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Millions of eggs on volcanic summits reveal extraordinary deep-sea reproductive strategies

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Abstract

We studied two newly discovered nurseries on seamounts to examine the reproductive investment of large, solitary deep-sea predators. *In situ* observations revealed millions of skate egg cases on each summit—orders of magnitude beyond anything previously known—and deep-sea reproductive behaviours, including egg-laying females actively selecting habitats across nested spatial scales: from the seamounts, to their highest ridges, and ultimately to sites of localized geothermal venting. Our findings show deep-sea life histories operating across extensive landscapes and timelines–including potentially decade-long incubation–yet with substantial reproductive investment ultimately concentrated within small, specific geological habitats.

Introduction

Once perceived as a vast, uniform abyss, the deep ocean is increasingly recognized as a heterogenous landscape where discrete habitats shape complex life histories. This is particularly evident in reproduction, as recent discoveries[1] reveal nursery grounds concentrated within small, specific—and easily overlooked—habitats. Documented largely through trawls or isolated observations, deep-sea nurseries remain poorly understood. Rajiformes (skates; belonging to the subclass Elasmobranchii, alongside sharks and rays; Fig. 1) are tractable study systems because they are oviparous and their durable egg cases persist through multi-year development and after hatching[2], providing a time-integrated record of reproductive habitat use. Skates appear to select stable nursery conditions that alleviate typical deep-sea constraints on embryonic development, notably relatively warm, well-oxygenated conditions[3]. Previously known deep-sea skate nurseries contain hundreds to thousands of egg cases across diverse habitat types, including coral reefs on Tasmanian seamounts[3], methane seeps in a Norwegian canyon[4], and diffuse hydrothermal vents along a Galápagos ridge[5]. These studies identify potentially favourable nursery conditions but understanding how reproductive strategies are structured—across space and time and in relation to habitat and behaviour—is increasingly important amid global declines in elasmobranch populations and expanding anthropogenic pressures in the deep ocean[6]. Here, we address this knowledge gap at two newly discovered skate nurseries.

We discovered dense egg-case aggregations of *Bathyraja spinosissima*, the Pacific White Skate (PWS), and *Amblyraja hyperborea*, the Arctic Skate (AS) (Fig. 1a-f) on Ts'íidaa and Endeavour seamounts, two geothermally active sites ~ 400 km apart, in the northeast Pacific (Fig. 2a) (Methods). Both species are among the deepest- and widest-ranging skates (to ~ 3,000 m; North–Equatorial Pacific and near-global, respectively[7]) but differ markedly: PWS is roughly twice as large and highly mobile, frequently swimming meters above the seafloor, whereas AS is more sedentary and bottom-associated[7]. Across four expeditions (2021–2025), we combined 81 hours (spanning 18.5 km) of visual survey lines (Fig. 2b-c), egg-case collections, and mapping (Methods) to quantify reproductive investment, assess persistence, resolve habitat selection across nested spatial scales, and characterize adult nursery-use behaviours.

Results & Discussion

PWS and AS egg cases revealed reproductive investment orders of magnitude beyond any previously known skate nurseries, with remarkable consistency across the two seamounts. Both main nursery areas covered ~ 0.4 km^2 of each seamount's summit ridge and contained approximately 2 million egg cases (~ 420 tonnes), at densities averaging ~ 5 m^{-2} (Fig. 2d-e; Tables 1), with at least hundreds of thousands more estimated to extend downslope (Methods). PWS cases dominated both nurseries at a ~ 4:1 ratio to AS and were twice their size and weight (Table 1; Supplementary Table S1). Cases spanning all stages, from newly deposited gold-coloured to dark brown, black, and degrading[3], were observed on both seamounts on every expedition (Fig. 1d-f). Together, these observations document hundreds of tonnes of reproductive biomass transported by females from the abyss and concentrated within small seamount summit ridges, and demonstrate persistent reproductive habitat use through time.

