# Selectivity estimates for *Sepiella inermis* (Van Hasselt, 1835) in 40 mm diamond mesh codend trawl net

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Cephalopods are mostly targeted by trawlers and *Sepiella inermis* (spineless cuttlefish), contributes about 2-4 percent of total cephalopod landings in India. Cephalopods accounted for 6.9 percent of total landings in Gujarat in 2018, with *S. inermis* accounting for approximately 1 %. The most common length of this species in the fishery is between 35 mm to 147 mm. The length at first sexual maturity varies along the coast, and recent estimates for west coast of India for this species is 48 and 55 mm for males and females, respectively.

There are no estimates of trawl codend selectivity for this species and experiments were carried out using a 40 mm diamond mesh codend using covered codend method. The selection parameters for *S. inermis* were derived using SELECT methodology and the length at 50 % retention (L50)±(s.e.) was worked out as 36.2±1.2 mm and selection range as 19.9±2.1 mm. The selection factor and the selection ratio for the codend were worked out as 0.9 and 0.55, respectively. The suggested mesh size for the codend based on length at first sexual maturity (LFM) of females (55 mm) and males (48 mm) were estimated as 60 and 53 mm (diamond mesh), respectively. This is the first estimate of trawl selection for this species and operational parameters like towing speed, codend catch etc., that could influence selectivity were not considered and hence more studies by incorporating these factors will help in further refining the parameters of the selection curve.

[**Keywords**: Cephalopods, Covered codend, L$_{50}$, SELECT, Selectivity]

## Introduction

Cephalopods are a major fishery in India, with the bulk of the catches being landed by the trawlers. The total landings of Cephalopods along the Indian coast during 2018 was about 2.2 lakh tonnes, with squids and cuttle fishes contributing to 54 and 34 %, respectively to the total catch and the rest by Octopus[1]. Contribution of Cephalopods to the total landings have steadily increased from 2014 and during 2018, they constituted 6.3 % of the total marine fish landings of India. The spineless cuttle fish *Sepiella inermis* forms about 2-4 % of the total cephalopod landings in India[2].

Cephalopods add substantially to the molluscan resources of Gujarat, with landings of 54,023 t in 2018, and accounting for 6.9 % of the state's overall marine landings, with *S. inermis* accounting for about 1 % of the cephalopod landings. The length of this species caught in the fishery varies from 35 to 147 mm, with a mean length (mantle length) of capture measured at 35 mm[1].

Wide variation in length at first sexual maturity (LFM) *i.e.*, length at which 50 % of the individuals mature, has been observed along the Indian coast for this species. Females are reported to mature later, and the LFM of *S. inermis* along the Indian coast was estimated at 82 mm[3]. A more recent study reports the dorsal mantle length at LFM along the west coast of India as 48 and 55 mm, respectively for males and females[4]. The length at which 50 % of *S. inermis* become vulnerable to fishing gears along the Mumbai coast is reported at 42 mm[5]. The species is reported to have a very high growth rate (K = 1.37 to 2.63)[6,7] and two to three spawning peaks in a year along the north west coast of India. This species has a wide distribution range along the Indo-pacific and the length at first sexual maturity reported is higher along the Indonesian waters, estimated at 91.63 mm for females and 73.24 mm for males[8]. Life span of the species is reported to be around 2.19 years, though it becomes vulnerable to the fishery at the age of 5 months itself[4]. It is also reported that most of the individuals caught along the northwest coast of India, were below the length at first sexual maturity, which could have implications in the management of this resource, since continuous capture of juveniles at this rate can lead to growth overfishing[5]. The high growth rate is one reason for the steady catch rates for this

species, despite drastic reduction in the catches of many other commercially important species along the Gujarat coast[5].

