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A modified key for rapid determination of Blennioidea (Pisces: Perciformes) in the Adriatic Sea

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The identification key covers 20 species of Blennioidea presently known in the Adriatic Sea, and one additional species known to occur in freshwaters. The standard format of a dichotomous bracket key was used. The key was developed in order to make the process of identification of Adriatic blennioids clear, simple and non-destructive, thus providing a small number of easily verifiable characters instead of proposing overlapping or highly variable characters. The key is also aimed at in-the-lab-training of SCUBA observers, since many biases may influence the accuracy and precision of blennioid identification when using non-destructive visual census techniques.

Key words: Blennioidea, identification key, non-destructive, main characters, Adriatic Sea

INTRODUCTION

Blennies and their relatives are abundant representatives of the coastal fish community in the Mediterranean and other seas. To date, one clinid (genus *Clinitrachus*), three tripterygiids (genus *Tripterygion*), and 17 blenniids (genera *Aidablennius*, *Blennius*, *Coryphoblennius*, *Lipophrys*, *Parablennius*, *Paralipophrys* and *Salaria*) are known to inhabit the Adriatic Sea (Table 1) (LIPEJ *et al.*, 2008). One of the blennies (*Salaria fluviatilis*) is a freshwater species.

The recognition of blennioids in European waters started in the 19th century (KOLOMBATOVIĆ, 1882a, 1882b, 1892) and experienced a major expansion in the second half of the 20th century (ŠOLJAN, 1965; WIRTZ, 1976; WIRTZ & ZANDER, 1986; ZANDER, 1986a, 1986b; ABEL, 1993; JARDAS, 1996). In the Adriatic Sea, local checklists were prepared by SEGANTIN

(1968) for the Venice area, KOLOMBATOVIĆ (1892) and PALLAORO (1989) for the middle eastern Adriatic, PALLAORO & ŠTEVČIĆ (1989) for the whole Adriatic (which already listed 21 species of Blennioidea), and by LIPEJ & RICHTER (1999) for Slovenian coastal waters. The presence of one species in the Adriatic Sea is still questionable since the specimen of *Salaria basilisca* captured near Piran in 1874, and deposited in the Natural History Museum of Vienna (DULČIĆ *et al.*, 2006), is the only confirmed example of this species in the Adriatic Sea.

The need for a new identification key for Adriatic Blennioidea arises firstly from the fact that blennioids, which are common fish in the rocky Adriatic mediolittoral and upper-infralittoral belts, could, in our opinion, be properly identified without using destructive techniques. Knowledge about these benthic fish species

Table 1. List of recorded blennioid species in the Adriatic Sea

Family	Species
Blenniidae	<i>Aidablennius sphynx</i> (Valenciennes, 1836)
	<i>Blennius ocellaris</i> Linnaeus, 1758
	<i>Coryphoblennius galerita</i> (Linnaeus, 1758)
	<i>Lipophrys adriaticus</i> (Steindachner & Kolombatović, 1883)
	<i>Lipophrys canevae</i> (Vinciguerra, 1880)
	<i>Lipophrys dalmatinus</i> (Steindachner & Kolombatović, 1883)
	<i>Lipophrys nigriceps</i> (Vinciguerra, 1883)
	<i>Parablennius gattorugine</i> (Linnaeus, 1758)
	<i>Parablennius incognitus</i> (Bath, 1968)
	<i>Parablennius rouxi</i> (Cocco, 1833)
	<i>Parablennius sanguinolentus</i> (Pallas, 1814)
	<i>Parablennius tentacularis</i> (Brünnich, 1768)
	<i>Parablennius zvonimiri</i> (Kolombatović, 1892)
<i>Paralipophrys trigloides</i> (Valenciennes, 1836)	
<i>Salaria basilisca</i> (Valenciennes, 1836)	
<i>Salaria fluviatilis</i> (Asso, 1801)	
Tripterygiidae	<i>Salaria pavo</i> (Risso, 1810)
	<i>Tripterygion delaisi</i> Cadenat & Blache, 1970
	<i>Tripterygion melanurus</i> Guichenot, 1850
	<i>Tripterygion tripteronotus</i> (Risso, 1810)
Clinidae	<i>Clinitrachus argentatus</i> (Risso, 1810)

