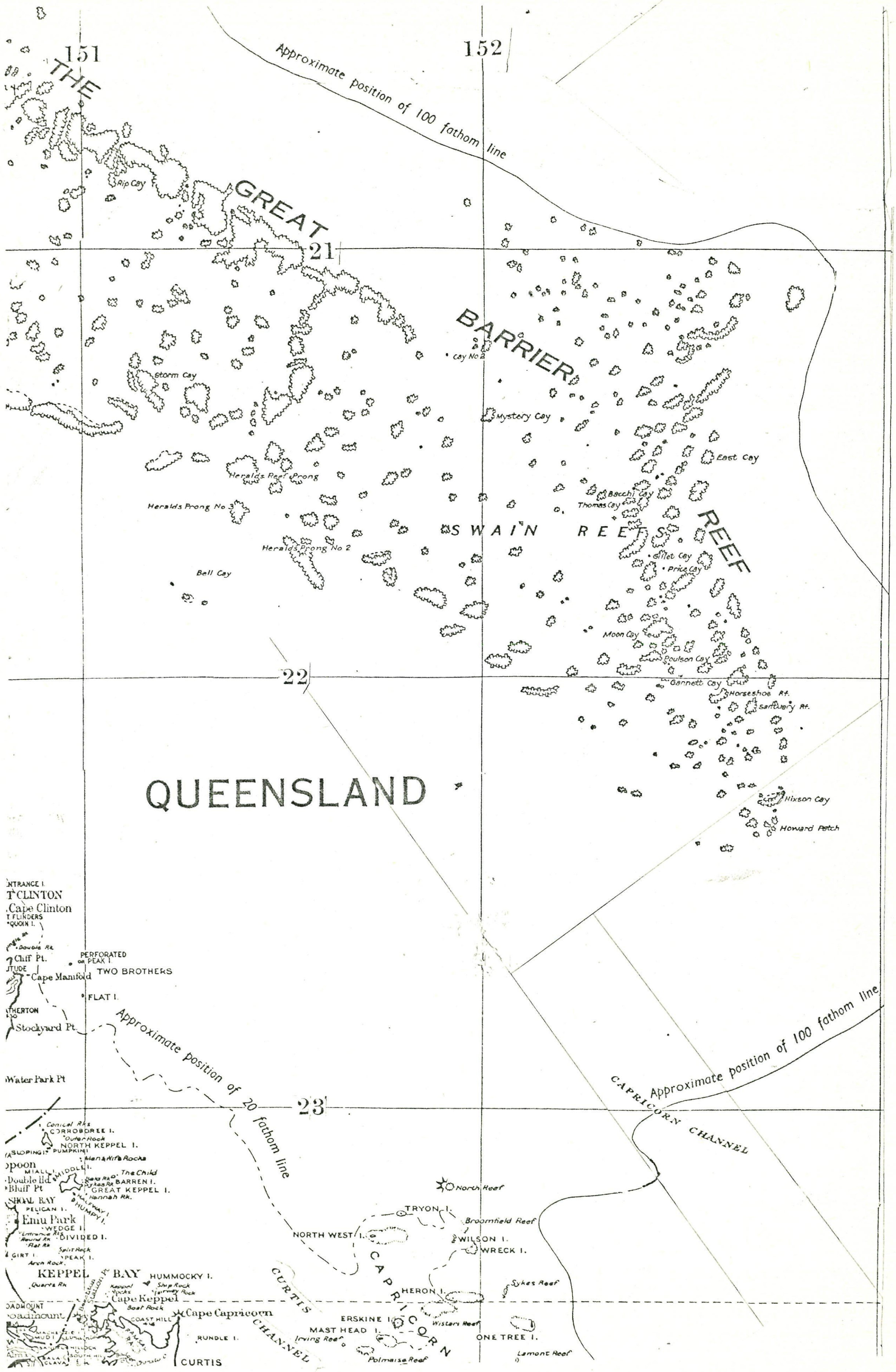
CONTRIBUTORS

Richard Martin has compiled the general background information on the history, climate, hydrology and geology of that is presented in this report. We are also grateful to: Professor H. Heatwole (biota of the islands); Dr. P. Saenger (algae); Captain H. Chesterman (navigation), Mr. R. Pearson (coral cover); and C. Limpus (turtles).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THE SWAIN REEFS

INTRODUCTION

The Swain Reefs represent the most eastern and southern development of the Great Barrier Reef system. They extend from 110 km to 250 km offshore and cover an area of some 16,000 km^2, lying between 20°53'S and 22°24'S, and 151°15'E and 152°48'E. This reef complex contains over 350 drying reefs, at least 20 coral cays and an unknown number of uncharted reefal shoals.

THE ENVIRONMENT

CLIMATE

An automatic weather station was established on Gannet Cay (22° 00'S, 152°28'E) in August, 1972, but no data have been published from this Station. Limited climatic information for offshore areas in the southern region of the Great Barrier Reef is contained in 'Sea areas around Australia' (Roy. Neth. Met. Inst, 1949). Brandon (1973) and Pickard et al (1977) have summarized much of the information relevant to reef waters.

