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THE INTERPRETATION OF SUBLITTORAL ECOLOGICAL SURVEY RESULTS USING A STANDARDISED PROCEDURE

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INTRODUCTION

In 1977, a project called the Species Recording Scheme (SRS) was started which requested information on the distribution of sublittoral speices from volunteer divers. This project proved to be successful (1) and the question arose as to how the information from this and other recording card projects could be interpreted in relation to more conventional approaches to sublittoral surveys using trained teams. A collection of record cards from a single site at St. Abbs was studied initially. If individual record cards were treated as single samples, and the number of species plotted against the number of samples (e.g. cards), a graph similar to a conventional species diversity - sampling intensity graph was obtained, albeit rather more erratic in the way the total number of species built up (Figs. 1A & B). It was also clear that the frequency with which species were recorded could be measured and expressed either as a fraction, e.g. 5 records of species X per 10 cards, or as a percentage, and that this could also prove informative.

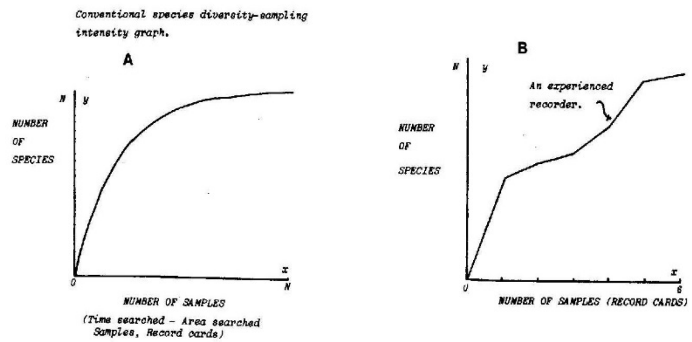

Figure 1. A comparison of minimum area graphs : (A) the smoothed type characteristic of small scale quantitative samples, (B) a similar graph based on in situ recordings over a larger area. In the text these graphs are referred to as species diversity (the number of species) - sampling intensity (SD-SI) curves.

It was decided to devise a repeatable method which could be used to simulate the collection of information from record cards. The object of this exercise was initially to understand how records could be interpreted for the Species Recording Scheme (SRS). It soon became apparent however that the method could be used for a number of other purposes which included :-

1. An instructional exercise to explain the principles of sublittoral species recording,
2. A method for utilising the skills of large groups of volunteer recorders to describe the species of a particular site,
3. A repeatable preliminary exercise to demonstrate aspects of community ecology and temporal changes in species composition.

The aim of this paper is to describe this method, and how the results derived from it can be applied to the objectives listed above.

METHODS

The design criteria used stemmed largely from the initial objective of trying to understand how Species Recording Scheme (SRS) record cards worked. The broad details of the method as presented to the students are set out below, however the exercise schedule is available on request from the author.

Six or eight pairs of divers were positioned approximately 20m apart along a fairly uniform stretch of coast at Farland Point, Millport, Scotland. The dive positions (1-8) were marked on the rock using paint, and each pair of divers were directed to a set position. The distance covered equates reasonably well with the likely accuracy which might be expected from returning to a site using only a map reference for guidance. Three main studies were carried out using field course students in July of 1979, 1980 and 1981; supplementary studies at the site were carried out during the courses and also at other times of the year. In 1981 a second exercise was conducted on the same day, with positions of the same pairs being changed and with a number of species categories, e.g. "fish" on a checklist being taken during the search. For the exercise to be organised effectively a non diving supervisor was found to be essential. Each pair of divers was instructed to record and/or collect all the species seen within a depth band of 5m on rock starting at the base of the rock-sand boundary and working upward. The duration of search was 20 minutes after which each pair was to return to the surface. Once in the laboratory each pair was instructed to complete a list of the species seen and hand this in after a period of 20 minutes (LIST 1). The 5m depth band, equated to that required on the SRS record card, the 20 minute search time to the likely amount of time any recorder

would spend in a single 5m depth zone, and the 20 minutes in the laboratory to the likely time a recorder would spend completing an SRS record card.

Each class was also asked to complete a second list (LIST 2) which required that they spent a further 40 minutes identifying material which they had collected during the dive. The two lists were completed without the advice of the instructors, using easily available texts. Finally the collections of each pair were put in labelled trays so that identifications could be verified by the class instructors. This procedure might appear contrived, but it does to a large extent reflect reality, both with regard to the SRS scheme and during surveys when *in situ* lists are written up and then further work completed to identify material collected which could not be identified *in situ*.