The scale of the nurseries implies substantial maternal energetic investment. Females of both skate species migrated unknown distances—potentially 100's to > 1,000 km based on movements documented in other skates[8]—and ascended ~ 1.5-km-high seamount slopes[9] (Fig. 2b-c), at times visibly struggling against prevailing currents, before prolonged oviposition (Supplementary Video & Supplementary Table S2). Observed females were adult-sized (all but one > 70% of known maximum length[6]) and showed reproductive maturity through protruding egg cases, gravid appearance, and behaviors associated with oviposition (Methods; Supplementary Table S2). To our knowledge, these are the first *in situ* observations of deep-sea skate oviposition. Females, with or without cases protruding from their cloaca, repeatedly cycled between swimming up and down in the water column and would brush the seafloor and corals, arch, raised their tails, and flex their pelvic fins when they returned to the seafloor. The PWS (*n* 32) displayed more dynamic behaviours than AS (*n* 15) (Fig. 1g-l; Supplementary Table S2).

Table 1

Summary of nursery characteristics, including estimated egg-case abundance and biomass, and adult skate observations at Ts'íidaa and Endeavour seamounts, with supporting data for Bathyraja spinosissima, the Pacific White Skate (PWS), and Amblyraja hyperborea, the Arctic Skate (AS).

	Ts'íidaa Seamount	**Endeavour Seamount**
Overview		
Summit depth	1588 m	1583 m
Summit lat/long	51.40156°, -131.01596°	48.29885°, -129.04398°
Est. total egg-case abundance	1.84 ± 3.23 million	1.90 ± 2.34 million
Est. new PWS egg-case abundance	0.09 ± 0.16 million	0.25 ± 0.31 million
Est. total egg biomass	412.7 ± 670.0 tonnes	427.2 ± 488.0 tonnes
Summit ridge (main nursery area)		
Length	1.0 km	1.1 km
Area	382,003 m²	415,182 m²
Depth (& vertical relief)	1700 – 1588 m (112 m)	1640 – 1583 m (57 m)
Egg-case presence, max depth	1856 m	1730 m
Egg cases on summit ridge (Supplementary Table S1)		
Density, mean ± SD	4.81 ± 8.46 cases per m²	4.57 ± 5.66 cases per m²
Density, max	67.80 cases per m²	30.37 cases per m²
Ratio, PWS new : PWS old	1 : 16.36	1 : 6.12
Ratio, PWS : AS	4.23 : 1	4.29 : 1
Est. PWS egg-case abundance	1.49 ± 2.61 million	1.54 ± 1.90 million
Est. AS egg-case abundance	0.35 ± 0.62 million	0.36 ± 0.44 million
Est. biomass of PWS	382.5 ± 667.9 tonnes	396.3 ± 486.5 tonnes
Est. biomass of AS	30.3 ± 53.2 tonnes	30.9 ± 38.2 tonnes
Survey effort, no. of photographs	208 photos	213 photos
Survey effort, egg-case count	1,464	1,341
Adult skate observations (Supplementary Table S2)		

	Ts'íidaa Seamount	Endeavour Seamount
Overview		
Total PWS & AS (% observed over summit ridge nursery)	46 (52%)	32 (66%)
PWS (% female & % male)	24 (70.8% & 29.2%)	27 (55.5% & 37.0%)
AS (% female & % male)	22 (68.2% & 31.8%)	5 (0.0% & 80.0%)
PWS female depth, mean ± SD	1,764 ± 172 m	1,633 ± 81 m
PWS male depth, mean ± SD	1,869 ± 85 m	1,724 ± 66 m
AS female depth, mean ± SD	1,713 ± 179 m	-
AS male depth, mean ± SD	1,755 ± 112 m	1,626 ± 17 m
Survey effort: depth range	2224 to 1588 m	1978 to 1583 m
Survey effort, hours of video	67	14
Survey effort, distance transected	13 km	5.5 km

Two PWS with protruding cases continued these behaviours for ~ 1 hour without completing oviposition (Fig. 1h), suggesting substantial energetic costs consistent with their remarkably large egg cases (up to ~ 40 cm; Fig. 1b). Assuming paired oviposition at 16–52 egg cases per female per year[10], likely exceeding actual rates, ~ 90,000–250,000 new PWS cases per nursery (Table 1) represent ~ 45,000–125,000 laying visits by ~ 1,700–15,600 PWS females annually. The lower estimate from Ts'íidaa may reflect reduced nursery use, either temporarily or over the longer term, associated with recent bottom-contact fishing[11], as proposed for another fished seamount skate nursery[3]. Despite uncertainty in PWS population size, reproductive frequency, and migration distances, these numbers are plausible—even for a large, solitary deep-sea predator—given population estimates for other, albeit shallower, *Bathyraja* species[12]. Standing abundance, persistent use, and the energetic demands of maternal migration and oviposition indicate the scale of reproductive investment concentrated at these nurseries.

