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Marine Biodiversity

Comparison of catch, landings and value of crayfish (*Palinurus elephas*) in tangle nets and pots in Tralee Bay 2021-2025

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Contents

Summary

1. Tangle nets are the main fishing gear used to target crayfish (*Palinurus elephas*) in Irish coastal waters. Most of the fishing effort is concentrated off the south west and south coasts.
2. Significant bycatch of protected and endangered species can occur in tangle nets targeting crayfish and finding an alternative more selective fishing method is a key objective for the fishery.
3. Fishing trials for crayfish were undertaken with traps (pots) during the period 2021-2025 to compare the catches, landings, and gross value of the landings from standardised amounts of tangle net and pot fishing effort.
4. Various pot designs were trialed. Entrances to the pot included top entry buckets and top, end or side ring entrances. The frame design of the pots and their internal volume varied. The shape of the frames were D shaped or rectangular. Some pots had second chambers with ring entrances.
5. Rectangular Aquamesh pots, with a top entry bucket and parlour, and top entry D shaped pots with parlours, had higher catches and higher catch diversity (lobster and crab) than other pot types. Nevertheless, the standard top entry bucket, single chamber (no parlour) pot was used in the main trials in order to follow a short soak time, frequent hauling, and lower input cost fishing strategy. In any transition from tangle nets to pot fisheries for crayfish, minimising competition with existing pot fisheries for lobster and crab and limiting the amount of extra fishing effort in a crayfish pot fishery will be important. Using relatively small amounts of fishing gear and working the gear multiple times per day is a useful strategy to minimise competition and input costs.
6. Top entry bucket single chamber pots were the main pot used in commercial scale trials in 2024 and 2025. These are commonly used to target spider crabs. The pot allows for easy entrance of crustaceans, but escapement rates are also high. Short soak time fishing strategies (3, 6, 12, 18hrs), where pots were hauled up to 4 times in 24hrs (approximately 6am, 9am, 12noon, and evening) was adopted to minimise escapement. Typically, each vessel used 90 pots deployed in three strings of 30 pots and hauled repeated according to the schedule above. Catches and landings of crayfish and lobster were recorded.
7. Eight commercial vessels were involved in the trials and data for 450 fishing trips involving 80,000 hauls of the single chamber top entry pot were reported.
8. Catches and landings of crayfish, together with the combined value of crayfish and lobster landings, were standardised to comparable units of fishing effort for tangle nets and pots. A net length of 0.7 km was regarded as equivalent to a string of 30 pots which is also approximately 0.7 km in length. Catch per unit effort (CPUE), landings per unit effort (LPUE) and monetary value per unit of effort (VPUE) were estimated.
9. Overnight soaks of 12-24hrs resulted in catches similar to 3hrs soaks. The 3hrs soak typically occurred between 6-9am but also throughout the day. Crayfish were caught at all soak times and throughout day, indicating that they were active during daylight hours and overnight.
10. Pots selected larger crayfish than tangle nets and the proportion of undersized crayfish was generally lower in pots than in nets. Pots caught more lobsters than nets.
11. Generalised Additive Models (GAMs) were developed to compare CPUE, LPUE and VPUE metrics across nets and pots while accounting for temporal (month, year) and operational (soak hours) effects. The model was used to predict the effects of changes in soak time of tangle nets on CPUE. LPUE and VPUE were not affected by soak time.

12. After accounting for month, year and soak time effects, tangle nets generally achieved higher CPUE, LPUE and VPUE than pots. The relative performance of the two gears varied seasonally. CPUE increased with soak time, but LPUE or VPUE did not.
13. Model predictions for different tangle net soak time scenarios and 3hrs pot soak times predicted lower pot/net CPUE ratios as net soak time increased, reflecting the increased in total catch with net soak time.
14. The predicted proportion of the catch that contributed to landings (the LPUE:CPUE ratio) was consistently higher for pots than for nets at the standard commercial tangle net soak time (120hrs). This ratio was lower at shorter net soak times.
15. The relative value of fishing crayfish with nets or pots depends on the landings for a given effort and the cost of purchasing and maintaining fishing gears. The five year costs of purchase, maintenance, and depreciation for tangle net and pot fishing gears at commercial fishing scale (120 pots, 8.4km of net) were estimated:
    a. Initial set up costs are higher for pots, but nets depreciate at a higher rate.
    b. Five year costs to maintain 120 pots and 8.4km of nets, which enable equivalent fishing effort, were estimated to be €22,586 and €57,343 respectively.
    c. The gross value of the landings, summed over five years, based on 120 fishing days per vessel per annum and using short soak strategy and frequent hauling of 120 pots or an equivalent 8.4km of nets, was estimated to be €403K for pots and €691K for nets.
    d. For this fishing effort the difference in net value of landings over five years for a vessel, after accounting for fishing gear depreciation, was €253K higher for nets.
16. The value of the landings per 30 pots in the crayfish pot trials (€56) was 90% of the value in 30 soft-eye pots in the commercial lobster fishery (€62) in the same location.
17. Although the net VPUE was lower for pots than for nets, under the trial conditions reported here, there are a number of advantages to fishing with pots including
    a. Elimination of bycatch of protected and critically endangered species.
    b. Minimising mortality of the catch, which can be 10-20% in nets.
    c. Better selectivity resulting in fewer undersized crayfish in pots.
    d. Higher vitality of crayfish caught in pots which reduces losses during storage and onward transport to international markets.
    e. A well-managed pot fishery for crayfish could achieve environmental accreditation, which may increase market access and value.
    f. Operationally, fishing a limited number of pots and hauling them frequently has lower input costs than fishing kilometres of tangle nets.

Introduction

The commercial fishery for crayfish (*Palinurus elephas*) in Ireland primarily uses large mesh tangle nets on reef habitat in coastal waters. This has been the main gear used in the fishery since the 1980s. Prior to that, top entrance 'French Barrell' pots and 'Wicker' pots were commonly used in the fishery. Declines in crayfish abundance in recent decades have made pot fisheries for crayfish uneconomic.

Tangle nets are efficient at capturing crayfish but have poor selectivity; undersized crayfish and lobster are frequently caught, and some mortality of these species occurs especially if nets are soaked for many days. Mortality is caused by scavenging isopods and by physical damage sustained while animals are entangled in the nets. There is also a significant bycatch of other species, some of which are endangered or critically endangered. Potting on the other hand causes little or no mortality of crustaceans and there is no bycatch of protected or endangered species.

Recent data on the Irish fishery for crayfish show significant increases in catch rates, landings and an expansion in the distribution of the fishery (Palma Pedraza and Tully 2026). Similar trends have also occurred in northern France and in the south west coast of England. Collectively, the data may suggest an increase in stock size due to higher recruitment in the past decade. Jackson (2021), using occupancy models from Seasearch (citizen science) records, also reported an increased prevalence of the species in coastal waters of the UK and Ireland. This raises the question as to whether pot fisheries for crayfish could once again become commercially viable while providing a low impact alternative to the current tangle net fishery. A small number of Irish vessels already use top entry pots for crayfish, suggesting that this approach may already be economically viable and that differences in earnings per quantity of fishing effort between tangle net and pot fisheries for crayfish may not be very significant.

A series of fishing trials, using a variety of pot designs, were completed in the Tralee Bay area between 2021-2025. The trials reported here compare catch rates in different pot designs and relative to equivalent amount of fishing effort with soft-eye pots for lobster and tangle nets for crayfish. These comparisons are used to assess whether a pot fishery for crayfish is an economically viable lower impact alternative to tangle nets. Trials continued in 2026 but are not reported here.

Methods

Study area

Vessels participating in the potting trial and fishing in outer Tralee Bay, between Brandon Point and Kerry Head (Figure 1, Figure 2), were contracted by the Marine Institute through framework agreements in 2021 and 2025 (ITT21-019, ITT25-005) to provide services including participation in this study.

The fishing area in outer Tralee Bay has extensive reef habitat for crayfish (*Palinurus elephas*) and lobster (*Homarus gammarus*), and crayfish have been fished with tangle nets in the area in recent decades. Lobster and brown crab (*Cancer pagurus*) are also targeted in this area using soft-eye side entry pots, which generally do not catch crayfish. Spider crab (*Maja brachydactyla*) is fished using top entrance pots mainly in the spring during the migration of spider crab to shallow waters. Vessels in the areas also target Pollack (*Pollachius pollachius*) using gill nets or hooks and lines. Vessels operating in this area are almost all potters or netters and are generally, but with exceptions, under 12 m in length.

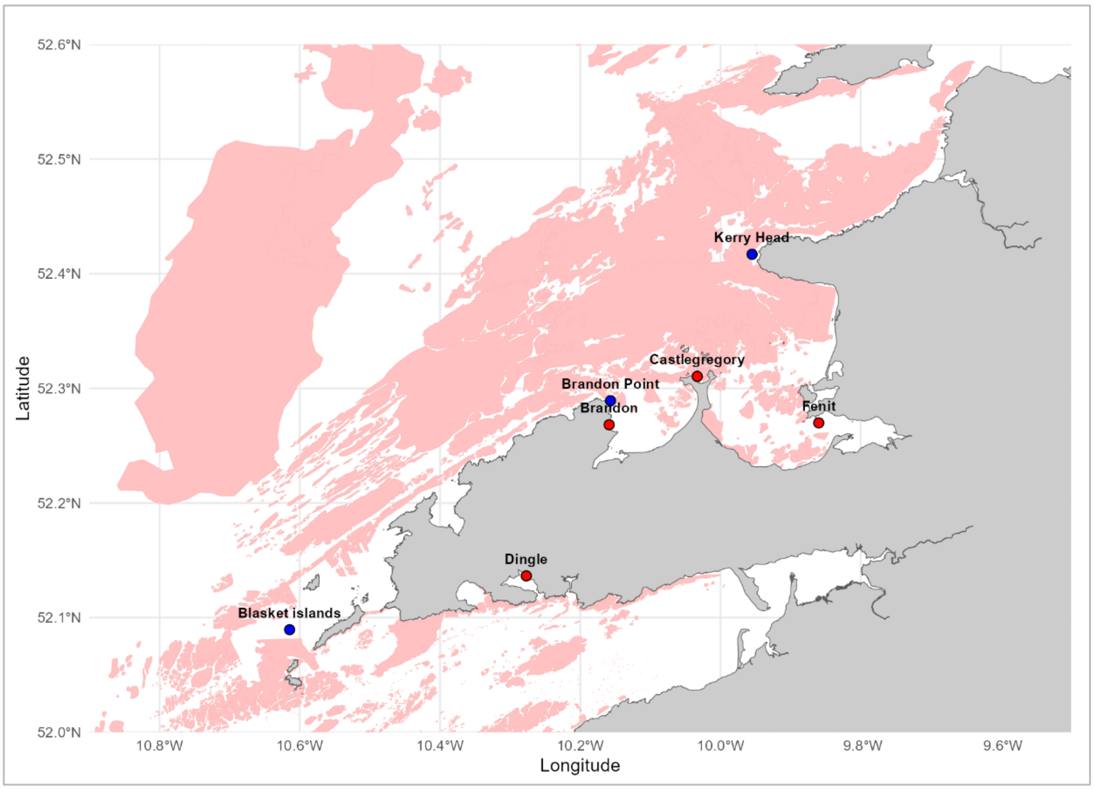


Figure 1. The distribution of reef habitat surrounding the Dingle peninsula in County Kerry.

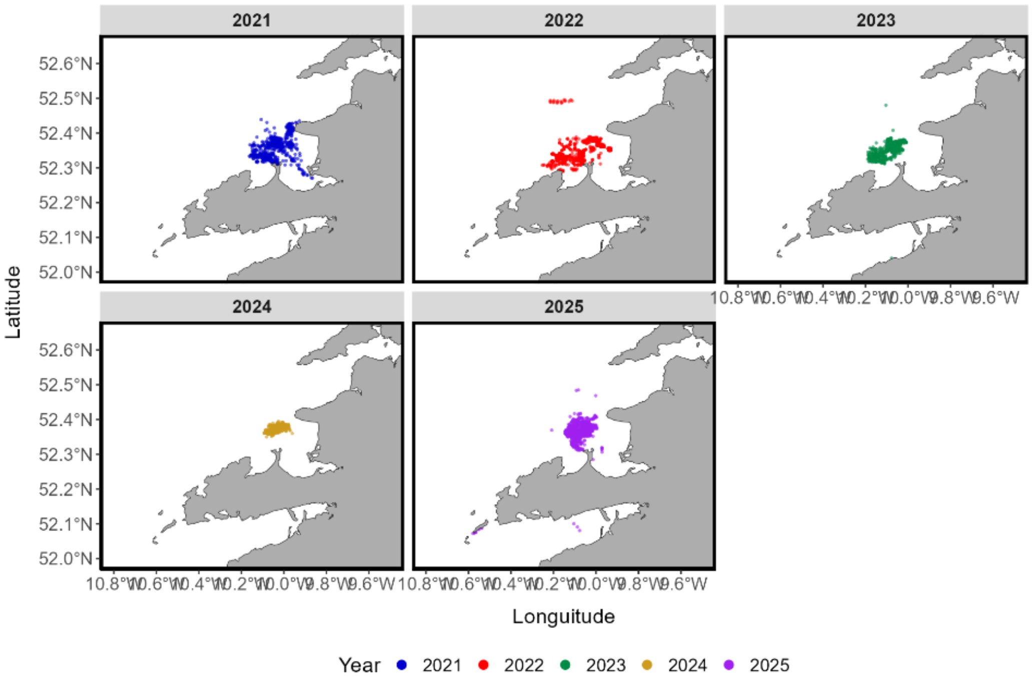


Figure 2. Vessel location reported data during potting trials for crayfish took place 2021-2025.

