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REVIEW, CONCEPT, AND SYNTHESIS

Advances in cephalopod research

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Abstract

There has been a significant increase in cephalopod research over the last decades, and the Cephalopod International Advisory Council (CIAC) has been playing a pivotal role in shaping and influencing the direction of cephalopod research since 1983. CIAC conferences are held every three years, gathering cephalopod researchers from around the world. This is a collection of research presented at the last CIAC Conference, held in Sesimbra, Portugal, in April 2022, as well as other timely cephalopod research. It includes 52 articles, divided into nine main topics, namely: (1) Taxonomy, Population Genetics & Phylogeography, (2) Reproductive Biology and Early Life History, (3) Age, Growth & Morphology, (4) Behavior & Locomotion, (5) Diversity, Ecology & Biogeography, (6) Climate change and Stress Physiology, (7) Feeding Ecology & Contaminants, (8) Conservation & Traceability, and (9) Culture and Welfare, and others. The upcoming triennial CIAC conference is scheduled to take place in Okinawa in October/November 2025. This event will provide a valuable platform for students, early-career researchers, and seasoned scientists from around the world to come together, exchange knowledge, and help shape the future of cephalopod research.

Keywords Behaviour · Cephalopods · Climate change · Diversity · Life history · Taxonomy

Introduction

The class Cephalopoda, within the phylum Mollusca, encompasses a highly diverse group of marine invertebrates, including octopuses, cuttlefish, squids, and nautiluses. They are solely marine and inhabit a diverse range of habitats, from shallow coastal zones to the deep sea (Hoving et al. 2014; Rosa et al. 2019, 2024a; Otjacques et al. 2023), and play key ecological roles as both predators and prey in marine food webs (Clarke 1996; Xavier et al. 2015, 2018; de la Chesnais et al. 2019). Their rapid growth, short lifespans, and high fecundity make them highly adaptable to environmental changes; therefore, cephalopods are potential indicators of ecosystem shifts (Pecl and Jackson 2008; Golikov et al. 2024). Cephalopods are an essential resource to fisheries worldwide, with several species being increasingly targeted due to declines in traditional fish stocks (Arkhipkin et al. 2015; Sauer et al. 2021). It has also been argued that some cephalopod populations may be benefiting from climate change, as well as from the removal of fish biomass (Doubleday et al. 2016; Oesterwind et al. 2022). However, further research is needed to corroborate this assumption, as evidenced by the meta-analysis on the topic in Borges et al.

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(2023), and the findings of the species distribution modeling studies in this collection (Guerreiro et al. 2023a, b).

There has been a significant increase in cephalopod research over the last decades (Fig. 1). The Cephalopod International Advisory Council (CIAC) has been playing a pivotal role in shaping and influencing the direction of cephalopod research since 1983. The last triennial CIAC Conference was held in Sesimbra, Portugal, in April 2022, and comprised 90 oral presentations and 145 posters, with 166 participants present in person and 109 participants online, from 33 countries. Four workshops were also held before the CIAC conference, namely: (i) "*Cephalopod macroecology and biogeography*", led by Christian Ibáñez and Rui Rosa, (ii) "*Collection, handling and care of cephalopod eggs and egg masses*", led by Roger Villanueva, Anne-Sophie Darmaillacq & Michael J. Kuba, (iii) "*The role of cephalopods as predators and prey: the relevance of cephalopod beaks in ecological studies*, led by José Xavier, Yves Cherel, Alexey Golikov, José Queirós, Catalina Perales-Raya & Rigoberto Rosas-Luis, and (iv) "*Cephalopod genomics and evolution*", led by Oleg Simakov and Caroline Albertin [see detailed information about the different workshops and the conference in Rosa et al. (2023)].