Females demonstrated active habitat selection across nested spatial scales. Most swimming females travelled upslope towards the summits or hovered over ridge crests (Fig. 2b-c), with laying behaviours concentrated at or near summit ridges (Supplementary Table S2). At finer scales, individuals of both species associated with geothermal features on Ts'íidaa (diffuse vent-fluid 1–2°C above ambient[11]), where gravid females hovered or rested directly over venting (Fig. 1k-l), potentially sensing and selecting these microhabitats through thermal, chemical, electrical, or other vent-associated gradients[13]. Egg-case distributions mirrored these patterns: densities increased with decreasing depth, were concentrated within the upper 60–110 m of summit ridge crests (Fig. 2d-e), and were highly patchy (standard deviations >2x the means), reaching higher densities around vent areas on Ts'íidaa, with up to 68 eggs

m^{-2} (Fig. 1e-f,j; Table 1). These findings support geothermal microhabitat selection, with elevated temperatures accelerating embryonic development[1,5,14]. In the energy-limited deep sea, lengthy incubation magnifies even small advantages, making optimal habitat disproportionately valuable. Using measured *in situ* temperatures[11] and the Hoff Eq. 1[4], just 0.16°C of warming above the 2.24°C mean ambient nursery temperature could shorten the skates' incubation by a year, while the ~ 1°C mean vent warming could nearly halve incubation from ~ 10 to 5.5 years– with this range still exceeding the longest incubation known for any animal[15].

Although males of both species occurred across the seamounts, they were observed deeper on average than females (Fig. 2; Table 1). Observations were female-biased overall, likely reflecting greater sampling within the nurseries where females were concentrated; most males occurred downslope, suggesting males could occupy the broader seamount in greater abundances than documented here. Nursery-bound females may create predictable mating opportunities that males intercept on the seamount slopes. Consistent with this possibility, while skates were usually solitary, three groups of PWS were observed (Fig. 2b; Supplementary Table S2), where individuals displayed behaviours rarely or not observed elsewhere, potentially associated with courtship or mating[18], including mixed-sex groups, females suspended motionless in a vertical position or resting on seafloor, and, in close proximity to males, one female with a sightly open cloaca with apparent discharge (Supplementary Table S2). These deeper, lower-flow environments may better accommodate copulation, which can be highly active and last for hours[19], while warmer ambient temperatures and access to geothermal heat may provide an energetic benefit. Behavioural thermoregulation during energetically demanding reproductive activities is a strategy known in terrestrial ectotherms[16] but would align with observations of females of both species positioning directly over vents during suspected oviposition. Additionally, one group of PWS females and males[7] were unusually stationary on seafloor suspected to be anomalously warm within a much deeper caldera[17] (Fig. 1b). If mating did occur here and elsewhere on the seamount slopes, female skates could subsequently use or store sperm[19], and females of other skate species have been shown to associate with egg-case nurseries for weeks to months, potentially providing multiple opportunities for mating and oviposition during an extended reproductive season[20]. Together, these observations suggest the nursery grounds and their setting—including geothermal heat—may benifit multiple stages of reproduction, from mating and oviposition to embryonic incubation—a potentially evolved strategy for exploiting rare heat in the otherwise near-freezing surrounding deep ocean.

The specificity of these egg-case nurseries, while likely driven in part by geothermal heat, reflects a broader convergence of favourable reproductive conditions. Both seamounts indeed concentrate nearly all conditions proposed to favour deep-sea skate egg development and survival[3,4,5,7,14] on narrow ~ 1-km-long summit ridges peaking at ~ 1580-m depth (Fig. 2d-e; Table 1): depths near the species' upper range; topographically enhanced currents increasing oxygenation and waste removal; low sedimentation limiting burial; rugged, low-gradient terrain retaining egg cases; warm ambient temperatures (summits ~ 1°C above typical deeper adult habitat[7]); physical isolation potentially reducing predation; environmental

stability; and proximity to deep water reducing migration. Yet these conditions alone cannot explain the specificity of site selection. Despite decades of regional exploration across seamounts, ridges, seeps, vents, and canyons sharing most or all these conditions[e.g., 9], no other nurseries have been discovered. Moreover, the two seamounts differ markedly in geology, local biological communities, and exposure to human pressures, including bottom-contact fishing[9,11,17]. Why, then, do these two sites support near-identical nurseries among so many apparently favourable alternatives?