Pot designs

Ten pot designs were included in the trials (Figure 3, Table 1). All pots had a steel frame and varied according to

- Frame structure, size and shape
- The presence or absence of a second chamber (parlour)

- The type of entrance to the second chamber
- The type of entrance to the pot (soft mesh, ring, bucket)
- The position and number of entrances (side, end or top of frame)

The pot entry affects catchability, size selection, and retention of crayfish.

Historically, the pot fishery for crayfish used a single chamber pot with a top bucket entrance. These were made from wooden batons (so called French barrel pot) and prior to that wicker pots, using willow rods woven onto a wooden frame, were common (Heritage Fisheries website). These pots were made by fishermen themselves and preceded industrial scale production of steel frame pots used today.

The modern equivalent of the older wooden pot is pot I (top entry bucket) (Figure 3), which is a single chamber steel frame pot with a single bucket entrance on top of the frame. Although catchability of crayfish using these pots and their wooden predecessors is high, retention of crayfish is low and escapement is easy. Various one way entry devices can also be attached to the bucket entrance to reduce escapement, but they also seem to reduce entry to the pot. Traditionally, these pots were hauled every few hours during daylight hours and rebaited as necessary to reduce escapement after the bait was consumed.

The best pot design, therefore, has both high rates of entry and high retention of crayfish, resulting in high catch rates.

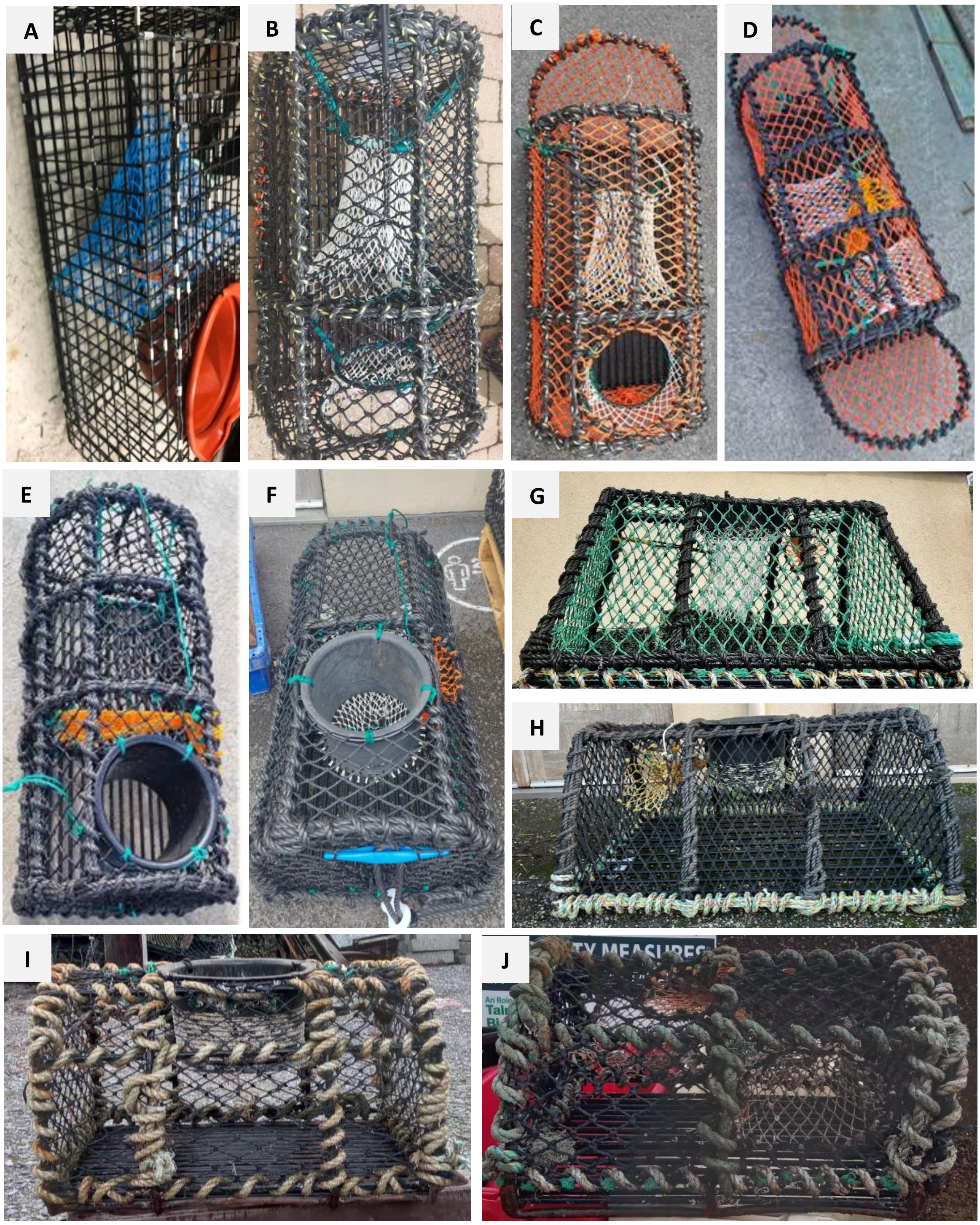


Figure 3. Ten pot designs used in trials for crayfish and for comparison with lobster and crab catches. A = Aquamesh top bucket entrance parlour B = End ring entrance parlour, C = Top ring entrance parlour, D = Double side ring entrance parlour, E = Top bucket entrance parlour (shallow), F = Top bucket entrance parlour, G = Top bucket entrance no parlour (medium frame), H = Top bucket entrance no parlour (large frame), I = Top bucket entrance no parlour (HETOP), J = Soft-eye side entrance no parlour (SESIDE).

Table 1. Features of the different pot designs used during crayfish catch trials in 2021-2025. Soft eye is a mesh entrance with a loosely hanging upper side.

	Pot structure				Entrance				Netting mesh
Pot type	**Dimensions**	**Shape**	**Frame**	**Parlour/Entrance**	**No**	**Shape**	**Position**	**Dimension**	**Type**
A	36” long x 20” wide x 18” high	Rectangular	Metal mesh	Yes/Soft eye	1	Bucket	Top of frame	10’’ to 6-8’’	Square
B	33’’ long x 20’’ wide x 18’’ high	Semi-cylindrical	Rope and steel	Yes/Soft eye	1	Ring with mesh funnel	End (short side) of frame	10’’ to 6-8’’	Diamond
C	33’’ long x 20’’ wide x 18’’ high	Semi-cylindrical	Rope and steel	Yes/Ring	1	Ring with mesh funnel	Top of frame	10’’ to 6-8’’	Diamond
D	33’’ long x 20’’ wide x 18’’ high	Semi-cylindrical	Rope and steel	Yes/Soft	2	Ring with mesh funnel	Sides (long sides) of frame	10’’ to 6-8’’	Diamond
E	33’’ long x 20’’ wide x 17’’ high	Semi-cylindrical	Rope and steel	Yes/Soft	1	Bucket	Top of frame	10’’ to 6-8’’	Diamond
F	33’’ long x 20’’ wide x 17’’ high	Semi-cylindrical	Rope and steel	Yes/Soft	1	Bucket	Top of frame	10’’ to 6-8’’	Diamond
G	89’’ long x 72’’ wide x 46’’ high	Semi-cylindrical	Rope and steel	No	1	Bucket	Top of frame	10’’ to 6-8’’	Diamond
H	94’’ long x 72’’ wide x 56’’ high	Semi-cylindrical	Rope and steel	No	1	Ring with mesh funnel	Top of frame	10’’ to 6-8’’	Diamond
I	24’’ long x 20’’ wide x 17’’ high	Semi-cylindrical	Rope and steel	No	1	Bucket	Top of frame	10”	Diamond
J	24’’ long x 18’’ wide x 14.5’’ high	Semi-cylindrical	Rope and steel	No	1	Mesh (soft eye)	On both long sides		Diamond

Trial design and data collection

After experimenting with a range of pot designs in 2022 and 2023 (Table 2), pot I (top entry bucket pot no parlour) was used in commercial scale trials in 2024 and 2025. To reduce escapement, short soak times were also used in the 2024-2025 trials, following the traditional fishing strategy for these types of pots. Although catch per unit effort was higher in some of the other pot designs, such as the rectangular aquamesh pot (pot A in Figure 3), which had a second chamber, operationally fishermen found it more difficult to fish with.

Pots were shot in short strings of connected pots. Individual pots within each string were separated by ~ 30 m of ground rope so that they fished independently of each other. A total of 370 fishing trips were reported by skippers, with a further 80 trips reported by observers during the period 2021-2025 (Tables 3, 4, and Figure 4). For each string of pots hauled, data were recorded on the date, shooting and hauling times, number of pots per string, GPS position of the deployment, soak time, total catch of crustacean species (crayfish, lobster, spider crab and brown crab), and the size and sex of all crayfish and lobster caught. Vessels reported GPS position at 10-minute frequency during the trial from iVMS devices installed on the vessels.

The pot trial catch data was compared to commercial catch rate data for tangle nets operating in the same general area. These nets were monitored and data reported by fishermen and scientific observers. A total of 2,638 net hauls representing 1,817 nm of nets were monitored between 2021 and 2025.

The pot trial data were also compared with the commercial soft-eye pot fishery for lobster/crab operating in the same location.

Table 2. Type of pots used in each year and duration of the trials.

Year	Start Date	End Date	Months	Pot type used
2021	10/08/2021	10/09/2021	Aug-Sept	I
2022	28/04/2022	23/10/2022	April-Oct	A, B, C, D, E, I, J
2023	09/07/2023	12/10/2023	July-Oct	F, G, H, I
2024	20/06/2024	03/10/2024	June-Oct	I
2025	09/05/2025	12/11/2025	May-Nov	I

Table 3. Total number of strings of pots hauled per year and month.

Year/Month	4	5	6	7	8	9	10	11
2021					549	160		
2022	12					684	178	
2023				220	275	188	42	
2024			102	337	9	66	24	
2025		36		8	561	185	259	45
TOTAL	**12**	**36**	**102**	**565**	**1,394**	**1,283**	**503**	**45**

Table 4. Total number of trial days reported annually by skippers and observers.

	2021	2022	2023	2024	2025	TOTAL
Skippers	73	89	76	44	88	370
Observers	16	13	22	7	22	80
TOTAL	**89**	**102**	**98**	**51**	**110**	**450**

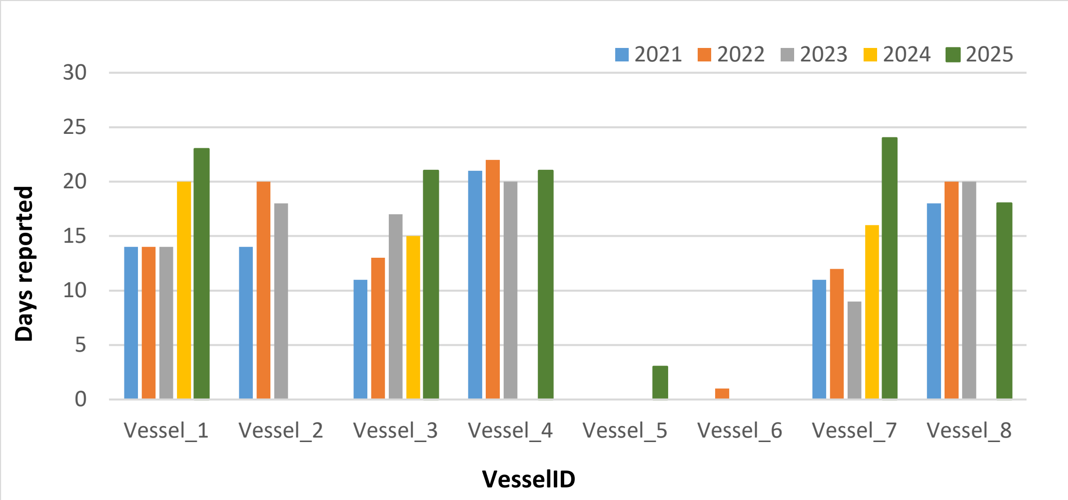


Figure 4. Number of trial days reported by vessel and year.

Generalised Additive Model of catch, landing and value data

Generalised Additive Models (GAMs) (Grüss *et al*. 2019) were developed to assess the influence of gear type (pots vs tangle nets) on three separate fisheries performance metrics: (1) standardised catch per unit effort (CPUE) of crayfish, (2) standardised landing per unit effort (LPUE) of crayfish, and (3) value per unit effort (VPUE), calculated as the gross economic value (sale price) of combined crayfish and lobster landings. Effort was standardised to a string of 30 pots for pot fisheries and 0.7 km of net length for tangle net fisheries to facilitate direct comparisons between gear types.

The GAMs were restricted to data collected during 2024 and 2025. Earlier pot surveys (2021–2023) used experimental fishing protocols and did not reflect commercial scale fishing practices. In contrast, the 2024 and 2025 surveys were conducted at commercial scale and adopted a specific short soak, high haul frequency fishing strategy. Restricting the analyses to these two years therefore provided a more consistent basis for comparing the relative performance of pots and tangle nets. To ensure comparable, within year, temporal coverage between gears and improve the balance of the experimental design, analyses were further restricted to the period May–November. Although tangle net data were available from April to November, pot data were available only from May to November.

Given the response variables (CPUE, LPUE and VPUE) included many zero observations and continuous positive values, GAMs were fitted using a Tweedie error distribution with a log link function (Shono 2008). Each model incorporated Gear_ID, Month and Year as parametric fixed effects, together with a Gear_ID × Month interaction to allow for seasonal differences in relative gear performance.

In this model framework, tangle nets, Month 5 (May), and Year 2024 were used as the baseline reference levels. Model coefficients, therefore, represent deviations from these reference categories. The potentially non-linear effect of soak time was modelled using separate smooth functions for each gear type, with the basis dimension set to k=8, allowing the relationship between soak duration and the response variables to differ between pots and nets. The k value is effectively the degrees of freedom (k-1) for fitting the smooth function.

