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First confirmed records of the Tortonese's stingray *Dasyatis tortonesei* (Elasmobranchii: Dasyatidae) in the Adriatic Sea, with notes on diagnostic characters and conservation implications

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Abstract

The Tortonese's stingray (*Dasyatis tortonesei* Capapé, 1975) is a poorly understood species, likely endemic to the Mediterranean Sea, where its distribution remains inadequately resolved due to historical taxonomic uncertainty and misidentification with its closely related congeners. The present study reports the first well-documented records of *D. tortonesei* in the Adriatic Sea, based on six specimens collected during systematic field surveys off Vlorë, Albania. All specimens were identified through a comprehensive assessment of diagnostic morphological features, and detailed biometric data are provided. Notably, one individual exhibited a fully healed traumatic loss of both the tail and stinging apparatus, suggesting a degree of resilience to sub-lethal injury. The present findings extend the range of *D. tortonesei* and establish a valuable baseline for future biodiversity assessments. In addition, this paper underscores the urgent need for integrative taxonomic approaches and regional capacity-building to improve species-level identification and inform effective conservation of Mediterranean elasmobranchs.

Keywords: stingrays; identification; taxonomy; distribution; Mediterranean Sea.

Introduction

Stingrays (Elasmobranchii: Myliobatiformes) are essential components of many coastal ecosystems, where they play critical ecological roles in shaping benthic community structure and influencing trophic dynamics (Vaudo & Heithaus, 2011; Dulvy *et al.*, 2014, 2021; Flowers *et al*., 2021). Among extant stingray diversity, species of the genus *Dasyatis* Rafinesque, 1810 (Myliobatiformes: Dasyatidae) are particularly prominent and widespread, especially in the Mediterranean Sea (Serena *et al*., 2020). This genus has undergone significant taxonomic revision in recent decades (Last *et al*., 2016a). Currently, three *Dasyatis* species are recognized in the Mediterranean region: the common stingray *Dasyatis pastinaca* (Linnaeus, 1758), the marbled stingray *Dasyatis marmorata* Steindachner, 1892, and Tortonese's stingray *Dasyatis tortonesei* Capapé, 1975 according to Golani & Capapé (2004). These three species exhibit close phylogenetic relationships and gross morphological similarity (Last *et al*., 2016a, b), which renders them susceptible to misidentifications (Chatzispyrou *et al*., 2020; Barone *et al.*, 2022). This is particularly true for *D. pastinaca* and *D. tortonesei* (Saadaoui *et al*., 2016), which share a greater proportion of morphological characters than either species does with *D. marmorata* (Last *et al.*, 2016a, b).

The Tortonese's stingray was originally described from a specimen collected off the Tunisian coast (Capapé, 1975, 1977). The species was initially considered as a junior synonym of *D. pastinaca* or a species inquirenda (Séret & McEachran, 1986; Tortonese, 1987; Compagno, 1999; Schrynmakers, 2001). Nevertheless, evidence had long suggested the presence of a morphologically similar but distinct species co-occurring with *D. pastinaca* in the Mediterranean Sea (Serena, 2005). Recent integrative taxonomic approaches, combining comparative morphological examinations and mitochondrial genome analyses (Capapé *et al*., 2012; Saadaoui *et al.*, 2016; Kousteni *et al*., 2021; Vella & Vella, 2021; Di Crescenzo *et al*., 2026) and even parasitic specificity (Neifar *et al.*, 2000), have clearly distinguished *D. tortonesei* as a valid and separate species. As a result, *D. tortonesei* has gained broader rec-

