

**Exploratory Fishing Trials for  
*Buccinum undatum* around  
the Islands of Barra and  
South Uist in the Western  
Isles**

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**Consultancy Report No. CR144**

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June 1998

**Sea Fish Industry Authority**

**Technology Division**



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**This project is part financed by the European Union  
under the Western Isles PESCA Programme**

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#### Summary

This report presents the results of exploratory fishing trips undertaken between Sept 1996 and June 1997 to assess catch rates and composition of whelks (*Buccinum undatum* and *Neptuna antiqua*) in locations around the Western Isles. *Buccinum* was captured routinely at all locations indicating a widespread occurrence throughout the two survey areas, whereas *Neptuna* was caught predominantly offshore, in deep water. However, the catch per effort was extremely low, and the areas investigated cannot be regarded as being able to support whelk fisheries. The predominance of animals with large and heavily fouled shells suggests the existence of an ageing population which, probably, would be unable to withstand sustained fishing effort. Furthermore, fishing opportunities would be severely restricted by potential conflict with other fisheries, in terms of seasonal access to grounds.

# Contents

Page

## Summary

<b>1. Introduction</b> .....	1
1.1 Purpose .....	1
1.2 Objectives .....	1
<b>2. Approach</b> .....	2
<b>3. Literature Survey</b> .....	3
3.1 <i>Buccinum undatum</i> .....	3
3.2 <i>Neptuna antiqua</i> .....	5
<b>4. Exploratory Trials and Quality Assessment</b> .....	7
4.1 Fishing survey .....	7
4.2 Timing .....	7
4.3 Equipment and personnel .....	7
4.4 Gear .....	7
4.5 Deployment .....	8
4.6 Data collection and supervision .....	8
4.7 Quality assessment .....	8
4.8 Results .....	8
4.8.1 Catch per effort .....	8
4.8.2 Distribution by weight and number .....	9
4.8.3 Length-frequency distribution .....	10
4.8.4 Cooked meat yield .....	12
<b>5. Discussion</b> .....	13
5.1 Catch rates .....	13
5.2 Catch composition .....	13
5.3 Condition .....	14
5.4 Fishery potential .....	14
<b>6. Conclusions</b> .....	15
<b>7. References</b> .....	16

## Appendix

## 1. Introduction

This report describes exploratory fishing trials commissioned under the Western Isles PESCA Programme by Western Isles Council (WIC) and Western Isles Enterprise (WIE). PESCA is a European Community initiative which finances diversification projects within fishery dependent communities. The project forms part of the Western Isles Pesca Programme to investigate opportunities for diversifying fishing effort within the region.

This study was interested in exploratory fishing of whelk resources (*Buccinum undatum* and *Neptuna antiqua*) in ICES Area IVa, in the proximity of Barra and South Uist at the southern end of the Western Isles. Potting for *Buccinum undatum* already occurs in the vicinity of the Isle of Lewis and off the northern coast of Scotland. Whelks are not considered to be fully exploited and market demand is good. Currently, the four main pot fisheries that Western Isles fishermen prosecute at different times of the year are: Nephrops (*Nephrops norvegicus*), lobster (*Homarus gammarus*), brown crab (*Cancer pagurus*) and velvet crab (*Necora puber*).

### 1.1 Purpose

The purpose of the research was to investigate whelk resources on selected grounds around South Uist and Barra, assess their potential to support a fishery that could complement existing fishing patterns and possibly supplement local processing activities. Access to a new fishery at times when normal target species were unavailable could increase earnings and could reduce pressure on currently exploited species.

### 1.2 Objectives

The objectives of the work were:

- \* to provide relevant biological information from existing literature;
- \* to investigate catch per effort from a number of locations using standard fishing procedure; and
- \* to determine the size composition and processed meat yield of animals from the main locations fished.

## 2. Approach

The work was carried out in four stages:

- \* accessing Aquatic Sciences and Fishery Abstracts (ASFA) and other databases for relevant biological information;
- \* meetings between Seafish, WIC, WIE and skippers to design the trials;
- \* exploratory fishing trials; and
- \* determination of processed meat yields at commercial premises.

### 3. Literature Survey

Literature surveys were carried out on the two species (*Buccinum undatum* and *Neptuna antiqua*) identified as likely to be captured.

#### 3.1 *Buccinum undatum*

##### Morphology

*Buccinum undatum* is a carnivorous marine snail, closely related to the periwinkle and other gastropod molluscs with spiral shells common along the shore line, (MAFF 1967), Plate. 1 Appendix. The robust shell is spirally coiled, and normally coloured yellowish-brown on the outside. The shell opening elongates into an open tube through which the siphon is extended, and is closed by the operculum, a cuticular oval disc, when the body retracts into the shell. The body mainly comprises a large muscular foot used for locomotion and a head which supports two tentacles. The proboscis, which is used for feeding, is extended through an aperture below and between the two tentacles

##### Location/distribution

*Buccinum* is common in the west Baltic, North Sea, English Channel and is distributed extensively around the UK coastline. It also inhabits Canadian waters near the Gulf of St. Lawrence. It occurs from the intertidal zone to deepwater (1200m) inhabiting a variety of marine substrates but occurs normally on muddy gravel or mud mixed with shell (Phillips 1987). In finer sediments animals remain buried for much of the time, often emerging only to feed. It is a euryhaline species generally inhabiting waters of salinities between 20 and 35 ppt, but is known to inhabit brackish waters with salinities as low as 14 ppt (Stalland 1986).

