FIELD CHARACTERISTICS OF SOME CONSPICUOUS SUBLITTORAL SPONGES FROM ROARINGWATER BAY, COUNTY CORK, IRELAND.

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ABSTRACT

Field characterizations (including both morphology and ecology) of nine common sublittoral sponges studied during 1982 and 1983 are given here as a contribution towards the improved delineation of these species. Detailed *in situ* observation formed the basis of the study, which investigated the variation exhibited by each of the sponge species and looked for its causes.

INTRODUCTION

Most sponge species, even the common ones, are still imperfectly known and this has prevented the improvement of species delineations. Knowledge of the living animal is particularly fragmentary due to previous difficulties of studying the sponge both in the laboratory and the field. Now that SCUBA diving techniques have made it possible to study sponges in their natural environment, a more balanced view of the sponge is emerging. External features can be critically assessed and existing diagnostic characters (mainly internal ones) can be re-evaluated, so helping to clarify the phenomenon of variation to which sponges are particularly prone. Variation has long confused the understanding of species. Until species can be clearly differentiated, classification above the species level will remain equivocal.

When Mr. Matt Murphy, the Director of the Sherkin Island Marine Station instigated an extensive SCUBA diving survey of the sublittoral sponges in Roaringwater Bay to establish a baseline for future pollution studies, it provided an opportunity to study sponges at species level. There is a tendency to collect unusual-looking specimens (the "dazzle effect"), which has had a distorting influence on species descriptions. This is one reason why a synthesis of existing specimen descriptions often fails to catch the essence of the species, and why recognition of the species remains uncertain.

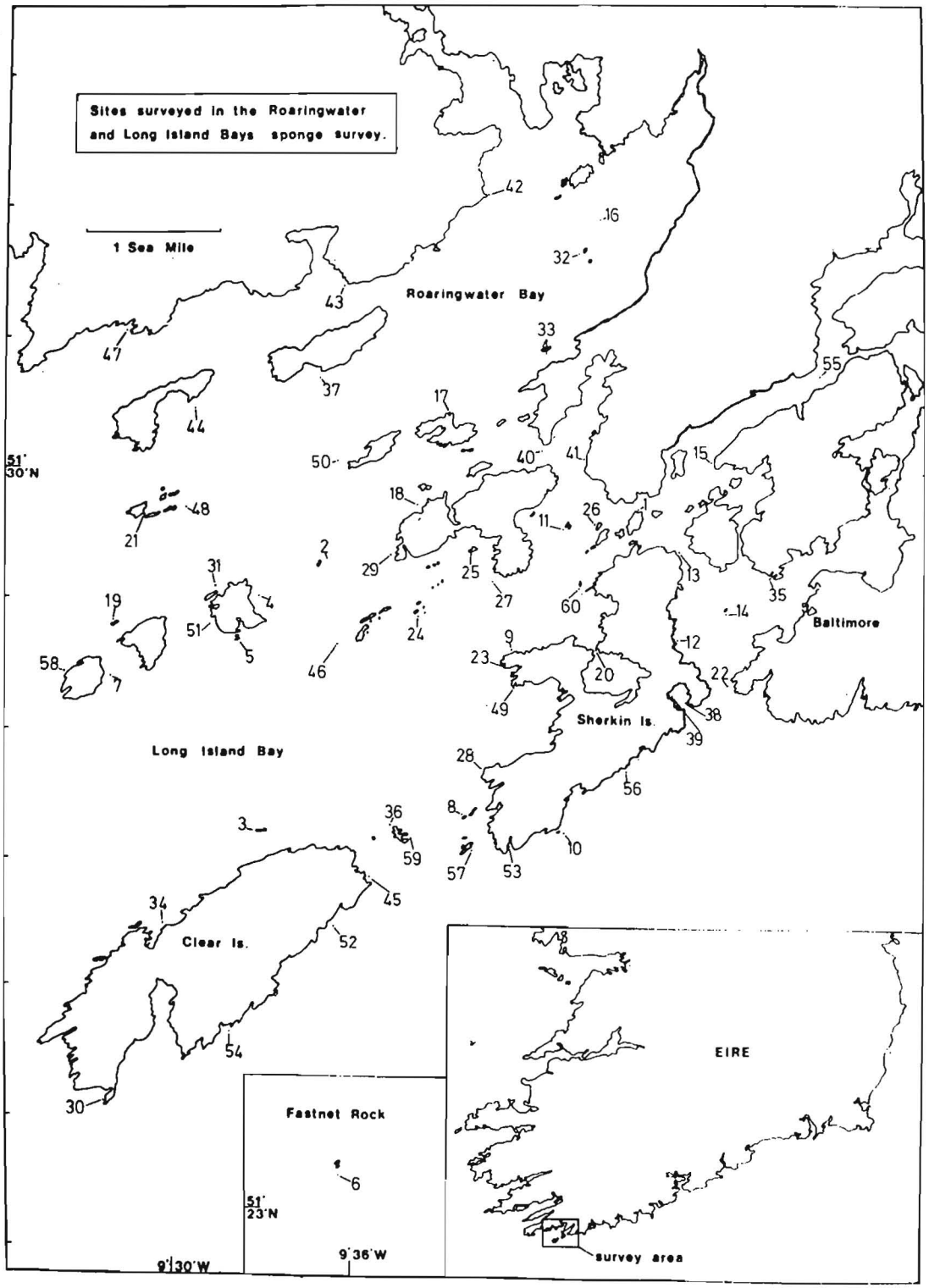
Our approach to the question of species delineation has been to attempt field characterizations based on *in situ* observations of a series of specimens found in a given area, in order to establish the typical appearance of the species and their ecological preferences. The success of this approach depends on the number of specimens studied and sites visited. The more polymorphic the species, the longer the series needed to assess the greater number of variables involved. A minimum of 20 individuals was found necessary to establish a reasonable field characterization. Previous investigations off the west coast of Ireland have helped to establish the broad composition of the sponge fauna and have indicated the environmental conditions (Lilly *et al.*, 1953; Könnecker 1973; Norton *et al*, 1977; Soest & Weinberg, 1980; Soest & Weinberg, 1981; Soest *et al*, 1981; Könnecker & Keegan, 1983).

