Reproduction and spawning patterns of the *Scomberomorus commerson* in the Iranian coastal waters of the Persian Gulf & Oman Sea

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Abstract

Reproduction and spawning patterns of the king fish (*Scomberomorus commerson*) were studied in the Persian Gulf (Hormozgan Province) and Oman Sea from Oct 2006 to Sep 2007. A total of 1120 fish was collected from different landing sites along the Iranian waters. Yearly analysis of the reproductive stages and gonadosomatic index showed a single reproductive cycle beginning in March and continued with a single spawning period from August to September. The mean length at first maturity (Lm 50%) for females was 83.6 Cm. The sex ratio was M: F = 0.97:1 which was not significantly ($P > 0.05$) different among samples (χ^2 test). Isometric growth for this species was approved.

Keywords: King fish, Persian Gulf, Oman Sea, Gonadosomatic Index, Sex ratio, Lm50%

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Introduction

King fish, *Scomberomorus commerson*, belongs to epipelagic species throughout the coastal tropical waters of the Indo-pacific (Mc pherson, 1992) and family of Scombridae with 15 genera and 49 species (Collette and Nauen, 1983). This fish is considered the most important commercial pelagic species (AL Hosni & Siddeek, 1999).A few studies have applied to *Scomberomorus commerson* by Siddeek (1993) in Indian Ocean (Kedidi *et al*., 1993), Bertignac and Yesaki, (1993) Govender (1993) in Saudi Arabia, Oman and South Africa coastal waters. Some studies were carried out by Hosseini *et al*., 2000, Ghodrati shojaei *et al*., 2007, Taghavi *et al*., 2008, in the coastal waters of Iran. The aim of this study was to determine the period and peak of spawning, the first length of maturation (Lm50%), GSI in *Scomberomorus commerson* in Iranian waters of the Persian Gulf & Oman Sea.

Materials and methods

The size frequency data were collected by gill net commercial catches of *Scomberomorus commerson* made off the coast of the Persian Gulf & Oman Sea from October 2006 to September 2007 (Figure1).Fish samples were selected randomly from landing sites; lengths were taken using a measuring board and recorded to the nearest 1 cm fork length (FL) with monthly target sample size of 100 fish. Biological data were collected during the first weeks of each month. Whole wet weight was taken with an electronic balance and recorded to the nearest 100 grams. Fish were sexed by macroscopic examination of the gonad which was dissected out and subsequently weighed to 0.1 g using an electronic balance. Length – weight relationships were studied by sex (male & female).The parameters of the L-W relationship were estimated through logarithmic transformation (Biswas, 1993):

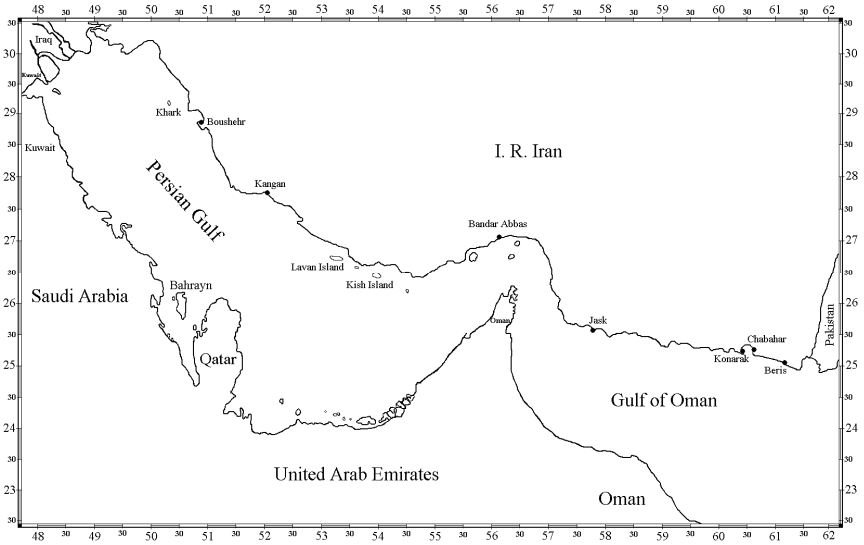

Figure 1: Landing sites of *Scomberomorus commerson* in the Iranian coastal waters of the Persian Gulf (Hormozgan province) & Oman Sea

