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Occurrence of an *acipenser sp.* (actinopterygii, acipenseriformes, acipenseridae) specimen from lemnos island, northeast aegean sea, Greece. How many sturgeon species are actually known?

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Abstract

Sturgeons are ancient and though that they were a major component of the inland fisheries globally, they are not well studied, and they face various threats like overharvesting, habitat degradation, anthropogenic interventions and others. Noteworthy, is that all European sturgeon species are threatened. Scientific community is not actually convinced on how many species, subspecies, or varieties are in fact living globally, clearly separated to each other. This controversy demonstrates at least important overlaps on their geographical distribution, maybe of genetic basis. The finding of the current study is quite unique since exhibits strong morphometric and meristic characters of two different sturgeon species *Acipenser sturio* and *A. stellatus*. The present specimen in view had 18 gill rakes (18-25 in *A. sturio* and 30-36 in *A. stellatus*) and 36 lateral scutes (24-39 in *A. sturio* and 30-36 in *A. stellatus*). Furthermore, the ratio of Snout Length / Head Length was 60.22% ($\leq 60\%$ in *A. sturio*, $\geq 60\%$ in *A. stellatus*). Also, the present study signifies the urgent need of unified protection and conservation measures before it is too late to act.

Keywords: sturgeons, conservation, morphology, Lemnos Island, Aegean Sea

1. Introduction

Four genera are composing Family Acipenseridae -*Acipenser*, *Huso*, *Pseudo scaphirhynchus* and *Scaphirhynchus* ^[1, 2], all of them occurring merely at the northern hemisphere, including arctic regions ^[3]. Scientific community is not actually convinced on how many species, subspecies, or varieties are in fact living globally, clearly separated to each other. The number of valid sturgeon species importantly differs in various studies from 17 ^[4] to 25 ^[5]. The study of ^[6] suggest that the genus *Huso* should not be considered as a separate taxonomic unit, while ^[7] clearly states the opposite. Moreover, *A. sturio* and *A. oxyrinchus* was believed that were the same species ^[8]. Also, some studies state that only *A. baerii* and *A. oxyrinchus* comprise subspecies ^[4], while others suggest that also *A. sturio* comprises subspecies ^[8]. This controversy demonstrates -at least, important overlaps on their geographical distribution especially as juveniles ^[4], maybe of genetic basis. Moreover, morphological differences can be observed. Juveniles of the Gulf sturgeon have different morphological characters, compared with the sub-adults and adults of the species from the same region ^[9]. Furthermore, sturgeon populations of the same species from different regions may exhibit variations ^[10]. Also, the intentional cross-breed of sturgeons from farmers ^[11, 12] or natural hybridization ^[13, 14] is contributing negatively to this complexity. Moreover, while genus *Acipenser* is the largest with native species occurring in Europe, North America and Asia ^[2] it is unclear how many species are composing the genus ^[4] or how many do dwell in European waters. For instance, it is controversial if the Adriatic sturgeon is or not endemic to Adriatic Sea ^[15]. Nowadays in Europe there are 8 sturgeon species, 2 of them endemic ^[16]. Furthermore, ^[17] states that *A. sturio* should be considered as extinct locally. Also, ^[16] state that the last record of *A. sturio* from Mediterranean Sea was in 1991. Meanwhile, in 2005 one *A. sturio* was reported from Evros River estuaries, Aegean Sea ^[18]. Also, one *H. huso* was reported from the same area in 2006 ^[18], but other study suggests that beluga should be considered as extinct from Aegean Sea ^[19]. Table 1 summarises the published data on the sturgeon species presence at the Greek

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freshwater systems and at Aegean and Ionian Seas starting from 2000. Over and above, recent occurrences of the Atlantic sturgeon *A. oxyrinchus* from European Atlantic [20, 21]

demonstrates that the species might not be extirpated as it was considered.

