Inf. Fischereiforsch. 56, 2009, 23–34
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e-ISSN 1861-2164
p-ISSN 1860-9902

Online: 23. 03. 2009
DOI: 10.3220/Infn56_23-34_2009

Diel differences in catches of Western Baltic Spring Spawning Herring Larvae (*Clupea harengus*)

Tag-Nacht-Unterschiede bei Fängen von Heringslarven (*Clupea harengus*) im Greifswalder Bodden

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Abstract

Comparative night and day catches of herring larvae were taken during the Rügen-Herring-Larval-Survey (RHLS) in 2007 and 2008 in the Greifswalder Bodden which is the main spawning area of the Western Baltic Spring Spawning Herring. The quantities and the size composition of larvae caught during night and day were examined. During night more larvae were caught compared to the samples taken at daytime, especially with larvae larger than 25 mm. This indicates avoidance reactions, which increase with the developmental stage of the larvae. The differences of the night and day catches are relatively constant until a length of about 25 mm, thus the night/day effect does not influence estimations concerning larvae smaller than 25 mm (e.g. N20 index). There might be an impact on estimations for larger larvae due to the night/day effect. For further research other aspects like cloud coverage at night, phase of the moon, underwater visibility and turbidity should be taken into account. These aspects might influence the avoidance reactions.

Kurzfassung

Im Zuge des Rügen-Hering-Larven-Surveys (RHLS) der Jahre 2007 und 2008 wurden vergleichende Heringslarven-Proben betrachtet von Nacht- und Tagfängen der Larven des Herings der westlichen Ostsee in dessen Hauptlaichgebiet. Der Gesamtfang und die Größenzusammensetzung der Larven wurden untersucht. Nachts wurden im Vergleich zum Tag mehr Larven gefangen. Dies war vor allem bei Larven, die größer als 25 mm waren, zu beobachten. Dies lässt vermuten, dass es zu Ausweichreaktionen kommt, die mit fortschreitender Entwicklung der Larven zunehmen. Die Unterschiede der Nacht- und Tagfänge sind bis zu einer Länge von rund 25 mm relativ konstant. Deshalb werden Untersuchungen der Larven, kleiner als 25 mm, nicht vom Nacht/Tag-Effekt beeinflusst (z.B. N20 Index). Eine Auswirkung für größere Larven ist allerdings möglich. Für weitere Untersuchungen sollten auch andere Aspekte, wie die Bewölkung in der Nacht, die Mondphase, die Unterwassersichtweite und -trübung miteinbezogen werden, da sie möglicherweise die Ausweichreaktionen beeinflussen können.

Introduction

The knowledge about the appearance of marine fish recruitment is an important basis for sustainable fisheries management. Ideally, studies of abundance and growth of fish larvae are based on yearly larvae surveys. An example is the Rügen-Herring-Larval-Survey (RHLS), which takes place from March to July having a weekly coverage of the Greifswalder Bodden and the Strelasund, with a total of approximately 14 weeks per year (Figure 1). The Greifswalder Bodden is a shallow coastal inlet (mean depth: 5.6 m; size: 51 200 ha) bordered by the island of Rügen and the mainland of Mecklenburg Western-Pomerania in northern Germany.

The RHLS was established in 1977 to investigate the larvae abundance and distribution of Western Baltic Spring Spawning Herring (WBSSH) on its main spawning ground. Among others, the data of the RHLS are used to develop a recruitment index for the WBSSH and to analyse the abundance and mortality of herring larvae cohorts. In the 1990s the spawning stock biomass of the WBSSH decreased in spite of high (even though changing) recruitment accompanied by decreasing landings (ICES 2008) (Figure 2 upper left panel). The mean fishing mortality of about 0.5 is very high in comparison to the typical value for sustainable fisheries on pelagic stocks of about 0.2

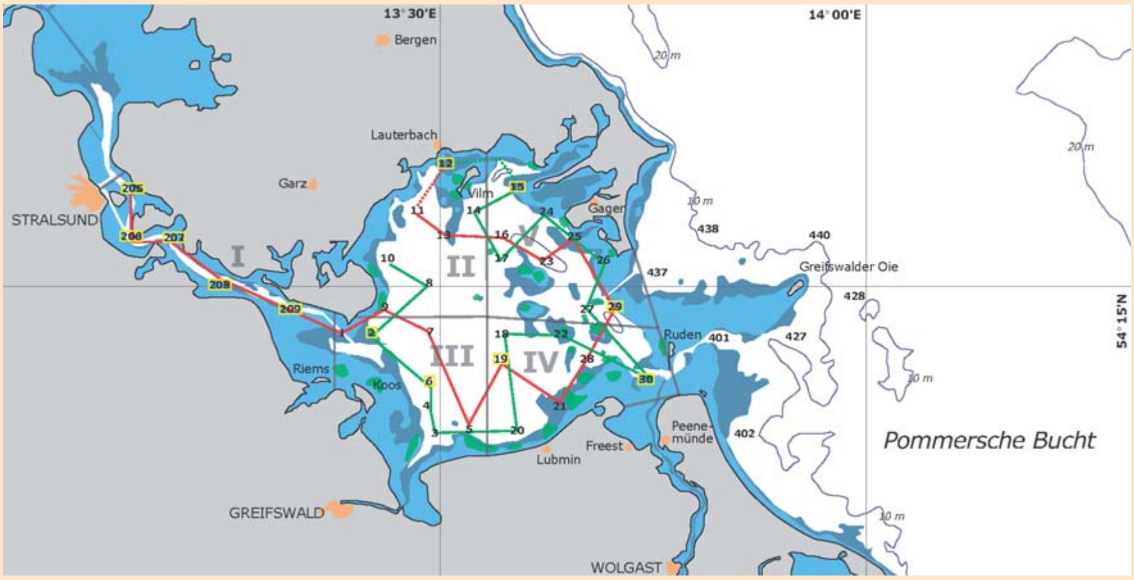

Figure 1: Map of the Greifswalder Bodden and the Strelasund showing the sampling stations of the RHLS. Some stations used for this study are simplified (302, 306, 312, 315, 319, 329 and 330 are characterised as 2, 6, 12, 15, 19, 29 and 30). Sampling stations of this study are marked in yellow.