Survey Area

Roaringwater Bay is situated in south-west Ireland (51° 25′ 00″ N. to 51° 33′ 00″ N.. and 9° 22′ 00″ W. to 9° 37′ 00″ W). Figure 1 shows its location and the sites surveyed.

The Bay, a large, complex area measuring approximately 16km x 16km, comprises open water and islands, and has an indented coastline of over 100km length (Hiscock & Hiscock, 1980).

A wide variety of habitats are present with conditions ranging from very exposed, at the seaward end, to very sheltered, at the head of the Bay. The rock base is drab grey and green sandstone interbedded with drab pale purple mudrocks thought to have been formed by deposition from braided river systems in the Upper Palaeozoic (Graham & Reilly, 1972; Reilly & Graham 1976). Such strata are much faulted and offer protection to sedentary forms from the full force of water movement. The pattern of tidal flow can be traced from the Admiralty Chart (Chart 2129), but the strength of current can be considerable at certain sites, e.g. Gasgaine Channel, where it is over 4 knots on the flood of spring tides. The algal-dominated infralittoral zone extends to a depth of 12 - 16m, and the circalittoral from there


Sites surveyed in the Roaringwater and Long Island Bays sponge survey.
1 Sea Mile
Roaringwater Bay
Long Island Bay
Clear Is.
Sherkin Is.
Baltimore
Fastnet Rock
EIRE
survey area
51° 30'N
51° 23'N
9°30'W
9°36'W

to a depth of 30 - 40m (the outer boundary of the Bay).

The clear waters of the north-east Atlantic drift which occurs off the west coast of Ireland have a salinity which remains relatively constant at 3.5% falling by no more than 0.4% at the Ilen River site. The average annual temperature range of surface waters in the outer Bay is from 9° C to 15.5° C. It can rise to 18.2° C in the outer Bay and to 19.2° C in the inner Bay, which might affect the fauna if sustained over a period. A temperature difference of no more than 3° C exists in the water column between 0.5m and 30m at any time of the year.

Methods

The survey lasted from March to November in 1982, and from April to July in 1983. The full results of the survey will be published in a later paper where details will be given of the procedure developed for this taxonomically orientated project.

To provide a complete coverage of the Bay, transect sites were chosen at random following a 1km interval along the coast of the mainland and of the larger islands, using the Admiralty Chart. Sites were chosen from all four sides of smaller islands, and sites of particular interest, isolated rocky pinnacles and outcrops were also included. A representative cross-section from across the exposure gradient and depth range, including a wide variety of substrata, resulted from this exercise.

Sixty sites were fully surveyed during the preliminary phase of the survey. Over 422 specimens were sampled for later analysis in the laboratory. The superficial appearance of the living sponge (based on gross morphological features) together with a description of the habitat and prevailing conditions found at each site, were recorded underwater. These data were subsequently analysed for each species, and their phenotypic variation and abundance plotted, together with their habitat preferences and local distribution. The specimens were preserved in 70% alcohol and deposited in the museum of Sherkin Island Marine Station.

Species abundances were assessed using the following scale:

Rare: less than 1 per $4m^2$
Occasional: 2 - 5 per $4m^2$
Frequent: 6 - 10 per $4m^2$
Common: 11 - 15 per $4m^2$
Abundant: more than 16 per $4m^2$

In addition to the type reference, (the first, and sometimes the second one cited which is given to the author who has transferred the species to the currently accepted genus) biologically and taxonomically useful references from reasonably accessible literature are cited for each species treated in the following account of the field characteristics.

