

**An Assessment of Damage  
and Mortality of the Brown  
Crab during Vivier  
Transport**

December 1996  
(Revised January 2005)

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SR294

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Seafish Technology SR294

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## **An Assessment of Damage and Mortality of the Brown Crab during Vivier Transport**

### **Summary:**

Two consignments of live crab have been studied to investigate damage and mortality between consignments of brown crab exported from the UK to Spain.

The consignment from the Hebrides was first transported by vivier lorry to N. Wales where it was off loaded, examined and repacked for onward shipment by a Spanish buyer's vivier lorry to Spain via France. In Spain the crab were again off loaded, inspected and repacked and sent in another vivier truck to the main wholesale fish market in Madrid. Each leg of this journey took 36 to 40 hours.

The second consignment was sent from the South Coast of England to Madrid and this journey also took 30-40 hours.

Although there are many variables to be considered the two samples were believed to be fairly typical consignments. Mortality in the Hebridan consignment on arrival in Spain was higher than the South Coast consignment and this was attributed to poorer selection of animals at the point of dispatch. There is an undoubted need for training here especially in the understanding of the transportation process and the requirements of the Spanish markets. Where the fishery only engages in crab fishing intermittently, or in an uncoordinated way, this is most apparent.

The South Coast consignment benefited from better selection and the lack of intermediate handling and repacking. Even amongst intact (undamaged) animals there was a higher mortality in the Hebridan consignments indicating other influences – possibly condition or seasonal factors which will need further investigation.

The report suggests protocols for both the catchers and the buyers to ensure that only animals which have a reasonable chance of survival and selected and thereafter are treated in a way that improves these chances.

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## **1. Introduction**

Seafish, in association with University of Hull, has been working for some time on some of the problems faced by the Shellfish Trade in the export of live crabs. Particular attention has been paid to mortality rates in order to determine the reasons behind some of the large variations which occur within and between consignments.

Hitherto, studies have looked in detail at aspects of the physiology of the various species, the quality of the holding water through various stages of the distribution network, current handling practices and how these elements can interact to place the animals at risk or, at least, to impair their quality as marketable products.

This study describes a different approach confined to brown crab only. Experience from other studies made in various parts of the UK and at importers' premises on the continent suggested strongly that good initial selection and appropriate handling practices of crab destined for export constitutes one important factor in determining the crabs' subsequent survival and quality. The journey to the continent is a long and arduous one for a live crab. High stress levels persist even on the best vivier lorries and it would seem sensible to do everything to ensure that only high grade, "fit" crabs are sent as any mortalities en route jeopardises the remainder of the load. Those who have long experience in the live trade are well aware of this fact and have continuously changed and refined their practices and techniques, often with substantial capital investment backup, to reduce this problem.

Those involved in crab fisheries which have only recently developed a live outlet are in a completely different situation from their colleagues in long-established fisheries. To a large extent they are prosecuting mixed fisheries and can apportion only a certain time to regular quality inspection of their crab catch, at first capture or during holding. The associated buyer may lack the quite sophisticated infrastructure of collection and storage that exists elsewhere. Importantly also, the detailed, intimate knowledge of the crab and the local crab grounds is still being gained. It is not yet at a level comparable to that of the Channel crabbers which allows them to exploit particular areas and avoid others at certain times in order to obtain 'grade' crabs.

Together, these constraints introduce uncertainties which place suppliers and wholesalers within such fisheries at a quality disadvantage over other, principally Southern, sources of supply. They are, however, supplying a product which is significantly cheaper at source.

This short study attempts to identify more clearly and to quantify some of the disadvantages and some of the benefits that could be attained by the upgrading of handling practices for the live trade. Supporting elements of this Seafish strategy include the provision of training seminars specifically for catchers, buyers and exporters of crabs, the production of information data sheets and regional studies of the collection and distribution infrastructure operating in different parts of the U.K.

## **2. Objectives**

This study was made in order to:

- a) Obtain scarce quantitative data on the extent of damage to crabs at various points in the export chain
- b) To assess the general quality of randomly selected consignments from different sources
- c) To determine whether a relationship exists between general quality and marketability
- d) To determine the type of loss of quality, as physical damage or death, which occurs during transit.

In addition to describing the results of this survey this particular document has the added objectives of:

- a) Publicising the nature of the problems that currently exist for those in the live trade who want to supply a consignment of high quality crab to a distant market
- b) To highlight the need for further work in this area.

