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ARAŞTIRMA MAKALESİ **RESEARCH PAPER**

Perspectives of Stakeholders on the Drivers and Impacts of the Decline of Piked Dogfish (*Squalus acanthias* L, 1758) in the Black Sea

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Abstract: This study investigated the dramatic decline of piked dogfish (*Squalus acanthias*) populations in the Black Sea by incorporating both ecological data and stakeholder viewpoints in 2024. Historically abundant and commercially targeted, especially in Türkiye's Sinop region, piked dogfish populations have sharply declined due to overfishing, habitat degradation, and regulatory gaps across riparian countries. Despite a national fishing ban in Türkiye since 2015, inconsistent conservation measures among Black Sea countries have hindered effective recovery. Focus group discussions with fishers, non-governmental organizations, scientists, and fisheries officials revealed broad support for continuing the fishing ban. The key concerns included ecological imbalances caused by the species' decline, disrupted migratory routes, and adverse effects of advanced fishing technologies. Stakeholders emphasized the importance of documenting bycatch, establishing protected marine areas, and regionally harmonizing regulations.

Keywords: Black Sea, fisheries management, *Squalus acanthias*, stakeholder engagement.

Karadeniz'deki Mahmuzlu Camgöz Köpek Balığı (*Squalus acanthias* L, 1758) Popülasyonundaki Düşüşün Nedenleri ve Etkilerine İlişkin Paydaş Görüşleri

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Öz: Bu çalışma, 2024 yılında Karadeniz'deki mahmuzlu köpekbalığı (*Squalus acanthias*) popülasyonlarında yaşanan dramatik düşüşü, hem ekolojik veriler hem de paydaş görüşlerini dikkate alarak incelemiştir. Tarihsel olarak özellikle Türkiye'nin Sinop bölgesinde bolca bulunan ve ticari olarak hedeflenen bu tür, aşırı avlanma, yaşam alanı tahribatı ve kıyıdaş ülkeler arasındaki yasal düzenleme boşlukları nedeniyle keskin bir azalma göstermiştir. Türkiye'de 2015 yılından bu yana uygulanan ulusal av yasağına rağmen, Karadeniz ülkeleri arasındaki koruma önlemlerinin tutarsızlığı, etkin bir toparlanmayı engellemektedir. Balıkçılar, sivil toplum kuruluşları, bilim insanları ve balıkçılık otoriteleriyle yapılan odak grup görüşmeleri, av yasağının sürdürülmesine yönelik geniş bir destek olduğunu ortaya koymuştur. Katılımcılar, türün azalmasının neden olduğu ekolojik dengesizlikler, göç yollarındaki bozulmalar ve gelişmiş av teknolojilerinin olumsuz etkileri gibi temel sorunlara dikkat çekmiştir. Paydaşlar, tesadüfi av kayıtlarının tutulmasının, deniz koruma alanlarının oluşturulmasının ve bölgesel düzenlemelerin uyumlaştırılmasının önemini vurgulamıştır.

Anahtar Kelimeler: Balıkçılık yönetimi, Karadeniz, paydaş katılımı, *Squalus acanthia.*

INTRODUCTION

Significant changes in the Black Sea ecosystem have been documented, largely due to fisheries (Zaitsev, 1992) and various other environmental pressures. These changes have led to a notable decline in the distribution and abundance of marine species (Kıdeyş, 1994; Bat, 2007; Akoğlu, 2023). The presence of non-native and undesirable species within the habitat has increased (Shalovenkov, 2019; Kamburska et al., 2006; Varshanidze et al., 2022; Dağtekin,

2023). A review of fishery statistics over the past 70 years clearly shows a downward trend in catch volumes in the Black Sea, highlighting the severity of the issue. Furthermore, FAO and GFCM assessments emphasize the urgent need for precautionary measures and improved stock management practices.

The most affected species is the spiny dogfish (*Squalus acanthias*), which has experienced dramatic population declines in the Black Sea. Although the global population structure of the spiny dogfish is not yet fully understood, individuals migrate extensively between coastal waters and ocean basins (Veríssimo et al., 2010). This species functions as one of the top predators in the Black Sea ecosystem. Its main prey includes bony fishes, crustaceans, nematodes, and actinarians (Avşar, 2001). The species is known for its slow growth and long lifespan (Galațchi et al., 2024).

Spiny dogfish is one of the most abundant shark species globally. Along the Turkish coast of the Black Sea, it is one of the most frequently caught shark species (Özdemir et al., 2023). Prior to the 1990s, it was caught in large numbers in the region (Düzgüneş et al., 2006). Historically, it has been targeted by fisheries in Türkiye, Bulgaria, Romania, and Ukraine. However, in recent years, its number has significantly declined (GFCM, 2024; Figure 1). Although Türkiye officially banned dogfish fishing in 2015, intensive fishing had previously occurred (Figure 2), especially in the Sinop region. The species was not highly valued by local consumers but was extensively fished for export markets.

Fishery regulations and enforcement practices widely differ among Black Sea countries. In Bulgaria and Romania, shark-targeted fishing vessels must hold valid licenses and permits. In contrast, Georgia and Türkiye have banned fishing for these species; thus, such licensing is not in place. All fishing vessels over 12 meters in Bulgaria, Romania, and Türkiye are equipped with VMS (Vessel Monitoring System), which ensures the monitoring of fishing activities. Fishers are required to record all shark catches. Georgia, however, has no such mandatory reporting system.