WINDS

The southern region of the Great Barrier Reef comes under the influence of the South East Trade winds and wind direction is generally from between south and east for most of the year. During spring and summer months there is a tendency for the wind to back 45° to 90°, south-east to north-east, during the afternoon (Pickard et al., 1977). There are no marked seasonal variations in average wind speed although gales are more common during summer months (Roy. Neth. Met. Inst., 1949).

CYCLONES

Tropical cyclones affecting the central Queensland coast originate in the Intertropical Convergence Zone between 8° and 18°S in the northern Coral Sea and are most common in January to March. From 1909 to 1975, 37 cyclones passed through the Swain Reefs and a further 27 approached within 100 km of the area (Laurenz, 1977).

RAINFALL

There are no published rainfall figures for the Swain Reefs area, however limited records are available for Heron Island and North Reef approximately 100 km to the southwest. Average rainfall at these stations is around 1000 mm/year which is only marginally higher than that on the coast at the same latitude (Pickard et al., 1977) and suggests that rainfall variation across the lagoon of the Great Barrier Reef is minimal. At Heron Island and North Reef rainfall during the months January to March accounts for 38-39% of the yearly total. Individual annual rainfall totals recorded at Heron Island range from 20 to 200% of the mean annual value.

AIR TEMPERATURE

Monthly mean air temperatures for one degree square areas covering the southern Great Barrier Reef are given in 'Sea areas around Australia' (Roy. Neth. Met. Inst., 1949). Air temperatures in the Swain Reefs area range from 27.3°C in February to 18.5°C in June. These values fall within the range given by Pickard et al (1977) for shore stations in the Mackay - St. Lawrence region.

There are few hydrological observations for offshore waters south of 20°S and no detailed time series data for any station in the region. Brandon (1973) described some properties of the water column in the southern region but much of his data relates to areas west of 152°E. Pickard et al (1977) have reviewed all hydrological information for Barrier Reef waters published up to 1975.

HYDROLOGY

TIDES

The Queensland coast between 20°S and 24°S is characterized by large tidal ranges which reach a maximum of over 9 m in Broad Sound. The tides are semi-diurnal with marked diurnal inequalities in the high tides. Co-range lines given in Maxwell (1968; Fig. 42) suggest that maximum tidal ranges in the Swain Reefs are from 3 m to 5 m. Admiralty chart AUS 367 however, gives the mean spring range at Gannet Cay (lat. 21°59'S, long. 152°28'E) as only 1.8 m and that at Bell Cay (lat. 21°49'S, long. 151°15'E) as 3.4 m. The tidal flood is from south-east to north-west and currents are reported to be strong in offshore reef areas (Maxwell, 1968). Away from constrictions to flow caused by reefs and islands current speeds are reported to average around 0.5 m/sec. (Pickard et al., 1977).

TEMPERATURE AND SALINITY

Brandon (1973; Fig. 3) provides temperature data in the form of graphs of monthly surface temperatures against latitude by 1° intervals. These show that mean monthly temperatures for the region between 21° and 23°S range from 20.6°C in July to 28.2°C in January and February. Surface temperatures given in 'Sea areas around Australia' (Roy. Neth. Met. Inst., 1949) fall within this range but the mean monthly maximum is over 1°C lower than Brandon's. Unfortunately neither source provides any indication of the range of values recorded in individual months.

Temperatures outside the reef in the vicinity of the Swain Reefs range from around 22.5°C in winter to 28°C in summer (CSIRO, 1974). The difference between Brandon's inshore minimum temperature and the CSIRO minimum suggests a temperature rise across the Great Barrier Reef lagoon during winter months (Pickard et al., 1977).

Sub-surface temperature regimes on the outer shelf are not known, however Brandon (1973) states that in the Capricorn Channel vertical temperature variation is only "1° - 2°C on the average."

Salinity variations on the inner shelf south of 20°S are small in comparison with those recorded in northern reef waters. Brandon (1973) states, "Salinities greater than 36.00‰ and less than 35.00‰ occur only rarely and for the most part, only near the continent." The CSIRO monthly oceonographic charts (CSIRO, 1974) show isohalines down to 34.7‰ on the outer shelf in the vicinity of the Swain Reefs. Temperature/salinity, time diagrams given by Pickard et al (1977; Fig. 23) show that variations in water density in the southern region of the Great Barrier Reef are due to changes in temperature and not salinity.

CURRENTS

The main sources of information on currents in Barrier Reef waters are the 'Australia Pilot' (1973) and 'Sea areas around Australia' (Roy. Neth. Met. Inst., 1949), both of which derive their information from ships logs. Woodhead (1970) used surface drifters to measure water currents in the Capricorn Channel between the Swain Reefs and Sandy Cape during September to December, 1966.

According to the 'Pilot' the prevailing wind is the main determinant of currents within the Great Barrier Reef. South of 20°S the prevailing wind is from the south-east and the current flow will therefore, be to the north or north-west. Current speeds south of 20°S are reported by the 'Pilot' to be less than the 0.25-0.6 m/sec recorded in more northern waters.

