

SR668 - Use of discards in bait

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The use of discards in bait

Final Report

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Executive summary

The reformed Common Fisheries Policy (CFP), which came into force in January 2014, includes provisions, under Article 15, for a landing obligation which will ban the discarding at sea of fish species managed by quotas (i.e. those for which a Total Allowable Catch (TAC) is set). These new rules will take effect from 1st January 2015 for pelagic species, covering all other fisheries between 2016-2019. The objective of the new regulation is to drive behavioural change within the fishing industry so as to avoid catching unwanted fish through improved selectivity and catch avoidance. However, there is consensus from fishermen, scientists and policy makers that despite best efforts to reduce unwanted catches there may still be some fish landed for which a market may not be available.

This study explores the potential for species and quantities of fish predicted to be landed under the future landings obligation by the English fleet and not sold for human consumption, to be used as bait in pot fisheries. In order to estimate the supply and demand for bait, the study involved: interviews with bait supply chain stakeholders; discard data analysis; and commercial sea trials to test the effectiveness of a range of discard species as bait. The findings will inform discussions between fishing industry groups and policy makers charged with implementing the landings obligation in 2015

Estimates of quantities and species of discards that could be supplied by the English fleet were taken from the Scientific Technical and Economic Committee for Fisheries (STECF) data for all English fleet gear types operating in the North sea, Irish sea, English channel and Celtic sea (i.e. ICES sub areas IV, VIIa and VII).

Estimates of the total weight of bait used by the English potting sector were calculated using two methods: one based on the total cost of bait used per year (from Seafish economic fleet survey data) and the other based on the weight of bait per boat and number of pots hauled per year across the fleet. Both estimates were used in the analysis of supply and demand to provide a range of possible scenarios. Data on the capacity and landings of the shellfish potting fleet data was supplied by the Marine Management Organisation (MMO). Fleet activity / effort data for the inshore shellfish fleet was supplied by Cornwall and Northumberland Inshore Fisheries and Conservation Authorities (IFCAs) and was supported by insight gained through interviews with skippers.

The analysis shows that the estimated demand for bait is significantly larger (~68%) than the potential supply from fish that would have previously been discarded. The potential exemptions (permitted within the regulation) from the landings obligation were considered, demonstrating that the exemption of species with likely high survivability could significantly reduce the level of discards being landed.

Summary table of discard supply and bait demand for English fleet

	Estimated discard landings (i.e. supply) by English fleet (tonnes)	Estimated demand for bait by English potting fleet (tonnes)	Supply-demand (tonnes)	Percentage of estimated discard bait landings against demand
North sea	4055	7532	-3478	54%
Celtic sea & western approaches	2284	12492	-10208	18%
Irish sea	206	393	-188	52%
<u>Total</u>	6543	20417	-13874	32%

Three sea trials were commissioned to test the effectiveness of fish that would have previously been discarded, referred to in this report as discard baits, compared to standard baits. These were conducted in three distinct and geographically independent pot fisheries. The trials were randomly assessed by independent fisheries observers and took place under commercial conditions to a scientific methodology approved by Seafish. Discards from two trawlers operating under simulated landings obligation conditions (granted by MMO dispensation) were retained and landed in Newlyn and Scarborough to provide bait for sea trials on commercial potting vessels.

The results of the sea trials confirmed the view of potting skippers interviewed that for targeted crab fishing, virtually any whole whitefish TAC species could be used effectively as pot bait. However, both sea trial results and skipper insights suggested that for targeted lobster fishing, salted or very oily baits were needed to attract lobsters. The impact of this on pot bait demand was thought to be considerable given that the value of lobsters landed by the English fleet was 50% of the total value of crab and lobster landings. Although pot numbers are not accurately recorded across the UK it was estimated that approximately half of the English shellfish potting fleet effort (in terms of pot numbers) was targeting lobster.

At port level there is evidence to suggest that skippers of under 10m and 10-15m potters already work closely with towed gear and static gear vessels to utilise a wide range of low value TAC and non-TAC species as fresh bait for pot fishing. Fresh bait is used preferentially to frozen bait as it is believed to be more effective, and is usually cheaper, than frozen bait due to the additional production costs associated with freezing. Larger vessels in the potting fleet require larger quantities of baits at more regular intervals and often at different locations due to the nomadic fishing patterns of some operators. As a result, these vessels tend to rely solely on frozen bait, bought at a bulk price (e.g. several tonnes).

Considerable volumes of fish processing by-products (mostly fish frames, ray backs and fish heads) are also used, fresh and frozen by pot fishermen. This is very much a symbiotic relationship between pot fishermen and processors. Some processors provide fresh processing by-product / waste to fishermen for pot bait at no cost recognising that this reduces their waste disposal costs which are known to vary between 5-15p/kg. Other

processors may levy a small charge of 20p/kg to cover the boxes used, icing, storage. Where fish processing by-product / waste is supplied frozen processors charge in the region of 30-35p/kg to recover the costs of freezing and cold storage. Fish processors expressed concern that flooding the bait market with once discarded fish would have the knock-on effect of increasing the amount of fish waste, incurring extra costs on processors, which could in turn result in lower prices being paid for fish at auction

Alongside the cost of fuel and replacing gear, the cost and availability of bait is seen as a significant issue by the shellfish sector, with the cost of bait accounting for up to 10-11%¹ of the gross turnover. For the majority of potting vessel operators the cost of bait is the key consideration when sourcing bait, although there are fishermen who will pay more for a particular bait species, but these are exceptions to the rule. The price of fish processing by-products effectively sets the bait price baseline for fresh and frozen (non-specific species) crab bait. The costs associated with freezing mean that even a discard product landed at zero price is unlikely to be cheaper than the existing cheapest frozen baits. This is due to the fact that processors are deriving economic value (a profit) from the retained processed fish product and this economic return helps to offset the cost of waste disposal and provides the capital for investment in freezing facilities. Based on estimated set-up and production costs (provided in this report), it is unlikely that any commercial business established purely to sell discards as bait would be able to produce and sell frozen discards as bait at the same price as frozen fish processing by-product. Under the new European Marine Fisheries Fund (EMFF) processors and trade bodies (such as Producer Organisations (POs)) will be able to access grant funding towards the cost of freezing equipment to support the processing of catches of commercial fish that cannot be destined for human consumption .

There may however be scope for industry bodies like Producers Organisations (POs) responsible for the disposal of members' landings to explore contract, outsourced contract freezing arrangements.

The study concludes that discard species can be used as effective pot bait when targeting crabs. Demand for bait is high so it is probable that significant quantities of previously discarded fish can, and will, be used for pot bait, particularly when fresh. However, it should not be assumed that this outlet will use all discards as fishermen targeting lobster, who account for 50% of shellfish capacity, will not use discard bait as it was proven to be less effective as Lobster bait. Furthermore, fishermen using cheap frozen bait or fish processing waste products will continue to source bait according to best price.

¹ Seafish fleet economic survey data 2009-2012

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1. Introduction

1.1 Background to the study:

Discarding is the practice of returning unwanted catches to the sea, either dead or alive, either because they are too small, the fisherman has no quota, the fish are un-marketable or because of certain catch composition rules. Many of the demersal fisheries in English waters are multispecies, meaning they target, and catch, a range of species at once. This means that matching catch to quota is more complex than in a clean fishery with limited by-catch. For example, the use of larger mesh sizes, designed release immature fish of one species (e.g. cod or haddock) might result in the significant loss of valuable marketable fish (e.g. squid or sole)².

Within the context of European Union (EU) fisheries, the reform of the Common Fisheries Policy (CFP) in 2012-3 provided the opportunity for both policy makers and politicians to act to address the wasteful issue of discarding. Amongst other 'landmark' commitments, such as the achievement of Maximum Sustainable Yield (MSY), the new basic regulation of the CFP is perhaps most famous for setting out an end to discards of Total Allowable Catch (TAC / quota) species. However, much of the detail around implementation of the landing obligation is able to be decided nationally or regionally by Member States with an interest in a particular fishery. This means that rules can be more tailored to the fishery in question. This is currently an ongoing process, (see section 2) and hence the full implication of the regulation can only be surmised, albeit through seeking expert opinion.

Based on current opinion the implementation of the landings obligation would mean that fishermen targeting pelagic or demersal species managed by quotas (TACs) would be required to land all the fish of these species they catch. At worst this would result in large scale landings of un-wanted fish; but, the consensus opinion of the fishing industry and policy makers is that this is not the intended outcome of the so-called discard ban. It is instead hoped that over time fishermen will modify their fishing patterns and fishing gears to avoid catching species of fish for which they have insufficient quota or limited marketing opportunities. Notwithstanding these best efforts to modify behaviour, industry leaders recognise there may still be some fish landed which cannot be sold for human consumption and which must enter the non-human consumption market.

The Defra funded 'Fishing for the Markets' initiative in 2011 considered the utilisation of species which, at the time, were discarded and which were considered to be 'un-marketable' and a number of recommendations were made, including for further investigations to be conducted in respect of the use of discards in fish meal and as pot bait. Through the work of the Seafish Discards Action Group (DAG), Seafish continued these work streams and in November 2012 published a Defra-funded report undertaken by Cefas which explored potential options for utilising discards not destined for human consumption in bulk uses such as fish meal and pet foods³.

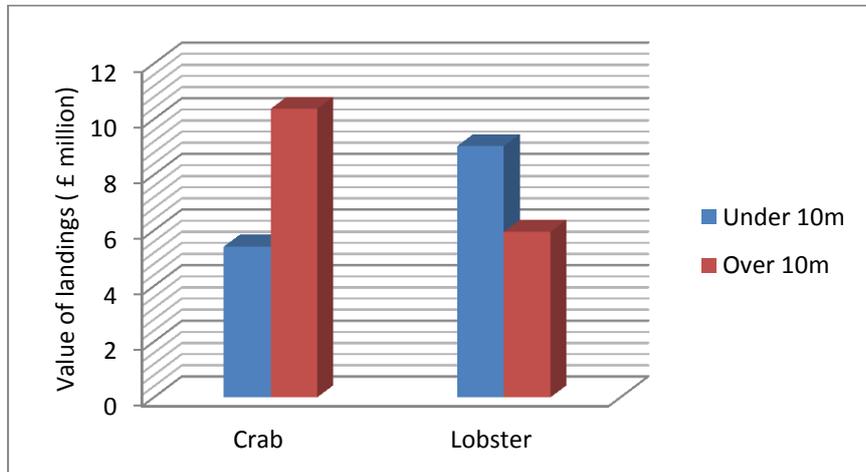
In contrast to whitefish fleets which have largely been constrained by stock recovery programmes and quota restrictions over the last 10-15 years the landings from the shellfish sector (scallops and crustacean fisheries) have steadily increased, being seen by many fishermen as a means of diversification into less restricted fisheries. In 2012, 1,496 English