ognition in the scientific literature (Last *et al*., 2016a, b; Saadaoui *et al*., 2016; Weigmann, 2016; Jabado & Derrick, 2021; Froese & Pauly, 2026). At present, records of *D. tortonesei* remain restricted to the coastal waters of Tunisia (Neifar *et al*., 2000; Bradai *et al*., 2004; El Kamel *et al*., 2009; Capapé *et al*., 2012; Saadaoui *et al.*, 2016; Enajjar *et al*., 2022), Malta (Vella *et al*., 2016, 2017), Sardinia (Di Crescenzo *et al*., 2026), Turkey (Kabasakal, 2016; Yildiz *et al.*, 2016) and in the Levant Basin (Golani, 1996; Ali, 2018), with unknown status in the rest of the Mediterranean Sea. The Tortonese's stingray inhabits shallow coastal and estuarine zones, typically down to depths of 100 m and adults can reach a maximum disc width (DW) of 84 cm, with an average of approximately 65 cm (Capapé, 1978). Reported size at sexual maturity ranges from 33–38 cm DW in males and 33–47 cm DW in females, with size at birth estimated at 15–16 cm DW (Capapé, 1978; Saadaoui *et al*., 2016). Despite the international recognition of *D. tortonesei*, critical gaps remain in our understanding of the species' biology and ecology, and it is considered data deficient globally by the IUCN (Jabado & Derrick, 2021). This is particularly alarming given the species' bio-ecological similarity to several of its congeners, which display life-history traits associated with vulnerability to overfishing and slow population doubling times (Cheung *et al*., 2005). Although species-specific data for *D. tortonesei* remain limited, these shared characteristics indicate a potential susceptibility to population decline, underscoring the urgent need for further research to clarify its true distributional range and population status across the Mediterranean Sea.

The present study reports the first well documented records of stingrays morphologically consistent with *Dasyatis tortonesei* in the Adriatic Sea, as well as one of the northernmost occurrences of the species in the Mediterranean Sea. Furthermore, the conservation implications of these findings are discussed, alongside the potential for historical misidentifications within the genus *Dasyatis* in the Adriatic region.

Material and Methods

A total of six stingrays were collected among specimens of 28 elasmobranch species retrieved dead from local fisheries in Vlorë, Albania, during the Sub-regional training on monitoring, identification and advanced research methodologies of the Cartilaginous Fishes (chondrichthyans) in the Adriatic Sea (21-23 January 2025, Vloré Albania), organized under the auspices of SPA/RAC - UNEP/MAP Barcelona Convention and the Italian Ministry of Environment and Energy Security (MASE) (SPA/RAC – UNEP/MAP, 2025a,b). The stingrays were caught by artisanal fishermen using gillnets within Vlorë Bay, on the inner side of the Karaburun Peninsula, at depths of 12–15 m, near coordinates 40.39961° N, 19.38643° E . All specimens were measured and examined for the extraction of biometric and morphological data following the protocol of Bello *et al*. (2014), recommended for first records.

The specimens were examined for the presence of morphologically diagnostic features as described in Capapé (1975, 1977), McEachran & Capapé (1984), Saadaoui *et al*. (2016) and Yildiz *et al*. (2016). In addition, a complete set of biometric measurements was recorded following Saadaoui *et al*. (2016), while gross pathomorphological examinations were performed in accordance with Crow (2004) and De Iuliis & Pulerà (2019). Morphological indices, including condition factor, hepatosomatic index, and gonadosomatic index were calculated to assess overall well-being, nutritional status, and reproductive stage (Logan *et al.*, 2018; Okoboshi *et al*., 2022), respectively. The condition factor (CF) was calculated using the formula: $CF = (DW \times 10^3) / (TW)^3$, where TW is the total weight (g) and DW is the disc width (cm) following Gajić *et al*. (2023) for stingrays. The hepatosomatic index (HSI) was calculated as $HSI = (LW / TW) \times 100$, where LW represents liver weight (g). The gonadosomatic index (GSI) was determined using $GSI = (GW / TW) \times 100$, where GW denotes gonad weight (g). Gut content was examined and identified to the lowest possible taxonomic level. Upon the examination, individuals were kept frozen in Sharklab ADRIA collection under catalogue numbers DTO/01/0505/24 to DTO/06/0505/24 for further studies.

Results

All six sampled stingrays (Fig. 1) were identified as *D. tortonesei* based on a combination of the following morphologically diagnostic features: a rhomboid disc with uniform yellowish to ochre-brown dorsal coloration (Saadaoui *et al*., 2016); an obtuse snout tip projecting beyond the sinuous anterior disc margins (Capapé, 1975, 1977); corrugated tooth crowns (Fig. 2; Saadaoui *et al.*, 2016); spiracle length exceeding 1.2 times the prenarial length (Saadaoui *et al*., 2016); dark markings of the nostrils (Fig. 3; Barone *et al*., 2022); a non-perforated anterior extremity of the basibranchial plate (Fig. 4; Saadaoui *et al*., 2016); tail length about 1.4 times the disc width (Capapé, 1975, 1977; Last *et al*., 2016b); and a membranous ventral fold and dorsal ridge extending from the spine to the tip of the tail (Capapé, 1975, 1977). Pronounced sexual dimorphism was observed in dentition (a phenomenon referred to as gynandric heterodonty, see Gayford (2023) and references therein), with males exhibiting sharply pointed tooth crowns forming distinct cusps, whereas females displayed broader, flattened teeth (Fig. 2). None of the examined individuals exhibited morphological diagnostic features characteristic of other *Dasyatis* species present in the Mediterranean, such as white margins on the nostrils and smooth tooth crowns.

