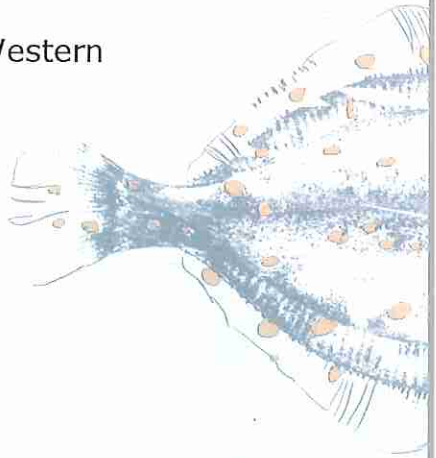
WAGENINGEN UR
For quality of life

Changing research vessels for a survey: does it matter?

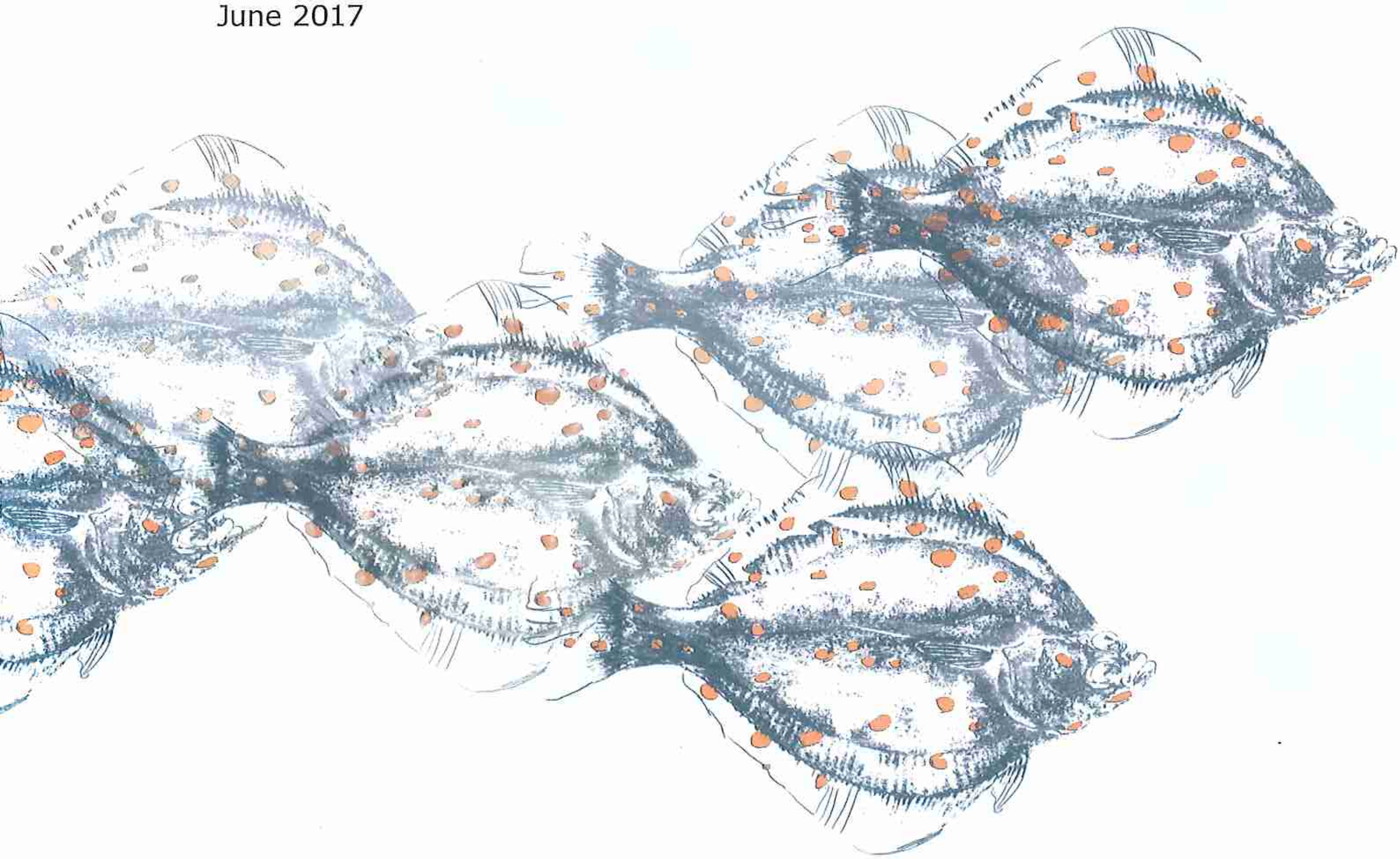
Comparison of two vessels and gears in the Eastern and Western Scheldt Demersal Fish Survey



I.J. de Boois, L.J. Bolle, C. Chen

CVO Report 17.011

June 2017



Centrum voor Visserijonderzoek (CVO)

Stichting Wageningen Research Centre for Fisheries Research (CVO)

Changing research vessels for a survey: does it matter?

Comparison of two vessels and gears in the Eastern and Western Scheldt Demersal Fish Survey

I.J. de Boois, L.J. Bolle, C. Chen

CVO report: 17.011

Commissioned by:
Ministry of Economic affairs
Attn.: ir. I. H. Janssen
Bezuidenhoutseweg 73
2594 AC Den Haag

Project number: 4311211029
BAS code: WOT-05-406-003-IMARES

This research is performed within EZ Wettelijke Onderzoekstaken

Publication date: 12 June 2017

Stichting Wageningen Research
Centre for Fisheries Research (CVO)
P.O. Box 68
1970 AB IJmuiden
Phone. +31 (0)317-487418
Fax. +31 (0)317-487326

Visitor address:
Haringkade 1
1976 CP IJmuiden

De Stichting Wageningen Research-Centre for Fisheries Research is registered in the Chamber of commerce in Gelderland nr. 09098104,
VAT nr. NL 8089.32.184.B01
CVO rapport UK V07

Table of Contents

Summary

Since 1970, the Demersal Fish Survey (DFS) in the Eastern and Western Scheldt has been carried out with the RV Schollevaar. In 2015 this vessel has been replaced by RV Luctor as a result of the current ship replacement policy of Rijksrederij (governmental shipping agency under Rijkswaterstaat) . Furthermore, the standard DFS gear had evolved to a gear with different specifications than the original and it was brought back into the original state. To be able to continue the use of the long and valuable time-series, the shift in vessel and the re-standardised gear was evaluated. During the 2015 DFS, sampling took place with both RV Schollevaar and RV Luctor and, on board Schollevaar, with the two gear setups. This resulted in 28 paired hauls for vessel comparison and 28 paired hauls for gear comparison.

The paired hauls were compared for catch rate as well as length distribution of plaice (*Pleuronectes plateassa*), sole (*Solea solea*), whiting (*Merlangius merlangus*) and brown shrimp (*Crangon crangon*) to investigate whether the catches of the RV Schollevaar and RV Luctor differ when using the same gear and survey set-up or not. Two analyses have been carried out: a paired t-test and linear regression. The t-test allows to compute the average difference between two vessels or gear configurations, the results of the linear regression show the correlation between the catches.

The vessel comparison showed a clear and significant difference in the catch rates of brown shrimp, with higher catches by the Luctor (new vessel). We suspect that this is an observer effect rather than a vessel effect. A potential observer effect, related to differences in sub-sampling strategy for especially shrimp, will be further examined during the 2017 surveys, to see if this can explain the differences. If not, then it is recommended that the parameters of the regression analysis are used as a conversion factor for brown shrimp.

The gear comparison showed higher number of zero-catches of the old, modified gear for plaice and brown shrimp. In this case a conversion factor cannot be applied, because the old nets were gradually modified over the years. This comparative fishing study underlines (a) the importance of monitoring the survey gears and renewing netting well before it is worn down, as well as (b) regular checks on the standardisation of the gear and the mesh size of the net.

Samenvatting

Sinds 1970 wordt de Demersal Fish Survey (DFS) in de Ooster- en Westerschelde uitgevoerd op onderzoeksvaartuig Schollevaar. In 2015 is dit schip vervangen door onderzoeksvaartuig Luctor ten gevolge van de vervangingsstrategie schepen van de Rijksrederij (Rijkswaterstaat). Daarnaast was het vistuig in de loop van de tijd beetje bij beetje geëvolueerd tot een vistuig met andere specificaties dan het originele. Bij de aanschaf van nieuwe vistuigen is de oorspronkelijke specificatie weer aangehouden.

Om de lange tijdserie van de bemonstering te kunnen blijven gebruiken is in 2015 op twee manieren vergelijkend gevist: de Schollevaar en Luctor hebben beide in de Ooster- en Westerschelde gevist met het vistuig conform specificaties, en aan boord van de Schollevaar is daarnaast aan de andere zijde gevist met het onbedoeld geëvolueerde vistuig. In totaal zijn er 28 gepaarde trekken gedaan voor vergelijking van schepen en 28 gepaarde trekken voor vergelijking van tuigen.