² Catchpole *et al*, 2012

³ Mangi *et al*, 2012

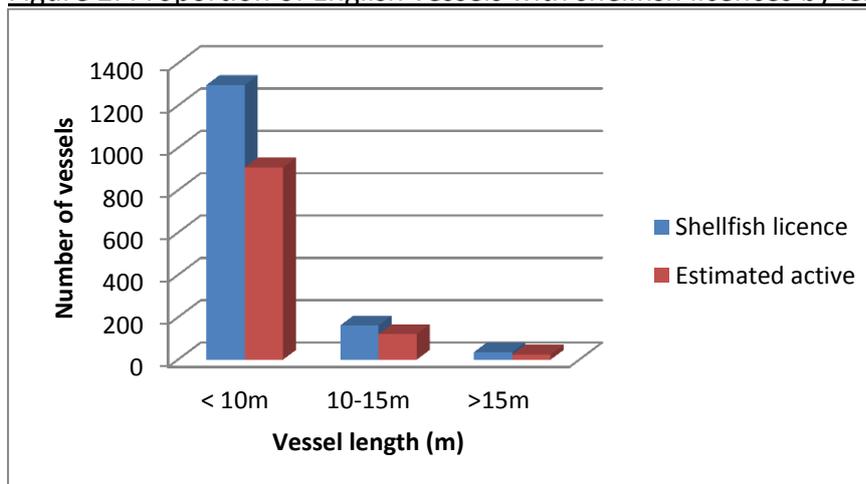
registered shellfish vessels landed 12,158 tonnes of crabs worth nearly £16m and 1,583 tonnes of lobsters worth ~£15m. Figure 1 demonstrates that larger vessels fishing offshore tend to target crab (with exceptions) and smaller vessels fishing inshore generally target lobster.

Figure 1: Value of crab and lobster landings by the English potting fleet into English ports⁴



The English shellfish fleet can loosely be divided into three fleet segments. First, the 1,299 under 10m vessels often operated single-handed and largely fishing waters within 0-6 mile of the coast. Of these around 900 are expected⁵ to be 'active' in shellfish potting although in the absence of more accurate data (requested) it was not possible to verify this figure. Secondly, 162 10-15m vessels, of which around 120 are thought to be actively engaged in potting for shellfish and are operated by 2-4 crew. These are mostly non-nomadic vessels fishing up to 40 miles from port. Thirdly, there are 36 over 15m English vessels of which 24 are thought to be potters, some of which fish are known to fish nomadically around the UK.

Figure 2: Proportion of English vessels with shellfish licences by length (in metres)



⁴ i.e. not including landings by English vessels into Wales, NI, Scotland or other Member States

⁵ Based on assumptions made within the UK Brown Crab study, produced by Nautilus in 2009

Alongside the cost of fuel and replacing gear, the cost and availability of bait is seen as a significant issue by the shellfish sector, with the cost of bait accounting for up to 10-11%⁶ of the gross turnover. The price of bait has also steadily increased in recent years due in part to an increased demand for fish for fishmeal, fish protein on the African continent and fish flesh recovery technologies improving the efficiency of fish processing operations. As a result traditional pot bait species such as frozen mackerel can often fetch over £1/kg.

1.2 Objectives of the study

Following on from the recommendation made in the 'Fishing for the Markets' report, this study explores the potential for species and quantities of fish landed following the implementation of the landings obligation to be implemented across the EU fleet from January 2016 to be used as bait in pot fisheries. It should be stressed at this point that the study focuses on TAC species as the landings obligation only applies to TAC species.

The utilisation of discard species for bait could provide both an outlet for discards that would be landed under the future landings obligation as well as an opportunity to reduce costs in the potting sector. However, there is a need to assess the suitability, seasonality, and geographic availability of the discard species for use in bait.

In order to assess this potential outlet for discarded fish, the study aims to:

- Obtain current information on the pot bait market
- Commercially trial and demonstrate the use of discard species for use as bait
- Estimate bait supply and demand by region
- Identify bait supply chain logistics and costs
- Make recommendations on the options that the industry can take forward / adopt, including cost implications
- Make a rigorous attempt to outline a range of discard / bait supply scenarios that could arise under the discard ban

Findings from this study will inform fishing industry groups and policy makers charged with implementing the landing obligation in England.

⁶ Seafish fleet economic survey data 2009-2012

2. Legislation

2.1 Regulatory framework

The key driver for the landing obligation (often referred to as discard ban) emanates from the basic regulation text of the new Common Fisheries Policy (CFP) agreed by the European Union (EU) Council of Ministers in June 2013 and which entered into force in January 2014. Specifically, Article 15 lays the foundation for the “*obligation to land all catches*” setting out the timescale for implementation across EU waters and potential cases in which exemptions from the regulation are permitted e.g. under conditions where survivability of discards is demonstrated. A number of other potential scenarios where exemptions could be granted are also included and the implications of these are considered later in this report.

2.2 Implementation timescale

In England, Defra are leading on the phased implementation of Article 15 of the CFP, starting with pelagic fisheries from the 1st January 2015 and then continuing with demersal fisheries (e.g. cod, haddock, sole and plaice) from 1st January 2016 and then all TAC fisheries by 2019.

In the intervening period, Member States will be required to present multi-annual fishing plans and discard action plans to the European Commission. Where exemptions from Article 15 are requested it is envisaged that these would be supported by a clear rationale and strong evidence base. Much of this work is also expected to be discussed at Regional Advisory Council (RAC) level.

Under the reformed CFP there are a number of exemptions to the landing obligation available:

- i. Species in respect of which fishing is prohibited and that are identified as such in a Union act adopted in the area of the CFP;
- ii. Species for which scientific evidence demonstrates high survival rates, taking into account the characteristics of the gear, the fishing practices and the ecosystem;
- iii. The *de minimis* exemption allows up to 5% of total annual catches to be discarded when:
 - a. where scientific evidence indicates that increases in selectivity are very difficult to achieve; or
 - b. to avoid disproportionate costs of handling un-wanted catches, for those fishing gears where unwanted catches per fishing gear do not represent more than a certain percentage, to be established in the annual plan for that gear

Other derogations and flexibilities are also available.

- i. When no quota is available, fishermen will be able to count some of their by-catch against their quota for their target species (up to 9%). This can only be applied when the by-catch species is within safe biological limits.
- ii. Fishermen can also bank and borrow up to 10% of their quota between consecutive years.

3. Approach used in study:

In order to investigate pot bait supply and demand issues, and questions identified in the objectives, the project was divided into four key stages; namely:

- i. to review the bait supply chain involving interviews with a wide range of stakeholders and through desk-top research;
- ii. to collate and review available discard data (by species, fisheries and areas) gathered from a range of sources;
- iii. to undertake commercial sea trials in different areas and fisheries to test the effectiveness of discard species as pot bait;
- iv. On completion of i), ii) and iii) to assess the feasibility of using discards in pot fisheries and report findings.

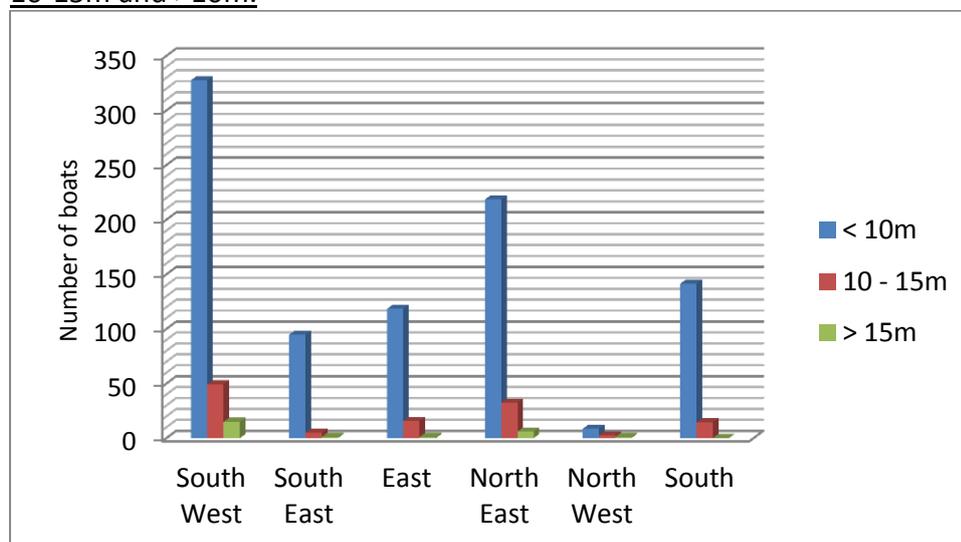
3.1 Interviews

Key to addressing the main objective of the study was to first understand the existing supply and demand for bait, by fishery and by area, taking into account any logistical or infrastructure 'pinch points' or obstacles along the way. It was agreed that the best way to capture details of the bait market, such as bait species preferences by fishery, pot types, costs, volumes, seasonality and logistics was through a process of one-to-one interviews.

Potential interviewees were targeted according to vessel size, location, gear type, target species to ensure coverage from potting vessels from 5 to 24m metres in length and from across England from the Isles of Scilly to Selsey, and from Cumbria to Northumberland.

Fleet licensing data from the MMO was used to focus particular attention on those areas known to have the highest shellfish landings and numbers of vessel with shellfish licences. Vessels administered in the South West and North East areas together represented 60% of under 10m vessels, 78% of the 10-15m shellfish vessels and 88% of the over 15m vessels with shellfish licences. Therefore, within the English national coverage it was decided to pay particular attention to the shellfish sector in North East England (centred at Bridlington) and South West (Cornwall and Devon).

Figure 3: Estimated number of 'active' shellfish vessels by area showing the proportion <10m, 10-15m and >10m.



Data on pot numbers, shellfish permits or observed trends in the shellfish sector was requested from all English Inshore Fisheries and Conservation Agencies (IFCAs) with supplementary information provided by e-mail.

In addition to interviews with skippers and owners, a number of people in the supply-chain were identified and where possible an informal interview was conducted to ascertain views and thoughts on the issues of pot bait. These included managers of Producer Organisations, commercial bait suppliers, specialist national fish hauliers, pot manufacturers, processing facility designers, harbour authorities, the National Federation of Fishermen’s Organisations (NFFO) and fish processors. In total 25 interviews were conducted (Annex II). Most interviews were one-to-one with over 50% of interviews being conducted face-to-face.

Interviews were structured with both open and closed questions and to capture both qualitative and quantitative data (Annex III).