This report should be read in conjunction with the following Seafish Technical Reports No. 259 "A Study of mortality rates of the velvet crab during holding and transport" - MacMullen, Wyman and Uglow and TR 280 "Live handling and transport of crustacean shellfish. An investigation of mortalities" - Uglow, Hosie & MacMullen which describe other aspects associated with the live trade of crabs to continental markets.

### 3. Methods

#### 3.1. Examination Locations

The original intention was for the investigators to make detailed, individual examinations of a large number of brown crabs at several points from catcher to final destination. The route selected for study was one that commenced in the Hebrides and proceeded using the U.K. buyer's vivier lorry to his premises in the U.K. This premises acted as a transfer point and the consignment was offloaded, examined, and transferred to a Spanish buyer's vivier lorry which proceeded across the Channel, through France to his premises in Northern Spain. Here, crab were again off-loaded, sorted, packed and sent in another vivier truck to Madrid where they were delivered to a number of wholesalers. One team of investigators (R.F. Uglow and D.A.Hosie) carried out the U.K. examinations; the other (P. MacMullen) made the examinations in Spain.

In the event it was not possible to conform exactly to the scheme and initial inspections in the Hebrides could not be made. However, a very detailed inspection was made at the U.K. transfer point and in N. Spain. A comparison was also made with a consignment of brown crab received in Madrid from a South Coast of England consignee.

#### 3.2. Examination Details

Prior to these examinations the investigators had run a "blind" trial at Hull to ensure that a consistent approach and interpretation of damage was made.

The following points were examined:

##### a) *Damage*

All physical damage was recorded. This was scored under various headings according to type:

1. broken dactyls - the last segment of the limbs
2. damaged or torn joints - including damage to the scar tissues that cover missing limbs
3. broken or snapped legs or claws
4. missing legs or claws
5. cracked or damaged carapace
6. damage to other parts - apron, mouth parts, etc.
7. intact - no physical damage seen

All such damage was further described as 'recent' or 'old'. The distinction between these was generally judged on the colour and condition of the scar-tissue. Black or dark brown scars being taken as 'old' which, in this context, are at least 1 week old. In instances where the limb was broken, but not autotomised or 'cast off', then this also was recorded.

*b) Sex and Size*

These were recorded as male or female and as small, medium or large (sizes).

*c) Condition*

1. Hard or soft (whiteface etc.)
2. Dead, moribund (very close to death) or lively
3. Presence of regenerated limbs

Usually heavy crops of encrusting tube worms or barnacles were noted as these indicated a considerable period since the animal last moulted.

Several of these types of damage are illustrated in Figure 1 and a sample data sheet is given in Figure 2.



## **4. Results**

Tables 1, 2 and 3 summarise the results of the inspections made in the U.K. and Northern Spain. From these findings can be drawn several interesting features relating to the dead/damaged animals and to the survivors.

In practical, commercial terms the negative points include the proportions of the loads at each inspection which were of little or no commercial worth and comprised the soft, dead, moribund, severely damaged and crippled animals. These were about 10 times higher for the Scottish crab than for the South Coast consignment. Should the continental buyer wish to keep animals alive for several days, then those with recently sustained damage (as opposed to those showing recent autotomy or casting) should also be rejected for this purpose. In this instance such animals would have comprised an additional 6% of the Scottish and 7% of the S. Coast loads. Many of these damaged animals could be made to cast their damaged legs and so become suitable for live storage (see flow-charts in appendix 1).

In terms of journey time, the three loads inspected were similar at between 36-40 hours on the vivier trucks. However, the Channel load had much the lower proportion of animals in the worthless category (approximately 10% of the load compared with 55% and 50% respectively for the Scottish and transfer-point consignments).

Comparison of the results of the inspections of the Scottish load made at the transfer point and in Spain shows that there was little change in the overall proportion of animals in the worthless category during the 2nd half of the journey (deads were of course removed at the half way point) but the proportion of dead/moribund animals was substantially higher in Spain.

Inspection of the dead/moribund animals gives some clues to the possible causes of death. A summary of these inspections is given in Table 4 which shows that nearly a quarter (23a) of the dead animals were either intact or had only old damage. They had not suffered any recent blood loss and it is not possible in this study to ascertain whether their deaths were due to an unknown condition factor or to travel conditions. However, the proportion was approximately the same for both halves of the journey and contrasts with the absence of death amongst the Channel crab. This latter consignment travelled under very similar vivier conditions and, perhaps, strengthens the "condition factor" argument as another cause of transport-associated death.

Soft crabs which may reasonably be considered as vulnerable to the stresses of transport, were comparatively hardy and comprised only 80 of the deaths (5 deaths in each half). Animals which had recently cast one or more limbs but had sustained no other damage, made up 28% of the deaths. Such losses were principally in the second half of the journey which suggests that such animals may be less tolerant to long-term stress than intact animals.