A key aspect of species conservation is the Minimum Conservation Reference Size (MCRS). In Bulgaria and Romania, it is prohibited to retain or sell dogfish under 90 cm. Georgia has set a slightly lower minimum size of 85 cm, although past regulations have aligned with the 90-cm threshold. The Ukraine currently has no MCRS regulation for these species. Bulgaria and Romania have introduced spatial restrictions, including a ban on trawling within 3 nautical miles of the coast. Romania also enforces closed seasons from March 15 to April 15 and from October 15 to November 30. Türkiye, Georgia, and Ukraine do not have similar seasonal closures. However, Türkiye has implemented area-based and 3-mile bans specifically for bottom trawl fishing.

Despite these efforts, the current measures have shown limited effectiveness. Although quotas and regulations are in place, their actual impact on the recovery of species remains insufficient. Variability in the age of sexual maturity across regions (Chatzispyrou & Megalofonou, 2005), as well as habitat alterations, may contribute to the species' vulnerability. Stakeholder meetings have been held in regions where the species was historically fished to evaluate the current situation and guide future actions.

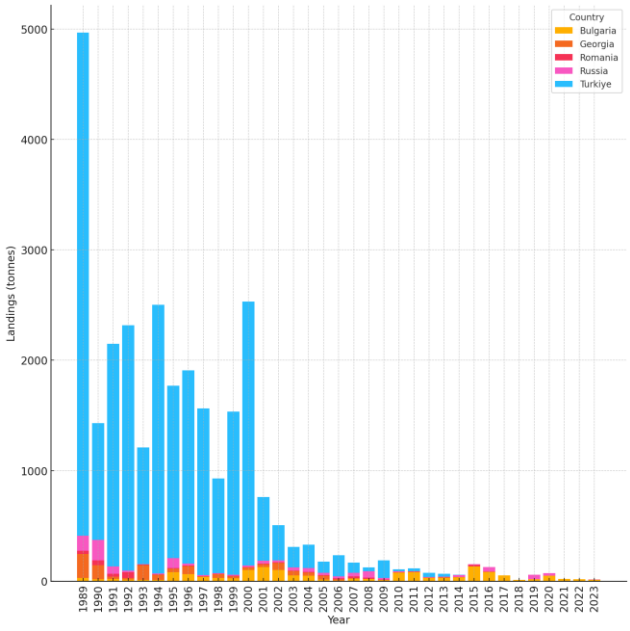

Figure 1. Temporal trends in *Squalus acanthias* landings (tonnes) reported by country.

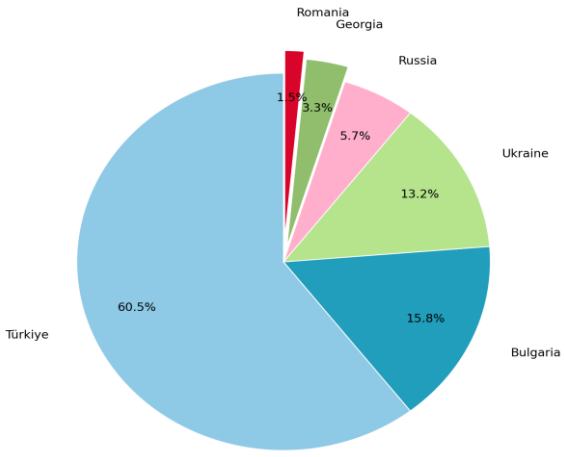

Figure 2. Temporal proportions of *Squalus acanthias* landings (GFCM 2025).

These efforts aim to assess the status of *Squalus acanthias* and determine its future management strategies. Surveys at sea, together with biological and catch data, are intended to provide a foundational resource for developing comprehensive management plans.

MATERIAL AND METHOD

This study employed a focus group methodology to engage key stakeholders in evaluating the current status and management of Squalus acanthias in the Black Sea. Participatory approaches such as focus group discussions are widely recognized as effective for understanding the perceptions, experiences, and concerns of those directly involved in fisheries (Schwermer et al., 2020; Bisack & Clay, 2020). Such methods enhance the accuracy of problem identification, improve inclusivity in decision-making, and foster mutual trust between stakeholders and institutions. By incorporating the knowledge of local fishers, cooperative leaders, regulatory authorities, and researchers, this approach aimed to generate a comprehensive understanding of the ecological and socio-economic dynamics of the species while also identifying practical challenges and opportunities often overlooked in top-down assessments.

The Sinop region—located on the northernmost coast of Türkiye—has historically been an important center for commercial spiny dogfish (S. acanthias) fishing. In light of the ongoing ban on dogfish fishing, a multi-stakeholder focus group was convened in Sinop on 20 August 2024. Participants were drawn from diverse groups, including representatives of the Ministry of Agriculture and Forestry, academic institutions, small- and large-scale fisheries, non-governmental organizations, and leaders of local fishing cooperatives (Table 1). When selecting participants, priority was given to individuals with direct experience and expertise in dogfish fishing, to ensure that discussions remained thematically focused.

The focus group was carried out in two separate sessions, with a combined duration of approximately five hours. At the outset, moderators developed guiding questions addressing the current status of S. acanthias populations and existing management measures. Participants were also invited to suggest additional issues. To ensure inclusivity, each participant completed a brief written questionnaire, enabling them to raise topics that might not surface during the oral discussion.