A rare but shared trait emerges at the tectonic scale: all four known PWS nurseries worldwide occur on spreading centres. In contrast, other skate species nurseries, including those of AS, occur across diverse settings[e.g., 3,4]. Ts'íidaa lies on a spreading centre at a triple plate junction and Endeavour is encircled by two spreading centres (Fig. 2a)—settings unique among regional seamounts[9]; the only other known PWS nurseries, in Galápagos and Costa Rica, likewise occur on spreading centres[5,21]. These tectonic settings produce extensive volcanic terrains, including seamounts and ridges. Deep lava fields are preferred adult habitat for both species, particularly PWS[7], potentially reducing migration costs[3] and supporting large reproductive aggregations. Young spreading-centre crust, lacking sediment cover, also has elevated heat flow and widespread hydrothermal circulation, potentially providing warm seafloor conditions beyond discrete high-temperature discharge[22]. At Endeavour, nearby hydrothermal systems[23], shared vent-associated fauna, and slightly elevated temperatures (unpublished data[17]) provide indirect evidence of such conditions. At Ts'íidaa, diffuse flow occurred across the summit, with vents associated with orange mineral precipitates (likely iron oxides) and patches of orange flocculent material (likely microbial)[11] (Fig. 1e,j-k). Venting was concentrated along the ridge crest, where fracturing and pressure gradients driven by thermal processes[22] and potentially by bottom currents across the ridge[24] could sustain highly localized warm-fluid discharge, accelerating development without the stochasticity and extremes of focused, high-temperature discharge.

The tectonic setting may also help adults reliably navigate. Whether PWS and AS return through natal homing, as in sea turtles and salmon, are attracted to conspecific eggs, as in some insects[25], or use another mechanism is unknown. Yet, millions of egg cases concentrated in discrete habitats imply a substantial capacity to locate these ideal nursery grounds. Geomagnetic gradients are proposed as navigational cues in elasmobranchs[26], and PWS travelling high above the seafloor suggests reliance on broad-scale cues. Spreading centres and seamounts generate distinctive magnetic signatures in basaltic crust[27], raising the possibility that tectonic landscapes aid navigation to these nurseries. Once established, aggregation could reinforce site use through increased mating opportunities and reduced per-egg predation, while rapid post-hatching dispersal of neonates[14] may minimize competition otherwise associated with dense nurseries (no neonates or juveniles were observed). Some skate nurseries have persisted over geological timescales[28], and navigation cues and these positive feedbacks could perpetuate nursery use over similarly long timescales.

Conclusion

The striking similarity of two independent nurseries ~ 400 km apart reveals convergence in nursery habitat selection, combining known conditions favouring egg development with potential advantages for adults conferred by their tectonic settings. Collectively, these findings expand our understanding of deep-sea animals, revealing complex behaviours and life-history strategies operating across vast spatial and temporal scales yet ultimately dependent on remarkably small, specific habitats. The nurseries also highlight an underappreciated ecological function of seamounts and hydrothermal systems as reproductive habitat, with geothermal heat potentially benefiting both developing embryos and reproductive adults. However, such specificity creates vulnerability: incubation periods approaching a decade and potentially population-scale maternal investment concentrated at discrete sites may leave few, or only suboptimal, alternatives should these habitats be disturbed. Fishing, climate change, deep-sea mining, and other pressures increasingly threaten deep-sea habitats, particularly seamounts. Given how little of the deep sea has been explored, comparable specialized reproductive habitats likely remain undiscovered. Finding them may reveal other unexpected life histories while identifying exceptional habitats warranting conservation.

Methods

Study systems and deep-sea expeditions

This study was conducted at Ts'íidaa Seamount, offshore Haida Gwaii, and Endeavour Seamount, offshore Vancouver Island, Pacific Canada (Fig. 2A; Table 1). Data were collected during four deep-sea expeditions: Ts'íidaa Seamount from 15–29 June 2021, 28 May–12 June 2023, 13 August–3 September 2024, and 4–18 September 2025, with Endeavour Seamount also surveyed during the 2021 and 2025 expeditions. The first three expeditions were aboard the Canadian Coast Guard Ship *John P. Tully* and the final aboard the Motor Vessel (M/V) *CanPac Valour*. Imagery was collected using forward-facing video cameras with scaling lasers on the *BOOTS* tow-camera system (2021), remotely operated vehicle (ROV) *ROPOS* (2023 and 2024), and ROV *MANTIS* (2025). For nursery extent surveys, platforms were operated as close to the seafloor as possible and, in 2025, a downward-facing camera collected digital still images for density counts. We surveyed ~ 13 km from 9 dives at Ts'íidaa and ~ 5.5 km from 2 dives at Endeavour.