The predominant feature of the dead animals was the incidence of recent damage - principally loss of the tips of walking legs or legs being snapped and broken. Such occurrences made up 430 of the total - some 49 of the 118 dead animals - and this is clearly a very important feature in transport-associated loss of quality. A further 61 live, non-soft animals inspected in Spain had recent

damage (= 140 of the live animals unloaded) and were thus a risk for vivier storage. In the Channel consignment, only 70 of the animals showed comparable recent damage.

A general observation made was that the strongest and liveliest animals invariably occupied the bottom layer of the tank and were clinging tightly to the pipework there. By contrast, most of the dead, moribund animals were towards the top of the tank. These findings and those made on other occasions suggest that there is considerable movement by the crabs to occupy the favoured lower positions.

The animals were all nicked and, amongst the Scottish load, there was evidence that some of the animals had been in storage for some time. The nicking scar was black and there was considerable tissue retraction from around the scar. In other cases there was evidence of old autotomy scars being reopened and bleeding. Small, regenerating limbs also appeared to be a common source of damage and blood loss. Forty four animals in the Scottish consignment had one or more regenerating limbs (70 of the animals). Also, in spite of being nicked, limb losses continued to occur during transport. Seventy eight cripples were packed at the transfer point and 85 were counted in Spain. Table 5 gives the numbers of limbs lost amongst the animals loaded at the transfer point, and unloaded in Spain. Clearly, the majority of such losses are with animals that have lost only one or two legs. However, an extra 38 legs were shed and the changes were most important., perhaps, in the cases where animals had lost more than 3 legs as such animals may be rejected from further live sale. In this instance the numbers of such animals increased from 15 to 29. The number of animals showing no limb losses decreased from 303 to 269 during the journey.

Considerable damage was seen to take place when the animals were transferred from one container to another. At such times they are particularly aggressive and can cause damage using their claws when they clench their limbs to their body trapping the limbs of other crabs.

**Table 1 – Summary of the inspection made of the brown crab off loaded at the U.K. buyer’s premises**

**Scottish Consignment**

Category	No.	* % of original load	* % of load to Spain
Animals	608	100	
Hens	521	86	
Cocks	87	14	
Dead/severely damaged	27/2 = 29	5	
<b>Live animals only</b>			
Packed for on-shipment	580	95	100
Intact animals	219	36	38
Old damage only	95	16	16
Those with no recent blood loss	314	52	54
Recent damage/limb loss	266	44	46
Lost more than 3 limbs	33	6	7
Lost 3 or less limbs	233	38	40
Recently crippled	43	7	7
Old cripple damage	35	6	6
Total cripples	78	13	13
Recent damage only	167	27	29
Soft	62	10	11

- All % values rounded off to the nearest whole number

**Table 2 – Summary of the inspection made at the buyer’s premises in Spain**

**Scottish Consignment**

Category	No.	* % of original load	* % of load to Spain
Animals	580	95	100
Dead/moribund	74/14 = 88	14	15
Soft (live)	57	-	10
Soft (dead)	5	-	-
Intact (live)	152	25	26
Intact (dead, soft, moribund)	32	5	6
Total intact-shipment	184	30	32
With old damage/loss only (live/non soft)	208	34	36
Those with no recent blood loss	208 + 152	59	62
Cripples (dead/soft)	31	-	-
Cripples (live)	54	9	9
Total cripples	85	14	15
<i>Refers to live/non soft</i>			
Recent damage	61	10	11
Lost more than 3 limbs	13	2	2
Lost 3 or less limbs	196	32	34

**Table 3**

**Madrid Inspection**

**South Coast Consignment**

Category	No.	= % of Original Load
Animals	98	
Cocks	27	28
Hens	71	-
Dead/severely damaged	0	-
Intact	41	42
Old damage only	50	51
No recent blood loss	91	93
With recent damage/limb loss	7/0 = 7	71
Lost more than 3 limbs	0	-
Lost 3 limbs or less	50	51
Lost 1 limb only	43	44
Cripples (old damage)	2	2
Soft	1	1

**Table 4**  
**Analysis of Dead/Moribund Animals**  
**Scottish consignment**

Category	At transfer point (29)	* Proportion (%) In Spain (89)	Total deads (118)
Intact or with old damage only	21	24	23
Soft (with or without damage)	17	6	8
Recent limb loss only	10	34	28
Recently damaged (with or without limb loss)	52	40	43

\* All % values rounded off to the nearest whole number

**Table 5**  
**Census of limb losses amongst animals loaded at the**  
**transport point and unloaded in Spain**  
**Scottish Consignment**

Number of limbs lost	0	1	2	3	4	5	6	7	8
Transfer point	303	157	68	24	10	4	0	0	1
Spanish premises	269	172	70	29	22	3	2	1	1
Change (actual)	-34	+15	+2	+5	+12	-1	+2	+1	0
Change (%)	-11%	+10%	+3%	+21%	+120%	-25%	-	-	-

## 5. Discussion

### 5.1. Background

These results need to be put into perspective, with the data being considered along with the circumstances which gave rise to them.