Each major theme was subsequently discussed in detail, and participants were encouraged to express their views verbally. To structure the evaluation, they were further asked to rate each issue using a three-point scale (“agree,” “disagree,” “undecided”). All discussions were recorded, and detailed notes were taken by two facilitators. The recordings and notes were later examined through a thematic content analysis, which allowed both qualitative insights and quantitative patterns (e.g., frequency of agreement or disagreement) to be identified.

Ethical considerations were strictly observed. Informed consent was obtained from all participants prior to the sessions, and both anonymity and confidentiality were guaranteed. The primary aim of the focus group was to assess the present status of the species and collect stakeholder perspectives on the continued prohibition of piked dogfish fishing. A majority of participants expressed strong support for the ban. The main discussion topics included: i.) The necessity of continuing the fishing ban on *S. acanthias.* ii). Major ecological shifts linked to species population decline. iii). Historical Overfishing and Its long-term impact. iv). Ecological consequences of reduced fishing pressure across Black Sea countries. v). Disruptions in the migratory routes. vi. Adverse effects of fishing gear technological advancements. vii). Ecological importance of releasing bycatch back into the sea. viii). Mandatory documentation of all incidental catches by fishing vessels. ix). Establishment of protected marine areas for conservation

Finally, the findings of the focus group were reviewed and validated through a participant satisfaction assessment (Lewin et al., 2025). This working group consisted of four researchers specializing in marine and fisheries sciences, three representatives of small-scale fisheries advocating sustainable fishing practices, three staff members from the Provincial Directorate of Agriculture and Forestry, one representative of fishing cooperatives, one NGO representative, one large-scale fisher, one moderator, and one fisheries department inspector.

Table 1. Description of stakeholder groups participating in the study

Group Name	Number of Participants	Description
Researchers	4	Experts conducting scientific research on fisheries and marine ecosystems
SSF (Sustainable Small-scale Fisheries) Representatives	3	Advocates for sustainable practices in small-scale fishing
Provincial Directorate of Agriculture and Forestry Staff	3	Fisheries management personnel from the Sinop Provincial Directorate
Fishing Cooperatives	1	President of the Sinop–Kastamonu Regional Fishing Cooperative
NGO Representative	1	Environmental advocate focused on marine protection
Large-scale Fishers	1	Commercial bottom trawl fishing at an industrial scale
Moderator	1	Neutral facilitator guiding the stakeholder dialog
Fisheries Department Inspector	1	Regulatory official overseeing compliance with fisheries

RESULTS AND DISCUSSION

***Ecological Consequences of Piked Dogfish Population Decline*:** There is a divergence of opinion among scientists regarding the ecological consequences of the decline in piked dogfish populations. While some researchers express uncertainty about the extent of these impacts, the prevailing consensus suggests that such a decline may further intensify existing negative ecological trends. Increasingly, climate change and ecosystem degradation are recognized as major drivers of species dynamics, including those of *Squalus acanthias*. In addition,

riverine pollution has been identified as a critical stressor affecting both the species and its habitat (Humborg et al., 1997).

Ultimately, addressing these interconnected issues is essential for restoring ecological balance and ensuring the long-term sustainability of piked dogfish populations in the Black Sea. Silkina et al. (2014) found that *S. acanthias* individuals inhabiting polluted areas exhibited weakened immune responses, elevated levels of lipid peroxidation products, and reduced antioxidant activity. These results demonstrate that environmental pollution has a direct and damaging effect on species' physiological health. From the stakeholder perspective, all non-scientist participants identified ecological change as the primary concern. Researchers, however, approached the issue more cautiously, and no clear neutral position was observed among them (Figure 3).

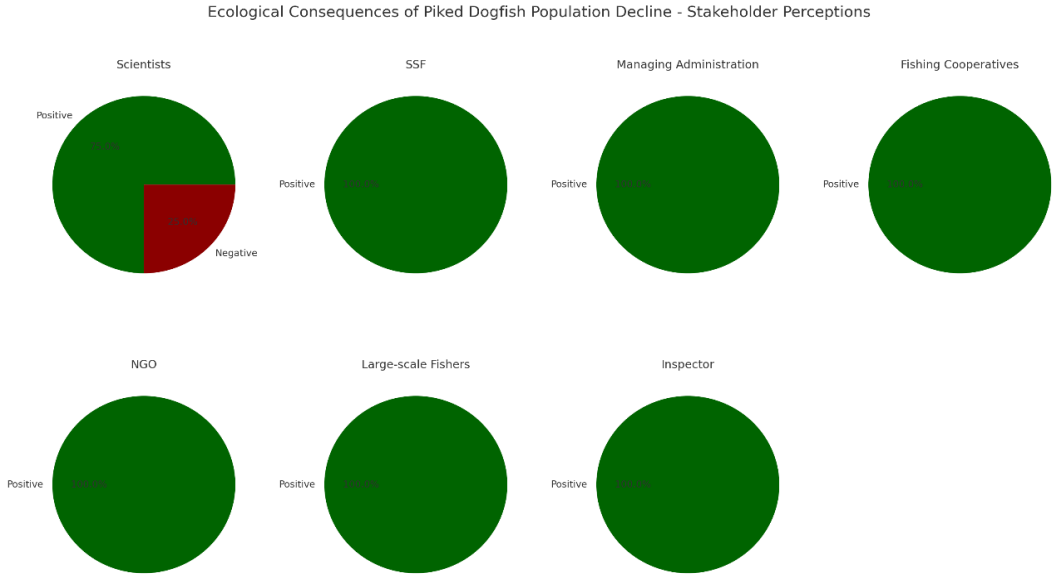

Figure 1. Stakeholder perceptions of the ecological consequences of piked dogfish population decline in the Black Sea.