Information on currents in 'Sea areas around Australia' is given in the form of current vectors in one degree squares and current roses for two locations near the Swain Reefs. Both presentations indicate that a south or south-easterly component of flow predominates throughout the year, however the current roses also show that there is a significant northward flow in most months. Average current speeds are around 0.4m/sec with speeds in excess of 1.0m/sec occurring only rarely.

The results of Woodhead's surface drifter studies (Woodhead, 1970) are consistent with the Dutch data to the extent that they indicate southerly and south-westerly components of flow during the months September to December. However, Woodhead's deduction of a north-westward flowing current in the Capricorn Channel, although consistent with the Dutch charts, appears to be based more on statements in the 'Pilot' than on drifter recoveries to the north of the release points. As Pickard et al (1977) point out, the effect of wind stress due to the south east trades causing a north-westerly flow in the surface layers of the Great Barrier Reef lagoon is generally accepted, although no direct measurements have been made to verify it. One can only agree with their conclusion that surface currents in the lagoon "may be more complicated than hitherto assumed".

GEOLOGY AND GEOMORPHOLOGY

SHELF STRUCTURE AND SEDIMENTS

South of 21°S, the Marginal Shelf (Maxwell, 1968) is divided into Eastern and Western Shelves by the Southern Shelf Embayment (Capricorn Channel). The Eastern Marginal Shelf as defined by Maxwell (1968) is a broad platform up to 130 km wide lying between the 64 m and 91 m depth contours. It supports the reefs of the Swain and Pompey Complexes which rise from a comparatively uniform surface at 59 m to 64 m that is believed to be a Quaternary strand-line (Maxwell, 1973). Seaward from the Eastern Marginal Shelf the continental slope extends for 130 - 190 km and descends gradually to 910 m at average gradients of between 0.5° and 1°.

Geophysical surveys and drillings (Wilson, 1969; Ericson, 1975) have shown that the physiographic units outlined above closely reflect the underlying tectonic framework. The main structural elements defined are (1) the Swain Reefs High, an area of shallow Palaeozoic (?) basement overlain by 1500 m or less of undated volcanics, and (2) the Capricorn Basin, a half-graben 32-113 km wide trending NNW along the eastern margin of the Swain Reefs High and containing over 3000 m of upper Mesozoic and Tertiary marine and non-marine sediments. The two structures are separated by normal faults.

According to Maxwell (1968), unconsolidated inter-reef sediments in the southern region of the Great Barrier Reef are thin, indicating that current rates of sedimentation are low. In the Swain Reefs, inter-reef sediments are dominated by a high carbonate (80%), slightly muddy sand facies consisting mainly of foraminiferan, *Halimeda*, molluscan, bryozoan and coral detritus of reef and inter-reefal origin (Maxwell, 1968). Grain size distributions are frequently bi- or polymodal reflecting in part the particular grade of material derived from the skeletal structures of specific organisms (Maxwell, 1968). The relative proportions of the major faunal components of the surface sediments are *Halimeda* 10-65%, foraminiferans 5-40%, bryozoans 5-30%, molluscs 1-30%, corals 5-10%, and lithothamioid algae 1-10%. Skeletal material from echinoderms and crustaceans generally comprises less than 5% of the surface sediments. Maxwell (1968, 1973) provides maps showing the distribution of the major faunal components of the inter-reefal sediments throughout the Swain Reefs.

REEF DISTRIBUTION AND MORPHOLOGY

The Swain reefs are characterized by a moderately uniform distribution of cuspate, platform and elongate platform* reefs and the absence of high density shelf-edge development. Drying reefs cover 10-15% of the shelf along the eastern margin of the complex and less than 5% in the central and western regions. The majority of drying reefs (about 74%) are less than 3 km long. Elongate reefs are mainly confined to the exposed eastern and southwestern margins of the complex and are usually orientated with their major axis normal to the prevailing swell direction.

The development of low, poorly vegetated, sand or rubble cays is a characteristic feature of the Swain Reefs. Over 20 cays have been reported from the area although few of these have been officially named and the location and status of many remain in doubt. Table 1 gives the name and approximate position of all cays reported in the literature to date. Only three cays, Bell, Hixson and East are located on reefs in exposed positions, the remainder occur in the inner more sheltered part of the Swains Complex.

Table 2 gives the size and general features of 11 cays described by Gillet and McNeill (1962). Their observations indicate that the cays of the Swain Reefs are in the early stages of development. Most are rubble cays and few show the development of beachrock. Vegetation when present, is mainly grasses (*Thuarea involuta*) although Bell Cay is reported by the 'Australia Pilot' (1973) to be covered by low bushes. The vegetated cays visited by Gillet and McNeill were all substantially larger than the unvegetated cays and presumably show some degree of persistence. Cays lacking vegetation were all less than 2 m high (above high water) and probably experience periodic inundation during storms and tropical cyclones when wave set up and storm surges may result in substantially elevated sea levels. Hixson Cay, an unvegetated cay at the southern extremity of the Swain Reefs is no longer recorded on admiralty charts as being a permanently emergent feature indicating that changes in wave climate may erode even apparently well established features.

