

SOME BIOLOGICAL PARAMETERS OF RED MULLET, *MULLUS BARBATUS* (LINNAEUS, 1758), IN MONTENEGRIN WATERS

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ABSTRACT

Red Mullet, *Mullus barbatus* (Linnaeus, 1758) is, next to European hake (*Merluccius merluccius*, Linnaeus 1758), economically most important and most exploited species in trawl fisheries in Montenegro. Data presented in this paper are results of annual investigations conducted in the frame of FAO AdriaMed Pilot study in period September 2009 – September 2010. Samples were collected monthly from all tree fish ports in Montenegro (Bar, Budva and Herceg Novi) and from almost all trawlers of Montenegrin fleet. Distribution, length-weight relation, length frequency structure, sex ratio, maturity ogive and maturity stages are described.

Keywords: Red Mullet, population structure, maturity, length-weight relationship

INTRODUCTION

The FAO AdriaMed Project provides support to the Adriatic countries in developing the necessary expertise and tools for the appraisal of the fisheries resources and of the main socio economic aspects related to the fisheries. The Montenegro joined AdriaMed in 2004 and since then the Project assisted the country in the establishment of a system for the fisheries resources evaluation and management. A Pilot study on biological and socio-economic fishery data collection was scheduled and implemented in Montenegro by the Institute of Marine Biology, Kotor with the support of the AdriaMed Project for the first time in September 2007 – September 2008 period (FAO AdriaMed Pilot study), and again in the period September 2009 - September 2010. The information on catch and effort of all the active fleet segments in the sampling ports were gathered by interviewing the fisherman, also the biological samples of the main target species were taken to study their biological characteristics.

Red Mullet, *Mullus barbatus* (Perciformes, Mullidae) is one of the economically most important species for Montenegrin trawl fishery. Data on distribution and participation of *M. barbatus* in trawl catches in eastern south Adriatic were presented by Merker & Ninčić (1973), Jovanović & Stjepčević (1982) and Joksimovic *et al.* (2005), while Mandić *et al.* (2011) described some biological characteristics of Red mullet. Results of detailed study of *M. barbatus* population dynamic on the shelf on Montenegrin coast are presented by Joksimović (2005). This paper presents the results of distribution, length-weight relation, length frequency structure, sex ratio and maturity stages and GSI of Red Mullet estimates during AdriaMed Pilot Study at Montenegrin coast in the period September 2009 - September 2010.

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MATERIAL AND METHODS

Material was collected on the Montenegrin shelf area, (Figure 1.) during the period September 2009 to September 2010 with commercial trawlers. Samples were collected on the monthly basis from 3 fishing ports (Bar, Budva and Herceg Novi). Total length (TL), from the peak of mandible to the stretched ends of the caudal fin was measured with the one mm precision. Weight of the fishes and gonad weight were measured with precision of 0.01 gram. Sexual maturity was determined according to the maturity scales proposed by MEDITS (immature, maturing, mature and spent – resting; respectively, stages 1, 2, 3 and 4).

These data allowed to estimate the size range and length frequency distribution, the sex-ratio as proportion of males over the combined number of males and females, the size at first maturity (size at 50 percent of maturity, $L_{50\%}$) and size at 25 and 75 percent of maturity ($L_{25\%}$ and $L_{75\%}$) according to the classical logistic model and the length-weight relationship parameters using a power function. The length–weight relationship was determined according to the logarithmic form of the original exponential equation (Ricker, 1975): $\log W = \log a + b \log L_T$, where a is the proportionality constant, b the allometry coefficient, W is fish weight in grams, and L_T is total length in centimetres. The gonadosomatic index (GSI) was determined on the basis of their body mass and their ovary mass by applying the formula: $GSI = 100 \times G / W$, in which G is gonad weight and W is body weight.