OBSERVATIONS

The species chosen for inclusion here are those considered to be amongst the better known in the N.E. Atlantic, so that regional comparisons can be made with existing data.

It should be emphasised that the following field characterizations are for the sponges in Roaringwater Bay, the temptation to include features observed elsewhere being strongly resisted.

Phylum: PORIFERA
Class: DEMOSPONGIAE
Subclass: TETRACTINOMORPHA
Order: ASTROPHORIDA
Family: GEODIIDAE

Pachymatisma johnstonia (Bowerbank,1842)

Bowerbank in Johnston, 1842, p. 198, as *Halichondria;* Johnston, 1842, p.244.

Bowerbank, 1866, p.51; 1874, p.17, pl.8, figs. 1 - 7; Topsent, 1894, p. 321, pl. 11, figs.4-5, pl. 16, figs. 1 - 5; Arndt, 1935, p.28, fig. 39. Plymouth Marine Fauna, 1957, p.29. Borojevic *et al*, 1968, p.3.

This generally large, massive, grey/purple sponge (up to 24 x 24 x 4cm), is rare in the infralittoral and circalittoral (5 to 25m) but becomes locally frequent in surge gullies and caves between 5 and 10m (e.g. at Truhane Point, Carrigcleamore Rock and Fastnet Rock).

It favours surge conditions, being found at sites which are very exposed to wave action and to varying degrees of current exposure, conditions which allow only a light covering of silt to settle out on the sponge and adjacent surfaces. It is firmly attached by a broad base to bedrock on vertical surfaces or under overhangs, which are usually covered by hydroid/bryozoan "turf". At nearby Lough Hyne, on the mainland, this species is common on the boulder slope at Whirlpool Cliff down to 18m, where it most often encrusts the undersides of the piled-up boulders and bridges intervening gaps.

The sponge develops from low cushions to a more solid, massive form, typically with rounded ridges and often of irregular outline due to short,

lateral extensions. It becomes pendulous when growing from over-hanging surfaces. It has a smooth, but undulating surface that is divided into two regions, the ridge-tops, which are noticeably slimy, and the sides which are not. Small, round oscules are distributed along the ridges and are sometimes grouped into clusters on raised prominences. Only a few are seen open, the majority being closed and resembling small pin-points set in lighter-coloured surface depressions. The texture is compact, "rubbery" and barely compressible, and cannot be flexed (cf. *Cliona celata).*

When out in the open, the colour is a consistent elephant-grey/purple. In darkened caves it is a dirty white. Specimens are often found at Lough Hyne with a deposit of microscopic algae forming a 'dust-like' layer on the riges which discolours the surface. This deposit can be rubbed off with the finger.

Juveniles of this species were not seen in the Bay, and no regular associates were observed.

Order: HADROMERIDA
Family SUBERITIDAE

Suberites carnosus (Johnston, 1842)

Johnston, 1842, p. 146, pl. 13, figs. 7 - 8, as *Halichondria;* Gray, 1867, p.523.

Bowerbank, 1866, p. 203; 1874, p.91, pl. 36, figs. 5 - 9, as *Hymeniacidon;* Topsent, 1900, p. 233, pl. 7, figs. 1 - 5; Arndt, 1935, p. 38, fig. 61; Plymouth Marine Fauna, 1957, p. 29; Cabioch, 1968, p. 216, fig. 3A - D; Borojevic *et al.*, 1968, p. 9.

A pale orange, contractile, fig-shaped sponge usually found in open situations from the upper infralittoral (4m) down to the lower circalittoral (25m), at sites where moderate water movement allows the silt to fall out of suspension lightly covering the sponge. It varies from rare to locally abundant (e.g. North Sandy Island).

It prefers stable substrata such as bedrock, but in sheltered situations it can be found attached to scallop shells or pebbles. It is found at all angles of attachment except under overhangs. On near-vertical surfaces, the sponge body may be held upright or hang down below the stalk.

Typically, the body is squat and fig-shaped (up to 15cm diameter x 20cm long), but misshapen specimens are observed, e.g. the body may be slightly flattened or elongated, and if the elongation is very pronounced, it becomes lobed or divided into several lobes. The body is attached by a thick, fleshy stalk which becomes longer as the surface to which it is attached becomes more vertical. There is usually one open oscule set in a shallow depression at the top of the body, but there may be two or three; the lobed form has one apical oscule per lobe. Inhalent pores are seen as pin-points over the surface, with a density of eight per cm^2.

The sponge is responsive to touch, the speed of contraction being proportional to the pressure applied. Gentle pressure produces a local contraction, but firm pressure results in overall contraction, the body contracting to two-thirds of its fully expanded size in a few seconds. Changes in appearance result, e.g. the oscula and pores become obscured, and the soft, spongy texture becomes firm and barely compressible. The smooth, even, velvety surface of the expanded body consolidates into a smooth contracted state.