3.2 Discard data

Discard data was gathered from four main sources:

- Cefas reports (from discard observer data)
- STECF data (supplied via Defra)
- Validation of STECF through conversations with skippers
- Fisheries Science Partnership (FSP) and Catch Quota Trial reports

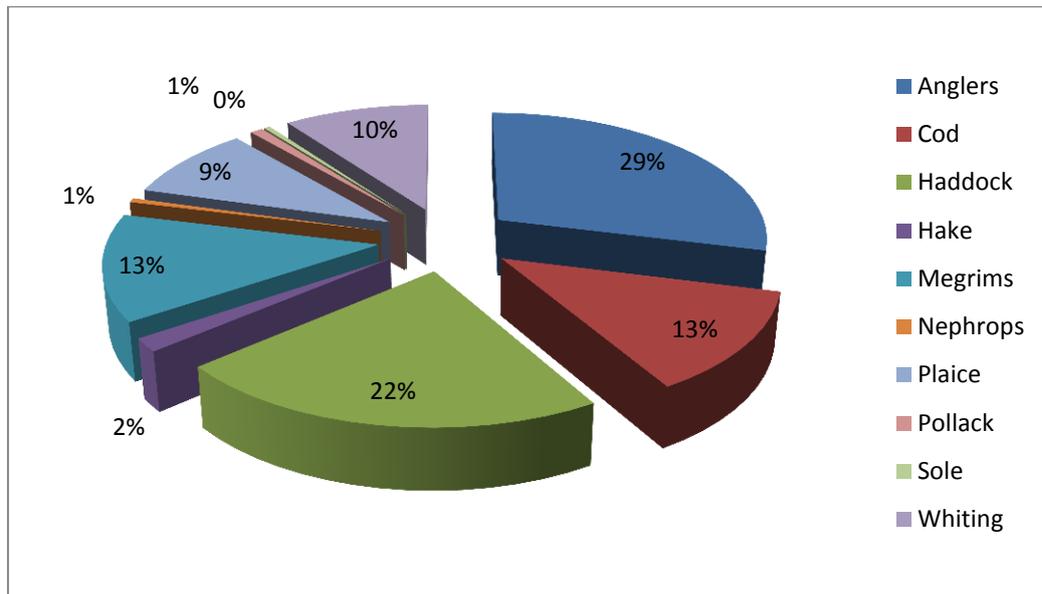
The data covered the three main fisheries management areas of relevance to the vast majority of the English fleet. These were the North Sea, English Channel & Celtic Sea and the Irish Sea (i.e. ICES sub areas IV, VIIe,f,g,h,j,k and VIIa respectively). The data was then grouped by gear codes and sorted into commercially significant quantities of TAC species.

3.2.1 Estimated discards – ICES Area VII (English Channel & Celtic Sea)

Table 1: STECF estimated discard data for English fleet in ICES Area VII

Species	2010	2011	2012	Average
Anglers	440	544	998	661
Cod	97	582	184	288
Haddock	217	662	648	509
Hake	18	41	55	38
Megrim	134	287	494	305
Nephrops	1	13	23	13
Plaice	96	146	393	212
Pollack	8	42	11	20
Sole	24	5	1	10
Whiting	318	142	225	228
Total				2284 tonnes

Figure 4: Estimated discards by English fleet in Area VII in 2012 showing the proportion discarded for each species.

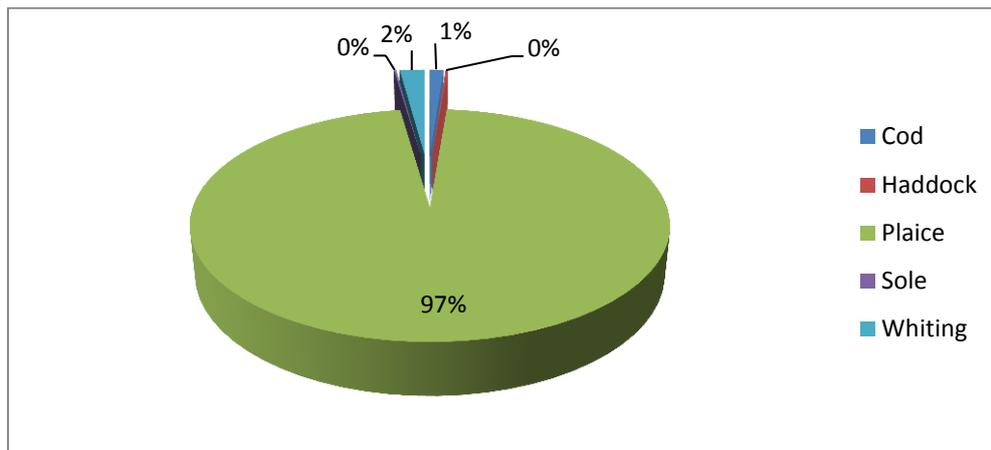


3.2.2 Estimated discards – ICES Area VIIa (Irish Sea)

Table 2: STECF estimated discard data for English fleet fishing in ICES Area VIIa

Species	2010	2011	2012	Average
Anglers	0	0	0	0
Cod	0	0	7	2
Haddock	0	0	1	0
Hake	0	0	0	0
Megrim	0	0	0	0
Nephrops	0	0	0	0
Plaice	0	100	494	198
Saithe	0	0	0	0
Pollack	0	0	0	0
Sole	0	1	0	0
Whiting	0	4	9	4
Total				206 tonnes

Figure 5: Pie chart showing % of estimated discards by English fleet in Area VIIa in 2012

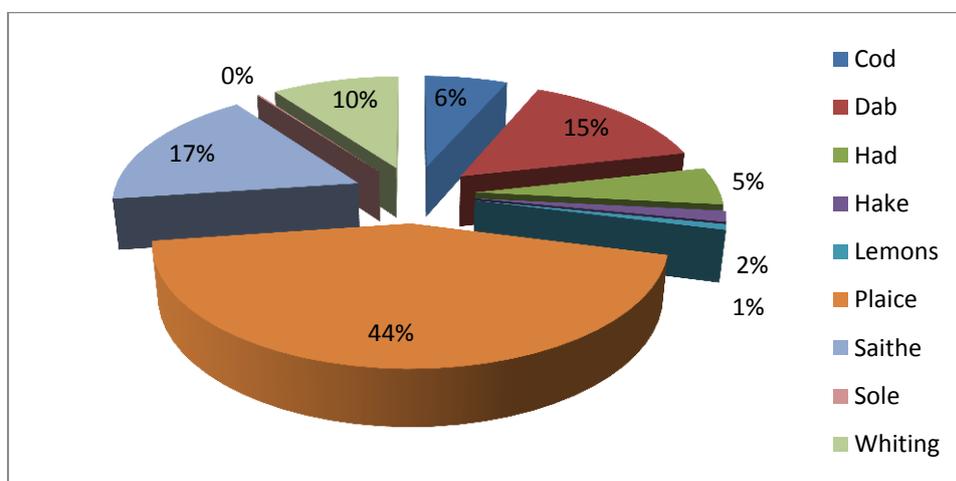


3.2.3 Estimated discards – ICES Area IV (North Sea)

Table 3: STECF estimated discard data for English fleet fishing in ICES Area IV

Species	2010	2011	2012	Average
Cod	235	449	105	263
Dab	379	428	1011	606
Had	163	437	39	213
Hake	30	6	150	62
Lemons	22	22	50	31
Plaice	2471	1435	1422	1776
Saithe	241	498	1344	694
Sole	15	5	3	7
Whiting	419	414	373	402
Total				4055 tonnes

Figure 6: Pie chart showing estimated discards by the English fleet in Area IV in 2012



3.3 Analysis of bait supply and demand

The information from interviews (3.1) was analysed against fleet discard data provided by Cefas, Defra and STECF (3.2) landings; fleet licensing data provided by the Marine Management Organisation (MMO); and Seafish economic data. To permit direct comparison of the discard data with pot bait usage / demand, two methods were used to assess demand. The first, was to back calculate quantities of bait used from costs reported in the Seafish economic fleet survey data and then raise up to fleet level by length band. The annual cost of bait per kilo was taken from interview data, therefore allowing annual financial figures to be converted into a quantity of bait. The second method was to base pot bait use on an assumption of a quantity of kilos of bait used per pot and then to multiply up by typical number of pots per vessel per fleet length segment (based on Cornwall IFCA permit data) and average number of days at sea per year.

3.4 Sea trials

Based on the discard data (Section 3.2) two trawlers were selected to simulate the landings of catches of all TAC species as will be required under the landings obligation. These were the 20m “Crystal Sea” SS 118 operating from Newlyn and the “Emulator” SH83 operating out of Scarborough. For both vessels dispensations in respect of minimum size rules and quota limits were applied for from the MMO. The Producer Organisation (PO) of each vessel was also contacted and consented to the vessel taking part in the trial.

The storage, transport and (where necessary) freezing of bait was arranged with local fish processors and co-operatives under audit trail terms set down by the MMO. These supply chain operations were charged at standard commercial rates in order to ascertain accurate costing for each process.

As with the discard catching vessels, those vessels selected for conducting the commercial sea trials were selected on the basis of area of operation, pot type, target species and vessel size. To achieve broad coverage of each fleet segment and geographical sea areas, three vessels were approached. These were the 9.9m “Tizzardleoon” PW 16 operating from Newquay (Cornwall), the 11.9m “Moyallon” SH24 operating from Bridlington and the 24m “Amadeus” TH 7 based in South Devon but fishing nomadically and during the trial period fishing in the Eastern part of the North Sea.

Sea trial data collection forms (see Annex I) were developed in conjunction with Seafish and explained to each skipper by the NFFO observer. Full reports of each commercial bait sea trial are included at Annex I and provide comprehensive details of pot types, normal (control) baits, trial baits used and shellfish species targeted.

The experimental design was based on discussions with each skipper. It was agreed that a whole string of pots (which varied between 30 and 100 pots depending on vessels size) would be baited with experimental or trial bait as the effect of baiting alternate pots with different baits would likely be affected by a scent plume carried by the tide. The total catch (pre-sorting) was estimated for the whole string of pots. The control was the closest string of pots, deployed on the same type of seabed, at the same time and using the same pot design in order to limit the number of variables.

The baits used in the control strings were the baits that each vessel would use normally in order to get an accurate comparison against normal operating conditions. The control baits therefore included salmon heads, ray backs and saithe (coley) frames.

Each skipper received guidance on the trial and data recording from the NFFO observers. The data was collected by skippers with randomly selected trips sampled by observers to ensure data was being collected correctly. The data was collated from all three vessels at the end of the sea trials and simply compared for quantitative differences between catch rates in the experimental and control strings of pots.