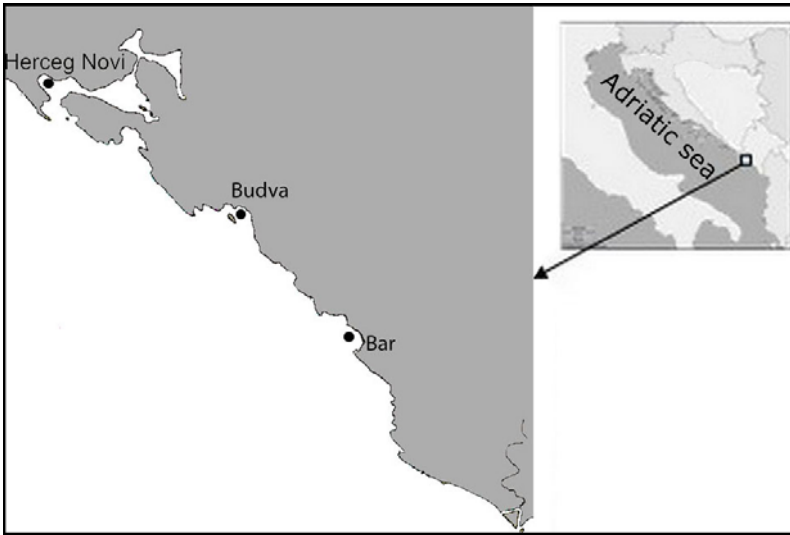


Figure 1. Map of the study area

RESULTS AND DISCUSSION

Red mullet, *Mullus barbatus*, was well represented in the catch throughout the year, and was the most abundant in November and March. A total number of 430 specimens of the Red mullet were sampled and size range of the collected specimens was between 11.0 and 26.5 cm TL, with an overall average length of 15.2 cm. Length frequency distribution of males reveal that the size range extends from 11.2 to 21.5 cm, with size groups 14.0 to 15.0 cm dominating in the catch, while the length frequency distribution of females reveal that the size range extends from 11.5 to 26.5 cm with size groups 14.0 to 16.0 cm dominating in the catch (Figure 2.). The LFD of the whole sample demonstrated that the individuals between 14.0 and 15.0 cm were highly representative in the catch (Figure 3.).

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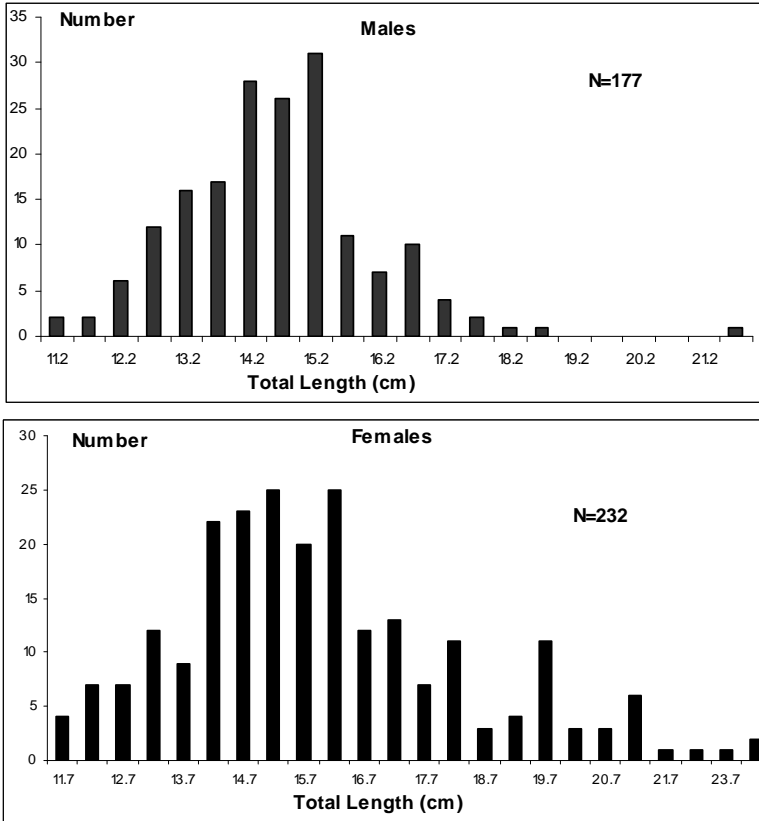


Figure 2. Length frequency distribution by sex of *M. barbatus* caught in national waters of Montenegro during the 2009-10 sampling period. N = number of specimens