has recently been increasing in the Adriatic Sea by the use of non-destructive visual census methods, aided by SCUBA (PATZNER, 1985; KOPPEL, 1988; KOTRSCHAL, 1988; PALLAORO, 1989; KOVAČIĆ, 2002; LIPEJ & ORLANDO-BONACA, 2006; ORLANDO-BONACA & LIPEJ, 2005, 2007). By using only visual diagnostic characters there is no need to damage the fish. Our main goal in the preparation of the key was ensuring the functionality of the key in order to assure correct species identification in the field and from photographic evidence. The phylogenetic approach was not taken into consideration, since phylogenetic relationships among Mediterranean blennioid species are still under discussion (ALMADA *et al.*, 2005; 2009).

MATERIAL AND METHODS

The present identification key is based on data from material collected during the last decade from Slovenian coastal waters (LIPEJ & RICHTER, 1999; LIPEJ *et al.*, 2003, 2005; ORLANDO-BONACA & LIPEJ, 2005, 2007, 2008a, 2008b; LIPEJ & ORLANDO-BONACA, 2006). Using easily recognizable morphological characters the key completes the keys of SEGANTIN (1968), WIRTZ (1976), WIRTZ & ZANDER (1986), ZANDER (1986a, 1986b) and other morphological works (PAPACONSTANTINOU, 1979; ZANDER, 1969, 1972, 1980; ABEL, 1993; FARIA *et al.*, 2005) for Adriatic species. In addition to the fresh material, photographic evidence of specimens from other Adriatic areas

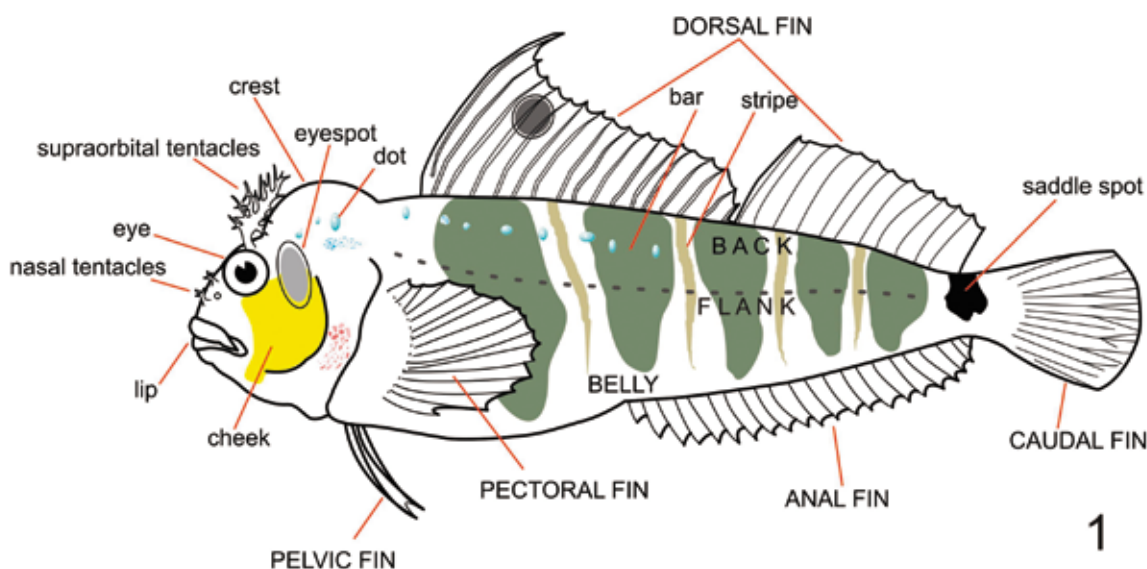


Fig. 1. A hypothetical blenny with the morphological characters used in the key for the identification of Adriatic blennies (drawing: T. MAKOVEC)

(found in books, like JARDAS (1996), and on web pages such as FishBase from FROESE & PAULY (2005)) were analyzed, in order to confirm the presence of the morphological characters taken into consideration.

