

Notes

Comparative Morphometric Traits of Hybrids between Red Sea Bream (*Pagrus major*) and Black Sea Bream (*Acanthopagrus schlegelii*)

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Morphometric characteristics of female red sea bream, *Pagrus major* (Temminck et Schlegel) and male black sea bream, *Acanthopagrus schlegelii* (Bleeker) hybrids is described. From the result of our study, the morphometric characters of hybrid may be 7 paternal-like, 2 maternal-like or even out of the range of parental species. The pigmentation of the hybrid is intermediate in some respects and resembles that of the parental species in others. This study of characterization in morphometric traits of the hybrids, red sea bream and black sea bream may be useful for distinguish of each genotype in commercial sea bream aquaculture.

Key words: *Acanthopagrus schlegelii*, Hybrid, Morphometric traits, *Pagrus major*

Introduction

The range of the red sea bream *Pagrus major* Temminck et Schlegel and black sea bream *Acanthopagrus schlegelii* Bleeker extends from Korean and Japanese waters to the South China Sea (Choi et al., 2002). Both Sparidae species support large recreational fishing and commercial aquaculture in Korea and attain a high market price. Hybridization provides information on the genetic, evolutionary, and behavioral relationships of species (Purdom, 1972; Chevassus, 1983; Park et al., 1997a, 1997b, 2003). Because of unique combinations of parental chromo-somes, hybrids sometimes combine valuable traits such as morphology, physiology, growth, survival, and food habits from both parents (Anne and Colura, 1984; Kim et al., 1996; Park et al., 1996, 2003).

To gain hybrid vigor for higher productivity, hy-

brids between female red sea bream and male black sea bream were produced and reported in a previous paper (Murata et al., 1995, 1997; Park et al., 2004; Kim et al., 2005). However, few studies have reported on the morphometric traits of the induced hybrids. This study investigated the morphometric traits of hybrids produced from female red sea bream and male black sea bream.

Materials and Methods

In May 2001, eggs were similarly stripped and mixed from two female red sea bream, and from two female black sea bream. Eggs from red sea bream were then divided into two groups; one group was fertilized with mixed sperm from male red sea bream (red parent sea bream), and the other group was fertilized with mixed sperm from three black sea bream males to produce hybrids. Eggs from

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black sea bream were also fertilized with black sea bream sperm, which were also used for the production of hybrids, to produce offspring from black parents. This series of fertilization resulted in three groups of offspring: red sea bream, black sea bream, and hybrids from female red and male black sea bream.

A quantity of 50 one-year-old fish was sampled from each hatchery-produced offspring group (hybrid, red parent, and black parent sea bream) in May 2002 and were compared to determine differences in general morphology and 21 morphometric traits. Fish were starved 24 h prior to sampling to avoid measuring fish with guts that were distended by large quantities of food (Park et al., 2001). Fish were captured and killed with an overdose of lido-caine-HCl/NaHCO₃, and the morphometric traits were measured to the nearest 1.0 mm on a measuring board and with a Vernier caliper.

Measurements were made for 22 distances between landmarks on the body outline (Fig. 1) including the standard length (Ls), caudal peduncle height (CH), caudal peduncle length (CL), head width at the posterior margin of the eye (HWPE), horizontal distance between the anterior edge of the upper lip and the posterior margin of the eye (HALPE), horizontal distance between the anterior margin of the eye and the posterior margin of the eye (HAAPE), direct distance between the anterior edge of the upper lip and the anterior insertion of the dorsal fin (DALAD), direct

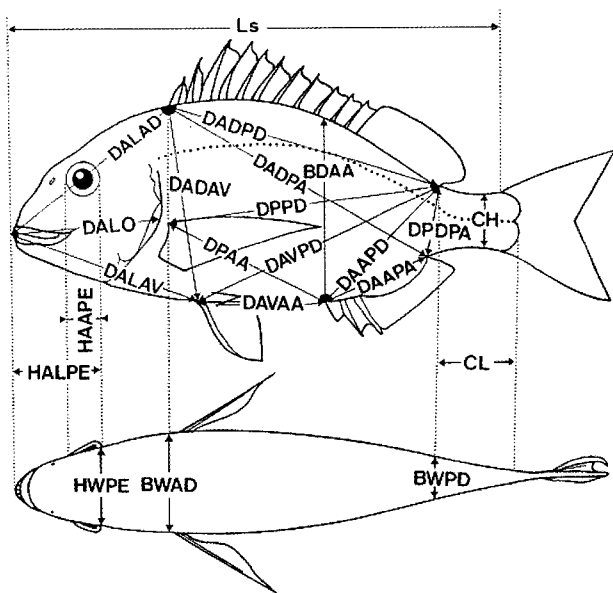


Fig. 1. Morphometric measurements of red seabream, *Pagrus major*; black seabream, *Acanthopagrus schlegelii* and red seabream (♀) × black seabream (♂) hybrids used in this study. For abbreviations see text.