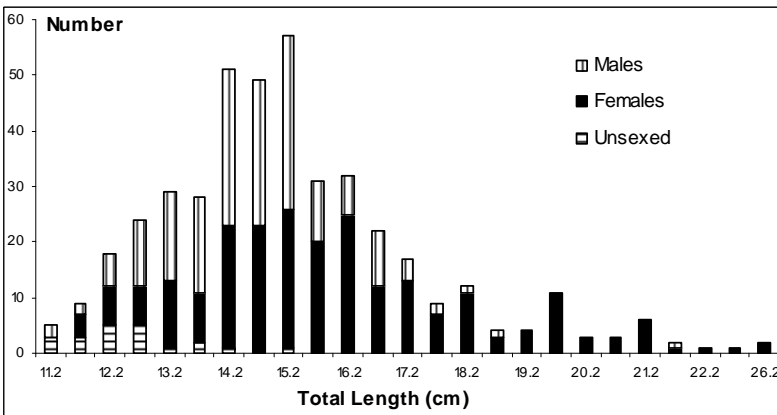


Figure 3. Length frequency distribution for the whole sample of *M. barbatus* during the 2009-10 sampling period.

The sample was composed of 232 females (54.0%), 177 males (41.2%) and 21 unsexed individuals (4.9%) (Figure 4.). The sex-ratio value of the whole data set for the 2009-10 sampling period was 0.43; females constitute a majority in the catches above 15.5 cm TL (Figure 5.). Mature specimens of *M. barbatus* were found at wide size range, TL varying between 11.4 and 21.5 cm in males and between 11.5 and 26.5 cm in females (Table 1). The greatest number of individuals, both males and females, were in maturity stage 2 (Figure 6.). The largest fraction of spawning specimens (maturity stage 3) was found during the sampling in April-May period.

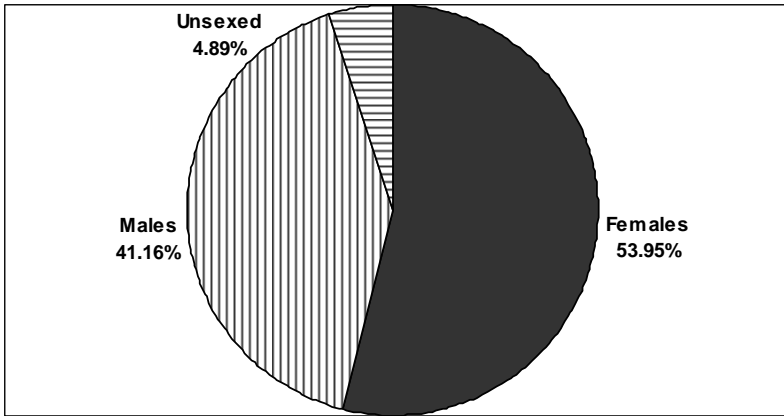


Figure 4. Sex ratio variations for the whole catch of *M. barbatus* for the 2009-10 sampling period.

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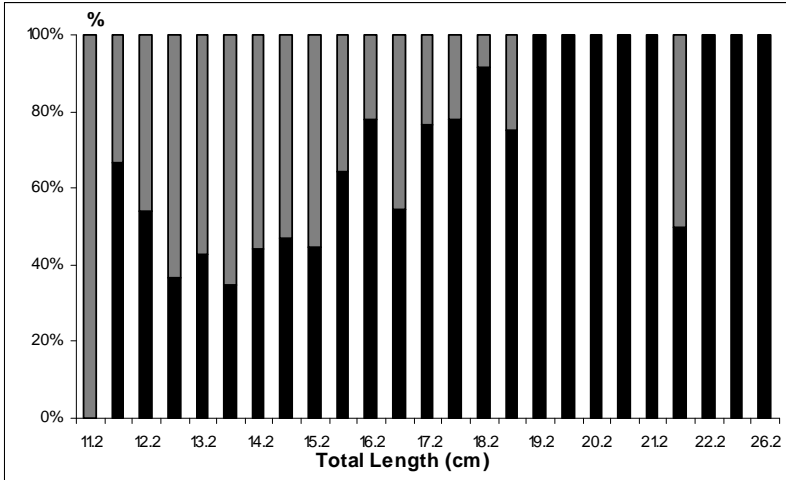


Figure 5. Sex ratio variations according to size class of *M. barbatus* during the 2009-10 sampling period. Black bars = females; gray bars = males.