Abbildung 1: Karte (Greifswalder Bodden und Strelasund) mit den Probenahmestationen des RHLS. Einige Stationen wurden in der Karte vereinfacht bezeichnet (302, 306, 312, 315, 319, 329 und 330 bezeichnet als 2, 6, 12, 15, 19, 29 und 30). Die Probenahmestationen dieser Untersuchung sind gelb markiert.

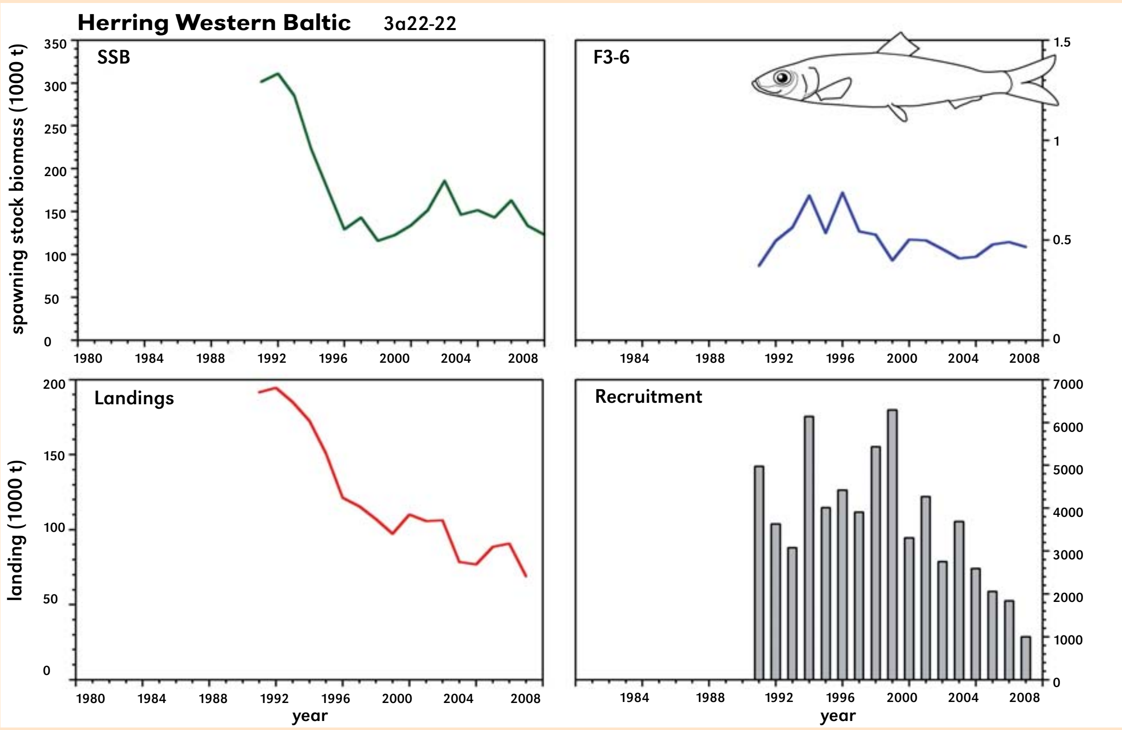

Figure 2: Time series of spawning stock biomass [1000 t], mean fishing mortality, landings [1000 t] and recruitment at age 0 [Mill.].

Abbildung 2: Zeitserie der Laicherbestandsbiomasse [1000 t], der durchschnittlichen, fischereilichen Sterblichkeit, der Anlandungen [1000 t] und des Rekrutment (Alter 0) [Mill.].

Table 1: List of stations and their geographical position. The x-mark indicates, whether day/night investigations were carried out at this station during a given cruise

Tabelle 1: Liste der Stationen mit zugehörigen geographischen Positionen. Mit x wird angezeigt, ob an dieser Station (während der betreffenden Reise) Tag/Nacht-Untersuchungen durchgeführt wurden.

Station	Lat (N)	Lon (E)	2007-9	2007-11	2007-13	2008-2	2008-9
205	54°19.00	13°08.20				x	x
206	54°16.80	13°08.30	x		x	x	x
207	54°16.85	13°11.10	x		x	x	x
208	54°15.30	13°14.30	x	x	x	x	x
209	54°14.15	13°19.30	x	x	x	x	x
302	54°12.10	13°25.20	x	x	x	x	x
306	54°11.10	13°28.80	x	x	x	x	x
312	54°19.70	13°29.60	x	x	x	x	x
315	54°19.50	13°34.70	x	x	x	x	x
319	54°11.50	13°33.50	x	x	x	x	x
329	54°14.40	13°41.50	x	x	x	x	x
330	54°11.35	13°44.00	x	x	x		x

(Figure 2, upper right panel). Since 2000 a dramatic decline of the recruitment has been recorded (ICES 2008) and this trend seems to continue in 2008 (Peters and Zimmermann pers. comm.). The decreasing spawning stock biomass and landings going along with the low recruitment led to the recommendation of ICES to reduce the fishing mortality substantially in 2009 (Advice for Herring in Subdivisions 22-24 and Division IIIa 2008). However, the time series is relatively short (starting in 1990), which, prior to 1990,is a consequence of difficulties to separate the North Sea Herring and the Western Baltic Herring, which are caught together in subdivision IIIa.

Earlier studies had indicated that the Greifswalder Bodden and the Strelasund were the main spawning grounds of WBSSH, which was recently confirmed by studies in 2007 and 2008 (Zimmermann and Stepputtis pers. comm.)

In 2006 the RHLS was scrutinized by an international in-depth review (Dickey-Collas and Nash 2006). Among other aspects the logistics of the survey, the potential use of the surveys in stock assessment and fisheries sciences as well as the scientific value of the time series were evaluated. One aspect which was considered as an important research need was the comparison of night and day catches in the RHLS, especially with regards to length-dependent aspects.
Larger larvae have a higher swimming speed, and can, after having reached a certain size, avoid the sampling gear by sensing its surge. Moreover, they are able to avoid nets at day-time, due to their visual senses and spectral sensitivity (Blaxter 1964). Some studies have shown that different sampling gears can induce different avoidance reactions (Brander and Thompson 1989; Brander, Nichols and Thompson 1987) and, in some cases, that night samples provide larger catch sizes than day samples of larvae of mid- and late-stages (Brander and Thompson 1989; McGurk 1992). As a consequence it is important to take this fact into consideration in order to minimise the underestimation of growth and the overestimation of mortality.
To investigate the diel effect the Institute for Baltic Sea Fisheries Rostock conducted additional night samples in the RHLS to test this phenomenon in the region of the Greifswalder Bodden in 2007 and 2008. The day and night catches are compared to ascertain whether there are significant differences, which have to be considered for further studies.