De gepaarde trekken zijn geanalyseerd op de vangstomvang en de gemiddelde lengte voor schol (*Pleuronectes plateassa*), tong (*Solea solea*), wijting (*Merlangius merlangus*) en garnaal (*Crangon crangon*). Om overeenkomsten en verschillen te detecteren zijn twee analyses uitgevoerd: een gepaarde t-test en een lineaire regressie. Met de t-test kan worden aangetoond of er verschil is tussen de gemiddelde vangsten van beide schepen of beide tuigconfiguraties, de uitkomsten van de lineaire regressie geven aan in welke mate de vangsten gecorreleerd zijn met elkaar.

De analyses zijn zowel uitgevoerd voor de vergelijking tussen de twee schepen als tussen de twee varianten van het vistuig.

Bij de vergelijking tussen de beide schepen werd een duidelijk en significant verschil waargenomen in de vangsten voor garnaal, met hogere vangsten bij het nieuwe schip (Luctor). Het vermoeden bestaat dat dit vooral veroorzaakt wordt door personele verschillen en minder door verschillen tussen de schepen. Dit kan ontstaan door verschillen in bemonstering van met name soorten waarvan slechts een gedeelte wordt gemeten, wat het geval is voor garnaal. Of dit inderdaad de verklarende factor is zal in 2017 gedurende de DFS worden onderzocht. Mocht dit niet het geval zijn dan wordt voor garnaal aangeraden de parameters uit de regressie-analyse te gebruiken als omrekeningsfactor in de tijdserie.

De vergelijking van de vistuigen laat vooral een verschil zien in het aantal trekken waarin geen schol of garnaal was gevangen. Voor deze vergelijking is het niet mogelijk om een conversiefactor toe te passen omdat de oude netten over de tijd –en dus niet sprongsgewijs- zijn gewijzigd. De aangetroffen verschillen onderstrepen het belang van (a) het tijdig vervangen van netten voordat ze versleten zijn en (b) frequente controle van de vistuigen en de netten om te zien of ze nog voldoen aan de beschrijving van de standaard.

1 Introduction

Since 1970, the Demersal Fish Survey (DFS) in the Eastern and Western Scheldt has been carried out with RV Schollevaar. As a result of the ship replacement policy of Rijksrederij (governmental shipping agency under Rijkswaterstaat), in 2015 this vessel was replaced by RV Luctor. To be able to continue the use of the long and valuable time-series, comparative fishing between the two vessels has been carried out during the 2015 DFS.

Furthermore, the standard DFS gear had over the years gradually been modified to a gear with different specifications compared to the original and in 2015 it was brought back into the original state when the gears and nets had to be replaced. Although the differences in gear were minor, it was decided to investigate the effect on the catches by fishing with both gears on board RV Schollevaar, by handling one type on starboard and the other on portside. For the vessel comparison both vessels used the new gears (thus using the original standardised gear design).

Both analyses are presented in this report.

2 Research questions

The primary question was: are there any significant effects on the catches caused by the change in vessels. Additionally we examined if there are any significant effects on the catches caused by the re-standardisation of the gear.

The two questions were addressed by comparing paired hauls of RV Schollevaar and RV Luctor, and by comparing paired hauls of the two gears on board RV Schollevaar. Comparisons were carried out for two components of the catch: catch rate and length distribution. This resulted in the following questions:

1. Do the catches of RV Luctor and RV Schollevaar differ when using the same gear? (paragraph 4.1)
   i. Is there any difference in catch rate? (paragraph 4.1.1)
   ii. Is there any difference in length distribution? (paragraph 4.1.2)
2. Do the catches of the new (re-standardised) and old gear differ, when employed from the same vessel? (paragraph 4.2)
   i. Is there any difference in catch rate? (paragraph 4.2.1)
   ii. Is there any difference in length distribution? (paragraph 4.2.2)

3 Materials and Methods

3.1 Field work

In September 2015, RV Schollevaar and RV Luctor fished in the Scheldt estuaries (Eastern Scheldt and Western Scheldt) in parallel. RV Luctor fished with one type of gear: the new, re-standardised gear. RV Schollevaar fished with different gears on either side of the vessel: the old gear and the new, re-standardised gear (differences in Annex 1). The nets were set at the same time and location as good as possible.

During the first week (Western Scheldt) the rigging of the gears was fine-tuned and the operation of the gears (mainly w.r.t. the length of the line shot) by the two skippers of the two vessels was standardised. These hauls were not included in the analysis. During the second week (Eastern Scheldt) the rigging and operation was considered to be sufficiently standardised between the vessels and gear types and no further changes were made. This resulted in 28 comparative tows for the vessel comparison, and 28 comparative tows for the gear comparison.

Analyses for question 1 were carried out on 28 paired hauls only using re-standardised gear, while analyses for question 2 were carried out on 28 paired hauls from RV Schollevaar.

All hauls were treated equally: the catch was sorted following the standard DFS protocol (van Damme *et al*., 2015; current version van Damme *et al*., 2016), fish were measured 'to the cm below' and brown shrimp 'to the mm below'. Data were entered in the programme Billie Turf, and after standard quality assurance procedures added to the database 'Frisbe'.

3.2 Data analysis

On board, a rough estimate of total catch is made, but the quality and consistency of information is not sufficient to use for a sound comparison of the total catch.
The most commonly occurring species of commercial and ecological interest were selected: plaice (*Pleuronectes platessa*), sole (*Solea solea*), whiting (*Merlangius merlangus*), and brown shrimp (*Crangon crangon*). Plaice, sole and shrimp are the original target species for the survey, and are being used in stock assessments. Whiting is chosen as a proxy for roundfish species; it is the most frequently caught roundfish species in the survey.

The catches were compared for the two vessels as well as the gears, regarding two aspects:

i. the catch rate (total number caught per swept area (in ha)) per haul;
ii. the mean length per haul, which is a summarized characteristic of the length frequency distribution of the catch, no weighting for total numbers in a haul applied.

A paired t-test and linear regression were conducted for both catch rate (4^{th} root transformed numbers per ha) and mean length (no transformation).

The average difference between two vessels or gears was computed using the paired t-test. It was assumed that a significant p-value at the significance level of 0.05 indicates a systematic difference between the two vessels. The significance level is however a matter of choice, and should always be seen in the scope of the question to be answered.

For the vessel comparison the following linear regression models have been used:
$y_{\text{luctor},i} = \alpha + \beta \times y_{\text{schollevaar},i} + \varepsilon_i$

$l_{\text{luctor},i} = \alpha + \beta \times l_{\text{schollevaar},i} + \varepsilon_i$

For the gear comparison the following linear regression models have been used:
$y_{\text{new},i} = \alpha + \beta \times y_{\text{old},i} + \varepsilon_i$
$l_{\text{new},i} = \alpha + \beta \times l_{\text{old},i} + \varepsilon_i$

The term y_i indicates the catch rate (in n/ha) and l_i indicates the mean length (in cm) of the i^{th} pair, either by vessel (RV Luctor or RV Schollevaar) or by gear (old, modified or new, re-standardised). For each model, the error ε_i follows a normal distribution.

The estimated parameters of a linear regression may be used as conversion factors between the two vessels or gears. Furthermore, the parameters (with standard error estimates (SE)) can be used to interpret the linear relationship between the two vessels or gears.

If the catch rates or mean lengths are identical for both vessels or gears then the estimated intercept (α) will be zero and Beta (β) will be one. The p-values indicate whether the estimated parameters are significantly different from zero. A significant intercept implies a significant difference between the vessels or gears at catch rates or mean lengths close to zero. A significant Beta implies a strong linear correlation between the vessels or gears. Note that a significant p-value of Beta can be obtained if the vessels or gears are in exact agreement (i.e. α=0 and β=1), but also if there are large differences between the vessels or gears (e.g. α=1 and β=2; or α=0 and β=2). Therefore, the fitted relationship is presented with the 95% confidence interval. This can be visually compared to the exact agreement relationship (α=0 and β=1; also presented). If the exact agreement line falls within the 95% confidence interval of the fitted relationship, then the differences between the vessels or gears can be considered to be insignificant.

4 Results

4.1 Vessel effect

4.1.1 on catch rates

Plaice (Pleuronectes platessa)

The difference in the average total number of plaice is not statistically significant (at the significance level of 0.05) between RV Schollevaar and RV Luctor (Table 4.1.1). The parameter estimates for the linear model (Table 4.1.2) are visualised by the fitted linear relation in Figure 4.1.1. The exact agreement line ($\alpha=0$ and $\beta=1$) falls within the confidence interval of the fitted linear regression, thus indicating no significant differences between the vessels in the catch rates of plaice.