The lists were carefully scrutinised by the instructor and doubtful records eliminated; such doubtful records are usually very apparent and derived mainly from the common error of trying to match a specimen to a species figured in the popular guides. Certain species groupings e.g. barnacles, chitons were left in this form of notation. Where species names are used in this text all have been verified by experts. Mis-identifications could also be detected by scrutinising the specimen collections at the end of the exercise. The instructors were then able to verify identifications and add new species. Species recorded from the sediment were not included. A list of species described during these exercises is given in Appendix 1.

The Farland Point site is a moderately exposed headland with the rock-sand boundary varying in depth from 9 to 14m (chart datum) in a rather erratic manner along the coastline surveyed. The kelp zone comprises a mixture of *Laminaria hyperborea*, *L. saccharina* and *S. polyschides*, and extends to depths of between 5-7m. Below the kelp zone a large population of the urchin *Echinus* grazes the '*Lithothamnia*' covered rock surface; often a good deal of silt covers the rock. The rock includes both featureless gently sloping bedrock faces (15^{o}-30^{o}), and 'wedges' of boulders (20-50cm in size); larger boulders are also found. The depth zone studied falls across two zones, namely the lower infralittoral zone and the upper circalittoral zone as defined by Hiscock and Mitchell (4).

RESULTS AND DISCUSSION

How many species were recorded?

The following pooled results were obtained from the four exercises plus additional work by the author.

Total number of species	127
Animals	101
Plants	26
Species only recorded by author	16
Underboulder/crack/crevice fauna	35
Species recorded in situ	96
Species only recorded in the laboratory	15

These species are listed in Appendix 1. Further work at this site would doubtless add additional species to the overall list, although these are less likely to be conspicuous or abundant. The total number of species recorded (127) illustrates clearly the dilemma facing ecologists conducting synecological surveys in the shallow sublittoral zone. This diversity is all the more remarkable because the 'grazing' pressure from Echinus and the other abundant predators means that this situation is not obviously as diverse as for example some circalittoral rock communities in the south west of Britain where animal 'turf' communities predominate.

The diving ecologist is not constrained by the various limitations imposed by remote sampling devices and can observe a wide size range of species as well as describing many biological and habitat relationships relevant to each species. This comparative lack of constraint in situ as well as the ability to collect from particular micro-habitats (e.g. the under-boulder fauna) can lead to enormous difficulties in deciding how much work is to be done at a particular site. This is all the more problematical when large numbers of samples are collected since significant numbers of smaller algae, macrofauna and even meiofauna can be easily collected. The potential diversity of such sites is enormous if one considers these groups. Moore (5) for example reported 387 species of macrofauna and meiofauna for the Laminaria hyperborea holdfasts of the north east coast of Britain. Whilst conducting limited-duration expeditions diving survey ecologists are unlikely to be able to afford the luxury of being able to record the complete faunal and floral diversity of the site because of the time-cost penalty involved with such work. The rarer, smaller 'tail' species (see below) can be preserved for later work in the base laboratory IF time permits. The rather open ended nature of in situ diver sampling and the comparatively limited use made of 'tail' species in final descriptions of communities or sites suggests that in preliminary surveys records from more stations or sites are more useful than longer species lists from fewer sites.

How frequently were these species recorded?

Fig. 2 shows the number of times the species were recorded in the pooled 28 samples taken during the study. Only 21 species (17%) were recorded in more than half the samples, whilst 87 species (70%)

were recorded in less than a quarter of the samples. The 'tail' of species recorded in only one or two samples made up 54 species or 43% of the total species recorded. These figures are for the total list compiled from lists from all four studies, including instructor verification. This provides at least some comfort to the survey ecologist for it is likely that most of the 'important' (large, conspicuous, abundant) species will be recorded in situ, whilst many species which are missed will be the so called 'tail species'. If special emphasis is given to making sure dominant species (e.g. Laminaria hyperborea) and habitats and micro-habitats (e.g. the under-boulder fauna) are recorded, at least an indication of potential diversity can be obtained since the associated species have in a number of cases been well documented (e.g. Laminaria holdfast faunas, Moore (5)).