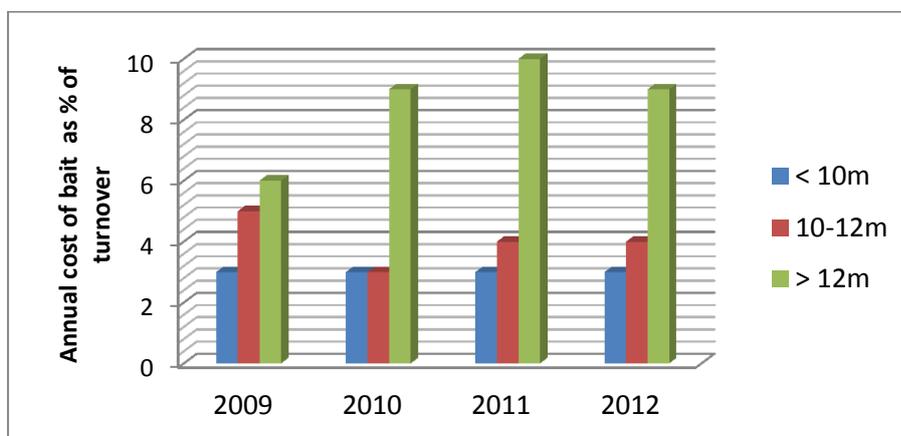
4. Results and analysis

4.1. Interview data

4.1.1 Cost of bait

Data from the Seafish economic fleet survey for the shellfish / potting sector was analysed alongside interview responses. There was a strong correlation between Seafish data and from interview responses from skippers / owners of the larger vessels in the fleet but for the under 10m vessels there was a significant disparity in figures. It is believed that the Seafish average annual cost of bait for the under 10m fleet is broadly accurate, reflecting the fact that less bait is bought by under 10m vessels.

Figure 7: Chart showing potters' bait costs as a percentage of turnover



Results from all of the under 8m operators interviewed confirmed that many vessels in the sector spend considerable time and effort catching their own bait (using handlines or nets), or source mixed discards from local trawlers (where applicable) or use fish processing by-products at little or no cost. The average price of bait for vessels in the sector is close to zero. Consequently, the value of bait equated back to a quantity in kg based on an average price grossly underestimates the quantity of bait used by inshore potters. This led to an alternative model being developed to estimate the amount of bait used by the inshore fleet (see Section 4.1.3).

Pictures 1 & 2: Fish processing by-product used as pot bait by inshore potters



Similar results were evident for vessels between 8-10m and 10-12m, however, larger vessels in this fleet segment reported that they did not have time to catch their own bait. Where possible these vessels would source fresh bait opportunistically from other vessels targeting 'whitefish' species in the local or nearby fleet at £10/box (i.e. 25p/kg based on a 40kg box). These supply routes however, were said to be inconsistent and could not always meet the demand. Under a landing obligation, it is likely that the supply chain will be more consistent, increasing the potential availability of fresh whitefish for the bait market. These skippers reported an increased reliance on frozen bait with vessels having more regular and formalised arrangements in place to buy bait fresh or frozen, at prices that were relatively consistent across all part of England. Typically, frozen bait prices ranged from 30-40p /kg for ray backs, lesser spotted dogfish and coley frames (the skeletons of filleted fish); frozen gurnards at 50-60p/kg to £70p to £1/ kg for mackerel or scads. The bait prices in the North West were the highest recorded and for the other areas they were broadly similar with prices often reduced for higher volumes (i.e. discounting on bulk buying). Bait appeared to be bought either at, or very close to, cost price by the shellfish merchant or co-operative buying the vessel's catch as a service to the vessels. Fish processors regarded the bait market as a means of making their waste streams cost-neutral, while dedicated bait suppliers reported only small profit margins.

The over 15m fleet was shown to require significant volumes of bait all year round as the fishing patterns (and number of days at sea) of these vessels were less affected by weather conditions. Bait was almost always frozen and was usually bought from one or two suppliers at a fixed price often set several weeks in advance. Operators of these vessels either required larger frozen cold storage for up to 10 to 15 tonnes of frozen bait stock or had an arrangement with the supplier to store frozen bait for them, drawing down from this stock as and when required.

Pictures 3 & 4: Typical fish processing by-product used as bait for larger potters



4.1.2 Bait size (weight)

The weight of bait used per boat varied greatly with skippers noting that quantities of bait put in the pots could change on a weekly basis. Key factors influencing this decision were reported to be: i) price of bait; ii) species of bait; iii) anticipated soak time; iv) target species, v) type of pot and vi) toughness / longevity of bait. For example skippers reported that if they

knew they would not be hauling pots for a few days due to strong tides or bad weather they would “over bait” with cheaper types of bait.

More expensive, but popular bait species such as mackerel, gurnard, redfish or scad were used sparingly and in a mixed crab and lobster fishery were often mixed in a pot with cheaper species such as ray backs or fish frames. Estimates of the weight of bait per pot were based on the amount of bait taken per day divided by the number of pots hauled. Results ranged from 0.5kg to 1kg with the average around 0.8kg per pot.

4.1.3 Quantities used

As bait was often sourced through multiple routes (particularly on smaller vessels) and at different prices the annual quantity of bait used was hard for most skippers and owners to quantify. Therefore, the quantities of bait used were estimated using two techniques; the first, used the Seafish fishing vessel cost and earnings survey data for the shellfish sector of the last four years. Here the annual cost was divided by the average price of bait to get the quantity of bait used. The second method was based on the average kilos of bait used multiplied by pot hauls per week and average number of hauls per year, based on information by skippers interviewed and the average numbers of days at sea per year, again taken from the Seafish costs and earnings data.

Those skippers that could provide figures for tonnages used suggested that this figure was purely a function of number of pots and number of days fished, with the smallest inshore potters using between 3 and 4.5 tonnes a year, based on 100-150kg per week for a 30-wk season. At the other end of the scale the >15m crabbers used around four to six tonnes a week (depending on target species and bait species) giving an annual quantity of bait used of around 190 to 290 tonnes, based on a 48-wk fishing year.

4.1.4 Target species

When targeting lobster there was broad agreement from skippers and owners interviewed that a salted or very oily fish was required to ‘draw in’ lobsters. The use of fresh or frozen whitefish or flatfish was reported to simply result in more small crabs (and in some areas conger eels) providing extra work for the crews to clear the pots without any extra income. Lobster fishermen therefore believed that there would be little scope to use discarded whitefish for lobster fishing.

Vessels targeting a mixed crab and lobster fishery used a mixture of salted / oily bait and fresh or frozen whitefish in each pot. Boats purely targeting crab were the least concerned about the species of bait used with most skippers believing that all but a few of the TAC species considered likely to be landed by vessels subject to the landings obligation could be used as pot bait. One of the few exceptions to this was Monkfish which was not a popular bait.

4.1.5 Bait species

The majority of skippers reported that fresh or frozen gurnards, typically of 15 to 20cm in length were one of the most favoured baits due to its longevity in the pot due to its tough skin, bony head and slightly oily nature. Target species, bait durability (how long it remains in the pots fishing before breaking down), bait ‘oiliness’, price and availability were the five key factors in determining bait used.

Other bait species commonly bought frozen were mackerel frames, bass frames, whole mackerel, whole scad, whole whiting, whole redfish, cod heads, whole pouts, ray backs, coley frames, flukes (flounder), salmon heads, herring and lesser spotted dogfish. Whole species were preferred to frames as it was thought that the extra flesh provided a greater attraction to crabs.

Due to the surge in popularity and price of gurnard for human consumption resulting from promotion by celebrity chefs (such as Hugh Fearnley-Whittingstall's 'fishfight' campaign), many skippers reported that gurnards had become too expensive and that they had therefore switched to a lower price alternative like ray backs.

4.1.6 Fresh vs frozen

All skippers stated a preference for fresh bait, provided that it had been properly stored (i.e. well iced) but almost all relied on frozen bait to supplement fresh bait at some points during the year. Under a landing obligation it is anticipated there will be an increase in the volume of once discarded fish coming ashore, and therefore a larger potential supply of fresh fish for the bait market. Skippers and owners operating from ports where there were trawlers tended to negotiate directly with these trawler skippers for mixed boxes of fresh bait although these typically consisted of non-TAC species such as lesser spotted dogs and smaller, un-marketable sizes of gurnards. Frozen bait was reported to be more expensive due to the extra processing costs.

4.1.7 Implication of pot type

Skippers and owners reported that 'hard' baits (i.e. bony, tougher skinned species) were required for pot types fitted with a black plastic neck such as parlour pots and inkwells. In these pots it was explained that three or four baits are pushed under the rubber bait band that is secured around the outside of the pot neck to hold the bait securely. Skippers reported that 'soft' baits such as whiting, hake and megrim were un-suitable for these pots as would either simply wash out (especially in areas of stronger tidal flow) or would be quickly consumed by shellfish trapped in the pot and hence reduce the effectiveness of the pot. The same would be true of small fish below the minimum conservation reference size (MCRS).

So-called 'soft-eye' pots have two or more side entrances constructed out of funnelled netting. The bait in this type of pot is stuffed into a removable bait bag constructed out of small mesh netting and secured inside the pot with a clip. Leading pot suppliers suggested that sales of 'soft-eye' pots now far outstrip those with 'hard eyes' with the effect of broadening the range of baits that could be used to include softer species such as whiting as well as mixed fish processing by-products. The bait bag system used on soft eye pots also lends itself to the use of small fish (those below the MCRS). Under a landing obligation fish below MCRS will need to be landed and sold into the non-human consumption food chain.

Pictures 5 & 6: Showing the different designs of 'hard' and 'soft' eye pots



4.1.8 Supply chain changes

Owners and operators of potting vessels had noted an increase in the price of pelagic bait species (i.e. mackerel, herring and scad) in recent years, which had mirrored the same trade in human consumption market for these species. On the East coast where vessels had traditionally sourced fish frames, cod heads and salmon heads from large fish processors on Humberside it was noted that recent advancements in fish flesh recovery from frames and heads coupled to growing demand in Africa for fish protein was driving the prices up for these bait products. The knock on effect was that bait was transported in to the area from further afield (SW England and Scotland) adding considerable transport costs.

4.1.9 Storage & logistics

Limited bait storage was identified as a common issue to the whole sector with smaller vessels using domestic chest freezers in garages or stores to hold up to three or four days stock of bait. Operators of smaller vessels explained that salted baits gave the benefit that a whole season's stock of bait could be salted down in sealed plastic drums over the winter months.

Medium size operators often relied on frozen bait storage as part of the 'service' offered by commercial bait suppliers or had negotiated mutually beneficial working arrangements with local fish processors to provide between four and six days stock of bait. Operators located further afield from fish processing centres or fish markets were at a significant disadvantage as they often had to spend time using their own transport to collect bait, in the worst case undertaking a round trip of four hours to collect 500kg of bait.

Larger operators, vessel agents and co-operatives used bulk buying power to negotiate better deals on purchase, storage and transport costs on full loads of up to nine or ten tonnes per order. However, in these cases frozen cold storage capacity (and cost of outsourcing cold storage) was a limiting factor in holding stock of bait.

Pictures 7 & 8: Showing typical frozen cold store arrangements:



4.1.10 Trawler skippers

Trawler skippers and owners recognised that local sales of hitherto discarded species were important, reporting that extra efforts to reduce discards through selling more fish via this outlet had been made in recent years in response to negative publicity surrounding discarding. However, on the subject of the landings obligation most skippers highlighted a range of practical issues for which they were awaiting further guidance on how it would be implemented. Skippers believed that changes in behaviour and fishing patterns had already contributed to lower discards and that this trend would continue when the discard ban was introduced.