The standard format of a dichotomous bracket key was used. The criteria for the choice of appropriate characters followed some baseline principles:

- avoid characters that could not be checked without damaging the fish (like the number of teeth or the presence/absence of the isthmus between gill membranes);

- avoid characters present only in young specimens;
- avoid characters related to basic colour pattern, since many species change their colour pattern due to spawning or intraspecific competition (*sensu* ABEL, 1993);
- use simple and constant characters, avoid large individual variations;
- use characters that are sex-related only when they are peculiarities of the genus or species, as well.

The morphological characters used in the key for the identification of Adriatic blennies are presented in a hypothetical blenny in Fig. 1.

IDENTIFICATION KEY

1. Identification key for families

- | | |
|--|----------------|
| 1 Dorsal fin divided into three parts (Fig. 2a). | Tripterygiidae |
| 1* Dorsal fin not divided into three parts. | 2 |
| 2 Dorsal fin divided into two parts after the first 3 spines (Fig. 2b). | Clinidae |
| 2* Dorsal fin not divided into two parts after the first 3 spines (Fig. 2c). | Blenniidae |

2. Identification key for genera

Family Tripterygiidae

In the Adriatic Sea just of the genus: *Tripterygion* Risso, 1826

Family Clinidae

In the Adriatic Sea just of the genus: *Clinitrachus* Swainson, 1839

Family Blenniidae

- 1 Spinous part (anterior) of the dorsal fin is as high as the soft part (posterior) or just a little higher (Fig. 3).
Anterior rays of the dorsal fin not elongated beyond the fin membrane 2
- 1* Spinous part of the dorsal fin is conspicuously higher than the soft part (Fig. 4).
Anterior rays of the dorsal fin are elongated beyond the fin membrane *Blennius*
- 2 On the nape a central series of unpaired tentacles:
the first one fleshy, triangular and fringed (Fig. 5). *Coryphoblennius*
- 2* If unpaired tentacles are present on the nape
the first one is not fleshy, triangular and fringed. 3
- 3 Supraorbital tentacles absent. 4
- 3* Supraorbital tentacles present. 5
- 4 Upper edges of eyes higher than head profile (Fig. 6).
Lower nasal openings with at least nine small tentacles. *Paralipophrys*
- 4* Upper edges of eyes not higher than head profile (Fig. 7).
Lower nasal openings with less than nine small tentacles
(normally less than four)
- Lipophrys*
- 5 Supraorbital tentacles hardly visible (very simple unbranched filaments).
Mature males with a crested head (Fig. 8) *Salaria*
- 5* Supraorbital tentacles well developed, at least 3 mm in height.
Mature males without a crested head. 6
- 6 Behind the eyes a blue eyespot with a red margin (Fig. 9).
Supraorbital tentacles unbranched.
- Aidablennius*
- 6* Behind the eyes no eyespots.
Supraorbital tentacles branched.
- Parablennius*

3. Identification key for species**Family Tripterygiidae**

Genus: *Tripterygion* Risso, 1826

Nasal and supraorbital tentacles simple and tiny. Body laterally compressed, covered with ctenoid (rough) scales. Dorsal fin divided into three parts: the first two with spiny rays, the last with soft rays. In the Adriatic Sea are three known species.

- 1 Dark and large vertical bars across the flanks 2
- 1* No vertical bars across the flanks. *T. melanurus*
- 2 The last dark bar forms a clear black saddle spot on the caudal peduncle, with an extension

onto the base of the caudal fin rays (Fig. 10a).

During the spawning season males are bright yellow with black head.

T. delaisi

2* The last dark bar does not form a black spot and has no extensions onto the base of the caudal fin rays (Fig. 10b).

During the spawning season males are bright red with black head.

T. tripteronotus

Family Clinidae

Genus: *Clinitrachus* Swainson, 1839

Nasal and supraorbital tentacles simple and tiny. Muzzle pointed, large lips. Body laterally compressed, covered with cycloid scales. Dorsal fin divided into two parts: anterior part with 3 spines, posterior part with at least 15 spinous and three soft rays. In the Adriatic Sea is one known species: *C. argentatus*.

Family Blenniidae

Genus: *Blennius* Linnaeus, 1758

Nasal tentacles simple and tiny. Supraorbital tentacles simple or with short tentacles on the posterior part. Dorsal fin with a distinct notch between spinous and soft part. Between dorsal fin rays 6 and 7 is present a blue or black spot with a white margin. In the Adriatic Sea is one known species: *B. ocellaris*.