Spatial location and vessel identity were not included in the final models. Pot and tangle net surveys were conducted in adjacent reef habitats (approximately 5-8 km apart) but were not deployed on the same fishing grounds for two reasons; operationally it was difficult to deploy pots in the same area as tangle nets because of the amount of netting activity present and secondly, the two gears needed to operate as independently of each other as possible to avoid interference competition for crayfish catch between gear types. Consequently, there was little spatial overlap between gears, meaning that inclusion of a spatial smooth would require substantial extrapolation beyond the geographic distribution of the observed data. Vessel effects were also excluded because gear and vessel were partially confounded: several vessels operated only one gear type, while vessel identity was also closely associated with location.

The analysis therefore focused on estimating seasonal differences in gear performance while accounting for year, month, and gear-specific soak time effects.

Models were fitted using restricted maximum likelihood (REML), implemented via the *mgcv* package in R, with additional shrinkage penalties applied to smooth term (select = TRUE) to reduce the risk of overfitting. Model structure and settings are fully described in Annex I.

Standardised model predictions

To compare the relative performance of pots and tangle nets under different soak time scenarios, standardised predictions were generated from the fitted GAM model of CPUE (soak time had no effect on LPUE and VPUE). Predictions were obtained for each combination of gear type, month (May-November) and predefined soak time scenarios.

Three soak time scenarios were tested for the CPUE response variable only as net soak hours had no effect on LPUE or VPUE. The scenarios included 3hrs soak for pots and 24hrs, 48hrs and 120hrs for tangle nets. These values were selected to reflect typical fishing practices and alternative management scenarios for soak time proposed by industry and were selected within the range of observed conditions to minimise extrapolation. The 3hrs soak time assigned for pots represent a short soak duration to minimise catch escapement, while the 24hrs and 48hrs soak times assigned to tangle nets represent potential management measures designed to reduce mortality of elasmobranch species caught as bycatch. The 120hrs represents the most common soak duration used in the commercial tangle net fishery.

For each scenario, model predictions were first generated separately for 2024 and 2025 and for each month. Predictions were then averaged across years to obtain a standardised mean predicted response for each combination of gear, month and soak time scenario.

The monthly pot to net ratios were calculated from the corresponding model predictions on the response scale by dividing the predicted response for pots by the predicted response for nets under the three soak time scenarios. Overall mean pot/net ratios for each soak time scenario were then calculated by averaging the monthly ratios across May–November, giving equal weight to each month to provide a representative seasonal estimate of relative gear performance.

The predicted proportion of the catch that contributed to landings was calculated from the model predictions of CPUE and LPUE for each gear type, month and soak time scenario. For each combination, the predicted landing proportion was calculated as the ratio of predicted LPUE to predicted CPUE (LPUE/CPUE). The resulting proportions were then compared between gear types by calculating the ratio of the predicted landing proportion for pots to that for tangle nets.

Results

Catches relative to pot design

Approximately 80,000 top entry pots (Type I, HETOP) were hauled during the trials (Table 5). Trial effort for the remaining pot types was substantially lower, amounting to less than 5,000 pot hauls per pot design.

The proportion of strings of pots that caught crayfish was low across all pot types. However, the top entry pot showed a substantial increase in positive catches over years, from 38% strings in 2021 to 75 % in 2025.

Spider crab was the dominant species in the catch during all trials, followed by brown crab, lobster and crayfish (Table 6).

The end ring entrance parlour pot (Type B) had the highest crayfish CPUE (0.14 per pot in 2022). Other parlour-style pots, such as the Aquamesh (Type A; CPUE 0.09) and top bucket entrance parlour pot (Type E; CPUE 0.08), also had relatively higher crayfish catch rates compared to other pots (Figure 5, Table 7).

Table 5. Summary statistics for annual trial data for crayfish catch by pot type.

Year	Pot type	Total pots hauled	Total strings hauled	Average pots per string	Strings with zero catches	% strings with zero catches	% strings with catches
2021	I_HETOP	21956	709	31	443	0.62	0.38
2022	A_Aquamesh	576	197	3	175	0.89	0.11
2022	B_End ring entrance parlour	49	49	1	42	0.86	0.14
2022	C_Top ring entrance parlour	152	57	3	52	0.91	0.09
2022	D_Double side ring entrance parlour	922	203	5	191	0.94	0.06
2022	E_Top bucket entrance parlour	1013	209	5	169	0.81	0.19
2022	I_HETOP	1845	63	29	25	0.40	0.60
2022	J_SESIDE	4177	92	45	91	0.99	0.01
2023	F_Top bucket entrance parlour	4627	236	20	194	0.82	0.18
2023	G_Top bucket medium frame	1427	73	20	53	0.73	0.27
2023	H_Top bucket large frame	3029	155	20	133	0.86	0.14
2023	I_HETOP	5138	261	20	154	0.59	0.41
2024	I_HETOP	14171	538	26	209	0.39	0.61
2025	I_HETOP	32290	1097	29	269	0.25	0.75

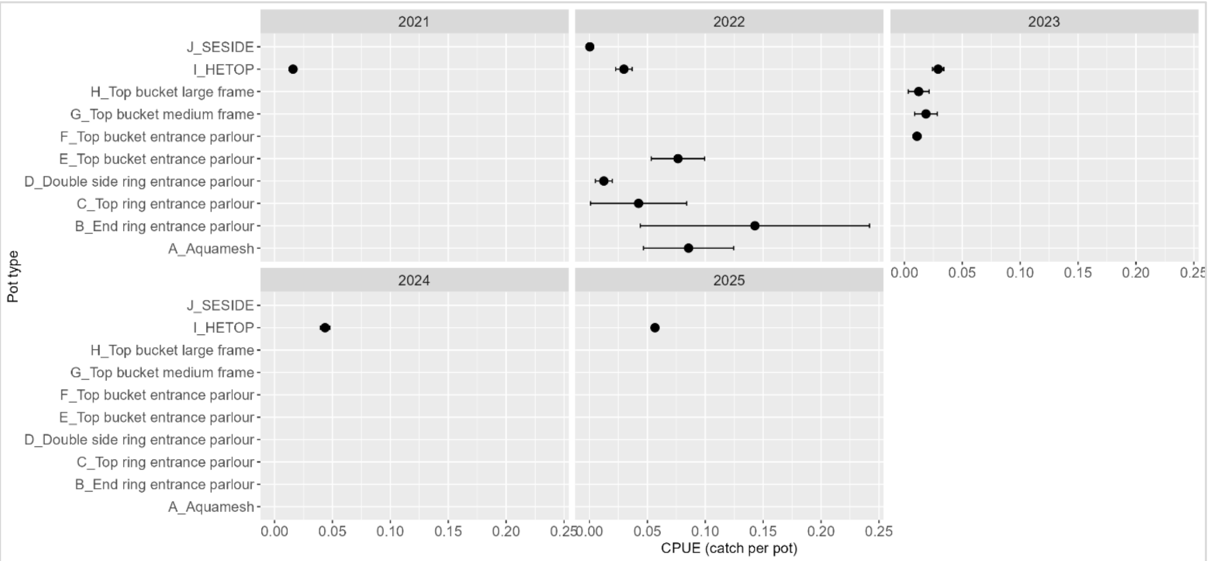


Figure 5. Catch per unit effort (CPUE) of crayfish by pot type in each trial year.

Table 6. Total catches by species per year per pot type.

Year	Pot type	Total crayfish	Total lobster	Total spider crab	Total brown crab
2021	I_HETOP	359	902	23,860	3,753
2022	A_Aquamesh	23	275	1,706	420
2022	B_End ring entrance parlour	7	27	91	34
2022	C_Top ring entrance parlour	5	29	414	45
2022	D_Double side ring entrance parlour	13	311	1,445	543
2022	E_Top bucket entrance parlour	47	303	2,638	435
2022	I_HETOP	52	98	3,880	425
2022	J_SESIDE	1	819	2,026	4,175
2023	F_Top bucket entrance parlour	51	859	6,700	1,225
2023	G_Top bucket medium frame	24	172	1,822	282
2023	H_Top bucket large frame	27	262	4,219	416
2023	I_HETOP	152	421	6,895	1,189
2024	I_HETOP	637	776	18,934	1,723
2025	I_HETOP	1,930	1,624	32,796	4,089

Table 7. Catch rates (per pot) of crayfish in different pot types.

Year	Pot type	CPUE crayfish	CPUE lobster	CPUE spider crab	CPUE brown crab
2021	I_HETOP	0.02	0.04	1.15	0.17
2022	A_Aquamesh	0.09	0.28	4.13	0.67
2022	B_End ring entrance parlour	0.14	0.55	1.86	0.69
2022	C_Top ring entrance parlour	0.04	0.24	2.28	0.43
2022	D_Double side ring entrance parlour	0.01	0.34	1.55	0.63
2022	E_Top bucket entrance parlour	0.08	0.34	2.48	0.47
2022	I_HETOP	0.03	0.05	2.33	0.21
2022	J_SESIDE	0.00	0.19	0.52	0.99
2023	F_Top bucket entrance parlour	0.01	0.19	1.45	0.26
2023	G_Top bucket medium frame	0.02	0.12	1.29	0.20
2023	H_Top bucket large frame	0.01	0.08	1.39	0.14
2023	I_HETOP	0.03	0.08	1.34	0.23
2024	I_HETOP	0.04	0.05	1.39	0.12
2025	I_HETOP	0.06	0.05	1.08	0.12

Catches in top entry bucket pots

Crayfish CPUE per 30 pot hauls in top entry bucket pots increased from 0.48 in 2021 to 1.70 in 2025. Lobster catch rate increased from 2021-2023 but declined in 2024-2025. Spider crab catches were highest in 2022. Catch rate of brown crab was lower in 2024-2025 than in 2021-2023. (Table 8 and Table 9).

Crayfish catches were higher in July-September than in other months. The CPUE data was statistically overdispersed with higher incidence of high catch rate events in these months in particular. Similarly, the annual increase in mean CPUE of crayfish was also characterised by higher variance and incidence of high catch rate events (Figure 6). CPUE tended to decline monthly from July to November other than in 2024 (Figure 7).

Table 8. Standardised catch rate per 30 pots for four species annually in top entry bucket pots.

Year	Species	Standard CPUE	SD	SE	Lower CI	Upper CI
2021	Crayfish	0.48	0.72	0.03	0.42	0.53
2022	Crayfish	0.89	0.87	0.11	0.68	1.11
2023	Crayfish	0.87	1.20	0.07	0.73	1.02
2024	Crayfish	1.31	1.48	0.06	1.18	1.43
2025	Crayfish	1.70	1.49	0.05	1.61	1.79
2021	Lobster	1.23	1.36	0.05	1.13	1.33
2022	Lobster	1.47	1.39	0.17	1.13	1.82
2023	Lobster	2.45	2.14	0.13	2.19	2.71
2024	Lobster	1.60	1.43	0.06	1.48	1.72
2025	Lobster	1.53	1.93	0.06	1.42	1.65
2021	Spider crab	34.50	25.42	0.95	32.63	36.37
2022	Spider crab	69.81	46.68	5.88	58.28	81.33
2023	Spider crab	40.28	23.23	1.44	37.46	43.10
2024	Spider crab	41.80	22.31	0.96	39.92	43.69
2025	Spider crab	32.43	25.19	0.76	30.94	33.92
2021	Brown crab	5.18	4.36	0.16	4.86	5.50
2022	Brown crab	6.44	4.89	0.62	5.24	7.65
2023	Brown crab	6.94	5.20	0.32	6.31	7.57
2024	Brown crab	3.69	2.92	0.13	3.45	3.94
2025	Brown crab	3.66	3.34	0.10	3.46	3.86

Table 9. Standardised landing rates per 30 pots effort for crayfish and lobster annually in top entry bucket pots.

Year	Standard LPUE crayfish	Standard LPUE lobster
2021	0.25	0.34
2022	0.82	0.80
2023	0.62	0.84
2024	1.03	0.29
2025	1.16	0.51

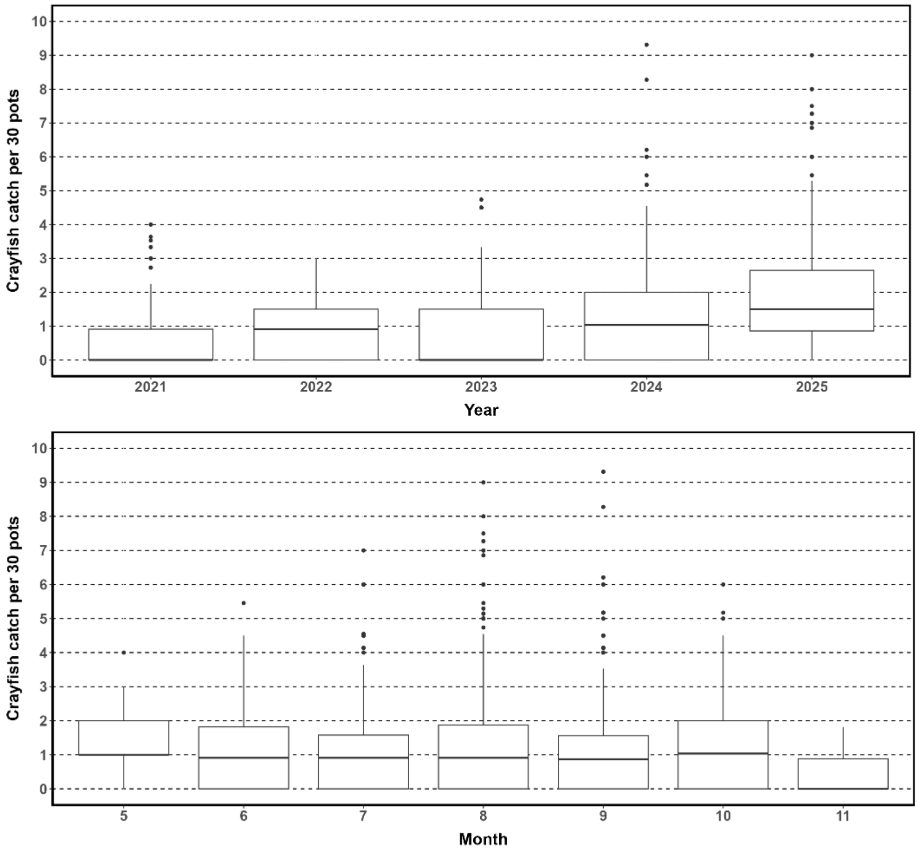


Figure 6. Distribution (boxplots) of annual and monthly catch rates of crayfish in top entry bucket pots.