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$W = a L^b$

W = Weight (g)

FL = Fork Length (Cm

a,b = parameters

LnW = Ln a + b Ln FL

If the calculated number for "b" does not have a significant difference with 3, the species has isometric growth. To test this difference, we used the below equation (Pauly, 1984):

$t = [(s.dx) / (s.dy)] \times [(| b-3 |) / (\sqrt{(1-r^2)})] \times [\sqrt{(n-2)}]$

s.d (x) = Std. Ln fork length

s.d (y) = Std. Ln weight

r^2 = Coefficient of determination

n= Sample number

The maturity development stages were assessed (table 1) according to the criteria of Biswas (1993).The mean size at first maturity (Lm) was estimated for female by fitting the logistic function to the proportion of mature fish in 20 cm (LF) size categories and determined as the size at which 50% of individuals were mature. Monthly gonad somatic index means (GSI) were calculated for both sexes by expression the gonad weight as a proportion of the total body weight. GSI was calculated using the following formula (Claereboudt *et al*., 2005).

GSI=Mass of gonad (g)/gutted fish mass (kg)

The timing and frequency of spawning were established by plotting of fish by maturity stage and gonado- somatic index against the sample period. The population sexual structure was examined using Chi-Square (χ^2) goodness of fit tests. Independent tests were conducted to determine whether sex ratio differed significantly from unity for the whole sample. The probability level was set at 0.05.

Results

A total of 1120 biological samples were collected (Figure 2) ranging in size from 35 to 144 cm FL (Males) and 29 to 154cm FL (Females).

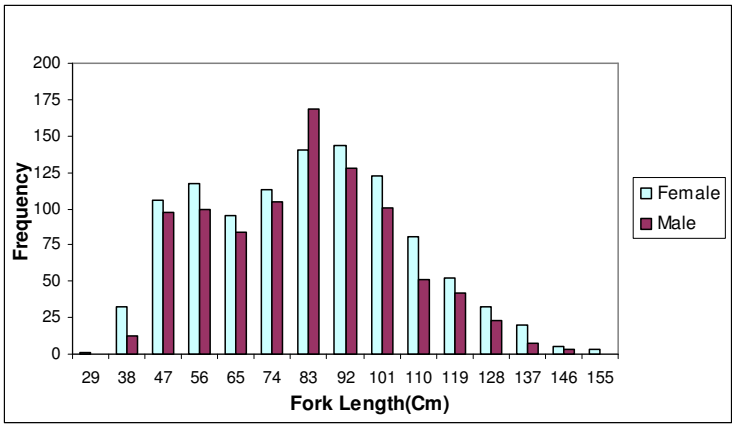

Figure 2: Fork length frequency distribution (male and female) of *Scomberomorus commerson* in the Persian Gulf & Oman Sea (Oct. 2006 – Sep. 2007)

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The "b" parameter value in the length-weight relationship model, $W = 0.0119\ L^{2.9}$, R^2=0.99 for female and $W = 0.0113\ L^{2.9}$, $R^2 = 0.98$ for male that are closed to 3 for males and females, indicating isometric growth (Figure 3, 4).