The colour is normally a uniform orange, but individuals are observed with pale yellow undersurfaces.

Juveniles (0.5cm diameter) were observed grouped in the vicinity of larger specimens more than once. One individual was seen apparently undergoing vegetative reproduction with the body detaching from the top of the constricted stalk, connected only by a thin strand of tissue, and leaving behind a stalk which had developed several functional oscules. This species seems to be prone to damage but further study is needed.

Apart from gammarids living in small surface burrows, no other regular associates were observed.

Suberites ficus (Linnaeus, 1767)

Linnaeus, 1767, p. 1295, as *Alcyonium;* Nardo, 1833, p.523.

Topsent, 1900, p.203, pl. 5, figs.6 - 15, as *Ficulina;* Arndt, 1935, p. 39, fig. 64; Hartman, 1958, p. 3, pl. 1, fig. 5; Plymouth Marine Fauna, 1957, p. 29, as *S. domuncula;*

Borojevic *et. al*, 1968, p.8, as *Ficulina ficus.*

The local form of this polymorphic species is the dark orange, massive sponge generally attached to hard substrata. It is found in the infralittoral (between 2 and 15m) at sites where the water movement allows the silt to fall out of suspension, settling as a light cover of fine silt in hollows on the upper surface of the sponge. It is rare, except at the sheltered maerl bed site where it becomes frequent.

It prefers upward facing surfaces, usually bedrock, but the outsize, flattened forms which appear to be lying free on the surface of the

maerl bed initially encrust shells or pebbles, which later become engulfed as the sponge grows larger. It can attach at all angles including overhangs.

The sponge develops from a cushion into substantial masses (up to 30cm across by 15cm high). It can be irregular or lobed, with an even but undulating and minutely hispid surface. A few large oscules (7.5mm or more in diameter) are usually situated on upper prominences and lobe apexes. The texture is firm with only slight contraction occurring in response to touch.

The colour is a uniform dark orange, including both surfaces of the flattened maerl bed form which suggests periodic turning, possibly by crabs. The tissues of a specimen fixed to a pebble below the sediment surface were lacking in colour, indicating that prolonged concealment does result in absence of colour. The surface seems to be prone to damage, with splits and tears, and wounds inflicted by the nudibranch *Archidoris pseudoargus* showing as paler scar-tissue.

Some juveniles were observed at the maerl bed site. Regular associates were not observed.

Family: POLYMASTIIDAE

Polymastia mamillaris (Müller, 1806)

Müller, 1806, p.44, pl.158, figs. 1-4, as *Spongia;* Bowerbank, 1864, p. 178.

Bowerbank, 1866, p.71; 1874, p.31, pl.12, figs. 1 - 11; Topsent, 1900, p.131, pl.4, figs. 8 - 13, Arndt, 1935, p. 33, fig. 48; Plymouth Marine Fauna, 1957, p. 29; Borojevic *et al.,* 1968, p. 9; Boury-Esnault, 1974, p. 141.

This pale yellow, papillate sponge is recorded as occasional and is found scattered at many sites from the upper infralittoral (3m) to the lower circalittoral (29m), wherever moderate water movement allows the silt to fall out of suspension, thickly covering surfaces.

It favours open situations and is found only on bedrock or stable boulders, usually attached at shallow angles on upward facing surfaces. However, sometimes it is found on vertical rock faces, on ledges or tucked into silty pockets.

A variable number of semi-contractile papillae arise vertically from a flat, spreading, circular to rectangular basal pad (up to 30cm diameter by c. 1 cm thick), which is usually buried beneath coarse sediment and firmly attached to the underlying rock. The pad is firm and has a surface roughened by projecting spicules. Papillae are only rarely silt-covered (e.g. specimens at Inane Point). They are stiff and will spring back to the vertical, if displaced.

Sponges were observed with up to three different kinds of papillae, their frequency, position and length varying individually. The most frequent is slender and blind-ending, tapering to a point (up to 4cm. high). The next most frequent is stouter, with squared-off ends which are normally open (average 1cm. high). Both these kinds have an open scalariform, reticulated surface, and are a light yellow or off-white colour. The third kind of papilla, which is not found on all individuals, appears to be a developmental stage of the other two kinds. It is interspersed between the other two over the basal pad. It is short (c. 0.5cm high), obtuse-ended, and has a dense, smooth-looking surface. It is dark yellow, similar in colour to the basal pad. Papillae have a tendency to orientate themselves to best functional advantage. For example, they will turn away from adjacent rock faces and may become longer.

Juveniles have a relatively smooth, dome-shaped basal pad (c. 1cm x 1.5 cm thick), with few comparatively long, thin papillae.

Bryozoans were found growing on exposed sponge surfaces.

