



## DRIFTING NETS AS A TOOL TO ACHIEVE FISH MANAGEMENT AND CONSERVATION PURPOSES IN THE LOWER DANUBE RIVER

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### ABSTRACT

Drift trammel netting is a traditional method for commercial fish catches in the Danube River, especially along the Bulgarian stretch. Potentially, non-commercial or endangered fish species may be caught as bycatch, but no official statistics exist. Recently, freshwater fish populations, including commercial species, have declined. In light of these facts, the study aims to examine recent quantitative fish catches from drift netting in the Lower Danube from a conservation point of view. During the early summer of 2024, 54 transects with drifting trammel nets were performed at two sampling sites on the Lower Danube (Bulgaria). The fishing gear and methodology used were similar to those in commercial fishing. 18 fish species were captured, including one sturgeon species. 9 are under protection in the NATURA 2000 network, and 15 are mentioned in at least one regulatory document. On this basis and for better assessment and conservation, bycatch and discards should be officially registered, and quotas should be considered. As additional output, the presence of Pontic shemaya was confirmed in a new NATURA 2000 site, BG0000530. Thus, it should be included in this site accordingly, since it is the most suitable for its monitoring.

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## INTRODUCTION

“Difana” or drifted gill net fishing (*DNF*) is a traditional method for commercial catches in the Lower Danube River. Depending on the legally approved mesh sizes, the target species may be small-bodied, such as bleak, medium-sized, such as sander and carps, or larger specimens (wels and Asian carps) (Raykov and Triantafyllidis, 2015). Potentially, other species, such as sturgeons, may be caught as bycatch, but no official statistics exist, despite a recent permanent moratorium on these species (MOEW, 2025a). This fishing method is used on clean bottoms, which are continuously maintained by local fishermen. On these fishing grounds, pressure is constantly exerted, in some cases for 24 hours per day. These activities stop only during spawning periods (EAFA, 2025a), or under extreme weather conditions – floods, extremely dry seasons, cold, etc.

Historical records concerning the fisheries along the Danube date back to the Palaeolithic Era, mainly associated with large sturgeons (Balon, 2004; Bartosiewicz and Bonsall, 2004; Dinu, 2010). Data on Danube fisheries have been recorded since 335 BC when the Greeks commercialized fish in the Dacian territory of the Lower Danube (Romanescu, 2013). During the Thracian, Roman, Proto-Bulgarian and Ottoman periods, fish were an important food resource for riparian communities. Other large fish, such as carp, pike and wels, as well as smaller cyprinid species (asp, bream), were used as food resources (Bartosiewicz and Bonsall, 2004; Dinu, 2010). One of the oldest fishing settlements along the Bulgarian sector was discovered near Russe (Zmееv, 1995). After Bulgarian independence, commercial fisheries increased, in parallel with the first regulations. This process accelerated further after the end of WW2 and until 1990. During the last 3 decades, the number of fishermen and the Danubian fisheries have decreased compared to the previous period (Zmееv, 1995).

Historically and at present, as a rule, the largest fishing communities are concentrated around urban centers. Along the Bulgarian sector, there are 6 such centers (Nenov, 2025), where the main traditional fish markets near the Danube still operate. Around them, smaller rural communities on the Danube rely on the Danube to obtain fish resources. Almost every riparian village supports at least some fishermen.

Currently, about 1500-1600 commercial fishermen work in the Bulgarian section of the Danube River, according to the permits from EAFA, and the number of declared fishing boats varies between 650 and 850. However, at the beginning of the previous century, there were more than 2000 fishermen around Tutrakan alone. Most settlements along the Bulgarian bank of the Danube River use at least one fishing ground, often longer than one kilometer. There are no precise data on the total length or area of the national fishing grounds.

Proper species assessment and conservation depend on adequate data acquisition and analysis. These preliminary data should be derived from all possible sources in order to achieve credible population trends – especially concerning commercial fish species. In practice, commercial fisheries and angling jointly exploit resources in the Lower Danube, with a clear negative trend (Bulgarian Ministry of Agriculture and Food, 2024). A similar European trend was established decades ago (Zlatanova, 2004). Landings have specific references: shad, wels, some percids, and cyprinids, which are reported separately according to the latest report for 2025. In total, 77,771 tons were exploited during the same year (EAFA, 2025b).

