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RARE SPECIES OF THE BALTIC SEA ICHTHYOFAUNA BASED ON THE EXAMPLE OF *CHELIDONICHTHYS LUCERNUS* – YELLOW OR TUB GURNARD (L., 1758)

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Abstract

Due to an observed increase in occurrence of alien species in Polish waters, research monitoring of the western region of the Baltic Sea has been conducted, in order to assess the spontaneous fish invasions. The outcome of that work was extraction of tub gurnard, *Chelidonichthys lucernus* (L., 1758), a fish belonging to ichthyologic rarities of the Baltic Sea. It prefers warmer and more saline waters of the Atlantic Ocean, the Mediterranean Sea and the North Sea. The specimens acquired were used for basic specific studies, describing the shape and size of the body.

Five measurable and twenty-seven countable traits were analyzed. As the result of this research the following formula, concerning the number of hard and soft fin rays, was composed: D_1VIII; D_2 15-16; A 15-16; V 7; P III, 15; C 19-20.

The results constitute input material necessary for further observations on tub gurnard's ecology and biology. This research will add some new information to our modest knowledge about this species. It will become a significant source of information, especially if the gurnard as an alien species should have detrimental influence on the Baltic Sea's biodiversity.

Key words: *Chelidonichthys lucernus*, tub gurnard, morphometry, invasive species, the Baltic Sea

INTRODUCTION

Tub gurnard, *Chelidonichthys lucernus* Richards, 1968 (syn. *Trigla lucerna* L.,1758) is a fish from the Triglidae family, occurring in the north-eastern Atlantic, the Mediterranean Sea and the North Sea. At the same time, it rarely visits western parts of the Baltic Sea. Nonetheless, during certain times, especially after heavy storms with the west wind, a higher ratio of the gurnard is observed among native ichthyofauna.

The number of the organisms is usually small. The collected data concerning tub gurnard biology and ecology is valuable and important, because it improves the usually poor knowledge of the species.

Chelidonichthys lucernus has a cone shaped elongated body. The head is slightly concave and covered with a shell of bone plates. The colour of the spine is red with dark transverse stripes. The ventral part is pink. The pectoral fins are red and the others are reddish. *Chelidonichthys lucernus* has two dorsal fins, one anal fin, long ventral fins, large pectoral fins with first three rays solid, free and movable. They serve the purpose of movement and to dig nourishment out of the seabed.

From the Baltic Sea in 2004 nine specimens of tub gurnard were caught and analyzed morphologically. We described the shape, size and colour of the body of this fish. The objective of this work is to present tub gurnard morphology, its morphometric and meristic features.

The results obtained from this research will substantially improve the knowledge about tub gurnard originating from Kołobrzeg's fisheries. It is worth noting, that tub gurnard is one of several alien species, which have been present in our waters for some time now. The research can also have a significant ecological and economical value for the Baltic Sea, and more so, if the gurnard was to become a new species, invading our waters, just as round goby *Neogobius melanostomus* (Pallas 1811) (Sapota 2005).

MATERIALS AND METHODS

The research material was caught in 2004 as a catch of fishing boats. The fish were frozen. Then a catch was gradually tested and morphometrically analyzed. The measurement of the total length was conducted with a ruler of the accuracy of 1 mm. The remaining features were measured with a digital caliper with an accuracy of 0.001 mm, in accordance with methods of Holčik's et al. (1989). The scheme of measurement is presented in Fig. 1. The results of measurements were transferred to the Microsoft Excel calculation spreadsheet with the help of Marcom-Software. At the same time the results were shown as the indices of a given feature and expressed as a percentage to the body length (l.c.). This method was presented by Pravdin (1966), and since then it has been systematically used in studies.

RESULTS

The analysis of the measurable features (Table 1) leads to the following formula for the number of hard and soft rays in the following fins: the first dorsal D_1 VIII; the second dorsal D_2 15-16; anal A 15-16; ventral V 7; pectoral P III, 15; caudal C 19-20.

