

This paper not to be cited without prior reference to the author

International Council for the  
Exploration of the Sea

C.M. 1980/G:46  
Demersal Fish Committee

On the relation between depth and redfish  
in spawning condition, SW of Iceland.

by

Jakob Magnússon  
Marine Research Institute, Reykjavík

Abstract

Differences in the horizontal and vertical distribution of mature females of the two Sebastes species, S. marinus and S. mentella, are described and the depth range and temperature in which each species "spawn" is defined.

Introduction

The depth in which redfish "spawn" is one of the many problems unsolved hitherto in redfish research. TÅNING (1949) was assuming that redfish in Icelandic waters spawn in 200-500 m depth, within the temperature range of 3° to 9°C. EINARSSON (1960) dealt with Tåning's assumption in his paper and i.a. indicated that "spawning" of redfish might as well take place in depths of 500 to 800 m and within a narrower temperature range, i.e. 4 - 5°C. These assumptions here referred to were based on the larval distribution of redfish in connection with hydrographic conditions and at that time, they made no distinction between S. marinus and S. mentella. Jones (1969) indicated that S. mentella descend for spawning since handline fishing at "Alpha" down to 400 m was unsuccessful in April while it was most successful in 100-250 m depth at other times of the year.

### Material and methods

In late April 1978 and 1980, during two research cruises, the relationship between depth and redfish in spawning condition was studied. The sampling was carried out exclusively with bottom trawl. The area investigated, located SW of Iceland, was divided into six sub-areas (Fig.1).

The maturity stages of female redfish here referred to are as follows:

- Stage I: Immature
- " II: Ripening
- " III A: Eggs lose in the ovaries (i.e. they are fertilized)
- " III B: Embryos can be seen in the eggs with the naked eye.
- " III C: "Spawning" or "running", i.e. the egg membrane has been broken and the larvae released
- " IV: Post-spawning

The expression "spawning" is used in this paper for stage III C only, and "spawning condition" for all three grades of stage III.

As expected at the time of observation, females of stage II were not present in the catches except three specimens which are excluded here.

### Sex composition and maturity

There was a considerable difference between the two species in the mingling of sexes. The proportion of sexes of S.mentella was rather equal in all areas though males were in slight majority, except in area 4 (51.1 % females). On the other hand, females of S.marinus were in majority in all six areas, sometimes over 90% (areas 4 and 6), which indicates a separation of sexes during the spawning time by this species (Table 1).

There were also considerable differences between the two species regarding the proportion of immature females in the catches in both years. The percentage of immature S.marinus females was generally low while immature females of S.mentella were well abundant. The presence of immature females of both

species in the catches was lowest in area 4 (2.7% of S.marinus and 40.3% of S.mentella) and highest in area 6 (61.6% of S.marinus and 91.6% of S.mentella, Table 2). The percentage of postspawners was rather low for both species but it differed between areas. The percentage of S.marinus females, stage IV, was highest in area 6 but for S.mentella females, it was highest in area 1, i.e. in the area where relatively few females in spawning condition were found (Table 3). In general, the low percentage of stage IV, particularly in areas where considerable spawning was observed, and a relatively high percentage of stage IV in areas with few females in spawning condition might indicate that redfish in post-spawning condition leave the spawning area rather quickly.

#### Horizontal distribution

Considering the areal distribution of mature females, both species were most abundant in area 2 and least in area 6 (Table 3). In area 2, the majority of the mature females of both species were of stage III B, i.e. just before spawning. A similar situation was observed in area 5 (Table 3). About 40% of mature females of both species were in running condition (stage III C). These were mainly abundant in areas 3 and 4, in both years of observation (Table 3).

Comparing the above mentioned differences in the areal distribution (see Fig. 1), it can be concluded that female redfish in spawning condition migrate from the slope areas (i.e. areas 1, 2 and 5, 6 see also Fig.1) to the Reykjanes Ridge area (areas 3 and 4).

#### Vertical distribution

As to the distribution according to depth, there is a difference between the two species in spawning condition which can be seen in Tables 4 and 5. In these tables, the material for each species is arranged in 50 m depth intervals for all sub-areas combined but for the two years separately.