4.1.11 Views from other supply chain partners

Bait suppliers were broadly positive about the potential opportunity to increase volume and agreed that many of the likely discard species could be used as pot bait for crabs. They believed though that price was the critical factor and thought that unless the discard baits were considerably cheaper than existing baits that many skippers would be unlikely to switch baits.

On the subject of capacity to deal with increased landings of discard species most bait suppliers felt that with increased staff levels they could handle more bait without the need for investment or expansion.

There was some concern from fish processors that the landing and use of discards as pot bait could upset or displace the use of fish processing by-products as bait, resulting in an increase in waste handling costs to processors. One processor had investigated the option of investing in food processing equipment to mince bulk discards and then re-form them into bait sticks but had felt that due to the high cost of the equipment that it would take some considerable time to realise a return on this capital investment.

Producer Organisations (POs) and other industry bodies were not convinced that the introduction of the landings obligation would lead to wide scale changes in the quantities of TAC species landed. They believed that after a six-month period of bedding in, fisher behaviour would be forced to change as a result of landing quotas species for little or no

value. Despite the new roles and functions of the POs set out under the new CMO Regulation (Article 7), the responses to the questions indicated that they did not see it as a function of the PO to become involved in the handling, and ultimately disposing, of their members discards.

Although harbours were concerned about the implication of the landings obligation on harbour management none had felt that they were suitably well-informed to make investment in quayside facilities at this stage. The key concern being who would ultimately be paying for the costs of boxing, icing and chilled storage of discards prior to shipping elsewhere or further processing.

4.1.12 Transport / logistics

Processors, bait suppliers and fishermen’s organisations felt that prior to processing there would be a ‘pinch point’ in the supply chain with restricted chilled storage capacity at most of the major ports. However, once processed they believed that there were sufficient specialised hauliers offering nationwide coverage to transport frozen bait to any location in England. Quayside distribution based in Grimsby confirmed this was the case although the cost of this would vary according to whether loads were full and whether trailers would return loaded. Similarly, it was felt that a number of large commercial cold stores existed around the country where frozen cold storage space could be rented. A concern raised here was that charges were often structured on entry and exit costs and less around time spent in storage which would prevent small quantities being drip fed out of cold storage. If this pricing system was amended it would make the use of frozen cold storage for bait more efficient for industry.

4.2 Sea trials – key findings

4.2.1 South West under 10m

Trials were conducted on the Newquay-based under 10m potter “Tizzardleon” PW 16 fishing between 3 and 10 miles off the Cornish coast from November to January for mixed crab and lobster using a mixture of inkwell and parlour pots. The trial consisted of 12 hauls of strings of 30 pots (i.e. 360 in total) baited with frozen haddock compared to a control bait of ray backs (the normal bait used). The haddock bait used was caught by the Newlyn-based trawler “Crystal Sea” under a dispensation provided by the MMO. The bait was then frozen at Falfish in Redruth.

Picture 9: MFV “Tizzardleon” PW 16



Picture 10: Crew clearing and baiting a pot



The objective of this trial was to test the effectiveness of locally landed Haddock from Newlyn as this was perceived by the local trawl fleet as the most likely discard species.

Table 4 : Summary sea trial results from Cornish under 10m potter in a mixed shellfish fishery

	Catch with trial bait - Haddock (kg)	Catch with control bait – Ray backs (kg)	Difference in catch weights (kg)	% difference trial to control	Difference in catch value*(£) between trial vs control baits
Crab	447	420	+ 27kg	+ 6%	+ £37.80
Lobster	34	13	+21kg	+ 162%	+ £210.00

*based on crab price of £1.40/kg and lobster price of £10.00/kg with standardised bait costs to enable direct comparison

The results showed that catches of crab were marginally higher and catches of lobster much higher (albeit exaggerated as a small catch) when using haddock. The total equated uplift in catch for the whole trial was £ 247.80 or 63.5p per pot.

The skipper felt that haddock and a range of other whitefish TAC species (including whiting, megrim and plaice) could be effective pot bait for crab, but not lobster. Although the lobster catches in the trial strings were significantly higher the skipper felt that such fluctuations were often seen between strings with the same bait and therefore this was not seen as significant. He felt that price would dictate whether or not the use of discard baits would happen in practice as he would be unwilling to pay more than he was currently paying for bait. Leaving aside the increase in lobster catch and based on an average of hauling 300-400 pots a day the increased catch rate of crab could result in an increase in the value of landings of 10p per pot giving an additional £30-40 per day, equating to over £4-6k pa based on 160 days fished a year.

4.2.2 North Sea 10-15m

Trials were conducted on the Bridlington-based 12m potter “Moyallon” SH 24 fishing between 6 and 20 miles off the East Yorkshire coast from November to December for targeted crab and lobster fishing with a mixture of parlour and soft-eye pots. The trial consisted of 10 hauls of strings of 40 pots (i.e. 400 in total) baited with frozen haddock, whiting, ray backs and codling compared to a control (normal) bait of salmon heads. The baits were trialled separately on known lobster and crab grounds as well as in a mixed lobster and crab fishery area. Discards were supplied by the Scarborough based 18m trawler “Emulator” SH83 fishing under dispensation from the MMO.

Picture 11: MFV “Moyallon” SH 24



Picture 12: Salmon heads for ‘control’ bait



The objective of this trial was to test the effectiveness of a range of locally landed ‘discard’ species from a Scarborough trawler in order to simulate (and test) a local supply chain.

Table 5: Summary of results from 10-15m potter trialling four baits in a targeted crab fishery with salmon as the control bait.

Trial 1: Targeting Crab with various baits	Difference (experiment- control) in crab catch weights (kg) during trial	Difference in lobster catch weights (kg) during trial	% Difference in crab catches	% Difference in lobster catches	Difference in catch value*(£) between trial vs control baits
Haddock	+30kg	-5kg	+50%	-50%	£ -8
Whiting	+30kg	-7kg	+50%	-70%	£ -28
Ray	+30kg	-7kg	+42%	-30%	£ 12
Codling	+25kg	-3kg	+50%	-60%	£ 5

*based on Crab at £1.40/kg and Lobster at £10.00/kg with standardised bait costs to enable direct comparison

Table 6: Summary results from 10-15m potter trialling four baits in a targeted lobster fishery with Salmon as control bait.

Trial 2: Targeting Lobster with various baits	Difference (expt- control) in crab catch weights (kg) during trial	Difference in lobster catch weights (kg) during trial	% Difference in crab catches	% Difference in lobster catches	Difference in catch value*(£) between trial vs control baits
Haddock	+30kg	-5kg	+50%	-87%	£ -123
Whiting	+30kg	-7kg	+100%	-80%	£ -73
Ray	+30kg	-7kg	+100%	-75%	£ -143
Codling	+25kg	-3kg	+100%	-85%	£ -156

*based on Crab at £1.40/kg and Lobster at £10.00/kg with standardised bait costs to enable direct comparison

The results from Tables 5 and 6 demonstrate that species of fish which are currently discarded (which will not be permitted to be discarded under a landings obligation) could

result in the same or a slight increase in catch value when targeting crab. However, when targeting lobster the decrease in catches (and value) of the target species (lobster) outweighs the uplift in catch value of crab and for this reason these species were not seen as a viable bait when targeting lobster.

Figure 8: Graph showing difference in catch values during bait trials off Bridlington

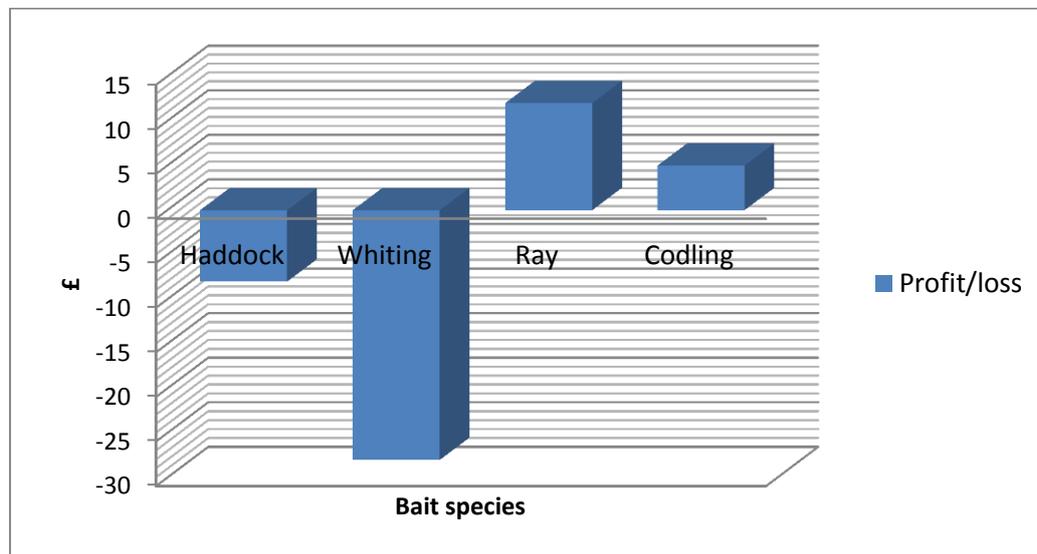


Table 7: Summary results from 10-15m potter trialling four baits in a mixed shellfish fishery with mackerel frames as control bait

Trial 3: Targeting Mixed fishery with various baits	Difference in crab catch weights (kg) during trial	Difference in lobster catch weights (kg) during trial	% Difference in crab catches	% Difference in lobster catches	Difference in catch value*(£) between trial vs control baits
Whiting	+5kg	-3kg	+33%	-17%	£ -23
Codling	+0kg	-2kg	0%	-28%	£ -20

The results supported the views of skippers interviewed that fresh whitefish species were not suitable bait for a targeted lobster fishery. The skipper believed that 'oilier' bait (such as mackerel) was needed and that a lobster would be put off entering a pot that was overcrowded with small / undersized crabs.

The skipper felt that while whitefish TAC species (including whiting, cod and haddock) were more effective at catching crab they reduced the small but valuable lobster by-catch seen in a directed crab fishery using the control boats. On that basis the skipper would be unwilling to switch supply totally to discard species but felt that locally discard species could be used when fresh (and cheap) to supplement existing baits when fishing for crab.

Over the course of a year the skipper thought there would be times when baits from 'discards' could be used without resulting in a decrease in the value of catches and would therefore have liked the sea trials to last a bit longer.

Full details of all of the sea trials can be seen at Annex I of this report.