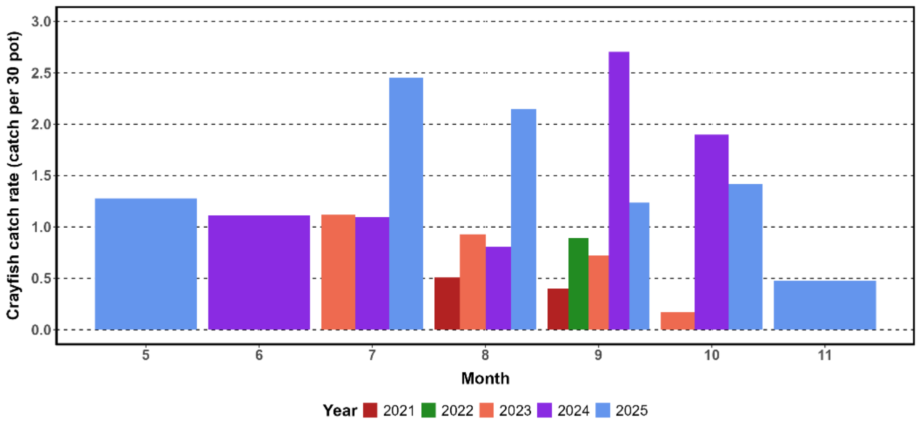


Figure 7. Standardised catch rate per 30 pots by month (May to November) and year (2021-2025) in top entry bucket pots.

Catches relative to soak time and time of day

The catch rate of crayfish in top entry pots (Type I) peaked at 3 and 3-6 hours soak, with a second peak observed at 12-24 hours, which typically corresponded to pots that were soaked overnight and hauled early in the morning (Figure 8). Strings hauled in the late morning (09:00-12:00) and afternoon (12:00-15:00) had higher crayfish catch rate than in early morning or late afternoon and were soaked for approximately 3 hours (Figure 9).

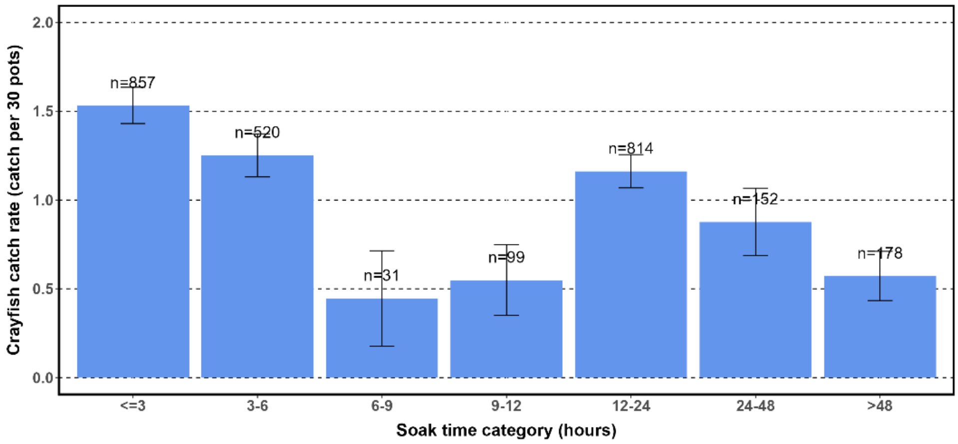


Figure 8. Soak time effects (±95% confidence intervals, sample sizes shown) on crayfish catch rates over all years 2021-2025 in top entry bucket pots.

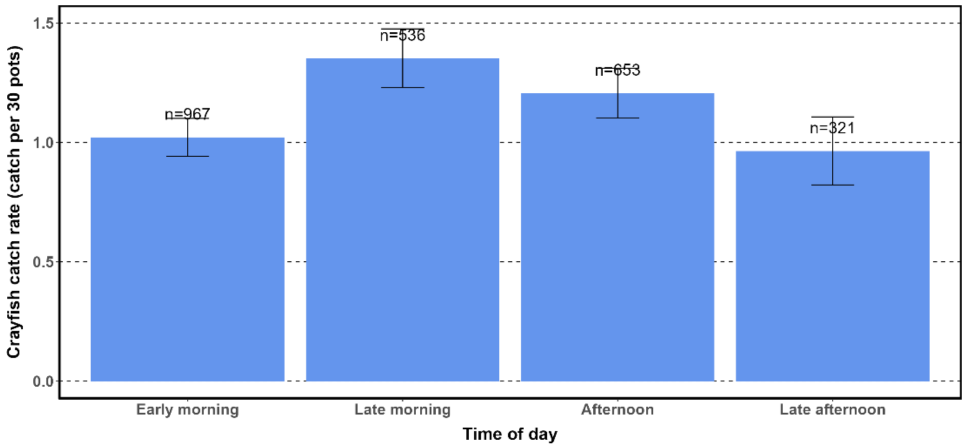


Figure 9. Time of day effects (±95% confidence intervals, sample sizes shown) on crayfish catch rates over all years 2021-2025 in top entry bucket pots. Early morning hauls were for pots soaked overnight.

Size distribution of crayfish and lobster in relation to pot design

Crayfish

The percentage of crayfish above the minimum conservation reference size (MCRS; 110mm carapace length) in top entry bucket pot (Type I) was 69%. This was higher than for all other pot types, except for pot B, where 80% of crayfish were above the MCRS (Table 10, Figure 10).

In 2022 pot types A and E selected smaller crayfish compared to top entry bucket pot (Type I). Similarly, in 2023, pot types F, G and H also retained smaller crayfish than Type I. Overall, the end ring entrance parlour (Type B) and top bucket entry (Type I) pots were the most selective for legal sized crayfish, whereas the top bucket medium frame (Type G) pot was the least selective. The soft-eye side entrance single chamber pot, which is used to target lobster (Type J), captured only one crayfish.

Table 10. Number of crayfish caught, landed and discarded per pot type. Q25 and Q75 are the first and third quartiles. Pot types are ordered by percentage landed.

Pot type	Year of pot trial	Number caught	Number landed	Number discarded	% landed	Median size	Q25 size	Q75 size
B	2022	5	4	1	80	111	110	111
I	2021-2025	3067	2124	943	69	116	104	122
C	2022	3	2	1	66.7	110	98	115

H	2023	25	16	9	64	113	99	120
D	2022	10	6	4	60	110	92	113
F	2023	51	29	22	56.8	116	100	122
A	2022	21	10	11	47.6	108	91	118
E	2022	40	19	21	47.5	103	91	114
G	2023	23	10	13	43.5	107	97	114
J	2022	1	1	0				

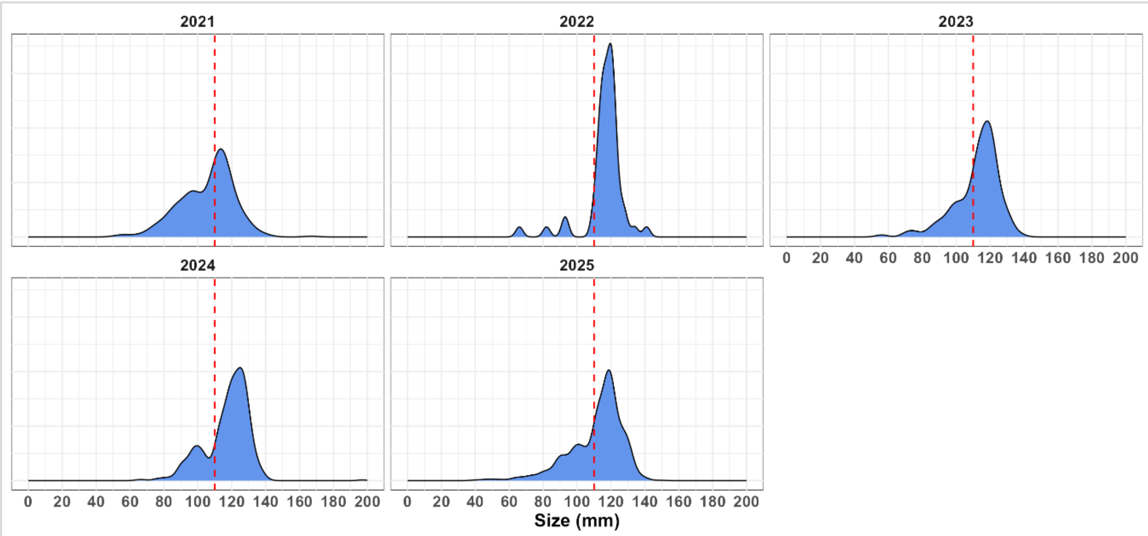


Figure 10. Size frequency distribution of crayfish (both sexes combined) in top entry bucket pots annually 2021-2025. Only data for Pot type I is shown; catch numbers were low in other pots.

Lobster

Although the top entry bucket pot (Type I) selected larger crayfish, these pots did not select larger lobster. Only 29.6% of lobster were over the MCRS of 87mm in these pots. Pot type A and J were more selective for lobsters above the MCRS. Pot types B and C did not catch lobsters (Table 11, Figure 11).

Table 11. Number of lobsters caught, landed and discarded per pot type. Pot types are ordered by percentage landed.

Pot type	Year of pot trial	Number caught	Number landed	Number discarded	% landed	Median	Q25	Q75
A	2022	199	120	79	60.3	89	84	95
J	2022	702	408	294	58.1	89	81	97
G	2023	171	84	87	49.1	87	78	92
H	2023	238	109	129	45.8	85.5	78	93.7
D	2022	18	7	11	38.9	83.5	79.2	96
E	2022	9	3	6	33.3	84	84	94
F	2023	849	252	597	29.7	80	70	89
I	2021-2025	3707	1097	2610	29.6	81	73	88

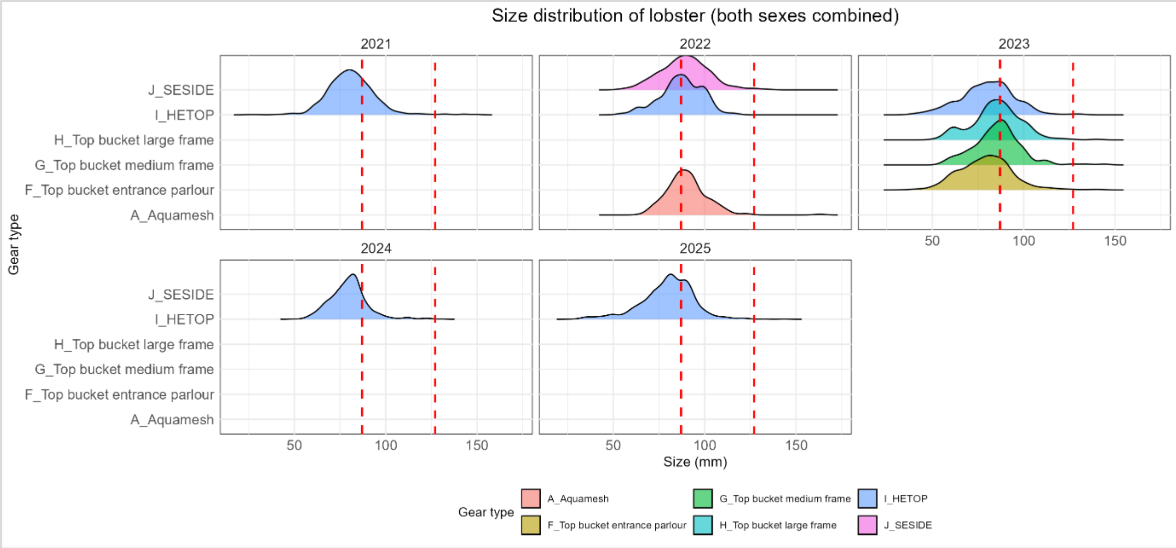


Figure 11. Size frequency distribution of lobster in pot types, where more than 100 lobsters were caught, annually 2021-2025.

Comparison of pot trial catches and commercial tangle net catches of crayfish

The objective of the pot trials described in this report was to evaluate the economic viability of commercial crayfish fishing using pots and to compare it with the economics of targeting crayfish using tangle nets.

Catch data from the pot trials and from commercial tangle nets were standardised for equivalent fishing effort. Equivalence was based on a common gear length, where a string of 30 pots was considered equivalent to 0.7 km of tangle net. Catches and landings were, therefore, standardised to these gear specific effort units prior to analysis.

As described above and in Annex I, Generalised Additive Models (GAMs) were developed to compare crayfish catch rates (CPUE), crayfish landing rates (LPUE) and economic value of combined crayfish and lobster landings (VPUE) between pots and tangle nets. The models evaluated the relative effects of gear type, season and soak time on these response variables, providing standardised estimates and predictions while accounting for temporal and operational sources of variation.

Catch rate (CPUE) data

Crayfish CPUE (numbers per 0.7 km tangle net), averaged 4-5 during 2021-2025. Lobster CPUE was relatively low at around 0.10-0.20. Spider crab catches were highest in 2025. CPUE of brown crab varied between 3-3.5 over the five years (Table 12 and Table 13). Crayfish catches were higher in July-August than in other months (Figure 12). Catch rates tended to decrease from September, except in 2021 (Figure 13).