Sole (Solea solea)

Sole catch rates were low: in 5 paired hauls sole was caught by both vessels, in six paired hauls sole was only caught by one of the vessels (up to 4 specimens per haul) and in 17 pairs no sole was caught (Figure 4.1.2). No significant differences were observed between the vessels in the average catch rate of sole (Table 4.1.1). The exact agreement line falls within the confidence interval of the fitted linear regression (Figure 4.1.2).

Whiting (Merlangius merlangus)

Whiting catch rates were low: in 9 paired hauls whiting was caught by both vessels, in seven paired hauls whiting was only caught by one of the vessels (up to 18 specimens per haul) and in 12 pairs no whiting was caught (Figure 4.1.3). The average catch rate of whiting was significantly higher in the RV Luctor catches compared to the RV Schollevaar catches at a significance level of 0.05 (Table 4.1.1). This is confirmed by the comparison of the exact agreement line with the confidence interval of the fitted linear regression (Figure 4.1.3). The difference between the vessels is entirely caused by the high number of zero catches of RV Luctor.

Brown shrimp (*Crangon crangon*)

The average catch rate of brown shrimp was significantly higher in the RV Luctor catches compared to the RV Schollevaar catches (Table 4.1.1). This is also visible in the scatterplot (Figure 4.1.4), although the upper limit of the 95% confidence interval of the fitted linear regression almost coincides with the exact agreement line.

Table 4.1.1 Results of the paired t-test comparing catch rate of both vessels (numbers per ha; zero catches included)

species/group	n hauls	df	Mean of difference RV Luctor vs RV Schollevaar	p-value
brown shrimp	28	27	-1.45	<0.01
plaice	28	27	-0.01	0.95
sole	28	27	0.14	0.32
whiting	28	27	-0.42	0.02

Table 4.1.2 Results of the linear regression comparing catch rates of both vessels (numbers per ha; zero catches included)

species/group	n hauls	Model parameter	Estimate	SE	p-value

brown shrimp	28	Intercept	-2.92	2.04	0.16
		Beta	1.22	0.30	<0.01
plaice	28	Intercept	0.57	0.42	0.19
		Beta	0.68	0.22	<0.01
sole	28	Intercept	0.26	0.16	0.10
		Beta	0.73	0.17	<0.01
whiting	28	Intercept	0.03	0.21	0.88
		Beta	0.57	0.15	<0.01

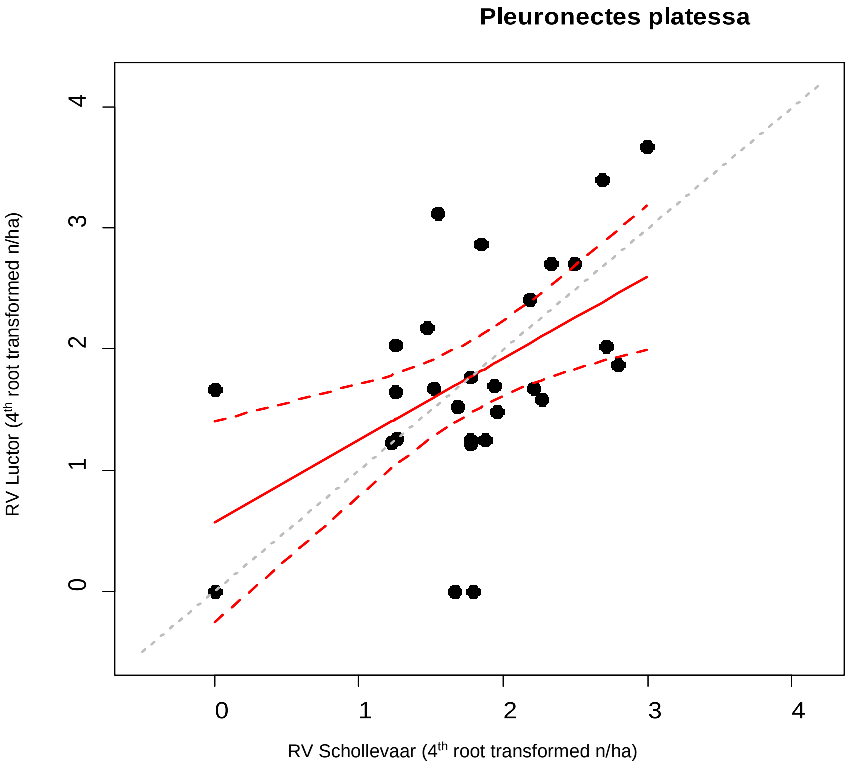


Figure 4.1.1 Observed and fitted linear relation of the 4th root catch rate between RV Luctor and RV Schollevaar for plaice. The fitted relationship is plotted in red with 95% confidence interval in dashed lines. The grey dotted line is the 45 degree diagonal line ($\alpha = 0$ and $\beta = 1$).

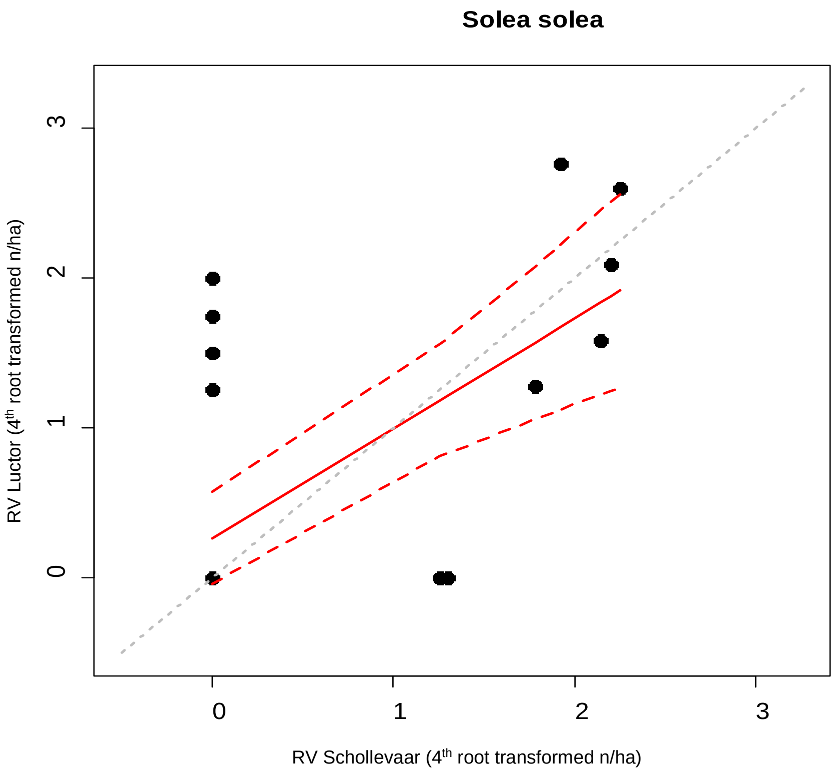


Figure 4.1.2 Observed and fitted linear relation of the 4th root catch rate between RV Luctor and RV Schollevaar for sole. The fitted relationship is plotted in red with 95% confidence interval in dashed lines. The grey dotted line is the 45 degree diagonal line ($\alpha = 0$ and $\beta = 1$).

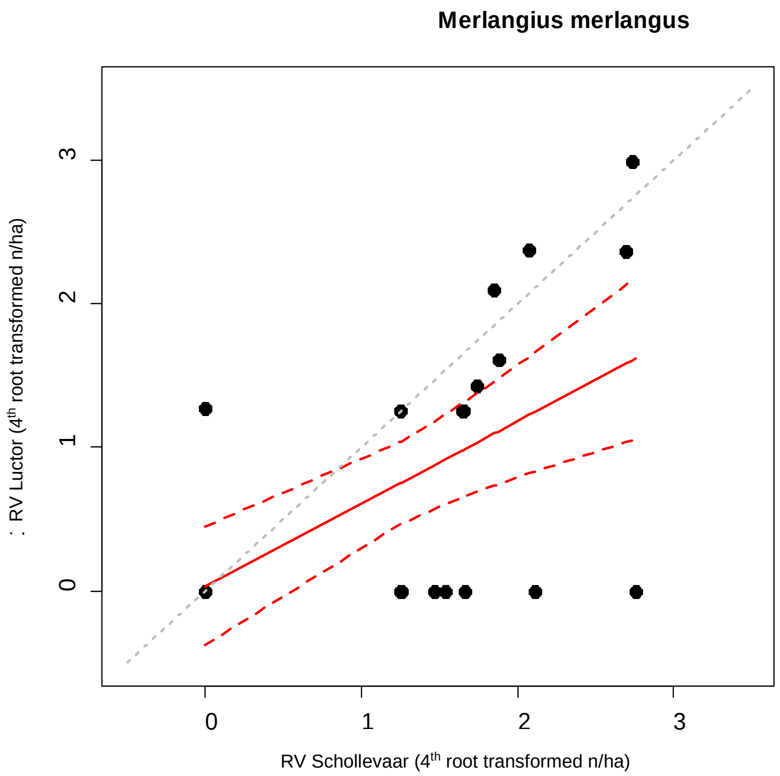


Figure 4.1.3 Observed and fitted linear relation of the 4th root catch rate between RV Luctor and RV Schollevaar for whiting. The fitted relationship is plotted in red with 95% confidence interval in dashed lines. The grey dotted line is the 45 degree diagonal line ($\alpha = 0$ and $\beta = 1$).