The Historical Impact of Overfishing: Stakeholders generally agree that the reduction of *S. acanthias* fishing pressure in Black Sea countries has notable ecological implications (Figure 4). Nonetheless, all small-scale fisheries expressed that they do not perceive fishing as having a significant impact. In contrast, representatives from large-scale fisheries acknowledged that they had historically participated in *S. acanthias* fishing and recognized that this past activity contributed to the problem. Fishery managers, on the other hand, remained uncertain about whether overfishing is directly responsible for the species' decline. The inconsistent implementation of fishing bans across the region was a primary concern among participants. Many emphasized the need for a unified, collaborative approach among Black Sea countries to enhance the efficiency of conservation measures. In this context, stakeholders proposed establishing a joint regional ban to ensure consistency and shared responsibility. The collective commitment of these nations is viewed as essential for the sustainable management of *S. acanthias* populations and for maintaining the ecological balance of the Black Sea.

Scientific findings from other regions support these concerns and emphasize the species' biological vulnerability. For instance, Bubley et al. (2013) reported that in the Gulf of Maine, sexual maturity in *S. acanthias* occurred at 63.1 cm and 7.5 years for males and at 76.9 cm and 9.1 years for females. Notably, the maturity parameters for females had declined by 7 cm and 3 years compared to values recorded two decades earlier—a shift that coincided with a period of intensified fishing pressure. Similarly, Yiğin and İşmen (2013) highlighted that although *S. acanthias* is a commercially valuable species, its biological traits—particularly slow growth and delayed sexual maturity—make it highly vulnerable to overfishing. These characteristics limit the species' ability to recover rapidly from population declines and result in weak compensatory responses to exploitation.

Additional evidence from the Black Sea supports this pattern. Avşar (2001), Demirhan and Seyhan (2006, 2007) emphasized that low fecundity combined with intense fishing pressure could significantly threaten *S. acanthias* populations in the region. Moreover, studies from other regions (e.g., Stevens et al., 2000; Belleggia, 2012) have confirmed that the biological sensitivity of this species has led to severe population declines and even stock collapses in several areas, underscoring the global need for precautionary management of this vulnerable *S. acanthias*.

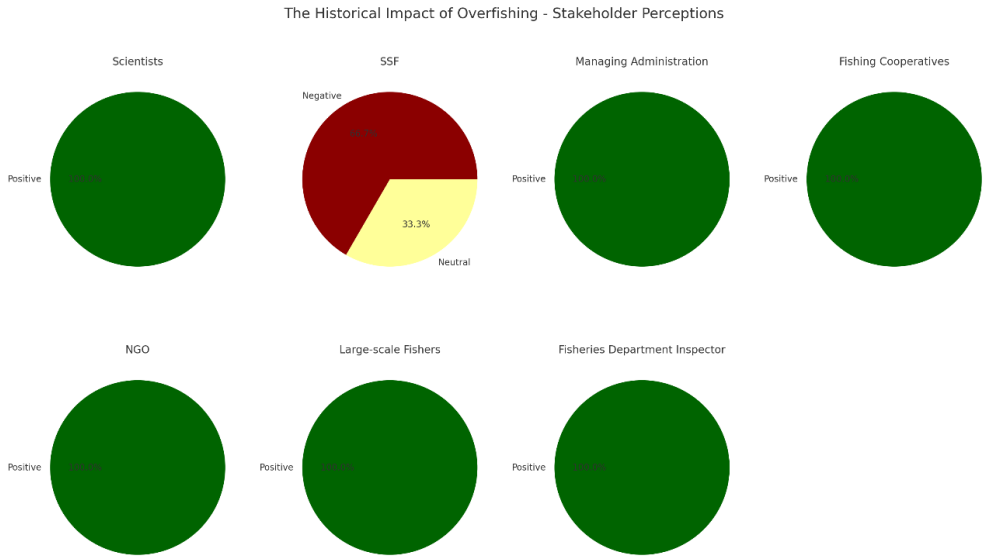

Figure 4. Stakeholder perceptions of the historical impact of overfishing on *S. acanthias* in the Black Sea.

Effects of the Reduction in Fishing of Piked Dogfish Across Black Sea Countries: The reduction of *S. acanthias* fishing is generally supported by stakeholders. However, small-scale and large-scale fishers hold a negative perspective on reducing fishing pressure and express uncertainty regarding its overall impact. An underlying reason is that these fishers often perceive the problem as not primarily driven by overfishing. In contrast, all other stakeholder groups have largely endorsed this measure (Figure 5). A common view is that implementing a harmonized fishing ban across all Black Sea countries would enhance the effectiveness of conservation efforts and facilitate the recovery of the species. Nevertheless, at present, no specific conservation measure has been implemented for this species in the Black Sea. Comparable shortcomings in cooperation are observed globally across various species. As reported by Østhagen et al. (2020), climate change has altered the distribution of mackerel stocks in the Northeast Atlantic, thereby weakening cooperation among coastal states. The predominance of national interests, disputes over scientific assessments, and unclear allocation principles have all contributed to the collapse of the management regime. Establishing a shared scientific foundation among stakeholders is therefore critical to achieving long-term solutions.