Table 1. Gonad maturity stages by sex of *M. barbatus* during the 2009-10 sampling period. F = female; M = male; TL = total length in cm; 1-4 = gonad maturity stage.

Mullus barbatus	M				F			
	No	%	TL		No	%	TL	
			min	max			min	max
1	10	5.65	11.2	15.0	6	2.59	11.8	14.0
2	144	81.36	11.4	21.5	168	72.41	11.5	26.5
3	19	10.73	13.2	16.9	48	20.69	13.1	22.0
4	4	2.26	14.5	15.2	10	4.31	13.2	19.8
Total	177	100.00			232	100.00		

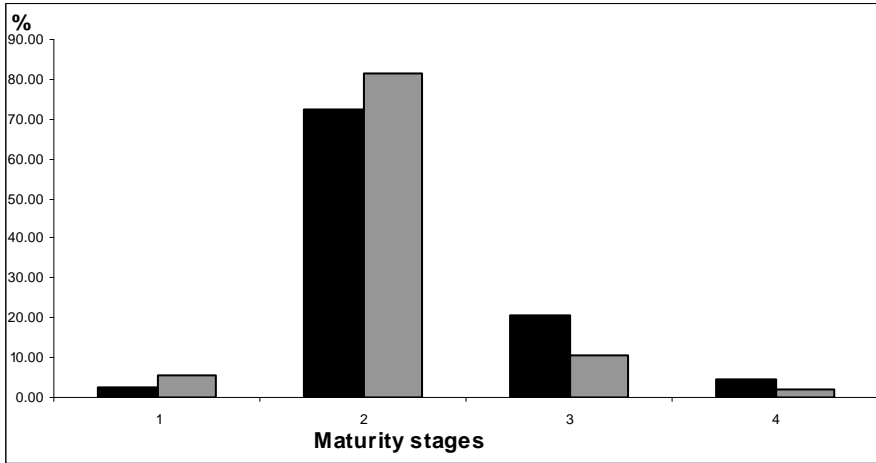


Figure 6. Gonad maturity stages proportion by sex of *M. barbatus* during the 2009-10 sampling period. Black bars = females; gray bars = males

The length at first maturity ($L_{50\%}$) of both sexes combined was 12.19 cm TL (Figure 7.). The values of $L_{25\%}$ and $L_{75\%}$ are presented in Table 2. The length at first maturity males reach at 11.05 cm, and females at 11.57 cm.

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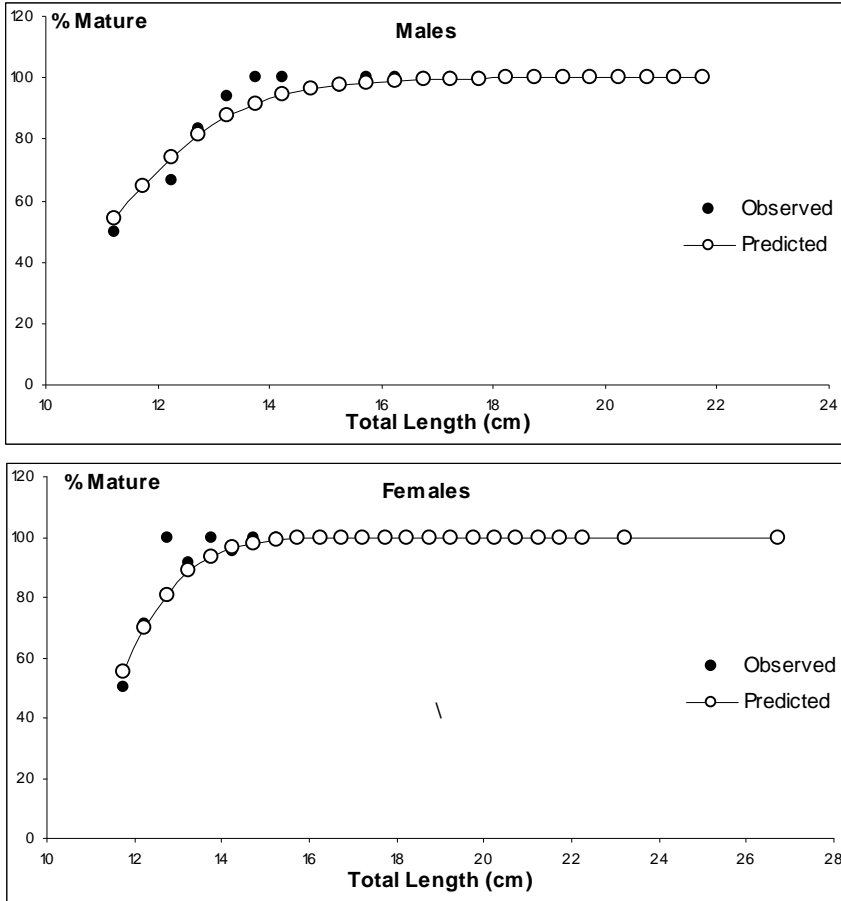