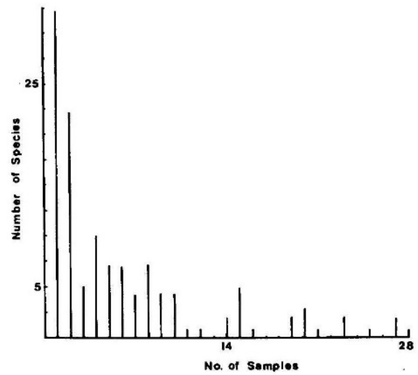

Figure 2. The number of species in sample frequency categories ranging from 1-28. A total of 127 species were either recorded frequently, 14 to 28 out of 28 samples, or less frequently, 1-14 out of 28 samples.

The most abundant species at Farland Point in relation to their recorded frequency out of 28 samples were :-

Ulva (21)
Echinus (28)
Marthasterias glacialis (23)
Cancer pagurus (19)
Ophiocomina nigra (15)
Membranipora membranacea (20)
'Lithothamnia' (23)
Clavelina lepadiformis (25)
Delesseria sanguinea (14)
Blanaus spp. (15)
Pollachius pollachius (Pollack)(14)
Laminaria saccharina (20)
Asterias rubens (27)
Ctenolabrus rupestris (Goldsinney wrasse)(24)
Pagurus bernhardus (15)
Alcyonium digitatum (27)
Gibbula cineraria (20)
Pomatoceros triqueter (19)
Desmarestia aculeata (16)
Phycodrys rubens (15)
Labrus mixtus (Cuckoo wrasse)(15)

Traditionally recording card schemes have made use of only the 'geographic' component of the information returned on the cards. Thus most dot maps convey only geographic presence-absence information for a particular sample area.

Given a set of records from a particular area, for example a 10km grid square (SRS project) or the list above, it is possible to give the record frequency of particular species (i.e. the number of times that species has been recorded from the total number of cards for that area). Since in the SRS the methods and sampling bias are reasonably consistent it is possible to infer from record frequency a species relative abundance. This provides a more informative display of the results obtained from a recording scheme.

How many samples are required?

Table 1 shows the results from the four exercises conducted from 1979 to 1981. Clarification of the procedures, LISTS etc., are given in the methods.

The mean number of species recorded in situ by each pair in the four exercises was remarkably similar during the first 3 exercises (21 or 22); in 1981 (2, afternoon) the team had gained experience from the previous exercise (1981, 1, morning) and the average species per group increased to 28. Dr. F.A. Dipper took part in each exercise and it is her records which provide the highest range values/pair during the four exercises (35-44 species recorded in situ; LIST 1). Lower totals were obtained by the author during recording dives at this site at other times of year. This again suggests that unless the recording time spent at a site is increased markedly many species are likely to go unrecorded during short survey dives even though these are likely to be 'tail' species. The inclusion of an expert recorder in the exercises parallels situations relating to recording scheme cards which have been completed by experts. The information collected

Table 1. Species totals recorded in Farland Point Studies (1979-1981)

	1979	1980	1981(1)	1981(2)
A. Species recorded in situ + 20 minutes in lab. LIST 1				
(1) Mean no. of species recorded/pair of divers and range	22(8-35)	21(16-35)	22(14-44)	28(23-40)
(2) Total number of pooled species from all pairs of divers	68	56	68	69
B. Additional species (LIST 2). The additional species records collected after a further 40 minutes work in the laboratory	Range	Range	Range	Range
(1) Mean number of additional species and range of values/pair	3(2-7)	5(3-9)	7(3-13)	3(2-7)
(2) Number of new species added by students (pooled)	8	-	16	5
(3) Number of new species added by instructors	3	-	6	6
(4) Total number of new species (2+3) in LIST 2	11	17	22	11
C. Grand Total (A2 + B4) of pooled species recorded from LISTs 1 and 2	79	73	90	80

during these exercises and plotted in Fig. 3 suggests that comparatively few record cards (5-6) from an area would be sufficient to produce a reasonable species list, more records would provide fewer new species (unless an expert in a particular group sent in specialist records or photographs taken at the site were received) but more information upon which to base frequency records.

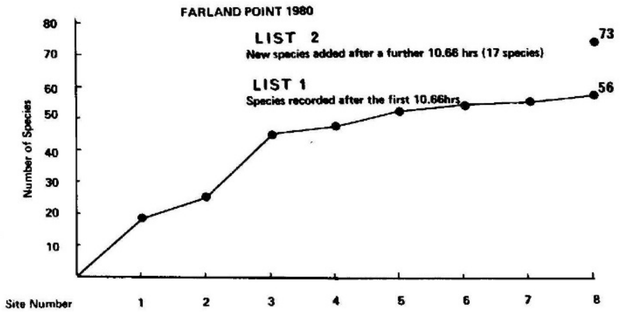

Figure 3. A typical species diversity-sampling intensity curve resulting from the 1980 Farland Point study. Eight sites (samples) were studied and the number of species found after the first part of the exercise, LIST 1 which took in total (diving + laboratory) 10.66 man hours to complete, and LIST 2 which took an equal time are shown. The shape of such graphs depends upon the order in which samples are plotted.