Freshwater fish are not only a significant food resource but also serve as indicators for ecological assessments of European rivers (Solheim et al., 2025). For fish monitoring in the Danube River, electrofishing should be used as the main sampling method; nevertheless, additional methods such as *DNF* can contribute to good results (Apostolou et al., 2021). It is known that *DNF* is, in general, less effective in registering more species (Zajicek and Wolter, 2018) and may be more lethal than electrofishing. In any case, *DNF* is a non-selective fishing gear, catching more mobile species, in addition to strictly territorial ones (Rudstam et al., 1984). Electrofishing is best suited to sub-littoral habitats close to the shoreline, since the efficiency is only approximately 2 m depth (CEN - EN 14011, 2003). This protocol represents a standardized Pan-European sampling method, contributing data for the national or regional fish assessments (Liska et al., 2022). Fish assessment methods were developed accordingly, and reference communities were accepted mainly on this basis. Pelagic or bottom-dwelling fish species are often missing, especially some percids, shads, cyprinids, sturgeons, etc. (Apostolou et al., 2021). Along the Bulgarian Danube stretch (which is characterized as a Highly Modified Water Body), 24 Natura sites include at least a small section of the river. 16 fish species included in the Habitat Directive inhabit this stretch (MOEW, 2025b), including 4 critically endangered sturgeons (IUCN, 2026). Targeted species monitoring often requires selective sampling which does not focus on general fish community structure and parameters. In contrast, *DNF* is a non-selective fishing method, which can potentially collect every available specimen of a given size and spatial/temporal distribution. Thus, the study aims to establish the actual catches from drift netting in the Lower Danube and to examine them from a conservation point of view.

## MATERIALS AND METHODS

From May to July 2024, scientific drift trammel netting (*DNF*) was undertaken at two sampling sites, along the Bulgarian sector of the Danube River (river kms 579/582 and 395/400 from west to east), following all necessary official permits (scientific fishing license 16/17.05.2024).

It was performed on commercial fishing grounds, using fishing gear and methods similar to those in commercial fishing. Each targeted transect covered at least one km in length, except in extraordinary circumstances, e.g. obstacles, net ruptures, etc. The inner mesh size was 22 mm, and the outer 200 mm. Thus, specimens from 0.2 to about 1 m in body length could theoretically be sampled, if present. The net was 150 m long and 2 m wide. After each transect and when disengaged, each specimen was identified to species level and immediately released into the water in order to minimize mortality. The catch per unit effort (CPU) was calculated as ind. and kg/ha, where the transect area represents the transect length X transect width. The transect width was assumed to be the net length, always equal to 150 m. Each species was then categorized, according to its national and international conservation status, as well as its registered abundance and biomass.

The index of relative importance (IRI) was also calculated for each species, according to Tian et al. (2025). Abundance–Biomass Comparison (ABC) curves and *W* statistics were calculated, according to Yemane et al. (2005), and visualized with Primer 6 (Clark and Warwick, 2001). For individual ABC curves, only species with occurrence >10 times in the catches (or >18%) were considered in order to provide reliable results. For the total community curves, the parameters of all registered fish specimens were used. Statistics were performed using PAST (Hammer et al., 2001) and Primer 6 (Clark and Warwick, 2001) software.

