Sexual dimorphism in razorbelly scad (*Alepes kleinii*) based on morphology, meristic and truss-based morphometric characters

Suhestri Suryaningsih, Lis A. Rismawati, Sri Sukmaningrum

Faculty of Biology, Jenderal Soedirman University, Central Java, Indonesia. Corresponding author: S. Suryaningsih, suhestri.suryaningsih@unsoed.ac.id

Abstract. *Alepes kleinii* (Bloch, 1793), known as razorbelly scad or kite fish, is a member of the Carangidae family. Razorbelly scad does not show sexual dimorphism, so other characters are needed to distinguish male and female individuals. This study aimed to describe the morphological appearance, meristic and truss morphometric characters that can be used to distinguish male and female Razorbelly scad fish. This study used a survey method. Fish samples were taken using the purposive sampling technique. As many as 60 sample specimens were obtained from the Fish Auction Place of the Cilacap Ocean Fisheries Port Cilacap Regency. Through measurements of meristic and truss morphometric characters, it can be concluded that the meristic characteristics (such aș bilaterally flat body shape, protruding mouth and terminal mouth position, forked caudal fin, cycloid scale type and conical tooth type) cannot be used as differentiators for male and female *A. kleinii*, while the truss morphometric characters (such as the distance from the base of the lower jaw to the tip of the snout) can. The growth analysis of morphometric characters showed that there was a linear relationship between all morphometric characters and the total length. The growth types of all morphometric truss characters in male and female Razorbelly scad fish had a negative allometric.
Key Words: *Alepes kleinii*, morphological appearance, truss morphometrics, meristic.

Introduction. One of the reef-associated fish species in the tropical marine of the family Carangidae (Jack family) is the razorbelly scad, *Alepes kleinii* (Bloch, 1793). The dorsal surface of the *A. kleinii* is generally bluish grey to greenish-grey, while the ventral surface is lighter and more silvery, in live specimens. In some specimens, dark vertical stripes are present above the lateral line and the presence of a large black spot on the upper operculum is also a key characteristic when identifying this species. The majority of the fins are transparent to pale in color, with the caudal fin being predominantly yellowish. *A. kleinii* has predatory habits and generally preys upon small crustaceans, copepods, larval fish, lucifer shrimp, prawns, amphipods and fish eggs. It is widely dispersed throughout the Indo-West Pacific region, including: the coast of Pakistan, the south-eastern coast of India, Sri Lanka, Indonesia, Philippines, Taiwan, Papua New Guinea, Japan and northern Australia (Siddik et al 2017).

A. kleinii is mostly caught by fishermen, to be sold in fresh condition and processed into salted fish (Munawaroh et al 2014; Qamar et al 2016). Currently, the effort to catch and use fish is growing, due to the increasing human need for animal protein. The rapid development has brought various interrelated problems, such as the declining quality of the aquatic environment, overfishing and the search for superior fish species (Nur et al 2020). Therefore, it is necessary to make efforts for conservation, so that the sustainability of *A. kleinii* is maintained. The success of conservation and domestication is influenced by several things, including basic biological information related to the sexual dimorphism. Sexual dimorphism is defined as systemic morphological differences or phenotypic differentiation between individuals of different sexes within the same species, which is used to externally differentiate sexes (Mehanna & Soliman 2017). Sexual dimorphism can be identified from primary sexual characters, genital papillae or genital pores (Esmaeili et al 2017), and from secondary characteristics: color, body size, morphology and other body characteristics, including the relationship between the length of certain body parts with the total body length (Nahar et al 2017; Siddik et al 2017).

Morphometrics is the quantitative study of organisms morphological characters' size and shape. Methods can be standard or truss morphometrics. In truss morphometrics, the points are determined on certain body parts, then the points are connected horizontally, vertically and diagonally to each other, so that a large number of truss morphometric distances are formed. Furthermore, each truss morphometric distance is compared with the standard length or total length to get a constant ratio value, even though the observed fish size varies (Siddik et al 2017). Meristic is a method of counting characters, which is done by counting certain body parts. Among the variables included in the meristic there can be: the number of fin rays, the number of scales, the number of teeth and the number of gill filters (Sajina et al 2013). Morphometrics and meristics have been proven to be able to accurately distinguish male and female fish. This has been tested in several fish species for example in male and female mullet fish species. The difference lies in the total length, standard length, head width and in the number of scales on the lateral line (Masood et al 2015). In three spine stickleback fish, results show that the head and jaw sizes in male fish are much larger than in female fish (Kitano et al 2007).

The purpose of this study was to determine the morphological appearance of male and female meristic *A. kleinii* fish, their truss morphometrics and also to determine the growth pattern of fish obtained from The Fish Auction Place of the Cilacap Ocean Fisheries Port Cilacap Regency. The research results are expected to provide new scientific information to the *A. kleinii* fish database, as a basis for conservation.

Material and Method

Fish resources. This research was conducted at the Laboratory of Animal Taxonomy, Faculty of Biology, Unsoed from March to August 2019. Sixty samples of *A. kleinii* (17 males and 43 females) were collected randomly from The Fish Auction Place of the Cilacap Ocean Fisheries Port Cilacap Regency, Central Java, The fish were brought to the Laboratory of Animal Taxonomy, Faculty of Biology, Unsoed, using an icebox, then stored in deep-frozen condition, at a temperature of -20°C, to maintain freshness.