Figure 7. Length at first maturity (50%) for both sexes, for males and for females of *M. barbatus* during the 2009-10 sampling period

Table 2. Length at first maturity and logistic curve parameters of *M. barbatus* for the 2009-10 sampling period

Mullus barbatus (2009-10)	Logistic curve parameters		Length at maturity (cm)		
	a	b	L _{25%}	L _{50%}	L _{75%}
Females	14.1605	1.2238	10.673	11.571	12.469
Males	9.7319	0.8811	9.798	11.045	12.292

During the 2009-10 sampling period, for females one peak GSI was noticed during the April while for males, two peaks were recorded, the first one in March-April period and the second in June. Peaking was more pronounced for females. Minimal GSI for both sexes was noticed in October 2009; maximal GSI was in March for males, and for females it was in April (Figure 8.).

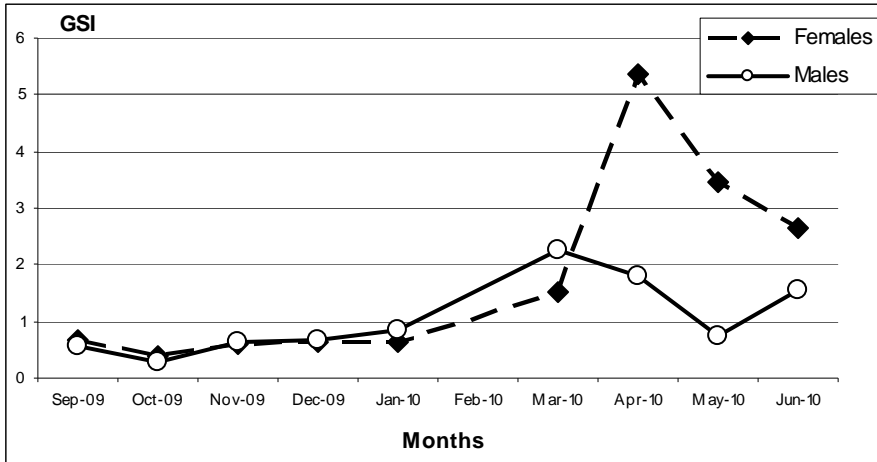


Figure 8. Mean monthly gonadosomatic index for males and females of *M. barbatus* during the 2009-10 sampling period.

Value of allometric coefficient b of length-weight relationship was 3.211 for females, while for males its value was 2.951 (Table 3, Figure 9).