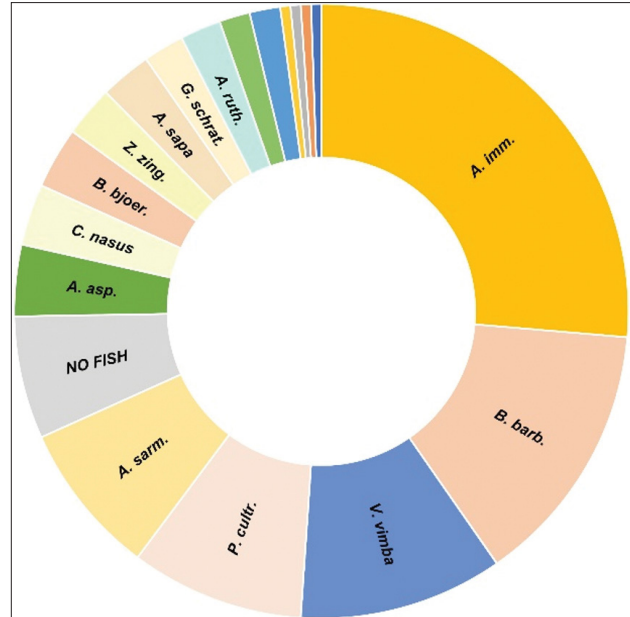
## RESULTS

During the early summer of 2024, 54 transects with DNF in two sampling sites of the Lower Danube (Bulgaria) were performed (Figure 1).



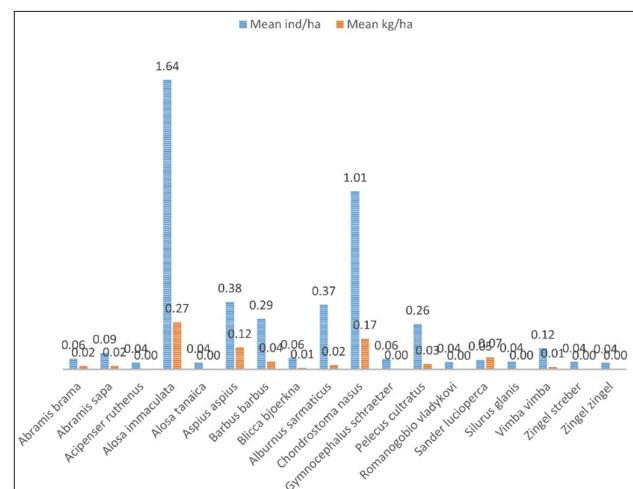
**Fig 1.** Fish monitoring sites in the Lower Danube using drifting trammel nets in 2024 at two Bulgarian NATURA 2000 sites

18 fish species were captured, and 9 were under protection in the NATURA 2000 network. An additional sturgeon species was also registered (*Acipenser ruthenus*). 5 species (Figure 2) showed higher frequencies of occurrence, registered in more than 50% of the samples. Certain transects also failed to register any fish – 12 out of 54 (22%).



**Fig 2.** Fish frequency of occurrence, as established in the Lower Danube in 2024 by drifting net monitoring

In view of their population density, *Alosa immaculata* and *Chondrostoma nasus* (Figure 3), followed by *Aspius aspius*, *Barbus barbus*, *Alburnus sarmaticus*, and *Pelecus cultratus*, were most abundant. In view of their relative importance and according to their IRI in the catches, the most abundant *Alosa immaculata* was determined as dominant, while *Barbus barbus* was categorized as common. All other species were of minor importance (Table 1).