Research procedure. The research stages consisted of identifying fish species, observing morphological appearance, calculating meristic characters, measuring truss morphometrics characters, dissecting fish and observing male and female gonads, to ascertain the sex of each individual fish observed. Fish were identified and determined using the guidelines of Kumar (2020), Ulićević et al *(*2018) and Záhorská et al (2013), and the morphological appearance of Razorbelly scad fish was observed, including the body shape, fish mouth shape and position, caudal fin shape, scale type and tooth type (Nur et al 2020).

Meristic measurement. The calculated meristic characters were the number of rays of anal fins, abdominal fins, dorsal fins, pectoral fins, number of scales above and below the lateral line, number of lateral line scales, number of gill filters and number of scales surrounding the caudal peduncle (Figure 1) (Sajina et al 2013).

Truss morphometrics measurement. The observed truss morphometrics character is based on 17 truss morphometrics points, then each point is connected horizontally, vertically, and diagonally, forming 32 truss morphometric distances (Figure 2) (Turan 1999, 2004).

Truss morphometric characters measurement were carried out using a digital caliper of 0.05 accuracy, by placing the fish on a millimeter block paper that has been laminated, which is given a styrofoam base, with the position of the head facing to the left (Munawaroh et al 2014).

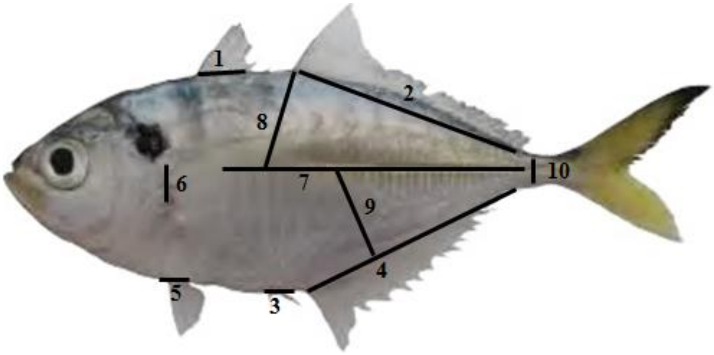

Figure 1. Meristic characters observed in *Alepes klenii* (White et al 2013): (1) Number of first dorsal fin rays; (2) Number of second dorsal fin rays; (3) Number of first anal-fin rays; (4) Number of second anal-fin rays; (5) Number of abdominal fin rays; (6) Number of pectoral-fin rays; (7) Number of lateral line scales; (8) Number of scales above the lateral line; (9) Number of scales below the lateral line; (10) Number of scales surrounding the caudal peduncle.

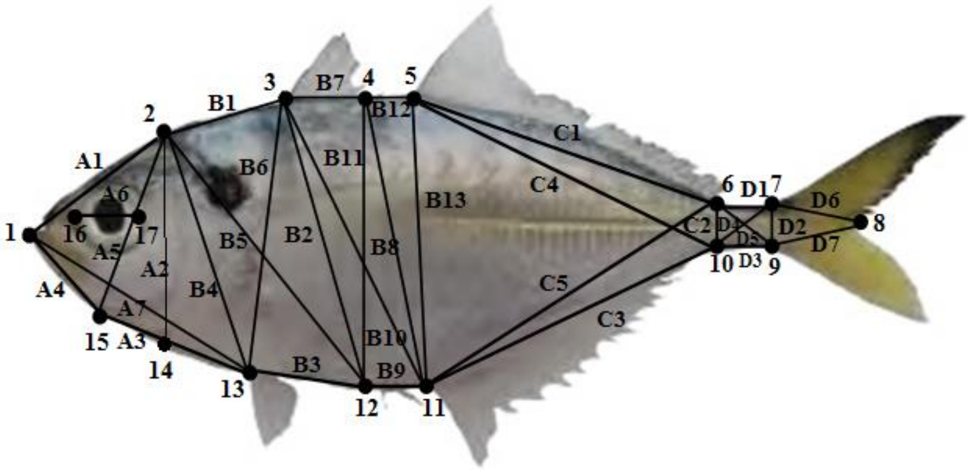

Figure 2. Truss morphometrics character observed in *Alepes kleinii* with modifications (White et al 2013): (1) Mouth tip to premaxilla (MTPM); (2) Mouth tip to dorsal fin (MTDF); (3) Mouth tip to operculum top (MTOT); (4) Pre maxilla to dorsal fin (PMDF); (5) Pre maxilla to operculum tip (PMOT); (6) Pre maxilla to pectoral fin (PMPC); (7) Pre maxilla to pelvic fin (PMPV); (8) Dorsal fin to operculum tip (DFOT); (9) Pectoral fin to operculum tip (PCOT); (10) Pectoral fin to pelvic fin (PCPV); (11) Dorsal fin to pelvic fin (DFPV); (12) Dorsal fin front to dorsal fin back (DFDB); (13) Dorsal fin to anal fin (DFAF); (14) Pelvic fin to anal fin (PVAF); (15) Dorsal back to anal fin (DBAF); (16) Dorsal fin back to caudal top (DBCT); (17) Dorsal back to caudal bottom (DBCB); (18) Anal fin to caudal top (AFCT); (19) Caudal top to caudal bottom (CTCB); (20) Anal fin to caudal bottom (AFCB); (21) Dorsal fin back to pelvic fin (DBPV).