Table 1: A summary on sturgeon species presence in Hellenic freshwater and at Aegean and Ionian Seas based on published data 2000-2015

Sturgeon species References	[22]	[23]	[24]	[25]	[26]	[27]	[28]	[18]	[11]	[29]	[30]	[19]	[31]	[32]	CS
<i>A. sturio</i>	-	+	+	+	+	+	+	+	+	+	+	+	+	+	-
<i>A. stellatus</i>	-	+	+	+	+	+	+	-	+	+	-	+	+	+	-
<i>A. naccarii</i>	-	-	-	+	-	-	+	-	+	-	-	+	-	+	-
<i>A. baeri</i>	+	-	-	+	-	-	-	-	+	-	-	-	-	+	-
<i>A. gueldenstaedtii</i>	+	-	+	+	+	-	+	+	+	+	-	+	-	+	-
<i>A. ruthenus</i>	+	-	-	-	-	-	-	-	+	-	-	-	-	+	-
<i>A. trasmontanus</i>	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
<i>Huso huso</i>	-	+	+	+	-	+	+	+	+	+	+	+	+	+	-
<i>Acipenser</i> hybrid	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
<i>Acipenser</i> sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+

[22] Economidis *et al.*, 2000a, [23] Economidis *et al.*, 2000b, [24] Bilecenoglu *et al.*, 2002, [25] Bobori and Economidis, 2006, [26] Economou *et al.*, 2007, [27] * Fricke *et al.*, 2007, [28] Paschos *et al.*, 2008, [18] Koutrakis *et al.*, 2011, [11] ^{2*} Nearhus, 2012, [29] Bilecenoglu *et al.*, 2014, [30] Bianco, 2014 [19] ^{4*} Barbieri *et al.*, 2015, [31] Cicek *et al.*, 2015, [32] ^{5*} Louisy, 2015, CS: Current study * Fricke *et al.* suggest that the *A. sturio* and *A. stellatus* should be considered as extinct from Turkey, ^{2*} the hybrid of *A. gueldenstaedtii* x *A. baeri* refers only into individuals from aquaculture, so far there are no records from the wild, ^{3*} Bianco, 2014 suggest that *A. sturio* and *H. huso* should be considered as extinct, while *A. ruthenus* and *A. trasmontanus* were excluded since there is no reproductive success in the wild, ^{4*} Barbieri *et al.*, 2015 suggest that the species *A. naccarii*, *A. stellatus* and *H. huso* should be considered as extinct from the Hellenic waters, ^{5*} this study states that *A. stellatus* has disappeared from the Aegean Sea

The finding of the current study is quite unique since exhibits strong morphometric and meristic characters of two different sturgeon species *A. sturio* and *A. stellatus*. Also, demonstrates the lack of scientific knowledge on the actual sturgeon species globally and signifies the need of unified protection and conservation measures for these ancient fishes before it is too late to act.

Aegean Sea has a complex topography [33]. The area demonstrates important physiochemical variations from North to South [34]. North Aegean Sea is an area with high productivity, compared to the east Mediterranean, due to the interconnection with the Black Sea [35]. Therefore, it is an important fishing ground [36]. The north-eastern part of Aegean is impacted by the low salinity and cold Black Sea waters [34], that demonstrate seasonality. Also, the north Aegean Sea exhibits unique bottom topography features (North Aegean Trough) that dispenses the area into three sub-basins: Lemnos-Saros Islands Basin at the east, Athos Basin in the middle and North Sporades Basin at the west [33,34].

2. Materials and Methods

A single specimen (Fig. 1) of genus *Acipenser* caught in gill-nets by artisanal fishermen at the northeast shores of Lemnos Island and delivered to Lemnos Island’s fisheries department.



Fig 1: The *Acipenser* sp. from Lemnos Island. (A) the specimen in full length, presented tied due to *rigor mortis*. (B) head and snout, detail. (C) the markings of the four

barbells. (D) The lateral scutes

3. Results

The individual was identified, to genus level, according to [2, 37]. Meristic and morphometric characteristics were obtained and presented at Table 2. Lengths were measured with the use of digital callipers to the nearest 0.01 mm. Weight was measured with electronic scale to the nearest 0.01 g. The specimen in view had 18 gill rakes and 36 lateral scutes. While the portion of snout length to head length was 60.22%. A morphological comparison among the current individual and of the species *A. stellatus* and *A. sturio* follows. The specimen was deposited at the Ichthyology laboratory, Department of Marine Science, University of the Aegean.