Family: CLIONIDAE

Cliona celata Grant, 1826 (the massive form)

Grant, 1826, p.78.

Bowerbank, 1866, p.354; 1874, p.165, p. 64, figs. 1 - 5, as *Raphyrus griffithsii;* Topsent, 1900, p.32, pl.1, figs. 5 - 9; Arndt, 1935, p.44, fig. 74; Hartman, 1958, pp. 16, 87. pl. 1 fig. 4; Plymouth Marine Fauna, 1957, p. 30;

Borojevic *et. al*, 1968, p.6.

This large, conspicuous, yellow sponge is widespread in the Bay, being recorded as rare to occasional in the infralittoral (below 2m), depending on the degree of wave exposure, and frequent to common in the circalittoral (30m max.).

It can tolerate some wave action, but prefers open situations in the circalittoral where the nutrient-rich silt remains in suspension due to strong tidal streams. Occasionally it becomes heavily silted, but periodic pumping clears the fine silt from the openings. Ridged forms are usually aligned across the current. It shows no preference for any particular angles of attachment. It is often found at the base of vertical rock surfaces, just above the seabed.

Typically it develops into a ridged form (up to 150cm long x 40cm high), firmly attached

by a broad base to stable substrata such as bedrock. It is also found as flattened, spreading cushions or can become pyramidal when attached to vertical surfaces, or wedge-shaped when infilling cracks. The round, contractile oscules (up to 7mm diam.) are concentrated along the ridge tops, and upper prominences, with a proportion closed at any one time. When open, the oscule rims are flush with or slighty raised above the surface. The oscules contract to the size of pin-points when closed. Retractable, inhalant papillae with openings covered by sieves and slightly expanded rims, cover the remaining surfaces. They extend to a height of 3mm , but retract below the surface when closed, leaving distinct depressions on an otherwise smooth and undulating surface. The animal responds to touch by showing a slight contraction of the oscules and a rapid retraction of the inhalent papillae.

The texture is firm and "rubbery", and in the tall, ridged forms it is sufficiently pliable to be flexed from side to side without tearing. The surface has the feel of chamois leather. The colour is generally a uniform cheddar-yellow, but occasionally darker coloured individuals are seen. Scar-tissue shows as pale sulphur yellow patches.

A marked absence of small specimens (in the size range between the gamma-stage and approximately 5 x 5 x 1cm) was observed in the Bay during the two seasons, though boring forms are widespread and common.

A wide range of organisms were observed at different times growing on the sponge, including other sponges (*Amphilectus fucorum, Axinella infundibuliformis* and *Sycon* sp.), the protozoan *Haliphysema tumanowiczi,* hydroids, bryozoans and tunicates (*Aplidium* sp), and the small red alga *Delesseria sanguinea* . Small gammarids and ophiuroids live inside the oscules and occasionally the sea urchin *Echinus esculentus* was seen grazing the surface. In some sponges a microscopic alga discolours the surface red around the oscules.

Subclass: CERACTINOMORPHA
Order: HALICHONDRIDA
Family' HALICHONDRIIDAE

Halichondria panicea (Pallas, 1766)

Pallas, 1766, p.388, as *Spongia;* Fleming, 1828, p.520.

Johnston, 1842, p.114, pls.10, 11, fig.5; Bowerbank, 1866, p.229; 1874, p.97, pl.39, figs.1-6, p.99, pl.40, figs. 1-5; Lundbeck, 1902, p. 17, pl. 9, fig. 1; Arndt, 1935, p. 103, fig. 221; Plymouth Marine Fauna, 1957, p. 35; Hartman. 1958, p. 29, fig. 9; Borojevic *et al.*, 1968, p. 16; Vethaak, Cronie and Soest, 1982, p. 82, pl. 1, figs. 1 - 5, pl. 2, figs. 1 - 5, pl. 4, fig. 4.

A widespread species extending from the lower shore into the infralittoral to a depth of 10m. Three forms of this very polymorphic species are recognized in the Bay which appear to show a correlation with wave action:

i. *Flat Cushion Form*

This form is typically found as a flat, spreading patch of irregular outline (up to 200cm. diam. but exceptionally up to $2cm^2$, by c. 0.5cm thick), generally on vertical fissured rock in gulleys and on large boulders tidally and subtidally. It occasionally encrusts kelp holdfasts and stipes.

This is a stress-tolerant form, able to withstand both wave action and abrasion from kelp fronds experienced in the upper infralittoral. It is frequent to locally-abundant between 2 and 4m. becoming rare to occasional down to 10m. Exceptionally large patches can be found in surge conditions. The sponge generally remains clean even in calm conditions when the sediment falls out of suspension covering adjacent surfaces.