Twenty-seven measurable features underwent detailed morphometric analysis. The results of the measurement expressed as a percentage of the body length are presented in Table 1. The total length of measured fish was found to be between 276 and 372 mm, and the body length between 224 and 305 mm. The highest weight found was 640 grams whereas the minimum was – 207 gram.

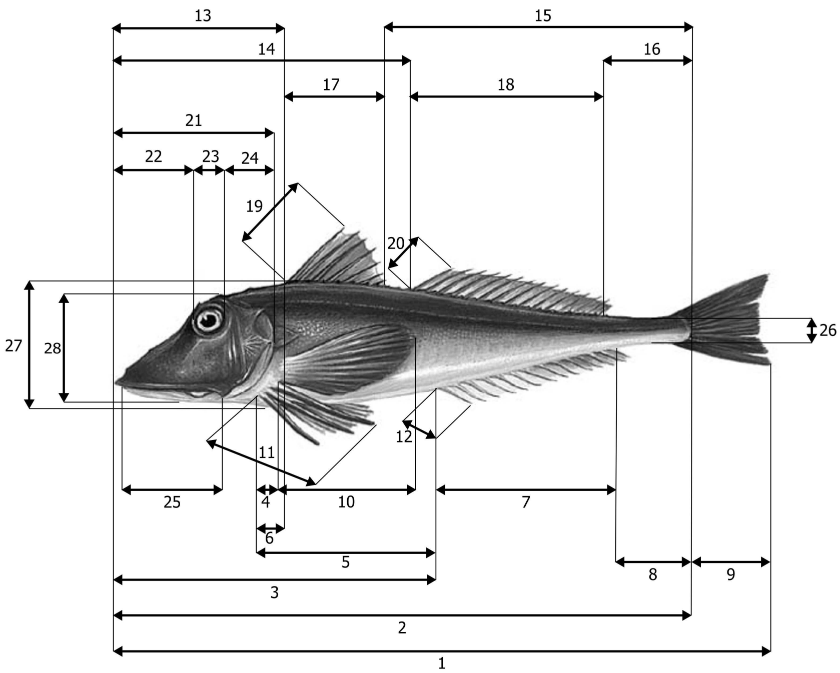

Fig. 1. A scheme of measurement of *Chelidonichthys lucernus* (L. 1758)

1. *Longitudo totalis* – Total length
2. *Longitudo corporis* – Body length
3. *Longitudo preanalis* – Preanal distance
4. *Distantia P-V* – P-V distance
5. *Distantia V-A* – V-A distance
6. *Distantia V-D_1* – V-D_1 distance
7. *Longitudo pinae A* – Anal fin distance
8. *Longitudo pedunculi caudae* – Caudal length
9. *Longitudo C inferior* – Length of lower lobe of caudal fin
10. *Longitudo pinnae P* – Pectoral fin length
11. *Longitudo pinnae V* – Ventral fin length
12. *Altitudo pinnae A* – Anal fin height
13. *Longitudo predorsale D_1* – Predorsal length D_1
14. *Longitudo predorsale D_2* – Predorsal length D_2
15. *Longitudo postdorsale D_1* – Postdorsal length D_1
16. *Longitudo postdorsale D_2* – Postdorsal length D_2
17. *Longitudo basis D_1* – First dorsal fin length
18. *Longitudo basis D_2* – Second dorsal fin length
19. *Altitudo pinnae D_1* – First dorsal fin height
20. *Altitudo pinnae D_2* – Second dorsal fin height
21. *Longitudo capitis* – Head length
22. *Spatium praeorbitale* – Preorbital distance
23. *Diameter oculi* – Ocular length
24. *Spatium postorbitale* – Postorbital distance
25. *Longitudo ossis dentale* – Length of lower jaw
26. *Altitudo corporis min* – Smallest body height
27. *Altitudo corporis max* – Greatest body height
28. *Altitudo capitis* – Head height

