ticular species, the effect may be considerable, and in this year it seems that spawning of the snapper was delayed for about a month by the lower temperature. To speculate further, it is possible that such a delay might have a very serious effect on the survival of that year's brood of young snapper.

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The Marine Algal Ecology of Some Islands of the Hauraki Gulf

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INTRODUCTION

I would like to present a brief picture of the algal zonation patterns that can be observed at various stations in the Hauraki Gulf. I will mention animal species to some extent in addition to the algal dominants as it is impossible to consider the plants by themselves. With respect to nomenclature, the terms of Stephenson and Stephenson (1949) will be used, except for the substitution of the prefix sub- for infra- in the case of infralittoral and infralittoral fringe.

I also wish to point out that much of the data that I will talk about are the results of the work of Dr. Cassie, and my own contribution is mainly limited to the observation of the sublittoral communities that I will describe (Dellow, 1955).

THE MARINE BIOTIC COMMUNITIES

1. LITTLE BARRIER

The entire shore of this island is composed of boulders forming beaches at the bases of high cliffs, with only occasional rocky headlands. The shore is subject to frequent vigorous wave action. We may divide the seemingly meaningless jumble of plants and animals into the surface pattern zonation and the between boulders zonation. These zonation patterns are listed in Table 1.

	SURFACE PATTERN ZONATION	BETWEEN BOULDERS ZONATION
UML	*Nerita melanotragus* *Apophloea sinclairii*	
ML	*Nemastoma oligarthra* *Haplospongidion saxigenum* *Ralfsia verrucosa*	*Lithothamnion-Basal Corallina* *Petrolisthes elongatus* *Heterozius rotundifrons* *Ozius truncatus*
LML	*Basal Corallina officinalis* *Ulva lactuca* *Gelidium caulacanthum* *(Halopteris spicigera)*	*Hildenbrandtia* sp. *Caulacanthus spinellus* *Chamaesipho columna*
SBLF	*Lithothamnion + Corallina crusts* *Xiphophora chondrophylla* *Cystophora retroflexa*	*Erect Corallina turf* *Xiphophora chondrophylla* *Pterocladia lucida* *Champia laingii*
USBL	*Carpophyllum plumosum* *Carpophyllum maschalocarpum* *Melanthalia-Vidalia-Pterocladia*	
MSBL	*Ecklonia radiata* *Cystophora torulosa* *Carpophyllum maschalocarpum* *Spatoglossum chapmanii*	

TABLE 1.—*Schematic pattern of zonation at Little Barrier. Brackets around the names of plants or animals indicate localised dominance.**

* The following abbreviations are used in the tables:—UML—upper midlittoral; ML—midlittoral; LML—lower midlittoral; SBLF—sublittoral fringe; SBL—sublittoral; USBL—upper sublittoral; MSBL—midsublittoral.

UML	*Chamaesipho brunnea* *Chaemaesipho columna* *Elminius plicatus*
ML	*Apophloea sinclairii* *Saxostrea glomerata* *Mytilus canaliculatus*
LML	*Corallina officinalis* *(Scytothamnus australis)* *(Hormosira banksii)* *(Leathesia difformis)*
SBLF	*Xiphophora chondrophylla*
USBL	*Carpophyllum maschalocarpum* *Carpophyllum plumosum* *(Ecklonia radiata)*
MSBL	*Melanthalia abscissa* *Pterocladia lucida* *Dictyota dichotoma*
LSBL	*Ecklonia radiata*

TABLE 2.—*Tarakihi (Shag Rock), also Otata (Noises Islands)*

2. TARAKIHI AND OTATA

These two islands can be thought of as being subjected to moderate to fairly severe wave action. Both islands possess firm, jointed greywacke shore platforms which are cut by deep wave channels and descend quite steeply into the sublittoral. The zonation pattern is summarised in Table 2.

3. ONETANGI

Waiheke is the largest of the inner islands of the Gulf and we find typical sheltered-coast algal zonation patterns on the southern shore. These are considered in the next section. On the northern shore, however, slight to moderate wave action is experienced. The outcropping headland at Onetangi possesses a litteral zone composed of angular greywacke and develops a typical rocky coast zonation pattern, which is shown in Table 3.