The study species—*Bathyraja spinosissima* (Beebe & Tee-Van, 1941), the Pacific White Skate (PWS), and *Amblyraja hyperborea* (Collett, 1879), the Arctic Skate (AS)—belong to the Chondrichthyes (Elasmobranchii). Both are solitary, highly mobile animals. When encountered opportunistically, dives were paused to document individuals and their behaviour. Following PWS often required the ROV to rise high above the seafloor and travel considerable distances to maintain visual contact.

Egg cases were collected from both nurseries in 2025 and photographed, examined, and measured in a shipboard laboratory[17] (Supplementary Table S1). Because PWS cases significantly tan, harden, and shrink with age, 24 newly deposited (golden) cases were used for morphometric measurements. Developmental stages are less readily distinguished by colour in AS, making targeted collection of newly

deposited cases more difficult. One early-stage AS case was collected, and its measurements therefore may underestimate the size and weight of newly deposited cases. Measurements included egg-case length (ECL; aprons included, horns excluded), egg-case width (ECW), and wet weight (WW), recorded in centimetres (cm) and grams (g), respectively.

Ship-based multibeam bathymetry was collected for Ts'íidaa Seamount in 2025 aboard M/V *CanPac Valour* at 15-m resolution[17] and for Endeavour Seamount in 2023 aboard Research Vessel (R/V*) Nautilus* and in 2025 aboard R/V *Atlantis*[29], both at 50-m resolution.

Observations of live skates were conducted remotely using non-invasive underwater imaging, without capture, handling, or experimental manipulation. A small fraction of new skate egg cases (n = 25; <<0.001% of the estimated abundance) were collected from spatially separated patches for laboratory examination under a Fisheries and Oceans Canada licence for scientific purposes. The egg cases contained early developmental stages unable to survive outside the egg capsule. The 2025 survey of Endeavour Seamount were conducted within the Tang.□□wan–ḥačx̌iqak–Tsigis Marine Protected Area (TḤT MPA), established in 2024, with all research activities reviewed and approved by the MPA management board through the required activity plan application process. All activities were conducted in accordance with applicable guidelines and regulations.

Image analysis

Dives totaled 81 hours of imagery: 67 hours at Ts'íidaa and 14 hours at Endeavour. Egg cases were annotated in two ways: for presence/absence, from forward-facing video for all dives, using BIIGLE (v.2); and density, from downward-facing stills, using ImageJ (v.1.54t). In total, 221 stills were analysed for egg-case species (based on published morphological taxonomy) and abundance, representing ~ 2–5 m^2 every 10 seconds on-bottom and standardized sampling effort between seamounts without image overlap. Scaling lasers were absent from still images, which were therefore scaled using visible egg cases as reference objects, based on the consistent mean PWS ECL of collected specimens (Supplementary Table S1). Bright-golden PWS cases were classified as newly deposited, compared with aged brown or black cases (e.g., Fig. 1D). Subtle colour differences in AS cases precluded equivalent classification. All intact egg cases were included in density measurements because hatched or predated eggs could only be distinguished if collected and examined.

In total, 78 adults of the study species (PWS and AS) were identified using published morphological taxonomy, along with four *Bathyraja abyssicola* (Gilbert, 1896), the Deep-sea Skate (Supplementary Table S2; no egg cases of this third species have been identified on the seamounts). Each observation was systematically assessed for demographic information, location, behaviour, and where applicable, swimming direction at first encounter, followed by documentation of subsequent behaviours or notable events. Location was derived from survey platform navigation data. Observation duration varied according to platform and operational constraints (e.g., in 2021 observations were < 1 min because of towed-camera limitations). AS tended to remain stationary on the seafloor as the platform approached,

making observations relatively easy. PWS, in contrast, were usually swimming above the seafloor, moving toward the summit, or engaged in active laying behaviour. The two longest observations followed PWS females with egg cases visible in the cloaca to document oviposition behaviour and duration.