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* The use of this nomenclature does not necessarily imply acceptance of the relationships between the various reef types as proposed by Maxwell (1968).

Table 1. LOCATION OF NAMED CAYS OF THE SWAIN REEFS CAYS

Name	Location			Condition (where known)
Zodiac	$21^{\circ}06'$S	$152^{\circ}04'$E		Barren[1]
Three Cays	$21^{\circ}06'$	$152^{\circ}10'$	*	
Twin Cays	$21^{\circ}12'$	$152^{\circ}00'$	*	
Riptide	$21^{\circ}13'$	$151^{\circ}50'$	*	
Mystery (2 cays)	$21^{\circ}22'$	$152^{\circ}02'$	*	Barren[1]
East	$21^{\circ}30'$	$152^{\circ}33'$		
Tiny	$21^{\circ}34'$	$152^{\circ}01'$	*	
Bacchi	$21^{\circ}35'$	$152^{\circ}22'$		Vegetated[2]
Thomas	$21^{\circ}36'$	$152^{\circ}21'$		Vegetated[2]
Gillet (Frigate?)	$21^{\circ}43'$	$152^{\circ}25'$		Vegetated[2]
Price	$21^{\circ}45'$	$152^{\circ}27'$		Vegetated[2]
Carruth (Riversong	$21^{\circ}47'$	$152^{\circ}25'$		Vegetated[2]
Bylund cays?)	$21^{\circ}48'$	$152^{\circ}25'$		Vegetated[2]
Bell	$21^{\circ}49'$	$151^{\circ}15'$		Low Bushes[3]
Moon	$21^{\circ}54'$	$152^{\circ}25'$		Barren[2]
Bowden	$21^{\circ}55'$	$152^{\circ}26'$		Barren[2]
Poulson	$21^{\circ}58'$	$152^{\circ}25'$		Vegetated[2]
Pam's	$21^{\circ}59'$	$152^{\circ}43'$		Barren[2]
Gannet	$22^{\circ}00'$	$152^{\circ}28'$		Vegetated[1]
Capre	$22^{\circ}11'$	$152^{\circ}40'$		Barren[2]
Hixson	$22^{\circ}21'$	$152^{\circ}40'$		Barren[1]

* Approximate position only.

[1] Heatwole, unpublished; [2] Gillett and McNeill, 1962; [3] The Australian Pilot.

Table 2. NAMED REEFS WITHOUT CAYS?

Name	Location	
Follett	$21^{o}58'S$	$152^{o}40'E$
Horse Shoe	$22^{o}02'$	$152^{o}35'$
Sanctuary	$22^{o}03'$	$152^{o}39'$
Heralds Prong No. 1	$21^{o}30'$	$151^{o}25'$
Heralds Prong No. 2	$21^{o}35'$	$151^{o}25'$
Heralds Prong No. 3	$21^{o}45'$	$151^{o}35'$

Table 3. SIZE, HEIGHT AND GENERAL FEATURES OF CAYS VISITED BY GILLET AND McNEILL (1962)

Name	Size (L x B; m)	Height (m)	General Features
Vegetated Cays:			
Poulson	322 x 160	2.7	
Bylund	274 x 183	3.7	Beach-rock
Carruth	152 x 107	2.7	
Price	305 x 206	2.4	Beach-rock
Gillet	461 x 274	4.3	
Thomas	128 x 103	2.1	
Bacchi	274 x 94	2.1	
Unvegetated Cays:			
Capre	93 x 75	1.7	Coarse shingle, breccia and shells.
Pam's	91 x 46	0.6	"
Bowden	69 x 27	1.2	
Moon	312 x 9	0.6	

Table 3. RECORDED BIRD SPECIES AND BREEDING COLONIES, SWAIN REEFS (RECORDED X; BREEDING (X)).

Species	Poulson	Carruth	Bylund	Price	Gillet	Thomas	Bacchi	Gannet
Wedge-tailed Shearwater *Puffinus pacificus*					X*			
Masked Gannet *Sula dactylatra*	(X)	(X)	(X)		(X)	(X)	(X)	(X)
Brown Gannet *Sula leucogaster*	(X)	(X)	(X)	(X)	(X)	(X)	(X)	(X)
Lesser Frigate Bird *Fregata ariel*					(X)			
Common Sandpiper *Tringa hypoleuca*					X*			
Common Noddy *Anous stolidus*			X	X	(X)	X		X
Silver Gull *Larus novaehollandiae*	X	X	X	X	X	X	X	X
Little Tern *Sterna albifrons*					X*			
Bridled Tern *Sterna anaethetus*	(X)				(X)		X	
Crested Tern *Sterna bergii*		X	X	(X)	(X)	X	X	X
Black-naped Tern *Sterna sumatrana*					X*			X
Roseate Tern *Sterna dougalli*					X*			
Sooty Tern *Sterna fuscata*								X
Ruddy Turnstone *Arenia interpres*								X

Sources: Gillet and McNeill (1962); McMichael (1963); Costello (1978); Heatwole (unpublished).