Practically no S.marinus were caught in depths greater than 700 m (except 2 specimens in 1978). On the other hand, S.mentella were absent in depths less than 350 m (except 1 specimen in 1980).

The percentage of mature females of S.marinus was higher in 1978 than in 1980 (60.4% and 49.9% resp.), while for S.mentella, it was practically the same in both years (26.2% and 26.8% resp.). Males and immature females of S.marinus were scarce in depths greater than 400 m in 1978 but there, they were abundant in 1980. Such differences were not so pronounced for S.mentella.

In Table 6, mature females of S.marinus are arranged according to maturity stages by depth for each year separately.

In both years, the majority of spawning females (stage III C) were within the depth range of 300 to 550 m, although they could be observed in depths from 250 to 700 m. Also in both years, relatively few females had reached stage IV and these were only observed in the same depths as females of stage III C. Yet there was a considerable difference between 1978 and 1980 as to the maturity stage. In 1980, the majority of mature females were of stage III B while in 1978, they were mostly of stage III C (running).

According to these observations, the main spawning of S.marinus takes place in depths from 300 to 550 m. Females approaching stage III C are moving deeper which can be concluded considering the data of the year 1980 when the bulk of the mature females were of stages III A and III B and when they were quite numerous in depths from 200 to 300 m, too. But in 1978, as mentioned before, the bulk of the mature females were of stage III C, and very few mature females were observed in depths less than 300 m.

The data for S.mentella were arranged accordingly in Table 7. Spawning S.mentella females were not observed in depths less than 450 m but they were present in the greatest depth fished, i.e. 850 m. However, the main spawning of S.mentella seems to take place in depths of 500 to 700 m with the greatest density in 550 to 650 m which is a narrower depth range than for S.marinus. In fact, very few mature females were observed in depths less than 450 m and those were mainly of stage IV which indicates that spent females of S.mentella seek somewhat shallower water after spawning.

According to investigations on redfish larvae in the past years, redfish are spawning over great depths adjacent to the area investigated. The spawning redfish (both species) caught with bottom trawl as described above, derive most probably from the periphery of the main spawning area, and it is believed that the depth ranges for spawning given here, i.e. 300 to 550 m for S. marinus and 550 to 650 m for S. mentella, are also the main depth ranges for spawning in the oceanic area.

#### Relation to temperature

Temperature observations made in the eastern Irminger Sea, SW of Iceland, in April, show that the temperature in 300 to 650 m depth ranges from about 5.5° to 7.5°C (ICNAF, Spec. Publ. 1968 and our observations). The above defined spawning depth of S. marinus would correspond to water layers of mainly 6-7°C while the corresponding temperatures for the spawning depth of S. mentella would be about 5.5° to 6.5°C. Thus, S. marinus spawn in higher temperatures and in lesser depths than S. mentella.

#### Discussion

Both cruises were carried out in the same area and in the same time, i.e. the last third of the month April in 1978 and 1980. Nevertheless, the great differences in the proportion of spawning females of S. marinus between the two years might indicate that the onset of spawning differs from year to year, at least for S. marinus, and that S. marinus are sensitive for changes in the environmental conditions, as e.g. temperature. There are also indications that S. marinus spawn earlier than S. mentella. This is i.a. supported by recent research on planctonic stages of larvae of both Sebastes species (J.V. Magnússon, person communication):

As has been mentioned here, it is assumed that both depth and temperature are decisive for the spawning of redfish. It is, however, not known which one of these two factors are the more important one, but variances in the depth and/or temperature range given in this paper for each species are most probably depending on them.

References

Anon. 1968: Environmental Surveys-Norwestlant 1-3, 1963,  
Part II, Atlas.  
ICNAF, Special Publication No 7.

Einarsson Hermann 1960:  
The Fry of Sebastes in Icelandic Waters and  
adjacent Seas.  
Rit Fiskideildar, Vol. II, No. 7

Jones, D.H. 1969:  
Some characteristics of the pelagic redfish  
(Sebastes mentella, Travin) from Weather  
Station Alfa.  
Journal du Conseil. Vol. 32, No 3

Tåning, Å.V. 1949:  
On the Breeding and Abundance of the Red Fish  
(Sebastes) in the North Atlantic.  
Journal du Conseil, Vol. 16, No 1.