Materials and methods

For the present study, ichthyoplankton stations in the Greifswalder Bodden were sampled during day and during the following night, whereby stations at five different cruises were sampled; cruises 9, 11 and 13 in 2007 (cruise 9: 21/05/07 to 24/05/07; cruise 11: 04/06/07 to 07/06/07; cruise 13: 18/06/07 to 21/06/07) and cruises 2 and 9 in 2008 (cruise 2: 25/03/08 to 27/03/08; cruise 9: 13/05/08 to 16/05/08). The investigations were carried out with RV "Clupea" at a series of stations (Table 1) in the Greifswalder Bodden and the Strelasund (Figure 1) in 3 to 7 m water depth. Due to bad weather conditions several stations had to be left out during some cruises (Table 1).

The sampling gear was a HYDROBIOS-Bongo net (diameter: 60 cm), the inner net with a 335 µm and the outer net with a 780 µm mesh size (Figure 3). The towing speed was 3 kn, whereby double-oblique tows were conducted (V-tows: surface - 2 m above bottom - surface). The flow through the nets was measured by mechanical flowmeters. These values were used for the estimation of filtrated volumes. After removing the samples from the sampling gear, they were preserved in a 4% borax buffered formalin-seawater solution.

At each plankton station the water temperature, the salinity and the concentration of dissolved O^2 (each at the surface and at the bottom) was measured by means of a $CTDO^2$-sensor. Furthermore the water transparency (Secchi depth), cloud coverage, sea state, wind speed, air pressure and air temperature were recorded. The plankton samples were sifted and washed in the laboratory. The herring larvae were sorted out, counted and length-measured. Three sub-samples of 200 individuals were taken at random out of samples with more than 1000 larvae to measure the length. These length distributions were raised to the complete catch. The total length of the larvae was measured to the millimetre below, whereby the larvae were grouped in 5 mm length classes for this study. A micrometer and a binocular microscope were used for this procedure. Damaged larvae were not length-measured but only counted. However, the damaged larvae were used for length-independent analyses and excluded for length-dependent analyses.
The flowmeter data and the total numbers of larvae were used for the conversion into densities (individuals per m^3; $ind*m^{-3}$). The statistical analyses were carried out with the statistical package R (R Development Core Team 2008).

Length independent night-day catch relation
The larvae densities [$ind*m^{-3}$] of the night and the day samples per station and cruise were regarded for this part of the data analysis. With a one-sided t-test for paired samples the difference of mean night and day densities was tested for significance. The precondition for using this test is a normal distribution of differences. Therefore, the differences of paired measured values (night/day) should be normal distributed, which was tested by drawing a qq plot. The qq plot shows a normal distribution, when the data points are located as near as possible to the bisecting line. This graphical test showed that there was no normal distribution. To attain a normal distribution, the density values were transformed. In this case the decadal logarithmic transformation was deployed. Because values from 0 to 1 occur in the data, 1 was added to all the values before the transformation, in order to avoid negative results. After the transformation, the test for normal distribution was accomplished again and showed an approximate normal distribution.

Figure 3: HYDROBIOS-Bongo net
Abbildung 3: HYDROBIOS-Bongo Netz

Length distribution
To compare the length distributions of night and day catches, the relative frequencies per length class were examined. To test for significant differences between the length distributions of day and night catches the Kolmogorov-Smirnov test (K-S test) was used. The K-S test is a nonparametric test of equality of one-dimensional probability distributions, which can be used to compare the distribution of two samples. For this test a series of measurements was needed in R. Therefore, frequency distributions from RHLS database (numbers per length class/net/station/cruise) were transformed to disaggregated data for each measured individual. A two sided K-S test and both versions (less and greater) of the one sided K-S test were carried out.

Length dependent night/day catch ratios
Length dependent night/day catch ratios were examined to see the correlation between the differences of the night and day samples in regard to the length of the larvae. These ratios were transformed with natural logarithms. For particular length classes those cruises were excluded, when no larvae were caught during day and night (night/day catch ratio = 0/0).

Results

The size spectrum of herring larvae or juvenile herring caught, ranged from a total length of 5 to 76 mm.
Table a (Annex) provides an overview of the larvae density [$ind*m^{-3}$] and the mean length [mm] of larvae for the 335 µm net as well as the 780 µm net per station and cruise; the mean length [mm] is also given for each station. The means are calculated from untransformed data. The mean length is relatively constant at all stations per cruise (Figure 4). The very high maximum values (e.g. 76 mm in the night sample of cruise 9 in 2007 at station 315) derive from cases, where also juvenile fish were caught. No lines were drawn, where no larvae were caught. The mean lengths of