Standard length measurements were made from the front end of the snout to the base of the fish's caudal fin. For each sample, 17 points were determined which were used as benchmarks for the truss morphometric points. These points were marked by sticking needles through the preparation, to penetrate the styrofoam, then the distance was measured according to the truss morphometrics measurement guidelines. The 17 benchmark points for the truss morphometrics are:

1) The tip of the snout;
2) The border between head and body (dorsal region);
3) The front base of first dorsal fin;
4) The hind end of the first dorsal fin;
5) The front base of second dorsal fin;

6) The tip end of the second dorsal fin;
7) The dorsal tail folding;
8) The back end of the tail fold;
9) The ventral tail folding;
10) The hind end of the anal fin;
11) The anal fin anterior base;
12) The high point of the ventral fish body;
13) The front base of ventral fin;
14) The boundary head and body ventral;
15) The base of the lower jaw;
16) The front base of the eye is wide;
17) The wide eye.

Gonad morphological observation. Morphologically, *A. kleinii* characters cannot be distinguished between males and females, so surgery was carried out to determine the sex of the observed fish. Surgery is done by positioning the fish head on the left. The abdomen near the anal fin is dissected using surgical scissors in an anterior direction, being careful not to damage the gonads. The gonads were then observed macroscopically and microscopically, as well as the topography of the gonads (Anumudu 2015). The microscopic gonad quick identification is done by taking a small portion of the gonad that has been isolated from the sample fish and then finely chopped on an object-glass. The chopped gonads were then dripped with acetocarmine solution and then there were done smear preparations. Observations of the preparations were carried out using a microscope with weak to strong magnification, until the presence of ovarian and testicular tissue was seen (Masood et al 2015; Önsoy et al 2010).

Statistical analysis. The data from the observation of morphological appearance were analyzed descriptively. If the meristic observation data are similar or the difference is very small, the statistical analysis will not be performed, but if the values differ significantly enough, a t-test analysis will be carried out. The data from the observation of the truss morphometrics characters were statistically analyzed using a t-test. The results of the truss morphometrics measurements were compared with the standard length to get the truss distance ratio with a constant number. The ratio of truss morphometrics distance between male fish was then analyzed using a t-test. Parameter significance was calculated using a t-test at 95% and 99.9% confidence intervals.

The allometric growth pattern, referring to (Paiva et al 2015) was calculated using regression analysis based on the function Y = aSLb, where 'Y' is a morphometric variable, SL is the Standard Length, 'a' is a constant number and 'b is the slope. Allometric growth variables consist of positive allometric (A+) if $b>1$, negative allometric if $b<1$, and isometric $b=1$.

Results

Description of A. kleinii. The fish species used in this study were *A. kleinii* which had been identified using the Fishbase (2017), the book of White et al (2013) and FAO (1999). The number of fish sampled observed was 60 fish with a total length range of 126.82-174.22 mm (Siddik et al 2017). The results of observations of the morphological appearance were as follows: *A. kleinii* body shape is bilaterally flat, with a darker gray body color on the dorsal side, with vertical stripes and the ventral part is light gray and there were identifieddorsal, pectoral, ventral and anal fins. The caudal fins had a deep forked type. Almost all of the fins are white to transparent, except for the caudal fin which is yellow with a little black spot at the edges of the fin. The lateral linea of the Razorbelly scad starts from a black spot on the posterior part of the operculum, curves dorsally to nearly reach the tip of the pectoral fin, then run horizontally to the base of the tail (Figure 4). *A. kleinii* also have scutes which are located in the horizontal lateral line.

According to Qamar et al (2016) and Siddik et al (2017), *A. kleinii* has an elongated body shape, bilaterally flattened. The ventral body is more convex than the dorsal. The dorsal surface is generally bluish-gray to greenish-grey, while the ventral surface is lighter and more silvery in color in live specimens. It has two separate dorsal fins, long and sickle-shaped pectoral fins, short and glossy white pelvic fins, anal fins with 2 separate anal spines, and a forked caudal fin of a length of almost 30% of the body length. The majority of the fins are transparent and pale in color, the caudal fin being predominantly yellowish (Figure 3). The lateral line is curved and there are scutes on the lateral line.