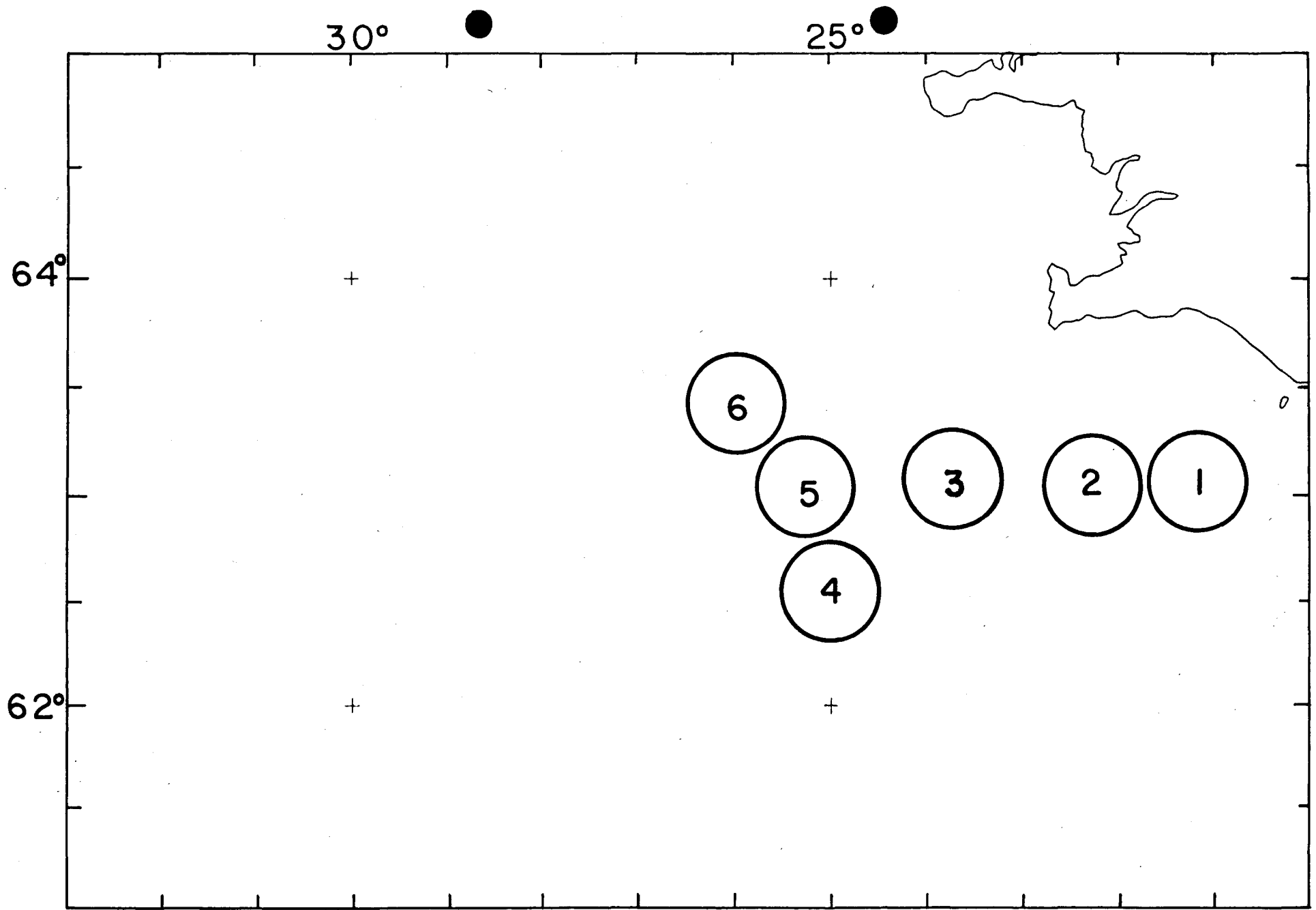


Fig. 1: Chart showing the areas fished in April 1978 and 1980.

Table 1

Females in the catches by areas, combined  
for both years 1978 and 1980.