Alongside the Research Topic entitled "*Cephalopods in the Anthropocene: Multiple Challenges in a Changing Ocean*", which comprised 16 articles (see Rosa et al. 2023)," the present collection "*Advances in Cephalopod Research*" (https://link.springer.com/collections/ibdehacbcb) also aimed to compile the work presented at CIAC 2022, but was not limited to it.

Present collection

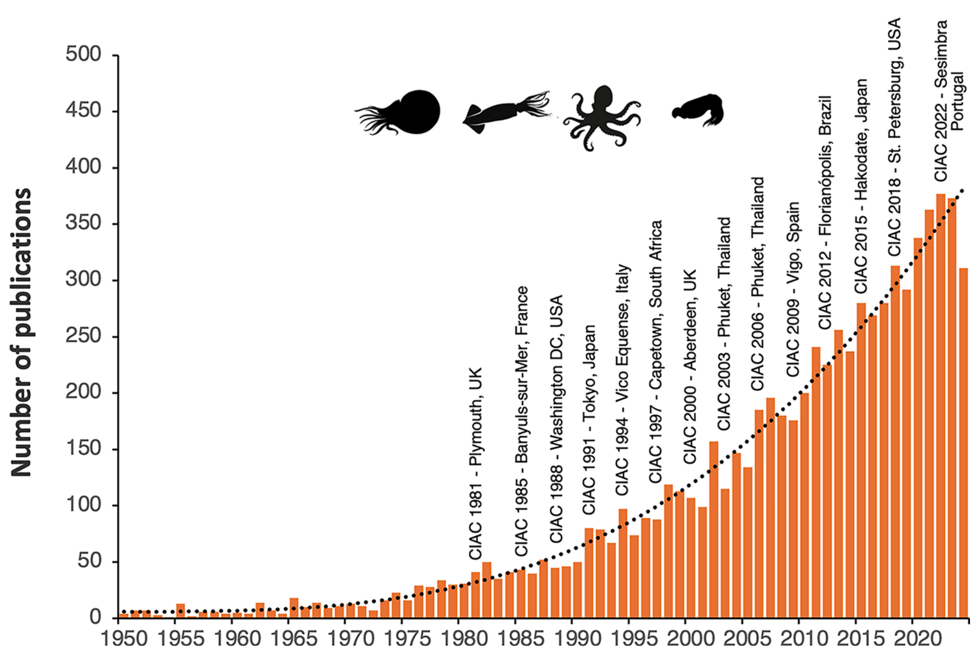
The present collection comprises 52 articles, covering different ocean basins (Fig. 2A) and cephalopod groups (Fig. 2B), and spanning from local to global scales (Fig. 2C) and from coastal waters to the deep sea (Fig. 2D).

These articles were divided into nine main topics, namely: (1) Taxonomy, Population Genetics & Phylogeography, (2) Reproductive Biology and Early Life History, (3) Age, Growth & Morphology, (4) Behavior & Locomotion, (5) Diversity, Ecology & Biogeography, (6) Climate Change and Thermal Stress, (7) Feeding Ecology & Contaminants, (8) Conservation & Traceability, and (9) Culture and Welfare.

Taxonomy, population genetics and phylogeography

Cranchiids ('glass' squids) constitute a diverse group of oegopsid squids, with representatives found in all oceans except the Arctic. Evans and Bolstad (2023) provide a review on the taxonomy and diversity of genus *Leachia* in the Pacific Ocean and describe a novel species – *L. separata* (from Aotearoa, New Zealand). Reid et al. (2023) described two new pygmy squid from the Ryukyu archipelago, Japan, namely *Kodama jujutsu*, n. gen., n. sp. and *Idiosepius kijimuna*, n. sp. Systematic descriptions, phylogenetic and behavioural analyses are described. Sajikumar et al. (2024) provided detailed morphometric and morphological characteristics of the pelagic octopus *Tremoctopus gracilis* off the south-eastern Arabian Sea. Furthermore, molecular species identification was carried out through mitochondrial markers (COI & 16S rRNA). Phylogenetic analysis generated a