Clearly, different crab fisheries operate under different conditions and constraints and those that are geared up to supplying the live trade are generally better able to provide suitable quality crabs than those that are not or which fish for a variety of species.

It is also true that there is no such thing as a typical load on a vivier lorry and crab usually comprises only a part load with other crustacean and mollusc species. Product quality can vary greatly not only between areas but also between individual sources within a single fishery. Some of the fundamental biological reasons behind such quality differences are still unknown or only suspected, but quality changes which occur after capture can be identified with more precision and positive steps can be taken to remedy them. Thus the authors are not seeking here to identify biological condition differences which may or may not exist between Channel crabs and those from Scotland, neither are they claiming that the consignments studied are typical or representative - though it is suspected that they might be not too unrepresentative. Rather, these are the results of the examinations of a randomly-chosen set of consignments made possible by the cooperation and kindness of the wholesalers involved. The results, however, enable a number of further observations to be made:

They have emphasised once again that in several areas of the Highland and Islands, crab fishing may not be a full-time occupation. It can vary from a pastime pursued by those unemployed or employed elsewhere, a by-catch fishery by *bona fide* fishermen principally interested in other species such as lobster or finfish, or a full-time, directed fishery for brown crabs.

In many instances, buyers will take crabs (and other species) from sellers in all these categories with the inevitable result that the handling history of the crabs in any consignment may be very varied. When demand is high and competition for supply is intense this is almost invariably the case.

When the logistical constraints of pier-head sales in remote areas are added, along with the infrastructure problems of collection in such areas, then this may also lead to greater uncertainty as to the quality and condition of crab within any consignment. Such arrangements often leave time for no more than a cursory inspection to select out low-grade crab - especially those with minor limb damage: Often the absence of local processing facilities means that there is no way of defraying potential losses by, for example, sending sub-standard crab for boiling. Those involved in buying, transporting and selling-on crab under these circumstances must do so with the anticipation of particular mortality and quality problems and adjust their pricing structure accordingly.

Economic considerations must make this kind of fishery, supplying this grade of crab viable; it is quite common as a "part-load" operation with its disadvantages being accepted. Such disadvantages will include, variable and occasionally high mortalities, low prices (c.f. high-grade Channel crabs), irregular demand as a 'second choice' commodity and the attendant difficulties of dovetailing with the lucrative "high-grade" end of the market when circumstances require it. One of the aims of this discussion is to suggest alternative procedures to those involved in this type of fishery. This requires too, that some account be taken of national supply and demand and the changes forecast as likely to occur in the near future.

Markets which hitherto were restricted to a season corresponding to that of the Southern crab fishery, have now increased their demand in response to the new fisheries developing in other parts of the U.K. - principally Scotland. It is most likely that fisheries in the N. Isles, E. Coasts of Scotland and England, as well as other countries such as Eire and Denmark will also be responding to the increased opportunities in the live trade. Each fishery will experience greatest demand during the times when their crab reach peak condition for live export. Correspondingly, foreign importers are likely to show greater willingness to change their sources of supply through the year in order to take advantage of the seasonal nature of each region's fishery.

As a result of this, each fishery must be prepared and able to take advantage of all the market opportunities for their products and be flexible enough to accommodate seasonal changes in the type and volume of demand.

## **5.2. A Development Strategy**

In the context of the foregoing, consideration can be given to the type of development which would be appropriate to the regional fisheries. Generally this consideration relates to two independent but mutually cooperating sectors; the catchers and the buyers.

Fishermen who have formed or joined existing associations are able to work towards agreed standards of handling and product quality. This provides a bargaining point for better prices commensurate with a better product. They are committed to the crab fishery for a major proportion of their income and their interests are served by the preservation of prices as high and as consistent as possible.

The opportunist and mainly part-time sector makes no such commitment and generally sets standards at the lowest level that will still enable the product to be sold. Alternatively, some other strategy may be used such as the insistence that the buyer takes one part of the catch (e.g. crabs) to gain access to another (e.g. lobsters). By such means can quality suffer and whole loads be put at risk.