DISCUSSION

In the western part of the Baltic Sea, especially following violent storms, “visitors” appear. Some of these are: common sole (*Solea solea*), Atlantic mackerel (*Scomber scombrus*), wrasse (*Labrus berggylta*), greater weever (*Trachinus draco*), Atlantic horse mackerel (*Trachurus trachurus*), red mullet (*Mullus barbatus*), European seabass (*Dicentrarchus labrax*), flathead grey mullet (*Mugil cephalus*), European anchovy (*Engraulis encrasicolus*), as well as grey (*Chelidonichthys gurnardus*) and tub gurnards (*Chelidonichthys lucernus*), ocean pipe-fish (*Entelurus aequoreus*) (Lam-

Table 1

The morphometric research of *Chelidonichthys lucernus* (L. 1758)

Characteristic / number of fish	1	2	3	4	5	6	7	8	9	Min.	Max.	Mean
1	2	3	4	5	6	7	8	9	10	11	12	13
Weight (g)	320	307	295	312	207	267	227	504	640	207	640	342.11
Numerus radiorum pinnae P	III*/15	III*/15	III*/15	III*/15	III*/15	III*/15	III*/15	III*/15	III*/15	III/15	III/15	III/15.00
Numerus radiorum pinnae V	7	7	7	7	7	7	7	7	7	7	7	7.00
Numerus radiorum pinnae D_1	VIII*	VIII*	VIII*	VIII*	VIII*	VIII*	VIII*	VIII*	VIII*	VIII	VIII	VIII
Numerus radiorum pinnae D_2	15	15	15	15	15	15	15	16	16	15	16	15.22
Numerus radiorum pinnae A	15	15	15	15	15	15	15	16	16	15	16	15.22
Numerus radiorum pinnae C	19	19	19	19	20	19	19	19	19	19	20	19.11
Longitudo totalis	318	290	306	316	276	281	276	355	372	276	372	310.00
Longitudo corporis	261	236	261	270	224	234	228	290	305	224	305	256.56
Longitudo corporis 100%	100	100	100	1000	100	100	100	100	100			
Longitudo praeanalis	53.25	57.15	55.89	55.79	57.27	54.40	56.14	58.97	56.72	53.25	58.97	56.18
Distantia P-V	6.17	5.25	4.84	5.00	4.51	5.79	5.67	5.50	5.70	4.51	6.17	5.38
Distantia V-A	29.03	29.13	30.34	31.41	32.07	29.35	31.96	35.00	30.48	29.03	35.00	30.97
Distantia $V\text{-}D_1$	4.36	3.27	5.48	3.69	4.91	5.87	5.59	5.29	4.67	3.27	5.87	4.79
Longitudo basis A	30.11	29.85	29.80	29.67	27.16	30.41	28.04	28.71	29.66	27.16	30.41	29.27
Longitudo pedunculi caudae	16.63	14.28	16.06	14.60	16.65	14.53	14.95	14.94	15.83	14.28	16.65	15.38
Longitudo pinnae C	21.17	19.82	16.66	17.93	20.29	18.44	20.46	22.00	20.87	16.66	22.00	19.74
Longitudo pinnae P	33.51	35.67	34.03	30.79	39.88	37.27	36.10	36.75	35.50	30.79	39.88	35.50