The further 40 minutes of laboratory work (LIST 2) plus instructor verification not only adds new species to the total list (Table 1, lines B2 and B3) but, just as importantly, provides many 'CONFIRMATIONS'; that is to say it provides more records of species which had been recorded only infrequently in situ, and which were on LIST 1. With new record cards from a particular site the same is true, usually a small number of new species are added to the total species list but the bulk of the records add 'CONFIRMATION' records which provide information on species record frequency. In 1980 for example LIST 1 produced a total of 56 species from a total of 157 individual species records. LIST 2 produced a further 17 new species (a 30% increase) but produced a further 80 individual species records (CONFIRMATIONS) (a 60% increase). The instructors (line B3, Table 1) were also able to add new species and confirmations to student lists once they had completed the exercise. Should large teams of volunteer divers be deployed in this type of project, then the samples they collect can provide a very valuable source of records which can be used to confirm in situ identifications.

The average total number of species derived from these exercises (line C, Table 1) is 80, which is 63% of the 127 species total recorded from all the exercises. The highest number of species recorded by one pair in both LIST 1 and LIST 2 was 50 species which is 39% of the total number of species recorded at the site, the usual in situ mean score of 21-22 species per pair is 17% of the total number of species recorded during the exercises.

The comparatively low percentage of recorded species could be due to many factors operating in concert, these include :-

a) Lack of recording skill, both in terms of observation and identification,

b) Not searching micro-habitats,

c) The comparative scarcity of many species (e.g. the large proportion of 'tail' species),

d) The small size and inconspicuous nature of many 'tail' species.

Reference has already been made to Fig. 3 which is the type of graph used to assess how many samples are required for a representative sample of a particular area.

The question of how many samples are required arises frequently in planning sampling programmes, and in order to obtain an answer to this question species diversity/number-sampling intensity (SD-SI) graphs were plotted. There is apparently (7) no convention for determining the order in which samples are plotted, and there are 40,320 ways of ordering the 8 samples on the x axis all of which are 'correct' (factorial 8). The precise shape of the graph depends upon the order in which the samples are plotted. The convention used in this study in order to standardise procedure was to plot samples in relation to their linear position on the shore (1 to 8). As Fig. 3 shows such graphs are rather more erratic than conventional plots of quantitative data. There are probably two main reasons for this :-

1: Variable recorder expertise

2: Some sample stations being richer than others.

In any batch of samples the end point - the total number of species recorded - is fixed, whatever the graph looks like. Drew (7) suggests that in such graphs a suitable point to select as minimum sampling area is that at which 100% increase in effort yields only 10% or 5% more species. The results derived from this study suggest that 5-6 samples are required in most exercises to derive the large bulk of those species which are likely to be recorded in situ. These studies were conceived to test the effectiveness of unsupervised volunteer recorders; and whilst careful scrutiny must be made of such species records, the fact that they accumulate with a relatively low cost over a period of time represents a considerable cost saving advantage. Once the SD-SI curve has levelled off there is little point in continuing with the same method unless 'confirmation' information is required. In the SRS project some species have up to 900 individual records, however it has been found that very little change in the pattern of depth, geographic or substratum distribution is found once approximately 500 records have been obtained. This has important consequences for the publication of project results since there is little point in accumulating information for the sake of it.

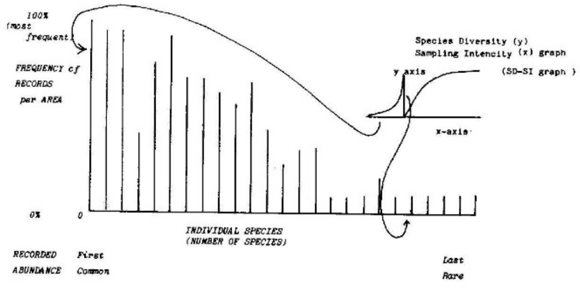

Figure 4. A derivative curve from the SD-SI curve (see inset) which utilises the y axis of the SD-SI curve. If this y axis is then used as an x axis and species frequency (i.e. the number of times each species was recorded out of n samples plotted) an informative graph is produced. Such derivative graphs illustrate clearly a number of features, including the number of species recorded, the order in which they were recorded, the fact that the most commonly recorded species are generally recorded first and that these species are usually prominent, conspicuous and easy to identify. The species (x axis) are ranked according to when they were recorded (i.e. chronological order) and so whilst the overall trend is as described above there will always be rarer species recorded in early samples. This graph illustrates the 'tail' of species recorded less frequently.