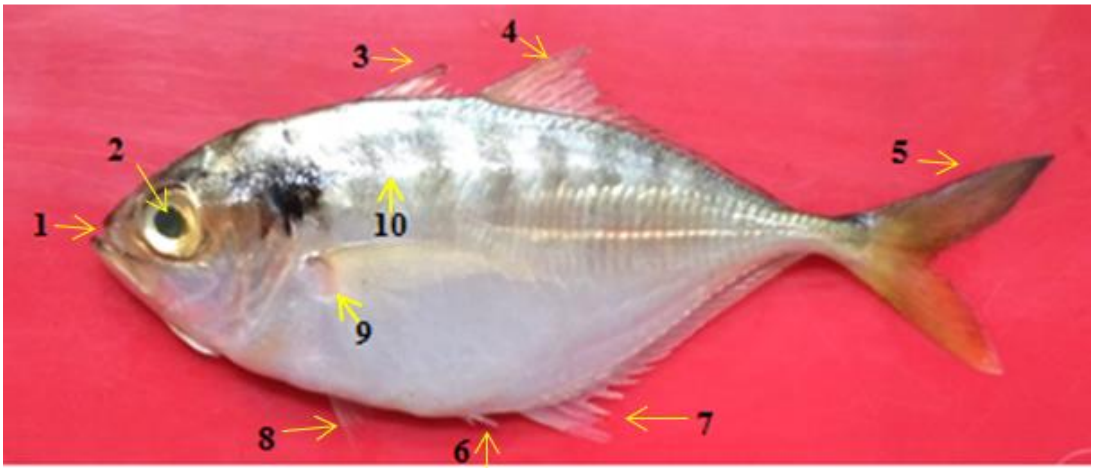

Figure 3. Morphology of *Alepes kleinii*: (1) Snout; (2) Eye; (3) Dorsal fin-1; (4) Dorsal fin- 2; (5) Caudal fin; (6) Anal fin-1; (7) Anal fin-2; (8) Ventral-fin; (9) Pectoral fin; (10) lateral line.

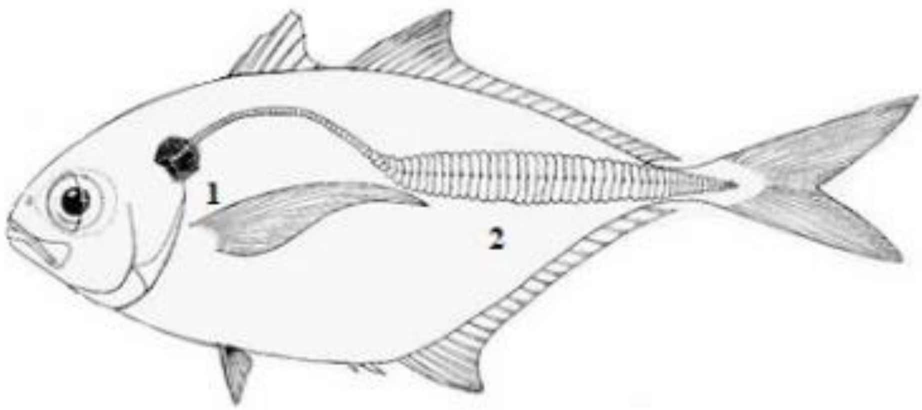

Figure 4. Lateral line and scute in *Alepes kleinii*: (1) Lateral line; (2) Scute.

The presence on the *A. kleinii* of: dark vertical stripes on the dorsal side, of lateral line and of a large black spot on the dorsal operculum are a key identifying characteristics for this species (Figure 5). The results of observations made on *A. kleinii* have quite large eyes; on their eyelids there is an adipose membrane up to half of the eye. *A. kleinii* has a small snout and a small head. The morphological appearance characteristics of the observations above are in accordance with the statements of Qamar et al (2016) and Siddik et al (2017) which stated that the eye diameter is the same as the length of the snout, while the head length is about 24% of the body length. The posterior half of the eye is covered with the adipose membrane of the eyelid (Figure 5). Adipose membrane is a condensation of fat around the eye which may or may not be present, depending on the genus. When the fish is alive, the adipose membrane is transparent in color and will become opaque after the fish dies (González et al 2016).

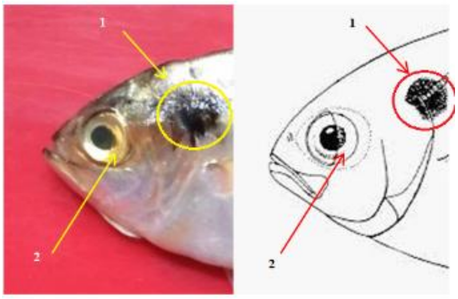

Figure 5. The head of *Alepes kleinii:* (1) Large black spot over the operculum; (2) Adipose membran in a half of the eye.

The male and female *A. kleinii* cannot be distinguished directly (Figure 6), so the sex difference of the fish needs to be done surgically. Observation of fish gonads can be done by macroscopic and microscopic observations. The results of the research on *A. kleinii* gonads macroscopical observations showed that the male gonads or testes, of even numbers, were round, elongated and slightly wavy, sand had a milky white color at the gonad maturity level III (Figure 6). Visually observed female gonads or ovaries in *A. kleinii*, also of even numbers, had a round shape and a yellowish white to reddish yellow color at the gonad maturity level III (Figure 7). The results of observations of the abdominal cavity topography in male and female *A. kleinii* showed that the testicular tissue was already recognizable, namely the elongated rounded shape, the milky white color and a relatively large size (Figure 6). The female gonad is clearly visible with a reddish yellow color, a solid round shape and ovum granules are already visible (Figure 7). This is as stated by Nahar et al (2017): the fish gonads are elongated and compact, hanging at the top of the body cavity, located lateral or ventral to the swim bladder. The gonads of fish, disposed by pairs, had the size and color varying, according to the level of development. The testes are white to milky white, while the ovaries are white to reddish yellow, as they approach spawning. The male and female gonads of Razorbelly scad can be seen in Figure 6. The microscope observation of the gonads of *A. kleinii* using acetocarmine dye obtained an image of an ovum with a round shape and a nucleus surrounded by a clearly visible cytoplasm. The male gonads look like grains of sand and are found in a very large number (Figure 6). This is in accordance with the statement of Darlina et al (2011): the gonads are identified as ovaries, if the tissue shows the presence of spherical oocytes, with a much larger size than the spermatozoon cells, with paler colored nuclei and surrounded by darker cytoplasm. The testicular tissue is recognized as small dots like grains of sand (Figure 6). This is in accordance with the statement of Ulićević et al (2018): the sperm cells are small dots, while the egg cells appear to have the form of large spheres and the nucleus is in the middle, with a paler color surrounded by a clearer colored cytoplasm.