##### Diet/feeding

*Buccinum* eats both dead and living animal flesh using a radula on the tip of the proboscis. Dead fish and crabs are known to be eaten as they are commonly used as bait, along with shark meat, whalemeat, skate and dogfish, (MAFF 1967). Whelks are also reported to feed on live mussels, cockles, clams and scallops, and occasionally oysters (Hancock 1960).

Animals maintained in the laboratory exhibited maximum feeding rates in the spring (April). Feeding occurred during the winter, but practically ceased at extremely low temperatures and also during the warmest summer months (Hancock 1960). In Canadian studies *Buccinum* exhibited maximal feeding from October to May, with little activity for the rest of the year.

##### Locomotion/migration

Whelks move towards food using the large muscular foot. In response to the detection of food, speeds of 8.3 - 20 cm per min have been recorded indicating that considerable distances could be covered in a relatively short time, if such rates could be maintained. However, in other recapture studies whelks took 3 days to cover a distance of 30 metres, suggesting that some other factors acted to hinder their rate of movement (Himmelman 1988 and Sainte-Marie 1991).

Although whelks have the ability to move at relatively high speeds there is little evidence of large scale migration. Extended release - recapture studies using tagged whelks have shown no indication of tagged individuals being captured outside the study area (Sainte-Marie 1991).

### **Growth and reproduction**

It is not possible to apply any of the usual methods of age determination, such as annual growth rings; and tag-recapture methods have been used to determine age of whelks. Animals on the south coast of the UK are reported to grow to about 25 millimetres height in the first year and by decreasing increments thereafter. The most rapid growth occurs during spring and summer (MAFF 1967). Height is defined as the distance from the apical shell tip to the end of the siphonal canal, Fig. 6, Appendix.

Previous studies indicate that a male whelk may be classified as mature when the penis is at least half the height of the shell. On the south coast of the UK (Whitstable) it is reported that animals do not spawn until they are nearly 50mm in shell height when 2-3 years old (MAFF 1967). Results from England and Wales indicate that size at maturity exhibits considerable regional variation. Small animals from the Channel coasts mature, on average, at about 55mm shell height (33mm shell width), whereas whelks from Wales and the east coast of England mature at about 71mm shell height (42mm shell width). The size at maturity of whelks from the Thames estuary was very variable (MAFF leaflet - News from the Shellfish Resource team at Lowestoft). In Scotland specimens up to 155mm height have been found in summer (MAFF 1967).

In Europe fertilisation occurs in late autumn and is followed by spawning in November when the temperature drops below 9°C. After about 4 months development the fully formed juveniles emerge from the egg capsules during February to March (MAFF leaflet - News from the Shellfish Resource team at Lowestoft). In contrast, in Canadian waters, mating commences in mid May, peaks in June and terminates in July. Egg laying begins in late May, peaks in June/July and can continue until late August.

### **Availability and catchability**

There is evidence that *Buccinum* become less available to baited pots during certain times of year. Observations at Whitstable indicate a considerable reduction in catch per effort (cpe) in July and August, and some reduction during the winter months of January and February (MAFF 1967). Whether this is related to temperature or aspects of the life cycle is uncertain. Animals may become less active at high temperatures or they may be more interested in copulating than feeding during the summer. These results are similar to fishermen's observation off Norfolk which indicate a reduction of cpe during August. In light of how the seasonal cycles differ with location, c.f. Canadian studies (Sainte-Marie 1991) it is uncertain how these observations relate to the Western Isles.

Tidal current conditions have been found to influence catchability. Canadian studies have shown that recovery of tagged whelks was better from down current of the bait and at low current speeds (Himmelman 1988). The observation that catchability is likely to be higher at low current speeds agrees with theoretical studies cited in the above paper. Thus catchability is likely to be higher during neaps than springs.



### Management regimes

Within the UK only the Isle of Man imposes a minimum landing size, set at 70mm (shell height). Elsewhere in Europe whelk fisheries are regulated by minimum landing sizes, set at values of 45mm shell height in Ireland and France.

MAFF are investigating the average size at which whelks become reproductively mature around the UK (MAFF leaflet - News from the Shellfish Resource team at Lowestoft). The intention is to use size at maturity as a basis for a minimum landing size that is intended to enable whelks to spawn at least once before exploitation. Data on shell widths has also been recorded on the assumption that a riddle tuned to shell width would be the most practical way of enforcing a minimum size.

### 3.2 *Neptuna antiqua*

Due to its toxicity, targeted fisheries have not developed, thus knowledge of its biology is less extensive than *Buccinum*. The common name is the almond whelk.

#### Morphology

*Neptuna* has a smooth shell, marked with fine spiral ridges and grooves, without the coarse ribbing of *Buccinum*. The aperture is more narrowly oval, tapered towards a moderately long, curving siphonal canal.