There is a useful graphical derivative of the species diversity - sample intensity (SD-SI) curve (Fig. 4). If one looks at the y axis of the SD-SI graph it is clear that a number of terms can be used to describe this axis. These are :-

1. Species number - i.e. as used in the SD-SI plot
2. Species recorded first and species recorded last. In general, commoner species are recorded earlier than rarer species.
3. Abundance : If the frequency of species records is plotted using the y axis - as an x axis (see Fig. 4) using this sampling procedure an albeit crude estimate of relative abundance can be derived. Clearly these record frequency figures do not give as accurate a reflection of abundance as would quantitative data, however the potential for a quantitative approach can at least be assessed. As Fig. 4 shows those species recorded first tend to be those which are recorded most frequently, whilst those which are recorded last are the least frequently recorded.
4. Size and prominence : Once again in general terms those species which are recorded first are those which are often the largest and most conspicuous (and prominent) whilst the reverse is true for 'tail' species.

If species-frequency records are ranked, not in chronological order as in Fig. 4, but in the frequency categories, a smoothed curve is produced, fully illustrating the long 'tail' of species which are rarely recorded. It may well be that with sufficient samples statistical transformations of such curves (using logs for example) may prove to be a way of providing a statistical representation which might be as useful as the log-normal distributions applied to quantitative infaunal benthic data. The transformation of the information in this way is rather similar to the so-called log-normal distribution described by Preston (9). It would appear that although a majority of rare species is an intrinsic property of ecological samples the reasons why this is so are difficult to establish. Ricklefs (10) describes the features of such curves but concludes "the basic theory of the log-normal curve of abundance is so obscure and there are so many exceptions to Preston's predictions that there is little point in pursuing the log-normal distribution further".

Fig. 5 illustrates such a graph ranked on the basis of frequency categories. The samples were collected from St. Abbs Head and show many characteristic elements of the Laminaria hyperborea.

How accurate is the in situ identification?

Professional biologists will always remain sceptical about the identification skills of volunteer divers who take part in recording projects. It is clear however that recording skills can be taught, compare Table 1 A 81(1) with 81(2), and that like volunteer ornithologists many divers can become extremely