An otherwise level surface is interrupted at regular intervals by single oscules raised on low conules (up to 2mm high) with small openings. Oscules remain open showing no response to touch, only closing under extreme stress (e.g. prolonged water temperatures above 16° C). Subectosomal canals are sometimes seen below the smooth, waxy-looking, non-slip surface, and in large individuals, a fine delicate reticulation often develops. The tissue is hard and incompressible, breaking under pressure. The colour ranges from a dirty yellow to a dull green with increasing exposure to light, suggesting a symbiotic algal association. This form has the sharp, pungent smell characteristic of the species.

A patch may comprise more than one individual. Individuals often 'die-back' in the autumn through fragmention. Regrowth the following spring can result in the fusion of several adjacent but often unrelated fragments.

Regular associates include red macroalgae, hydroids and bryozoans.

ii. *Digitate Form*

This form typically develops into low, sprawling growths (up to 30cm x 30cm), often showing multi-dimensional subdivision giving rise to digitate processes which fuse with each other at points of contact.

It is the form most commonly seen in the Bay. It is found in silty situations associated with wave-sheltered but current-exposed sites, being frequent between 6 - 8m but becoming occasional towards its limits at 2 and 10m. The sponge becomes covered in silt in calm conditions. It favours upward facing bedrock, but it also encrusts *Laminaria* holdfasts and red macroalgae.

Several hollow digitate processes (average 10m long; exceptionally up to 30cm long) seemingly arise haphazardly from a relatively small basal cushion (7 - 25cm diameter). Large, terminal oscules are situated on the digitations, and can sometimes be found scattered along their length. The oscules are normally open, but under extreme stress, they do become closed-off by a membrane, reinforced by a spicular-plug occluding the inner lumen below the apex. Subectosomal canals are sometimes visible below the smooth surface which becomes progressively obscured by innumerable small irregularities and projections. The tissue is normally firm and resilient but is not strong enough to support finger-like growth across the current as is the case in other sponges (e.g. *Haliclona simulans).* The colour ranges from a pale yellowish green to dark green, sometimes with paler patches giving a mottled appearance to the individual. This form also has the sharp, pungent smell characteristic of the species.

Regular associates include the anemone *Cereus* sp., often seen between the digitations, and gammarids which burrow into the surface.

iii. *'Organ-pipe' Form*

This form, known only from one area between wave-sheltered North Sandy Island and Baltimore Harbour, is found in the silty thick kelp between 4 and 6m.

It has well-developed, simple, upright oscular tubes, arising from a relatively substantial basal cushion. The terminal oscula are large and generally open. The surface is smoother and more matt-like, with fewer irregularities than the digitate form. The strong currents help to remove the heaviest silt from the surface. The texture is noticeably soft, and the colour is a dull, dark green. The smell has yet to be checked.

Family: HYMENIACIDONIDAE

Hymediacidon perleve (Montagu, 1818)

Montagu, 1818, p.86, as *Spongia:* Bowerbank, 1866, p.179.

Bowerbank, 1874, p.87, pl.34, figs.1-2; Arndt, 1935, p. 105, fig.226, as *H. sanguinea;* Plymouth Marine Fauna, 1957, p. 31; Borojevic *et al*, 1968, p.17, as *H. sanguinea; Stone,* 1970, p.443.

This orange, polymorphic species is widely distributed, extending from mid-tide level on the shore down to 10m in the infralittoral. It is recorded as occasional except in the estuarine conditions of the River Ilen where it becomes locally abundant (c. 2m).

It favours silty sites subject to some current, but it can also tolerate very sheltered conditions as well as moderate wave exposure. It is normally found on stable substrata, e.g. bedrock of the slopes and rocky outcrops and on cave walls, but it is also found on mobile bottoms, both in sheltered conditions (e.g. maerl bed site) and in turbulent situations (e.g. Kinish Harbour narrows), when it is usually attached to a pebble or shell. It shows no particular preference for angle of attachment.

The sponge develops from thin, flat, hard, bright orange, spreading sheets (0.5cm thick) typical of the intertidal and shallow water form, to soft, dull orange, compressible cushions of irregular outline (c. 10cm diameter by c. 3 cm thick) found subtidally. The estuarine form develops into substantial masses (up to 30cm diameter by c. 7cm thick) with pronounced mammiform outgrowths (c. 3 cm high) bearing terminal oscules, which occasionally extend into digitate processes. The development of such outgrowths appears to be a strategy used to overcome smothering.

In flat sheet forms, the oscules are scattered and inconspicuous, lying almost flush with the surface, but in cushion forms they are raised on conules (up to 4cm high), some open and some closed. The surface is smooth, compact and usually clean in the sheet form, becoming wrinkled, folded and progressively more silted in the massive, estuarine form. A translucent, faintly reticulated membrane can be seen sometimes covering the surface and forming a collar around the larger oscules.