Sex of individuals was determined by presence (male) or absence (female) of claspers. Distinguishing features, such as scars from scrapes and bite marks, were used to identify PWS individuals during dives; no individuals were identified across years. Equivalent individual recognition was not possible for AS because mottled patterns obscured these features. Behaviour at first encounter was classified following Kuhnz et al.[7] as resting, swimming, hovering, presumed feeding activity, or sediment burial (no feeding activity was observed), with qualifiers for swimming height (low 0–30 cm, medium 30–100 cm, and high > 100 cm) and swimming pace. Where possible, movement direction relative to slope was also recorded at first encounter. Subsequent behaviours, including those associated with egg laying (using publication descriptions of skates in captivity[19]), and observations of egg cases visible in the cloaca were documented throughout the remainder of each observation.

Size was measured in ImageJ when scaling lasers were projected onto the skate along its body axis. When lasers were aligned with the wingspan axis, body length was estimated using published wingspan-to-length ratios for PWS[30] and AS[31].

Mapping

Mapping and analyses were conducted in ArcGIS Pro (v.3.3.0) using image annotations (egg-case and adult presence/absence and egg-case density), submersible navigation data, and high-resolution multibeam bathymetry. Egg-case density was used to estimate total abundance, which was converted to biomass using the observed species ratio and species-specific wet weights from 24 collected PWS egg cases and one AS egg case (Supplementary Table S1). Abundance was also estimated separately for newly laid PWS egg cases. For consistent and conservative estimates, calculations used only two-dimensional surface area and were restricted to the shallowest, highest-density feature of each seamount: the summit ridge above 1700 m on Ts’íidaa Seamount and 1640 m on Endeavour Seamount. Abundance estimates exclude lower-density egg cases observed extending downslope, including beyond surveyed transects, therefore underreporting potentially hundreds of thousands of additional egg cases. Consequently, the full extent of nursery habitats meeting the definition[32], and their total egg-case abundance and biomass, are likely greater but remain unknown.

Declarations

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Author Contribution

All authors conducted fieldwork, wrote one or more sections of the manuscript, and reviewed the manuscript. C.D., H.G., and D.L. contributed to conceptualization, methodology, and analysis. M.B. and H.G. contributed to data curation. C.D., H.G., S.D., and M.B.-D. contributed to visualization. C.D. and T.N. contributed to funding acquisition and resources.

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Data Availability

All data supporting the findings of this study are available within the paper and its Supplementary Information. All dive imagery is available via SeaTube at https://data.oceannetworks.ca/ExpeditionManagement.