#### Location/distribution

*Neptuna antiqua* is common in the North Sea and North Atlantic. Although occurring inshore it is generally found offshore in deeper waters (Phillips 1987).

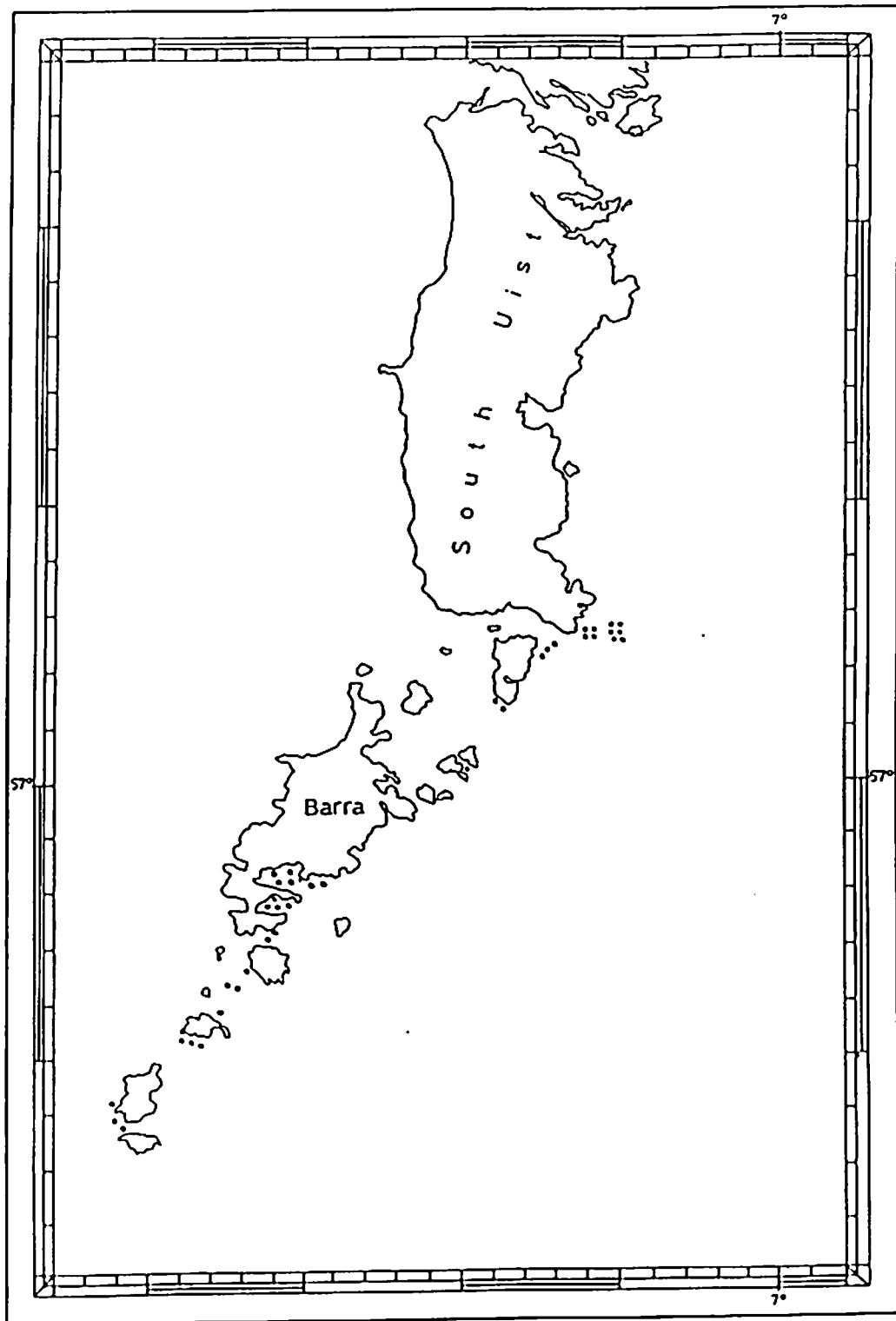
#### Feeding

In aquariums *Neptuna antiqua* does not take food as readily as *Buccinum* indicating more specialised feeding habits. Specimens have been observed eating dead crustaceans such as green shore crab (*Carcinus maenas*) and prawns (*Nephrops norvegicus*). It is suggested that *Neptuna* uses a poison located in the salivary gland to attack prey items on which it feeds. Research indicates that the poison is an ammonium compound called tetramine (Fänge, R.).

#### Toxicity

Tetramine has known toxicity for humans. Mild symptoms include severe headache, dizziness, vomiting and visual disturbances, whereas large concentrations can cause death. Consumption of a related species, *Neptuna arthritica*, which occurs in the northern seas of Japan, has caused many poisonings; the cause being tetramine located in the salivary gland (Asano, M. And Itoh, M. 1960). It is reported that the concentration of tetramine in the salivary gland of *Neptuna antiqua* can be up to three times that found in *Neptuna arthritica* (Fänge, R.).