Table 12. Annual average catch rate per 0.7 km of tangle net for four species.

Year	Species	Standard CPUE	SD	SE	Lower CI	Upper CI
2021	Crayfish	4.48	3.17	0.16	4.16	4.80
2022	Crayfish	4.84	4.06	0.16	4.53	5.14
2023	Crayfish	4.95	3.63	0.13	4.69	5.21
2024	Crayfish	4.24	3.80	0.17	3.89	4.58
2025	Crayfish	4.97	4.06	0.21	4.55	5.39
2021	Lobster	0.10	0.29	0.01	0.07	0.13

2022	Lobster	0.18	0.42	0.02	0.15	0.21
2023	Lobster	0.17	0.44	0.02	0.14	0.20
2024	Lobster	0.14	0.38	0.02	0.10	0.17
2025	Lobster	0.20	0.41	0.02	0.15	0.24
2021	Spider crab	6.65	8.01	0.41	5.84	7.46
2022	Spider crab	6.05	11.11	0.43	5.21	6.89
2023	Spider crab	5.96	11.30	0.41	5.16	6.77
2024	Spider crab	6.82	18.34	0.84	5.17	8.48
2025	Spider crab	14.06	20.48	1.08	11.94	16.18
2021	Brown crab	3.49	2.91	0.15	3.20	3.79
2022	Brown crab	3.30	3.08	0.12	3.07	3.53
2023	Brown crab	3.16	3.68	0.13	2.90	3.42
2024	Brown crab	2.88	3.72	0.17	2.54	3.21
2025	Brown crab	2.89	2.62	0.14	2.61	3.16

Table 13. Standardised landing rate per 0.7 km for crayfish and lobster annually in tangle nets.

Year	Standard LPUE crayfish	Standard LPUE lobster
2021	2.75	0.04
2022	3.05	0.13
2023	2.91	0.09
2024	2.08	0.10
2025	2.36	0.12

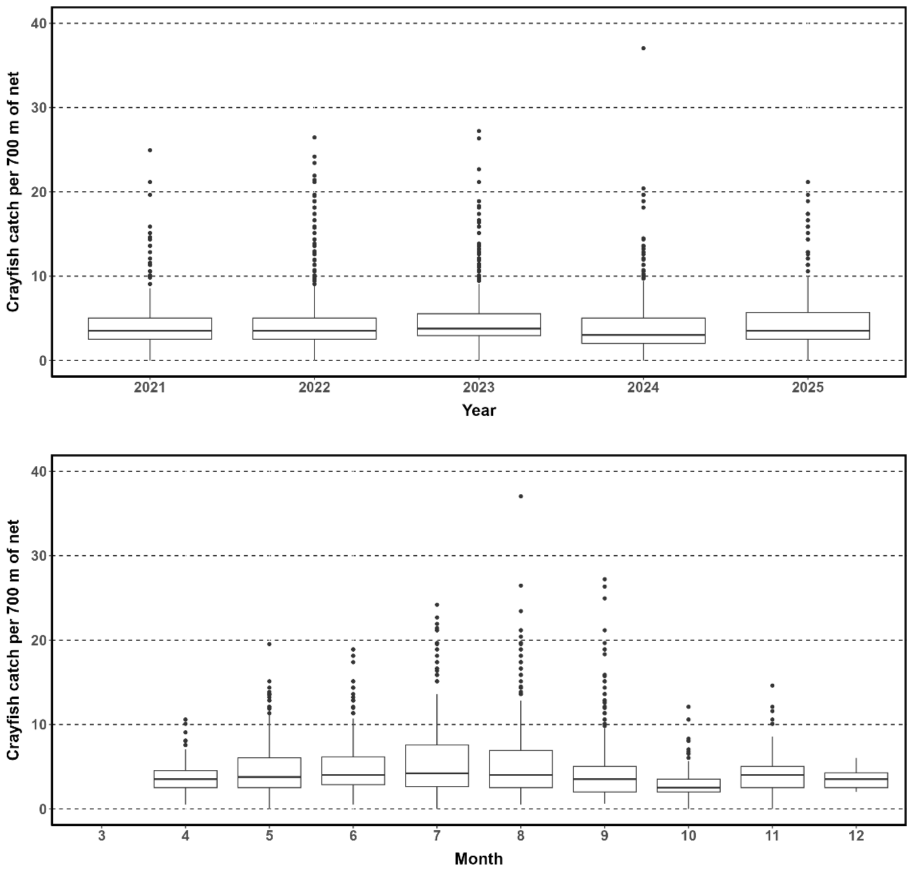


Figure 12. Distribution (boxplots) of annual and monthly catch rates of crayfish in tangle nets.

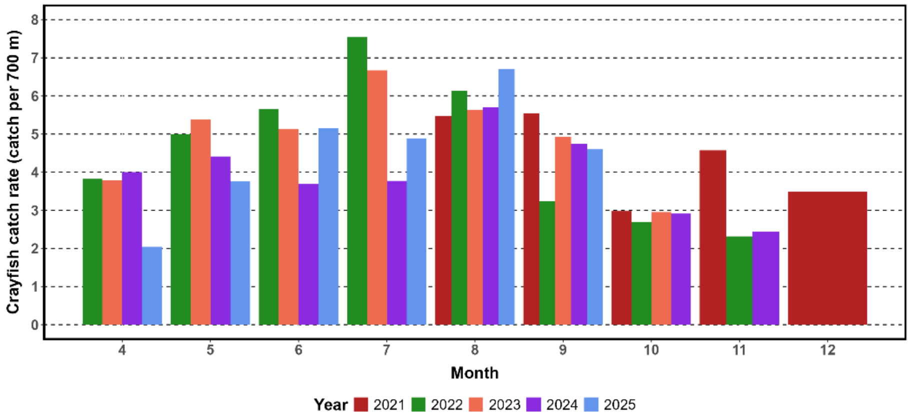


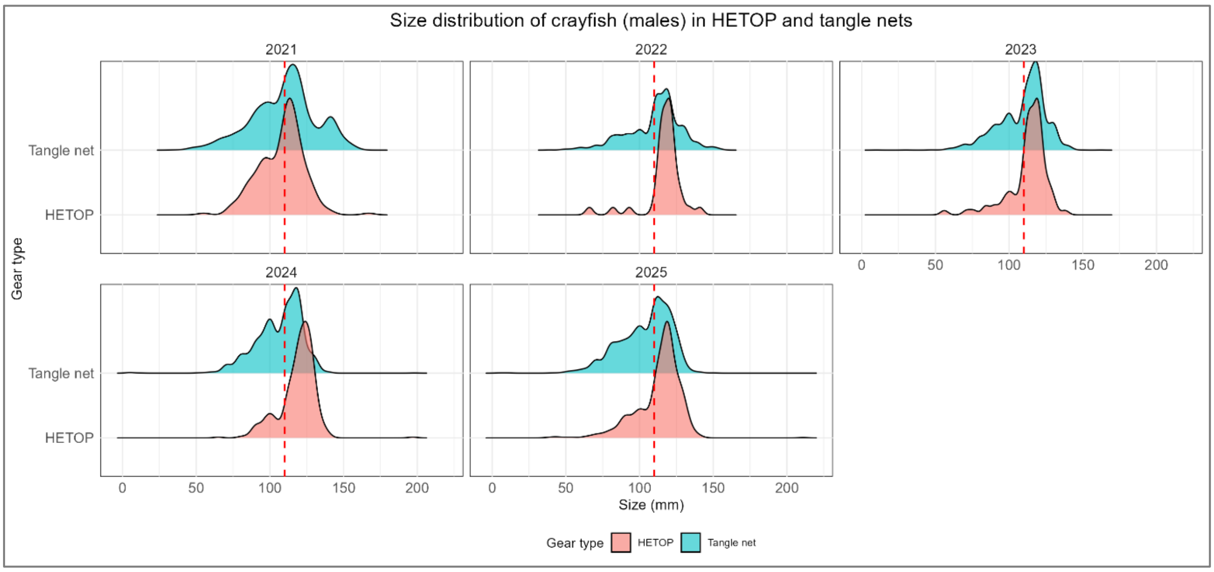
Figure 13. Standardised catch rate per 0.7 km of tangle net by month (April to December) and year (2021-2025).

Size distribution of crayfish in top entry bucket pots and tangle nets.

The proportion of crayfish above and below the MCRS varied between pots and nets (Table 14 and Figure 14). The percentage of male crayfish above the MCRS of 110mm was generally higher in pots than in nets throughout the study period. However, the percentage of female crayfish above the MCRS was similar to or higher in pots during 2023-2025.

Table 14. Size distribution of crayfish (male and female) in top bucket entry pots and tangle nets.

Year	Sex	% Landed (Type I pots)	% Landed (tangle nets)
2021	Male	35	32
2022	Male	70	41
2023	Male	44	40
2024	Male	62	38
2025	Male	51	37
2021	Female	18	35
2022	Female	22	27
2023	Female	27	26
2024	Female	16	15
2025	Female	18	12



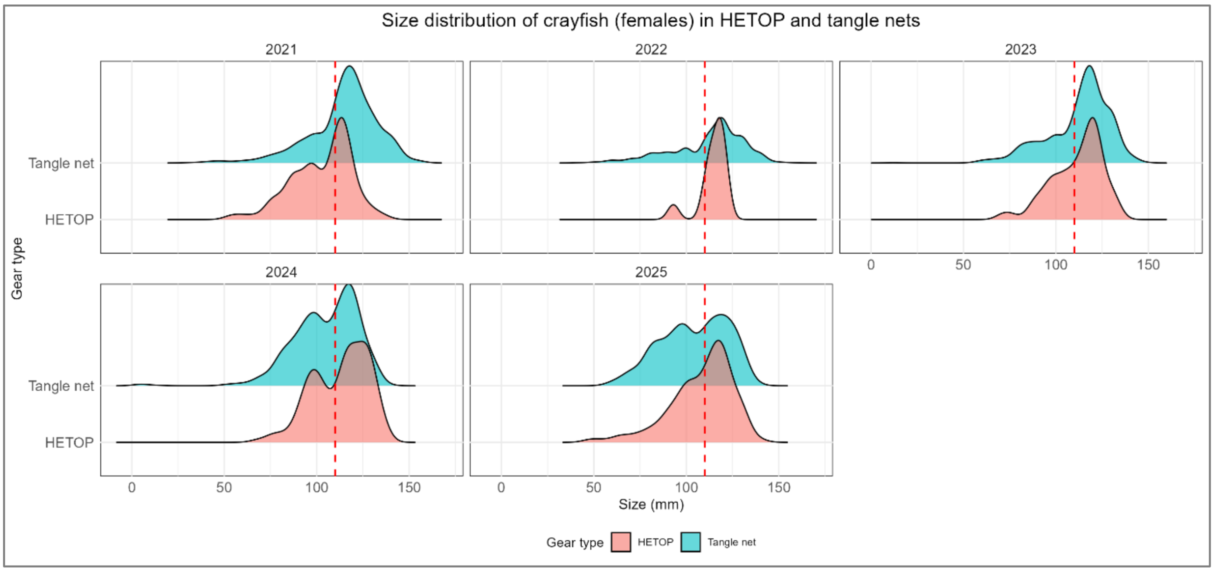


Figure 14. Size frequency distribution of crayfish in top entry bucket pots (HETOP) and tangle nets annually 2021-2025. Males are shown in the upper panel and females in the lower panel.

Relative economic value of catches in top entry bucket pots and tangle nets.

A successful transition from fishing with tangle nets to fishing with pots, with the aim of eliminating bycatch, depends on the relative economic value of crayfish catches in both gear types. The relative value of landings generated from equivalent levels of netting and potting effort (0.7 km of nets and 30 pots) is compared below.

Crayfish pots

Commercial species caught in the top entry pot trials in 2021-2025 include crayfish, lobster and brown crab (Table 15 and Table 16). Spider crabs were caught in high numbers but were deemed to be of no commercial value. The proportion of brown crab over the MCRS was estimated from other scientific observer data in top entry pots in the same area. In 2025, the average value per 30 pots hauled (crayfish, lobster and brown crab) was €56. Crayfish accounted for 80% of the value (Table 16).

Table 15. Summary of effort, crayfish, lobster and brown crab catch in top entry crayfish pots in 2021-2025.

Year	Total pots hauled	Total crayfish	Total lobster	Total brown crab
2021	21,956	359	910	3,753
2022	1,845	52	100	425
2023	5,138	152	421	1,189
2024	14,171	637	777	1,723
2025	31,962	1,910	1,574	4,056
Total	**75,072**	**3,110**	**3,782**	**11,146**

Table 16. Total value and value per standard amount of fishing effort in top entry pot trials in 2021-2025.

Species_Year	% legal	Landed (kgs)	Total value	Value per pot hauled	Value per 30 pots hauled
Crayfish_2021	52	217	€7,960	€0.4	€11
Crayfish_2022	92	55	€1,806	€1	€31
Crayfish_2023	72	136	€4,521	€1	€26

Crayfish_2024	79	643	€21,474	€1.5	€44
Crayfish_2025	68	1,613	€55,334	€2	€50
Lobster_2021	26	121	€2,109	€0.1	€3
Lobster_2022	53	28	€490	€0.24	€7
Lobster_2023	34	76	€1,216	€0.23	€7
Lobster_2024	18	76	€1,218	€0.1	€3
Lobster_2025	33	254	€4,718	€0.15	€5
Brown crab_2021	82	1,653	€4,178	€0.2	€6
Brown crab_2022	77	176	€551	€0.3	€9
Brown crab_2023	21	134	€272	€0.05	€2
Brown crab_2024	31	287	€512	€0.04	€1
Brown crab_2025	30	659	€1,278	€0.04	€1

Tangle nets

Catch, effort and size distribution data from the tangle net fishery in the Tralee area between 2021 and 2025 were used to estimate total catches, the proportion of the catch above the MCRS, and landings per standard unit of tangle net effort (0.7 km). These data were reported by fishermen and scientific observers (Table 17; Palma Pedraza and Tully 2026). The total value of the landings per 0.7 km of net hauled (including crayfish, lobster and brown crab) was €96 in 2025 (Table 18). This compares with €56 for an equivalent level of effort from 30 pot hauls, as shown above (Table 16). The value of the landings in pots therefore averaged 60% of the value in nets for equivalent amounts of effort.