Fig. 1 Long-term temporal changes (from January 1950 to December 2024) in the number of cephalopod-related publications, with the indication of the triennial CIAC conference alongside. Data was obtained in Clarivate-Web of Science (WoS) database featuring the term 'cephalopod' in the title, abstract, or keywords



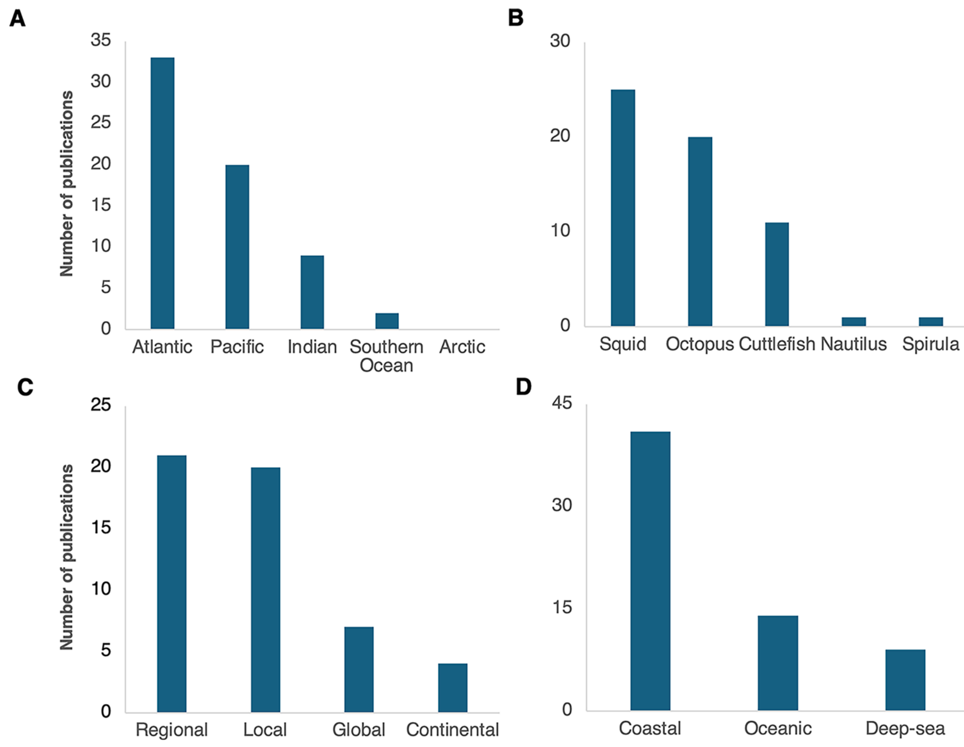


Fig. 2 Publications of the collection categorized by oceans (panel **A**),taxonomic groups (panel **B**), spatial scale (panel **C**), and habitat (panel **D**)

single clade that included sequences from the Indian and Pacific Oceans, including those misidentified as *Tremoctopus violaceus* from the Pacific.

Bein et al. (2023) presented a population genomic study of *Octopus insularis*, a species found in western coastal regions and oceanic island habitats off the tropical Atlantic Ocean. The authors found that the South Equatorial Current is the primary barrier to gene flow between the southern and northern parts of the range, and that the genetic diversity of insular populations decreases significantly with increasing distance from the continental shelf. García-Mayoral et al. (2024b) examined the population genetics of the European squid, *Loligo vulgaris*, along the western Iberian Peninsula, using the mitochondrial cytochrome oxidase subunit I gene (COI) and genomic markers obtained via double digest restriction-site associated DNA sequencing (ddRADseq), and both genetic approaches showed homogeneity and strong genetic flux, identifying a unique population in that region. Hua et al. (2023) examine the phylogeographic relationships among octopus species (*'Octopus' berrima* and *'Octopus' pallidus*) and the level of population genetic structuring within species in southeast Australia. Besides morphometric traits, cytochrome oxidase subunit III (COIII) was sequenced along with ddRADseq derived markers. While some populations of *'Octopus' berrima* were morphologically similar and genetically distinct, '*Octopus*' *pallidus* populations were both morphologically and genetically distinct across the studied regions. The study highlighted the importance of genomics tools in the conservation management of commercially and recreationally important species.