The present sample of Tortonese's stingray included three males (53.2–68.7 cm TL, 1.02–2.86 kg TW), of which two were sexually mature (DTO-02 & DTO-03), and three females (53.0–73.4 cm TL, 1.15–2.87 kg TW), all of which were sexually immature (Table 1). Full biometric data of the recorded specimens are provided in Table 2. All examined females had severely autolysed ovaries and associated epigonal organs; therefore, GSI

Fig. 1: Two male and two female specimens of Tortonese's stingray (*Dasyatis tortonesei*) captured using artisanal gillnets in Vlorë Bay, Albania. Photos credit: A. Gajić & E. Neuman / Sharklab ADRIA.

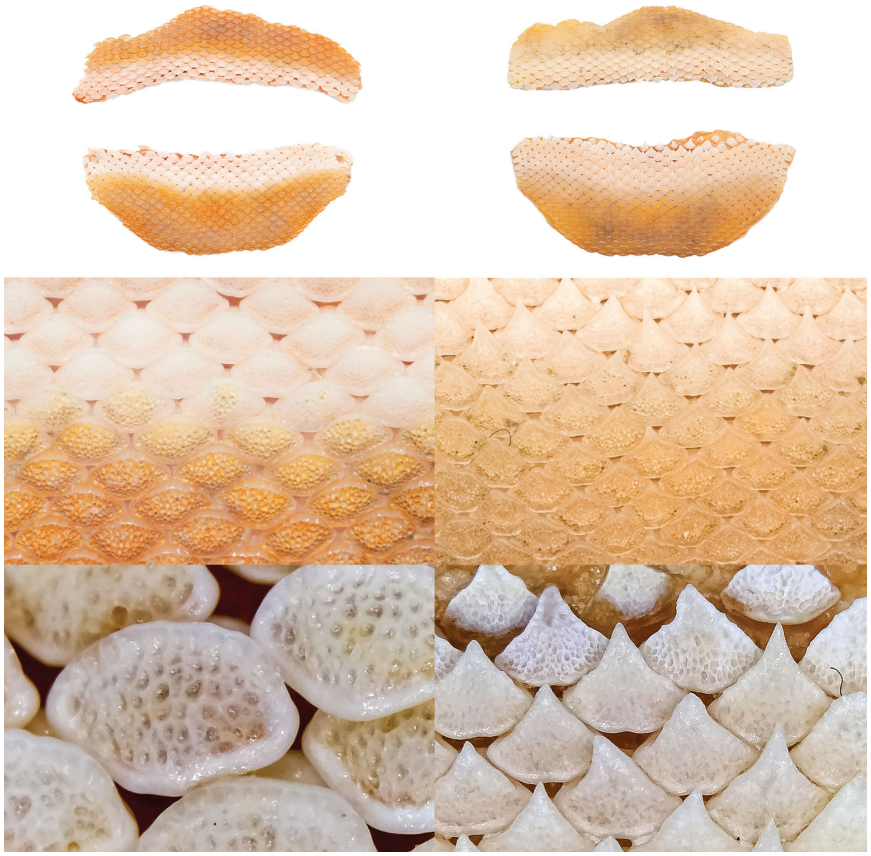

Fig. 2: Comparative dentition of female (left) and male (right) *Dasyatis tortonesei*, highlighting pronounced sexual dimorphism. Males exhibit sharply pointed, cuspidate crowns, whereas females possess broader, flattened teeth. Corrugation of the tooth surfaces is evident in both sexes. Photos credit: A. Gajić & E. Neuman / Sharklab ADRIA.