distance between the anterior edge of the upper lip and the margin of the opercular cover (DALO), direct distance between the anterior edge of the upper lip and the anterior insertion of the ventral fin (DALAV), direct distance between the anterior insertion of the dorsal fin and the posterior insertion of the dorsal fin (DADPD), direct distance between the anterior insertion of the dorsal fin and the posterior insertion of the anal fin (DADPA), direct distance between the anterior insertion of the dorsal fin and the anterior insertion of the ventral fin (DADAV), direct distance between the anterior insertion of the ventral fin and the posterior insertion of the dorsal fin (DAVPD), direct distance between the anterior insertion of the ventral fin and the anterior insertion of the anal fin (DAVAA), direct distance between the anterior insertion of the anal fin and the posterior insertion of the dorsal fin (DAAPD), direct distance between the anterior insertion of the anal fin and the posterior insertion of the anal fin (DAAPA), direct distance between the base of the pectoral fin and the posterior insertion of the dorsal fin (DPPD), direct distance between the base of the pectoral fin and the anterior insertion of the anal fin (DPAA), direct distance between the posterior insertion of the dorsal fin and the posterior insertion of the anal fin (DPDPA), body depth at the anterior insertion of the anal fin (BDAA), body width at the anterior insertion of the dorsal fin (BWAD), and body width at the posterior insertion of the dorsal fin (BWPD).

After arcsine square root transformation, each measurement relative to the standard length was analyzed with one-way analysis of variance (ANOVA) to determine if significant differences in the measured variables existed among the three groups of sea bream offspring. Sidak multiple pairwise comparison tests were used to identify significant differences between paired groups of offspring. Differences between means were regarded as significant when the associated *P*-value was less than 0.05.

Results and Discussion

Average values and ranges of the morphometric dimensions of red sea bream, black sea bream, and red sea bream hybrids [red sea bream (♀) × black sea bream (♂)], and the results of the ANOVA ($p=0.05$) for differences among groups are shown in Table 1. Mean Ls of each genotype was 16.1 ± 1.28 cm for red sea bream, 15.6 ± 1.17 cm for hybrids, and 15.2 ± 1.09 cm for black sea bream. The

average values of red sea bream were close to those of black sea bream for HALPE, HAAPE, DADPA, DPPD, CH, and BWPD characters. The average values of DALAD, DADPD, DAVPD, BDAA, DAAPD, DAAPA, DPDPA, and CL for red sea bream were greater than those for black sea bream. The average values of DALO, DALAV, DPAA, DAVAA, HWPE, and BWAD for black sea bream were greater than those for red sea bream.

No differences in HAAPE and CH were noted among red sea bream, black sea bream, and hybrids. The average value of DADAV in black sea bream was intermediate between those of red sea bream and hybrids. On average, hybrid measurements were smaller than red sea bream and black sea bream for HALPE, DADPA, DPPD, DAVPD, BDAA, DPDPA, and BWPD; similar to red sea bream for DALO and CL; and similar to black sea bream for DALAD, DADPD, DPAA, DAVAA, DAAPD, HWPE, and BWAD.

Similar results have been reported for other fishes. Ross (1977) found that the hybrid of the probable

Table 1. Means and standard deviations for morphometric dimensions of red seabream, *Pagrus major* black seabream, *Acanthopagrus schlegelii* and red seabream (♀) × black seabream (♂) hybrids, and results of ANOVA-test for differences among groups*