Table 17. Summary of effort, crayfish, lobster and brown crab catch in tangle nets in 2021-2025.

Year	Total nets hauled	Total miles of net hauled	Total crayfish	Total lobster	Total spider crab	Total brown crab
2021	374	273.5	3,121	72	4,551	2,525
2022	671	477	5,602	214	6,757	3,975
2023	762	492.9	6,109	189	7,163	3,967
2024	473	329.7	3,435	106	5,423	2,272
2025	358	243.9	2,970	135	8,943	1,756
Grand total	**2,638**	**1,817**	**21,237**	**716**	**32,837**	**14,495**

Table 18. Total value and value per standard amount of fishing effort in tangle nets in 2021-2025.

Species_Year	% legal	Landed (kgs)	Total value	Value per 700 m of net hauled
Crayfish_2021	66	2,350	€92,043	€140
Crayfish_2022	68	4,902	€179,906	€151
Crayfish_2023	65	4,815	€175,365	€134
Crayfish_2024	52	2,152	€74,210	€88
Crayfish_2025	55	1,753	€60,308	€93
Lobster_2021	65	17	€347	€0.5
Lobster_2022	73	90	€1,628	€1
Lobster_2023	56	65	€1,041	€1
Lobster_2024	73	48	€781	€1
Lobster_2025	55	47	€816	€1
Brown crab_2021	50 (assumed)	682	€1,548	€2
Brown crab_2022	50 (assumed)	1,073	€2,436	€2

Brown crab_2023	50 (assumed)	1,071	€2,431	€2
Brown crab_2024	50 (assumed)	637	€1,446	€2
Brown crab_2025	50 (assumed)	474	€1,076	€2

Modelled crayfish CPUE

The GAM explained 38.2% of the deviance in standardised CPUE (adjusted $R^2 = 0.398$; n = 2,358). In the reference month (May), estimated pot CPUE was approximately 31% of that for tangle nets (exp (-1.165) = 0.31; $p < 0.001$). For tangle nets, CPUE did not differ significantly from May in June or July, increased significantly in August, and declined significantly in October. November did not differ significantly from May. CPUE was also significantly higher (approximately 9% higher) in 2025 than in 2024 ($\beta = 0.087$, $p = 0.038$) (Table 19).

A Gear × Month interaction was included to allow the relative performance of the two gears to vary seasonally. Including the Gear x Month interaction term improved the model fit ($\Delta AIC \approx 19$). However, most individual interaction terms were not statistically significant. The strongest evidence for a seasonal change in relative gear performance occurred in October, when the pot–net difference was significantly smaller (54%) than in May ($\beta = 0.557$, $p = 0.012$).

Soak time had a significant gear specific effect on CPUE. The relationship was strongly non-linear for tangle nets (edf = 5.06, $p < 0.001$), whereas the soak time effect for pots was effectively linear (edf = 1.13, $p < 0.001$), indicating that CPUE responded differently to soak time between gears.

Table 19. Model summary for CPUE. Parametric coefficients and smooth terms for CPUE.

Component	Term	Estimate	Std Error	t-value	p-value
a. Parametric (linear coefficients)	(intercept)	1.141	0.148	7.716	0.0000 ***
	Gear_Pot	-1.165	0.258	-4.519	0.0000 ***
	Month 6	-0.003	0.078	-0.042	0.9661
	Month7	-0.004	0.081	-0.043	0.9654
	Month8	0.230	0.076	3.037	0.0024 **
	Month9	-0.048	0.075	-0.650	0.5159
	Month10	-0.449	0.116	-3.867	0.0001***
	Month11	-0.217	0.259	-0.837	0.4027
	Year2025	0.087	0.042	2.076	0.0380*
	Gear_Pot:Month 6	-0.026	0.230	-0.115	0.9088
	Gear_Pot:Month7	-0.033	0.208	-0.159	0.8740
	Gear_Pot:Month8	0.255	0.196	1.301	0.1934
	Gear_Pot:Month9	0.357	0.202	1.765	0.0777
	Gear_Pot:Month10	0.557	0.220	2.525	0.0116*
	Gear_Pot:Month11	-0.743	0.399	-1.861	0.0628
Component	**Term**	**edf**	**Ref.df**	**F-value**	**p-value**
b. smooth terms (non linear variables)					
	s(SoakTime):Gear_Tangle net	5.032	7.000	41.136	0.0000 ***
	s(SoakTime):Gear_Pot	1.131	6.000	1.977	0.0004 ***

Signif. Codes: 0 <= '***', < 0.001 < '**' < 0.01 < '*' < 0.

Modelled crayfish LPUE

The model explained 14.6% of the deviance in standardised LPUE (adjusted $R^2 = 0.154$; n = 2,358). In the reference month (May), the estimated pot LPUE was approximately 41% of that estimated for tangle nets (exp (-0.899) = 0.41; $p < 0.001$). For tangle nets, LPUE did not differ significantly from May in June, July or September, was significantly higher in August, and was significantly lower in November. LPUE in October was also lower than in May, although the difference was marginally non-significant ($p = 0.051$). There was no evidence of a difference in LPUE between 2024 and 2025 ($\beta = -0.058$, $p = 0.189$).

The model estimated pot/net LPUE ratios ranged from approximately 32% to 54% across months (Table 20). However, there was no statistical evidence that the relative performance of pots and tangle nets were different across months, as none of the Gear × Month interaction terms were significant (all $p > 0.05$).

The smooth effect of soak time was significant for pots ($p < 0.001$) but not for tangle nets ($p = 0.062$), indicating that although soak time influenced pot LPUE, there was no strong statistical evidence of an effect of soak time on tangle net LPUE ($p = 0.060$).

Table 20. Model summary for LPUE. Parametric coefficients and smooth terms for LPUE.

Component	Term	Estimate	Std Error	t-value	p-value
a. Parametric (linear coefficients)	(intercept)	0.803	0.071	11.304	0.0000 ***
	Gear_Pot	-0.899	0.208	-4.317	0.0000 ***
	Month 6	-0.130	0.085	-1.526	0.1272
	Month7	0.003	0.084	0.034	0.9726
	Month8	0.268	0.078	3.418	0.0006 ***
	Month9	0.030	0.077	0.383	0.7015
	Month10	-0.226	0.116	-1.950	0.0513
	Month11	-0.970	0.309	-3.137	0.0017**
	Year2025	-0.058	0.044	-1.313	0.1893
	Gear_Pot:Month 6	-0.050	0.215	-0.233	0.8160
	Gear_Pot:Month7	-0.224	0.194	-1.153	0.2490
	Gear_Pot:Month8	0.026	0.182	0.143	0.8862
	Gear_Pot:Month9	0.156	0.188	0.832	0.4056
	Gear_Pot:Month10	0.288	0.205	1.401	0.1612
	Gear_Pot:Month11	-0.036	0.420	-0.085	0.9325
Component	**Term**	**edf**	**Ref.df**	**F-value**	**p-value**
b. smooth terms (non linear variables)					
	s(SoakTime):Gear_Tangle net	1.233	7.000	0.489	0.0598
	s(SoakTime):Gear_Pot	1.159	6.000	2.193	0.0002 ***

Signif. Codes: 0 <= '***', < 0.001 < '**' < 0.01 < '*' < 0.05

Modelled crayfish and lobster VPUE

The model explained 10.1% of the deviance in VPUE (value of the lobster and crayfish landings combined; adjusted $R^2 = 0.117$; n = 2,358). In the reference month (May), predicted pot VPUE was approximately 59% of that predicted for tangle nets (exp (-0.531) = 0.59; $p < 0.01$).

For tangle nets, VPUE did not differ significantly between May, July, August or September and decreased significantly in June, October and November relative to May (

Table 21). No significant difference in VPUE was detected between 2024 and 2025 (β = -0.054, p = 0.30).

The pot/net VPUE ratio ranged from approximately 40% to 78% across months. However, these apparent seasonal differences in relative gear performance were not supported statistically, as none of the Gear × Month interaction terms were significant.

The effect of soak time on VPUE was significant for pots (p = 0.021). No significant soak time effect was detected for tangle nets (p = 0.217).

Table 21. Model summary for VPUE. Parametric coefficients and smooth terms for VPUE.

Component	Term	Estimate	Std Error	t-value	p-value
a. Parametric (linear coefficients)	(intercept)	4.629	0.078	59.599	0.0000 ***
	Gear_IDPot	-0.531	0.191	-2.777	0.0055 **
	Month 6	-0.254	0.101	-2.511	0.0121*
	Month7	-0.150	0.101	-1.479	0.1394
	Month8	0.131	0.095	1.385	0.1663
	Month9	-0.093	0.093	-1.006	0.3143
	Month10	-0.445	0.142	-3.136	0.0017 **
	Month11	-1.033	0.333	-3.099	0.0020 **
	Year2025	-0.054	0.053	-1.028	0.3042
	Gear_Pot:Month 6	-0.134	0.222	-0.605	0.5454
	Gear_Pot:Month7	-0.374	0.201	-1.864	0.0625
	Gear_Pot:Month8	-0.169	0.185	-0.911	0.3622
	Gear_Pot:Month9	0.021	0.192	0.110	0.9125
	Gear_Pot:Month10	0.280	0.218	1.286	0.1986
	Gear_Pot:Month11	0.045	0.419	0.108	0.9140
Component	**Term**	**edf**	**Ref.df**	**F-value**	**p-value**
b. smooth terms (non linear variables)					
	s(SoakTime):Gear_Tangle net	0.606	7.000	0.127	0.2174
	s(SoakTime):Gear_Pot	0.908	6.000	0.737	0.0207 *

Signif. Codes: 0 <= '***', < 0.001 < '**' < 0.01 < '*' < 0.5

Predicted CPUE, under alternative soak time scenarios

To evaluate the influence of alternative soak time strategies on pot and net fisheries, predictions were generated from the fitted GAMs under a series of standardised soak time scenarios. Pot soak time was fixed at 3hrs in all scenarios since this is the fishing strategy typically used for minimising crayfish escapements. For tangle nets, three different soak time scenarios were evaluated: 24hrs and 48hrs representing a mitigation measure proposed by the fishing industry to reduce bycatch mortality, and 120hrs, which is the most common soak duration used in the commercial tangle net fishery. Predictions were only undertaken for CPUE as LPUE and VPUE were not significantly affected by net soak time.

Predicted CPUE under alternative soak time scenarios

Predicted CPUE values obtained from the GAM varied among the soak time scenarios (Figure 15). Under all scenarios, predicted CPUE for pots remained lower than for tangle nets. Predicted pot CPUE at 3hrs soak time varied seasonally from approximately 0.5 to 2 crayfish per standard fishing unit (30 pots), with the highest values predicted in August and the lowest in November. Predicted net CPUE increased with soak duration, from approximately 2–4 crayfish per standard fishing unit (0.7 km net) under the 24hrs and 48hrs scenarios, and 2.5–5 under the 120hrs scenario.

The relative performance of pots compared with tangle nets varied with the different soak time scenarios and month (Figure 16). Averaged across months, predicted pot CPUE was approximately 49% of that predicted for tangle nets when soak times were standardised at 3hrs for pots and 24hrs for tangle nets, 46% under the 3hrs and 48hrs scenario, and 38% under the 3hrs and 120hrs scenario. Across all scenarios, the pot/net CPUE ratio was lowest in November, while the relative performance of pots increased during August–October, particularly under the shorter net soak time scenarios.

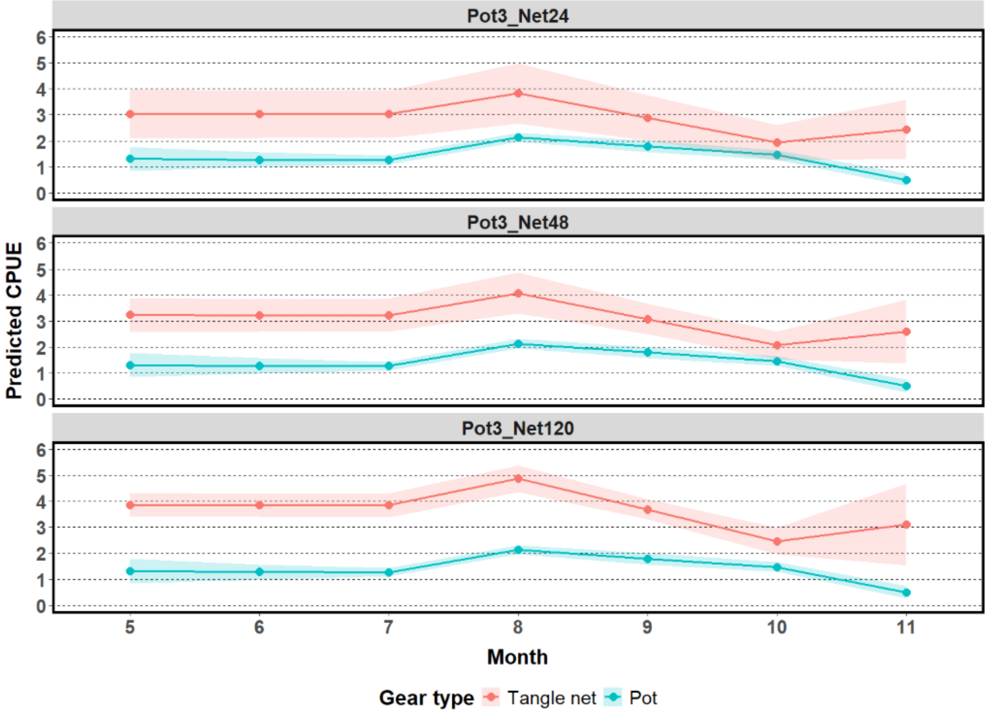


Figure 15. Predicted standardised crayfish CPUE derived from the GAM for pots and tangle nets across months and soak time scenarios. Pot3 – 3hrs soak for pots, Net24 is 24hrs soak for nets etc.