1	2	3	4	5	6	7	8	9	10	11	12	13
Longitudo pinnae V	26.11	25.41	25.23	23.80	25.58	23.94	25.20	24.87	25.35	23.80	26.11	25.05
Altitudo pinnae A	9.65	10.76	9.72	9.83	11.93	10.18	10.02	9.63	10.73	9.63	11.93	10.27
Longitudo predorsale D_1	31.18	31.42	30.54	33.13	31.46	30.38	30.41	31.19	30.87	30.38	33.13	31.18
Longitudo predorsale D_2	52.50	54.89	53.60	51.34	55.52	53.41	54.72	52.94	52.71	51.34	55.52	53.52
Longitudo postdorsale D_1	57.53	57.28	53.74	53.94	53.31	55.08	50.82	52.64	53.48	50.82	57.53	54.20
Longitudo postdorsale D_2	15.54	15.01	14.07	17.06	15.88	16.18	16.36	15.35	16.28	14.07	17.06	15.75
Longitudo basis D_1	14.44	18.56	16.16	16.81	18.82	19.04	20.27	15.64	18.01	14.44	20.27	17.53
Longitudo basis D_2	35.16	35.35	32.30	32.76	33.71	32.97	31.21	33.00	34.52	31.21	35.35	33.44
Altitudo D_1	13.93	16.27	11.74	13.68	15.99	15.29	15.64	16.57	15.42	11.74	16.57	14.95
Altitudo D_2	10.67	10.89	9.24	9.69	10.60	10.72	11.31	9.63	10.75	9.24	11.31	10.39
Longitudo capitis	29.10	32.65	30.15	30.55	30.58	30.52	30.27	31.40	28.92	28.92	32.65	30.46
Spatium praeorbitale	14.97	16.81	15.08	14.67	13.61	12.78	13.49	14.94	11.84	11.84	16.81	14.24
Diameter oculi horizontalis	5.91	5.81	6.61	5.83	6.83	5.49	6.65	6.40	6.20	5.49	6.83	6.19
Spatium postorbitale	11.03	10.76	9.61	10.53	11.17	10.38	10.61	12.28	11.45	9.61	12.28	10.87
Longitudo ossis dentale	13.99	11.85	11.45	10.13	11.23	12.13	10.02	10.00	9.76	9.76	13.99	11.17
Altitudo corporis minima	5.07	4.95	5.01	4.61	5.46	5.04	5.44	4.48	5.43	4.48	5.46	5.05
Altitudo corporis maxima	21.24	21.71	20.33	16.03	20.19	21.00	18.66	20.55	21.15	16.03	21.71	20.09
Altitudo capitis	20.80	21.42	20.01	18.31	17.71	19.82	17.70	17.80	18.02	17.70	21.42	19.07
Latitudo capitis	18.93	20.99	19.43	17.91	18.42	20.07	19.36	20.58	21.35	17.91	21.35	19.67
Latitudo corporis	21.36	21.03	20.84	19.20	19.43	20.75	19.89	21.83	23.02	19.20	23.02	20.81

* hard rays of fin

part-Kałużniacka et al. 2009, Kostrzewa et al. 2004). Their presence in our waters may disturb the biodiversity of the Baltic Sea. The body of water itself is described by many scientists as particularly prone to flora and fauna invasions, hence it has many characteristics facilitating not only their immigration, but acclimation as well. One such characteristic is the location of the sea, which basically is a closed sea, penetrating the European continent, but still maintaining a connection with the World Ocean through the narrow, and relatively shallow Danish Straits. Other such characteristics are: its hydrological conditions, which promote persistence of all, freshwater, saltwater and marine species (Skóra 1996); active international ship navigation, which enables organisms to cross geographical barriers (Leppäkoski et al. 2002); limited biodiversity in the Baltic itself, resulting from its young age and from several changes in the salinity of its waters during this time. All of the above make our waters attractive to many newcomers, who, with time, become native inhabitants. Such species are for example: a macroalga *Sargassum muticum*, a snail *Potamopyrgus antipodarum*, a barnacle *Balanus improvisus*, polychaeta *Marenzelleria viridis* and *Polydora redeki*, a cladoceran *Cercopagis pengoi*, shrimps *Hemimysis anomala*, *Palaemon adspersus* and *Palaemon elegant*, Chinese mitten crab *Eriocheir sinensis*, Harris mud crab *Rhithropanopeus Harrisii*, a crayfish *Orconectes limosus*, zebra mussel *Dreissena polymorpha*, round goby *Neogobius melanostomus*, sea walnut *Mnemiopsis leidyi* (Gruszka 1991, Lampart-Kałużniacka 1998, Leppäkoski and Olenin 2000).