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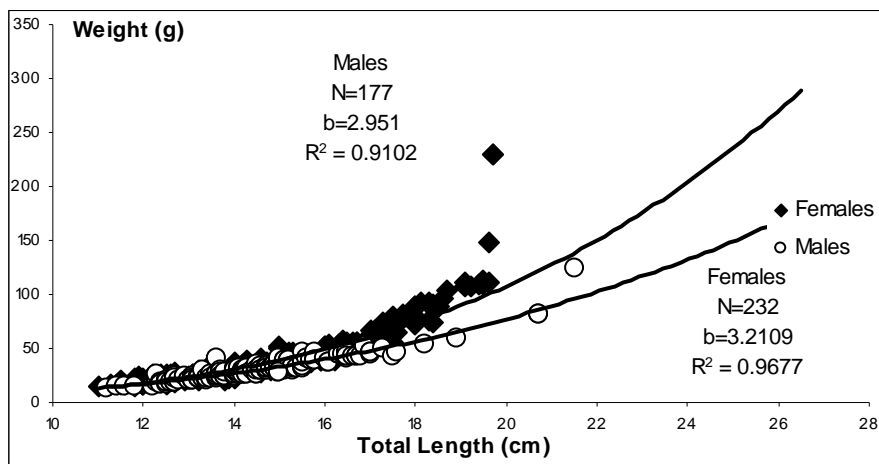


Figure 9. Length-weight relationship for males and females, and their respective estimated slope (b) for *M. barbatus* caught in Montenegrin national waters during the 2009-10 sampling period. N = number of specimens.

Table 3. Values of the regression parameters (a, b) of the length-weight relationship of *M. barbatus* by sex by species for the 2009-10 sampling period

Mullus barbatus (2009-10)	Length-weight relationship parameters			
	females		males	
	a	b	a	b
Mullus barbatus	0.0056	3.2109	0.0112	2.951

In the period 2009-10 Red Mullet was more abundant in November and March, unlike the previous sampling (September 2007–September 2008) where this species was more abundant in the catch in May-August period. The size range of the collected specimens in 2009-10 was wider (11-26.5 cm) than in period 2007-08 when it was between 9.1 and 21.5 cm total length.

Overall average length of 15.2 cm is in accordance with National Law on Marine fisheries and Mariculture (Official gazette 08/11) according to which minimal allowed length in catch of Red Mullet is 13 cm. More unsexed individuals were found in 2009-10 (4.9%) than in the previous sampling when only 2 unsexed individuals were found (0.4%). The sex-ratio value of the whole data set was almost equal i.e. for the 2009-10 sampling period that value

was 0.43 while in the 2007-08 it was 0.39. These values showed predominance of females in both periods. Both samplings reported that females constitute a majority in the catches above 15.5 cm TL in 2009-10 and from 16.0 cm TL onward in 2007-08 period. Predominance of females could be explained by different growth parameters (Vrgoč 2004, Joksimović 2005). Similar results were obtained in earlier investigations in eastern Mediterranean (Çelik i Torcu, 2000), while the investigations in the middle Adriatic gives opposite results (Županović, 1963). Mature specimens of *M. barbatus* were found from 11.4 cm in males and 11.5 cm in females which is in accordance with results of Joksimović (2005) who found that in the same area *M. barbatus* reaches first sexual maturity at 11-14 cm TL. In previous sampling (2007-08) mature males were found at the same minimal length (11.4 cm), whereas the minimal length for mature females was 10.9 cm (Mandić *et al.*, 2011). The largest fraction of spawning specimens (maturity stage 3) was found during the 2009-10 sampling in April-May, whereas in the previous sampling period these specimens were found in June (Mandić *et al.*, 2011). These results are in accordance with other authors who reported that spawning period of this species lasts from end of winter to the beginning of summer, with the peak at the end of May and beginning of June (Jardas, 1996). The size at first maturity ($L_{50\%}$) of both sexes combined was 12.19 cm TL, whereas in the previous period (2007-08) that value was 11.15 cm TL. The length at first maturity was 11.05 cm for males and 11.57 cm for females. In the previous sampling period that values were 10.41 cm for males and 12.35 cm for females. Values of GSI indicate that spawning period of Red Mullet in this area lasts from March to July, with the peak in April. Earlier investigations of GSI in the same area showed the same period of spawning (March to July) with the peak in May-June (Joksimović, 2005), which indicates that the peak of spawning season depends on environmental conditions. Values of allometric coefficient b of length-weight

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relationship were higher in females ($b=3.2109$) than in males ($b=2.951$). In previous investigation in 2007-08 females also had higher allometric coefficient than males ($b=2.992$ and $b=2.7288$ respectively, Mandić *et al.*, 2011), while Joksimović (2005) reported values $b=3.118$ for females and $b=3.090$ for males in the same area.

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