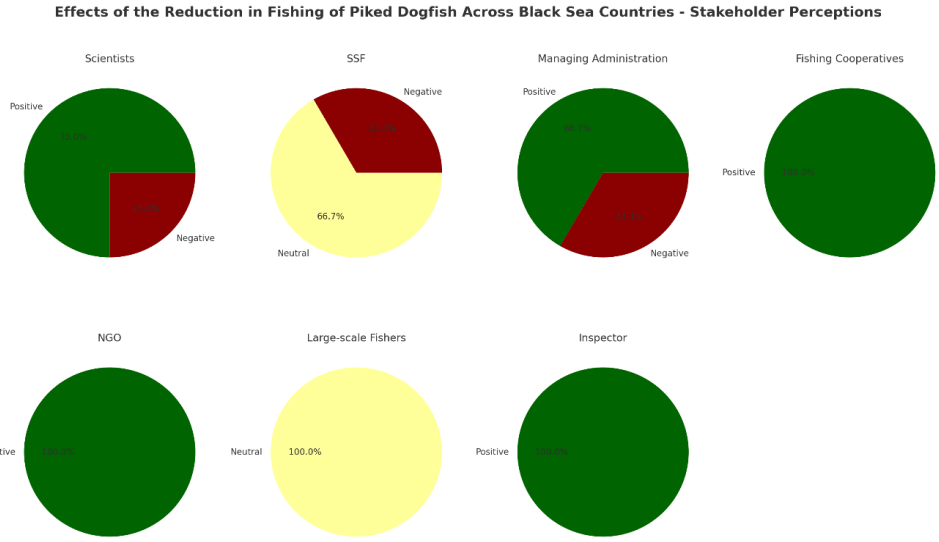

Figure 5. Effects of the reduction in fishing of piked dogfish across Black Sea Countries - Stakeholder perceptions.

Effects of changes in migration pathways: Scientists have adopted a cautious stance regarding the historical accuracy of changes in *S. acanthias* migratory routes, emphasizing the need for further empirical evidence. Conversely, fishers suggested that climate change may significantly influence migratory patterns. They also reported a noticeable increase in the presence of the species in recent years, particularly in areas where fish

cages are concentrated along the eastern Black Sea (Figure 6). This observation may indicate a shift in distribution, possibly linked to environmental changes or localized ecological conditions. Historical studies have provided valuable insights into the migration dynamics of the piked dogfish (*S. acanthias*) in the Black Sea. This species has been reported to inhabit the entire continental shelf within a temperature range of 6°C–15°C and to undertake distinct seasonal migrations (Kirnosova 1990). In autumn, large feeding aggregations were observed along the wintering grounds of anchovy and horse mackerel near the Crimean, Caucasian, and Anatolian coasts. Reproductive migrations were reported to occur twice annually—in spring and autumn—during which females approached shallow coastal waters (10–30 m) for parturition, while males remained offshore at depths of 30–50 m (Maklakova & Taranenko, 1974; Serobaba et al., 1988).

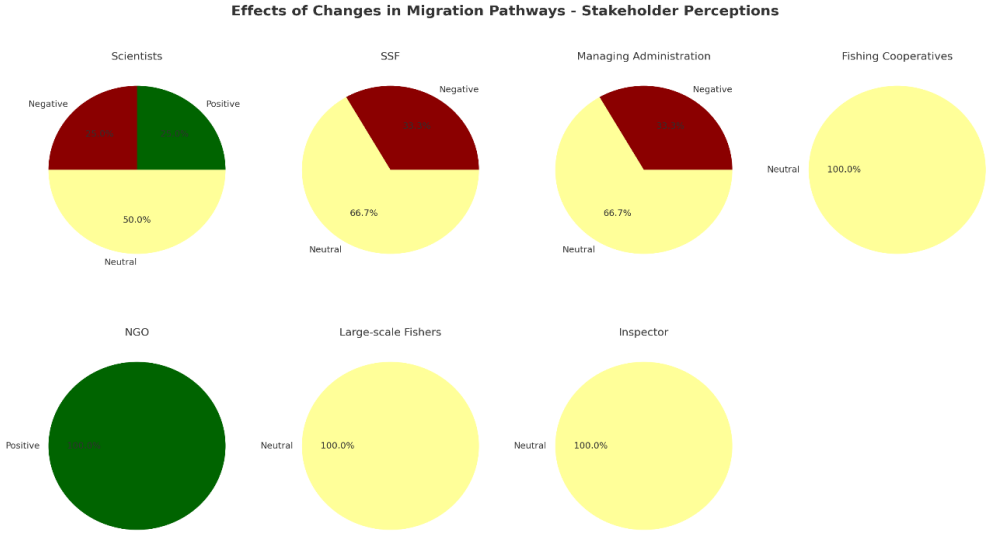

Figure 6. Effects of changes in migration pathways of *S. acanthias* in the Black Sea — Stakeholder perceptions.