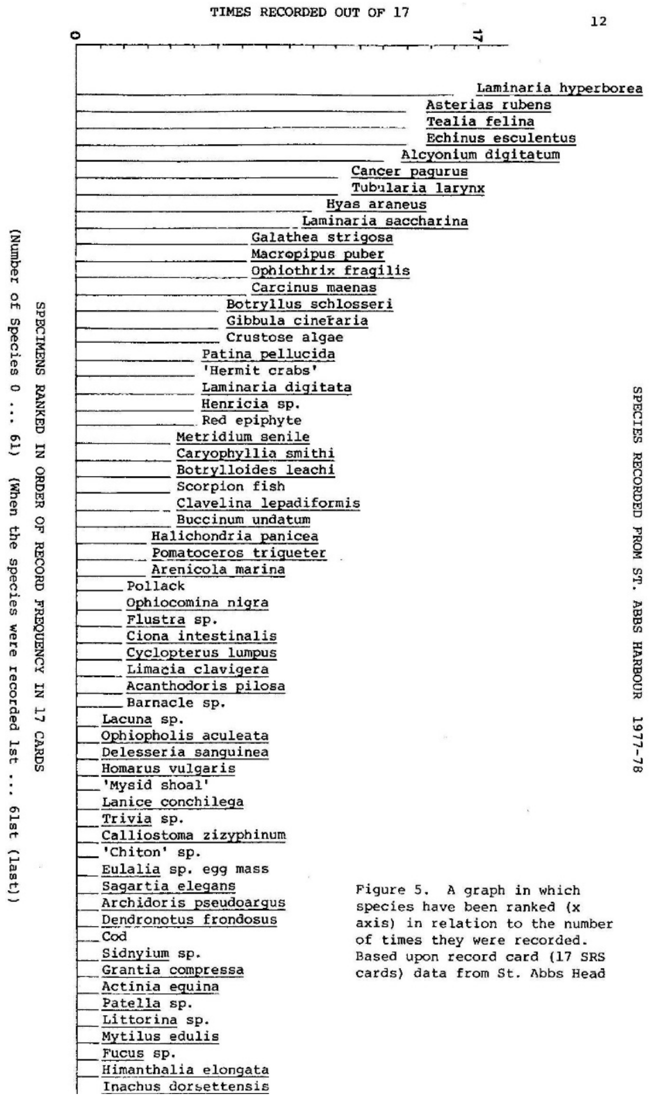

Figure 5. A graph in which species have been ranked (x axis) in relation to the number of times they were recorded. Based upon record card (17 SRS cards) data from St. Abbs Head

proficient. In any event this exercise procedure has the ultimate check of instructor scrutiny. Record cards however seldom get such field scrutiny but there are at least two mechanisms which can be employed to ensure the final accuracy of the published information. The first is provided by the cards themselves, since for a particular area it is possible to assess the frequency with which a species is recorded. Those species with a high frequency of records are more likely on balance to be correct. With a batch of cards from St. Abbs for example L. hyperborea was recorded 16 times out of 17 by 19 different recorders and this provides a high degree of cross checking (Fig. 5). The ultimate mechanism is not to use the record. These Millport studies reflected, as one might expect, the difficulty of identification posed by certain groups; these problems are identical to those confronting professional recorders.

What are the biological end points of such studies?

It is important not to lose sight of the fact that these recording efforts are directed towards learning more about the species concerned, and their inter-relationships.

1. Geographic distribution

The Species Recording Scheme has now acquired in excess of 1500 completed recording cards, and one of the main features of these records is the information on geographic distribution. A comparison between Farland Point where Marthasterias (23/28) and cuckoo wrasse (Labrus mixtus) (15/28) were recorded frequently can be compared with St. Abbs (Fig. 5) where neither of these species was recorded. These differences do appear to reflect generally valid zoogeographic differences between the east and west coast distributions of these two species, and illustrate how the SRS geographic information will be interpreted.

2. The diversity and associations shown in micro-habitats

It was clear that bodies of information in the records came from groups of species which were often associated. A simple example is illustrated with the occurrence at St. Abbs of Laminaria hyperborea and several species which are associated specifically with the frond, for example, Patina, Obelia and Membranipora, in the latter case an associated predator the nudibranch Polycera quadrilineata is also noted. It is convenient to think of these groups of species in terms of information modules, aspects of whose biology can be classified into discrete sections. The best example of a micro-habitat 'module' at Farland Point comes in relation to the under-boulder - crevice fauna. Biologists on the sea shore have become used to turning over boulders in order to find species which are hiding from predators and escaping the rigors of dessication, however in heavily grazed situations such as the exercise area this micro-habitat enables species of avoid grazing pressure and more conventional forms of predation. Pisidia longicornis, scale worms and Ophiopholis show rapid escape responses when boulders are turned over. Encrusting fauna particularly sponges and ascidians noticeably absent from the upper surfaces of the boulders show a remarkable diversity. A total of 35 under-boulder/crevice species have been identified from Farland Point to date, and many of these species also occur in the same situation at other sublittoral sites. One of the most interesting discoveries at Farland Point was that underneath one boulder the sponge Clathrina and the sea squirt Dendrodoa were living in close association, the former growing around the latter. These two species are becoming increasingly well known from exposed but shaded infralittoral cliffs where they cover extensive areas. To find them at a sheltered site under a small boulder suggests they do indeed show a strong 'association'.

From a comparative point of view the grouping of species into micro-habitat modules facilitates interpretation of batches of record card information such as the example provided from St. Abbs.

3. Grazing pressure

At this site the frequency of Echinus (100%) and Marthasterias (93%) and Asterias (96%) suggested that this zone suffers from the effects of 'grazer' pressure, a common feature of Scottish circalittoral communities. The frequent records of species such as Alcyonium digitatum, barnacles, Pomatoceros, and the less frequent records of hydroids such as Halecium, Nemertesia ramosa and N. antennina also confirmed this impression of high grazing pressure.

4. Temporal changes in abundance

For common species one has a record of relative abundance which might prove useful in the context of recording changes either on a seasonal basis or over longer periods of time. At the very least the records provide a clear checklist for in situ recording on any particular temporal scale. Large changes were recorded in the frequency of Clavelina, Ulva* and Goldsinney wrasse (*recorded only once in April, 1979) but which were ubiquitous in eight samples in July 1979; sessile fauna, foliaceous algae, and fish predators are particularly prone to seasonal fluctuations. The occurrence of cuckoo wrasse in numbers at Farland Point since 1980, when there were no records from a trial study and a complete study (14 samples) in 1979 is also of interest.