<u>Area</u>	<u>Sebastes marinus</u>		<u>Sebastes mentella</u>	
	no.	%	no.	%
1	354	91.5	233	46.8
2	642	74.1	665	48.0
3	468	58.4	531	47.9
4	275	91.2	593	51.1
5	358	59.4 <sup>1)</sup>	584	49.8 <sup>1)</sup>
6	147	54.5	84	36.1 <sup>2)</sup>

1) Only fished in 1978

2) Only 1 single S. mentella in 1978.

Table 2

The proportion of immature females in the  
catches by areas for both years combined.

Area	<u>Sebastes marinus</u>		<u>Sebastes mentella</u>	
	no	%	no	%
1.	34	10.0	164	74.1
2.	94	14.5	252	43.5
3.	87	18.7	304	58.2
4.	8	2.7	236	40.3
5.	163	45.5 <sup>1)</sup>	260	44.5 <sup>1)</sup>
6.	98	61.6	76	91.6 <sup>2)</sup>

1) Only fished in 1978

2) " " S. mentella in 1978



Table 3

Mature females by stages and areas for *Sebastes marinus* and *Sebastes mentella*, both years combined.

<u>Sebastes marinus</u>										
Area	III A		III B		III C		IV		Total	
	no	%	no	%	no	%	no	%	no	%
1	17	5.3	174	54.4	123	38.4	6	1.9	320	100.1
2	68	12.4	341	62.2	134	24.5	5	0.9	548	100.0
3	20	5.3	150	39.4	203	53.3	8	2.1	381	100.1
4	4	1.5	50	18.7	204	76.4	9	3.4	267	100.0
5	14	7.2	136	69.7	31	15.9	14	7.2	195	100.0 <sup>1)</sup>
6	4	8.3	12	25.0	15	31.3	17	35.4	48	100.0
Total	127	7.2	863	49.1	710	40.4	59	3.4	1759	100.1
<u>Sebastes mentella</u>										
1	4	6.0	9	13.4	39	58.2	15	22.3	67	99.9
2	7	1.7	303	73.4	89	21.6	14	3.4	413	100.1
3	9	4.0	75	33.0	116	51.1	27	11.9	227	100.0
4	10	2.8	85	23.8	238	66.7	24	6.7	357	100.0
5	8	2.5	235	72.5	66	20.4	15	4.6	324	100.0 <sup>1)</sup>
6	-	-	4	50.0	3	37.5	1	12.5	8	100.0
	38	2.7	711	50.9	551	39.5	96	6.9	1396	100.0

1) Not fished in 1978.

Table 4

Sebastes marinus. Proportion of males, immature and mature females by depth for 1978 and 1980 for all areas combined.

1 9 7 8

1 9 8 0

Depth in meters	Males		Females				Total		Total 1978 no	Males		Females				Total		Total 1980 no
	All stages no	%	St. 1 no	%	St. III(A-C) and IV no	%	Total no	%		All stages no	%	St. 1 no	%	St. III(A-C) and IV no	%	Total no	%	
200-250	-	-	-	-	-	-	-	-	-	93	46.3	23	11.4	85	42.3	108	53.9	201
251-300	109	68.1	16	10.0	35	21.9	51	31.9	160	21	23.8	13	14.8	54	61.4	67	76.2	88
301-350	113	27.2	32	7.8	270	65.0	302	72.8	415	39	19.4	22	10.9	140	69.7	162	80.5	201
351-400	103	30.7	55	16.4	177	52.9	232	69.3	335	68	28.7	27	11.4	142	59.9	169	71.3	237
401-450	3	11.1	6	22.2	18	66.7	24	88.9	27	333	38.2	230	26.4	308	35.4	538	61.8	871
451-500	10	8.3	1	0.8	109	90.9	110	91.7	120	41	22.4	12	6.6	130	71.0	142	77.5	183
501-550	4	7.0	-	-	53	93.0	53	93.0	57	83	26.5	43	13.7	187	59.8	230	73.5	313
551-600	1	5.0	-	-	19	95.0	19	95.0	20	17	47.3	3	8.3	16	44.4	19	52.7	36
601-650	1	14.3	-	-	6	85.7	6	85.7	7	2	33.3	1	16.7	3	50.0	4	66.7	6
651-700	-	-	-	-	6	100.0	6	100.0	6	-	-	-	-	-	-	-	-	-
701-750	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
751-800	-	-	-	-	1	100.0	1	-	1	-	-	-	-	-	-	-	-	-
801-850	1	100.0	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Total	345	30.0	110	9.6	694	60.4	804	70.0	1149	697	32.6	374	17.5	1065	49.9	1439	67.4	2136

Table 5

Sebastes mentella. Proportion of males, females immature and mature by depth for 1978 and 1980 for all areas combined.