Genus: *Coryphoblennius* Norman, 1943

On the nape a central series of unpaired tentacles: the first one fleshy, triangular and fringed, followed by several smaller tentacles. Nasal tentacles short and fringy. Upper lip distinctly fleshy. Dorsal fin with a notch between spinous (lower) and soft part (higher). In the Adriatic Sea is one known species: *C. galerita*.

Genus: *Paralipophrys* Bath, 1977

Supraorbital tentacles absent. Upper edge of eyes above head profile. A distinct groove between the eyes is present. Nasal tentacles fringy. Dorsal fin with a distinct notch between spinous and soft part. In the Adriatic Sea one known species: *P. trigloides*.

Genus: *Lipophrys* Gill, 1896

Supraorbital tentacles absent. Lower nasal openings with small tentacles. The front profile of the head, from the eye to the mouth, mainly steep. Upper edge of eyes below head profile. Dorsal fin with a distinct notch between spinous and soft part. In the Adriatic Sea are four known species.

- | | | | |
|----|---|----------------------|---|
| 1. | Body uniformly red. | <i>L. nigriceps</i> | |
| 1* | Body not uniformly red. | | 2 |
| 2 | On the upper part of flanks many dark brown rectangles (Fig. 11).
In the spinous part of the dorsal fin 13 rays. | <i>L. canevae</i> | |
| 2* | The upper part of flanks without dark brown rectangles.
In the spinous part of the dorsal fin 12 rays. | | 3 |
| 3 | On the upper part of flanks six or seven dark vertical bars.
Lower half of flanks and belly white. | <i>L. adriaticus</i> | |

- 3* On the upper part of flanks from eight to eleven dark vertical bars.
Lower half of flanks and belly not white. *L. dalmatinus*

Genus: *Salaria* Forsskål 1775

Supraorbital tentacle very tiny and simple, only a few mm in height. Nasal tentacles very small or atrophied. Dorsal fin with a slight notch between the spinous and the soft part, or without the notch. Mature males with a crested head. In the Adriatic Sea are three known species.

- 1 Behind the eyes a red-brown oval spot with a light blue margin (Fig. 8). *S. pavo*
- 1* No oval spots behind the eyes. 2
- 2 Typical zebra pattern on flanks (Fig. 12).
No light lines from the eyes to occiput. *S. basilisca*
- 2* No zebra pattern on flanks.
On the head two light lines from the eyes to occiput,
where they connect and form the letter V (Fig. 13). *S. fluviatilis*

Genus: *Parablennius* Ribeiro, 1915

Nasal and supraorbital tentacles well developed. *P. zvonimiri* also with tentacles on nape. Dorsal fin with a notch between the spinous and the soft part, which is more evident in *P. zvonimiri* and *P. incognitus*. In the Adriatic Sea are six known species.

- 1 Dorsal fin with a distinct notch between spinous and soft part (Fig. 14). 2
- 1* Dorsal fin with a slight notch between spinous and soft part (Fig. 3). 3
- 2 Fringed tentacles near lower and upper nasal openings (Fig. 15).
A series of tiny and simple tentacles on nape.
Five to seven white spots on the back. *P. zvonimiri*
- 2* Fringed tentacles only near lower nasal openings (Fig. 16).
No tiny and simple tentacles on nape.
No white spots on the back. *P. incognitus*
- 3 Supraorbital tentacle from one thick trunk, with many branches
on anterior and posterior sides (Fig. 17).
In the spinous part of the dorsal fin 13–14 rays. *P. gattorugine*
- 3* Supraorbital tentacle with branches only on posterior side (Fig. 18)
or composed by tiny filamentous branches (Fig. 19).
In the spinous part of the dorsal fin 11–12 rays. 4
- 4 Body white or yellowish with typical dark stripe from the eye
to the base of the caudal fin (Fig. 20). *P. rouxi*
- 4* Body not white or yellowish. No dark stripe on flanks. 5
- 5 Supraorbital tentacle with branches only on posterior side,
much longer than the eye diameter (Fig. 18). *P. tentacularis*
- 5* Supraorbital tentacle composed by tiny filamentous branches,
shorter than the eye diameter (Fig. 19). *P. sanguinolentus*

Genus: *Aidablennius* Whitley, 1947

Supraorbital tentacle simple and filamentous. Fringed tentacles near nasal openings. Dorsal fin with distinct notch between spinous and soft part. Behind the eyes a blue eyespot with a red margin. In the Adriatic Sea is one known species: *A. sphynx*.