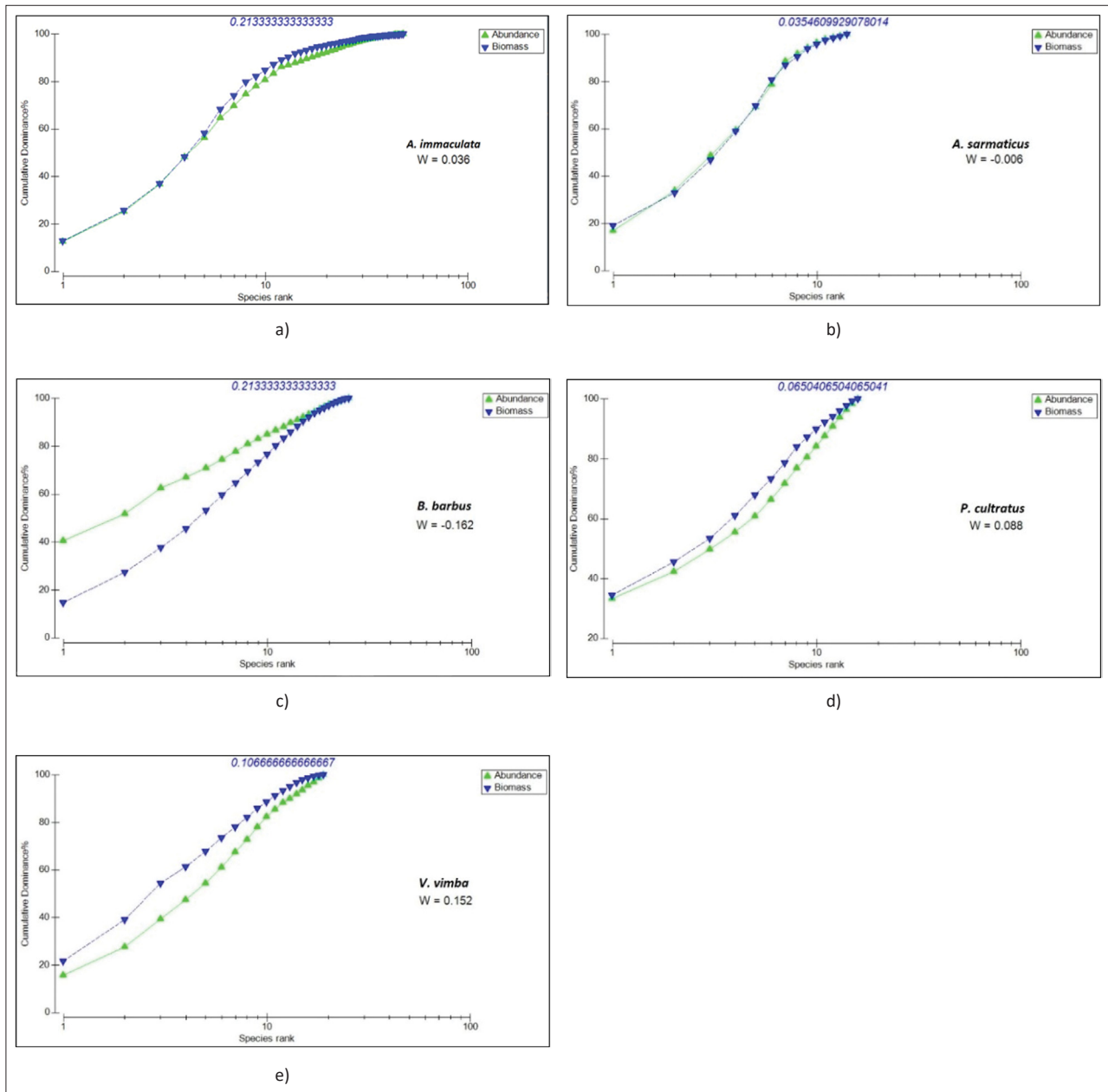
**Fig 3.** Fish CPU expressed in ind/ha and kg/ha, as established in the Lower Danube in 2024 by drifting net monitoring

**Table 1.** Conservation status of fish species registered in the Bulgarian stretch of the Danube River during 2024 by drifting trammel net monitoring

Species *_ migratory species	Density 2024 ind/ha	IRI	Sampling occurrences N = 54	IUCN 2025	NATURA 2000	Bern Conv.	Article 17 Habitats Dir.	BG Red Data Book 2015
<i>A. brama</i>	0.061	4.18	3	LC	-	-	-	-
<i>A. sapa</i>	0.093	13.42	5	LC	-	App. III	-	-
<i>A. ruthenus*</i>	0.039	1.91	4	<b>EN</b>	-	App. III	Yes	<b>EN</b>
<i>A. immaculata*</i>	1.638	4827	49	LC	Yes	App. III	Yes	VU
<i>A. tanaica*</i>	0.039	0.19	1	LC	Yes	-	Yes	VU
<i>A. aspius*</i>	0.382	25.97	7	LC	Yes	App. III	Yes	VU
<i>B. barbus*</i>	0.286	877	26	LC	-	-	Yes	VU
<i>B. bjoerkna</i>	0.063	6.64	6	LC	-	-	-	-
<i>A. sarmaticus*</i>	0.366	56.06	15	<b>EN</b>	Yes	App. III	Yes	<b>EN</b>
<i>C. nasus*</i>	1.008	111.67	6	<b>NT</b>	-	App. III	-	-
<i>G. schraetzer</i>	0.058	2.47	4	LC	Yes	App. III	Yes	VU
<i>P. cultratus*</i>	0.256	147.63	17	LC	Yes	App. III	Yes	VU
<i>R. vladkovi</i>	0.042	0.62	1	LC	Yes	App. III	Yes	VU
<i>S. lucioperca</i>	0.053	1.90	1	LC	-	-	-	-
<i>S. glanis</i>	0.044	0.19	1	LC	-	App. III	-	-
<i>V. vimba*</i>	0.119	11.87	20	LC	-	App. III	-	-
<i>Z. streber</i>	0.042	3.52	3	LC	Yes	App. III	Yes	<b>EN</b>
<i>Z. zingel</i>	0.038	2.00	5	LC	Yes	App. III	Yes	<b>EN</b>