Regular associates include red and green algae, bryozoans and *Sycon* sp. Small gammarids *(Tritaetes* sp.) often live in surface burrows, and more than once, the sponge was seen attached to stalks of dead *Nemertesia ramosa.*

Order: POECILOSCLERIDA

Family: MYCALIDAE

Subfamily: ESPERIOPSINAE

Amphilectus fucorum (Esper, 1794)

Esper, 1794, p.278, pl.49, figs.1, 2, as *Spongia;* Vosmaer, 1880, p.117.

Johnston, 1842, p. 112, pls. 9, 12, fig. 2, as *Halichondria;* Bowerbank, 1866, p. 322; 1874, p. 142, pl. 56, figs. 16 - 19, as *Isodictya;* Burton, 1932, p. 289, p. 154, figs. 1 - 4; Arndt, 1935, p. 53, figs. 92, 92A.; Plymouth Marine Fauna, 1957, p. 33; Borojevic *et al.,* 1968, p. 19, as *Experiopsis;* Uriz, 1983, p. 237, as *Experiopsis.*

This intense orange sponge is a very polymorphic species. Three forms are recognized in the Bay:

i. Encrusting, as thin sheets.
ii Cushions, with conules.
iii. Cushions, with 'branchlets'.

The three forms could be regarded as a progressive growth series, but a correlation appears to exist between form and water movement, which effectively confines them to different habitats.

The species which is widespread in the Bay, is found in the infralitteroral from 1.5m down to 13m. Preferred sites are those where vigorous water movement keeps the nutrient-rich silt in circulation, and though adjacent surfaces may become heavily silted, the sponge remains clean or only lightly covered.

It is a characteristic component of the silty "turf" cover found under the kelp canopy. It prefers to attach firmly to underlying bedrock before growing out to envelop the surrounding "turf" cover. The close association which often exists between this sponge and the "turf" and foliaceous algal species appears to be due to rapid overgrowth by the sponge, rather than penetration of the sponge by the other species. The angle of attachment is from the horizontal to the vertical, never pendulous, with a preference for more vertical surfaces in shallow waters above 6m.

All three forms have a smooth, even surface which becomes more 'open-structured' as the animal grows. In large specimens the surface can be wrinkled. Pores are seen peppering the surface as small, dark pin-points and sometimes, darker subectosomal canals are visible. The texture is relatively soft and the tissues are easily torn, which is surprising in view of the exposed situations in which the sponge generally grows. One interesting characteristic is the loss of pigment when gently squeezed. The sponge also has a distinctive, acrid smell.

i. *Encrusting, as thin sheets*

This form is found as spreading patches of irregular outline (up to 10cm diameter by 3mm thick) attached to rock or kelp. A few low-lying oscules with transparent, membranous collars lie scattered over the surface.

This form can tolerate wave-exposed sites down to 6m, where it is found in the half light under the kelp canopy, often abraded by the fronds. Normally recorded as common, it can become locally abundant.

ii. *Cushions, with conules*

Cushions of irregular outline occur either as groups of small individuals of different sizes (up to 15cm. diameter by c. 1cm thick) or as single large individuals (up to 30cm diameter). A few oscules (10 per $5cm^2$) develop on thick conules (up to 7mm high).

This form occurs most often in light, semi-wave-exposed sites at about 5m., where it is frequent to common, but it can extend from sheltered sites at 1.5m down to current-exposed sites at 13m, where it is occasional

It attaches to pebbles, infills crevices on faulted bedrock, encrusts *Laminaria* holdfasts and stipes, and envelops hydroids, bryozoans and foliaceous algae. It can be found encrusting the legs and carapace of the spider crab *Inarchus* sp., and has been observed with the anemone *Sagartia elegans* growing through it. This form has also been found in association with the bed of brittlestars *Ophiothrix fragilis* to the north of Sandy Island, where it seems to be little disturbed by the periodic covering it receives from the migrating *Ophiothrix.*

iii. *Cushions with 'branchlets'*

This form develops weak, branch-like processes which straggle out from an irregularly shaped basal cushion (up to 8cm diameter), seeking support from adjacent rock surfaces, kelp stipes, or hydroids such as *Nemertesia antennina.* The 'branchlets' are of varying lengths and though they do not subdivide, they do fuse to each other. They have a tendency to terminate in broad, flattened blind-ending tips. They sometimes re-attach to the substratum in the manner of blackberry stolons, so this may be a means of colonizing new territory. An individual can reach extensive proportions, covering an area of up to 75 x 50cm A few large oscules lie almost flush with the surface of the cushion, often with 'branchlets' growing out from the rims. Smaller openings may be aligned along the 'branchlets'.

This form reaches maximum development in the dim, wave-sheltered clearings in the kelp park

at 10m, where the plants begin to thin out. It is found infrequently at 5m but is occasional at 10m.