4.2.3 Nomadic offshore over 15m

Trials were conducted on the Teignmouth-registered nomadic 24m potter “Amadeus” TH 7 fishing around 30 to 40 miles off the Dutch coast in the Southern North Sea during January 2014 on a targeted crab fishery using solely inkwell pots. The trial consisted of 5 hauls of strings of 600 pots (3000 in total) baited with frozen haddock compared to a control bait of frozen coley frames. The haddock bait used was caught by the Newlyn-based trawler “Crystal Sea” under a dispensation provided by the MMO. The bait was then frozen at Falfish in Redruth.

Picture 13: MFV “Amadeus” TH 7



Picture 14: Crew baiting and stacking pots



Table 8: Summary results from >15m potter trialling Haddock bait in a targeted Crab fishery:

	Catch (kg) with trial bait-haddock	Catch (kg) with control bait – coley frames	Difference in catch weights (kg)	% difference trial to control	Difference in catch value*(£) between trial vs control baits
Crab	3740	3170	+ 570kg	+ 18%	+ £798

*based on crab at £1.40/kg

The results showed that catches of crab were higher. The total equated uplift in catch for the whole trial was £798 or 27p per pot.

Based on an average of hauling 800-1000 pots a day the increased catch rate could result in an increase in the value of landings by £216 per day, equating to over £51k based on 240 days fished a year.

The skipper felt that haddock and a range of other ‘roundfish’ whitefish TAC species (including whiting, cod and saithe) could be effective pot bait for crab. He felt that price would dictate whether or not this would happen in practice as would be unwilling to pay more than he was currently paying for bait, currently in the region of 30p/kg.

Full details of all of the sea trials can be seen at Annex I of this report.

4.3 Supply vs Demand by Area

In order to assess the potential for whether discards arising from the implementation of the landings obligation could meet the demand of shellfish potting sector in England it was first necessary to estimate the demand for bait based on a number of assumptions. These were the average number of days at sea and weight of bait per pot and number of pots as described under 4.1.3 above. These were multiplied against the number of vessels in each vessel length band from each of the coastal regions of England. The supply of discards was taken to be the quantities discarded as reported through the STECF data (<http://stecf.jrc.ec.europa.eu/data-reports>, shown in tables 1,2 & 3) and in each case kept at ICES area level to ascertain the regional implications.

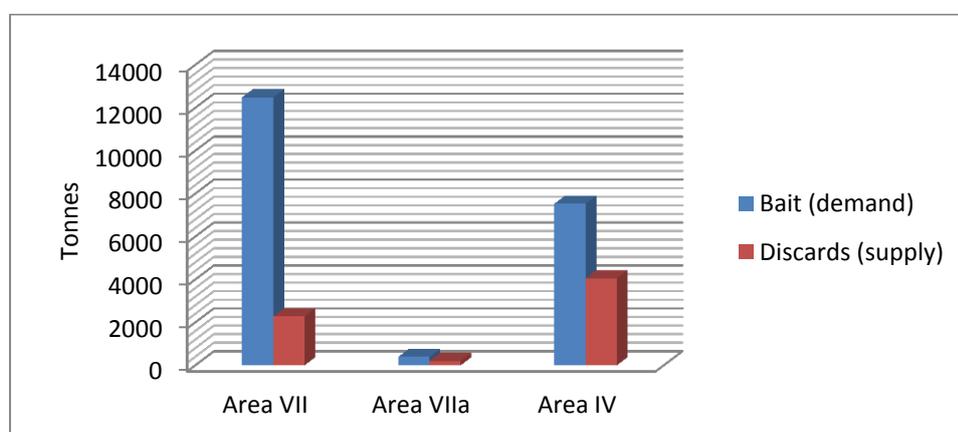
Table 9: Estimated demand vs supply for the English fleet based on no exemptions and demand calculated on interview data on bait use

Area	Bait demand (tonnes) < 10m	Bait demand (tonnes) 10-15m	Bait demand (tonnes) > 15m	Total bait Demand (tonnes)	Estimated Supply of discards (tonnes)	Supply-Demand (tonnes)
South West	3273	3168	2304	8745	2284	-10208
South	944	309	154	1407		
South East	1413	927	0	2340		
Area VII total				12492		
East	1182	1005	154	2341	4054	-3478
North East	2182	2087	922	5191		
Area IV total				7532		
North West	84	155	154	393	205	-188
Area VIIa total	84	155	154	393	205	
Total	9078	7651	3688	20,417	6543	-13874

Based on assumptions:

- i. Average weight of bait used per pot is 0.8kg
- ii. Average days at sea – under 10m (111), 10-15m (161) and over 15m (240)
- iii. Average number of pots hauled per boat - <10m (238⁷), 10-15m (500) and >15m (800)

Figure 9: Chart showing bait (demand) vs discards (supply) by sea area



⁷ Based on Cornwall IFCA permit data

Figure 10: Chart showing breakdown of bait demand by vessel length

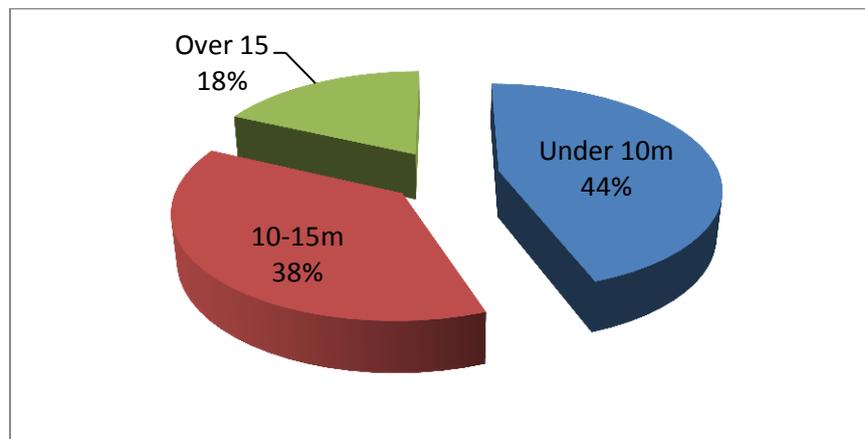


Table 10: Estimated annual bait usage derived from Seafish economic survey data

	No. of vessels	No. of 'active' vessels	Average number days fished pa	Average annual bait cost (£)	Average annual bait cost as % T/O	Estimated annual tonnage purchased	Estimated total bait demand (tonnes)
< 10m	1298	908.6	111	1429	3%	4.8t @30p/kg	4,361
10 -15m	163	118.8	161	4528	4%	12.94t @35p/kg	1,537
> 15m	36	24	240	27143	9%	67.86t @40p/kg	1,629
Totals	1497	1051.4					7,527

The demand for bait calculated from Seafish economic fleet survey data was 65% lower than that calculated using estimates of vessel number, pot numbers and kilos of bait used per pot (as set out in table 9). This can in part be explained by smaller vessels in the fleet having lower bait costs resulting from catching their own bait, or by using by-products from local fish processors (see 4.1.1). Notwithstanding the significant difference between the two estimates of demand, it is likely the actual figure is somewhere between these two and assuming that is the case then the demand for bait is still likely to outstrip the available supply from discard sources. Furthermore, with many of the under 10m vessels targeting lobster for at least part of the year much of the bait demands from this segment of the fleet will not be for whitefish TAC species.

On the assumption that plaice was awarded a high survival exemption⁸ in all fisheries a second scenario of supply-demand was calculated (Table 11). This showed a net reduced national deficit in bait demand on -3,170 tonnes, with the North Sea and North West seeing

⁸ No high survival exemptions have as yet been granted, but studies have shown that adult plaice has a survival rate of 63%, Revill (2012).

the largest effects of removing plaice from the equation, making up 95% of English Irish Sea discards and 44% of English North Sea discards. This would reduce the overall availability of discard species which, if landed, could be utilised for bait.

Table 11: Estimated demand vs supply based Seafish economic survey data and removing plaice from the discard column on grounds of high survivability

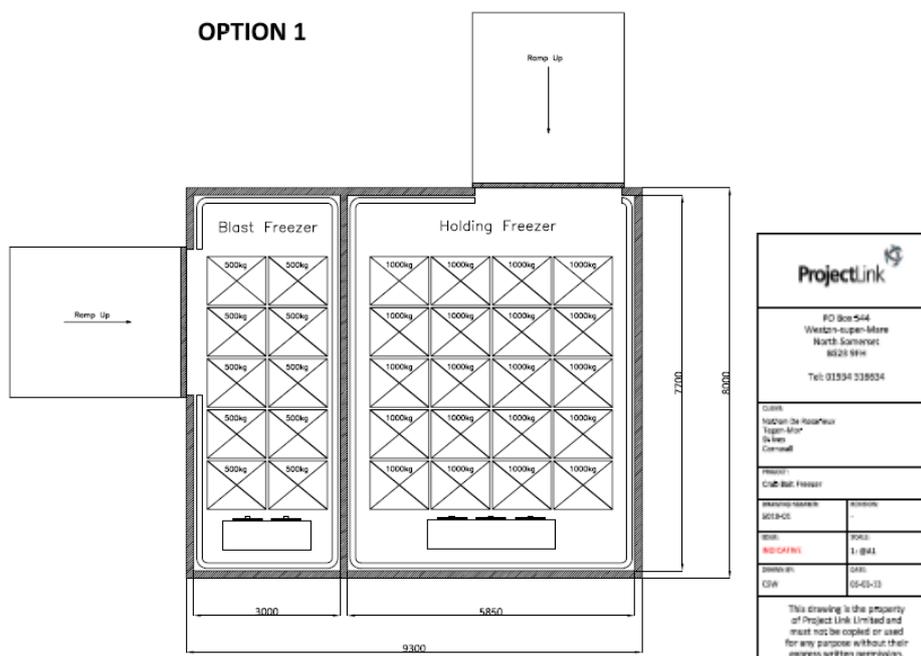
Area	< 10m	10-15m	> 15m	Total bait Demand (t) ¹	Estimated Supply of discards (t)*	Supply-Demand
South West	1572	637	1018	3227	2,072	-2,604
South	679	186	0	865		
South East	454	62	68	584		
Area VII total	2705	885	1086	4676	2,072	-2,604
East	568	202	68	838	2,278	-435
North East	1048	419	407	1875		
Area IV total	1616	621	475	2713	2,278	-435
North West	40	31	68	139	7	
Area VIIa total	40	31	68	139	7	-64
Grand total	4,361	1,537	1,629	7,527	4,357	-3,170

¹ based on bait demand from Table 10; * minus plaice discards

4.4 Costing for set-up and operation of additional supply chain capacity

Based on the assumption that it would be impossible to manage a bait supply-chain of only fresh discards, an attempt was made to model the cost of setting up a quayside unit to freeze and store bait on a not-for-profit, for example if run by a PO or Co-operative. Food factory design engineers and project planners Project Link Ltd. provided drawings for a freezing facility and indicative electricity costs.