The following points should be considered amongst the first moves towards a general up-grading of brown and velvet crab commercialisation:

## **For Catchers**

1. The need to become organised and recognised. Individuals operating on their own are very vulnerable to a number of influences. In the context of this report, individual fishermen tend to be isolated and have little or no control over the market. By joining or forming a group such as Marketing Cooperative individuals can themselves control the quality and marketing of their products and influence the general management of their fishery. Such groups need not be complex or difficult to set up and Seafish can provide advice on this.
2. The need to be informed. Formal or informal groups have the power to organise seminars and to make requests to Group Training Associations for special training provision. Seafish are currently offering to interested fishermen seminars on good live-handling practice.
3. Once there is confidence that a better product can be supplied, tell the buyer so. It is advisable to try to arrange for your crab to be held separately in any communal or buyer's tanks (if possible) so that there is minimum risk of them being mixed with crab from a dubious source.

## **For Buyers**

1. Where ever possible buy from bona fide, full-time fishermen and try to be as helpful and constructive as you can to people with handling problems.
2. Inform your fishermen how you want your crab handled, selected and presented. Seafish can advise buyers as well as fishermen and the live-handling seminars are equally applicable to both groups.
3. Give consideration to installing tanks at strategic locations as temporary holding/collection facilities. This is a good way of reducing stress and aerial exposure levels on the crabs and thereby reducing loss of quality. Such tanks can readily be made from (second-hand) prefabricated sections.
4. Try to avoid too much hurry at the collection and packing stages. Consider re-scheduling to give more time for thorough selection and better handling. This is particularly important if the purchased animals need to be kept for periods of several days before being moved on and it applies to buyers in this country and on the continent.
5. If you have vivier tank capacity and regular supplies from fishermen then consider sub-dividing the tanks to keep each person's consignments separately. It is important to identify sources of poor quality crab so that effective remedial action can be taken.

For both catchers and buyers flow charts are given in Appendix 1 which describe the selection sequence for the brown crab.