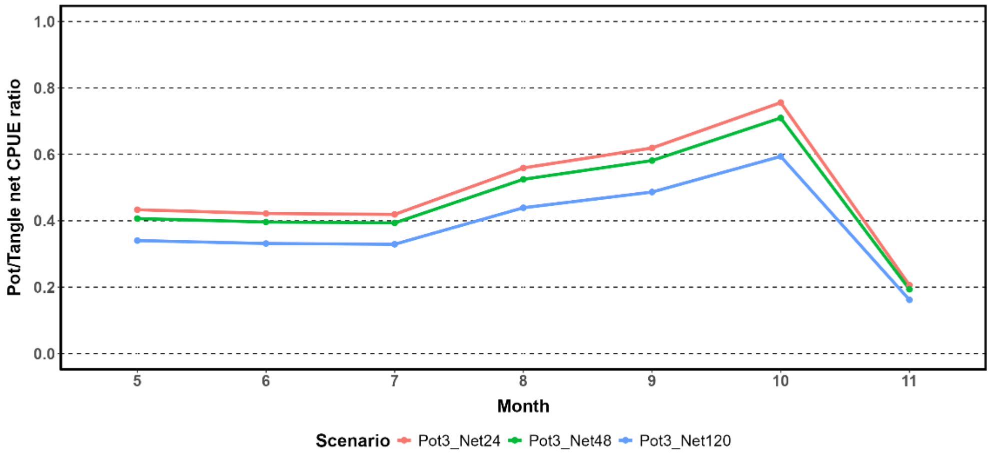


Figure 16. Pot to net CPUE ratio under alternative soak time scenarios across months. Pot3 – 3hrs soak for pots, Net24 is 24hrs soak for nets etc.

Predicted proportion of catch contribution to landings

The proportion of catches that contribute to landings and therefore to the economic gross value was evaluated under alternative soak time scenarios during the fishing season. Where pots are soaked for 3hrs and tangle nets for 120hrs, the predicted proportion of the catch that is landed between May and October ranged from approximately 49% to 69% for tangle nets, and 70% to 84% for pots. The proportion of the catch that was landed therefore was consistently higher for pots than for tangle nets. In November, the predicted proportion contributing to landings declined dramatically for tangle nets to approximately 26%, while remaining high for pots at approximately 81% (Figure 17).

For 48hrs and 24hrs net soak time scenarios, the pattern changed. Under the 3hrs pot and 48hrs net scenario, the predicted proportion of the catch landed for pots and nets were similar from July onwards, with values ranging from approximately 70–84% for pots and 59–83% for nets. For the 3hrs pots and 24hrs nets soak time scenario, the proportion of the catch contributing to landings was higher for pots in May and June but was similar between gears from July to September and was slightly higher for tangle nets in October. In November, the predicted proportion contributing to landings again declined dramatically for tangle nets (approximately 31–34%), while remaining approximately 81% for pots.

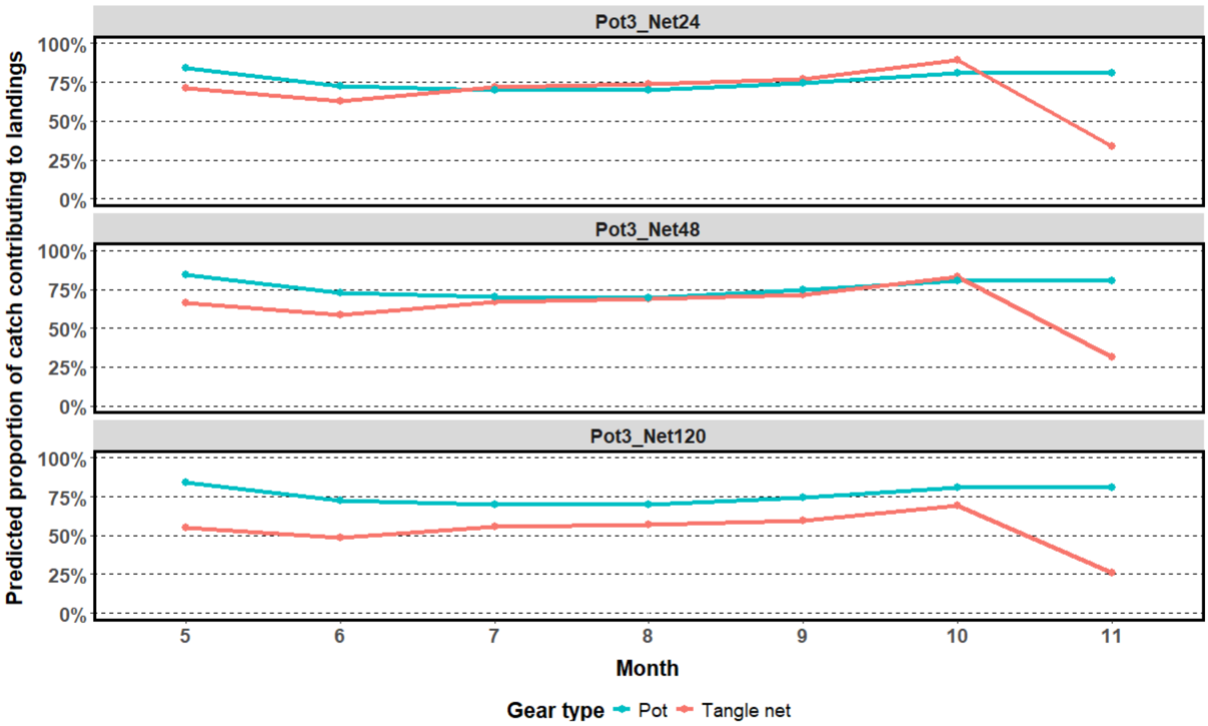


Figure 17. Predicted proportion of catch that contribute to landings under alternative soak time scenarios by month and gear type. Pot3 – 3hrs soak for pots, Net24 is 24hrs soak for nets etc.

Comparison of catch value in crayfish pots and the commercial pot fishery for lobster

Catch rate and landings value for the lobster fishery, operating in the same area as the pot trial for crayfish, are provided here for years 2021-2024 in order to compare the value of fishing for crayfish with pots relative to that of the commercial pot fishery for lobster. The lobster data come from observers working on board lobster vessels, from a sentinel vessel programme (SVP), where skippers report daily landings and effort, and from a Skipper self-sampling programme where skippers are contracted by the Marine Institute to report operation level catch and effort data. The size distribution of the catches is also reported and used here to estimate the proportion of the catches above the MCRS (Table 22).

Mean lobster CPUE (numbers per pot) varied between 0.27 and 0.50, with the highest catch rates observed in 2022. Brown crab CPUE were more variable ranging from 0.26 to 2.16 and peaking in 2022. The proportion of strings with positive catches and landings was generally high for both species throughout the study period (Table 23).

Table 22. Fishing effort, catch and landings data for lobster and brown crab from fisheries monitoring programmes in soft-eye pots in the crayfish trial study area.

Year_Species	Total pots hauled	Total caught	Total landings
2021_Lobster	45,458	12,178	5,091
2022_Lobster	32,817	12,855	5,445
2023_Lobster	29,212	10,493	4,433
2024_Lobster	36,813	18,814	8,203
Total	**146,852**	**55,306**	**23,733**
2021_Crab	47,069	27,809	25,216
2022_ Crab	19,334	10,814	3,894
2023_ Crab	15,420	4,181	2,238
2024_ Crab	23,516	28,725	13,826
Total	**107,891**	**71,529**	**45,174**

Table 23. Fishing effort data, CPUE and LPUE for lobster and brown crab in soft-eye pots in the crayfish trial study area. SD = standard deviation.

Year	Species	Total pots hauled	Total strings hauled	Average pots per string	% strings with catches	Mean CPUE per pot	SD CPUE per pot	% strings with landings	Mean LPUE per pot	SD LPUE per pot
2021	Crab	5,095	153	33	1	0.26	0.24	0.95	0.16	0.14
2021	Lobster	6,324	194	33	0.97	0.27	0.21	0.93	0.13	0.11
2022	Crab	4,994	116	43	0.94	2.16	4.22	0.86	0.46	0.81
2022	Lobster	4,930	151	33	0.98	0.5	0.37	0.95	0.17	0.12
2023	Crab	3,589	123	29	1	0.76	0.49	0.96	0.19	0.14
2023	Lobster	8,033	234	34	0.99	0.3	0.16	0.96	0.13	0.09
2024	Crab	9,039	234	39	1	0.5	0.52	0.65	0.13	0.12
2024	Lobster	9,262	239	39	1	0.44	0.18	0.95	0.18	0.11

Lobster CPUE increased from 4.36 kg per 30 pots hauled in 2021 to 6.73 kg in 2025. Brown crab CPUE reached a maximum of 11.94 kg per 30 pots in 2022, followed by a second peak in 2025 with 7.56 kg per 30 pots hauled (Table 24).

The combined value of lobster and brown crab landings averaged €62 per 30 pots hauled during 2021–2024. Lobster accounted for 80–88% of the total catch value, depending on year, while the contribution from brown crab declined in 2023 and 2024 (Table 25). For comparison, the mean value generated by 30 crayfish pots in 2025 was €56.

Table 24. Catch and landing rates (in kg) for lobster and brown crab per 30 soft-eye pots in the crayfish trial study area.

Year_Species	Average CPUE (kg/30 pots)	Average LPUE (kg/30 pots)
2021_Lobster	4.36	2.48
2022_Lobster	6.15	3.25
2023_Lobster	4.84	2.67
2024_Lobster	6.73	3.66
2021_Crab	4.76	4.38
2022_Crab	11.94	4.97
2023_Crab	5.12	2.71
2024_Crab	7.56	4.32

Table 25. Total value and value per standard amount of fishing effort in the lobster and brown crab fishery in Kerry 2021-2024.

Species_Year	% legal	Landed (kgs)	Total value	Value per pot	Value per 30 pots
Lobster_2021	42	3,226	€111,421	€1.5	€46
Lobster_2022	42	3,444	€110,852	€2	€59
Lobster_2023	42	2,811	€83,800	€1.5	€45
Lobster_2024	44	5,177	€155,501	€2	€59
Total/average		**14,658**	**€461,573**	**€1.8**	**€52**
Crab_2021	91	13,385	€33,398	€0.3	€10
Crab_2022	36	2,067	€11,503	€0.5	€15
Crab_2023	54	1,191	€4,226	€0.2	€7
Crab_2024	48	7,331	€19,788	€0.3	€8
Total/average		**23,973**	**€68,914**	**€0.3**	**€10**

Comparison of costs and earnings in a pot and net fishery for crayfish

The value of landings for equivalent amounts of effort in targeted crayfish fisheries using tangle nets and pots are presented above. The value of the catch from tangle nets, based on observed data and GAM model estimates, was approximately twice the value from top entry pots in 2025. The value per unit of effort in the crayfish pot trials in 2025 was 90% of the value of the catch in commercial lobster and crab fishery, using soft-eye pots, in the same area.

The above comparisons do not take into account fishing costs. To evaluate the relative fishing costs and therefore the net difference in catch value between tangle nets and pots, a five year fishing enterprise scenario was developed. Gear set up and depreciation costs over five years were estimated for pots and nets, based on the pot fishing strategy used in the potting trials. This strategy would use a relatively small number of pots (~120 pots), which would be hauled three times in 24hrs, as generally reflected in the trial design. Under this approach, the input capital costs, gear depreciation cost, bait use and fuel consumption are minimised.

A sustainable potting fishing strategy for crayfish should avoid a progressive increase in pot numbers, as controlling fishing effort is essential to limiting operating costs, maintaining economic viability and maintaining crayfish stocks at levels that support economically viable catch returns. Although parlour pots are likely to be more efficient than top entry bucket pots used in this study, their use in the absence of legally binding pot limits, which have proven difficult to implement in Ireland, would likely lead to an increase in pot numbers and associated increase in capital and operational costs. This would also increase competition with existing crab and lobster fisheries. Furthermore, the economic viability of this approach would be highly dependent on maintaining sufficiently high crayfish catch rates to justify the additional investment in gear. Unregulated potting effort would reduce crayfish stock abundance, catch rates and value per effort and eventually drive the fishery to low profitability (the open access equilibrium dilemma).

Set up and operating costs per annum were estimated for top entry pots (short soak time strategy) and compared with existing set up and operating costs for an equivalent amount (length) of tangle nets. The pot strategy is

1. 120 top entry pots (no parlour) per vessel
2. Haul three times per day April-Oct; sunrise, morning, evening, overnight soak
3. Total pot hauls per day = 360 (8.4 km length of gear)

The set up unit costs, scaled costs, depreciation and gross and net value of the catch per day and over a five year period using this fishing strategy is compared to the equivalent amount of fishing effort (8.4 km) with tangle nets. Standardising comparisons by gear length is useful because the time and cost of shooting and hauling fishing gear are generally related to the length of the gear. However, differences in the actual time required to haul pots and nets were not explicitly incorporated into the analysis. In practice, gear handling time for nets is usually longer particularly when there is bycatch.