Fig. 1: Areas fished around South Uist and Barra - each mark represents a single haul



## 4. Exploratory Trials and Quality Assessment

### 4.1 Fishing survey

The exploratory trials were conducted in two geographical areas: south east of South Uist and south of Barra. The locations of hauls are shown in Fig. 1, opposite. The strategy was to target numerous locations within 5 miles of the shore on a variety of substrates, as identified by echo sounder. Around South Uist both shallow (20-40m) and deep (140-180m) locations were investigated, whereas around Barra fishing occurred in shallow water depths ranging from 10-60m.

### 4.2 Timing

The trials around South Uist were carried out during autumn 1996 (24/9/96 to 18/11/96) during which 15 days of exploratory fishing were conducted. The trials around Barra were conducted during late spring 1997 (01/05/97 to 18/06/97) and comprised 10 days' fishing effort.

Weather and operational constraints determined that fishing occurred throughout the spring/neap tidal cycle.

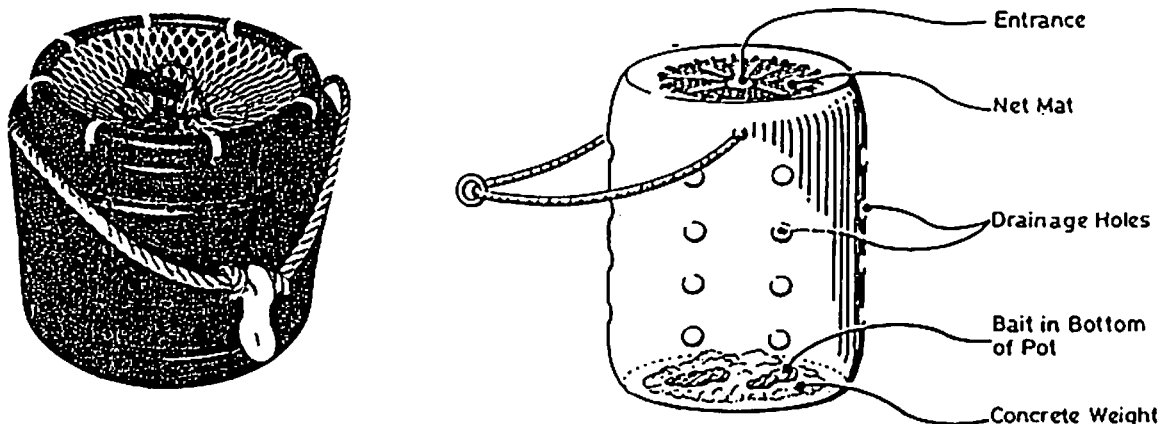
### 4.3 Equipment and personnel

The exploratory trials were carried out by two fishing vessels: the MFV *Huba* an 11m wooden vessel skippered by Mr. A. Campbell and the MFV *Southern Star* a 10m GRP vessel skippered by Mr. D. Gillies. Seafish staff provided advice on species identification, gear and deployment, and attended two trips to observe fishing methods and grounds, and collect samples for subsequent analysis.

### 4.4 Gear

The gear used for the trial was standardised, as far as possible. A typical string comprised 50 pots of the same design, set 30m apart on 3m strops. Two pot designs were used; the plastic five gallon drum and a new heavier design, favoured on the east coast of England, Fig.2. Pots were usually baited with a mixture of brown crab and dogfish.

Fig. 2: Design of pot used for the trial. The pot on the left is produced commercially, whereas the one on the right was fabricated from a 5 gallon plastic drum.



#### 4.5 Deployment

As far as possible deployment was standardised. Strings were usually deployed across the tide to ensure maximum coverage of the ground by the scent of the bait. Soaktime was normally 24 hours, although longer immersion periods were experienced when adverse weather conditions prevented access to gear.

#### 4.6 Data collection and supervision

Data was collected via direct sampling during sea trips and a log sheet, (Fig.3, Appendix) which the fishermen completed and sent to Seafish for evaluation. Data were collated and processed to provide information on the following:

- \* catch per effort on different grounds;
- \* species composition;
- \* length frequency composition; and
- \* cooked meat yield.

#### 4.7 Quality assessment

The quality of the catch was assessed at the premises of Kintorran Shellfish Ltd in Grimsay, North Uist where samples were analysed for species, size composition and cooked meat yield.

Cooked meat yield (condition index) describes a sample of animals in terms of the relationship between the weight of cooked meat and weight of the live animals. The cooked meat yield was determined according to standard commercial procedure. A sample of animals was weighed and immersed in boiling water, the temperature of which remained above 95°C. When the water returned to the boil the sample was cooked for 12 minutes, removed and cooled in air. Cooked meats were removed from the shell, blotted dry and weighed.

$$\text{Cooked meat yield} = \frac{\text{weight of cooked meat}}{\text{weight of live animals}} \times 100\%$$

#### 4.8 Results

##### 4.8.1 Catch per effort

The catch per effort on different ground types in the two areas is summarised in Table 1. The values shown represent the combined catch of both species.