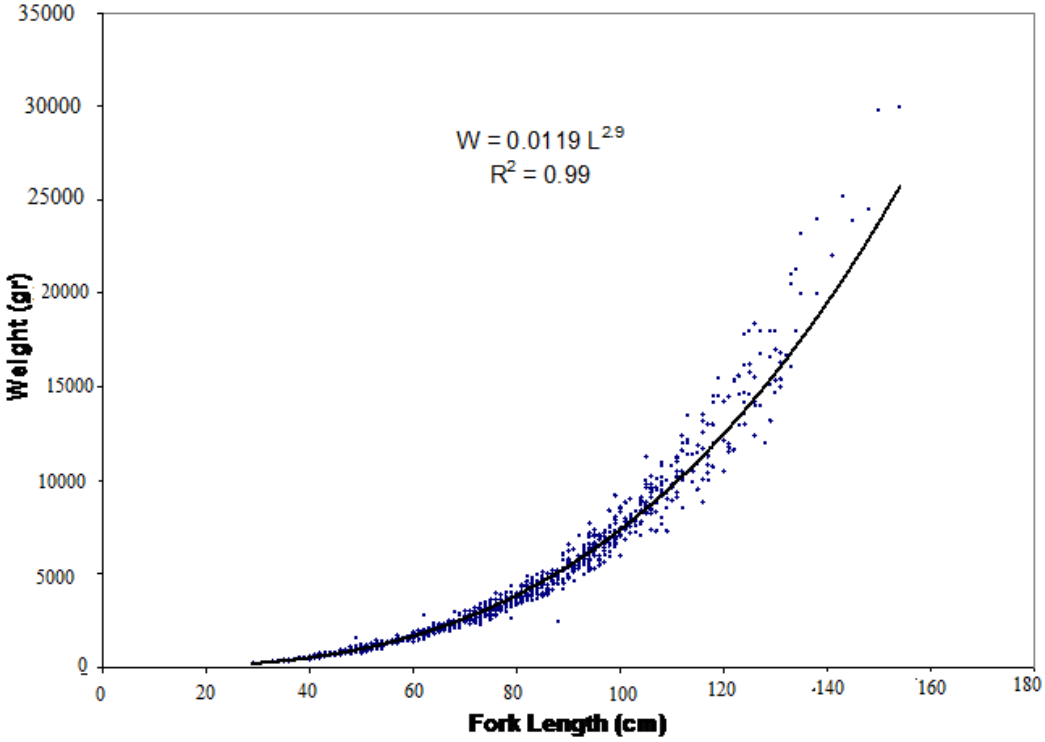

Figure 3: The length- weight relationship curve of *Scomberomorus commerson* (female) in the Persian Gulf & Oman Sea (October 2006- Sep 2007)

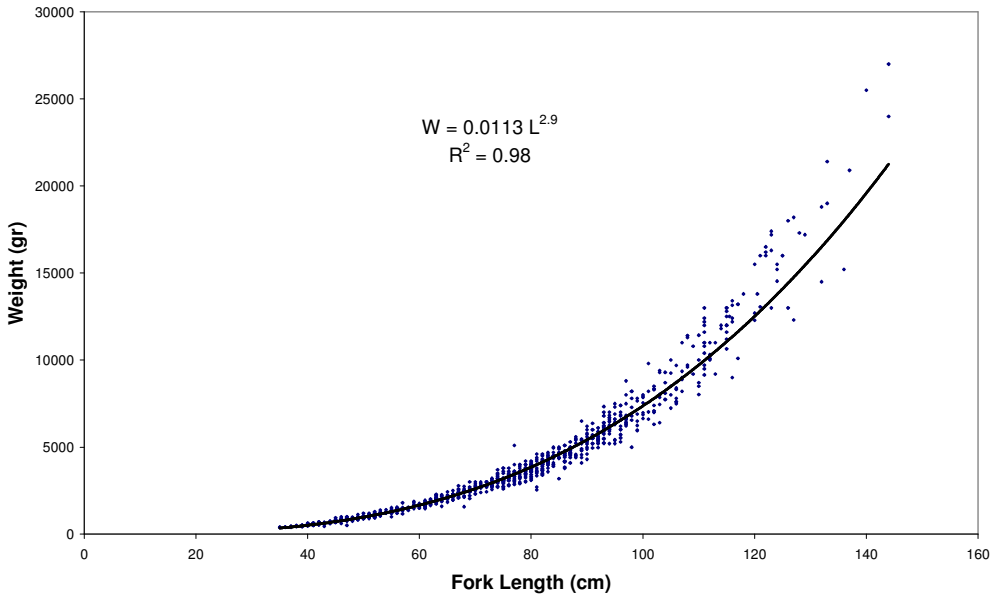

Figure 4: The length- weight relationship curve of *Scomberomorus commerson* (Male) in the Persian Gulf & Oman Sea (Oct. 2006- Sep. 2007)

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The t –test was used for "b" parameter correctness evaluation with comparing to table value. The "b" value indicated no significant difference ($p > 0.05$).