During winter, the densest concentrations of *S. acanthias* were documented in Georgian and Turkish waters, closely associated with anchovy stocks, as well as off the coasts of Ukraine and Romania, where the species aggregated at depths of 70–120 m around whiting and sprat concentrations (Kirnosova (1990); Figure 7). However, in recent decades, coastal habitats in the Black Sea have undergone significant degradation. Moreover, the main prey species of *S. acanthias*—anchovy, sprat, and whiting—are no longer considered to be in favorable condition compared to 50 years ago, with their stock status generally recognized as depleted or under stress (STECF, 2017). Considering these ecological shifts and trophic alterations, it is plausible to hypothesize that historical migration patterns of the piked dogfish may have undergone notable changes, warranting further investigation. Recent unpublished studies also appear to support this view. In a 2024 study, Dağtekin et al. (2025) reported an apparent increase in the occurrence of *S. acanthias* near fish cages along the eastern Black Sea coast, suggesting a potential disruption or reduction in traditional migration behavior (Figüre 8). These cage areas are characterized by increased shelter availability and higher food concentrations, which may offer favorable conditions for residency. In another recent (yet unpublished) study conducted by the same author, a localized population increase of *S. acanthias* in the same region was also observed, further reinforcing the hypothesis that changes in habitat structure and food availability may alter the movement patterns of the species.

Concerns Regarding the Negative Effects of Technological Advancements in Fishing: Some fishers do not support the notion that technological advancements in fishing gear have adverse effects on marine ecosystems, leading to a generally neutral stance within this group. In contrast, representatives of fishing cooperatives and other stakeholders have expressed concerns that these innovations may pose significant risks to marine life, including piked dogfish (*Squalus acanthias*). This divergence reflects a clear split in stakeholder perspectives: while some view modern technologies as beneficial tools for enhancing catch efficiency, others emphasize the potential ecological threats they may introduce (Figure 9). Acknowledging and addressing these differing viewpoints is essential for fostering constructive dialog on the sustainable use of fishing technology and its broader implications for marine ecosystem health. Aquatic environments are increasingly exposed to increasing diversity and noise pollution intensity. However, the precise effects of such noise on marine organisms remain unclear. A comprehensive meta-analysis was conducted to address this knowledge gap, synthesizing 2,354 data points

from 42 independent studies. The findings demonstrated that anthropogenic noise exerts significant negative effects on the behavioral and physiological responses of fish. Although uncertainties persist regarding the full extent of these impacts, Cox et al. (2018) emphasized the presence of such effects in their global synthesis.

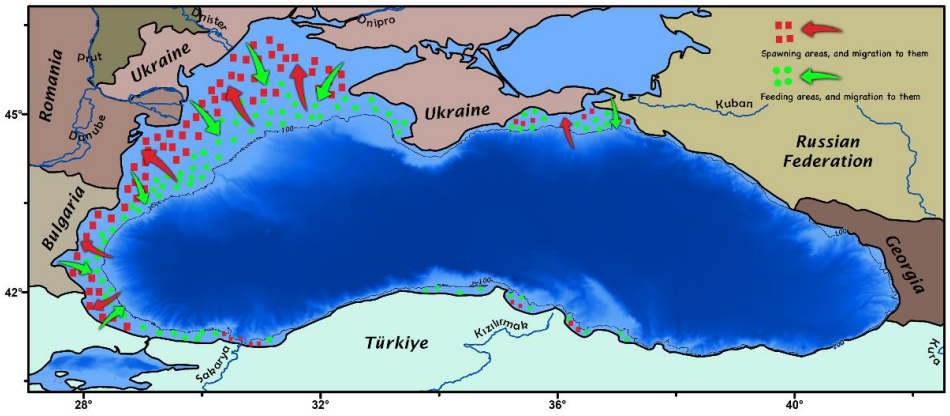

Figure 7. Seasonal migration patterns of the *S. acanthias* in the Black Sea, based on historical data. The arrows indicate feeding and reproductive migration routes across the continental shelf, modified from Ivanov (1985).

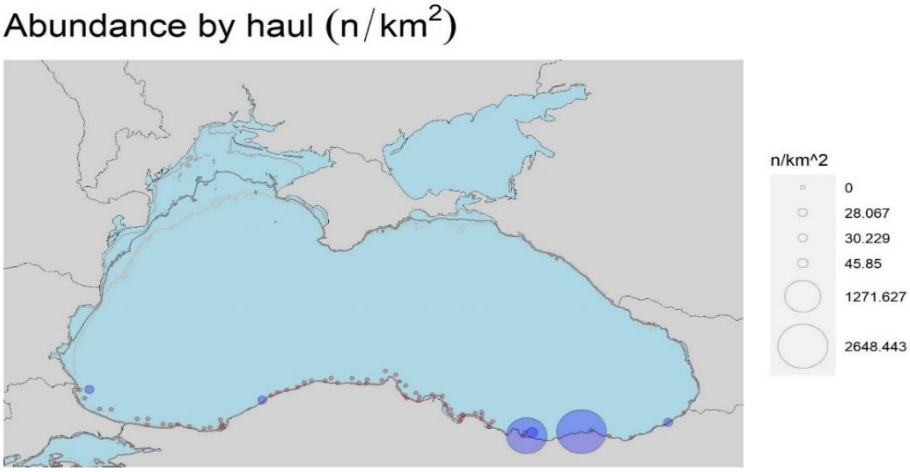

Figure 8. Spatial distribution of *Squalus acanthias* abundance (ind./km²) during the autumn 2024 demersal trawl survey by Dağtekin et al. (2025).