It encrusts faulted bedrock and kelp holdfasts, and grows over foliaceous algae and hydroids. It was once observed growing over the massive form of *Cliona celata.*

Order: DICTYOCERATIDA
Family: DYSIDEIDAE

Dysidea fragilis (Montagu, 1818)

Montagu, 1818, p.114, pl. 16, figs. 1,2, as *Spongia;* Gray, 1848, p.19.

Bowerbank, 1866, p. 381; 1874, p. 175, pl. 69, figs. 1 - 3; Burton, 1934, p. 583, figs. 18-33; Arndt, 1935, p. 107, fig. 231; Plymouth Marine Fauna, 1957, p. 31; Vacelet, 1959, p. 67; Borojevic *et al.,* 1968, p. 28; Pulitzer-Finali and Pronzato, 1976 [1977], p. 87.

The most common species in the Bay, this distinctive yet polymorphic, greyish sponge is widely distributed in the infralittoral from 2m down to 10m. It is frequent to common from 4 - 6m and rare or occasional elsewhere, depending on exposure.

It frequents wave-exposed sites, avoiding the direct force of the water by living in crevices or lying behind rock projections. It is a characteristic component of the silty "turf" cover found under the kelp canopy, where it is sometimes seen in small groups. The sponge usually remains clean or only lightly covered despite the silty conditions. It is usually firmly attached to bedrock or immobile boulders on vertical or near vertical surfaces (sometimes horizontal or overhanging surfaces). It has also been observed on red macroalgae.

The sponge develops from a flat, spreading sheet (0.5cm thick) into the more typical low cushion of irregular outline with an undulating surface (up to 20cm diameter by 2cm thick). Specimens may develop elongated processes (up to 5cm. long) in more sheltered, shady sites, especially under overhangs. When the processes become too large they tend to fragment.

The surface is minutely conulate, being lifted up at regular intervals by the underlying skeletal fibres (c. 2mm high). A transparent surface membrane is sometimes visible through which the denser parts of the body and subectosomal canals can be seen. Oscules (1 - 6, depending on size of sponge), often surrounded by transparent, membranous collars, are raised on prominences or are terminal on the lobes (2mm diameter on 5cm lobe). The texture varies from weak and soft to firm and resilient, even crumbly, depending on the amount of foreign matter (e.g. sand grains) coring the spongin skeletal fibres. The colour varies from a uniform, dull off-white to beige, sometimes tinged with a pale pink.

Possible predation by the nudibranch *Archidoris pseudoargus* needs confirmation. The jewel anemone *Corynactis* was seen growing through one sponge, otherwise no regular associates were observed.

DISCUSSION

A dynamic interaction exists between the sponge and its environment. With the more responsive species, this often leads to physical change which is recorded as variation. The range of variation has yet to be established for the majority of sponge species.

The preliminary results of this investigation have shown the complexity of the problem and indicate the subtlety of response shown by sponges to their environment, which requires equal subtlety of interpretation by the observer.

Particular attention was given to environmental factors which might be the cause of variation. It has been shown that for species such as *Halichondria panicea, Hymeniacidon perleve* and *Amphilectus fucorum,* gross morphology can be profoundly affected by wave action or water speed (together with the interrelated factor of siltation).

In a relatively shallow, exposed area like Roaringwater Bay, where availability of substrate is no problem, water movement, siltation and temperature fluctuations can strongly influence the species composition and the habitat preferences of the species which settle there.

For example, despite the availability of suitable substrata, a scarcity of branching Axinellids (e.g. *A. polypoides*) was observed, which could be attributed to wave action pushing the species below their normal depth range. This was a factor noted further north in Galway Bay by G. Könnecker (person. comm.), where the affects of wave action extend down to 40m.

Abnormally large specimens of *Halichondria panicea, Amphilectus fucorum* and *Dysidea fragilis* were seen at two sites (Lettuce Point and Inane Point) at the outfall of the Ilen River. They were noticeably weak, soft and impregnated with sediment. It seems likely that this was due more to the plentiful food supply leading to excessive growth and causing them to become virtual 'silt-traps', than to the affects of sheltered conditions.

Field characterizations of the less polymor-

phic species such as *Pachymatisma johnstonia, Cliona celata,* and *Suberites carnosus* are well advanced, but the more polymorphic species such as *Halichondria panicea, Hymeniacidon perleve* and *Amphilectus fucorum* require further study.

There is a need for both qualitative and quantitative field studies throughout the distribution range of each species to introduce regional and seasonal comparisons (Hiscock *et al* (1983). Much useful information can be collected by using such a simple though painstaking approach as indicated here.

It is clear that there is no quick solution in understanding sponge species. The more complex the animal, the greater is the need for detailed studies to gain an insight into the dynamics involved. Despite an often extensive literature, surprisingly little useful data is available, and until it does materialize, species will remain equivocal. The full range of living characteristics need to be combined with details of the morphology of preserved material to give a balanced view of each species. In this way, the delineation of species can proceed.

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