The knowledge on selectivity of commercially important gears is vital for the effective monitoring, management and sustainable exploitation of the fishery resources. Usage of selective gears help to minimize the capture of juveniles by regulating the length at first capture, increasing the yield per recruit of targeted species and in reducing the discards generated by the fishery[9,10]. The codend of fishing net is the portion of trawl net where fishes aggregate and try to escape; while changes made to this part of the net, offers better escape opportunity for the juveniles and non-target species and thereby significantly improve selection of targeted size[11]. The main factors that affect the codend selectivity of trawl nets are the size of the mesh openings of the codend net and the probability that the fishes come across these openings[12]. Other factors that are found to influence the selection parameters of the trawl codend are twine diameter[13], material used for fabrication of codend[14], speed of tow[15], seasonal changes in fish condition[16], codend circumference[17], codend catch weight[18] and shape of the mesh opening[19, 20].

Even though the government has made the use of 40 mm square mesh codends net mandatory[21], most fishing trawls along the Gujarat coast use diamond mesh codend nets with mesh sizes ranging in length from 20 to 30 mm[22]. Although studies are conducted using 40 mm square mesh codend nets[23], fishermen are often skeptical of using square mesh codend nets out of fear of losing the catch and continue using diamond meshes. A diamond mesh codend net was used to find the selection properties, since data on selectivity estimates for this species in this codend will be helpful for devising different management options including optimization in the size or shape of net codends in this fishery[24].

The logistic curve which is represented as, $r(l) = \dfrac{\exp(a+bl)}{1+\exp(a+bl)}$ , (where, $r(l)$ is the probability that a fish of length $l$ retained in the codend, and $a$ and $b$ which are the intercept and the slope of the equation to be estimated), which is a monotonically increasing curve that is expected in case of selection curves for towed gears. Other parametric, non-parametric and semi-parametric curves are also widely used based on the experiments and the nature of data collected[12].

From the above equation, the selectivity parameters are derived from the intercept and the slope values. The length at 50 % of the fish captured denoted by $L_{50}$ is - $a$ / $b$, the selection range (SR) which is the difference between the 25 % retention ($L_{25}$) and the 75 % retention ($L_{75}$) values is SR = $2\log_e(3)$ / $b$ = 2.197 / $b$. The size of selection range indicates how sharp the selection curve is for that codend, a large value indicates a gradual slope and low value indicates a knife edge selection, which is considered ideal. Selection factor (SF) is an important parameter derived by dividing length at 50 % retention by the codend mesh size and this value is often used to derive a suitable mesh size for a species[12].

The model that is now used as the standard for estimating the selectivity parameters is SELECT (Select Each LEngth's Catch Total)[25]. This methodology is now used as a standard for both the towed gears and static gears[26,27]. This model does not require the quantification of the length frequency of the population $\lambda_l$, which is difficult to quantify, but rather is dependent on the proportion of catch of a particular length class retained by the experimental gear. From the general model the expected value of a particular length class $l$ in $j$ hauls may be modeled as $\phi_{lj} = E(y_{lj}) = \dfrac{p_j \lambda_j(l)}{\sum_j p_j r_j(l)}$, which is equal to= $\dfrac{p_j r_j(l)}{\sum_j p_j r_j(l)}$, where $j$ is the number of hauls and $y_{lj}$ is the proportion of the length class $l$ taken in the $j$ hauls. Here the probability does not depend on $\lambda_l$ and the log-likelihood for the data $y_{lj}$ is $\sum_l \sum_j n_{lj} \log_e(\phi_{lj})$ and on maximizing the log-likelihood gives the selectivity estimates and the parameters defining the selection curve[28].

In case of the covered codend method, the SELECT methodology corresponds to a standard binomial regression and the parameter estimates for the regression can be derived using the generalized linear modeling[28].

Usually, estimates of a gear's selectivity are obtained from multiple tows, and between-haul difference in size selectivity for various species is reported[28]. The reason for the variation in the selectivity can be due to many factors like the towing speed, towing direction, water depth, and the spatial structure of the population encountering the net[27]. This between-haul variability should be taken into consideration for valid conclusion regarding the selectivity estimates for the gear. Inference regarding the between-haul variation is done by estimating the

Replication Estimation of Dispersion (REP) and is estimated by comparing how well the expected curve, fitted using the combined hauls data fits the observed catch curves of each individual haul. REP is calculated using the Pearson chi-square statistic for model goodness-of-fit and dividing by its degrees of freedom. Under the null hypothesis of no extra-Poisson variation, the distribution has an approximate chi-square distribution on degrees of freedom and if the null hypothesis is rejected, then the standard error of the estimated parameters should be multiplied by square root of REP[28].