Fig. 3: Distinct dark pigmentation along the margins surrounding the nostrils dental apparatus observed in *Dasyatis tortonesei* specimens from Vlorë Bay, Albania. Photos credit: A. Gajić & E. Neuman / Sharklab ADRIA.

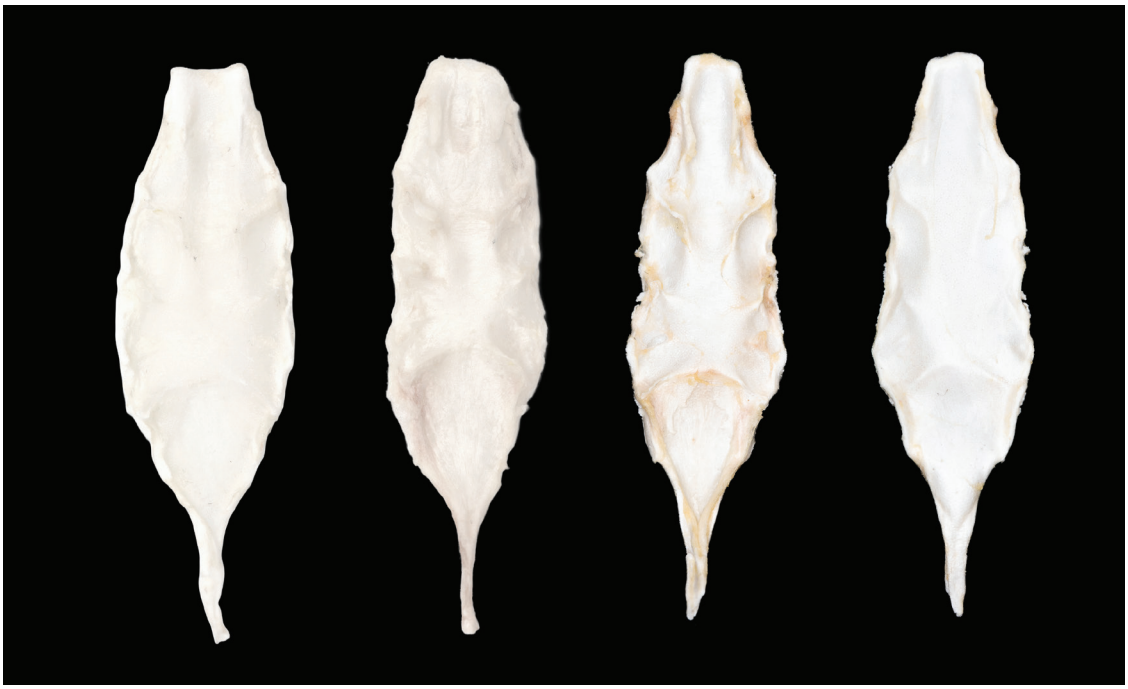

Fig. 4: Basibranchial of *Dasyatis tortonesei* from Vlorë Bay, Albania, showing a non-perforated anterior extremity. Photos credit: A. Gajić & E. Neuman / Sharklab ADRIA.

could only be determined for one individual (DTO-04).

Gross pathological examination revealed presence of superficial lacerations and bruises, consistent with handling-related trauma during net capture (Fig. 1). This lesion exposed underlying soft tissue with possible necrotic changes but showed no signs of active haemorrhage. In addition, one individual (DTO-05) exhibited a wound in which the size, shape, and localized nature were consistent with a single bite (Fig. 1). No other changes were observed in the major viscera and all the examined individuals appeared to be in a robust health prior to the capture.

Discussion

Despite decades of taxonomic uncertainty, recent integrative studies combining morphological and molecular evidence have confirmed *D. tortonesei* as a valid and distinct species, clearly distinguishable from its sister taxa *D. pastinaca* and *D. marmorata* based on well-defined morphological diagnostic characteristics including aspects of disc shape, tooth morphology and elements of the endoskeleton (Capapé, 1977; Saadaoui *et al*., 2016). Consequently, recent studies have demonstrated that the

Table 1. Morphometric and physiological indices of examined Tortonese's stingray (*Dasyatis tortonesei*) specimens from the Adriatic Sea.