1 9 7 8

1 9 8 0

Depth in meters	Males		Females				Total		1978 no	Males		Females				Total		1980 no
	no	%	St. I no	%	St. III(A-C) and IV no	%	no	%		no	%	St. I no	%	St. III(A-C) and IV no	%	no	%	
200-250	-	-	-	-	-	-	-	-	-	-	-	-	1	100.0	1	100.0	-	
251-300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
301-350	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
351-400	3	75.0	-	-	1	25.0	1	25.0	4	4	100.0	-	-	-	-	-	4	
401-450	46	48.4	44	46.3	5	5.3	49	51.6	95	143	58.1	101	41.1	2	0.8	103	41.9	246
451-500	131	55.5	90	38.1	15	6.4	105	44.5	236	355	60.0	195	32.9	42	7.1	237	40.0	592
501-550	381	58.9	206	31.8	60	9.3	266	41.1	647	427	60.5	211	29.9	68	9.6	279	39.5	706
551-600	63	20.9	48	15.9	191	63.2	139	79.1	302	310	36.5	144	17.0	395	46.5	539	63.5	849
601-650	92	41.6	50	22.6	79	35.8	129	58.4	221	234	40.8	92	16.1	247	43.1	339	59.2	573
651-700	70	54.3	31	24.0	28	21.7	59	45.7	129	132	50.8	38	14.6	90	34.6	128	49.2	260
701-750	82	67.2	7	5.7	33	27.1	40	32.8	122	78	47.0	13	7.8	75	45.2	88	53.0	166
751-800	37	71.2	5	9.6	10	19.2	15	28.8	52	122	69.3	16	9.1	38	21.6	54	30.7	176
801-850	19	76.0	-	-	6	24.0	6	24.0	25	23	67.7	1	2.9	10	29.4	11	32.3	34
Total	924	50.4	481	26.2	428	23.4	809	49.6	1833	1828	50.7	811	22.5	968	26.8	1779	49.3	3607



Table 7 S.mentella. Mature females by years, stages of maturity and depth for all areas combined.

1 9 7 8

1 9 8 0

Depth	III A		III B		III C		IV		TOTAL	III A		III B		III C		TOTAL		
	No	%	No	%	No	%	No	%		No	%	No	%	No	%			
200-250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
251-300	-	-	-	-	-	-	-	-	-	1	100.0	-	-	-	-	1		
301-350	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
351-400	-	-	-	-	-	-	1	100.0	1	-	-	-	-	-	-	-		
401-450	-	-	-	-	-	-	5	100.0	5	1	50.0	1	50.0	-	-	2		
451-500	-	-	-	-	-	-	15	100.0	15	2	4.8	27	64.3	7	16.7	6	14.3	42
501-550	4	6.7	8	13.3	35	58.3	13	21.7	60	2	2.9	39	57.4	21	30.9	6	8.8	68
551-600	8	4.2	23	12.0	157	82.2	3	1.6	191	8	2.0	289	73.2	92	23.3	6	1.5	395
601-650	2	2.5	9	11.4	64	81.0	4	5.1	79	7	2.8	148	59.9	85	34.4	7	2.8	247
651-700	-	-	2	7.1	19	67.9	7	25.0	28	1	1.1	74	82.2	12	13.3	3	3.3	90
701-750	-	-	1	3.0	29	87.9	3	9.1	33	1	1.3	69	92.0	-	-	5	6.7	75
751-800	-	-	2	20.0	8	80.0	-	-	10	1	2.6	15	39.5	16	42.1	6	15.8	38
801-850	-	-	-	-	4	66.7	2	33.3	6	-	-	4	40.0	2	20.0	4	40.0	10