**Table 1: Catch per effort on different ground types**

Area	Ground type	Catch per Effort: (kg/pot/24 hrs)		Effort 'pot days'
		Mean	Range	
South Uist	hard clean	0.34	0.01-1.25	820
	hard and sand	0.13	0.13	60
	hard and soft	0.04	0.03 - 0.05	520
	sand and mud	0.25	0.25 - 0.25	40
	soft mud	0.03	0.03 - 0.03	600
Barra	hard	0.065	0.01- 0.18	1050
	hard and sand	0.06	0.01- 0.07	150
	hard sand	0.06	0.01- 0.10	300
	sand	0.00	0.00 - 0.00	100

The average catch per effort (cpe) values at locations in both areas was low, ranging from zero to a maximum of 1.25kg/pot/24 hours. Values around South Uist showed greater variation than those around Barra which, excluding the value for sand, were fairly constant.

Animals were captured on all substrates except sand. The greatest cpe values were obtained on sandy mud and rocky areas containing patches of sand, whereas the lowest values were obtained on soft mud and sand. The effort expended on each substrate is described in terms of the number of pot days fished and indicates the concentration of fishing activity. Interpretation of the figure for effort value on soft mud around South Uist should be treated with caution as the presence of sea lice in empty pots (no bait) suggests that pots had not been fishing for the entire immersion period.

#### 4.8.2 Distribution by weight and number

The species composition of whelks sampled on supervised trips around South Uist and Barra is summarised in Tables 2 and 3, respectively. The data are presented as the proportion (%) that each species comprises, in terms of the number of individuals and live weight.

**Table 2: Species composition around South Uist**

Depth/location	Species	% by Number	% by Weight
Shallow (0-60m) Inshore	<i>Buccinum</i>	approx. 100	approx. 100
	<i>Neptuna</i>	negligible	negligible
Deep (150m) Offshore	<i>Buccinum</i>	37.5	30.9
	<i>Neptuna</i>	62.5	69.1

**Table 3: Species composition around Barra**

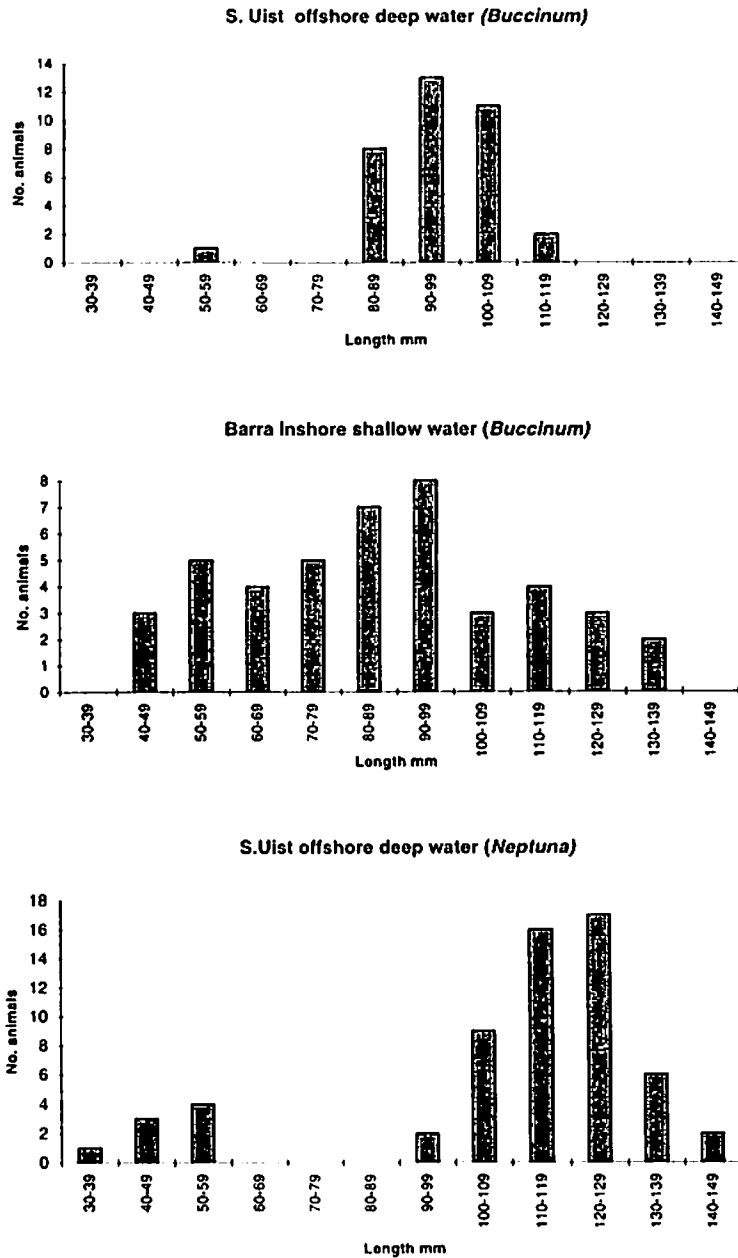
Depth/location	Species	% by Number	% by Weight
Shallow (0-60m) Inshore	<i>Buccinum</i>	approx. 100	approx. 100
	<i>Neptuna</i>	negligible	negligible

Very little *Neptuna* was caught in shallow waters around both South Uist and Barra, the catch comprising predominantly *Buccinum*. However, in deep waters around South Uist, most of the animals caught (62.5%) were *Neptuna* and they accounted for the majority (69.1%) of the live weight.