Ibáñez et al. (2023b) assessed the interspecific differences in several morphometric traits of loliginid squids in relation to their geographic and bathymetric distributions and phylogeny. A correlation was found between adult mantle length and fin size, as well as their geographic and bathymetric distribution, but not with hatchling size. Jeena et al. (2023) provided the first report on the mitogenome of the enigmatic giant form of the Indo-Pacific purpleback flying squid (*Sthenoteuthis oualaniensis*). Phylogenetic analyses divided the different lineages into two sister clades, one containing the giant and dwarf forms and the second containing all middle-sized forms. The authors argued that the major lineages originated through adaptive radiation, and that the lack of distinct morphological differences between certain forms indicates that they are probably in the grey zone of speciation.

Lupše et al. (2023) reconstructed sepiid phylogeny based on reliably identified cuttlefish species. The Sepiidae genera *Acanthosepion* Rochebrune, 1884; *Ascarosepion* Rochebrune, 1884; *Aurosepina* Jothinayagam, 1987; *Decorisepia* Iredale, 1926; *Doratosepion* Rochebrune, 1884; *Rhombosepion* Rochebrune, 1884, and *Spathidosepion* Rochebrune, 1884 were reinstated and formally recognised as valid. Sales et al. (2024) investigated the evolutionary history of the loliginid squid *Doryteuthis pealeii*, and their findings indicate that two previously detected lineages diverged from one another ~ 8 million years, compatible with the formation of the Caribbean and the establishment of the Amazon plume. Furthermore, separation between a North Atlantic and a Gulf of Mexico lineage during the Pleistocene period was noted. Thus, *D. pealeii* is restricted to northern Atlantic Ocean and the lineage that occurs in the southwestern Atlantic represents an undescribed species. The authors argue that this cryptic diversity may have negative implications for the development of effective conservation and fisheries measures.

Sheerin et al. (2023) investigated the phenotypic plasticity in the loliginid squid *Alloteuthis media* from morphological analyses on North Sea specimens and DNA barcoding of the genus across its latitudinal range, from Guinea Bissau to the Irish shelf and North Sea. According to the authors, the phenotypes vary substantially across the geographic range, which explains the difficulties in morphological identification. Moreover, interregional analyses suggest that character displacement may occur where species co-exist. Vargheese and Basheer (2024) studied the phylogeography within *Sepiella inermis* species complex along the Eastern Arabian Sea and Bay of Bengal. Although morphological analysis did not show distinct differences between the two populations, phylogenetic analyses (using the mitochondrial COI and 16 S rRNA genes) revealed two genetically distinct clades – one from the Arabian Sea and the other from the Bay of Bengal (the northern and north-eastern part of the Indian Ocean). This study also provides evidence of previously undocumented sub-population structuring in the Northern Indian Ocean.

Last, Ziegler and Sagorny (2023) studied the effects of fixation and long-term preservation on finned (cirrate) octopods from eight currently recognized genera, and provided pre- and post-fixation color imagery of entire specimens as well as measurements of taxonomically relevant characters.