Figure 11: Outline plans for blast freezer and frozen cold store

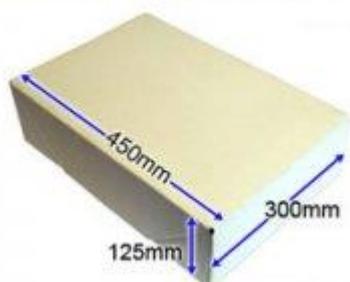


The unit would have external dimensions of 9.3m long x 8m wide x 3.5 high and would consist of a blast freezer capable of blast freezing 5,000kg of 10kg boxed product on open racks and a holding freezer capable of holding upto 20,000kg of boxed product on pallets. In the absence of daily / weekly / monthly discard data the capacities were based on 'worst case' scenario at larger ports like Newlyn or Brixham but could easily be scaled up (or down) to fit any port where discards are landed. To build and commission the unit would be £91,000 plus VAT. Electricity consumption based on 55kwh refrigeration duty charged at 10p per kwh. As annual running costs would vary it is not possible to provide anything more than an estimate of initial set up costs at this time.

Commercial bait suppliers and fish processors provided information on labour costs and output rates, while the cost of packaging costs (10kg waxed cardboard cartons) was obtained from the website of JB packaging ([www. http://www.jbpackaging.co.uk/](http://www.jbpackaging.co.uk/)) – see below

2st Waxed Cardboard Box (pallet)

2 stone



PALLET

Our

Price: **£1,184.04**(E

xc. 20%

VAT)(£1,420.85 Inc.

VAT)

ADD TO BASKET

Quantity:

1x Pallet (875 bases & lids) (BRX)

Collection: Only available from Brixham (BRX)

External Dimensions: 460 x 310 x 129mm

Availability:

Raw materials are assumed to be zero cost, with the cost of boxes, ice etc being borne by the vessel. Based on similar size units in Cornwall, the annual lease costs and business rates for a unit of this size has been estimated at £13,000 pa. For the purposes of these ballpark calculations staffing has been assumed as two staff and one manager. Annual production has been estimated at 730 tonnes based on 2 tonnes per day, 52-wks a year, which is broadly a third of the STECF ICES Area VII estimated discards of 2284 and therefore in line with a split across the three SW ports / markets.

Summary of costings:

Electricity	4.92p/kg
Boxes	13.50p/kg
Labour	5.00p/kg
Overheads	5.21p/kg
Total	28.63p/kg

These figures do not make any allowance for providing a return to cover re-payment of, or return on, the initial investment or holding of frozen stock. Furthermore, for the haulage of frozen bait from the South West (where most English discards are expected to be landed) to Grimsby for the East Yorkshire coast ports, Quayside distribution confirm that cross country transport would be in the region of £35/tonne (3.5p/kg).

The calculations suggest that even from a zero cost product, frozen discard bait would cost in the region of 25-30p/kg to produce, with delivery (or collection) costs for potters operating away from the main discard landing ports adding a further 3-5p/kg. This figure, although cheaper than gurnards, mackerel or scads brings frozen discard bait into the same price bracket as other second division baits such as spotted dogs, flukes, and ray backs. It is however, likely to remain more expensive than fresh discards or fresh and frozen fish processing by-products as processors are deriving economic value (a profit) from the retained processed fish product and this economic return helps offset the cost of waste disposal and provides the capital for investment in freezing facilities. This allows some processors to provide fresh processing by-product / waste to fishermen for pot bait at zero cost recognising that this reduces their own waste disposal costs (known to vary between £50-£150/tonne). Others processors may levy a small charge of 20p/kg to cover the boxes used, icing, storage. Where fish processing by-product / waste is supplied frozen, processors charge in the region of 30-35p/kg to recover the costs of freezing and cold storage and is therefore comparable to the estimated price of frozen discard bait.

There is a strong prospect of fresh discards being used by local potters operating from, or close by, the port where the discards were landed (i.e. local supply chains). However, calculations produced in this report suggests that the cost of processing and delivering frozen discards could exceed the price that potters are currently paying for equally effective crab baits. Therefore, despite the national demand for bait more than doubling the estimated quantity of discards, it cannot be assumed that pot fishermen will simply utilise these quantities and species in the bait supply chain as cost of bait is a key driver for pot fishermen.

5. Discussion

5.1 Discard bait supply chain

This study estimated that demand for bait from the around 1,051 active vessels in the English shellfish potting sector was between 7,527 tonnes and 20,417. The lower estimate (i.e. 7,527 tonnes) is likely to be a considerable under-estimate based on the knowledge that many inshore fishermen have zero cost for much or all of their bait. Using STECF data the study estimated that the total discards (of key commercial species) by English vessels fishing in ICES Areas IV, VII and VIIa were 6,543 tonnes. Therefore, assuming that all TAC discards from the English fleet would be suitable for pot bait, demand would strip supply by between 984 tonnes and 13,874 tonnes. The most significant mis-match between supply and demand being in Area VII, highlighting the need for solutions based on a regional approach. This means that there is the potential for significant quantities of discards to be consumed within the pot bait market.

The results of the commercial sea trials confirmed the views of skippers and owners, that almost any TAC species could be used as pot bait for targeting crab although the catch rates may increase or decrease slightly depending on bait species. For lobster the catch rates from sea trials and interview responses both conclude that discard baits would not replace traditional salted bait and consequently demand for discards from dedicated lobster fishermen is likely to be low. Consequently, the demand for TAC discards would likely be reduced by 4540 tonnes (22%) assuming that at least half of the under 10 fleet were targeting lobster. Although, this factor would substantially reduce the demand for bait from the potential discard supply chain the demand for crab bait would still outstrip supply.

The nature of the bait demand does not vary widely by region of England. The price of bait is determined by species of bait, volume purchased, production / processing costs (usually freezing) and transport costs, with potting operators located away from major whitefish landing ports or processors paying significantly more for bait. As a result, the location of discard landings would have an implication of the bait supply chain cost. One of the more extreme examples would be the landing of English registered beam trawlers in Holland. These vessels are estimated to have significant discards of plaice but transport costs would almost certainly make it prohibitive to ship these back into England for bait.

Similarly, 44% (9,078 tonnes) of bait demand comes from the under 10m fleet which is known to be geographically widely dispersed and often remote from the larger landing ports. Therefore, further work is needed to identify potential discard landings by port and whether outlying harbours, beaches and coves would have sufficient demand to justify transport costs. Minimum orders would need to be calculated and this would then raise the issue of capacity of local storage facilities, which is known to be limited to less than a week in many cases.

The demand for bait is high and prices of the more popular bait species, such as gurnard, mackerel and scad have steadily increased over the last four years, although operators of all vessel sizes have mitigated against this by switching to alternative, cheaper baits. By nature of the lower demand, inshore operators tended to be more flexible and opportunistic in approach to sourcing bait and would use discards fresh but would be unlikely to pay for frozen bait, or do so only as a last resort. The trend of small inshore catching for sourcing their own baits is unlikely to change as these boats typically spend less than 4% of their

annual costs on bait. As vessel size increased, skippers and owners tended to have more formal arrangements in place for sourcing and storing bait.

Insight gained from interviews suggests that the shellfish potting sector use significant volumes of low-cost fish processing by-products (e.g. frames, heads, smaller size grades) and therefore plays an important role in reducing fish processing waste. In this context, fish processors were concerned that an increased supply of fishing discards in the supply chain could potentially displace fish processing by products and consequently drive up the cost of waste disposal in the processing sector.

The bait supply chain is well established with bait being supplied by a mixture of local processors, specialised bait suppliers, shellfish merchants and co-operatives. Bait suppliers interviewed reported that they would take more bait if it was available (at the right price) and either have existing capacity to handle these, or would invest in increased capacity or would outsource freezing and frozen storage to third parties under contract. Under the new European Marine Fisheries Fund (EMFF) processors and trade bodies (such as Producer Organisations (POs)) will be able to access grant funding towards the cost of freezing equipment to support the processing of catches of commercial fish that cannot be destined for human consumption

The costs of establishing and running port-based bait co-operatives to facilitate local bait supply chains were investigated as a means of providing a more co-ordinated and transparent approach. However, based on the responses to the interviews, Producer Organisations or harbour authorities were concerned that this is not part of their current role and would require new organisations or co-operatives to be set-up. Furthermore, while every effort would be made to match fresh supplied discards to demand during the course of a year, an over-supply of discards would likely occur at port level and require the freezing of discards. Initial costing of this type of operation appears to indicate that profit margins would be tight and even with support from EMFF it might not be an appealing investment to purely commercial operators. However, it may be a viable proposition for a PO, a co-operative or similar 'not for profit' organisation but a more detailed assessment of this cannot be made at this time on the data available.

Separate consideration of bulk outlets for discards⁹ indicated that the potential use of discards in the fishmeal industry, where bulk discards would be collected direct from ports and transported away in a cost-neutral supply chain would require little or no additional investment from catchers. As such this appears to be a simpler and more cost-effective option than bait. From a social and environmental point of view though there could be an argument that where possible discards should be used locally and here there could be grounds for hybrid arrangements where discards are used fresh for bait when / where possible with the excess being diverted to the fishmeal route.

Fishing industry representatives believed that perhaps the largest influence on the discard bait supply chain existed within the policy dimension around the application of the potential exemptions permissible under Article 15 of the CFP. In reality, we will not know how much

⁹ Mangi, S.C., Catchpole, T.L. (2012) Seafish report SR-661, Utilising discards not destined for human consumption in bulk uses

fish that would have been discarded will be brought ashore under a landing obligation until it is in place. As such, there is uncertainty surrounding estimates of the potential supply to the bait market. Policy decisions, such as the exemption of species scientifically verified to have a high rate of survival, and changing fishing behaviour under a landing obligation are focused on reducing the amount of unwanted fish caught by industry, maximising industry profit while protecting fish stocks. For example, if plaice was scientifically agreed to have a high rate of survival after discarding it could receive an exemption. If this was the case it could result in a reduction of 2,186 tonnes, equivalent to 33% of the total English fleet discards, coming ashore. Industry bodies therefore strongly advocate that exploration of other permissible exemptions be concluded before further investigation or investment in fishmeal or pot bait supply chains.

6. Conclusions

1. Virtually all TAC species currently discarded in English demersal fisheries could be used as pot bait (fresh or frozen) for crab and therefore as an outlet for discards of these species the pot bait channel for discard utilisation is significant; however there is little or no demand for discard species as lobster bait as these were seen to have a negative impact on catch rates of lobster when compared to a traditional bait.
2. Demand for bait (discards) far outstrips the 'worst case' (i.e. no exemptions applied) supply of discards from English registered vessels, indicating the bait market could potentially absorb the majority of unwanted catches brought ashore under a landing obligation.
3. Policy decisions taken on implementation over the next two years are likely to have the greatest bearing on potential for discards to be used at pot bait.
4. The degree to which discards could replace existing baits will largely depend on price.
5. Managing the supply of a solely fresh discard / bait supply chain could be difficult due to fluctuating supply and demand and limited product shelf-life. As a result, the freezing of discards destined for the pot bait market is likely to be the norm. This would incur costs similar to those associated with freezing for human consumption (i.e. packing materials, labour, electricity, cold storage, boxes, premises, business overheads) which even on a not-for-profit model would result in them at close to or the same cost as traditional crab baits.
6. Consideration should be given to the displacement of fish processing by-product as pot bait with discards as potentially this could have the un-intended consequence of driving up the operating costs of fish processors.
7. The South West of England is likely to be the highest area of both supply and demand. The North East will potentially need to import bait from other areas, most likely from Scottish ports as opposed to SW ports due to proximity and therefore cheaper transport costs.