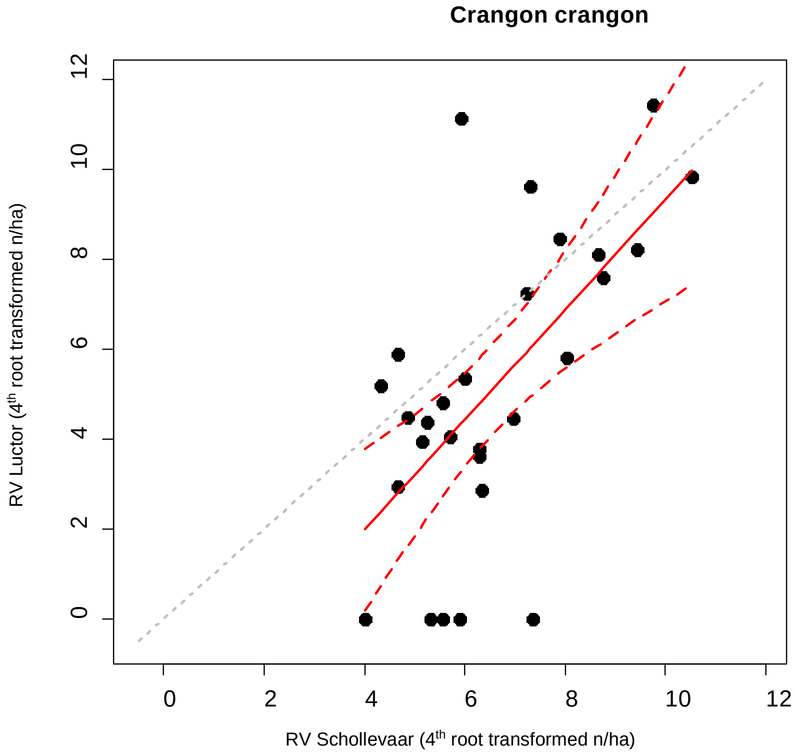


Figure 4.1.4 Observed and fitted linear relation of the 4th root catch rate between RV Luctor and RV Schollevaar for brown shrimp. The fitted relationship is plotted in red with 95% confidence interval in dashed lines. The grey dotted line is the 45 degree diagonal line ($\alpha = 0$ and $\beta = 1$).

4.1.2 on mean lengths

Plaice (Pleuronectes platessa)

There is no significant difference (at the significance level of 0.05) in the overall average of mean lengths of plaice between the two vessels (Table 4.1.3). The linear regression analysis appears to show a difference between the vessels, but this is driven by an outlier (Figure 4.1.5).

Sole (Solea solea)

Mean lengths can only be compared between vessels in the case of non-zero catches on both vessels. Only five paired observations were available for sole, which is too low for a sound statistical analysis. No significant difference in the overall average of mean lengths was observed based on these 5 pairs (Table 4.1.3). Linear regression based on five pairs is considered to be not relevant.

Whiting (Merlangius merlangus)

Only nine paired observations were available for whiting, which is also considered to be too low for a sound statistical analysis. No significant difference in the overall average of mean lengths was observed based on these nine pairs (Table 4.1.3). Linear regression based on nine pairs is considered to be useless.

Brown shrimp (*Crangon crangon*)

There is no significant difference in the overall average of the mean lengths of brown shrimp between the two vessels (Table 4.1.3, Figure 4.1.6).

Table 4.1.3 Results of the paired t-test comparing mean length in RV Luctor and RV Schollevaar catches (zero catches excluded)

species/group	n hauls	df	Mean of difference RV Luctor-RV Schollevaar	p-value
brown shrimp	23	22	-0.10	0.19
plaice	24	23	0.26	0.71
sole	5	4	0.46	0.71
whiting	9	8	0.64	0.46

Table 4.1.4 Results of the linear regression comparing mean length in RV Luctor and RV Schollevaar catches (zero catches excluded)

species/group	n hauls	Model parameter	Estimate	SE	p-value
brown shrimp	23	Intercept	1.55	1.00	0.14
		Beta	0.65	0.21	<0.01
plaice	24	Intercept	7.91	1.84	<0.01
		Beta	0.19	0.19	0.32

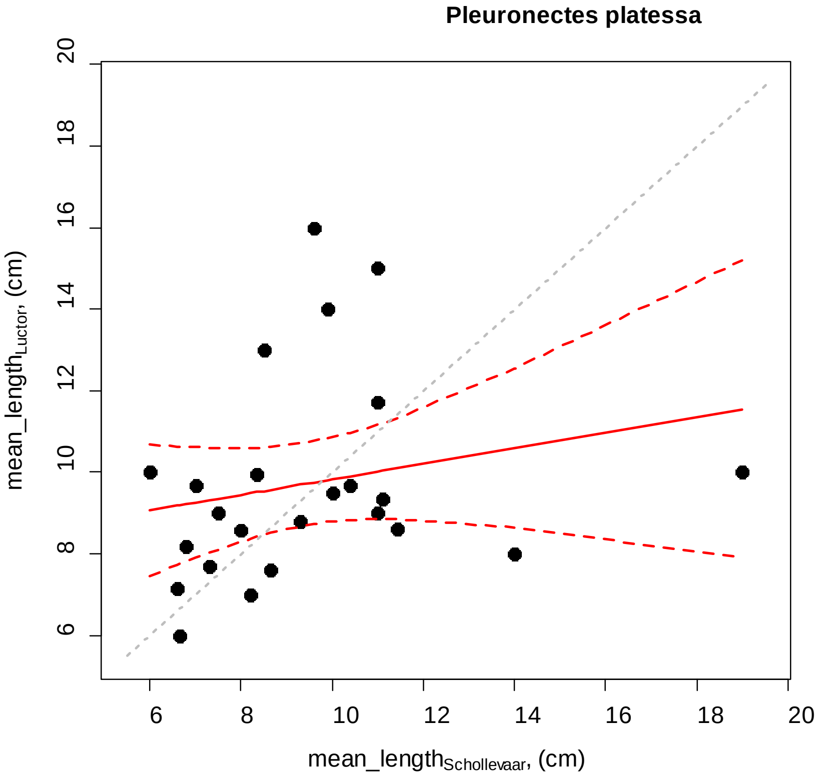


Figure 4.1.5 Observed and fitted linear relation of the mean length between Luctor and Schollevaar for plaice. The fitted relationship is plotted in red with 95% confidence interval in dashed lines. The grey dotted line is the 45 degree diagonal line ($\alpha = 0$ and $\beta = 1$).

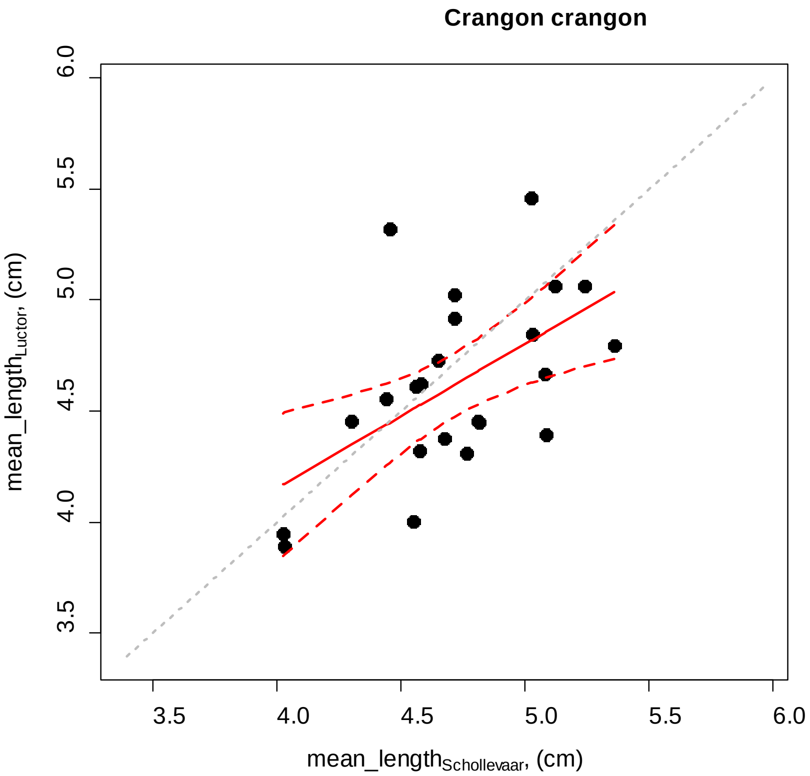


Figure 4.1.6 Observed and fitted linear relation of the mean length between Luctor and Schollevaar for brown shrimp. The fitted relationship is plotted in red with 95% confidence interval in dashed lines. The grey dotted line is the 45 degree diagonal line ($\alpha = 0$ and $\beta = 1$).