UML	*Chamaesipho brunnea* *Bostrychia arbuscula* *Chamaesipho columna*
ML	*Saxostrea glomerata* *Scytothamnus australis* *Splachnidium rugosum*
LML	*Ralfsia verrucosa* *Hormosira banksii* *Codium adhaerens*
SBLF	*Xiphophora chondrophylla*
SBL	*Carpophyllum maschalocarpum* *Carpophyllum plumosum* *Carpophyllum flexuosum* *Ecklonia radiata*

TABLE 3.—*Onetangi - Waiheke Island.*

4. SHELTERED COAST STATIONS (e.g. COWES BAY, SCORIA FLAT, SMELTING HOUSE BAY, PAKIHI)

The zonation pattern summarised in Table 4 is a generalised one that includes the prominent plant and animal associates of the sheltered stations in the Gulf. The substrate for this typical zonation is usually a gently sloping wave-cut platform of Waitemata sandstone. The occurrence and abundance of any given species may be modified to a certain extent at any one station, but in general, most of the dominants listed may be recognised. This type of zonation is the most typical seen in the Gulf, and is notable for the very important contribution made by the barnacles, *Saxostrea*, and *Hormosira* to the orderly series of zones.

UML	*Chamaesipho brunnea* *Chamaesipho columna* *Elminius modestus* *Elminius plicatus* **Enteromorpha procera f. minuta*
ML	*Gelidium pusillum* *(Volsella neozelanicus)* *Saxostrea glomerata* *Caulacanthus spinellus* *Gelidium caulacanthum*
LML	*Pomatoceros coeruleus* *Hormosira banksii* or *Hormosira - Corallina* *Laurencia* sp. *Codium adhaerens* ** { *Microdictyon mutabile* *Enteromorpha procera f. novaezelandiae* *Leathesia difformis* *Colpomenia sinuosa* *Lunella smaragda* }
SBL	*Carpophyllum maschalocarpum* *Carpophyllum plumosum* *Ecklonia radiata*

* On the barnacles.
** On the coralline mat where this is present.

TABLE 4.—*Sheltered Stations (Cowes Bay, Waiheke; Scoria Flat, Rangitoto; Smelting House Bay, Kawau; Pakihi).*

DISCUSSION

Four major subdivisions of the algal zonation of the Gulf may be described on a basis of wave exposure and substrate. The effect of wave exposure can be seen in the complete replacement of *Saxostrea* by *Lithothamnia* or *Chamaesipho columna* on the more exposed shores, and the replacement of *C. columna* itself by *Elminius modestus* in brackish or sheltered conditions. The effect of the type of substrate can be seen in the absence of *Apophloea sinclairii* from Waitemata sandstone and the lower mid-littoral dominance of the *Hormosira-Corallina* association on this substrate.

The combined effects of both factors can be seen in the replacement of the *Hormosira-Corallina* association on exposed coasts by red and green algal mats (e.g. Little Barrier).

The sublittoral fringe is clearly defined on the exposed coasts but this zone disappears at the more sheltered stations and here the fringe species are those dominant in the sublittoral, e.g. *Carpophyllum maschalocarpum*. I have divided the sublittoral into upper, mid, and lower sublittoral. Brown algal species such as the *Carpophyllums* characterise the upper sublittoral and a red algal belt composed of *Pterocladia-Vidalia-Melanthalia* the midsublittoral. Then follows a further brown algal zone in deeper water with *Ecklonia radiata* as the physiognomic dominant. Only if the water is sufficiently deep do all these sublittoral zones occur, and on sheltered coasts, there is frequently a telescoping of the upper and lower sublittoral with the exclusion of the red algae of the middle zone.

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Fish of the Hauraki Gulf

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This paper presents some biological and ecological information obtained from records of the last six years of catches in the inner Gulf and adjacent fishing areas by the Marine Department's fishery research trawler, *Ikatere*.

ABUNDANCE

Snapper was the most abundant commercial species caught by *Ikatere* in the inner Gulf, with gurnard second and trevally third. John dory, mackerel, kahawai, leatherjacket, various rays (especially the eagle ray) and spotted dogfish were all reasonably common. Flounder and lemon sole were caught in small numbers along the south-eastern and eastern shores. Tarakihi, second in commercial importance to snapper, was plentiful in the outer Gulf and Bay of Plenty (immediately south-east of the outer Gulf) in the deeper waters, where it accounted for practically the entire difference between snapper and the total marketable catch.

Annual percentages of snapper in relation to the total marketable species are shown in Table 1.

Numbers alone do not give a measure of productivity. A unit which includes fishing effort (i.e., numbers of legal-sized fish per fishing hour) has therefore been introduced into the table for comparison. This unit is not readily compared with commercial standards of weights and values, but it is fairly adaptable and shows clearly the relative states of the various grounds as judged by *Ikatere's* trawling records. The total marketable catch has been chosen for this comparison because this affects the availability of fish to the public rather than a unit involving one particular preferential species.