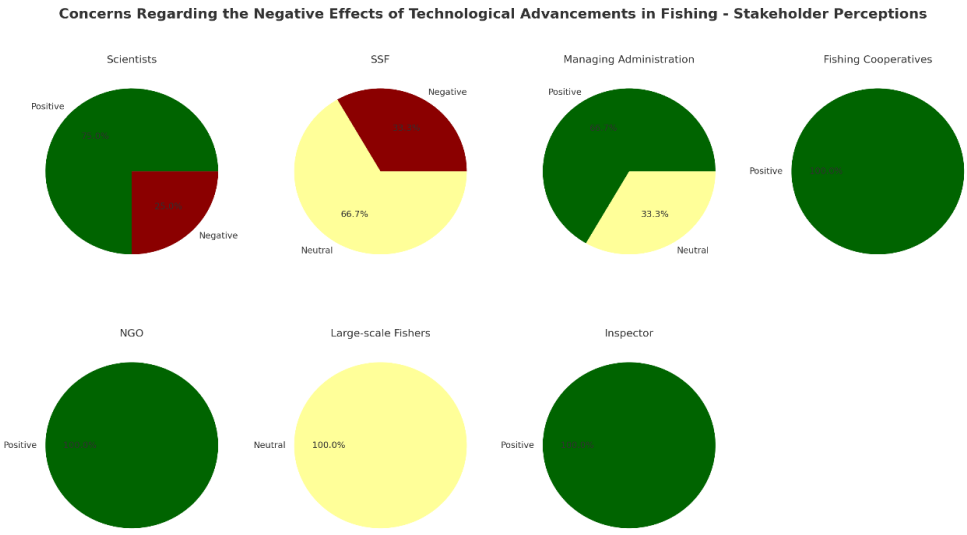

Figure 9. Stakeholder perceptions of the negative effects of technological advancements in fishing on *S. acanthias.*

Necessity of Incidental Catches Recording: Although some fishers oppose mandatory reporting, there is broad agreement among stakeholders on the importance of incidental catch documentation. Such documentation is essential for generating accurate data and enhancing the effectiveness of fisheries management strategies. Concerns

have emerged regarding the unrecorded quantities of non-targeted individuals caught unintentionally in fishing gear following the implementation of fishing bans. Stakeholders emphasized that quantifying these bycatch events is critical for understanding the true impact of fishing activities on protected species and for developing informed conservation policies (Figure 10). The systematic recording of incidental catches provides concrete evidence for evaluating the impact of fishing activities on non-target species. A study conducted in the Bahía Sebastián Vizcaíno (BSV) region of Mexico reported that despite legal prohibitions on white shark fishing, incidental catches (bycatch) persist due to artisanal fishing practices involving spearguns and bottom-set gillnets. The authors emphasize that future regulatory efforts should focus on the live release of incidentally caught juveniles. Additionally, the active involvement of local fishers in management initiatives is highlighted as essential for improving awareness and increasing the effectiveness of conservation measures. Finally, the study identified the strengthening of data collection systems and formal monitoring of fisheries as critical actions for developing effective and evidence-based species protection strategies (García-Rodríguez & Sosa-Nishizaki, 2020). According to Murray et al. (1993), observations on Japanese longline vessels operating off New Zealand over 785 days between 1988 and 1992 documented the incidental capture and drowning of numerous individuals from 12 seabird taxa, most of which were breeding adults and six of which are endemic to New Zealand. Albatrosses were primarily caught during daylight hours, whereas petrels were more frequently caught at night, with capture events showing non-random, spatially and temporally clustered patterns indicative of behavioral interactions with fishing operations. Importantly, the implementation of mitigation measures led to a substantial decline in seabird mortality, from 3,652 individuals in 1988 to 360 in 1992.

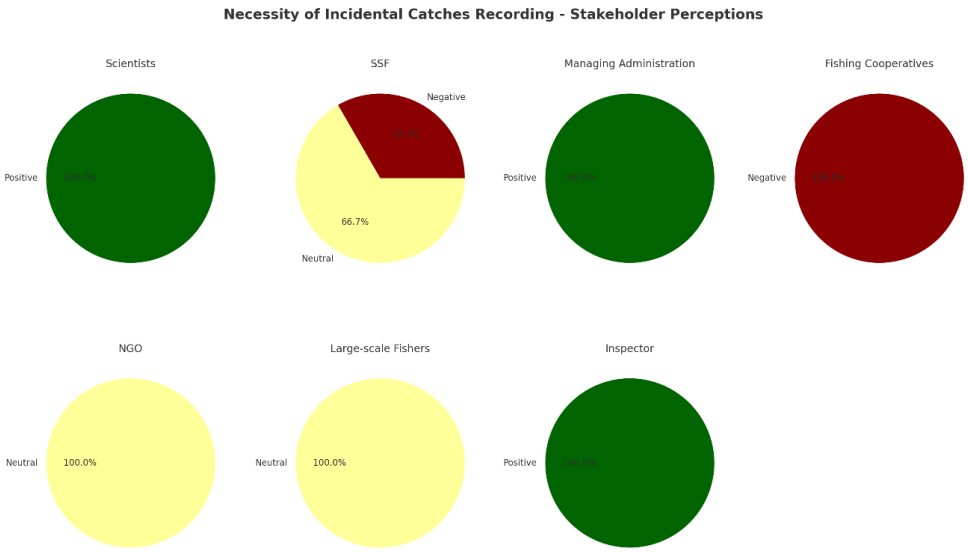

Figure 10. Stakeholder perceptions on the necessity of incidental catches recording for the conservation of *S. acanthias* and other non-target species.