4.2 Gear effect

4.2.1 on catch rates

Plaice (Pleuronectes platessa)

The average total number of plaice was not significantly different (at the significance level of 0.05) between the old, modified gear and the new, re-standardised gear (Table 4.2.1). The regression analysis showed a difference between the gears at lower catch rates, which was driven by the higher number of zero-catches of the old, modified gear (Figure 4.2.1).

Sole (Solea solea)

Sole catch rates were low: in five paired hauls sole was caught in both gears, in five pairs sole was caught in one gear (up to 10 specimens per haul) and in 18 pairs no sole was caught in either gear (Figure 4.2.2). No significant differences were observed between the gears in the average catch rate of sole (Table 4.2.1) and no clear differences were observed in the linear regression (Figure 4.2.2).

Whiting (Merlangius merlangus)

No significant differences were observed between the gears in the average catch rate of whiting (Table 4.2.1) and no significant differences were observed in the linear regression (Figure 4.2.3).

Brown shrimp (*Crangon crangon*)

No significant differences were observed between the gears in the average catch rate of brown shrimp (Table 4.2.1). The regression analysis showed a difference between the gears at lower catch rates, which was driven by the higher number of zero-catches of the old, modified gear (Figure 4.2.4).

Table 4.2.1 Results of the paired t-test comparing catch rate of both gears (numbers per ha; zero catches included)

species/group	n hauls	df	Mean of difference re-standardised vs. modified gear	p-value
brown shrimp	28	27	0.43	0.15
Plaice	28	27	0.19	0.16
Sole	28	27	-0.03	0.84
Whiting	28	27	0.01	0.91

Table 4.2.2 Results of the linear regression comparing catch rates of both gears (numbers per ha; zero catches included)

species/group	n hauls	Model parameter	Estimate	SE	p-value
brown shrimp	28	Intercept	3.16	0.62	<0.01
		Beta	0.55	0.09	<0.01
Plaice	28	Intercept	1.00	0.19	<0.01
		Beta	0.50	0.10	<0.01
Sole	28	Intercept	0.20	0.16	0.23
		Beta	0.53	0.17	<0.01
Whiting	28	Intercept	0.29	0.16	0.09
		Beta	0.74	0.11	<0.01

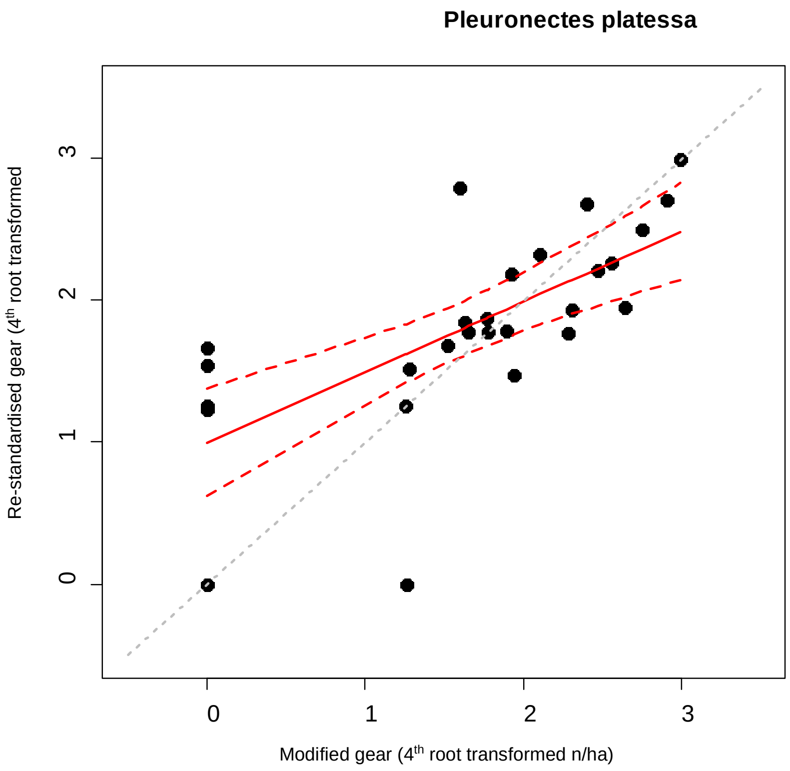


Figure 4.2.1 Observed and fitted linear relation of the 4th root catch rate between the two gears for plaice. The fitted relationship is plotted in red with 95% confidence interval in dashed lines. The grey dotted line is the 45 degree diagonal line ($\alpha = 0$ and $\beta = 1$).

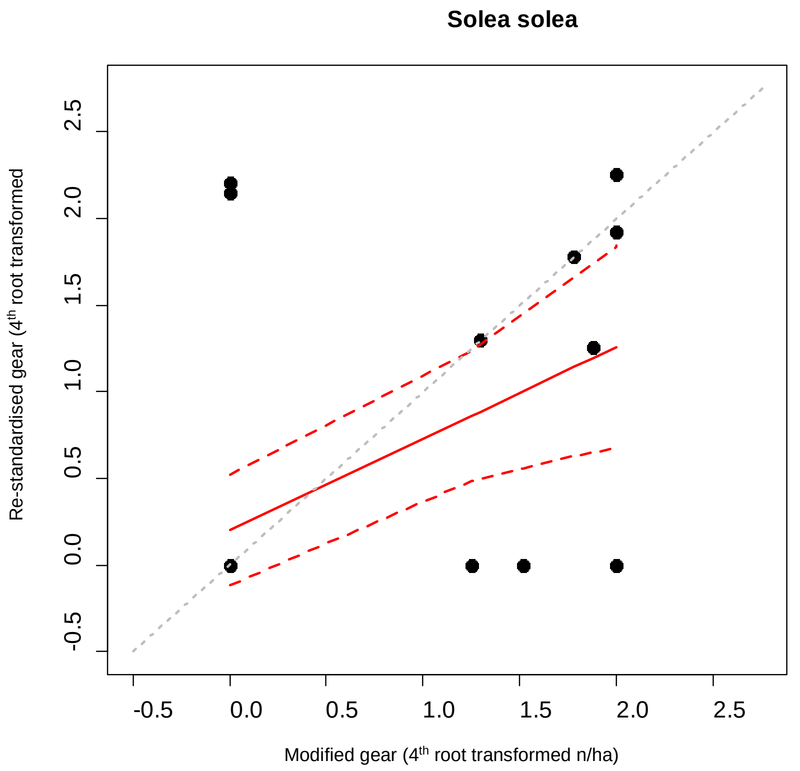


Figure 4.2.2 Observed and fitted linear relation of the 4th root catch rate between the two gears for sole. The fitted relationship is plotted in red with 95% confidence interval in dashed lines. The grey dotted line is the 45 degree diagonal line ($\alpha = 0$ *and* $\beta = 1$ *).*

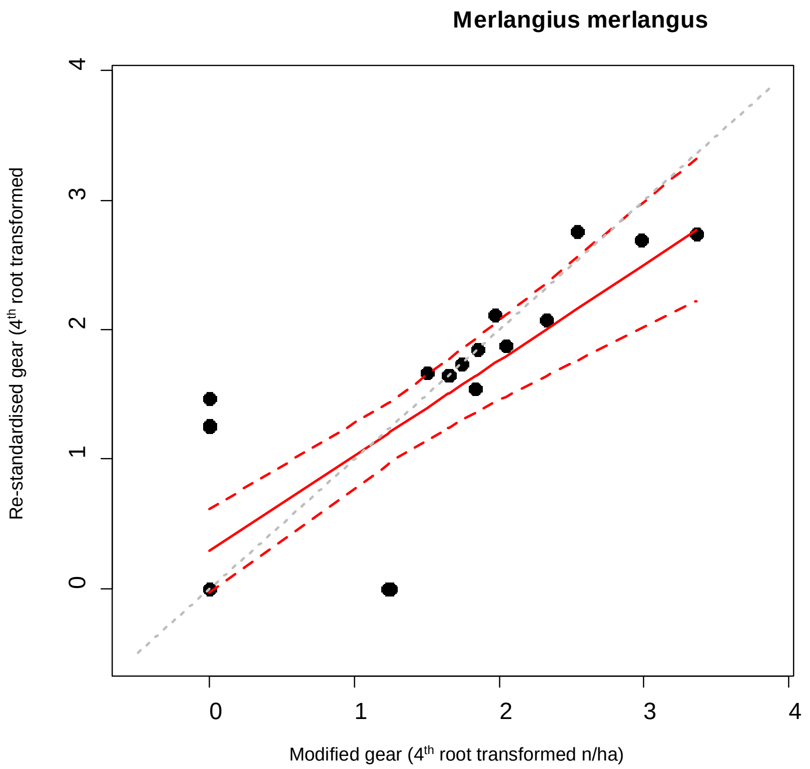


Figure 4.2.3 Observed and fitted linear relation of the 4th root catch rate between the two gears for whiting. The fitted relationship is plotted in red with 95% confidence interval in dashed lines. The grey dotted line is the 45 degree diagonal line ($\alpha = 0$ *and* $\beta = 1$*).*