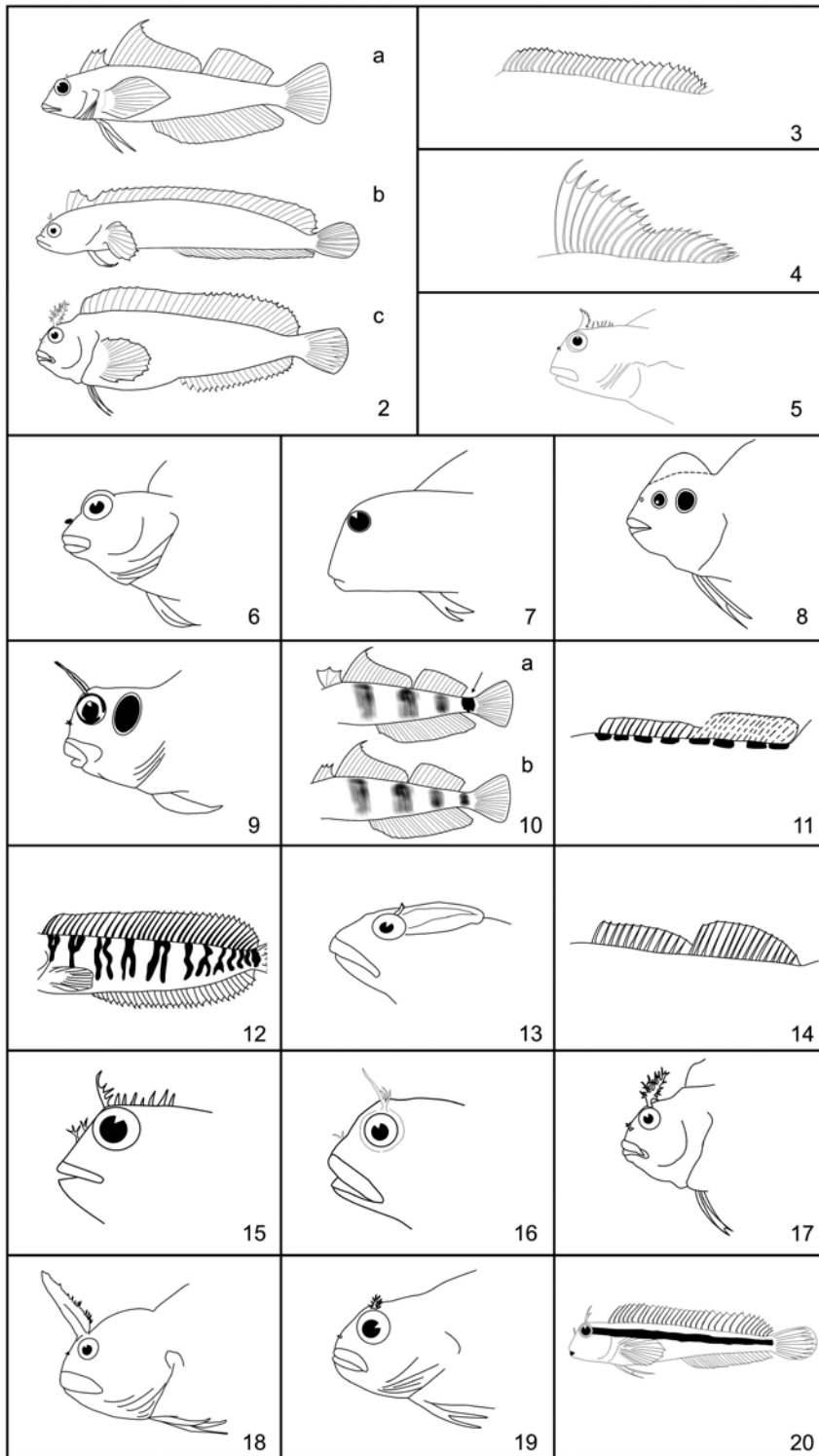


Fig. 2 - 20. Main distinguishing characters to discriminate among blennioid species. See the key for details (drawing: T. Makovec)