Most of the species registered during 2024 (83%) - except for *S. lucioperca*, *A. brama*, *B. bjoerkna* - are mentioned in at least one document, in view of national and international legislation (Bulgarian information system for protected areas from the ecological network NATURA, 2000; IUCN, 2026; Bern Convention; etc.) (Table 1).

The ABC curves, in parallel to *W* statistics, showed a relatively stable fish community in the Lower Danube. Individual curves for 4 most frequently registered species also showed good population structure (Figure 4 A-F). Only *B. barbus* showed an imbalance ( $W = -0.162$ ; Figure 4C).



**Fig 4.** a-e. ABC curves and  $W$  statistics of the most frequently registered fish species, and in total, as established in the Lower Danube in 2024 by drifting net monitoring

## DISCUSSION

As an outcome, the study achieved an additional goal. Both sampling sites are part of the NATURA 2000 network: Persina BG0000396 and Pozharevo-Garvan BG0000530 (Figure 1). According to the Standard Data Form (SDF) for BG0000530, Pontian shemaya (*Alburnus sarmaticus*) is not listed for this site (MOEW, 2026: NATURA 2000), but it was confirmed during the study. Therefore, this species should also be included in this NATURA site. Moreover, this particular monitoring site in BG0000530 seems to be especially suitable for the assessment of this species. The use of *DNF* is an effective method for sampling pelagic, as well as some benthopelagic fish species, in flowing

waters. The method was successfully introduced for the Danube area (Raykov and Triantafyllidis, 2015), as well as for scientific purposes (Hont et al., 2021). The use of *DNF* is still common practice, contributing significantly to fish production in Bulgaria (EAFA, 2025b). Moreover, pontic shad (*Alosa immaculata*) is caught in both the Black Sea and the Danube River. According to national legislation, mesh sizes of 16-70 mm may be legally used depending on the targeted commercial species (Ordinance 37, 2008). Thus, sensitive species may also appear as bycatch (e.g. sturgeons). Except for direct elimination, other indirect impacts may contribute to cumulative pressure. Gill

nets can damage sensitive habitats (Dias et al., 2020) or become permanent death traps through ghost fishing when lost (Matsuoka et al., 2005). Moreover, key habitats and biotopes could potentially be exploited exhaustively since cross-checking with conservation approaches is still lacking. There are alarming notifications that even two decades ago inland (freshwater) fisheries were overexploited globally (Allan et al., 2005). In certain cases, fisheries may contribute to unsustainable assessment of resources, biodiversity loss, or altered ecosystems (Hilborn et al., 2003). Here, using fishing gear and methodology similar to those used commercially, the majority of the registered species were found to be under some kind of protection, or at least under assessment, as mentioned in at least one regulatory document – national or international (Table 1). In parallel, 9 species or 50% are categorized as potamodromous or anadromous, ordinarily vulnerable, due to their expanded ranges. The fishing effort achieved during this study (15 sampling days, 54 transects, 759 ha covered) is insignificant compared with that of the commercial fisheries. The Bulgarian stretch of the Danube River is 469 km. These river kilometers are exploited internationally by two countries (Bulgaria and Romania, according to Balaci et al., 2025). The weaknesses mentioned are relevant to both countries; special attention should be paid by the authorities. According to available Bulgarian public sources, only landings are declared, neglecting bycatch and discards if they are not commercial. The declaration of sturgeon bycatch became obligatory in 2025, but other species are not covered by this obligation. It is recognized that overexploitation remains the most common pressure threatening fish (UNEP-WCMC, 2024), in parallel to habitat fragmentation and destruction, pollution, etc. Exploitation without management is a practice that must be changed because of the particular conditions and species richness of the Danube, which is home to about 100 fish species (Liska et al., 2022). With a full understanding of the actual situation concerning commercial catches, better management and conservation will follow. It is essential to introduce the best practices for sustainable commercial fishing, decreasing or at least registering all bycatch. Alternatively, innovative methods, such as metabarcoding, could also help obtain valuable information (de Bruyn et al., 2021). In parallel, quotas (concerning populations, fishing gear, commercial vessels, and fishing permits) and control could contribute to better management strategies. This particular study represents only the tip of the iceberg; many issues remain to be clarified or explained, including some apparently controversial data established here. For example, *B. barbatus* showed a higher frequency of occurrence but a lower population density than *C. nasus* (Figures 2, 3). In practice, this “paradox” is derived from the concentration of solid aggregations of *C. nasus* closer to the river bank, outside the main net’s passageway. As established, the ABC curve of *B. barbatus* showed population imbalance, derived mainly from the registration of juvenile specimens.