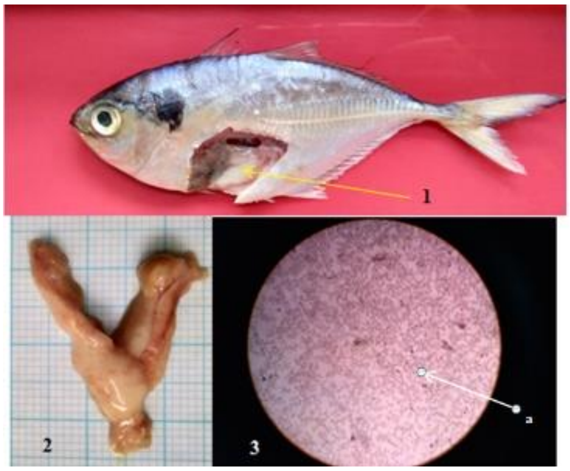

Figure 6. Male gonads of *Alepes kleinii*: (1) Testes; (2) Makroscopic of testes; (3) Mikroscopic of testes (a) Spermatozoa cells.

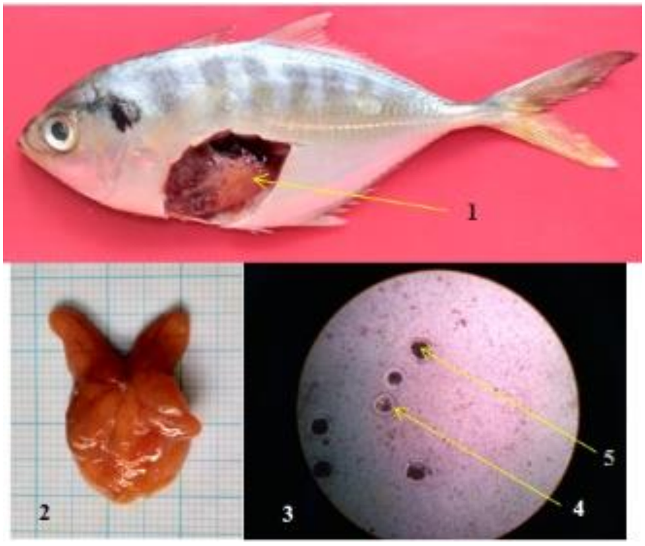

Figure 7. Female gonads of *Alepes kleinii*: (1) Ovaries; (2) Makroscopic ovary; (3) Ovum.

Morphological, meristic and truss morphometric appearance of *A. kleinii*

Morphological appearance. Morphological appearance observed in *A. kleinii* included: body shape, mouth shape, mouth position, caudal fin shape and scale type. The results of observations of the morphological appearance of *A. kleinii* are bilaterally compressed or flattened (Figure 8). The position of the *A. kleinii* mouth is terminal, facing forward and it can be popped out (Figure 8). As stated by Al-faisal et al (2015), most fish species, members of the Carangidae Family, have an elongated and compressed body shape. According to Kumar & Pandey (2017) a terminal mouth position means that the mouth is located at the tip of the nostril. The results showed that there was no difference in the body shape and mouth type between male and female Razorbelly scad fish.

Figure 8. Mouth type of *Alepes kleinii*: (1) Mouth terminal position; (2) Mouth can be popped.

Observations on the jaws and teeth of *A. kleinii* showed that it has small jaws with rows of teeth on the upper and lower jaws. This is in accordance with the statement of Gürkan (2008): the maxilla is slightly concave posteriorly and there are small comb-like teeth in the upper jaw (Figure 9). It is also stated by Masood et al (2015) that in the upper jaw there are two rows of small cone teeth that are located irregularly, while in the lower jaw there are fewer teeth (Figure 10). According to Dimijian (2005), *A. kleinii* has pluriseriate teeth on the premaxilla, whereas in other members of the Carangidae it is generally uniseriate.