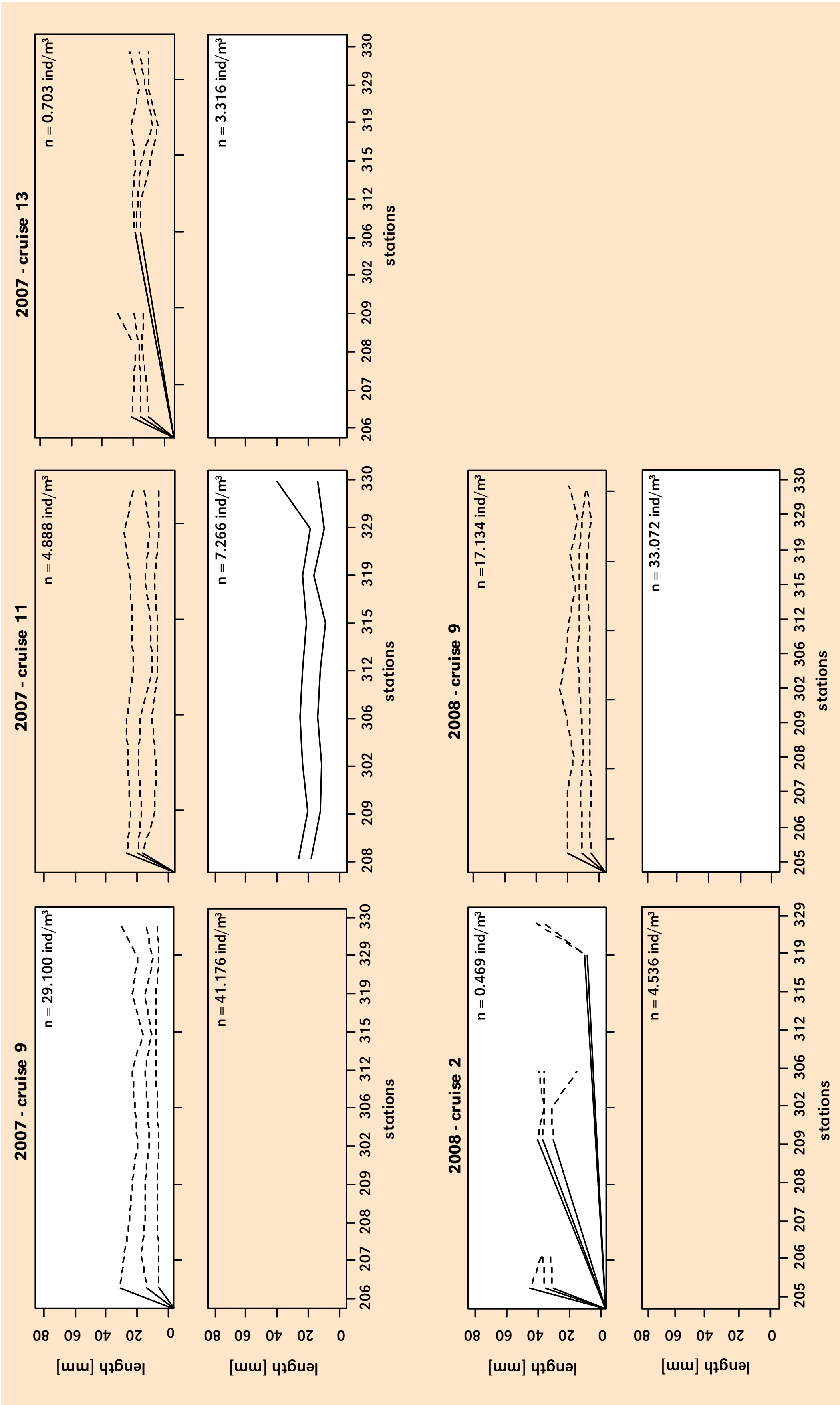

Figure 4: Maximum (upper line), mean (middle line) and minimum (lower line) length values [mm] at each station for each cruise. The dashed line represents the day catches and solid line represents the night catches.

Abbildung 4: Maximale (obere Linie), mittlere (mittlere Linie) und minimale (untere Linie) Längenwerte [mm] für jede Station und jede Reise. Die Tagfänge werden durch die unterbrochene Linie und die Nachtfänge durch die durchgezogene Linie dargestellt.

Table 2: Mean size [mm] of herring larvae caught at night and at day for each cruise (total density values [ind/m³] in parentheses)

Tabelle 2: Durchschnittslänge [mm] der Heringslarven der Nacht- bzw. Tagfänge jeder Reise (Total-Individuendichte [ind/m³] in Klammern).

	2007-9	2007-11	2007-13	2008-2	2008-9
Day	14.108 (n=29.100)	14.836 (n=4.888)	18.342 (n=0.703)	29.687 (n=0.469)	10.303 (n=17.134)
Night	12.080 (n=41.176)	23.265 (n=7.266)	26.801 (n=3.316)	9.101 (n=4.532)	12.264 (n=33.072)

larvae caught at night and day in each cruise are compared in Table 2. In cruises 11 and 13 in 2007 and cruise 9 in 2008 the mean lengths are higher at night than at day. To assess the data of Table 2 the densities need to be taken into consideration. For example, the high mean length of day samples of cruise 2 in 2008 is caused by very low abundance of herring larvae found and hence of less importance for the overall picture.

Length independent night-day catch relation

The relation of the larvae density at night and day [ind/m³] for each station is given in Figure 5. The densities of the five cruises differ however, ranging from 0.01 (2008, cruise 2, day) to 12.76 ind/m³ (2007, cruise 9, night). The data points located on the bisecting line represent cases of equal densities at night and day. The data points located above the bisecting show