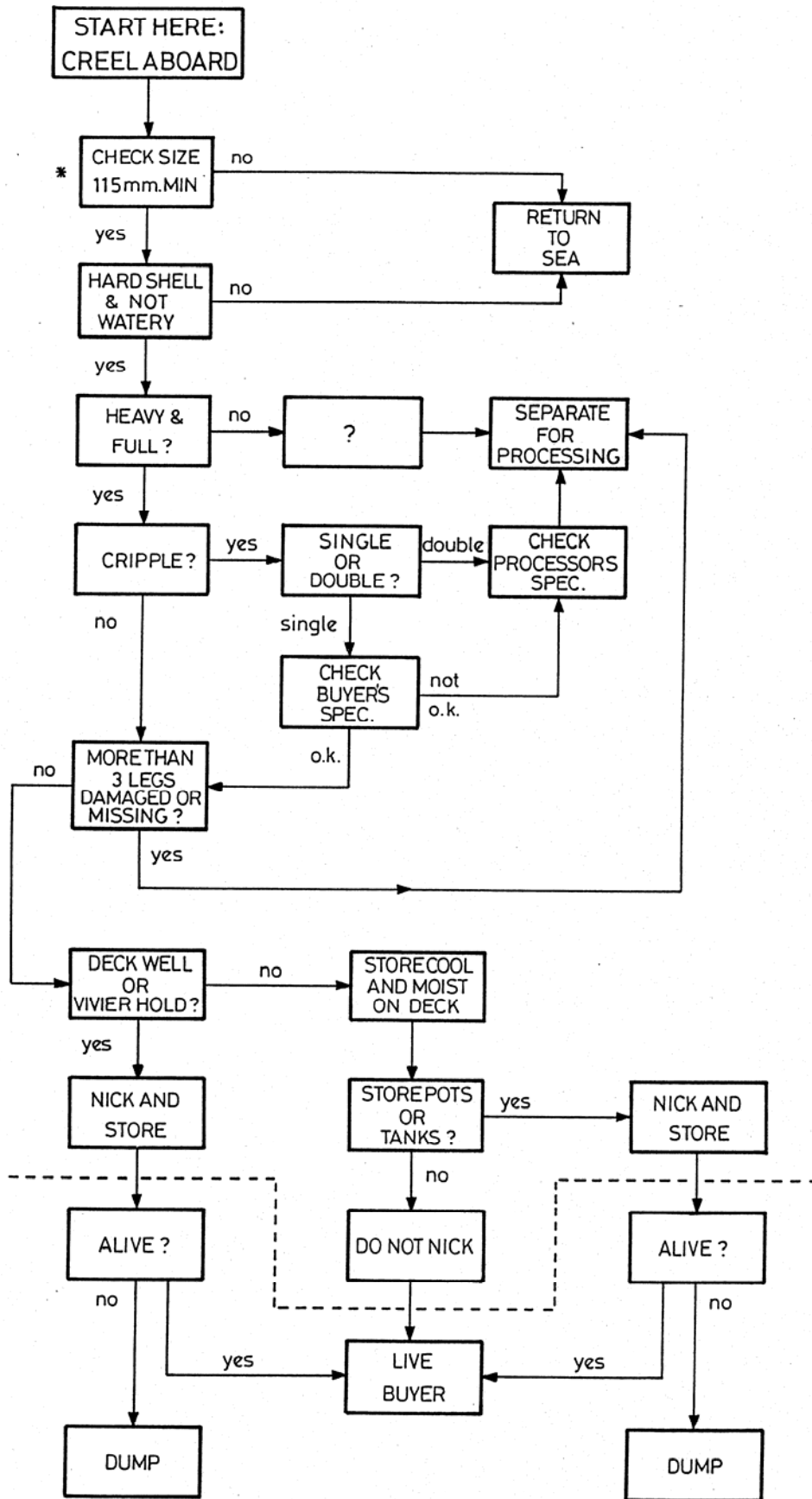
## **6. Conclusions**

From this study, the following conclusions may be reached:

- i) Significant differences were found between the consignments of brown crab which were examined. It is quite reasonable to attribute the poorer quality of the Scottish consignment to ineffective selection. As a result, that load lost perhaps 30% of its potential value by the time it reached its final destination.
- ii) The damage rate increased through the journey which indicates scope for further work possibly on the packing procedures followed.
- iii) The root causes of the problems are seen partly as structural - requiring changes in the collection system - and partly as training - indicating the need for training provision.
- iv) The significant numbers of intact animals, or those with no recent damage, which died suggests the presence of other influences - perhaps a condition factor with a different seasonality between the Scottish and Channel populations. Some aspects of this have been investigated in earlier studies. Further work is indicated on this aspect and on the effects of nicking on crab being held medium- to long-term. Further work is also indicated for alternatives to nicking such as body-banding.
- v) It is realised that only a single Scottish consignment was examined and that this may not be truly representative. However, the investigators have experience with many such consignments and this plus the opinions of the buyers give us confidence to suggest that the load was not unrepresentative. One shortcoming which was unavoidable was the failure to inspect the load at the start of the journey from Scotland. How much damage is incurred during first handling and during store-pot lifting and loading is an unknown quantity. However, as the crabs at this time will be at their most alert and aggressive it is reasonable to assume that a large proportion of the damage seen here occurs at these times. Many of the deaths in transit are probably caused by the injuries which were incurred 24 to 48 hours earlier. Crabs are cold-blooded animals and at a low transport temperature, will take many hours or even days to die.
- vi) We are able to suggest protocols for handling/selection procedures by taking the present findings in conjunction with the expert advice of S. Coast buyers with long experience of providing a quality product to Continental buyers who insist on stringent quality criteria. These are included in the appendices and are designed to promote an up-grading of quality consistent with speed and ease of operation.