#### 4.8.3 Length-frequency distribution

The length frequency distributions of samples of *Buccinum* and *Neptuna* caught on the same substrates during two supervised trips around South Uist and Barra are shown in Fig 5. In comparing data it should be noted that animals were sourced from deepwater (156-180m) at South Uist, but caught in shallow water at Barra.

Fig. 5: The length frequency distributions of samples of *Buccinum* and *Neptuna* caught on the same substrates around South Uist and Barra



Large whelks of both species predominated in the offshore catches. Smaller size groups of both species were present, but *Neptuna* catches contained a higher proportion of small animals.

Inshore catches consisted entirely of *Buccinum* which ranged from 40-139mm in height

#### 4.8.4 Cooked meat yield

The cooked meat yield of *Buccinum* samples caught from both areas is shown in Table 4.

**Table 4: Cooked meat yield of *Buccinum* from South Uist and Barra**

Area	Depth	Season	Condition Index
South Uist	Deep	Winter	25.2
Barra	Shallow	Summer	24.7

The condition indices of samples caught from both areas were similar, being 25.2% for South Uist and 24.7% for Barra. It should be noted that samples were taken from different depths at different times of the year.



## 5. Discussion

### 5.1 Catch rates

It is suggested that values obtained for catch rates are representative of potential catches available due to the level of effort expended during the trials and the gear used. Between ten and fifteen days exploratory fishing were conducted within each area, with effort on each ground type ranging from 100 to over 1000 'pot days' - a 'pot day' representing a single pot immersed for 24 hours. The gear selected for the trials is employed successfully in other fisheries and bait is reported to be one the most effective for whelks. Under these circumstances the catch rates probably represent those that would be obtained commercially, under similar conditions.

Despite widespread occurrence, catch rates at all locations were generally low, with values ranging from zero to 1.25 kg per pot for a standardised soaktime of twenty four hours. In many instances bait was often present in hauled pots, even after extended soaktimes, indicating that the pots had been actively fishing whilst immersed. Catch rates appeared to be unaffected by soaktime, with longer soaktimes usually producing greater catches.

The catch rates from the two areas were similar, despite the areas being fished at different times of the year (June and November). It is reported that the highest catch rates on the south coast of England occur in April/May and towards the end of the year in December (MAFF 1967). If this situation prevails in the west coast of Scotland then the two areas were investigated at times when catch rates would be expected to be approaching maximum values.

Most ground types exhibited variable catch rates, and the results suggest that substrate composition influenced availability. Catch rates were highest on muddy sand and rocky areas associated with patches of sand, whereas no whelks were caught on areas of soft sand. Few whelks were caught on either hard sand or soft mud substrates.

In light of the foregoing discussion it is probable that the low catch rates were due to the resource occurring extensively at low concentrations. This hypothesis is supported by the findings of previous exploratory fishing trials (*pers. comm.* Kintorran Fish Ltd) which exhibited similar low catch rates - despite trying many different combinations of gear, bait, location and season.

The low catch rates observed during these trials contrast markedly with those from established whelk fisheries which typically produce up to 25kg. per pot, often after short soak times of six to twelve hours.

### 5.2 Catch composition

The interpretation of catch composition is based on data obtained from two sampling trips and cannot be regarded as rigorous. It should be used to indicate the pattern of catch composition that could be expected from a more thorough investigation.

The data suggest that animal size and species composition might be dissimilar on similar substrates occurring at different depths. However, the deep and shallow samples were caught during different seasons and it could be that seasonality accounts for some of the differences observed. Nonetheless, two thirds of the live weight of the sample caught on hard sand in deepwater comprised large *Neptuna*, whereas few small specimens were caught on the same substrate inshore, in shallow water. In contrast, *Buccinum* was caught routinely on this substrate at both depths. However, inshore animals exhibited a greater size range. These observations agree with the literature which reports *Buccinum* as occurring from the lower tidal level down to 1200m, and *Neptuna* inhabiting mainly offshore grounds (Philips 1987).

### 5.3 Condition

Samples of *Buccinum* captured during supervised trips exhibited a median value for meat condition compared with whelks from other areas in the U.K. (Boulter *pers. com.*), despite animals exhibiting relatively thick shells. Without knowledge of the seasonal cycle in the locality it is not possible to determine whether the values, which were obtained at different times of the year, were maximal or otherwise.

### 5.4 Fishery potential

The findings of the trials suggest that the two areas would not support a viable fishery. Even though whelks were of a marketable size, commercial catch rates would be insufficient to justify fishing effort. Furthermore, the predominance of large and heavily fouled shells suggests the existence of an ageing population which may be fished out relatively quickly.

A further constraint is that for much of the year large areas would be unavailable for whelk fishing due to the existence of other fisheries. It is reported that scalloping occurs inshore to 100m depth, on most grounds, most of the year - the main season being November to February. Whelk fishing could occur in these areas only at times when the grounds were not being prosecuted by other fisheries. Such times might be incompatible with the current pattern of fisheries exploitation and thus offer no realistic fishing opportunities.