In total males (552) and females (568) were included in the analysis. The sex ratio in the samples M: F = 0.97:1 was not significantly different ($P > 0.05$) in the overall male to female sex ratio 1:1(χ^2 test) as showed in Table 2 and Figure 5.Length at first maturity of *Scomberomorus commerson measured* for females. The mean size at first sexual maturity (Lm50 %) was 83.6 Cm (Figure 6) in October 2006- Sep.2007.

Table 1: Female maturity stages classification of *Scomberomorus commerson*

Development	Category	Description
I	Immature	Gonad about one- third length of the abdominal cavity. Ovaries thin, pinkish, ribbon like and invisible to the naked eye.
II	Maturing	Gonads occupy about half of the abdominal cavity. Ovary pinkish, translucent; eggs visible under magnifying glass.
III	Ripening	Gonads about two- thirds length of body cavity. eggs large and readily seen with the naked eye. Ovary pinkish-yellow with granular appearance.
IV	Ripe	Gonad occupy about full length of the body cavity ovaries distended and containing large translucent eggs.
V	Spent	Gonads shrank having loose walls. Ovary may contain few ripe darkened or translucent eggs.

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Table 2: Sex ratio *Scomberomorus commerson* in the Persian Gulf & Oman Sea (October2006- Sep. 2007)

Sampling Months	No(Female)	No(Male)	Total No.
October	45	57	102
November	59	49	108
December	47	44	91
January	58	57	115
February	54	53	107
March	50	44	94
April	32	35	67
May	61	42	103
June	24	37	61
July	32	38	70
August	40	34	74
September	66	62	128
Total No.	568	552	1120

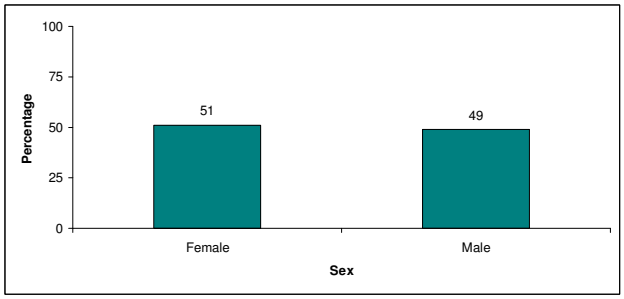

Figure 5: Sex ratio percentage *Scomberomorus commerson* in the Persian Gulf & Oman Sea (Oct. 2006- Sep. 2007)

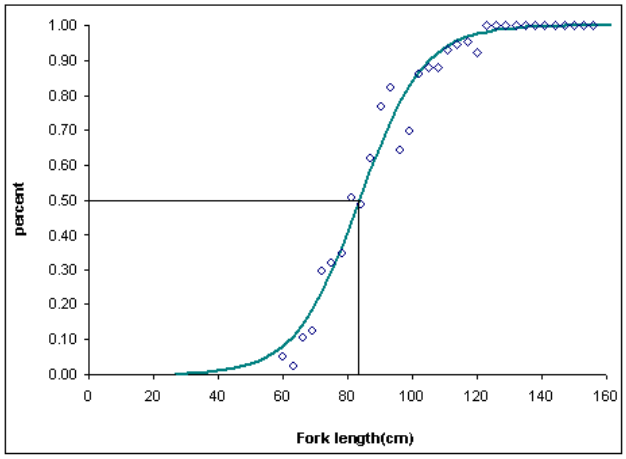

Figure 6: Cumulative relative frequency of the length at first maturity *Scomberomorus commerson* (female) in the Persian Gulf & Oman Sea (Oct.2006- Sep. 2007), the 50% maturity is marked by a thin horizontal line

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The smallest mature and largest immature female were respectively 52 and 100 Cm.The gonadosomatic index for both males and females increased rapidly during May and June with spawning occurred from June to September (Figure 7, 8).