Morphometric dimension	Red seabream (%)	Black seabream (%)	Hybrid (%)
HALPE/LS	10.1±1.08 ^a	9.7±1.25 ^a	9.3±1.03 ^b
HAAPE/LS	8.3±0.56 ^{n.s.}	8.1±0.61 ^{n.s.}	8.2±0.68 ^{n.s.}
DALAD/LS	41.1±1.79 ^a	39.4±5.24 ^b	39.7±1.86 ^b
DALO/LS	29.4±0.99 ^a	30.9±2.31 ^b	29.1±1.48 ^a
DALAV/LS	35.8±1.22 ^a	41.1±3.31 ^b	37.8±2.08 ^c
DADAV/LS	39.8±2.71 ^a	39.0±2.96 ^{ab}	38.4±2.20 ^b
DADPD/LS	52.1±1.10 ^a	50.5±4.56 ^b	49.4±2.84 ^b
DADPA/LS	59.1±1.81 ^a	59.4±3.80 ^a	57.9±1.63 ^b
DPPD/LS	53.9±0.80 ^a	52.4±6.91 ^a	49.7±2.06 ^b
DPAA/LS	39.5±1.71 ^a	43.3±7.19 ^b	40.5±2.30 ^b
DAVPD/LS	54.2±0.97 ^a	51.4±4.66 ^b	50.0±1.72 ^c
DAVAA/LS	31.3±1.53 ^a	33.2±3.02 ^b	33.3±1.80 ^b
BDAA/LS	35.8±1.58 ^a	33.5±2.68 ^b	32.3±1.30 ^c
DAAPD/LS	31.5±1.34 ^a	29.1±2.08 ^b	28.5±1.93 ^b
DAAPA/LS	17.2±0.80 ^a	14.7±1.26 ^b	16.2±3.36 ^c
DPDPA/LS	19.0±0.94 ^a	17.1±1.47 ^b	16.6±1.29 ^c
CH/LS	10.7±0.52 ^{n.s.}	11.1±1.41 ^{n.s.}	10.8±1.21 ^{n.s.}
CL/LS	21.8±0.57 ^a	16.1±2.71 ^b	21.4±1.99 ^a
HWPE/LS	13.4±1.35 ^a	16.0±0.89 ^b	13.8±1.00 ^b
BWAD/LS	16.0±1.69 ^a	17.5±0.95 ^b	16.1±1.22 ^b
BWPD/LS	7.6±1.55 ^a	7.4±0.30 ^a	7.1±1.30 ^b

Data were analysed using one-way ANOVA on data transformed to arcsine of square root. Mean values in each row having same superscript were not significantly different ($P>0.05$). n.s.: not significant. For abbreviations see text.

cross between the common shiner *Notropis cornutus* and longnose dace *Rhinichthys cataractae* diverged from intermediacy in several characters. Anne and Colura (1984) also observed that taxonomic characteristics of juvenile hybrids produced from female black drum *Pogonias cromis* and male red drum *Sciaenops ocellatus* were intermediate between the parent species. Hybrid body depth was greater than that of red drum, but less than that of black drum (Anne and Colura, 1984). As shown in Fig. 2, the external morphology and pigmentation of the hybrid were intermediate in some respects and resembled those of the parental species in others. The results of our study suggest that the morphometric characters of hybrids may be paternal-like, maternal-like, or even out of the range of parental species and that generalized conclusions cannot be made about the morphology and morphometry of hybrids. However, because some of the morphological and morpho-

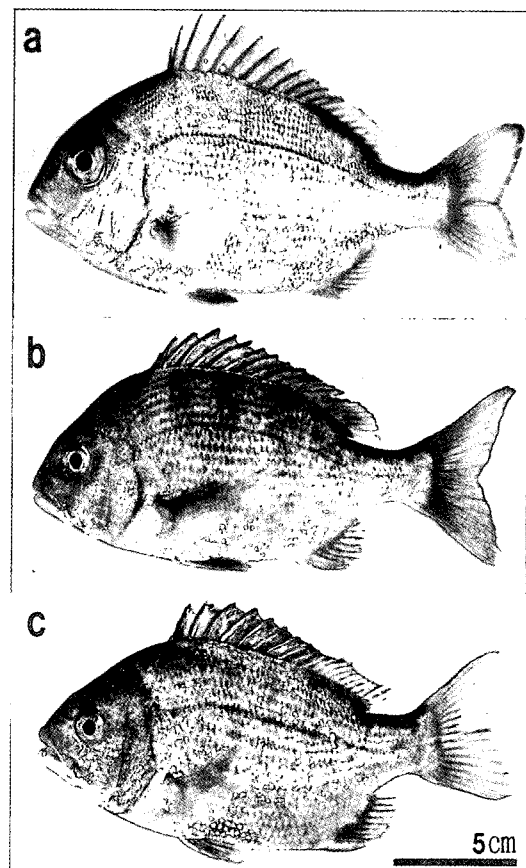


Fig. 2. External morphology of red seabream, *Pagrus major* (a), red seabream (♀) × black seabream (♂) hybrids (b) and black seabream, *Acanthopagrus schlegelii* (c).

metric traits in the hybrid offspring of red and black sea bream were different from those of the parental species, those morphometric characteristics as well as the external shape of hybrids can be used to identify and classify them during anesthetization without killing them.

A major purpose of most fish hybridization experiments has been to find favorable crosses for production in the aquaculture industry (Colin and William, 1992). The benefits of this strategy include heterosis and hybrid sterility (Chevassus, 1983; Scheerer and Thorgaard, 1983). In addition to studies related to morphometric characters, further investigation is needed to determine the potential use of red and black sea bream hybrids for commercial aquaculture.

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