Reproductive biology and early life history

Unlike most cephalopods, the firefly squid *Watasenia scintillans* is highly monoandrous. Alam and Hirohashi (2023) described the female squid's ability to sustain a monoandrous mating regime despite an extremely male-biased operational sex ratio, noting that there were no significant changes in the polyandry rate during the reproductive season. They also discussed the evolutionary mechanism underlying the persistence of this mating regime in this species. Sato et al. (2023) investigated the sperm storage pattern of the seminal receptacles (on the buccal membrane) of the female Japanese common squid *Todarodes pacificus*. The results showed that females were capable of storing sperm contributed by 9 to 23 males, suggesting that one function of having multiple seminal receptacles may be to ensure higher genetic diversity in the offspring. Rico et al. (2023) investigated the basic reproductive parameters, ecology, and size structure of the common cuttlefish *Sepia officinalis* off Mallorca Island's coast (western Mediterranean) during 2017–2019. The estimated size at first maturity was 87 mm for females and 78 mm for males. It exhibited a semi-continuous reproductive cycle throughout the year, with a spawning peak occurring between March and June, and asynchronous oocyte development. Among other findings, the authors advocate that this species fulfil the cost of reproduction through both current food intake and accumulated somatic reserves.

García-Mayoral et al. (2024a) investigated the age, body length, statolith length, and growth rates of loliginid paralarvae (*Alloteuthis media*, *A. subulata* and *Loligo vulgaris*) along the Galician coast (NW Spain), and found interspecific differences in growth curves and hatching seasons. Alongside, de Ortiz et al. (2024) evaluated, for the first time, the composition, distribution, and abundance of cephalopod paralarvae in southeast–south Brazilian outer shelf and continental slope (24°–34°S), and provided the first record of *Bolitaena pygmaea*, *Egea inermis*, *Pterygioteuthis* sp., and *Promachoteuthis* sp. paralarvae in the region. Montero-Ruíz et al. (2023) investigated the early ontogeny of *Octopus hubbsorum*, namely the embryonic development, and described the morphological, morphometric, and meristic characters of hatchlings. Roura et al. (2023) comprehensively investigated the settlement stage of the juvenile phase of the life cycle of *Octopus vulgaris*, and proposed three sub-stages, namely "pre-settlement", "settlement" and "post-settlement", based on morphological, anatomical, and behavioural changes.

Age, growth and morphology

Guerra-Marrero et al. (2023a) estimated the age, growth, and population structure of the African cuttlefish *Sepia bertheloti*, off Morocco and Guinea-Bissau coasts, based on beak microstructure. Growth rates varied between locations, with the highest values in Guinea-Bissau. While the males of both locations followed an asymptotic growth model, the females exhibited a non-asymptotic growth. A maximum life expectancy of around 14 months was observed for this cuttlefish species. Validating the periodicity of growth increments is an important aspect of cephalopod ageing studies (Durante et al. 2024; Guerra-Marrero et al. (2023b) validated daily growth increments in the beaks of cuttlefish hatchlings, namely *Sepia officinalis* from Gran Canaria (Spain).

The ram's-horn squid *Spirula spirula* is the only present-day representative of the order Spirulida, and it is known to secrete a coiled shell with a series of chambers divided by septa and connected by a siphuncle. Checa et al. (2022)

used different microscopy techniques to investigate diverse structures composing the shell (e.g., siphuncular tube, septum and associated structures), and reconstruct their morphology and distribution. Alongside, the homologies with *Nautilus* and *Sepia* were discussed. Hirota et al. (2023) used comparative proteomics to study the shell matrix proteins of *Nautilus pompilius* and other conchiferans (e.g., *Sepia pharaonis* and *S. spirula*), providing more insights into mollusk shell evolution at the molecular level.

Souquet et al. (2023) studied the growth and functional changes of the buccal mass in *Sepia officinalis* throughout ontogeny. They showed that both upper and lower beaks present significant ontogenetic shape variation in the rostrum area that might be due to wear induced by feeding. Moreover, the mechanical properties of the beaks in juveniles indicate greater resistance compared to adults. Additionally, an isometric relationship is observed in bite force, with no indication of compensation for feeding performance in juveniles. The authors argue that feeding performance thus does not reflect the ontogenetic shift from a crustacean-based diet in juveniles to a fish-based diet in adults.