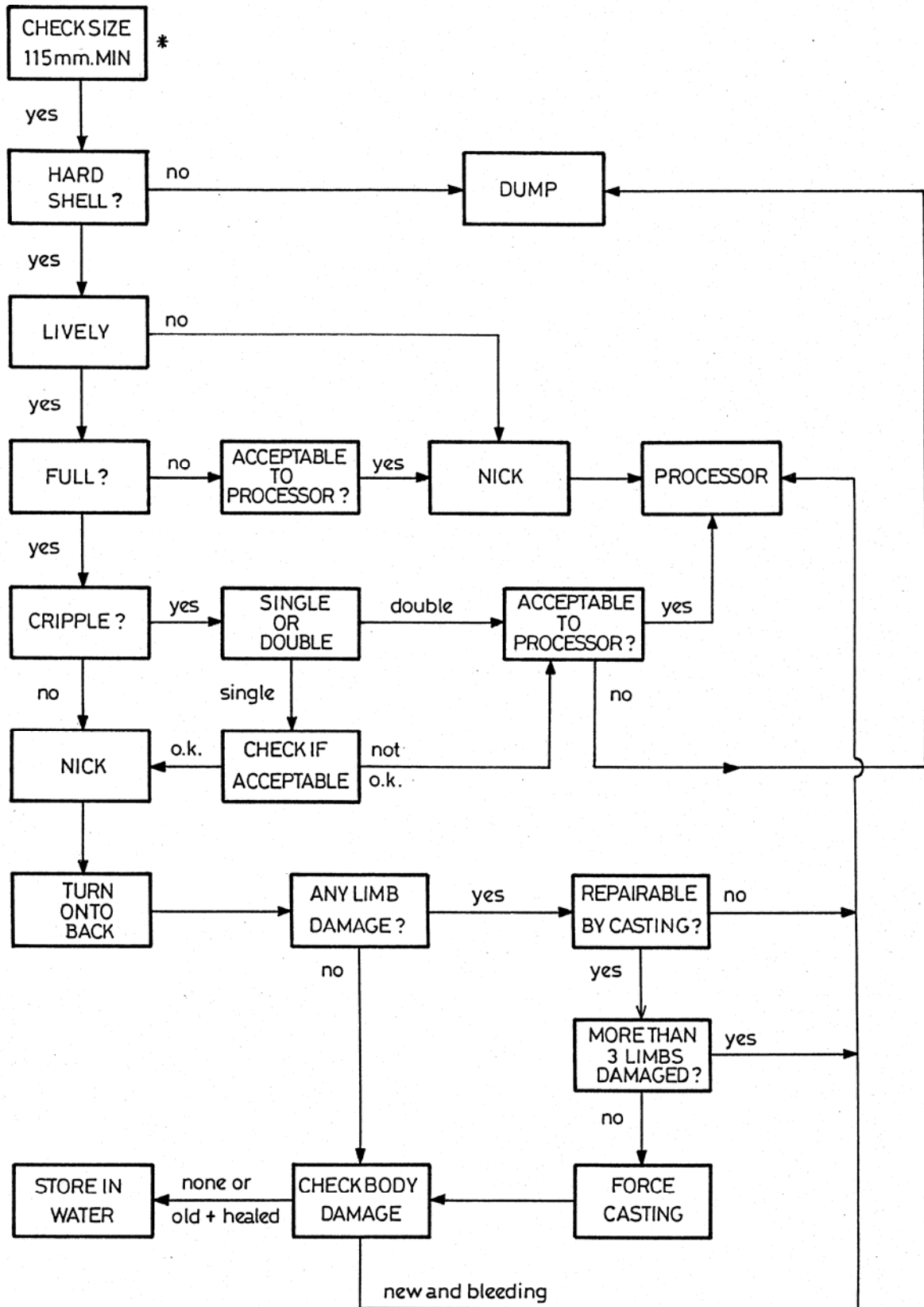
**Appendix I**  
**Selection Guides for Fishermen and Buyers**