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Figures

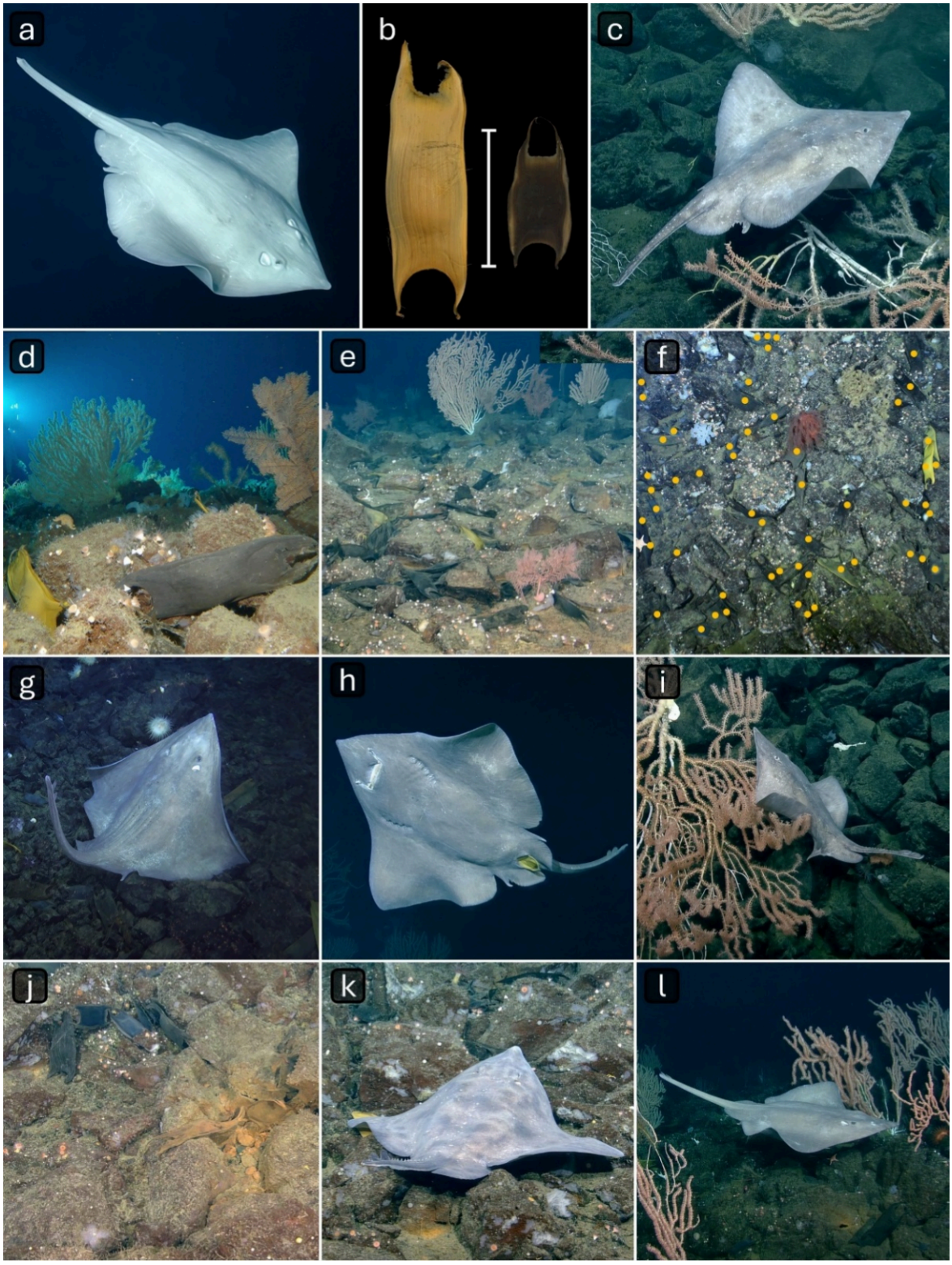


Figure 1

Female Bathyraja spinosissima, Pacific White Skate (PWS), and Amblyraja hyperborea, Arctic Skate (AS), egg-case nurseries, and oviposition behaviour on the summit ridges of Ts'íidaa and Endeavour seamounts. (A) Large (~2-m-long) PWS swimming high above the seafloor. (B) PWS (left) and AS (right) egg-cases, showing morphological differences (20-cm scale bar). (C) AS (<1 m long) swimming along the seafloor. (D-F) Egg-case aggregations: (D) a newly laid golden (left) and older dark-brown (right) PSW egg cases; (E)

dense PWS and AS egg cases among corals and fractured pillow basalt, with orange mineral precipitate associated with venting around rock bases; and (F) downward-facing still used to quantify egg-case density (yellow dots mark individual cases, 54 cases in frame). (G-I) Behaviors associated with oviposition: (G) PWS arching its body and raising its tail while brushing the seafloor, surrounded by egg cases; (H) PWS swimming high above the seafloor with protruding golden case; and (I) AS brushing the seafloor and coral while flexing its pelvic fins. (J-L) Interactions with vents: (J) dark PWS and AS egg cases in crevices with small patch of orange precipitate (top left) and PWS egg cases within a vent orifice coated in orange precipitate (middle right); (K) stationary AS with its pelvic region directly over a small vent orifice; and (L) PWS hovering over vent orifice. See Supplementary Table 2 and Supplementary Video for further information on habitat use and reproductive behaviour.