During the period when these exercises were completed night dives were undertaken several hundred metres away on the same stretch of coastline in virtually identical habitat conditions. It was particularly evident that leopard spotted gobies (Thorogobius ephippiatus), Galathea strigosa, juvenile cod (Gadus morhua), poor cod (Trisopterus minutus), in particular were all much more evident at night than during the day. The time of day also clearly affects the ecological picture obtained from a particular environment.

5. Behaviour

The mobile under-boulder species show very pronounced reactions to light in the terms of escape response, similarly fish (in particular Goldsinney wrasse) are able to learn that the presence of divers frequently means food (8). Both escape responses and learning in fish could be investigated with ease at the Farland Point site. Goldsinney wrasse when presented with food in the form of Echinus roe will readily accept it from the hand of the diver. In three trials where Echinus and then Clavelina were presented alternately to Goldsinneys they showed a clear ability to discriminate between the two, and would not feed on Clavelina. The highly conspicuous nature of Clavelina's delineating yellow bands might be one defence mechanism to help prevent predation by fish.

Use of the standardised procedure for teaching

These exercises were used to illustrate to the groups the problems posed by species recording from a site. The procedures structure was deliberately artificial but it does illustrate aspects of conducting sublittoral surveys. Concepts such as minimum area, species diversity, relative abundance, identification skills etc. can all be demonstrated. It also shows how laboratory work can be used to supplement field recording. If information collected from such exercises is to be used for any other purposes (e.g. such as this paper) then careful supervision both on site and in the laboratory is essential. A clear and well defined dive and laboratory plan are particularly important, as is the final verification of species identification.

This method can also be used to deploy the skills of comparatively large groups of volunteer divers. Initially this might be done to obtain a picture of the dominant species and habitats, however once this information becomes available a checklist of species whose abundance varies seasonally could be established. Regularly repeated dives at the same site would give a picture of seasonal fluctuations in species abundance.

CONCLUSIONS

These exercises initially were conducted to try and determine how species records from a site could be collected and interpreted. With this achieved, and a more detailed picture of the species of the area obtained, greater emphasis began to be placed upon biological aspects of the study. The method also proved to be a useful instructional exercise illustrating aspects of survey methodology.

ACKNOWLEDGEMENTS

My thanks must go to all the students who took part in these exercises and Dr. Frances Dipper who helped a great deal to make the exercises work during the UCS field courses, and to Dr. P.G. Moore, Dr. D. George and J. Shand for reading the manuscript. My thanks also go to the staff of the University Marine Station at Millport for providing such excellent facilities.

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APPENDIX 1

Species recorded during exercises at Farland Point

(Nomenclature and authorities follow the "Plymouth Marine Fauna" (2) for the animals and Parke and Dixon (3) for the algae.)

The figures given in brackets are the number of times the species was recorded out of 28 samples. * denotes species which were only recorded from material brought back to the laboratory, that is they were not identified in situ. UB - under-boulder species. RE - collected by the author.

ALGAE

Chlorophyceae : Ulva lactuca (21);
Phaeophyceae : Laminaria spp. (digitata & hyperborea)(10); Laminaria saccharina (20); Saccorhiza polyschides (9); Desmarestia aculeata (AGG)(16); Cutleria multifida (1*);
Rhodophyceae : 'Lithothamnia' (23); ?'Cruoria' (4); Bonnemaisonia asparagoides (9); Brongniartella byssoides (5); Delesseria sanguinea (14); Odonthalia dentata (10); Phycodrus rubens (15); Polysiphonia elongata (1); Ceramium spp. (1); Dictyota dichotoma (1); Palmaria palmata (2); Trailliella phase (4); Rhodomela sp. (1); Membranoptera alata (1); Chrondus crispus (3); Phyllophora sp. (1* RE); Compsothamnion thuyoides (1* RE); Antithamnion plumula (1* RE); Halarachnia ligulatum (1* RE).

1. Both L. hyperborea and L. digitata occur at the Farland Point site, however the in situ records cannot be relied upon AT THIS SITE because of the extended depth range of L. digitata.

2. ?'Cruoria' : An encrusting dark red species is abundant at this site but has not been reliably identified.