Establishment of protected marine areas

Scientists and non-governmental organizations (NGOs) generally support the creation of marine protected areas (MPAs), highlighting their potential benefits for biodiversity conservation and overall ecosystem health. In contrast, fisheries managers tend to adopt a neutral stance, whereas fishers and cooperatives remain skeptical about the necessity of such measures. They argue that existing practices, such as the release of caught individuals and spatial fishing restrictions, are sufficient. Regarding *S. acanthias*, this divergence of views reflects differing levels of trust in current management frameworks and the perceived effectiveness of additional conservation zones (Figure 11). The designation of Marine Protected Areas (MPAs) contributes to the conservation of biodiversity; however, an appropriate management framework is essential to ensure the sustainable implementation of such protection (Sarker et al 2023). It is important to consider this when developing and implementing conservation measures. Selig et al. (2014) emphasized that enhancing the effectiveness of conservation strategies has become increasingly critical in the face of rapidly declining marine biodiversity on a global scale. Based on a 20-year time series of observations conducted in the Great Barrier Reef of Australia, the study demonstrated that Marine Protected Areas (MPAs) can increase the resilience of coral reef communities to natural disturbances. The results showed that the reef community composition was 21%–38% more stable within MPAs, the impact of disturbances was 30% lower, and recovery was 20% faster compared to unprotected areas. These findings indicate that MPAs are effective not only in species conservation but also in

enhancing overall ecosystem resilience. A similar approach could potentially be applied to threatened species such as the *S. acanthias* in the Black Sea, where MPAs may yield positive outcomes in terms of both species protection and stock recovery. In this context, marine protected areas established at the regional level should be designed not solely based on species-specific protection but rather through an ecosystem-based management framework supported by long-term monitoring data.

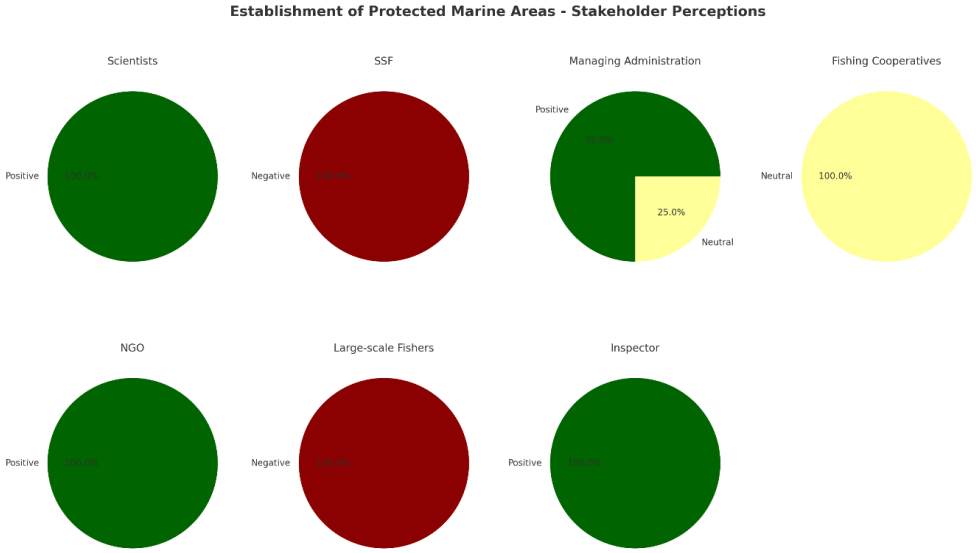

Figure 11. Stakeholder perceptions on the establishment of marine protected areas (MPAs) and their role in the conservation of *S. acanthias* in the Black Sea.

CONCLUSION

The findings of this study underscore the multifaceted nature of the decline in *Squalus acanthias* populations in the Black Sea, revealing the interplay between ecological pressures and regulatory inconsistencies. Stakeholder insights, gathered through focus group discussions, highlighted a broad consensus on the need to maintain the fishing ban while emphasizing critical issues such as bycatch documentation, regional policy harmonization, and the ecological consequences of advanced fishing technologies. Although uncertainties remain—particularly regarding migratory shifts and the extent of ecological disruption—most participants agreed that the loss of this apex predator contributes to increased ecosystem instability. Divergent views, especially concerning technological impacts and the establishment of marine protected areas, underscore the importance of inclusive, evidence-based policymaking.

Sustainable management of *S. acanthias* in the Black Sea will require strengthened enforcement mechanisms, ongoing dialogue among fisheries actors, and close cooperation among riparian countries. In this context, international organizations such as the IUCN, GFCM, STECF, and Black Sea Commission are strongly encouraged to jointly develop a regional action plan for piked dogfish. While stakeholders in Türkiye expressed generally positive attitudes toward conservation, there is a prevailing perception that without robust regional collaboration success will remain limited. Therefore, the formulation and implementation of a coordinated action plan is urgently needed to restore this vulnerable species and reinforce the ecological resilience of the Black Sea.

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