Observed measurement	DTO-01	DTO-2	DTO-03	DTO-04	DTO-05	DTO-06
Sex	♂	♂	♂	♀	♀	♀
Total weight	1.02	2.11	2.86	2.87	1.15	2.58
Condition factor	3.28	3.76	3.77	4.16	4.56	4.09
Hepatosomatic index	8.59	6.82	9.75	12.30	8.48	9.32
Gonadosomatic index	0.08	0.65	0.28	4.16	-	-

Table 2. Morphometric measurements (cm) of six *Dasyatis tortonesei* specimens from the Adriatic Sea; specimen DTO-05 exhibited survival following severe traumatic loss of the caudal region, including complete absence of the tail and spine, and presented with distinct bite-related lesions on the pectoral fins.

Observed measurement	DTO-01	DTO-02	DTO-03	DTO-04	DTO-05	DTO-06
Sex	♂	♂	♂	♀	♀	♀
Disc width	31.5	38.3	42.3	41	29.5	39.8
Disc length	25.3	31.4	35	34.8	25.1	32.6
Total length	53.2	68.7	67.1	73.4	53.0	70.1
Body length	27.1	34.5	38.8	38.5	28.3	35.6
Head length	12.2	15.2	17.2	16.2	12.1	15.1
Abdomen length	9.5	10	10.1	13.8	7.7	10.7
Snout to spine (barbel)	34.3	43.4	46	45.9	-	45
Pectoral anterior margin	19.2	23.6	28.5	24.4	-	24.5
Pectoral posterior margin	18.7	20.5	23.5	25.1	-	23.7
Pelvic anterior margin	4.5	5.8	6.4	6.3	5.4	6
Pelvic posterior margin	4.2	5	8.75	7.05	6.1	7.05
Tail length	30	38.9	33.5	39.9	-	38
Tail width	1.5	2	2.3	2.3	-	1.8
Preorbital length	5.85	7.2	8.4	7.9	6.5	8.4
Preoral length	4.9	6.4	6.3	6.6	5.7	6.35
Prenasal length	3.95	4.7	4.8	4.85	4.1	4.6
Interorbital distance	5.4	6.1	7.4	7.2	5.4	6.9
Internasal distance	2.6	3.4	3.85	3.85	2.6	3.75
Interspiracular	4.7	6	6.7	6.4	4.9	6.2
Spiraculum length	2.5	2.6	3.3	3.4	2.8	2.9
Spiraculum height	1	2.2	2.4	2.2	2.4	2.2
Mouth width	2.9	3.5	3.3	3.2	2.4	3.5
Snout to cloaca	22	28.6	31	31.1	23.6	30.1
Spine (barbel)	9.4	broken	broken	12.75	broken	11.1
Claspers (in males)	2.7	5.5	3.3	-	-	-
1st to 5th gill slit	4.15	4.8	5.7	5.9	4.2	5.5
Eyeball length	1.7	1.9	1.4	2.1	1.7	1.15

species can be reliably identified using a defined set of morphological criteria (e.g., Saadaoui *et al*., 2016). The gross morphology and meristic counts of all examined individuals in the present study are fully consistent with all the diagnostic features described for *D. tortonesei* by Capapé (1975, 1977), McEachran & Capapé (1984) and Saadaoui *et al*. (2016). As such, these findings confirm the identification of the species and support its inclusion in the ichthyofauna of the Adriatic Sea. Despite the fact that positive identification can be inferred from morphological examinations (Saadaoui *et al.*, 2016), future studies should include complementary molecular analyses to strengthen species delimitation and provide novel genetic data.