Occurrence of new organisms is a signal for scientific centers to conduct long-term biomonitoring. Such observations allow not only to control the "guest's" numbers, but also to improve a usually modest knowledge of its biology or ecology. One can never be sure whether an organism only visits given ecosystem or begins its expansion. Thus, it seemed important to study tub gurnard, which was noted only sporadically in the Baltic Sea, until 2004. Usually, only one specimen had been caught: in 1959 in Międzyzdroje (Klucze do oznaczania... 1962), in Gdańsk Bay in 1990 and 1991 (Skóra 1996) and in Międzyzdroje in 1998 and 1999 (Krzykawski et al. 2001). In 2004, though, as much as nine tub gurnard specimens were extracted from the Southern Baltic fisheries in its central part. Such a sample caught at once, called for detailed morphological analysis of the species. The goal of the analysis was to describe the shape and size of the body, using measurable traits of the fish, and to establish formulas concerning the number of fin rays, which, as meristic traits are taxonomic features (Ryby słodkowodne... 2000). Those, in turn, enable a proper taxonomic assignment of the fish, which is no mean feat, especially in case of a newcomer. After the analysis of the number of fin rays, slightly lower ranges of fin rays have been established, than reported by Rutkowicz (1982), Terofal and Militz (1996), Reichholf (Wielka encyklopedia... 1994) or Krzykawski et al. (2001). Only in the case of soft rays of pectoral and pelvic fins was such comparison not conducted because of lack of data in related literature.

The analyzed magnitudes, i.e. total length, body length, and mass indicated that we have dealt with medium sized specimen, which agrees with existing data (Rutkowicz 1982, Terofal and Militz 1996, Reichholf 1994). The remaining values were transformed into percentages of body length and presented as indices. Most of them have values close to the ones given by Krzykawski et al. (2001). Minor differences are found, among others, in horizontal eye diameter, preorbital distance, head height or the length of the lower jaw. Nonetheless, there are no grounds for estimating any differences of statistical importance. The research of *Chelidonichthys lucernus* from the Baltic Sea will contribute to better understanding of its morphometry and will have bearing on completing modest knowledge of the study cases of the subject.

The recently observed intentional and nonintentional introductions of organisms ending in their acclimation constitute a serious ecological threat in many regions (Khurshut 2010). Every invasive species, which completes the acclimation process becomes a danger for the autochthonous biodiversity. This has been observed in the Aral Sea, where due to the introduction of alien fish species, endemic sturgeon population levels dropped significantly. The alien becomes a potential competitor for habitats, feeding zones, mating zones, and, paradoxically, oftentimes the guest starts to win the competition and poses a threat to indigenous species. Similar phenomenon has been observed in the Baltic. On June, 9, 1990, a fish not noted there before was caught in the Puck Bay. After morphologic analysis it was ascertained, that the fish was the round goby *Neogobius melanostomus* (Pallas 1811), whose natural habitats are drainage basins of the Azov Sea, the Black Sea and the Caspian Sea. The fish was found to have entered the Baltic Sea in ballast waters (Sapota 2005). In the Baltic it found suitable conditions to grow and procreate, which quickly led to its expansion in all directions. As a result, it is found today not only in Polish, but also in German and Swedish waters of the Baltic Sea. Many factors contribute to round goby's success in conquering the new environment, i.e. lack of natural enemies, lack of parasites, food availability, the eutrophication of waters, and, probably, climate warming (Sapota 2005). The rising temperature on the globe causes progressively more migrations of warm climate zone species into cooler regions (De Wan et al. 2010). This phenomenon is not uncommon also to tub gurnard, because it belongs to sub-tropical fish, preferring water in the temperature range of 8-24°C. Its northern reach ends in the vicinity of the British Isles. Sporadically, in the hotter times it is found in the North Sea. Its southern reach ends off the coast of Senegal, but specimen were noted also in waters surrounding the Azores. In the Mediterranean Sea it is counted among typical and numerous species of ichthyofauna, whereas in the Baltic Sea it belongs to ichthyologic rarities. The global warming results in a shift of its occurrence zone (Kirschenstein 2011). This is justified, because in warmer water, there is less oxygen, to give but one example, due to decreased gas solvency in warmer water. Therefore, the fish from warmer parts either descend to the deeper layers or migrate to the colder waters closer to the poles (De Wan et al. 2010).