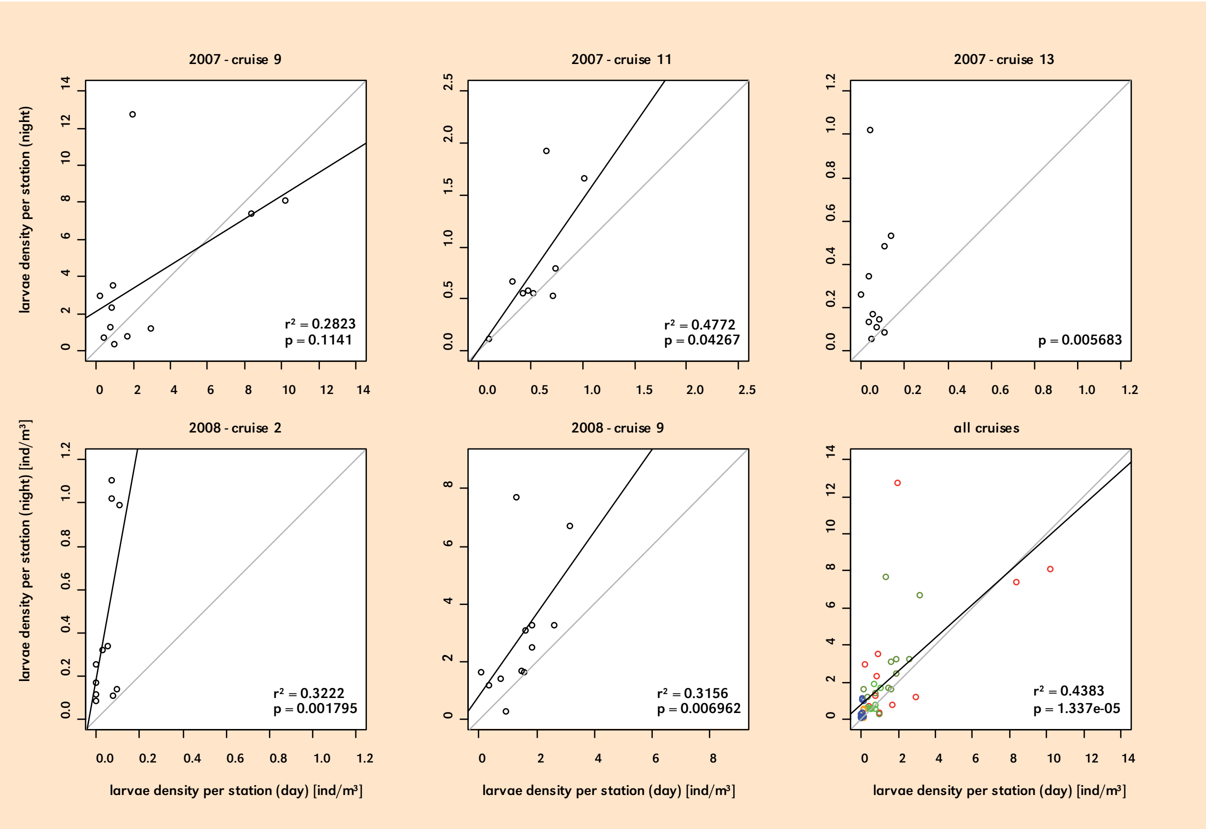

Figure 5: Larvae density values [ind/m³] of day samples versus the density values [ind/m³] of night catches for single cruises and all cruises together (red: 2007/9; green: 2007/11; orange: 2007/13; blue: 2008/2; olive: 2008/9). The grey line indicates the 1:1-relationship. The r²-values were calculated with the linear regression (black line). The p-values were derived from the t-test.

Abbildung 5: Larvendichtewerte [ind/m³] der Tagproben aufgetragen gegen die Dichtewerte [ind/m³] der Nachtproben für jede einzelne Reise und für alle Reisen zusammen (rot: 2007/9; grün: 2007/11; orange: 2007/13; blau: 2008/2; oliv-grün: 2008/9).

cases of more larvae caught at night than at daytime, the data points below the bisecting line show the opposite cases.
Due to the wide scatter the linear regression is not the optimum delineation for each case (e.g. 2007-cruise 13). Therefore, the t-test was carried out, in order to make a statement about the significant differences of day and night catches.
The results of the t-test showed that there is a significant difference between the night and day densities and that the night catches were significantly higher than the day catches. The only exception occurs in cruise 9 in 2007 (see p-values in Figure 5). On that account the regression line in the lower right Figure (Figure for all cruises) lies close to the bisecting line, although in four of five cruises considerably more larvae were caught at night than at day.

Length distribution

The day and night distributions of the five cruises differ with regard to the relative frequencies of the night and day samples for each length class (Figure 6). Regarding to the three cruises in 2007, the larvae length increased in the course of time. In addition, differences of night and day catches can be detected. For example, in both cases (net 780 µm and 335 µm) of cruise 11 and 13 in 2007 the larger larvae were caught at night. In some samples there are two peak curves (e.g. 2007-11-335 µm net and 2007-11 780 µm net). The K-S test was carried out for different day and night distributions in general (two-sided test), which showed that in each case the distributions for day and night samples were significantly different. Afterwards two one-sided tests were carried out, to test whether the distribution of the night catches are less or greater than the one of the day catches. The test results evinced that in six of ten cases the distribution of the night catches was significantly greater than the one of the day catches (Table 3).

Length dependent night/day catch ratios

For a better estimation of the differences in the mean numbers of herring larvae in night and day catches, ratios per cruise and length class were calculated (Figure 7). Figure 7 shows that the ratios are not throughout constant with increasing length. Below a