Earlier works indirectly inferred the potential presence of *D. tortonesei* in the Adriatic Sea (McEachran & Capapé, 1984; Amori *et al.*, 1993; Bello, 1999). However, subsequent reviews and recent checklists have not validated any of these records, and to date the species has remained absent from all officially published checklists of Adriatic fishes (Lipej & Dulčić, 2010; Kovačić *et al*., 2020). To date, no scientifically examined and verified records of this species exist from the Adriatic Sea (Soldo & Lipej, 2022; Balàka *et al*., 2023). Thus, the specimens recorded here represent a significant range extension and suggest that *D. tortonesei* may be more widely distributed across the Mediterranean Sea than previously recognized (Vella & Vella, 2021; Di Crescenzo *et al*., 2026). These findings also challenge current assumptions regarding the frequency and distribution of *D. pastinaca*, highlighting the need for more rigorous species-level identification in regional assessments. The absence of earlier records of *D. tortonesei* from the Adriatic can likely be attributed to historical taxonomic confusion and morphological similarity with *D. pastinaca* compounded by a lack of targeted monitoring and systematic studies in the southern Adriatic region, particularly related to elasmobranchs (Gajić & Sulikowski, 2024; Gajić & Karalić, 2024; Gajić, 2024, 2025). These factors likely contributed to persistent misidentifications, suggesting that the records reported here are unlikely to reflect a recent range expansion or migration of the species. Misidentification due to subtle morphological distinctions can result in underreporting and misinformed population assessments, further reinforcing conservation blind spots (Simpfendorfer *et al.*, 2011; White & Last, 2012). The population assessments of dasyatid stingrays in the Mediterranean Sea may therefore be biased by historical misidentifications, obscuring their true distribution patterns and conservation status.

The condition factor (CF), hepatosomatic index (HSI), and gonadosomatic index (GSI) presented here represent the first data of its kind for this species in the Adriatic Sea (Table 1). The observed variations among the sampled individuals may reflect differences in sex and reproductive status (Hussey *et al*., 2009; Rizzo & Bazzoli, 2019), as well as physiological stress (Skomal & Mandelman, 2012), warranting further investigation. The female with a complete loss of the tail and traumatic pectoral fin injury exhibited the highest CF among all individuals. While this elevated CF likely reflects a favourable somatic condition and the individual's apparent resilience and successful recovery post-injury (Debaere *et al*., 2025), it may also result from altered body proportions and compensatory tissue remodellin (DeFalco & Capel, 2009; Rajasilta *et al*., 2016).

While this study provides important novel recog (Peig & Green, 2010). Notably, despite exhibiting the highest CF, this individual had the lowest HSI, particularly in comparison to [AG2.1] other females, suggesting depleted energy reserves and potential metabolic compromise. Additionally, the largest male exhibited a single testis and a notably low GSI (0.28), potentially indicating gonadal atrophy, unilateral degeneration, or a congenital developmental anomalyrds of *D. tortonesei*, key knowledge gaps remain concerning population size and structure, habitat preferences, and vulnerability to anthropogenic threats such as overfishing, habitat degradation, and pollution (e.g., De Loose *et al.*, 2025).

Low-selectivity gears such as demersal trawls and static nets have been identified as major contributors to fishing-related risk for elasmobranch assemblages in the Mediterranean Sea (Scacco *et al*., 2023), with the Adriatic basin, recognized as one of the most heavily trawled regions globally, particularly by demersal trawling (Amoroso *et al.*, 2018; Pitcher *et al.*, 2022; FAO, 2022; Maioli *et al.*, 2023). Implementing targeted conservation strategies, such as reducing bycatch, improving species-specific identification, and enhancing post-capture survival, will be essential to mitigate ongoing population declines of stingrays in the Adriatic Sea (Gajić & Karalić, 2024). In the case of *D. tortonesei*, such measures could help ensure the long-term viability of the species while contributing to broader efforts to preserve elasmobranch biodiversity in the region.

Comparable challenges are evident in other Mediterranean stingrays. The marbled stingray (*D. marmorata*), currently listed as data deficient in the Mediterranean Sea (Bradai *et al*., 2016), has historically been represented by sparse and geographically fragmented records and was only recently confirmed in Greek waters through combined morphological and genetic analyses (Chatzispyrou *et al*., 2020). Similarly, the common stingray *D. pastinaca*, currently listed as Vulnerable in the Mediterranean Sea (Serena *et al*., 2016), may be affected by persistent misidentifications and data deficiencies, particularly due to confusion with both *D. tortonesei* and *D. marmorata* (Jabado *et al*., 2021). These cases collectively demonstrate how taxonomic uncertainty and limited empirical data can obscure true distribution patterns and conservation status. Accordingly, a comprehensive taxonomic reassessment, potentially including redescription where necessary, as well as further studies integrating robust morphological diagnostics, molecular validation, and ecological context is essential to resolve species boundaries and refine distributional knowledge. For poorly studied Mediterranean elasmobranchs, such integrative approaches are not simply methodological enhancements but a fundamental prerequisite for accurate risk assessment, evidence-based management, and long-term population persistence.

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