It is worth remembering, though, that the biological invasions only superficially enrich the Baltic Sea's biodiversity, and that their presence does not have a positive bearing on the economy (Skóra 2000). That said, it seems prudent to take actions, make legislation and conduct enterprise in order to prevent both, purposeful and accidental introduction and acclimation of organisms in Polish waters. Moreover, a formidable contribution is made by the scientific and educational centers monitoring the waters, which adds to our knowledge of a new species, i.e. its appearance, propagation, migration routes, morphological composition or survival strategies (Gatunki obce... 2011). Usually, this is a way of informing public opinion, as well as the institutions responsible for the management of the waters, and taking proper steps to reduce introduction in our country. However, through the analysis of the rate of discovering alien species (at present the number of plants, animals and fungi in the Polish database is 1,060) (Gatunki obce... 2008) it seems, that the problem we are facing today is a serious one.

CONCLUSIONS

Morphometric research and analysis was performed for the first time on the tub gurnard from samples caught in the Kołobrzeg fishery on the Baltic Sea. The fish is an ichthyologic rarity in the Baltic normally having a preference for the warmer and more salty waters found in the Atlantic Ocean as well as the Mediterranean and North seas. This data contributes toward the establishment of a modest knowledge base of its behavioral characteristics. Since the introduction of this invasive species may have deletorius effects on the established biodiversity with consequences for the local economy a more complete understanding of the species is appropriate, so that proper action can be taken to mitigate an unwanted migration of this species to local waters.

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RZADKIE GATUNKI ICHTIOFAUNY MORZA BAŁTYCKIEGO NA PRZYKŁADZIE KURKA CZERWONEGO *CHELIDONICHTHYS LUCERNUS* (L., 1758)

Streszczenie

W związku z obserwowanym wzrostem notowań obcych gatunków w wodach polskich przeprowadzono badania monitorujące zachodni rejon Morza Bałtyckiego pod względem samorzutnych inwazji ryb. Efektem tych prac było pozyskanie kurka czerwonego *Chelidonichthys lucernus* (L., 1758), ryby należącej do rzadkości ichtiologicznych Morza Bałtyckiego. Preferuje ona cieplejsze i bardziej słone wody Oceanu Atlantyckiego, mórz Śródziemnego oraz Północnego. Pozyskane osobniki wykorzystano do podstawowych badań gatunkowych opisujących kształt i wielkość ciała.

Analizą objęto 5 cech policzalnych i 27 mierzalnych. W wyniku prowadzonych badań ułożono następującą formułę dotyczącą liczby promieni w płetwach: D_1VIII; D_2 15-16; A 15--16; V 7; P III, 15; C 19-20. Długość całkowita badanych ryb zawierała się w przedziale 276--372 mm, a długość ciała 224-305 mm. Maksymalna masa wyniosła 640 g, a minimalna 207 g. Pozostałe cechy przedstawiono w postaci indeksów i wyrażono jako % długości ciała.

Wyniki uzyskane w niniejszych badaniach wpłyną na wzbogacenie wiedzy dotyczącej morfologii kurka czerwonego pochodzącego z łowisk kołobrzeskich. Należy zaznaczyć, że kurek jest jednym z kilku gatunków ryb obcych, które od pewnego czasu są notowane w naszych wodach. Jednocześnie badania te mogą mieć zasadnicze znaczenie ekologiczne i gospodarcze dla Morza Bałtyckiego, zwłaszcza jeśli kurek miałby się stać nowym gatunkiem inwazyjnym w naszych wodach, tak jak babka bycza *Neogobius melanostomus* (Pallas 1811).

Należy pamiętać, że każda introdukcja zakończona aklimatyzacją będzie stanowiła konkurencję dla rodzimej fauny związaną z miejscami do żerowania, tarła czy też bytowania. Z prowadzonych prac monitoringowych wynika, że coraz częściej ryby tropikalne są spotykane w zimniejszych rejonach. Spowodowane jest to globalnym ociepleniem klimatu. Ma to swoje uzasadnienie, ponieważ w cieplejszej wodzie jest chociażby mniej tlenu, ponieważ wraz ze wzrostem temperatury rozpuszczalność gazów maleje. Stąd coraz częściej ryby cieplejszych rejonów albo schodzą w głębsze partie wód albo migrują ku zimniejszym wodom znajdującym się bliżej biegunów naszej planety.