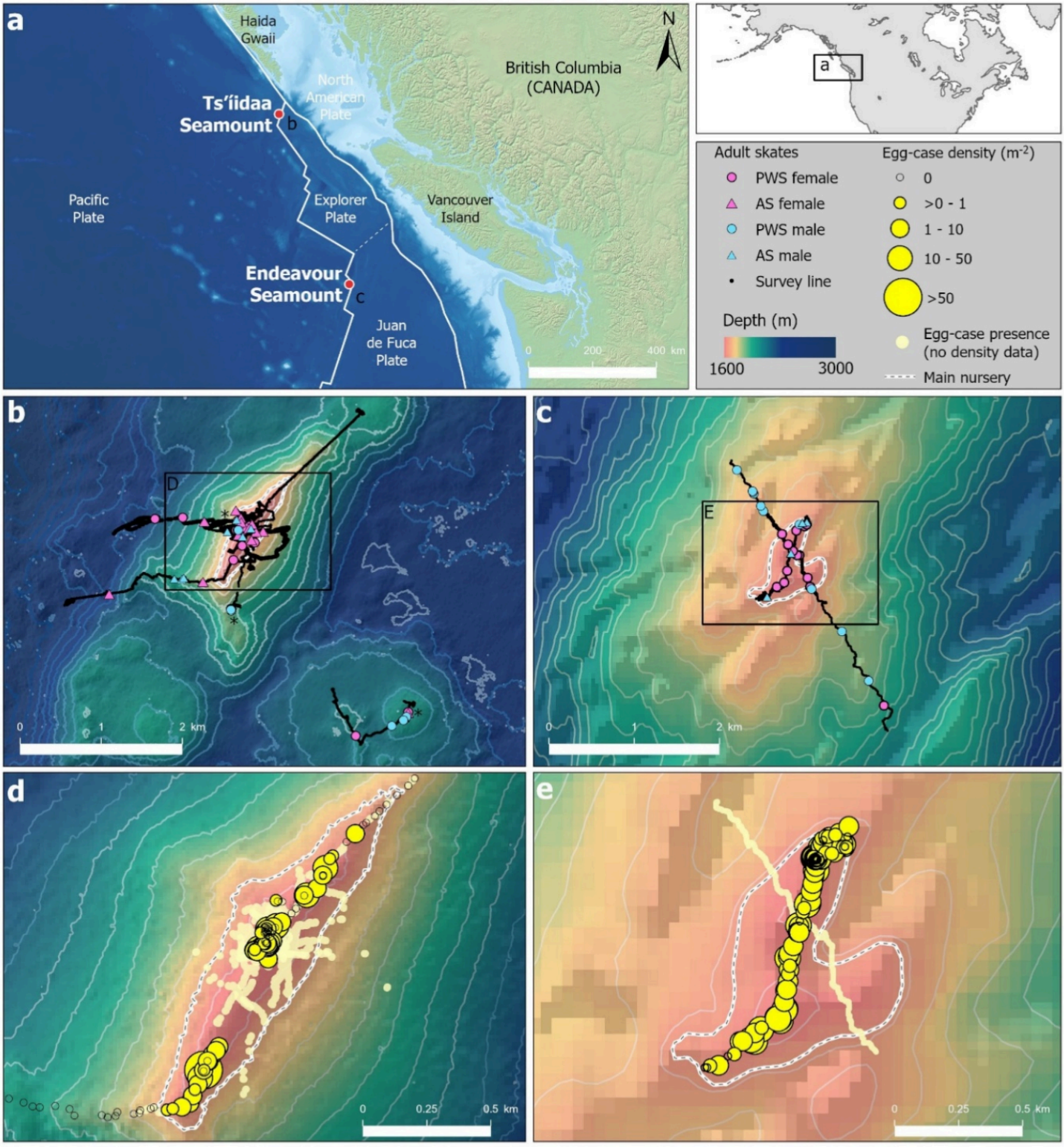


Figure 2

Spatial distribution of deep-sea skates and egg-case aggregations. (A) Location of Ts'ĭidaa and Endeavour seamounts off Pacific Canada in relation to tectonic plates. (B) Ts'ĭidaa Seamount and (C) Endeavour Seamount bathymetry showing survey tracks (black dots) and adult Bathyraja spinosissima, Pacific White Skate (PWS; circles), and Amblyraja hyperborea, Arctic Skate (AS; triangles), observations of females (pink) and males (blue), and shallow ridge crests (dashed outline). Asterisks indicate locations of groups of

skates, where symbols overlap and numbers and sex are obscured. (D-E) Summit egg-case distribution, showing presence (light yellow dots; presence confirmed but density not quantified) and density (graduated yellow circles) concentrated along the shallow ridge crests. Bathymetric contours are at 50-m intervals. See Table 1 for abundance and density estimates, Supplementary Table S2 for adult distributions and behaviours, Supplementary Video for in situ observations of the nurseries and adult reproductive behaviour, and Methods for details on bathymetry.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementaryTables.xlsx
- SupplementaryVideoSD480p.mov