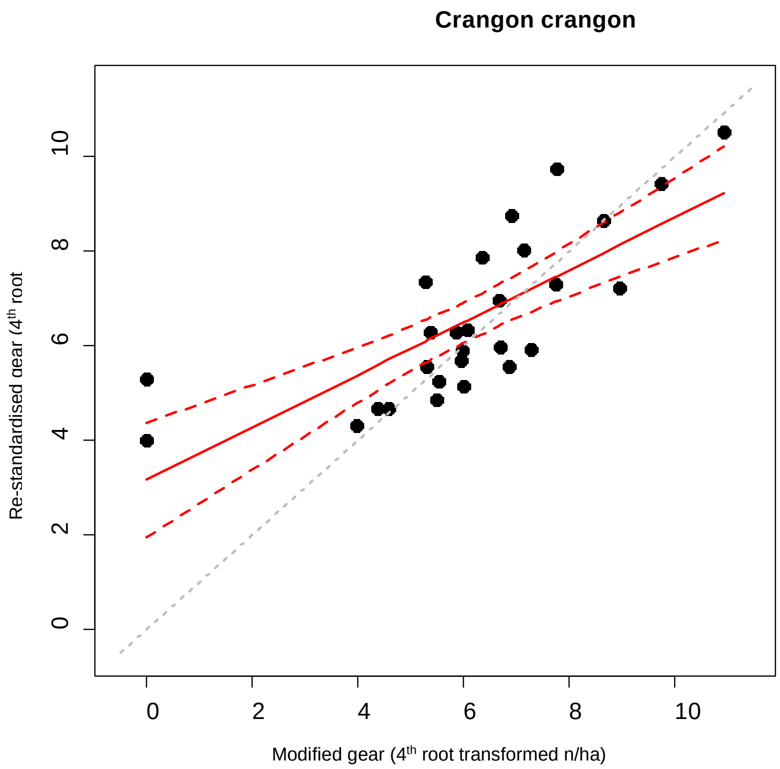


Figure 4.2.4 Observed and fitted linear relation of the 4th root catch rate between the two gears for brown shrimp. The fitted relationship is plotted in red with 95% confidence interval in dashed lines. The grey dotted line is the 45 degree diagonal line ($\alpha = 0$ and $\beta = 1$).

4.2.2 on mean lengths

Plaice (Pleuronectes platessa)

There was a significant difference in the overall average of mean lengths of plaice between the two gears (Table 4.2.3). On average, the new, re-standardised gear caught slightly (ca. 1 cm) larger plaice than the old, over years modified gear. The linear regression analysis showed that, although mean lengths appeared to be higher in the new gear, the exact agreement line almost falls within the 95% confidence interval of the fitted line (Figure 4.2.5).

Sole (Solea solea)

Mean lengths can only be compared between vessels in the case of non-zero catches on both vessels. Only 5 paired observations were available for sole, which is too low for a sound statistical analysis. No significant difference in the overall average of mean lengths was observed based on these 5 pairs (Table 4.2.3). Linear regression based on 5 pairs is considered to be useless.

Whiting (Merlangius merlangus)

There was no significant difference in the overall average of the mean lengths of whiting between the two gears. The exact agreement line falls within the confidence interval of the fitted linear regression (Figure 4.2.6).

Brown shrimp (*Crangon crangon*)

There was a significant difference in the overall average of the mean lengths of brown shrimp between the two gears (Table 4.2.3). On average, the new, re-standardised gear caught slightly (ca. 1 mm) smaller shrimp than the old, over years modified gear. The linear regression analysis showed that, although mean lengths appeared to be lower in the new gear, the exact agreement line almost falls within the 95% confidence interval of the fitted line (Figure 4.2.7).

Table 4.2.3 Results of the paired t-test comparing mean length in catches from both gears (zero catches excluded)

species/group	n hauls	df	Mean of difference re-standardised vs. modified gear	p-value
brown shrimp	26	25	-0.13	0.04
plaice	21	20	1.16	<0.01
sole	5	4	2.37	0.14
whiting	12	11	0.56	0.16

Table 4.2.4 Results of the linear regression comparing mean length in catches from both gears (zero catches excluded)

species/group	n hauls	Model parameter	Estimate	SE	p-value
brown shrimp	26	Intercept	1.46	0.61	0.02
		Beta	0.67	0.13	<0.01
plaice	21	Intercept	1.34	1.49	0.38
		Beta	0.98	0.17	<0.01
whiting	12	Intercept	4.86	4.38	0.29
		Beta	0.70	0.30	0.04

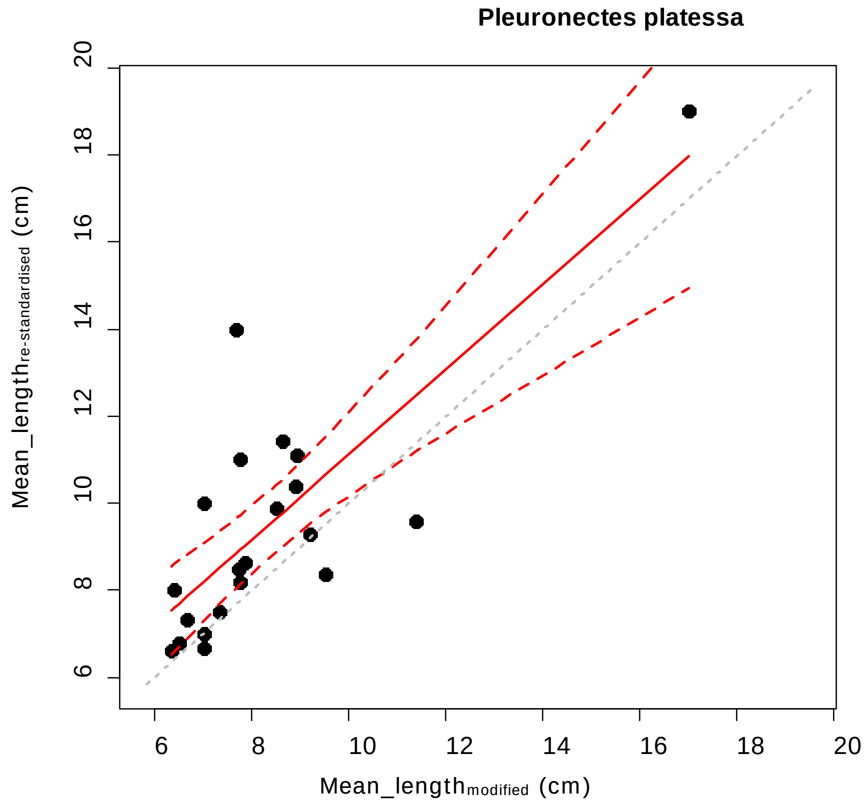


Figure 4.2.5 Observed and fitted linear relation of the mean length between the two gears for plaice. The fitted relationship is plotted in red with 95% confidence interval in dashed lines. The grey dotted line is the 45 degree diagonal line ($\alpha = 0$ and $\beta = 1$).