Behavior and locomotion

The unique organization of motor centers makes octopuses an exceptional example of motor control in a soft, flexible body. Here, Alupay et al. (2023) analyzed the kinematics of octopus's (*Abdopus* sp.) arm movement while 'slapping' at fish. The authors suggest that the octopus utilizes the kinematic primitives of rotation and translation of its hydrostatic arms, and that these primitives can be employed separately or combined serially and in parallel to form the complex 'slap' action. Turning is crucial for ecological success in the ocean, as it is essential for capturing prey, escaping predators, and navigating complex environments. Within this context, Bartol et al. (2023) studied the turning capabilities of neritic squids (*Lolliguncula brevis*, *Doryteuthis pealeii*, and *Illex illecebrosus*), and quantified the role and orientation of their propulsors (jet, fins, and arms) during turns. Ganley et al. (2024) investigated the turning abilities of the hatchlings of common cuttlefish (*Sepia officinalis*) and dwarf cuttlefish (*Sepia bandensis*), and found that *S. officinalis* hatchlings turned faster than *S. bandensis* and adults. Moreover, both hatchlings seemed to turn more closely than other jet-propelled animals and some non-jet-propelled swimmers.

Weertman and Scheel (2024) showed that male *Octopus rubescens* hold their third right arm (with hectocotylus) closer to their body (i.e., more protective) than the seven other arms while the females do not. Furthermore, in both males and females, the rear arm pairs operate closer to the body than the front arm pairs. Despite their anatomical similarity and potential redundancy, these results indicate differences in arm use by octopuses. Mather (2024) provided a brief note about sex bias in the study of squid reproductive strategies. Focusing specifically on the mating strategies of loliginid squid, the author found that most research collective focus was on males, mostly on aggression and actual mating techniques. Last, Battaglia et al. (2023) report in situ observations (using remotely operated vehicle - ROV) of rarely observed deep-sea cephalopods in the Mediterranean (northern Ionian Sea), namely *Chiroteuthis veranyi*, *Chtenopteryx sicula*, and *Octopoteuthis sicula*, and describe chromatic, postural, locomotor, and bioluminescent behavioral components for each species.

Diversity, ecology and biogeography

The first comprehensive review on the diversity of octopus fauna throughout the Americas (accompanied by a supplementary online database – AmeriCeph) was provided by González-Gómez et al. (2024). Besides the basic information about all known octopus species, it also included the institutional location of type material and the identification of voucher specimens and their depositories. Luna et al. (2024) investigated the zoogeographic regionalization of Cephalopoda in relation to the Canary Current upwelling system, and revealed that there were two major groups separated by latitude: "Temperate water" and "Tropical water" clusters. Yet, the presence of a minor third cluster - the "Upwelling" cluster - confirms the strong relationship between the three zoogeographical regions (temperate, tropical, and upwelling) and regional hydrology.

In the Eastern Pacific Ocean (EPO), the most frequent mass cephalopod strandings are of the jumbo squid *Dosidicus gigas*. Ibáñez et al. (2023a) assembled a database with historical stranding occurrences of this squid (from the nineteenth century to 2022), and revealed a dramatic increase in strandings since the year 2000 along the EPO. Different hypothetical causes were formulated (e.g., post-spawning mortality, high temperatures, toxins from harmful algal blooms, human disturbance), but the authors found limited evidence to support these causes. Hendrickson et al. (2023) showed that the cyclical trends in the high inter-annual variability in the biomass and mean body size indices of coastal squid (*Doryteuthis pealeii* and *Illex illecebrosus*) are closely linked to broad-scale climatic and physical drivers of oceanographic conditions within their habitats.

Climate change and stress physiology

Extreme events, including marine heatwaves (MHWs), have increased in frequency and intensity, exerting a strong influence over the structure and functioning of marine ecosystems (Sampaio and Rosa 2020; Sampaio et al. 2021).