Set up costs

Unit costs for pots, tangle nets, associated ropes and buoys, and the labour costs required to mount a sheet of net, are presented in Table 26. Pots and nets were compared using standard units of fishing gear. A standard string of pots comprised approximately 30 pots spaced at 24 m (12 fathoms), giving a total string length of 696 m. An equivalent length of net consisted of seven 100 m sheets (700 m total length).

Table 26. Unit gear costs for nets and pots in 2025. Labour costs for preparing nets (mounting nets) are included as there is significant labour involved.

Gear	Item	Euro	Unit	Length (m)
Net	Net prep costs (labour)	€40	per sheet	100
Net	Net purchase	€37	per sheet	100
Pot	Pot purchase	€103	per pot	
Both	Ground rope	€74	coil	220
Both	Buoy rope	€104	coil	220
Both	Buoys	€18	each	

The initial set up costs for 30 pots are significantly higher than the set up costs for an equivalent 0.7 km of net, mainly because of the high unit cost of pots (Table 27). Higher depreciation rates for nets, however, results in the five year costs for pots being only slightly higher than for nets (Table 28). Pots and nets were depreciated over 8 and 1.5 years respectively, with zero salvage value. Ground rope was depreciated over four years. Nets in their second year generally have lower catches and tend to be left for longer soak times, meaning their remaining economic value is very limited. This justifies a 1.5 year depreciation.

When costs are scaled to a commercial operation of 120 pots (with three repeat hauls per day) and an equivalent amount of daily net effort (8.4 km of nets), the costs over five years are ~€22K for pots compared with ~€57k for nets (Table 29). The difference here is mainly due to efficient use of limited potting gear which reduces input and depreciation costs.

Table 30 shows the gross value of daily catches in tangle nets (8.4 km net, €1,152 per day), which is approximately twice that in pots (360 pots, 8.4 km, €672 per day). This is based on Tralee pot trial data and data from tangle nets in the same area in 2025 (Table 16 and Table 18).

The gross five year earnings based on 120 fishing days per year and daily earnings in Table 30 is €403K and €691K for pots and nets respectively representing a difference of €288K over five years. However, after accounting for depreciation and replacement costs, the difference in net earnings is reduced to €324k for pots and €518K for nets respectively or a difference of €253K over five years. This reduction is mainly due to the higher depreciation and replacement costs associated with nets.

Table 27. Set up costs (inc VAT and 2025 prices) for a unit of pot and net fishing effort.

String of 30 pots	
Distance between pots (m)	24
Pots on string	30
Ground rope per string (m)	696
Pot costs	€3,099
Ground rope costs	€233
Buoy rope costs (depth 40m)	€47
Buoys	€37
Total	**€3,417**
A net of 0.7 km	
Sheets of net	7
Net costs	€258
Net mounting cost	€280
Lead rope	€387
Head rope	€258
Buoys	€37
Total	**€1,221**

Table 28. Five year costs (set up and depreciation) for equivalent pot and net fishing effort.

Five year cost per unit of effort (30 pots, 0.7 km net)	
Depreciation (years). Salvage value = 0	
Pots	**8**
Nets	**1.5**
Ground ropes for nets or pots	**4**
Annual depreciation cost	
Pots (pots and rope)	€445
Nets (nets and rope)	€529
Five year Costs	
Pots	€3,417
Nets (net mounting cost accumulated)	€2,131
Pots (depreciation cost)	€2,229
Nets (depreciation cost)	€2,648
Pots total cost	**€5,647**
Nets total cost	**€4,779**

Table 29. Five year costs to maintain 120 pots and equivalent net fishing effort.

Five year costs to maintain 120 pots and equivalent length of net	
Pots (120)	**€22,586**
Equivalent costs for nets (8.4km)	**€57,343**

Table 30. Expected value of the landings per day from pots and nets based on equivalent effort.

Value of landings per day	**Quantity**
Pots	
Number of pots	120
Hauls per pot	3
Total hauls per day	360
Value per 30 pots hauled (pot trial data)	€56
Value per day	**€672**
Nets	
Length of net (km) hauled	8.4
Value per 0.7 km (Tralee tangle net data)	€96
Value per day	**€1,152**

Discussion

This report compares crayfish targeted catches, landings and landed value, standardised for fishing effort, between commercial tangle nets and top entry pots. Pot data was obtained from trials run over five years using different pot types and commercial scale trials, using single chamber top entry pots in 2024 and 2025. Crayfish accounted for 95% of the value of the landings in tangle nets and about 75% of the landings value in top entry pots targeting crayfish. Lobster bycatch was more significant in top entry pots than in tangle nets.

Five year costs to purchase and maintain equivalent commercial quantities of tangle nets and top entry pots to target crayfish were estimated. These costs were used to provide net value, or pseudo net value given that not all fishing costs were included, of the landings that could be expected from equivalent quantities of each gear operating for a five year period.

Gross value of the landings per standard unit of effort in the tangle fishery was approximately double that achieved in commercial scale top entry pot trials in 2025. Gross value per effort in the top entry pot trials for crayfish was, however, 90% of the value of equivalent effort in local pot fisheries targeting lobster (with crab bycatch). Potting for crayfish during the summer months, therefore, provides a gross value per unit effort comparable to that of potting for lobster in this location. Top entry pots catch significant numbers of lobsters in addition to crayfish, while soft-eye pots do not catch crayfish.

The strategy adopted for the commercial scale pot trial in 2024 and 2025 for crayfish was specifically designed to minimise input gear costs by hauling the same gear repeatedly throughout the day to maximise the catching potential of the gear. It specifically avoided the use of parlour (second chamber) pots and opted for pots where escapement of crayfish was likely to be high if pots were left to soak for long periods. This approach reflects a fishing strategy that was used in the past to target crayfish.

Today this strategy would minimise competition with the existing lobster and crab pot fisheries, which already are at full capacity with respect to fishing effort potential and where each vessel uses hundreds or thousands of pots. We consider the short soak and minimum gear input strategy necessary to avoid unintended consequences for the lobster fishery if a transition away from tangle nets is to be achieved. The strategy adopted in this study also minimises bait input, as pots may not need to be baited after each haul in a fishery where the gear is being hauled every 3-6hrs.

Other pot designs were more efficient in the pot trials than the top entry bucket pots used in the 2024-2025 commercial trials. These included parlour pots, which reduce escapement and allow pots to be left to soak for more than 72 hours. This is an alternative strategy of using the most efficient pot designs but would need to be accompanied by limiting the number of pots per vessel for the fishery to remain sustainable. Not many Irish vessels currently use top entry parlour pots for crayfish, although there are some examples. Commercial crayfish value per unit effort in these data, which are not presented for confidentiality reasons and are based on only one or two vessels, is significantly higher than that observed in the pot trial data for Tralee Bay. There is scope, therefore, to adopt different pot fishing strategies to help bridge the earnings gap with tangle nets. However, during the pot trials crayfish mortality was significant in parlour pots if the crayfish had entered this second chamber of the pot. This mortality seemed to be caused by predation by peracarid crustaceans which may not be an issue everywhere.

The catch value in tangle nets was significantly higher than in commercial scale pot trials conducted in 2024-2025 for equivalent amounts of fishing effort. However, when gear purchase and depreciation costs for both gears are considered over a five year term, the net earnings from tangle net and pots fisheries are closer in value. This is mainly due to the very high depreciation costs and gear set up costs associated with tangle nets.

Catch rates of crustaceans in pots are usually regarded as an index of crustacean abundance. Maintaining high stock levels, therefore, is important in developing a viable pot fishery for crayfish. This was possible in the past, when up to 150 tonnes of crayfish were landed annually in Ireland using pots and catch rates were very significantly higher than those shown in this report. Re-building biomass of crayfish in local reef habitat would seem to be possible if fishing effort or landings are appropriately managed. Mark-recapture data from tagging programmes in the pot trial area between 2018-2024 showed a high level of residency of adult crayfish and repeat recaptures of the same individuals across years in local reef habitat showing how the stock biomass could be rebuilt by managing fishing mortality.

There are significant advantages in transitioning away from tangle nets to pots:

- Elimination of bycatch of critically endangered species reported by Palma-Pedraza and Tully (2026).
- Mortality of crayfish, including individuals below the MCRS, can be 10-20% in tangle nets depending on soak time and exposure to scavenging peracarid crustaceans, which is common in some areas of Tralee Bay. In contrast, mortality of both commercial sized and discarded crayfish caught in pots is expected to be negligible. In any case, the catch of undersized crayfish in the pot trials was much lower than in nets.
- In some pot trials, the average size of crayfish captured in pots was larger than those captured in nets, suggesting that pots may select larger individuals.
- Crayfish caught in pots generally had better condition and vitality than those caught in nets. Given that crayfish are stored live in holding facilities and transported live in water to European markets, maintaining high vitality is important for reducing losses during storage and transport. Lower

mortality and improved condition may increase the value of catches and potentially improve market opportunities, including access to new more distant markets.
- A well-managed pot fishery for crayfish could easily demonstrate its sustainability credentials in accreditation schemes, whereas tangle net fishery faces greater challenges due to bycatch of endangered species. This may support access to new markets and help maintain position in current markets.
- A fishing strategy based on a limited number of pots that are hauled frequently is more efficient in labour and fuel input costs compared with labour and maintenance of kilometres of tangle nets.

Nevertheless, based on the main pot type used in the trial and following a short soak and high haul frequency fishing strategy, the average value of the catch per day is significantly lower in pots than in nets. However, this difference is highly variable for both gears. Pot trial data and commercial netting data show high interannual variability, presumably reflecting changes in stock abundance, and catchability within the season and between years. The pot trials do show that earnings in a top entry pot fishery for crayfish can be commercially viable as they are only 10% less than the earnings in soft-eye pot fisheries for lobster for instance in the same location.

In the recent past, the species diversity of the commercial catch in tangle nets was higher than in pots. Monkfish (*Lophius* spp), turbot (*Psetta maximus*), Pollack (*Pollachius pollachius*) and crab (*Cancer pagurus*) were important commercial bycatch species in tangle nets. However, as reported by Palma Pedraza and Tully (2026), this is no longer the case, with crayfish now accounting for approximately 95% of the catch value. The catch diversity is currently higher in pots, where lobster and brown crab bycatch are more significant. In Tralee Bay, the same top entry gear can also be used to target spider crab in spring during migration of crab into shallow waters, providing additional fishing opportunities.

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Annex I. Generalised Additive Model (GAM)

Model overview

Generalised Additive Models (GAMs) were developed to assess differences in fishing performance between fishing gears (pots vs tangle nets) for three response variables: (1) standardised catch per unit of effort (CPUE) of crayfish, (2) standardised landing per unit of effort (LPUE) of crayfish, and (3) value per unit effort (VPUE), calculated from the combined crayfish and lobster landings. Fishing effort was standardised to 30 pots per string for pots and 0.7 km of net length for tangle nets to facilitate comparisons between gear types.

Separate GAMs were fitted for each response variable using an identical model structure. The models estimated differences in gear performance while accounting for variation associated with month, year and soak time. A Gear × Month interaction was included to allow the relative performance of pots and tangle nets to vary among months and therefore to account for potential seasonal differences in gear performance.

Tangle nets, May (Month 5) and Year 2024 were used as the reference levels in the models. The model intercept therefore represents the expected response for tangle nets in May 2024, at the reference value of the smooth soak time component. The remaining parametric coefficients represent deviations from these reference conditions associated with pot, alternative months, year 2025, and the Gear × Month interaction.

Interaction model formulation

The response variables included a mixture of zero observations (zero catches or landings) and continuous positive values. Consequently, GAMs were fitted using a Tweedie error distribution with a log link function (Shono 2008).

The model incorporated Gear_ID, Month, Year and Gear x Month interaction as parametric fixed effects, together with a gear specific smooth function of soak time:

$$\text{Log}(\mu_i) = \beta_0 + \beta_1 Gear_i + \beta_2 Month_i + \beta_3 (Gear\ x\ Month)_i + \beta_4\ Year_i + f_{Gear\ i}\ (SoakTime_i)$$

- μ_i is the expected CPUE, LPUE or VPUE for observation i.
- The β_0 is the model intercept.
- β_1, β_2 and β_4 are the parametric effects of gear, months and years, respectively.
- β_3 represent the Gear x Month interaction, allowing the difference between pots and tangle nets to vary among months
- $f_{Gear\ i}\ (SoakTime_i)$ is a gear-specific smooth function of soak time, allowing the relationship between soak time and the response variable to differ between pots and tangle nets.

Because the model uses a log link function, the model coefficients are estimated on the logarithmic scale. Exponentiating a coefficient converts it to a ratio, showing how the expected response changes relative to the reference condition.

Soak time smoothing

The potentially non-linear effect of soak time was modelled using separate smooth functions for each gear type (pot and tangle net), allowing the relationship between soak time and CPUE, LPUE or VPUE to differ between gears. The basis dimension (k=8), essentially setting the degrees of freedom for the application of the smooth function, was selected following preliminary model exploration and assessed using GAM diagnostics, including *gam.check()*, which indicated that the selected value was appropriate for representing the observed soak time relationships.

Model estimation

Models were fitted using Restricted Maximum Likelihood (REML), implemented via the *mgcv* package in R. This approach was used to estimate smoothing parameter because it provides stable and reliable model fitting and generally reduces the risk of overfitting compared with generalised cross-validation.

Additional shrinkage penalties (select = TRUE) were applied to smooth terms, allowing terms with limited explanatory power to be penalized towards zero where unsupported by the data.

Model predictions

Model predictions were generated for predefined soak time scenarios to facilitate direct comparison of gear performance for different fishing strategies. For the main comparison, pot predictions were generated at a 3hrs soak time and tangle net predictions at a 120hrs soak time. Predictions were generated for each gear and month and averaged across years. Alternative net soak time scenarios of 24hrs and 48hrs were tested.

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