## 6. Conclusions

- \* *Buccinum* occurred extensively throughout the two survey areas, whereas *Neptuna* was caught predominantly offshore, in deep water.
- \* Catch rates (combination of both species) at all locations were generally low, with values ranging from zero to 1.25 kg per pot for a standardised twenty-four hour soaktime.
- \* The values obtained for catch rates were considered representative of potential catch rates due to the level of effort expended during the trials and the gear used. The catch rates probably represent those that would be obtained commercially, under similar conditions.
- \* Substrate composition appears to have influenced availability. Catch rates were highest on muddy sand and rocky areas associated with patches of sand, whereas no whelks were caught on areas of soft sand. Few whelks were caught on either hard sand or soft mud substrates.
- \* The limited data on catch composition suggests that animal size and species composition might be dissimilar on similar substrates occurring at different depths.
- \* The cooked meat yields of samples of *Buccinum* captured during supervised trips around South Uist and Barra were 25.2% and 24.7% respectively.
- \* The research suggests that the two areas would not support a viable fishery in that catch rates would be insufficient to justify commercial fishing operations. Furthermore, fishing opportunities would be restricted due to the occurrence of other fisheries in the area.

## 7. References

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## Appendix I

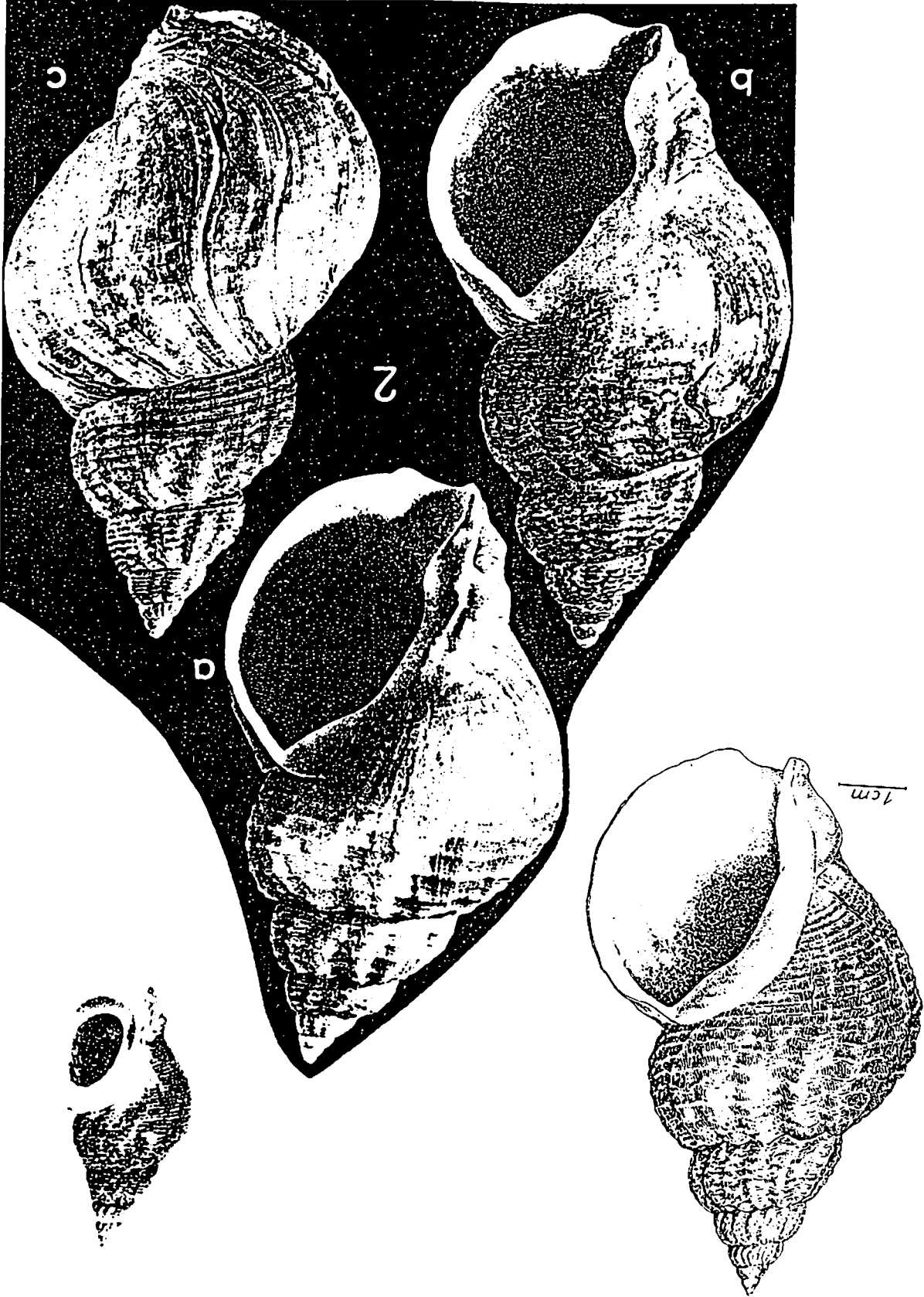
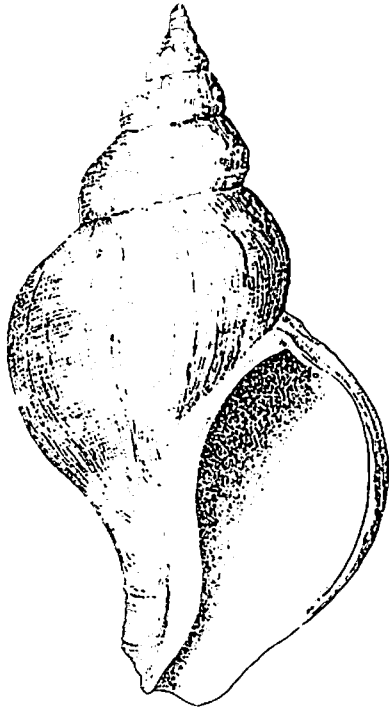