DISCUSSION

Often determining the discriminating features in some fish groups can be rather difficult and time consuming. The present key was developed in order to make the process of identification of Adriatic Blennioids clear, simple and non-destructive, thus providing a small number of easily verifiable characters instead of proposing overlapping or highly variable characters. The key should make clear, for example, the morphological differences between *P. incognitus* and *P. zvonimiri*, since the two species were often confused in the past (SEGANTIN, 1968). Both species have a similar body length, shape of the head, shape of supra-orbital tentacles and can exhibit similar basic red colouration. The main morphological differences between them are the presence of five to seven white spots on the back of *P. zvonimiri* (lacking in *P. incognitus*) and the presence of fringed tentacles near the lower and upper nasal openings in *P. zvonimiri* (while they are present only near the lower nasal openings in *P. incognitus*). However, they also have different ecological demands, e.g. they live in different habitat types, which could also prove to be helpful in species determination. *P. incognitus* is very abundant mainly in the first three meters of depth, on rocks covered by different low vegetation, occupying holes bored by *L. lithophaga*, but also oyster shells (ORLANDO-BONACA & LIPEJ, 2007). The presence of *P. zvonimiri* in Slovenian coastal waters was only recently confirmed (LIPEJ *et al.*, 2005), while it was previously known in the northern Adriatic (PATZNER, 1985; KOTRSCHAL, 1988). The species is mostly found from 2 to more than 10 m of depth, showing a high preference for rocks covered by precoralligenous bioformations (ORLANDO-BONACA & LIPEJ, 2007).

For males of species from the genera *Salaria* and *Tripterygion* morphological features that are sex-related were also considered. Even though the phylogenetic approach was not taken into consideration, the key takes into account the results from ALMADA *et al.* (2005, 2009), which reject the inclusion of the *Salaria* species in the genus *Lipophrys* as proposed by ZANDER (1986a).

With the analyses of molecular markers, the authors of these research works supported the monophyly of the genus *Salaria* and concluded that the species of *Salaria* are more closely related to species of the genus *Parablennius* (since they both have 14 rays in the pectoral fins, supraorbital tentacles and glands on the two anal spines in males) than to *Lipophrys* (12 rays on the pectorals and lack of supraorbital tentacles and anal glands). The present key, however, does not consider the proposed new genus *Microlipophrys* (ALMADA *et al.*, 2005) since it is not yet approved by FishBase and WoRMS (World Register of Marine Species). The recognition of the heads of certain blennies of the genus *Lipophrys*, which peep out from the endolithic holes of *Lithophaga lithophaga*, may cause some difficulties.

The key is also aimed at in-the-lab-training of SCUBA observers, since many biases may influence the accuracy and precision of blennioid identification when using non-destructive visual census techniques. Identification is in particular influenced by considerably reduced observation time in the field, as well as by the colour patterns and life habits of blennioid species (GUIDETTI & BUSSOTTI, 2000; ORLANDO-BONACA & LIPEJ, 2007). Also, it can be generally concluded that the more structured a habitat is, the less probable the detection and identification of specimens.

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SAŽETAK

Ključ za određivanje obuhvaća 20 vrsta babica koje su do sada poznate u Jadranskom moru te jednu slatkovodnu vrstu. Za ključ je uzet standardni oblik dihotomskog ključa sa zagradama. Ovaj ključ bi trebao omogućiti da proces određivanja babica u Jadranu bude jasan, jednostavan i nedestruktivan, te stoga sadrži mali ključ lako prepoznatljivih značajki u ključu umjesto preklapajućih ili značajki koje znatno kolebaju. Ključ je namijenjen i za one istraživače koje koriste SCUBA metode, s obzirom na mnoge neobjektivnosti koje mogu utjecati na ispravnost i preciznost određivanja babica pri uporabi nedestruktivnih vizualnih tehnika.

Ključne riječi: Blennioidea, ključ za određivanje, nedestruktivna metoda, osnovne značajke, Jadransko more