Table 2: Morphometric and meristic characteristics of the *Acipenser* sp. specimen from Lemnos Island

Total Length (TL)	75.2 cm
Standard length (sl)	64.6 cm
Fork length (fl)	58.5 cm
Head length (hl)	17.6 cm
Snout length (snl)	10.6 cm
Eye diameter (ed)	0.9 cm
Maximum width (mw)	6.4 cm
Minimum width (mw)	1.9 cm
Lateral scutes	36
Gill rakes	18
Weight	659.32 g

4. Discussion

Sturgeons were a major component of the inland fisheries in a global scale [38]. Nowadays, most of sturgeons face various threats such legal or illegal overharvesting [39], habitat degradation, anthropogenic interventions [38], pollution [40] and climate change. Sturgeons are experiencing the most challenging era of their presence since some species are facing their complete extinction. Furthermore, all European sturgeon species are threatened [16]. Unified protection measures and sufficient fisheries monitoring are essential for their protection, conservation and potential restoration through breeding programs [41]. The last years considerable

and concerted efforts were made in Europe for *A. sturio* [42]. Moreover, some north American sturgeons had positively responded at protection-conservation measures [43]. Some ecological remarks suggest that salinity should be the important factor regulating the geographical distribution of sturgeons in the area, considering as one centre of its speciation long ago Bosphorus and Dardanelles were open. So, any species dwelling in the Black Sea could easily migrate to Aegean Sea and then to Atlantic Ocean. Also, it seems that large rivers were necessary for reaching spawning areas. Such an area exists in a tributary of Arda River near to Kastanies village, at least for *A. sturio*. This habitat being characterized by shallow waters with gravel to gross sandy bottom. Regarding the recent years, the appearance of some other species, including *A. sturio*, *A. stellatus* and *H. huso*, is likely there they were originating from accidental hatchery releases. Aquaculture it is considered as important introduction vector of alien or genetically different species globally (e.g. *Pagrus major* [44]). In fact, near Plovdiv in Bulgaria there are some sturgeon hatching faculties (pers. comm. Angel Tsekov, Plovdiv University "Paisii Hilendarski"), as elsewhere in the country [45]. Unfortunately, there is no relative information from the Turkish Aegean, all efforts for contact were negative. Contrary, according to [46] some restoration initiatives had taken place in the Black Sea. So, it is very likely that recent catches, of various sturgeon species in north Aegean Sea are in fact hatchery releases. Regarding the specimen caught at Lemnos Island probably it is one of the above releases, attracted in the area by low salinity of upwelling water probably around Alyki area (39°56'18.7"N 25°23'20.2"E). Alternatively, the current specimen could be a stray individual off Black Sea origin. Also, the authors believe that the probability of transportation and introduction via ballast water should not be excluded since Lemnos Island is in proximity with the Dardanelles strait and therefore the Black Sea. Recently, many studies suggest shipping as an important vector of introduction [47]. It should be noted though that in the region there is no major port besides the port of Myrina (39°52'21.1"N 25°03'28.9"E) that is located at southwest. Lastly, the ornamental trade or a release from private aquarium could not be excluded, but this probability is rather slim since sturgeons are not very attractive species, at least for the Mediterranean countries.

5. Conclusion

The morphological features of the present individual are quite unique and present similarities with both *A. stellatus* and *A. sturio*. For instance, *A. stellatus* have 30-36 gill rakes and 30-36 lateral scutes, while *A. sturio* have 18-25 gill rakes and 24-39 lateral scutes. The in-view individual had 18 gill rakes and 36 lateral scutes. Furthermore, *A. stellatus* individuals show -commonly, a $\geq 60\%$ ratio of snout length to head length and *A. sturio* individuals a $\leq 60\%$ ratio of snout length to head length. The present individual showed an 60.22% ratio of snout length to head length, demonstrating morphological characters from both species. Given that there is great uncertainty of family systematics, it is important to use molecular tools for better approach [48]. Unfortunately, genetic analysis cannot be performed on the specimen in view since it was preserved in formalin and the rate of successful results would be at $<10\%$ (pers. comm. Theodoros.J. Abatzopoulos, Aristotle University of Thessaloniki).

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