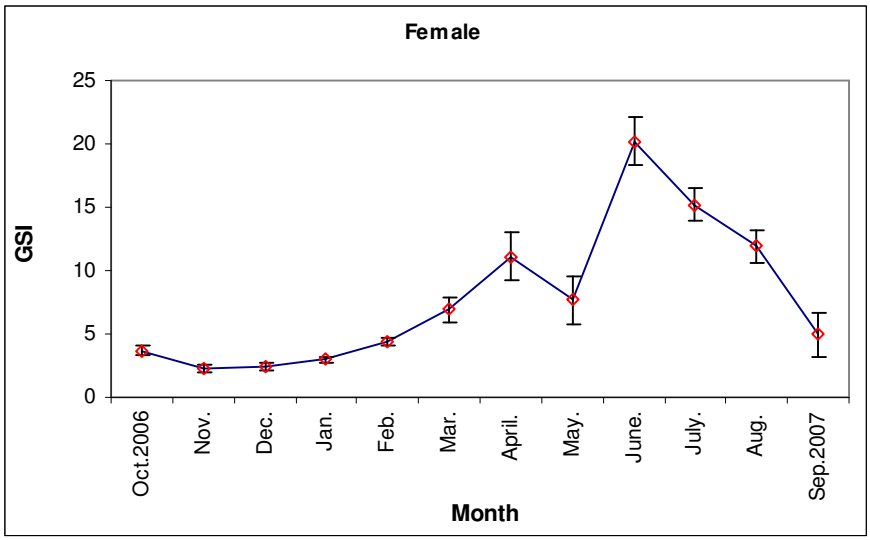

Figure 7: Mean monthly gonadosomatic index (7.81±1.32) *Scomberomorus commerson* (female) in the Persian Gulf & Oman Sea (Oct.2006- Sep 2007)

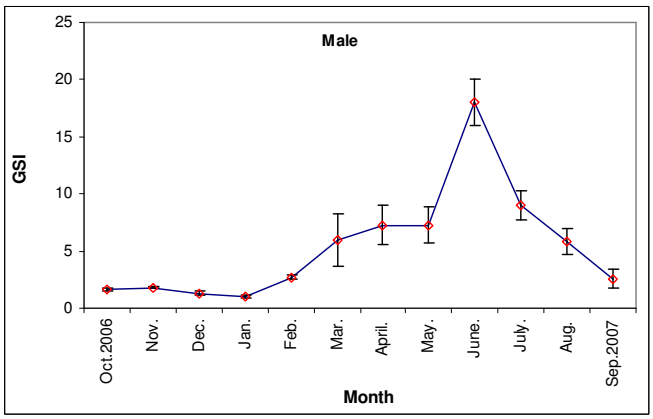

Figure 8: Mean monthly gonadosomatic index (5.37 ± 1.22) *Scomberomorus commerson* (male) in the Persian Gulf & Oman Sea (Oct.2006- Sep 2007)

The following results were based on macroscopically determination of different stages in females. Frequency of immature fish (stage 1) was shown an annual cycle with and almost complete absence during June to August.

The proportion of fish by maturity development stages also suggested that the peak of King fish spawning took place after June and also spawning condition being observed during this period (Figure 9).

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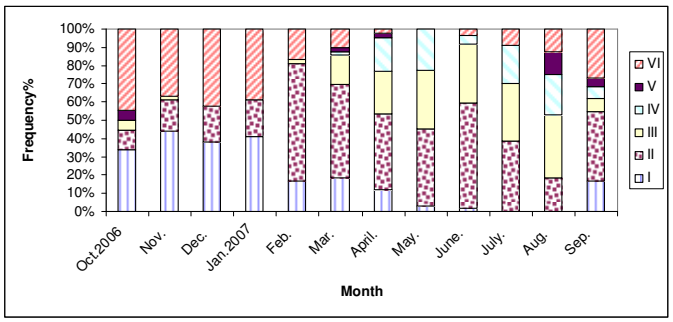

Figure 9: Reproductive stages percent of *Scomberomorus commerson* (female) in the Persian Gulf & Oman Sea (Oct. 2006- Sep. 2007)