The reports of selection properties of net codends for cephalopods are rare from the Indian waters[29], and there are no reports on the net codend mesh size selection for *S. inermis*. Therefore, this study was undertaken to estimate the selection properties and derive the selection factor for this important species, to determine an optimum codend mesh size. This information will be very crucial as an important background data for implementing mesh-based policy decisions.

## Materials and Methods

Trials were carried out on-board Departmental Fishing vessel MFV Sagar Kripa (15.5 m $L_{OA}$; 124 HP; Stern trawler) along the coastal waters off Veraval, Gujarat. The dimensions and the engine power of the vessel were similar to the commercial trawlers operating in the region. The study was carried out along the commercial fishing grounds off Veraval in the depth zone of 15-45 m using a 34 m high opening bottom trawl with 40 mm diamond mesh codend net, fabricated with 2.0 mm Ø HDPE twine. A codend cover of 20 mm mesh size made of 1.25 mm Ø PA twine was used as a cover over the codend net to capture the escapees and determine the escapement rate from the codend. The dimensions of the net codend cover were (1.5 times longer and wider than the net codend to avoid the masking of codend by the cover[30] and this method is found to be appropriate when the codend catches expected are less[31]. A pair of V-form otterboards (1.36 m x 0.79 m; 80 kg) was used and the bridle and the sweep length were fixed constant for all operations at 10 and 20 m, respectively, since it is found that changes could affect the catch rate and species composition in the trawl[32]. The speed of the vessel was maintained between 1.18 to 1.29 ms^{-1}.

A random check of the mesh size (40 meshes each) was carried out using a wedge-shaped measurement device with a 2 kg weight attached, to ascertain the changes in mesh size of the codend before each operation. All the operations were carried out during daytime and uniform shooting and retrieval procedures were adopted for all the tows. At the end of each tow, the catches from the codend and the cover were kept separately and after sorting, each individual was weighed, and the Dorsal Mantle Length (DML) was measured and recorded to the nearest mm. This study was of short duration conducted within two weeks, in the same fishing ground with hauls of same duration. Some of the factors that influence the selection properties of the gear are the time of the haul, season and variation in codend catch[25,27]. However, since the study was of short duration with nine hauls, these factors were assumed to be constant and not considered to be affecting the estimates of the selectivity of codend mesh size for this species[33].

The R-function code[34] using the package *nlm*, which is the built-in numerical optimizer in R-software[35], was used for the analysis. The length at 25, 50 and 75 % retentions, are represented as $L_{25}$, $L_{50}$ and $L_{75}$, respectively, selection range (SR), selection factor (SF) which is $L_{50}$/mesh size[12] and selection ratio (SRA), estimated as selection range (SR)/$L_{50}$, were also calculated for the codend. The confidence intervals for the selection parameters were calculated using their covariance matrix, which is obtained based on the maximum likelihood estimation procedure[12]. The diagonal elements in the covariance matrix represent the variance estimates for the selection parameters. When there is an indication of over dispersion in the data, the estimated variances are adjusted for this before the next step in the estimation of the confidence intervals[12,28]. The calculations of SF and SRA were based on the nominal mesh size (40 mm).

## Results

Escapement data of *S. inermis* from nine hauls using the 40 mm diamond mesh codend net were used for analysis. The average mesh size (39.8±0.1 mm) of the codend from the different measurements made did not vary significantly from 40 mm. The time of actual trawling was 90 minutes and was carried out during the day hours between 09:00 to 14:00 hours in the depths ranging from 15-20 m off Veraval coast, Gujarat, in the traditional fishing grounds of trawlers. The tows were made in the same fishing ground in the

month of October, when the sea was calm and the average sea surface temperature was 28 °C. The weight of total catch did not vary significantly in the codend and ranged from 25 to 40 kg, with fish belonging to the families Trichiuridae and Sciaenidae accounting for 80 % of the catch. Jellyfish made up between 10-15 % of the catches in each haul. The catches were not too large for *S. inermis* (2-3 % of total catch) and hence sub-sampling was not required and all the specimens caught were measured.