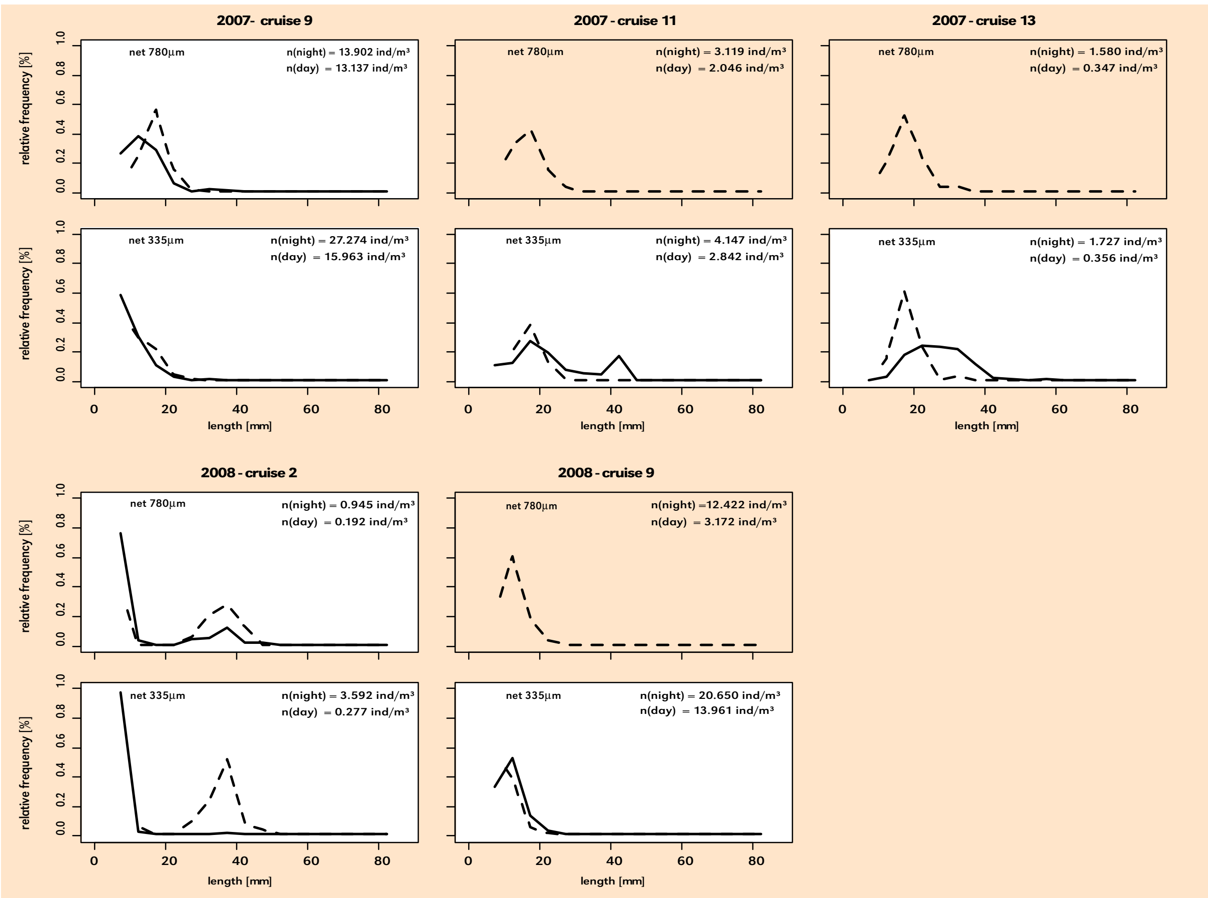

Figure 6: Relative frequency of larvae for each length class of the 335 µm net and the 780 µm net. The n values give the total density values [ind/m³] for the respective net of the night and the day samples per cruise.

Abbildung 6: Relative Häufigkeit der Larven für jede Längenklasse (jeweils für das 335 µm Netz und das 780 µm Netz). Die n-Werte geben die Total-Individuendichte [ind/m³] für das jeweilige Netz der Tag- bzw. Nachtfänge für jede Reise an.

Table 3: Comparison of length-distribution of day and night catches separated by cruise and net. Results of the Kolmogorov-Smirnov test; given are p-values and significant values (at 5% level) are marked with a star; N and D stand for the length-distribution of the night (N) and the day (D) catch.

Tabelle 3: Vergleich der Längenverteilung der Tag- und Nachtfänge je Reise und Netz. Ergebnisse des Kolmogorov-Smirnov-Tests; Angabe der p-Werte (signifikante Werte (Signifikanz-Niveau von 5 %) sind mit einem Stern markiert); N und D stehen für die Längenverteilung des Nacht- (N) und des Tagfangs (D).

year - cruise - net	N≠D	N>D	N<D
2007 - 9 - 780 µm	< 2.2e-16*	0.485	< 2.2e-16*
2007 - 9 - 335 µm	1.110e-15*	0.928	5.806e-16*
2007 - 11 - 780 µm	1.732e-14*	8.675e-15*	1
2007 - 11 - 335 µm	< 2.2e-16*	< 2.2e-16*	1
2007 - 13 - 780 µm	2.040e-07*	< 2.2e-16*	1
2007 - 13 - 335 µm	2.524e-07*	1.262e-07*	1
2008 - 2 - 780 µm	0.023*	0.995	0.01144*
2008 - 2 - 335 µm	< 2.2e-16*	1	< 2.2e-16*
2008 - 9 - 780 µm	0.0003132*	0.0001566*	1
2008 - 9 - 335 µm	< 2.2e-16*	< 2.2e-16*	1

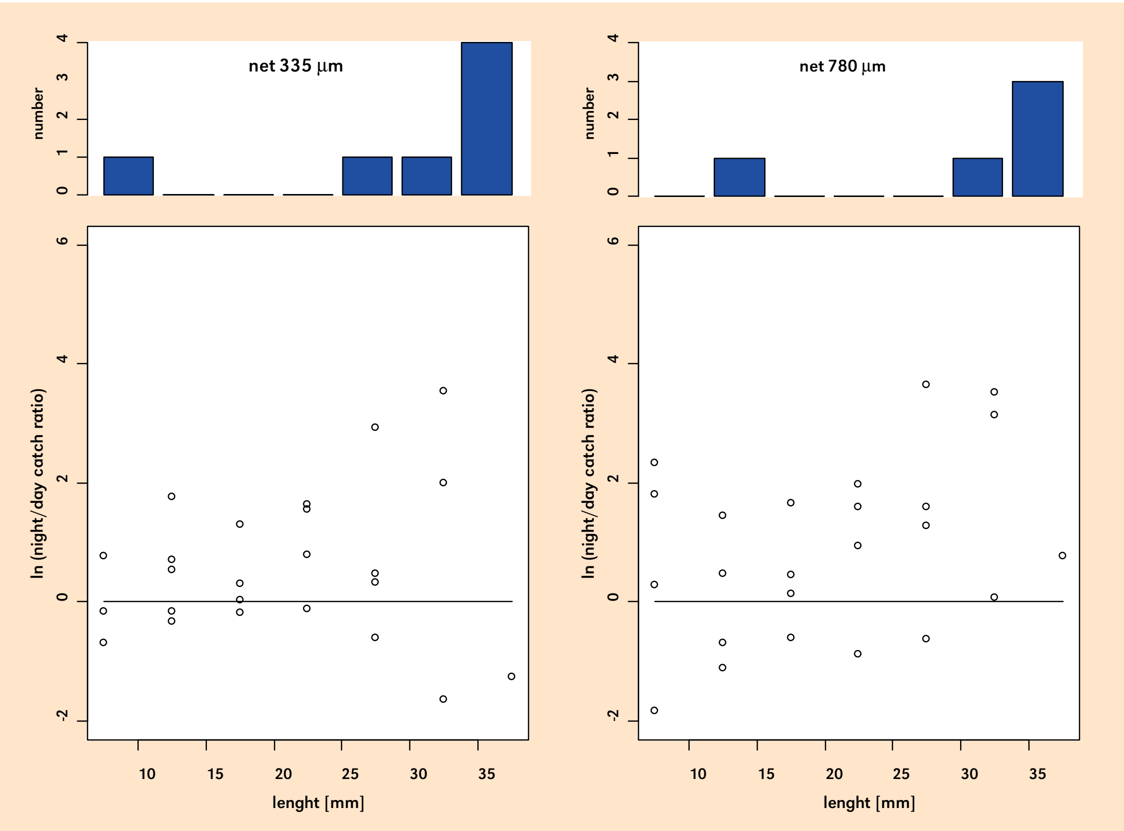

Figure 7: Lower panel: The ln(night/day) catch ratio 5mm-length classes [mm] and per cruise for the 335 µm net and the 780 µm net. Each data point of one length class represents the ratio value of one cruise. Solid line indicates 1:1 ratio. Upper panel: The number of cruises per 5 mm-length class, where no larvae were caught during the day in contrast to the night samples (night/day catch ratio = x/0)