Plate 1: *Buccinum undatum*

Exploratory fishing trials for *Buccinum undatum* around the islands of Barra and South Uist in the Western Isles

Plate 2: *Neptuna antiqua*



2 cm

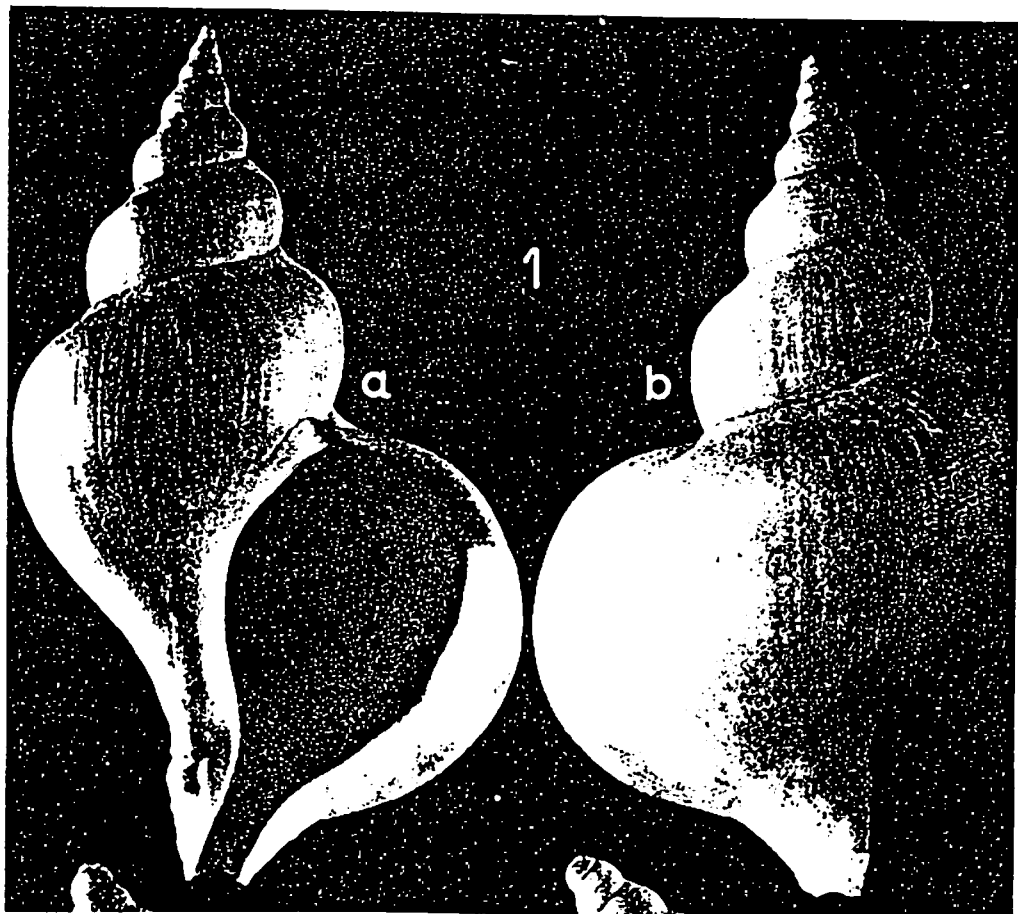


Fig. 3: Log sheet used by fishermen to collect data

## WHELK SURVEY LOG SHEET

<b>STRING CODE:</b>	
<b>BOAT:</b>	
<b>DATE SHOT:</b>	
<b>LOCATION DAHN (A):</b>	<b>LONG LAT</b>
<b>LOCATION DAHN (B):</b>	<b>LONG LAT</b>
<b>DEPTH:</b>	
<b>ORIENTATION:</b>	
<b>BAIT USED:</b>	
<b>SOAKTIME:</b>	
<b>GROUND TYPE:</b>	
<b>NUMBER OF POTS:</b>	
<b>NUMBER OF BUCCINUM: VOLUME OF BUCCINUM: WEIGHT OF BUCCINUM:</b>	
<b>NUMBER OF NEPTUNA: VOLUME OF NEPTUNA: WEIGHT OF NEPTUNA:</b>	
<b>COMMENTS:</b>	



Fig. 6: Height and width measurements on *Buccinum*