A total of 473 individuals (42 %) were retained in the codend and 653 individuals (58 %) escaped to the cover net. Count data for the number of fish retained in the codend and the cover were binned into one centimeter length classes and plotted. The size selection curve of *S. inermis* for the 40 mm diamond mesh codend is shown in Figure 1. The length at 50 % retention ($L_{50}$)±s.e. for the species was derived as 36.2±1.2 mm. The selection range was worked out as 19.9±2.1 mm. The selection factor and the selection ratio for this codend were worked out as 0.9 and 0.55, respectively. There was no significant variation in the total catch in the codend, with average catch of about 35 kg in each haul. The details of the parameters estimated, the

covariance matrices, the recommended mesh size based on the SF and length at first maturity values (from different studies) are given in Table 1.

Table 1 — Selectivity estimates of *Sepiella inermis* in diamond mesh codends

| | |
|---|---|
| Number of hauls | 9 |
| Total individuals in the codend | 473 |
| Total individuals escaped to cover | 653 |
| $L_{50}$ (cm) | 3.62 (0.12)* |
| Selection range (cm) (SR) | 1.99 (0.21) |
| Selection factor (SF) | 0.91 |
| Selection ratio (SRA) | 0.035 |
| *Parameter estimates* | |
| $a$ | -3.40 (0.30) |
| $b$ | 1.10 (0.07) |
| R11 | 0.092 |
| R21 | -0.0253 |
| R22 | 0.00772 |

Length at first sexual maturity ($LFM_{50}$) (mm) and optimum mesh size (mm) derived from using SF and LFM reported by authors:

| | |
|---|---|
| Sundaram & Khan[4]: 55 mm for ♀ | 60 mm |
| Sundaram & Khan[4]: 48 mm for ♂ | 53 mm |
| Silas[3]: 82 mm (pooled) | 90 mm |

* Standard errors are given in parentheses and are corrected for the between-haul variation using the replication estimate of dispersion
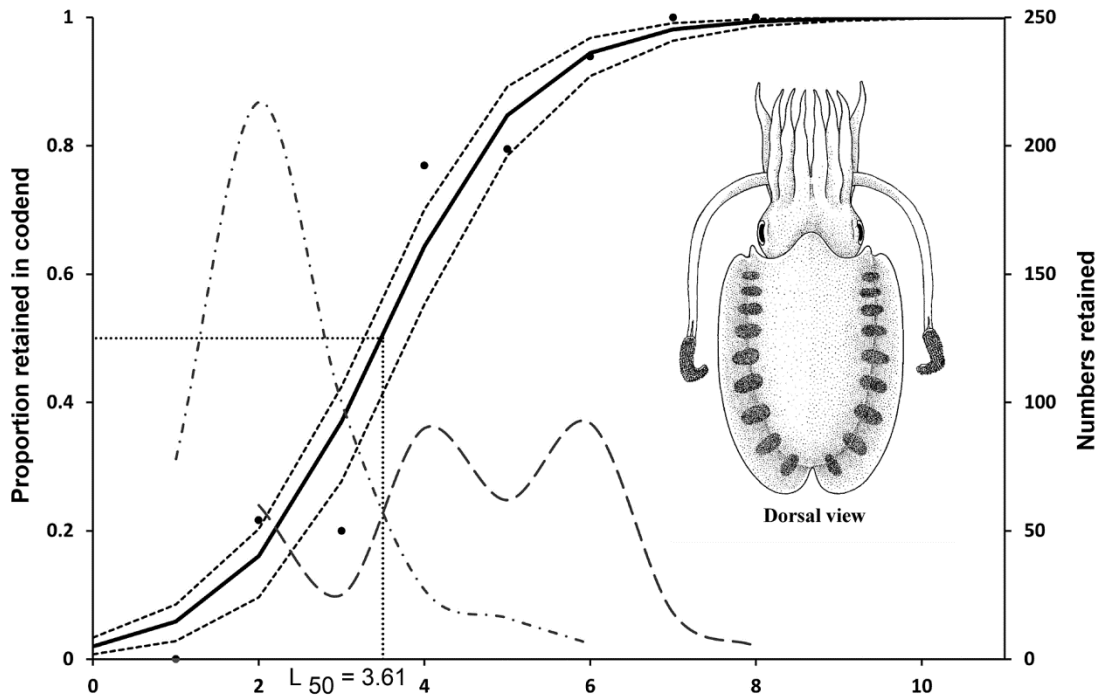