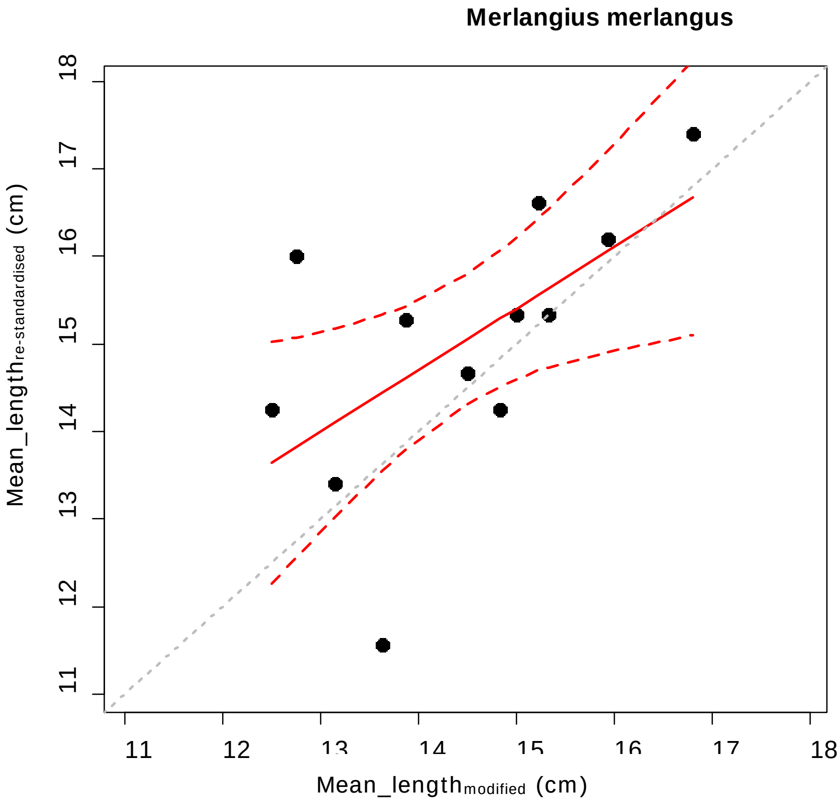


Figure 4.2.6 Observed and fitted linear relation of the mean length between the two gears for whiting. The fitted relationship is plotted in red with 95% confidence interval in dashed lines. The grey dotted line is the 45 degree diagonal line ($\alpha = 0$ and $\beta = 1$).

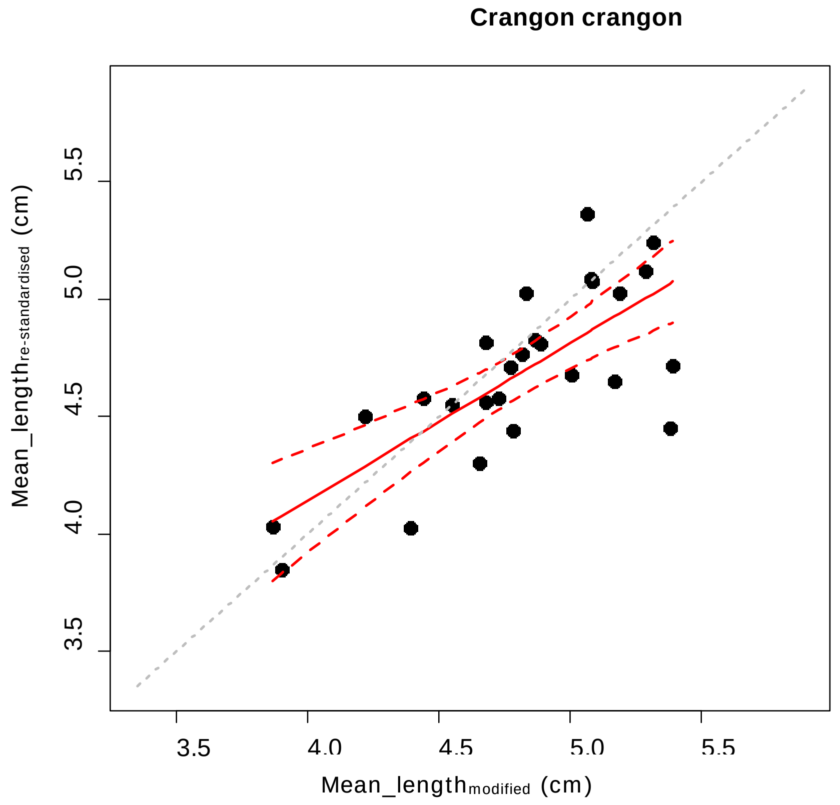


Figure 4.2.7 Observed and fitted linear relation of the mean length between the two gears for brown shrimp. The fitted relationship is plotted in red with 95% confidence interval in dashed lines. The grey dotted line is the 45 degree diagonal line ($\alpha = 0$ and $\beta = 1$).

5 Discussion

5.1 Vessel effect on catch rates and/or mean length

No differences were found between the catch rates of RV Schollevaar and RV Luctor for plaice and sole.

For whiting, RV Luctor had more zero catches than RV Schollevaar. This can be attributed to the patchy distribution of whiting and its schooling behaviour. Apart from the zero catches, there were no differences between the catch rates of both vessels.

For brown shrimp a significant difference in catch rates was observed between the two vessels. Overall RV Luctor appeared to have lower catch rates than RV Schollevaar. There is no obvious explanation why gear efficiency would differ for only one species (when using exactly the same gear and rigging). It is expected that this might be an observer effect rather than a vessel effect. Brown shrimps are usually abundant in coastal waters and relatively small compared to the other organisms in the catch. Therefore brown shrimp is almost always sorted out in a sub-sample of the catch. Differences in subsampling strategy between the observers on both vessels is evident from the data (table 5.1), and may have caused a difference in the estimated abundance. This is a point of concern which needs to be further examined.

For all species, no significant differences in mean length occurred. For sole and whiting the number of paired hauls with positive catch rates was too low to do any sound statistical analysis.

Table 5.1 Subsampling factor difference of *Crangon crangon* samples on board of both vessels fro paired hauls

Subsampling factor difference on both vessels	number of hauls
subsampling RV Schollevaar **>** RV Luctor	34
subsampling RV Schollevaar **<** RV Luctor	11
subsampling RV Schollevaar **=** RV Luctor	11

5.2 Gear effect on catch rates and/or mean length

No significant differences in overall catch rates were found between the old (modified) and new (re-standardised) gear for any of the species, but the gear comparison did show a higher number of zero-catches of the old, modified gear for plaice and brown shrimp.

Although the overall average of mean length of plaice and brown shrimp differed significantly between the two gears, the difference was small: ca. 1 cm larger plaice and ca. 1 mm smaller brown shrimp in the catches of the re-standardised gear. These differences are equal to the measurement precision and will therefore not have a noticeable effect on the results of the survey.

The catch differences between the old and new gear may have been caused by the wear of the netting of the old gear. The yarn of the nets gets thicker and the meshes get smaller with use, which hampers the flow through the net, thus reducing the gear efficiency.

6 Conclusions and recommendations

The vessel comparison showed a clear difference in the catch rates of brown shrimp. We suspect that this is an observer effect rather than a vessel effect. A potential observer effect, related to differences in sampling strategy, will be further examined during the 2017 surveys following pre-defined guidelines, to see if this can explain the differences. If not, then it is recommended that the parameters of the regression analysis are used as a conversion factor for brown shrimp.

The gear comparison showed a higher number of zero-catches of the old, modified gear for plaice and brown shrimp. In this case a conversion factor cannot be applied, because the old nets were gradually modified over the years. This comparative fishing study underlines the importance of monitoring the survey gears and renewing netting well before it is worn down, as well as regular checks on the standardisation of the gear and the meshsize of the net. The text in future versions of the manual for the seagoing monitoring programmes (2018 onwards) will be updated accordingly.

No comparison on total catch could be carried out due to the quality and consistency of the total catch information. For future comparative studies it is recommended that the total catch weight is measured, if possible by weighing the catch. If it is not possible to weigh the catch, a good volumetric measurement should be carried out, e.g. by following the protocol used in the demersal fisheries observer trips on board commercial vessels.

7 References

Boois, Ingeborg de, Loes Bolle, Thomas Pasterkamp, 2014. Voorstel nieuwe tuigen DFS Waddenzee en Ooster-/Westerschelde. Werkdocument ten behoeve van projectteam surveys en IMARES overleg met Rijksrederij. (added as Annex 2 in this report)

Damme, C. van, K. Bakker, L. Bolle, I. de Boois, B. Couperus, R. van Hal, R. Hoek & S. Fässler, 2015. Handboek en protocollen voor bestandsopnamen en routinematige bemonsteringen op het water. Versie 9, maart 2015. Internal CVO report 15.009

Damme, C. van, K. Bakker, L. Bolle, I. de Boois, B. Couperus, R. van Hal, H. Heessen, R. Hoek & S. Fässler, 2016. Handboek bestandsopnamen en routinematige bemonsteringen op het water. Versie 10, januari 2016. CVO rapport 16.001

8 Quality assurance

CVO utilises an ISO 9001:2008 certified quality management system (certificate number: 187378CC1-2015-AQ-NLD-RvA). This certificate is valid until 15 September 2018. The certification was issued by DNV GL Business Assurance B.V

A scientific review of this report has been carried out by ir. R. van Hal, researcher at Wageningen Marine Research.