Coelho et al. (2023) demonstrated that simulated MHW conditions did not induce significant sub-lethal physiological stress in cuttlefish (*Sepia officinalis*) embryos, and that they were also remarkably resilient to emersion conditions during low tide. Alongside, Domínguez-Castanedo et al. (2023) evaluated the cross-generational impacts of thermal stress on *Octopus maya* and showed that the embryos of thermally stressed females had smaller sizes, less yolk, and higher metabolic rates.

Using species distribution models, Guerreiro et al. (2023a) evaluated the potential effects of climate change on the distribution of nine cuttlefish species (in 2050 and 2100) under four representative concentration pathway (RCP) scenarios (RCP 2.6, 4.5, 6.0, and 8.5; CMIP5). The authors demonstrated that future cuttlefish habitat suitability and distribution are likely to decrease, with the most extreme impacts observed in *Doratosepion braggi* (a 31% decline) and the mildest in *Sepia officinalis* (a 2% decrease in average habitat suitability).

A similar approach was applied to the world's main commercial squid species (Guerreiro et al. 2023b). Here, these authors also showed that the responses were also species-specific, and stronger under harsher emission scenarios. Starting in 2050 (with RCP scenarios 4.6, 6.0, and 8.5), and especially due to the warming of the Arctic, squid (e.g., *Berryteuthis magister*, *Doryteuthis opalescens*, *Illex illecebrosus*, *D. pealeii*) habitat suitability should increase along both coasts of North America. On the other hand, in the Southern Hemisphere, squids (*Illex argentinus*, *D. gahi*, *Nototodarus sloanii*, *Loligo reynaudii*) may lose habitat with no poleward habitat alternatives to move into.

Vargas-Abúndez et al. (2023) evaluated the effects of warming on *Octopus maya* juveniles originated from control (25 °C) and thermally-stressed (30 °C) females. The results showed a transgenerational temperature effect that was expressed with low survival, depressed routine resting and high metabolic rates, decreased defense enzymes, and high levels of oxidative damage in juveniles from thermally stressed females.

Last, Röckner et al. (2024) studied the physiological and biochemical responses of *Octopus vulgaris* to emersion. Most biochemical markers revealed no significant differences between control (immersion) and air exposure (emersion) treatments, which indicates that octopus can tolerate exposure to short-term emersion periods due to an efficient antioxidant machinery and cellular repair mechanisms. Alongside, the authors show that the use of atmospheric air through the mucus-covered gills and/or cutaneous respiration may also help octopus withstand emersion and crawling on land.

Feeding ecology and contaminants

Cephalopods are known for their voracious and opportunistic feeding behaviors (Clarke 1996; de la Chesnais et al. 2019; Rosa et al. 2024b). Feng et al. (2023) employed stable isotope analysis to assess the dietary specialization of female jumbo squid (*Dosidicus gigas*) in three Eastern Pacific regions: the Equatorial waters, and the north and south Peruvian Exclusive Economic Zones. They found that the squid consistently increased their isotopic niche as they grew in each sampling region, and that female jumbo squid are diet generalists but exhibit individual specialization, possibly linked to energy acquisition for reproduction. Markaida (2023) provided the first systematic study of octopus diets based on direct observations of their recently taken prey. Catching *Octopus maya* with baited lines allows the collection of the prey that the octopus has just hunted. The author argues that the identification of prey found in the octopus' web is a friendly and non-invasive sampling method that allows for the detailed identification of both predators and prey.

Fee et al. (2023) evaluated the drilling precision on shelled molluscs by *Octopus vulgaris* type III (in False Bay, South Africa) and showed that the measurements of the locations of drill holes from collected shells of several prey species indicated that drilling locations were significantly non-random. Larivain et al. (2024) analyzed the English Channel loliginid squid (*Loligo forbesii* and *Loligo vulgaris*) diets using DNA-metabarcoding techniques, and identified 34 different types of prey at species level, including 17 teleost fish species. Differences in diet composition related to squid size do not suggest ontogenetic changes in trophic level during recruited stages. Oesterwind and Piatkowski (2023) presents stomach content analyses of various cephalopod species from the North Sea and argue that, alongside increasing biomasses, large-sized cephalopods are becoming more relevant as predators for commercially exploited fish species during recent years in this North Eastern Atlantic region.