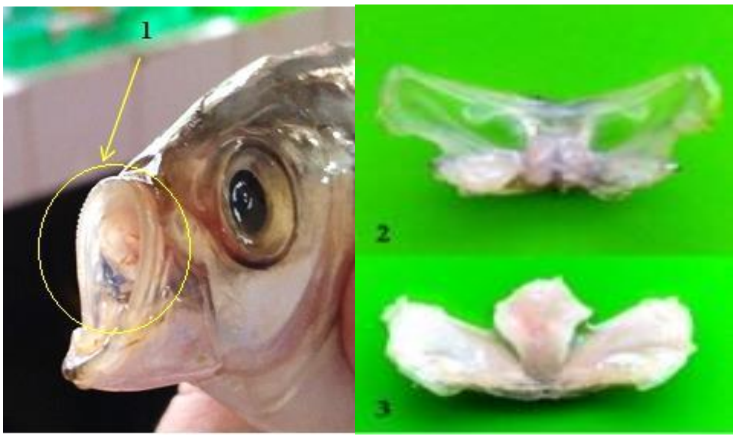

Figure 9. Rows of teeth in the jaws of *Alepes kleinii*: (1) Rows of the teeth; (2) Upper jaw; (3) Lower jaw.

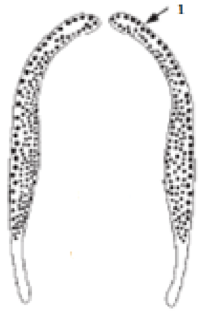

Figure 10. Rows of teeth in the jaws of *Alepes kleinii*: (1) Conical type teeth.

The observations of the *A. kleinii*'s morphology showed complete fins, namely two dorsal fins, caudal fins, anal fins, abdominal fins and pectoral fins (Figure 3), with the caudal fins having a deep forked shape (Figure 11). These results are in accordance with the statements of Al-Faisal et al (2015) and Mohamed et al (2017): the Carangidae family has anal fins in the form of spines, the scales are hardened at the lateral line, the dorsal fin is separated into two parts, the first dorsal fin consists of hard fingers and the tail fin is forked, with balanced lobes. Qamar et al (2016) also stated that *A. kleinii* has a deep forked caudal fin, measuring almost 30% of the standard body length. The results showed that the caudal fins between male and female Razorbelly scad did not differ.

Figure 11. Caudal fin type of *Alepes kleinii*: (1) Deep-forked type of caudal fin.

The scale type is also included in the morphological appearance observed in *A. kleinii*. Observations showed that the Razorbelly scad has a cycloid type of scale (Figure 12). This is in accordance with FAO's (1999) statement: members of the Carangidae family, including the *A. kleinii*, have small scales of the cycloid type. According to Brager & Moritz (2016), cycloid scales have a characteristic round shape with the posterior part not having spines or stenii (a kind of small tooth). The parts of the scales are focus, circle and radii (Rahardjo et al 2011). The focus is the initial point of scale development and is usually located in the center of the scale, although in later development the focus may shift more posteriorly or more anteriorly. The circle is a ring which develops around the focus. This cycle will always increase during the life of the fish, along with its growth (Mahmoud et al 2016)

Burhanudin (2008) stated that the type of cycloid scales on the anterior part of the body (especially those that enter the body) is transparent or colorless, while on the back (posterior) it is of a darker color than the front (anterior), due to pigment grains (chromatophores). Cycloid scales are commonly found in teleost fish and in fish with weak fin rays or Malacoptrerygii and fish with hard fin rays or Acanthopterygii. The type of cycloid scales in male and female Razorbelly scad did not differ.

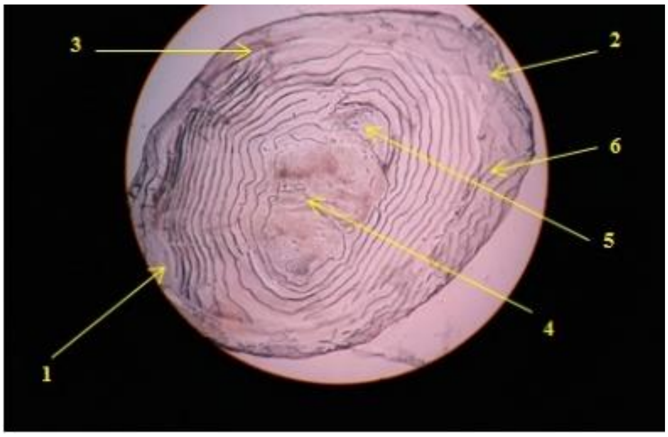

Figure 12. Scale type of *Alepes kleinii* with magnification 40x: (1) Posterior part of scale without cteni and webbed; (2) Anterior part; (3) Lateral part; (4) Focus; (5) Circulus; (6) Radii.

Meristic character. Meristic characteristics observed in *A. kleinii* are the number of fin rays (dorsal, anal, ventral and pectoral), the number of scales above and below the lateral line, the number of scales on the lateral line, and the number of scales surrounding the tail rod and the number of sieves. The gills are presented in Table 2. The results of the calculation of meristic characters are as follows: the dorsal fin consists of two fins, where the first dorsal fin consists of 8 spines, the second dorsal fin consists of 1 spine with 23-25 soft rays; the first anal fin consists of 2 spines and the second anal fin consists of 1 spine with 20-21 soft rays; the ventral fin consists of 1 hard and 4-5 soft rays; The pectoral fin consists of 1 spine and 19-21 rays. So the fin formula obtained is D1.VIII; D2.I.23-25; AI.II; A2.I.20-21; V.I.4-5; P.I.19-21. The number of scales on the top of the lateral line is 11-13, the number of scales below the lateral line is 14-15, the number of scales on the lateral line is 43-52 and the number of scales that surrounds the tail stem is 19-22.