Signature

CVO Report: 17.011
Project number: 4311211029

Approved by: Ing. S.W. Verver
Head WOT, Centre for Fisheries Research

Signature:

Date: June 12, 2017

Annex 1 Gear specifications

(from: de Boois *et al*. 2014)

		modified net and gear	re-standardised net and gear
shoe	height (cm)	60	64
	length (cm)	70	77
	width (cm)	15	20
	weight (kg)	50 per shoe	30 per shoe
	height sprout connection (cm)	32	30
beam	length (cm)	300 between shoes	300 between shoes
	pipe diameter (cm)	8.9	9.2
	weight (kg)	60	70
	thickness pipe surface (cm)	0.8	0.7
sprout	material	chain 9.5 cm link	chain 16 mm diameter
	length (cm)	240 per sprout	250 per sprout
net	mesh size (mm)	information not available	20, 24, 35
	material	information not available	nylon
	head rope (cm)	290	290
	ground rope (cm)	information not available	370
bobbin	length (cm)	356	350
	bobbin diameter (cm)	not measured	17
tickler	number	1	1
	length (cm)	400	310
	chain type	8 mm	3/8”

Annex 2 Voorstel nieuwe tuigen DFS Waddenzee en Ooster- / Westerschelde (in Dutch)

Ingeborg de Boois, Loes Bolle en Thomas Pasterkamp februari 2014

Probleemstelling

In de afgelopen jaren is gebleken dat de tuigen van de 3 meter DFS bemonstering flink verschillend zijn geëvolueerd. Hierdoor zijn ze nu behoorlijk verschillend. Het is de wens van IMARES om zo veel mogelijk standaard tuigen te gebruiken voor vergelijkbaar onderzoek ten behoeven van WOT Surveys. De tuigen wijken van elkaar af en van de oorspronkelijke beschrijving in het handboek, zie tabel 1.
Het is niet wenselijk om verschillende tuigen en netten te gebruiken tijdens de DFS survey. De vangstefficiëntie van beide tuigen zal verschillen, terwijl in de opwerking van de data ervan uitgegaan wordt dat de vangstefficiëntie gelijk is. De DFS gegevens worden, samen met de Duitse en Belgische gegevens, opgewerkt tot recruitment indices. Deze indices worden gebruikt voor vangstprognoses voor schol en tong. Het is belangrijk dat de vismethodes zoveel als mogelijk gestandaardiseerd worden. Idealiter zou er vergelijkend gevist moeten worden om de verschillen in vangstefficiëntie te kwantificeren. Er zijn voor de DFS meer netten in omloop dan bijvoorbeeld BTS en IBTS. Tijdens een survey gaan ook vaker netten onherstelbaar stuk. Er zijn in ieder geval nieuwe DFS netten nodig.

Tabel 1. Verschillen tussen DFS 3 meter tuigen en netten

		3m garnalennet Volgens Handboek versie 2	**3m garnalennet STERN Volgens meting 4 oktober 2005**	**3m garnalennet SCHOLLEVAAR Volgens meting mei 2006**
Slof	hoogte	64	64	60 cm
	lengte glijvlak	77	77	70 cm
	breedte glijvlak	10	20	15 cm
	gewicht	30 kg per slof	30 kg per slof	50 kg
	hoogte oog spruitstuk	30	30	32 cm
Boom	lengte	307	310	300 cm tussen sloffen
	buis	29 (omtrek)	29 cm omtrek buiten	28 cm
	dikte buis	0.7	0.75	8 mm
	gewicht	70 kg		60 kg
Spruitstuk	materiaal	ketting Ø 16 mm	staalkabel Ø 18 mm	Ketting 9,5 cm schalm
	lengte	455 per spruit	200 per spruit incl 2 x oog van 12	2,4 m
	borg	sluiting Ø 16 mm	draaiwartel	sluiting 10 cm
Net	maaswijdte	zie figuur 3.3.1	niet gemeten	18-22-30 mm
	materiaal	geknoopt nylon	Idem	nylon
	garendikte	210/18		2 en 2,5 mm
	bovenpees	lengte 290 gevlochten nylon, Ø 10 mm	lengte 285 niet gemeten	2,90 m
	grondpees	lengte 370 gevlochten nylon, Ø 10 mm	lengte 378 niet gemeten	3,80 m, gedraaid nylon
	klossenpees	350	316 + 2 x 20 ketting > 356, 9 klossen	13
	kettingpees			
	doorsnede klossen	17	niet gemeten	As 13 cm diam. dwarsdoorsnee 17 cm
Wekker	aantal	1	1	1
	lengte	310	380	400 m
	type ketting	3/8"	8 mm ketting	Schalmen 6,5 cm

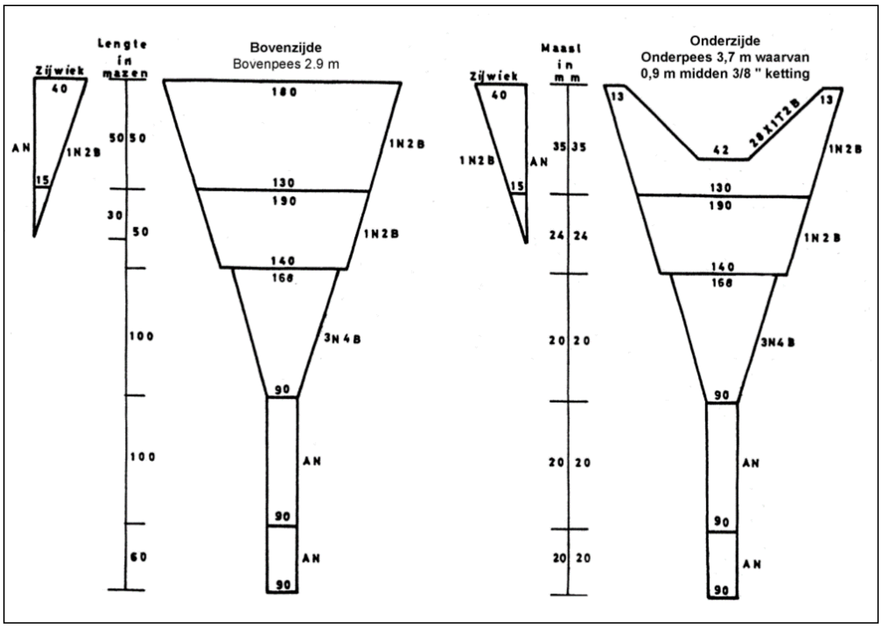
Voorstel

De tuigen en netten die door Schollevaar en Stern gebruikt worden ten behoeven van de WOT DFS Survey identiek aan elkaar maken. De karakteristieken staan hieronder beschreven in tabel 2.

Het dienen 2x 2-3 tuigen en 2x 4 netten beschikbaar te zijn. De netten en tuigen dienen gelabeld te worden zodat het duidelijk is welke wanneer gebruikt zijn. Het oude materiaal, in elk geval de oude netten, kunnen weg om verwarring te voorkomen. Omdat de kwaliteit van de bestaande netten wisselt, zullen om Rijksrederij (Fred Sehr) en IMARES (Thomas Pasterkamp) samen kijken naar de kwaliteit en constructie van de huidige netten. Op basis daarvan kan dan een inschatting worden gemaakt van het benodigd aantal nieuwe netten.
Het is wenselijk om een vergelijkende visserij uit te voeren om een indruk te krijgen van de vergelijkbaarheid van de oude en nieuwe tuigen. Over de mogelijkheden daarvoor en de invulling ervan zal worden gesproken tussen IMARES, EZ en de Rijksrederij.
In de afgelopen jaren heeft IMARES energie gestopt in het controleren van tuigen en netten van de WOT surveys, waardoor de kans klein wordt geacht dat het materiaal weer zo gaat divergeren als voorheen. De materialen worden jaarlijks gecontroleerd voorafgaand aan de survey.

Tabel 2. Voorgestelde karakteristieken DFS 3 meter tuig en net (Schollevaar en Stern)

		3 meter garnalennet
slof	hoogte (cm)	64
	lengte glijvlak (cm)	77
	breedte glijvlak (cm)	20
	gewicht (kg)	+/- 30 per slof
	hoogte oog spruitstuk (cm)	30
boom	lengte (cm)	300 tussen de sloffen
	doorsnee buis (cm)	9.2
	gewicht (kg)	70
	dikte buiswand (cm)	0.7
spruitstuk	materiaal	ketting 16 mm
	lengte (cm)	250 per spruitstuk
net	maaswijdte (mm)	20, 24, 35, zie nettek.
	materiaal	zie nettek.
	bovenpees (cm)	290 10 mm gevlochten nylon
	grondpees	370 10 mm gevlochten nylon
	type ketting grondpees	-
klossenpees	lengte (cm)	350
	doorsnede enkele klos (cm)	17
wekker	aantal	1
	lengte (cm)	310
	type ketting	3/8”



Figuur 1. Nettekening DFS 3 meter net (Schollevaar en Stern)