Fig. 1 — Selection curve of *Sepiella inermis* in 40 mm diamond mesh codend net. Thick continuous line is selection curve with confidence intervals. Black dots are observed proportions. Dotted lines indicate $L_{50}$. Dashed thin line shows population retained in the codend. Dash-dot-dash curve indicates the population escaped to the codend cover

## Discussion

This is the first report of the selection properties of *S. inermis* in the trawl net codends thus form a baseline data. The selection factor (SF) of 0.9 for this species was relatively low, when compared to the other fish and squid species studied along the Indian waters[29]. The selection factor for the squid *Uroteuthis duvauceli* along the Gujarat waters was 1.98 in 40 mm diamond mesh codend[36]. The low SF in the present study could be due to the shape of the species and the large and rigid cuttle bone, which prevents escape through the mesh lumen, unlike squids which have a pen which is thinner and flexible. There are no reports of selection in trawls for this species, but the selection properties of pink cuttlefish (0.7 in 44 diamond mesh; 0.6 to 0.9 in 40 mm hexagonal mesh and 0.9 to 1.0 in 40 mm square mesh) in the European waters and the overall selection properties of squid and other cuttlefish reported elsewhere agree with that of this study[20]. Only a marginal increase in the selectivity by using square mesh codends when compared to the loliginids caught by trawlers is reported by the previous study. There are no studies reporting the selectivity estimates of *S. inermis* and hence comparisons could not be made, but the results indicate, that selection for cuttlefishes in trawl codends, are lower when compared to fish species.

The reports on the stock characteristics of this species, along the Indian coast, indicate that the exploitation rate is above the optimum recommended values and hence urgent interventions are required. The recommended size of the codend along the Gujarat waters is 40 mm (square mesh) and the results of this study show that this size may not be large enough to achieve the management objective of releasing at least 50 % of the individuals at length at first maturity[4]. Though data for corresponding square mesh are not available, it can be inferred, from the studies Tosunoglu *et al.*[20] and Fonseca *et al.*[37] that compared to the selection properties of cephalopods in different mesh shapes, the use of square mesh codend could not have achieved a significant increase in length at capture for *S. inermis*.

It is found that operational parameters like speed of tow, codend catch, season and time of tow, thickness of twine, duration of tow etc., could influence the selectivity in trawls. However, this study did not consider these factors and all the above factors were assumed constant, none the less this is the first report of the trawl selection parameters for this species and will be a baseline document for more integrated studies by incorporating factors that could influence selection of *S. inermis*, an important trawl resource along the Indian coast. The findings of this study point to the use of larger mesh sizes for optimal resource harvesting, but this would increase escapees and possibly post-release mortality. However, there are no studies that report the survival of discarded *S. inermis*.

## Conclusion

The covered codend method used for deriving selection parameters of *S. inermis*, showed that the species has a low selection factor (SF) of 0.9, which means that the species would require a larger mesh size for escapement, when compared to other species groups. The $L_{50}$ value for this species in 40 mm diamond mesh codend was 36.2 mm and this is the first record of the selection parameter for this species. Selectivity studies from related species show that square mesh would not be very effective to increase $L_{50}$, in which case the stipulated mesh size of 40 mm square would have to be changed to meet the management objectives in the fisheries regulation.