Discussion

The calculated number for "b" has not shown any significant difference with 3 by Pauly equation. The "b" parameter value in the length – weight relationship was closed to 3 for the *S. commerson* in our study area (Area 51), indicating isometric growth (king, 1995).The sex ratio *Scomberomorus commerson* in the Indian waters, eastern Arabian Sea and Omani waters is approximately 1:1(Bal & Rao, 1990; Anon, 1995), which supported our results in this study. Observations from India (Devaraj, 1983) revealed that males were almost always slightly more abundant than females in the catches. Welsh *et al*. (2002) supported the migration and aggregation in larger numbers around several reefs just prior to spawning in the spring (Govender, unpublished) and found migration to the north to Mozambique to spawn then back south again for feeding.Devaraj (1983) estimated the size at first sexual maturity 75 cm FL in the northern Indian ocean, compared to the estimated size at spawning of 75-80cm FL given by Dudley *et al*.(1992) for males and females combined off Oman. Claereboudt *et al*. (2004) estimated the size at first sexual maturity (also off Oman) at 80.4 cm FL for females. *Scomberomorus commerson* has been found to mature between 70-80cm FL off Madagascar, Papua New Guinea, Fiji and north eastern Australia (Collete & Russo, 1979; McPherson, 1993). The mean size at first sexual maturity was also found in our study 83.6 cm FL for females which coincided well with the published values of size at first maturity of *Scomberomorus commerson.*The period in which there was a decline in the gonad somatic index and when fish in spawning condition were observed in our samples suggested a single spawning period from June to September. Although small short spawning took place during April to May. The results of Claereboudt *et al*.(2004) also revealed a single though earlier spawning season in May and June for king fish off Oman. The reproductive activity of *Scomberomorus commerson* in waters off the east coast of Australia also peaked in the spring and summer months (McPherson, 1993) in contrast to the defined single seasonal

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spawning pattern for this species, Devaraj (1983) established three distinct spawning periods between January and September in the waters off the southern coast of India. whilst seasonal fishery closures have often been dismissed as a management tool for tropical species because of the assumption that spawning is protracted, the existing ban on the use of gillnet to target *Scomberomorus commerson* between the end of April and the beginning of October is appropriate in relation to the reproductive cycle of this species. Bouhlel (1985) determined a peak of spawning from March to June for stocks in Djibouti coastal waters. Kedidi *et al*. (1987) reported a peak of spawning from March to June in Red sea and Persian Gulf. Nzioka (1991) reported reproductive activity during year with two peaks in May and October in coastal water in Kenya, according to this research, there was a direct relation between spawning peaks and monsoon intensity. Also Williams (1964) observed one spawning cycle of *Scomberomorus commerson* in a year in eastern waters of Africa. Abdulqader *et al*.(2001) reported *Scomberomorus commerson* spawning cycle is in March to June in Saudi Arabian waters and is in March to July in Gulf of Oman. Siddeek (1995) reported *Scomberomorus commerson* in 51 FAO region has two spawning peaks, one power peak during spring and summer, another weak peak in autumn and also his hypothesis about long time reproductive cycle based on high production annual of plankton and small pelagic fish in region. Also two peaks for spawning (spring and autumn)was synchronous to the beginning of monsoon, so larvae use of plankton and small pelagic fish in coastal waters after monsoon (Siddeek, 1995). Claereboudt *et al*.(2005) supported the idea of a migration (at least partial) out of Omani water during the reproductive season (April –May), moving north –wards (Iranian coasts) to spawn in the Persian Gulf (Claereboudt *et al*., 2005).Although the strong decrease in catches observed during the spawning season, and the decrease in GSI in large individuals support the hypothesis of a reproductive migration, part of the populations from both areas Gulf of Oman and Arabian Sea were locally engaged in spawning activity. Fully mature (stage III), spawning (stage IV) and spent (stage V) individuals have been found along both coasts in April-June and in June-September (Iranian coasts of Persian Gulf), supporting the existence of local spawning ground along three sides (Arabian Sea, Omani waters and Iranian waters). As mitochondrial DNA studies indicated that these are one genetic stock in the Persian and Oman Gulf (Hoolihan *et al*., 2006) and the current data set only belongs to one year, therefore future joints studies and researches should address the issue of migration, particularly during the reproduction season between northern and southern coasts of the Persian Gulf (Hoolihan *et al*., 2006).

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