3. A thin algal turf of fine red algae was recorded, and the main species comprising this turf were Trailliella phase sp., Compsothamnion thuyoides and Antithamnion plumula.

4. Certain littoral species were recorded notably Himanthalia and Fucoids; these are probably drift records.

PORIFERA

Halichondria panicea (2, UB,*); Suberites sp. (2); "Sponge" (4); Aplysilla sp. green-yellow (UB, 1*); Dysidea fragilis (UB, 1*); ?Jophon sp. (UB, 1*); Clathrina coriacea (UB, 1*).

CNIDARIA

Anthozoa : Alcyonium digitatum (27); Caryophyllia smithi (6); Tealia felina (4); Metridium senile (7).
Hydrozoa : Hydractinia echinata (on Pagurus bernhardus shells)(4); Obelia geniculata (9); Sertularella polyzonias (5); Halecium halecinum (8); Nemertesia antennina (8); N. ramosa (8); Tubularia sp. (1); Kirchenpaueria pinnata (4); Campanularia sp. (UB, 1*).
Scyphozoa : Scyphistoma larvae (2, *, UB, RE).

ANNELIDS and other worms

Pomatoceros triqueter (19); Chaetopterus variopedatus (11, UB-crevice); "Scale worms", (4, UB); "Spirorbids" (2, UB); Lineus longissimus (2);'Nereis sp.' (? pelagica)(2, UB); 'Flatworm' (1); Hydroides norvegica (2*, UB); Terebellidae (5, UB); Phyllodoce sp. (1).

MOLLUSCA

"Chitons" (7)
Nudibranchia : Limacia clavigera (6); Archidoris pseudoargus (8); Doto sp. (2*); Tritonia hombergi (2*); Cadalina laevis (2, *).
Prosobranchia : Gibbula cineraria (20); Acmaea spp. (5); Calliostoma zizyphinum (5); Buccinum undatum (2); Patina pellucida (1); Trivia monacha (8, UB); Lacuna sp. (2); Nassarius incrassatus (1, *, UB); Emarginula reticulata (1, *, UB);
Bivalvia : Saddle oyster (4, UB); Chlamys distorta (2, UB); Hiatella arctica (2, *, UB).

CRUSTACEA

Decapoda : Cancer pagurus (19); Liocarcinus puber (8); Pisidia longicornis (5, UB); Galathea sp. (3, UB); Carcinus maenas (2); Hyas sp. (1); Mysid shoal (2); Pagurus bernhardus (15).
"Caprellids (3, *).
Cirripedia : Balanus sp. (usually B. crenatus)(15); Balanus balanus (1, *, UB).

BRYOZOA

Membranipora membranacea (20); Parasmittina trispinosa (6); Electra pilosa (6); Alcyonidium 'gelatinosum' (6); Crissidae (1*, UB); Discoid species (1, *, UB); White encrusting species (1, *, UB).

ECHINODERMATA

Echinoidea : Echinus esculentus (28); Psamechinus miliaris (2, *, UB).
Asteroidea : Asterias rubens (27); Marthasterias glacialis (23): Luidia ciliaris (4); Henricia sp. (9); Porania pulvillus (5);
Ophiuroidea : Ophiocomina nigra (15); Ophiothrix fragilis (7, UB); Ophiura albida (2); Ophiopholis aculeata (10, UB).
Holothuroidea : Cucmaria saxicola (1, *, UB).

CHORDATA

Ascidiacea : Clavelina lepadiformis (25); Ciona intestinalis (8, UB); Ascidia mentula (10, UB & cracks); Botryllus schlosseri (2); Corella parallelogramma (4); Ascidiella aspersa (6); Ascidia conchilega (6, UB); Ascidia virginea (*, RE, one specimen only); Boltenia echinata (1, *, UB); Botrylloides leachi (1, *, UB); Dendrodoa grossularia (4, UB, in association with Clathrina).

VERTEBRATA

Topknot (Zeugopterus punctatus)(12); Goldsinney wrasse (Ctenolabrus rupestris)(24); Cuckoo wrasse (Labrus mixtus)(15); Ballan wrasse (Labrus bergylta)(7); Two spot goby (Gobiusculus flavescens)(2, RE); Leopard spotted goby (Thorogobius ephippiatus)(1); "Scorpion fish" (2); Conger eel (Conger conger); Poor cod (Trisopterus minutus) (1); Cod (Gadus morhua)(3); Pollack (Pollachius pollachius)(14); Dogfish (Scyliorhinus canicula)(1).