## Conflict of Interest

The author certifies that he has NO affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

## References

1  CMFRI, *Annual Report 2018-2019*, (Central Marine Fisheries Research Institute, Kochi), 2019, pp. 320.
2  Bhendekar S N, Chellappan A, Sonavane A E, Mohanty P, Singh R, *et al.*, Geo-spatial distribution and faunal diversity in the trawling grounds off Mumbai coast, Maharashtra, India, *Indian J Geo-Mar Sci*, 48 (09) (2019) 1435–1442.
3  Silas E G, Sarvesan R, Nair K P, Sastry Y A, Sreenivasan P V, *et al.*, Some aspects of the biology of cuttle fishes, In: *Cephalopod bionomics, fisheries and resources of the Exclusive Economic Zone of India*, edited by E G Silas, *Bull Cent Mar Fis Res Inst*, 37 (1985), pp. 49–70.

4    Sundaram S & Khan M Z, Biology of the spineless cuttlefish *Sepiella inermis* (d'Orbingy, 1848) from Mumbai waters, *Indian J Fish*, 58 (2011) 7–13.

5    Chakraborty S K, Biradar R S, Jaiswar A K, Palaniswamy R & Kumar P, Growth, mortality and population parameters of three cephalopod species, *Loligo duvauceli* (Orbingy), *Sepia aculeata* (Orbingy) and *Sepiella inermis* (Orbingy) from north-west coast of India, *Indian J Fish*, 60 (2013) 1–7.

6    Kasim H M, Growth, mortality rates and stock assessment of the cuttlefish *Sepiella inermis* (Ferussac and D'Orbingy) in Saurashtra waters, *J Mar Biol Assoc India*, 30 (1&2) (1988) 99–106.

7    Sundaram S & Khan M Z, Stock assessment of *Sepiella inermis* (Orbingy, 1848) from Mumbai waters, *J Mar Biol Assoc India*, 51 (2) (2009) 178–183.

8    Gofar A, The biology of the spineless cuttlefish *Sepiella inermis*, d'Orbingy in the north coastal waters of java, *J Coastal Dev*, 1 (1998) 179–188.

9    Armstrong D W, Ferro R S T, MacLennan D N & Reeves S A, Gear selectivity and the conservation of sh, *J Fish Biol*, 37A (1990) 261–262.

10   MacLennan D N, Fishing gear selectivity: an overview, *Fish Res*, 13 (1992) 201–204.

11   Macbeth W G, Broadhurst M K, Millar R B & Smith S D A, Increasing codend mesh opening: an appropriate strategy for improving the selectivity of penaeid fishing gears in an Australian estuary? *Mar Freshwater Res*, (2005) 889–900.

12   Wileman D A, Ferro R S T, Fonteyne R & Millar R B, Manual of methods of measuring the selectivity of towed fishing gears, *ICES Coop Res Report*, 215 (1996) pp. 126.

13   Sala A, Lucchetti A & Buglioni G, The influence of twine thickness on the size selectivity of polyamide codends in a Mediterranean bottom trawl, *Fish Res*, 83 (2007) 192–203.

14   Tokaç A, Özbilgin H & Tosunoglu Z, Effect of PA and PE material on codend selectivity in Turkish bottom trawl, *Fish Res*, 67 (2004) 317–327.

15   Dahm E, Wienbeck H, West C W, Valdemarsen J W & O'Neill F G, On the influence of towing speed and gear size on the selective properties of bottom trawls, *Fish Res*, 55 (2002) 103–119.

16   Özbilgin H & Wardle C S, Effect of seasonal temperature changes on the escape behaviour of haddock, *Melanogrammus aeglefinus* from the codend, *Fish Res*, 58 (2002) 323–331.

17   Broadhurst M K & Millar R B, Square mesh codend circumference and selectivity, *ICES J Mar Sci*, 66 (2009) 566–572.

18   Madsen N, Moth-Poulsen T, Holst R & Wileman D, Selectivity experiments with escape windows in the North Sea Nephrops (*Nephrops norvegicus*) trawl fishery, *Fish Res*, 42 (1999) 167–181.