According to the results of research by Siddik et al (2017), *A. kleinii* have complete fins, namely dorsal fins, anal fins, ventral fins and pectoral fins. First dorsal fin has 7-8 spines, second dorsal fin has 23-24 soft rays, first anal fin has 2 spines, second anal fin has 20-22 soft rays, ventral fin has 5 soft rays and pectoral fins have 23-24 soft rays. Qamar et al (2016) stated that Razorbelly scad fish have separate dorsal fins with the first dorsal fin webbed, with 7-8 spines, the second dorsal fin with 1 spine followed by 20-23 soft rays. The pectoral fins are elongated and the ventral fin is short, with soft rays. The first anal fin has 2 spines and second anal fin has 1 spine with 18-20 weak rays and the number of scales on the lateral line 28-31.

The results of the calculation of the meristic characters, presented in Table 2, show that among the eight meristic characters observed, none could distinguish between male and female *A. kleinii*. These results are consistent with the research of Mahmoud et al (2016) which stated that the species of fish *Carangoides bajad* and *Caranx melampygus,* from the Carangidae family, did not find sexual dimorphism in the characters, having the same number of dorsal, pectoral and anal fin rays. The results of Soliman et al (2018) also showed the same pattern between 64 male fish and 56 female fish of the *Lutjanus quinquelineatus* species (Bloch, 1790): there was not found any sexual dimorphism in the calculation of meristic characteristics, in particular the hard and soft rays of the dorsal, anal, pectoral, ventral and caudal fins. The same results were also obtained in the study of Fitriadi et al (2013), which stated that there was no difference in the meristic characteristics of male and female machete fish (*Chirocentrus dorab*) from Bengkalis Waters, Riau, Sumatra.

Table 1

The calculation of *Alepes kleinii* meristic character

No	*Meristic characters*	*Sex*	
		Male	*Female*
1	Number of first fin rays	8	8
2	Number of second dorsal fin rays	24-26	24-26
3	Number of first anal fin rays	2	2
4	Number of second anal fin rays	21-22	21-22
5	Number of pectoral fin rays	20-22	20-22
6	Number of ventral fin rays	5-6	5-6
7	Number of scales above the lateral line	11-13	11-13
8	Number of scales below the lateral line	14-15	14-15
9	Number of scales on the lateral line	47-51	43-52
10	Number of scales surrounding the caudal peduncle	19-21	19-22
11	Number of gill filters	37-40	37-40

The results of the calculation of the number of gill sieves for *A. kleinii* ranged from 37 to 40, with soft and tight gill combs (Figure 13). This is in accordance with Gunn's (1990) statement that there are 38-41 sieves in the *A. kleinii* gill. According to FAO (1999), *A. kleinii* have a total of 38-44 gill filters (including at the bottom). Mahmoud et al (2016) stated that the fish species *Carangoides bajad* and *Caranx melampygus* from the Carangidae Family did not find sexual dimorphism in the characters, in terms of number of gill filters.

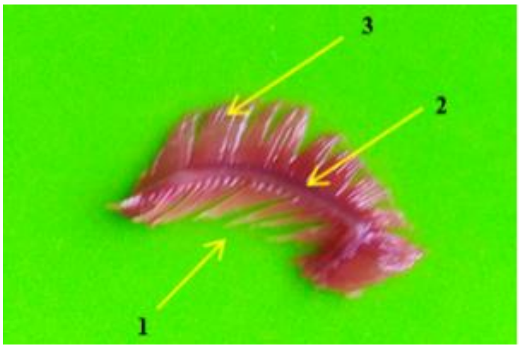

Figure 13. Gill filter of *Alepes kleinii*: (1) Gill filter; (2) Gill arch; (3) Gill filament.

Truss morphometrics characters. Analysis of sexual dimorphism can be done by measuring the bodies of male and female individuals using the truss morphometrics technique so that the body size of the organism can be visualized and the differences in the body shape between males and females can be seen (Sherwin et al 2012). The results of the calculation of the ratio of the truss distance to the standard length, using a t-test, between female and male *A. kleinii* are presented in Table 3. Based on Table 3 and Figure 14, there is 1 of the 32 truss spacing ratios that differs significantly between female and male Razorbelly scad fish, related to the head, namely A4. The ratio of the truss distance A4 which is the distance from the base of the lower jaw to the front end of the snout against the standard length of the female fish has a value of 0.110±0.012, which is greater than the value of 0.103±0.013, determined for the male fish. Although this difference is not easy to distinguish between male and female fish, it is still a significant taxonomic information.