* Approximate location.

BIOTA OF REEFS AND CAYS

TERRESTRIAL

Six islands in the Swain's Reefs have been visited between 1967 and 1977 and collections of the biota made. All these islands were coral cays. Three of these islands (Hixon Cay, and 2 unnamed cays on Mystery Reef) were very small and were completely barren. They contained no resident terrestrial fauna except for sea birds that momentarily landed there and no flora. These cays are probably washed over by high water and during storms. A fourth cay, near Zodiac Cay, consisted of coral rubble and contained no terrestrial vegetation. The only animals present were a dead booby with a tick attached to its bill.

Zodiac Cay itself was somewhat more complex. There was no vascular vegetation but there was a penicillium-like mold with green fruiting bodies growing on a dead sea bird. There was a green alga on some of the dead coral on the island.

Sea birds used the island, and terns and a frigate bird were seen in the vicinity. One old nest was present but no birds were nesting at the time of the visit (26th August 1967). Some ticks and one red mite were found under pieces of coral rubble.

The soil was coarse coral rubble with some coral sand, but few large coral chunks. There were 2 dead noddy terns present, one adult and one juvenile; guano occurred in patches.

The island is probably washed over during storms.

Gannet Cay was the only cay that was vegetated. It was visited on 2nd November 1967 and 9th October 1972. This low island has a wide beach of fine coral sand. The central part of the cay was sandy and had a 95% cover of low herbs and grasses (less than 25 cm tall). The species present were:

Nyctaginaceae
Boerhavia diffusa

Brassicaceae
Cakile maritima
Coronopus integrifolius

Poaceae
Lepturus repens
Thuarea involuta
Thuarea sarmentosa

There were also shrubs of *Tournefortia argentea* (fam. Boraginaceae) present.

There was no major change in the vegetation noted between the two visits.

A number of sea birds were observed on both occasions. The collective list is as follows:

Silver gull *(Larus novaehollandiae)*
Masked Gannet *(Sula dactylatra)*
Brown Booby *(Sula leucogaster)*
Noddy terns *(Anous stolidus)*
Crested tern *(Sterna bergii)*
Black-naped tern *(Sterna sumatrana)*
Sooty tern *(Sterna fuscata)*
Ruddy Turnstone *(Arenaria interpres)*

There were a number of dead gannets and other birds at each visit and there were beetles associated with them.

A total of 14 species of bird have been recorded from the Swain Reefs. Of these six are known to breed in the area and include the Masked Gannet, Brown Gannet, Lesser Frigate Bird, Common Noddy, Bridled Tern and Crested Tern (Table 3). Nesting birds have been reported on Poulson, Carruth, Bylund, Price, Gillet, Thomas and Bacchi Cays. Costello (1978) notes that birds (unspecified) have also been observed nesting on Gannet Cay. The cays of the Swain Reefs are the only breeding sites on the Great Barrier Reef south of Raine Island for the Lesser Frigate Bird and the Masked Gannet and the largest site south of Raine Island for the Masked Gannet (Lavery and Grimes, 1971).

A variety of terrestrial invertebrates were collected. They are as follows:

SPIDERS

Salticidae
Chiracanthium (check if a salticid)
1 unidentified species

TICKS

Amblyomma loculosum (feeds on sea birds)

ORTHOPTERA

Acrididae
Aiolopus tamulus (Fabr.) (Acridinae)

Tettigoniidae
Conocephalus sp. (Conocephalinae)

Gryllidae
?Ornebius sp. (Mogoplistinae)
Unidentified Trigonidiinae

Neuroptera
Chrysopa sp. (fam. Chrysipidae)

COLEOPTERA

Coccinellidae
Coccinella arcuata (Fabr.)
Stethorus sp.

Dermestidae
Dermestes ater Degeer

Histeridae
Saprinus australis

LEPIDOPTERA

Noctuidae (2 unidentified species)

HYMENOPTERA

Formicidae (ants
Ponerinae
Rhytidoponera metallica (Smith)

Myrmicinae
Tetramorium simillimum (Fr. Smith)

Diptera
Hypaspistomyia sp. (probably *H. albipennis)*

There are no unique terrestrial animals known from the islands of the Swain's Reefs, although further collecting may provide such. However, the islands themselves are valuable areas for scientific study as they provide an opportunity for studying the interaction of marine and terrestrial environments more easily than more complex terrestrial systems. For example, the concept of "transfer" organism that convey energy from the sea to islands and thereby support a whole terrestrial ecosystem was developed from study of such small, simple islands (Heatwole, 1971, Ecology 52: 363-366).

No terrestrial reptiles have been found in the Swain's Reefs. However, sea snakes are abundant (Heatwole, 1975).