19   He P, Selectivity of large mesh trawl codends in the Gulf of Maine: I. Comparison of square and diamond mesh, *Fish Res*, 83 (2007) 44–59.

20   Tosunoglu Z, AydIn C, Salman A & Fonseca P, Selectivity of diamond, hexagonal and square mesh codends for three commercial cephalopods in the Mediterranean, *Fish Res*, 97 (2009) 95–102.

21   Anonymous, Gujarat Fisheries Rules, Gujarat Government Gazette, Ex., 15-8-2003, Part IV-B, Extra No. 227, (Gujarat State), 2003, pp. 21.

22   Remesan M P, Madhu V R, Edwin L, Baiju M V, Pravin P, *et al.*, *CIFT Fishing Systems Catalogue 4- Mechanised Marine Fishing Systems: Gujarat*, (Central Institute of Fisheries Technology), 2015, pp. 82.

23   Mohamed K S, Pravin P, Asokan P K, Madhu V R, Ghosh S, *et al.*, Demonstration of responsible fishing for the trawl fisheries of Gujarat, (Project Final Report submitted to MPEDA), 2009, pp. 37.

24   Broadhurst M, Millar R B, Wooden M E L & Macbeth W G, Optimising codend configuration in a multispecies demersal trawl fishery, *Fish Manag Ecol*, 13 (2006) 81–92.

25   Millar R B, Estimating the size-selectivity of fishing gear by conditioning on the total catch, *J Am Stat Assoc*, 87 (1992) 962–968.

26   Millar R B & Holst R, Estimation of gillnet and hook selectivity using log-linear models, *ICES J Mar Sci*, 53 (1997) 471–477.

27   Millar R B & Fryer R J, Estimating the size-selection curves of towed gears, traps, nets and hooks, *Rev Fish Biol Fisher*, 9 (1999) 89–116.

28   Millar R B, Broadhurst M K & Macbeth W G, Modelling between-haul variability in the size selectivity of trawls, *Fish Res*, 67 (2004) 171–181.

29   Madhu V R, A review of trawl selectivity estimates carried out along Indian coast, *Fish Technol*, 55 (2018) 1–18.

30   Ragonese S & Bianchini M L, Trawl selectivity trials on the deep-water rose shrimp (*Parapenaeus longirostris*) in Sicilian waters, *Hydrobiologia*, 557 (2006) 113–119.

31   Guijjarro B & Massuti E, Selectivity of diamond and square-mesh codends in the deepwater crustacean trawl fishery off the Balaeric Islands (Western Mediterranean), *ICES J Mar Sci*, 63 (2006) 52–67.

32   Engaš A & Godø O R, The effect of different sweep lengths on the length composition of bottom-sampling trawl catches, *J Cons Int Explor Mer*, 45 (1989) 263–268.

33   Carlucci R, D'onghia G, Sion L, Maiorano P & Tursi A, Selectivity parameters and size at first maturity in deep-water shrimps, *Aristaeomorpha foliacea* (Risso, 1827) and *Aristeus antennatus* (Risso, 1816), from the North Western Ionian Sea (Mediterranean Sea), *Hydrobiologia*, 557 (2006) 145–154.

34   Millar R B, *Selectivity software and documentation*, https://www.stat.auckland.ac.nz/~millar/selectware/code.html (12/2019).

35   R Core Team, *R: A language and environment for statistical computing*, (R Foundation for Statistical Computing, Vienna, Austria), 2019, https://www.R-project.org/, (12/2019).

36   Madhu V R, Panda S K & Meenakumari B, Codend mesh selectivity of *Uroteuthis (Photololigo) duvauceli* (d'Orbigny, 1848), *Fish Technol*, 48 (2011) 33–40.

37   Fonseca P, Aida C & Garcia A, Bottom trawl codend selectivity for Cephalopods in Portuguese continental waters, *Fish Res*, 59 (2002) 263–271.