As mentioned above, cephalopods serve as a crucial prey base for megafauna, including marine mammals, seabirds, and fish. The longnose lancetfish (*Alepisaurus ferox*) is a cosmopolitan deep-sea predator with a broad-spectrum diet, and Chen et al. (2022) described the cephalopod component in the central North Pacific Ocean. Significant ontogenetic differences were found, with small lancetfish fed on smaller, muscular cephalopods from shallow habitats (< 500 m, e.g., Ommastrephidae, Onychoteuthidae), while large lancetfish consumed larger, gelatinous cephalopods from deeper waters (> 500 m, e.g., Amphitretidae, Cranchiidae).

Last, Lischka et al. (2023) quantified trace elements (Al, As, Cd, Co, Cu, Fe, Hg, Ni, Mn, Pb, U, V, and Zn) of the 'glacial' squid (*Psychroteuthis glacialis*), because it plays a central role in local marine food webs off the Ross Sea (Southern Ocean). The findings suggest different feeding patterns between juvenile and mature individuals; however, both stages exhibit lower concentrations of trace elements compared to their temperate and tropical counterparts.

Conservation and traceability

Cephalopods are being harvested at increasing rates, and there are signs of uncertainty in the annual catches of key commercial species (Sauer et al. 2021). Within this context, achieving reliable and effective traceability of cephalopods is of paramount importance. Gleadall et al. (2024) provide the first review of the topic, pointing out: (i) the need for strengthening and international coordination of legislation, (ii) more rigorous standards for seafood labeling, and (iii) taxonomic curation of DNA sequences (available in public databases) for use in cephalopod identification.

To manage the diverse human-related pressures in European Union seas, various initiatives have been implemented, including the European Marine Strategy Framework Directive (EU-MSFD), which aims to protect and preserve the marine environment and its natural resources. Within this context, Bobowski et al. (2023) described the status of cephalopods within the EU-MSFD, highlighting the main challenges (e.g., limited data) and future possibilities for their integration into this directive.

Culture and welfare

A key issue concerning octopus culture is animal welfare, and there have been criticisms related to the ethics of octopus culture (Jacquet et al. 2019, 2024; Birch et al. 2021). Yet, some argue that further research is needed to define which octopus species can be or cannot be cultured. For those that can be, the culture must adhere to several animal welfare standards regarding their physical and cognitive needs, including nutritional requirements, adequate space and refuge, proper health, and the prevention of unrestrained behavior and nervous system condition (Rosa et al. 2024b; Gleadall et al. 2025).

Regarding octopus in captivity, Colunga-Ramírez et al. (2023) described, for the first time, the presence of air bubbles in the epidermis of a cephalopod species during handling, namely in three females of *Octopus bimaculatus*. There was no evidence of bacterial infection or gas bubble diseases, and no biochemical changes were observed in the haemolymph of affected specimens. Further investigation is necessary to fully comprehend these findings to enhance the health and well-being of octopuses in captivity.

Final remarks

The editors would like to thank Marine Biology, specially Barbara Santer, for the support of this collection. As mentioned earlier, CIAC has been playing a pivotal role in guiding cephalopod research since 1983. The next triennial CIAC conference will be held in Okinawa, Japan, in October/November 2025 (https://www2.aeplan.co.jp/ciac2025/). It will be an excellent opportunity to gather students, early-career researchers, and experienced scientists working on cephalopods from around the world, and shape the future directions of cephalopod research.

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Declarations

Conflict of interest No conflict of interest.

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