MARINE

ALGAE

Saenger (1978) collected a total of 38 species of subtidal algae from 6 locations in the Swain Reefs during December, 1976 and May, 1977. Algae are apparently not a conspicuous feature of the biota of reefs in the area, nevertheless the number of species recorded is comparable to other regions of the Great Barrier Reef (see Appendix 1).

FAUNA

The limited information available suggests that faunal diversity in the Swain Reefs does not differ greatly from that of other regions of the Great Barrier Reef. During the Australian Museum expedition to the Swain Reefs in 1962, Whitley (1964) collected a total of 102 species of fish of which only three had not previously been recorded from other localities. This number compares favourably with other collections made by the Australian Museum at that time.

Gillet and McNeill (1962) commented on the abundance and diversity of corals in the Swain Reefs. However, estimates of coral cover made by the Queensland Fisheries Service in 1975 (Pearson and Garrett, in press) indicated that overall, live coral cover was similar to that recorded in other parts of the Great Barrier Reef.

SEA TURTLES

The area is poorly documented for sea turtles. These notes are based on two brief visits to the area.

Three species that occur are:

Green turtles *C. mydas:* common throughout the area. At least sporadic nesting occurs on all the islands with small nesting colonies occurring on several of the cays, especially those in the Frigate (Gillett?) Cay area. A larger but still small green rookery occurs on Bell Cay.

Loggerhead turtles *Caretta caretta:* occurs throughout the area. Taken together the loggerhead turtle nesting on all the cays from Gannet Cay to about 10 miles north of Frigate Cay constitutes one of the important loggerhead turtle nesting regions of eastern Australia (3rd most important after Capricorn-Bunker Groups and the mainland coast from Bundaberg to Round Hill Head. None of the individual rookeries are outstanding.

Hawksbill turtle: occurs at low density throughout these coral reefs. No nesting records.

There are no specific problems related to turtles in these two regions that I am aware of unless it is our ignorance of this resource in its feeding grounds.

GENERAL AND SCIENTIFIC HISTORY OF THE SWAIN REEFS

Because of their isolation and the many dangerous reefs in their waters, the Swain Reefs received little attention from the early explorers of the Queensland coast. The first reference to them was made by Matthew Flinders (1814) who noted that the southern most reefs observed from the 'Investigator', at lat. 21°S and long. 151°10'E, were undoubtedly connected with those further southward "...which Captain Swain of the 'Eliza' fell in with..." in 1798. He further records that "Mr. Swain did, indeed, get out at lat. 22°S, but it was by a long, and very tortuous channel".

During the early 1800's the Swain Reefs were probably visited frequently by the early beche-de-mer fishermen as the industry spread from the Coral Sea islands to the more protected and accessible reefs of the Great Barrier Reef.

Both Jefferys (1816) and King (1818 and 1822) passed well to the west of the Swains during their surveys of the Queensland coast. A wide berth was also given the area by ships travelling to Torres Strait and Asian ports. One vessel that did not was the 'Stirling Castle', carrying the Frazers, which was wrecked somewhere near the north eastern tip of the Swain Reefs in 1836.

The first detailed survey of the Swain Reefs was carried out by HMS 'Fly' in company with the tender 'Bramble'. The 'Fly' surveyed the outer edge of the reefs from lat. 22°25'S to lat. 21°S and 'Bramble' followed the inner margin as far north as lat. 21°50'S. Details of this survey, which still remains the only major hydrographic survey of the Swain Reef area, were recorded by J.B. Jukes in his narative of the voyage of HMS 'Fly' (1847).

Jukes' records, "These reefs consist of a compact body of coral masses, intersected by narrow channels of deep water; each mass varies in extent from one to several miles, some of them being almost dry at low water, others having lagoons or hollows of greater depth". He also observed large coral boulders thrown up on the seaward edges of the outer reefs and observed Bell and Hixon cays to be "insignificant sand patches". Jukes and Capt. Blackwood landed on several of the reefs and Jukes collected corals, shells, crustaceans and echinoderms.

Following the visit of HMS 'Fly' there are no records of further surveys or expeditions to the Swain Reefs until the 1960's although the area was probably visited with increasing frequency by fishermen from Queensland ports. In 1960 a party including Messers R. Poulson and K. Gillet made a brief survey of the southern region of the complex and located several uncharted cays (Gillet and McNiell, 1962).

The Australian Museum Expedition spent 11 days on the Swain Reefs in 1962 but confined their activities to the southern cays (McMichael, 1963). Observation and collections, some using a dredge, were made at Gillet, Price, Thomas and Capre Cays. Whitley (1964) has published an account of the fishes collected during the expedition. Clark (19) gives an account of the echinoderms.

Following the Australian Museum Expedition only two large scale surveys have been carried out in the area. In 1965 and 1966, Australian Gulf Oil carried out aeromagnetic and seismic surveys of the Swain Reef area and Capricorn Channel and in 1968 two wells were drilled just to the south of the Swain Reefs. Both were abandoned without showing traces of oil or gas (Wilson, 1969), but provided considerable information on structural and stratigraphic relationships in the Capricorn Basin (Wilson, 1967).