Table 2

The significance value of the T test of truss morphometric distance between male and female individuals of *Alepes kleinii*

Truss morphometrics distance	*Ratio of truss distance (Male, n=17)*	*Ratio of truss distance (Female, n=43)*	*t*	*t table 0.05*	*p*
A4 (1-15)	0.103±0.013	0.110±0.012	-2.081	2.002	0.042*

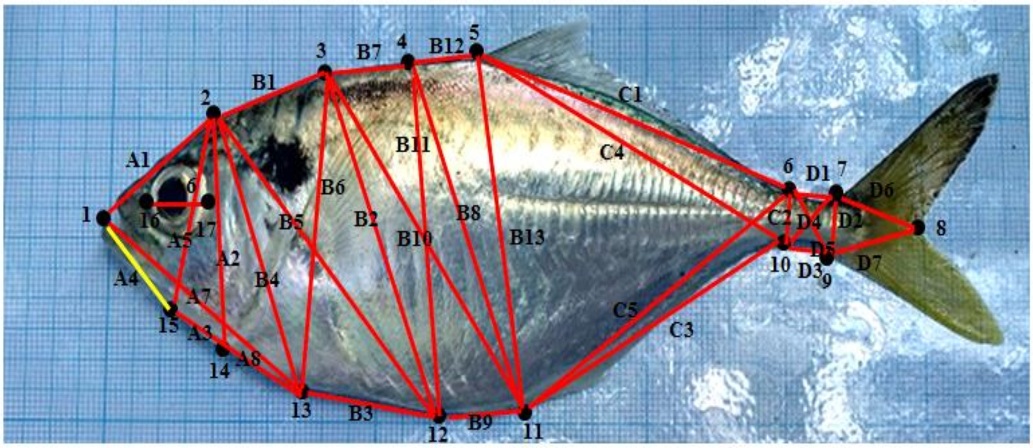

Figure 14. The significance value of the T test of Truss morphometrics distance in *Alepes kleinii* (Yellow line).

Among the research on the morphometric characters in several marine fish species with relatively similar results, there is the Guran study (2008), where there are differences in the pipefish *Syngnathus abaster* (Risso 1826) male and female specimens from the amalt Lagoon (İzmir Bay, Aegean Sea), namely in the length of the snout and in the length of the dorsal fin. A research with different results was conducted by Sukmaningrum et al (2020) on the Selar bengol fish (*Selar boops*): there was no difference in the snout, but in the body and tail areas. Different results were also found in the study of Wijayanti et al (2017) on related to the distance of the base of the lower jaw; in the front end of the snout, differences were not significant. Other studies were related to the morphometrics in the Carangidae family fish (Sley et al 2016), namely on the greater amberjack (*Seriola dumerili*), in the Gulf of Gabes Tunisia: there was no difference between male and female fish in the area around the snout, but only in the standard length, total length, head length, pectoral fin length, first dorsal fin length, second dorsal fin length, first dorsal fin width and second dorsal fin width.

Kitano et al (2007) regarding the sexual dimorphism of the three-spine stickleback (*Gasterosteus aculeatus*) stated that the sexual dimorphism can occur due to several factors, namely the niche of each sex, natural selection, different reproductive roles and intra-sexual competition, that can encourage differences in the external sexual structure. The ecological niche is the most influential factor in *A. kleinii* differences between sexes, determining genetic traits inherited by each sex. These impacts can occur in the body shape, size and number of body parts. Different results can also be caused by certain geographic distributions that are controlled by environmental physical conditions (Záhorská et al 2013). Size, distribution and variation of the morphometric characters are thought to be adaptations of fish species to their environment or habitat. Farrag et al (2016) stated that the influence of environmental interactions could trigger morphometric differences such as variations in growth, development and maturation among species.

The growth pattern of *A. kleinii*, based on the regression relationship between each truss morphometric distance and the standard length, is all linear, in both male and female individuals. Because the value of the constant "b" (slope) is <1, the growth pattern is a negative allometry. A negative allometric-type growth pattern at all truss morphometric distances was also found in *Silurus triostegus* (Jawad & Al-Janabi 2016). In addition to uniform growth patterns, there are also non-uniform growth patterns between morphometric distances, which can be linear growth patterns, linear splits and quadratic splits. The phenomenon of non-uniform growth patterns between morphometric trusses was found in the top mouth gudgeon *Pseudorasbora parva* (Zahorska et al 2013) and in the *Perca fluviatilis* (Ulicevic et al 2018).

Conclusions. Based on the results, it can be concluded that the morphological appearance of *A. kleinii* is a bilateral flat body shape. Its mouth can be raised and its position is terminal. It has a forked caudal fin, a cycloid scale type and conical tooth type, but none of them can differentiate between male and female fish, neither the meristic characters. The morphometric truss character that can be used to distinguish *A. kleinii* male and female individuals is the distance from the base of the lower jaw to the front end of the snout. The growth pattern of *A. kleinii* in both male and female individuals is negative allometric and it cannot be used as a difference between male and female individuals. Further research is needed on the *A. kleinii* species to strengthen the initial evidence of their morphological appearance, based on other taxonomic characters than meristics, truss morphometrics and growth patterns.

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Authors:
Suhestri Suryaningsih, Universitas Jenderal Soedirman, Faculty of Biology, JL. Dr. Soeparno No 63 Karang wangkal Purwokerto 53122, Indonesia, e-mail: suhestri.sutryaningsih@unsoed.ac.id
Lis Arofah Rismawati, Universitas Jenderal Soedirman, Faculty of Biology, JL. Dr. Soeparno No 63 Karang wangkal Purwokerto 53122, Indonesia, e-mail: lisarofah14@gmail.com
Sri Sukmaningrum, Universitas Jenderal Soedirman, Faculty of Biology, JL. Dr. Soeparno No 63 Karang wangkal Purwokerto 53122, Indonesia, e-mail: sri.sukamningrum@unsoed.ac.id

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