The role of Producer Organisations (POs), in respect of the new CMO Regulation, needs to be further clarified and is currently being discussed by Defra and the fishing industry.

7. Further considerations for implementation

1. An implementation policy based on agreement of the range and scope of possible exemptions permitted in the regulation need to be completed before investment can be considered by any commercial operator, harbour authority, producer organisation or auction market
2. Establish a more detailed English discard register by port, by gear type, by season; possibly through increased observer trips or through the use of data collected by Remote Electronic Monitoring (REM) technologies.
3. Under the new European Marine Fisheries Fund (EMFF) processors and trade bodies (such as Producer Organisations (POs)) will be able to access grant funding towards the cost of freezing equipment to support the processing of catches of commercial fish that cannot be destined for human consumption. Following the agreement of the implementation policy and armed with improved data, detailed business planning for investments in shore-side discard processing infrastructure at key ports should be further discussed with industry bodies.

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Revill, Broadhurst and Millar (2013), Mortality of adult plaice *Pleuronectes platessa* and sole *Solea solea* discarded from English Channel beam trawlers

Annexes

Annex I: Work plan for Pot Bait study sea trials 2013

Trial 1:	SW Inshore crabber
Vessel name /pln:	“TizzardleOn” PW 16, 9.90m GRP
Skipper:	Martin Gilbert
Trial area:	29E4 VII f
Home port:	Newquay, Cornwall
Main target spp:	Crab (lobster targeted earlier in season)
Lead contact for NFFO:	Nathan de Rozarieux
NFFO observer:	Spike Searle (Marrok Marine)
Start date:	30 th October 2013
Duration:	8-wks
Sample bait:	Frozen haddock and other TAC species
Control (closest string) bait:	Mixed processing by-product
Anticipated pot hauls:	960 pot hauls (60 trial pot string x 2 times a week x 8wks)
Actual pot hauls:	390 (due to worst winter storms in living memory)
Pot type:	Hard eye parlours
Analysis:	i. Catch rate (estimated catch) control vs trial ii. Economic assessment (cost-benefit)
Risk assessment:	NFFO conducted standard risk assessment and appropriate insurance cover will be in place.
Dispensation required:	Yes

Haul no.	Retained crab (kg) (haddock)	Retained lobster (kg) (haddock)	Retained crab (kg) (control)	Retained lobster (kg) (control)	soak (days)	No of pots	Comments
1	30	0	25	0	6	30	all bait gone; x2 congers in trial pots
2	20	0	20	1	6	30	all bait washed out; small crabs in trial
3	12	1	10	1	16	30	Bad weather
4	20	4	40	0	4	30	Lots Velvets and small Lobsters in trial
5	20	4	40	2	10	30	Lots of congers and Huss
6	30	4	20	2	10	30	Lots of Congers and Starfish
7	30	4	50	0	4	30	Lots of small lobsters
8	55	4	30	2	3	30	All baits gone, lots of Congers
9	35	4	50	1	3	30	Lots of Congers, Small Crabs & Dogs
10	40	5	40	2	6	30	Brittlestars
11	60	1	40	0	6	30	All baits eaten
12	45	2	45	1	7	30	Baits eaten, Congers & Huss in trial pots
13	50	1	10	1	6	30	Congers
Total	447	34	420	13	6.7	390	

Trial 2: NE 10-15 crabber

Vessel name /pln: "Moyallon" SH 24, 11.92m GRP
 Skipper: Ken Jowett
 Trial area: ICES statistical rectangle 36F0 and 37F0
 Home port: Bridlington, Yorkshire
 Main target spp: Targeted crab, targeted lobster and Mixed
 Lead contact for NFFO: Nathan de Rozarieux
 NFFO observer: Ian Rowe (NFFO Services)
 Start date: 30th October 2013
 Duration: 8-wks
 Sample bait: Frozen haddock and other TAC species
 Control (closest string) bait: Mixed processing by-product
 Anticipated pot hauls: 1660 pot hauls (40 trial pot string x 2 times a week x 8wks)
 Actual pot hauls: 400 pot hauls (trial hampered by very poor weather throughout)
 Pot type: Hard and soft-eye parlours
 Analysis: i. Catch rate (estimated catch) control vs trial
 ii. Use of four locally sourced fresh baits
 iii. trial on both crab and lobster grounds
 ii. Economic assessment (cost-benefit)
 Risk assessment: NFFO will conduct standard risk assessment and appropriate insurance cover will be in place.
 Dispensation required: Yes

					control= salmon Heads / mac. frames		
<u>Target</u>		Crab (haddock)	Lobster (haddock)	Crab (control)	Lobster (control)	soak (days)	No of pots
Crab	1	90	5	60	10	2	40
Lobster	2	15	2	10	15	5	40
					control= Salmon Heads / Mac frames		
<u>Target</u>		Crab (whiting)	Lobster (whiting)	Crab (control)	Lobster (control)	soak (days)	No of pots
Mixed	3	20	7	15	10	4	40
Crab	4	90	5	60	12	6	40
Lobster	5	10	2	5	10	2	40
					control = mackerel frames		
<u>Target</u>		Crab (Rays)	Lobster (rays)	Crab (control)	Lobster (control)	soak (days)	No of pots
Lobster	6	10	5	5	20	4	40
Crab	7	70	7	40	10	7	40
					control = mackerel frames		
<u>Target</u>		Crab (codling)	Lobster (codling)	Crab (control)	Lobster (control)	soak (days)	No of pots
Lobster	8 (Lobster)	15	3	5	20	4	40
Crab	9	75	2	50	5	5	40
Mix	10	5	5	5	7	3	40

Trial 3: Nomadic > 15m ‘super-crabber’

Vessel name /pln: “Amadeus” TH 7
 Skipper: Jamie McDade
 Trial area: ICES statistical rectangle 37F4
 Home port: Teignmouth, Devon (operating during trial from Holland)
 Main target spp: Crab
 Lead contact for NFFO: Nathan de Rozarieux
 NFFO observer: Spike Searle (Marrok Marine)
 Start date: 1st January 2013
 Duration: 4-wks
 Sample bait: Frozen haddock
 Control (closest string) bait: Coley frames
 Anticipated pot hauls: 2160 pot hauls (90 trial pot string x 3 times a week x 8wks)
 Actual pot hauls: 2800 (excess bait released the other trials allowed more hauls)
 Pot type: Hard eye inkwells
 Analysis: i. Catch rate (estimated catch) control vs trial
 ii. Economic assessment (cost-benefit)
 Risk assessment: NFFO will conduct standard risk assessment and appropriate insurance cover will be in place.
 Dispensation required: Yes

Results:

Haul	Weight of crab (kg) in trial pots	Weight of crab (kg) in control pots	% diff in crab catch	Soak (days)	No of trial pots hauled
1	1040	810	28%	2	600
2	850	820	4%	2	800
3	930	820	13%	2	600
4	90	140	-36%	2	200
5	830	580	43%	2	600
Total	3740	3170			2800

Sea trial catch recording form:



POT BAIT SEA TRIALS 2013



Vessel name: Date:.....
 Skipper name:.....
 Pot type (circle one): Inkwell / Parlour / Soft-eye Target species (circle one): Brown Crab / Lobster / Spider Crab / Mixture
 Standard bait: Fresh or Frozen (please circle which)
 (nearest string)
 Trial bait: Fresh or Frozen (please circle which)

Catch table:

	No. of pots in string	Soak time (in days)	Estimated retained Crab (kg)	Estimated retained Lobster (kg)	Estimated retained Spiders (kg)	Comments (for example condition of bait etc)
Standard						
Trial						

SIGNED

Annex II:

Interview / contact list

Shellfish sector

Rowse Fishing Ltd (4 10-18m vessels)		“Tizardleeon”	PW 16
Amadeus Fishing Ltd (2 super crabbers)		“Wendy Patricia”	BH 22
Independent Shellfish Co-Op (30 boats)		“Kerry Maria”	WA 261
“Brodi Sea”	SS 324	“Galcadora”	PW 15
“Gemma”	PZ 40	“Nazareen”	PZ 336
“Swift”	H 145	“Shamrock”	TO 40
“ Daybreak”	WA 1	“Janet Anne”	SS 144
“Vickyanna”	SC 32	“Sovereign”	FH 25
“Moyallon”	SH 24	“Robert Louise”	P 902

Whitefish sector:

“Crystal Sea”	SS 118	“Harvest Reaper”	PZ 329
W Stevenson & Sons		Waterdance Ltd	

Industry bodies:

National Federation of Fishermen’s Organisations
NFFO Shellfish Committee Chair
Cornish FPO
South Western FPO
South Devon & Channel Shellfishermen’s Association

Processors:

Falfish, Redruth	W Harvey & Sons, Newlyn
The Blue Seafood Company, Paignton	Seafoodandeatit, Newlyn

Bait suppliers:

Waterdance Ltd, Exeter	W Harvey & Sons, Newlyn
Independent Shellfish Co-Operative, Bridlington	Tasty Mac Pac

Supply-chain logistics

Newlyn harbour	Brixham Trawler Agents
Quayside transport	Project Link

Inshore Fisheries and Conservation Agencies (IFCAs)

Cornwall	Northumberland
Kent & Essex	

Marine Management Organisation (MMO)

Newlyn	Plymouth
Fish Stats unit, London	

Pot suppliers

Cornwall Creels

Defra

Discards team

Annex III

Interview questions:

1. Can you provide an estimate of how much kg of bait is used per pot
2. On average how many pots does your boat haul per day
3. What are your typical bait quantities / costs by day / month / year (as kg or cost); any trends in recent years?
4. What are your bait preferences by target species (e.g whether on Crab vs Lobster)
5. What are your views / experiences in respect of catch rates on fresh bait vs frozen bait?
6. How far in advance is bait bought / stored?
7. Do you have long or short term contracts for bait supply?
8. What is your bait storage and / or bait freezing capacity? – i.e. how many days fishing do you have in store? Does this give rise to any issues?
9. Which other species have you tried for bait?
10. Would you be willing to take part in a bait trial?
11. Does the type of pot used affect the bait used? e.g Soft-eye vs Parlour
12. Is there a difference in catch rates between whole round fish vs fish frames?
13. Are there any other baits you would like to have access to or be willing to pay for?
14. Do you have any other views on this subject you would like to share?