During 1975 and 1977 members of the Queensland Fisheries Service conducted surveys of the eastern and southern reefs to assess the distribution and abundance of *Acanthaster planci*.

Other scientific parties have visited the area from time to time since 1967 and the records of the fauna set out below are available as a result of those visits.

In recent years, concern expressed over the activities of foreign fishing vessels in the Swain Reefs, particularly those taking giant clams, have led to an increase in sea and air surveillance of the area by the armed forces.

USE AND IMPACT

COMMERCIAL FISHING

Fish have been taken commercially in the Swain Reefs since the late 1950's (Whitley, 1964) but there are no catch statistics available from which to evaluate the extent of this exploitation.

In recent years the activities of foreign fishing vessels in the area, particularly those collecting clam 'meat', have attracted considerable attention. Pearson (1977) has estimated that since 1969 over 156,000 clams have been removed from the Swain Reefs. Continued exploitation at this level can be expected rapidly decimate clam stocks in the area.

RECREATIONAL USE

Recreational use of the Swain Reefs is usually by way of charter boats operating out of Gladstone and Yeppoon. There are however, no records of the number of boats, the frequency of visits or the number of people visiting the area. Information from charter boat owners indicates that parties range in size from 4 to 14 and charters usually vary from 2 to 7 days. Users include line fishermen, skin divers, shell collectors and photographers. It is not known if certain areas are visited more frequently than others.

NAVIGATION IN THE SWAIN REEFS

The most southerly passage out through the reefs of the Great Barrier Reef is Magnetic Passage off Townsville. Shipping not using that passage must pass down through the inner route between the reef and the coast, and through the Capricorn Channel (between the Swain Reef complex and the Capricorn and Bunker groups of islands).

The Swain Reefs are mostly small, scattered haphazardly over a wide extent of the Continental Shelf up to 160 km from the coast. Here the water is especially clear with very little sediment and excellent visibility. It has been observed that the tides are not too strong in this area.

It is a favourite area for clam poachers and should be subjected to far greater surveyance on this account than has been possible up to this time.

The second of the two automatic weather stations that have been constructed on the Great Barrier Reef is located on Gannet Cay in the south of this reef complex.

There has not been adequate survey done in this area. The waters are best known to local fishermen, and to the lighthouse vessel, Navaid Tender, that regularly transports technicians to the Weather Station.

Mariners regard the Swain Reefs as the southern extent of the Great Barrier Reef.

SWAIN REEFS - SUMMARY AND RECOMMENDATION

SUMMARY

Although the Bunker and Capricorn Groups of islands are located slightly further to the south, the Swain Reefs Complex, far to the east and removed from terrestrial influences, is probably of greater importance in the biology of the Great Barrier Reef ecosystem. In addition to the absence of terrigeneous influences that could affect the habitat, their populations are more isolated from those on the continental coast than are the population of other reefs at the southern end of the GBR. Hindwood, Keith and Serventy (1963) have observed that the cays of the Swain Reefs are more like those of the Coral Sea than cays closer inshore as regards birds. This may be true also for other components of the biota. They have noted differences in relative species composition of the avifauna, in the Swain Reefs and the Bunker Capricorn Groups. Certainly the differences between the thick forest and scrub vegetation of the latter and the sparsely vegetated cays of the former is certain to result in very differing selective pressures at these two locations. The populations in the Swain Reefs are very likely contributing much to the genetic vigour and diversity of the species that occur there over their whole range in the Indo-Pacific through interbreeding with and recruitment into the populations of the reefs that lie to their north along the edge of the Continental Shelf.

Like some areas north of Lizard Island, the Swain Reef complex is relatively unaffected by present use. It is, however, more important biologically owing to its location at the southern end of the Indo-Pacific coralline region (the northern area is in the centre of that region). There are also great differences in the reef types in the two areas - there are no platform reefs in the south, the continental shelf is wider, the reefal area covers an extensive longitudinal range, and the reefs are further away from the coast.

The cays of the Swain Reefs are not well vegetated and are in an early stage in their evolution. Gannet cay is the only island with any appreciable vegetation. At this early stage in their history it is important that they not be disturbed. It is the pattern that derives from the hydrology of the reef that determines the accumulation of sediments that form the islands; and it is birds and turtles using the islands and the seeds, the carrion and the living organisms that are washed onto the islands or blown there by the wind that will determine their economy, and ensure the establishment and growth of the pioneer plant species that will consolidate them. Their plant and animal communities, and their sand and reefal configurations should be allowed to evolve without interference.

The Swain Reefs are sufficiently far from the mainland coast to be relatively inaccessible. The cost of getting there, the difficulties of navigation and uncertainty about weather will preclude all but a few experienced charter boat operators and fishermen from visiting the area. The existence of the more easily accessible Bunker/Capricorn Groups will, in any case, satisfy the main tourist demand in the area.