Abbildung 7: Untere Graphiken: Der natürliche Logarithmus des Nacht-/Tagfang-Quotienten in 5mm-Längenklassen pro Reise (je eine Graphik für das 335 µm Netz und das 780 µm Netz). Jeder Datenpunkt pro Längenklasse steht für einen Wert einer Reise. Die durchgezogene Linie zeigt das 1:1 Verhältnis an.
Obere Graphiken: Anzahl der Fälle (Reisen) in 5mm-Längenklassen, in denen -im Gegensatz zur Nacht- tagsüber keine Larven gefangen wurden (Nacht-/Tagfang-Verhältnis = x/0).

length of about 25 mm the ratios are relatively constant (with high variance) and probably no significant length-dependent differences between the day and night catches can be detected. From a length of about 25 mm however, the ratio increases with the larvae size. The bar plots show that the cases, when no larvae were caught at day but a certain number of larvae was caught at night, increase with larger length classes.

Discussion

The results of the comparison of night and day catches show that there is a difference in the catch size: more larvae are caught at night. This suggests that there is a certain proportion of avoidance during the day. One reason for the night/day effect with larvae of later stages may be the visual avoidance, although Brander and Thompson (1989) showed that there are also different avoidance reactions to different sampling gears at night. This implies that there must be other sensual impulses than only the visual one, for example the surge in the water or the noise of the sampling gear. Another reason for the higher avoidance rate of the larger larvae might be their better physical development, which allows them to react more effectively to stimuli of their surroundings (Brander and Thompson 1989) than the smaller, less developed larvae. This may be the reason for length-dependent catch rates (Figure 7). Important physiological and morphological changes start at a length of about 25 mm (Heath and Dunn 1990). These changes include the development of the rods (Sandy and Blaxter 1980) in the eye as well as the fins. From a length of about 25 mm the night/day catch ratio is increasing with the larvae length. For the estimation of growth and mortality of larvae larger than 25 mm this aspect should be taken into account. The tendency of the increasing night/day catch ratio with the larvae length agrees well with other studies (e.g. Brander and Thompson 1989).
These results support well the estimation of the N20 index. This index is defined as the total number of larvae that reach the length of 20 mm. The N20 index covers the main spawning area and coincides well with the recruitment estimates derived from the assessment (ICES 2008). The differences of night and day catches are relatively constant until a length of about 25 mm and seem to be length independent. Thus the calculation of the N20 index is not influenced by the night/day effect.
For future research the cloud coverage at night and phase of the moon should be taken into account. In bright moonlight the avoidance reactions might increase in comparison to conditions of intense cloudiness as well as new moon situations. Moreover the effects of other environmental conditions should be examined more closely, for example the water temperature, underwater visibility as well as the turbidity. All these aspects might be correlated with the avoidance reactions and might change the avoidance characteristics.
Analyses of larvae catches in 2007 and 2008 were partially hampered by very low numbers of caught larvae and the occurrence of several zero catches. Thus the significance of this study is not optimal. One reason for the little data is the very low recruitment of WBSSH in recent years (Figure 2). The informative value could be improved by gathering more data in further comparative night and day catch cruises. Nevertheless the occurring night/day effects and their length dependency could be ascertained.

Acknowledgements
We gratefully acknowledge the members of the Institute for Baltic Sea Fisheries, Rostock. Especially those, who have participated in the Surveys of the RHLS and analysing the samples and the crew of RV "Clupea".
Especially, we like to thank Heike Peters for her help and support of this work.

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Annex

Table a: Summary of larvae density values [ind/m³], mean length values [mm] for each net and mean length also for the complete sample at station. The ID of each station is composed of the following information: D or N (for day or night) Cruise/Year/Station.

Tabelle a: Zusammenfassung der Werte für die Individuendichte [ind/m³], die Durchschnittslänge [mm] (beides je Netz) und die Durchschnittslänge für die gesamte Probe (beide Netze zusammen) je Station. Die Stationsidentifikation (ID) setzt sich folgendermaßen zusammen:
D oder N (für Tag bzw. Nacht) Reise/Jahr/Station.

StationsID	Larvae density [ind/m³] 335 µm	Larvae density [ind/m³] 780 µm	Mean length [mm] 335 µm	Mean length [mm] 780 µm	Mean length [mm] per station (both nets)
D9/07/206	6.063	2.317	9.874	15.951	12.913
D9/07/207	3.138	7.055	15.605	18.017	16.811
D9/07/208	0.948	0.980	11.875	16.500	14.188
D9/07/209	0.509	0.264	14.091	15.500	14.795
D9/07/302	0.568	0.391	10.431	12.955	11.693
D9/07/306	2.085	0.854	12.245	13.676	12.961
D9/07/312	0.160	0.213	13.269	15.921	14.595
D9/07/315	0.161	0.021	11.071	10.000	10.536
D9/07/319	0.477	0.415	14.573	14.625	14.599
D9/07/329	1.358	0.327	8.077	11.503	9.790
D9/07/330	0.508	0.343	13.125	15.000	14.063
N9/07/206	5.665	1.721	8.997	11.778	10.388
N9/07/207	3.529	4.599	9.854	13.221	11.538
N9/07/208	9.805	2.956	9.620	13.439	11.529
N9/07/209	0.626	0.632	14.722	15.127	14.925
N9/07/302	0.211	0.159	17.500	17.500	17.500
N9/07/306	0.697	0.526	16.840	16.221	16.530
N9/07/312	0.421	0.245	15.000	15.921	15.461
N9/07/315	1.749	1.176	12.976	13.962	13.469
N9/07/319	2.065	1.465	15.000	17.195	16.097
N9/07/329	0.687	0.082	8.981	12.500	10.741
N9/07/330	1.909	0.443	9.507	13.529	11.518
D11/07/208	0.000	0.097	16.104	22.500	19.302
D11/07/209	0.372	0.346	17.132	16.094	16.613
D11/07/302	0.419	0.231	18.077	18.833	18.455
D11/07/306	0.286	0.447	17.292	18.013	17.652
D11/07/312	0.310	0.162	8.707	12.115	10.411
D11/07/315	0.244	0.076	10.577	11.875	11.226
D11/07/319	0.236	0.186	15.227	14.444	14.836
D11/07/329	0.436	0.090	9.257	14.375	11.816
D11/07/330	0.539	0.472	15.691	15.183	15.437
N11/07/208	0.021	0.097	23.972	22.500	23.236
N11/07/209	0.257	0.274	17.700	17.315	17.507
N11/07/302	0.827	1.098	21.875	20.437	21.156
N11/07/306	0.456	0.334	22.750	22.500	22.625
N11/07/312	0.349	0.226	19.464	22.222	20.843
N11/07/315	0.610	0.052	11.250	25.500	18.375
N11/07/319	0.283	0.267	21.923	20.500	21.212