Within the frame of the study, for certain reasons, the ABC curves should be considered as only indicative. By definition, increasing disturbance tolerates fast-growing species, in addition to slow-growing ones (Yemane et al., 2005). In this study, pelagic and mesopelagic medium-sized species were mainly sampled. Near-shore and small-bodied species are not targeted by DNF fishing; thus, the entire variety of habitats and, consequently, the entire fish community, was not covered.

Within the same scope, the growth, population structure, and mortality rate of many Danubian fish species, including protected ones, are crucial parameters for better management, yet they are still unknown. A multisampling approach is needed for a better understanding of the actual situation (Apostolou et al., 2021). Moreover, for monitoring the Danube River in Bulgaria, only 3 sampling sites are officially recognized (Liska et al., 2022). These monitoring sites are insufficient to cover the aforementioned 469 km of this large river, which contains a variety of distinct habitats and rare species. Thus, a multiannual, sophisticated, and combined approach is needed to improve stocks and population assessment, including sensitive/migratory/vulnerable species.

## PLUTAJUĆE MREŽE KAO ALAT ZA POSTIZANJE CILJEVA UPRAVLJANJA RIBAMA I OČUVANJA U DONJEM TOKU DUNAVA

### SAŽETAK

Rov riba plutajućim mrežama tradicionalna je metoda komercijalnog ulova ribe u rijeci Dunav, posebno u bugarskom dijelu. Potencijalno bi se nekomercijalne ili ugrožene vrste riba mogle uhvatiti kao prilov, ali takva službena statistika ne postoji. Nedavno se broj populacija slatkodvodnih riba smanjio, uključujući i komercijalne. U vezi s tim činjenicama, ova studija ima za cilj ispitati nedavne kvantitativne ulove ribe plovećim mrežama u donjem dijelu Dunava s gledišta očuvanja. Tijekom ranog ljeta 2024. godine provedeno je 54 transekta plovećim mrežama na dva mjesta uzorkovanja u donjem dijelu Dunava (Bugarska). Korišteni ribolovni alat i metodologija bili su slični komercijalnim. Ulovljeno je 18 vrsta riba; uključena je i jedna vrsta jesetre. 9 ih je pod zaštitom u mreži NATURA; 15 se spominje u barem jednom regulatornom dokumentu. Na temelju toga i radi bolje procjene i očuvanja, prilov i odbačeni ulov moraju se službeno registrirati, a kvote se moraju uzeti u obzir. Kao dodatni rezultat, potvrđena je prisutnost velike pliske na novom području NATURA 2000 - BG0000530. Stoga bi je trebalo uvrstiti u ovo područje, budući da je najprikladnije za njezino praćenje.

**Uključne riječi:** monitoring, procjena, riba, zaštićena vrsta

## CONFLICT OF INTEREST

The author declares no conflict of interest.

## DATA AVAILABILITY STATEMENT

The datasets generated and/or analysed during the current study are not publicly available but are available from the corresponding author upon reasonable request.

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