APPENDIX

SUBTIDAL ALGAE FROM THE SWAIN REEFS (P. SAENGER, IN PRESS)

CHLOROPHYTA

Fam. Cladophoraceae
Chaetomorpha indica Kützing

Fam. Anadyomenaceae
Microdictyon okamurai Setchell

Fam. Valoniaceae
Dictyosphaeria versluysii Weber-van Bosse

Fam. Siphonocladaceae
Cladophoropsis sudanensis Reinbold

Fam. Bryopsidaceae
Bryopsis indica Gepp and Gepp

Fam. Codiaceae
Codium spongiosum Harvey

Fam. Caulerpaceae
Caulerpa peltata Lamouroux
Caulerpa serrulata (Forskal) J. Agardh emend. Boergesen
Caulerpa cupressoides (Vahl) C. Agardh
Caulerpa racemosa var. *clavifera* (Turner) Weber-van Bosse
Caulerpa taxifolia (Vahl) C. Agardh

Fam. Udoteaceae
Chlorodesmis fastigiata (C. Agardh) Ducker
Rhipilia orientalis Gepp and Gepp
Halimeda tuna (Ellis and Solander) Lamouroux
Halimeda cylindracea Decaisne
Halimeda macroloba Decaisne
Halimeda incrassata (Ellis) Lamouroux
Halimeda opuntin (Linnaeus) Lanouroux
Penicillus nodulosus Blainville
Udotea argentea Zanardini

Fam. Dasycladaceae
Neomeris annulata Dickie

PHAEOPHYTA

Fam. Dictyotaceae
Dictyota bartayresii Lamouroux
Dictyota adnata Zanardini
Lobophora variegata (Lamouroux) Womersley
Padina tenuis Bory

Fam. Scytosiphonaceae
Hydroclathrus clathratus (C. Agardh) Howe

Fam. Sargassaceae
Sargassum aquifolium (Turner) J. Agardh

RHODOPHYTA

Fam. Helminthocladiaceae
Liagora ceranoides Lamouroux

Fam. Corallinaceae
Amphiroa crassa Lamouroux
Metagoniolithon graniferum (Harvey) Weber-van Bosse and Foslie
Mastophora plana (Sonder) Harvey

Fam. Plocamiaceae
Plocamium hematum J. Agardh

Fam. Champiaceae
Champia parvula (C. Agardh) Harvey

Fam. Ceramiaceae
Centroceras clavulatum (C. Agardh) Montagne
Haloplegma duperreyi Montagne

Fam. Rhodomelaceae
*Polysiphonia ferulacea*Suhr ex J. Agardh
Amansia glomerata C. Agardh

CYANOPHYTA

Fam. Oscillatoriaceae
Lyngbya majuscula Harvey ex Gomont

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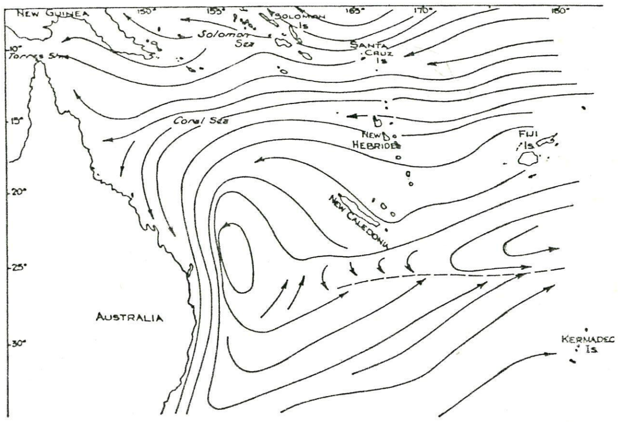
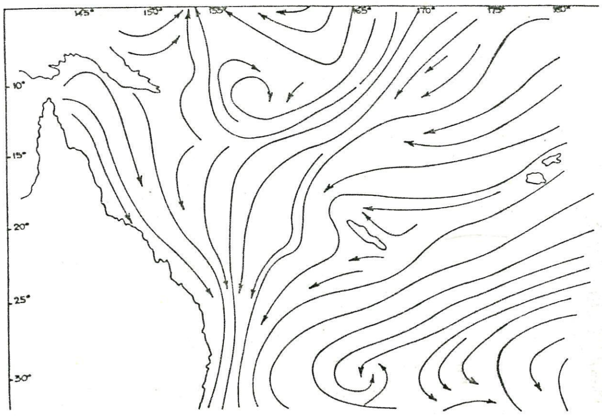


SURFACE WATER CIRCULATION
FOR JULY

(after Wyrtki 1960)



SURFACE WATER CIRCULATION
FOR JANUARY

(after Wyrtki 1960)

Oceanic current patterns of the South-West Pacific, based on data from Wyrtki (1960)

from Maxwell

Some hydrological work has been done in the south-west Pacific region, including the Coral Sea. At this stage, however, detailed hydrological work has not been done in the Great Barrier Reef Region where circulation is very much complicated by tidal currents and river effluents.

SWAIN REEFS.
CONSERVATION AND
USE. ~~BC 3619~~
Great Barrier Reef Committee

C. Dalliston	4·2·87	