StationsID	Larvae density [ind/m³] 335 µm	Larvae density [ind/m³] 780 µm	Mean length [mm] 335 µm	Mean length [mm] 780 µm	Mean length [mm] per station (both nets)
N11/07/329	0.389	0.168	14.914	17.917	16.415
N11/07/330	0.956	0.709	39.418	35.625	37.521
D13/07/206	0.026	0.017	20.833	12.500	16.667
D13/07/207	0.051	0.055	17.500	16.786	17.143
D13/07/208	0.042	0.029	17.500	17.500	17.500
D13/07/209	0.075	0.060	19.643	23.333	21.488
D13/07/302	0.000	0.000	–	–	–
D13/07/306	0.013	0.025	22.500	17.500	20.000
D13/07/312	0.012	0.023	17.500	20.00	18.750
D13/07/315	0.047	0.033	16.250	17.500	16.875
D13/07/319	0.054	0.000	19.500	–	19.500
D13/07/329	0.024	0.011	15.000	12.500	13.750
D13/07/330	0.012	0.093	17.500	18.125	17.813
N13/07/206	0.027	0.025	20.833	22.500	21.667
N13/07/207	0.043	0.041	21.500	22.500	22.000
N13/07/208	0.066	0.042	27.500	30.000	28.750
N13/07/209	0.299	0.231	24.808	23.804	24.306
N13/07/302	0.085	0.177	28.500	24.318	26.409
N13/07/306	0.559	0.465	30.217	30.183	30.200
N13/07/312	0.223	0.118	23.611	21.000	22.306
N13/07/315	0.054	0.093	23.500	27.500	25.500
N13/07/319	0.098	0.072	24.167	28.929	26.548
N13/07/329	0.088	0.048	24.643	30.000	27.321
N13/07/330	0.205	0.277	29.375	27.717	28.546
D2/08/205	0.041	0.010	41.250	27.500	34.375
D2/08/206	0.042	0.031	36.250	35.000	35.625
D2/08/207	0.000	0.000	–	–	–
D2/08/208	0.000	0.000	–	–	–
D2/08/209	0.063	0.031	33.500	37.500	35.500
D2/08/302	0.037	0.034	35.000	35.000	35.000
D2/08/306	0.080	0.027	31.667	37.500	34.583
D2/08/312	0.000	0.000	–	–	–
D2/08/315	0.000	0.000	–	–	–
D2/08/319	0.000	0.069	–	7.500	7.500
D2/08/329	0.014	0.014	37.500	42.500	40.000
N2/08/205	0.283	0.055	7.500	7.500	7.500
N2/08/206	0.097	0.014	8.214	7.500	7.857
N2/08/207	0.089	0.026	11.071	35.000	23.036
N2/08/208	0.069	0.014	8.500	32.500	20.500
N2/08/209	0.126	0.014	8.056	37.500	22.778
N2/08/302	0.817	0.203	7.500	13.864	10.682
N2/08/306	0.869	0.124	7.845	20.278	14.061
N2/08/312	0.238	0.013	12.794	7.500	10.147
N2/08/315	0.119	0.049	8.000	10.833	9.417
N2/08/319	0.687	0.417	7.585	11.357	9.471
N2/08/329	0.279	0.040	7.738	7.500	7.619
D9/08/205	1.502	0.347	9.400	11.894	10.647

StationsID	Larvae density [ind/m³] 335 µm	Larvae density [ind/m³] 780 µm	Mean length [mm] 335 µm	Mean length [mm] 780 µm	Mean length [mm] per station (both nets)
D9/08/206	2.450	0.158	9.512	12.167	10.839
D9/08/207	1.659	0.190	9.828	12.500	11.164
D9/08/209	1.214	0.401	9.763	11.250	10.507
D9/08/302	2.370	0.783	11.272	12.770	12.021
D9/08/306	0.713	0.600	11.968	14.405	13.186
D9/08/312	0.826	0.123	11.000	13.611	12.306
D9/08/315	0.037	0.049	9.167	15.000	12.083
D9/08/319	1.076	0.384	12.270	12.786	12.528
D9/08/329	0.255	0.074	9.000	11.667	10.333
D9/08/330	1.471	0.110	8.077	8.214	8.146
N9/08/205	0.102	2.390	12.315	14.049	13.182
N9/08/206	2.098	1.171	12.361	12.326	12.344
N9/08/207	1.941	1.306	12.885	13.620	13.252
N9/08/208	0.988	0.394	12.695	15.000	13.847
N9/08/209	1.918	1.159	12.278	14.543	13.411
N9/08/302	5.308	1.398	10.840	13.643	12.241
N9/08/306	4.373	3.332	13.309	14.037	13.673
N9/08/312	0.202	0.058	10.167	15.833	13.000
N9/08/315	0.951	0.678	12.821	14.500	13.660
N9/08/319	1.086	0.583	13.043	14.792	13.918
N9/08/329	0.986	0.197	9.075	11.833	10.454
N9/08/330	1.263	0.373	9.889	14.038	11.964