\* SCOTLAND AND CERTAIN OTHER REGIONS ONLY: IF IN DOUBT CHECK WITH DISTRICT INSPECTOR

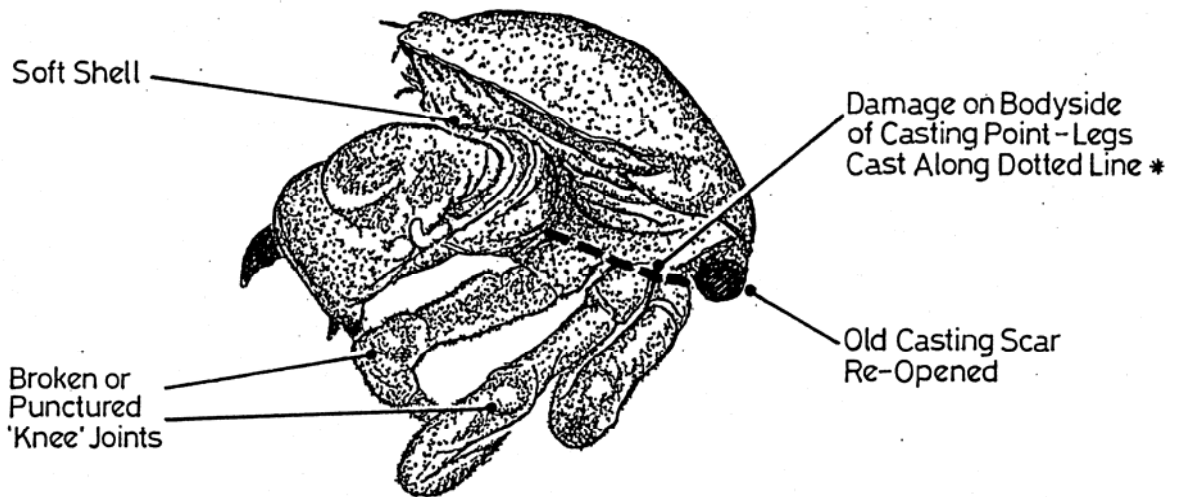
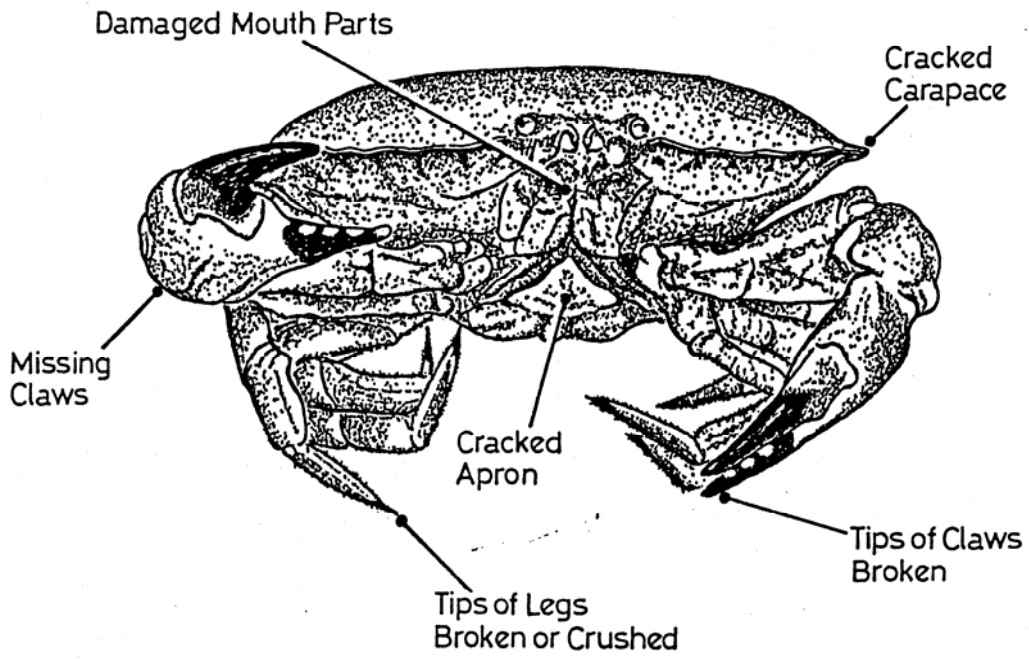


**Selection Guide for Fishermen**

\* SCOTLAND AND CERTAIN OTHER REGIONS ONLY: IF IN DOUBT CHECK WITH DISTRICT INSPECTOR



### Selection Guide for Buyers



\* Damage to Legs Can Be 'Repaired' by Casting; Damage Inside the Casting Point Cannot Be Made Good

**Fig 1 – Points of Damage Identified During the Survey**

## COLLECTION SAMPLE DETAILS

Notification \_\_\_\_\_

No.	SEX	DAMAGE				COMMENTS
		Recent Missing	Damaged	Old Missing	Damaged	
		R 12345 L 12345	R 12345 L 12345	R 12345 L 12345	R 12345 L 12345	
		R 12345 L 12345	R 12345 L 12345	R 12345 L 12345	R 12345 L 12345	
		R 12345 L 12345	R 12345 L 12345	R 12345 L 12345	R 12345 L 12345	
		R 12345 L 12345	R 12345 L 12345	R 12345 L 12345	R 12345 L 12345	
		R 12345 L 12345	R 12345 L 12345	R 12345 L 12345	R 12345 L 12345	
		R 12345 L 12345	R 12345 L 12345	R 12345 L 12345	R 12345 L 12345	
		R 12345 L 12345	R 12345 L 12345	R 12345 L 12345	R 12345 L 12345	
		R 12345 L 12345	R 12345 L 12345	R 12345 L 12345	R 12345 L 12345	
		R 12345 L 12345	R 12345 L 12345	R 12345 L 12345	R 12345 L 12345	
		R 12345 L 12345	R 12345 L 12345	R 12345 L 12345	R 12345 L 12345	
		R 12345 L 12345	R 12345 L 12345	R 12345 L 12345	R 12345 L 12345	
		R 12345 L 12345	R 12345 L 12345	R 12345 L 12345	R 12345 L 12345	
		R 12345 L 12345	R 12345 L 12345	R 12345 L 12345	R 12345 L 12345	

'Damage' in this scheme refers to legs. 'R' and 'L' refer to right and left sides and the numbers identify each leg, number 1 being the claw.

**Fig 2 – Sample Data Sheet**