



1 **KRILLBASE-larvae: a database of abundance of** 2 **eggs and larval stages of *Euphausia superba* in the** 3 **Southern Ocean spanning 1926-2024**

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28 29 **Abstract.**

30 Antarctic krill (*Euphausia superba*, hereafter “krill”) are an important component of Southern
31 Ocean food webs, are efficient in sequestering carbon and support a major fishery.

32 Knowledge of their early life cycle is key to understanding krill population dynamics and
33 essential for fisheries management in a warming climate. Many data have been collected
34 over the years on the distribution of krill larvae, but the data remain fragmented and hard to
35 re-use. Here we have put these disparate data sources together into a large database of
36 10,762 net-sampling records with numerical abundance data on the various larval stages.

37 This new *KRILLBASE-larvae* database complements two existing and circumpolar
38 *KRILLBASE* open-access databases, namely *KRILLBASE-abundance* (numerical
39 abundance of postlarval krill and salps) and *KRILLBASE-length frequency* (length, sex and
40 maturity stage of postlarval krill). By completing the set to include larvae, we provide
41 datasets that can underpin a more holistic appreciation of krill dynamics; for example to



42 model the krill life cycle, population dynamics, response to climate change and to help
43 manage the krill fishery. *KRILLBASE-larvae* is circumpolar, albeit with most data
44 concentrated in the SW Atlantic sector which appears to be the major spawning ground and
45 where the fishery operates. The data span 1926-2024 with >50 seasons of coverage
46 spanning two epochs: 1926-1937 and 1976-2024. The database is based on net haul data
47 on densities (numbers per m²) of eggs, nauplii, metanauplii, calypotopae- and furcilia stages,
48 alongside key sampling information such as sampling depths, net type, net mesh size, water
49 depth, temperature etc. This data paper provides a description of *KRILLBASE-larvae*,
50 mapping data coverage in terms of space, time and sampling depth, providing pointers and
51 caveats to its use. The *KRILLBASE-larvae* database is available here for reviewers:
52 [http://ramadda.data.bas.ac.uk/repository/entry/show?entryid=946546c8-b24f-422f-96e1-](http://ramadda.data.bas.ac.uk/repository/entry/show?entryid=946546c8-b24f-422f-96e1-3bd872506c5f)
53 [3bd872506c5f](http://ramadda.data.bas.ac.uk/repository/entry/show?entryid=946546c8-b24f-422f-96e1-3bd872506c5f) with user id `reviewer_02221` and password `VchJWSANpH1T5Wpj`
54 with instructions <https://www.bas.ac.uk/data/polar-data-centre/reviewer-access/> [Pending
55 publication and any subsequent amendment on review, the final dataset will be freely
56 available with a doi and single click to download]. We request that this data doi and the data
57 paper are cited when the data are used.

58 1. Introduction

59 *Euphausia superba* is an important species for Southern Ocean food webs (Voronina,
60 1998; Croxall et al., 1999), for biogeochemical cycling (Schmidt et al., 2016) and for carbon
61 export (von Bodungen et al., 1986; Cavan et al., 2019). It also supports the largest fishery in
62 the Southern Ocean, with annual landings now exceeding 0.6 million tonnes and valued in
63 hundreds of millions of \$US, making it of similar importance to other major global fisheries
64 (Meyer et al., 2025). With rapid warming and recent abrupt sea ice loss in Antarctica
65 (Raphael et al., 2025), an understanding of the life cycle, distribution and population
66 dynamics of krill is essential for understanding change in the Antarctic food web, carbon
67 export as well as for managing the krill fishery.

68 The importance of krill in the Southern Ocean food web was recognised well over a
69 century ago, and sustained, quantitative data on its abundance and population structure
70 span from the *Discovery Expeditions* starting in 1926 (Marr, 1962). In recent years these
71 major survey campaigns with nets have become less frequent, partly due to cost and partly
72 because of improvements of acoustics, imaging and autonomous platforms (Reiss et al.,
73 2021; Hill et al., 2024). However, net sampling remains essential to distinguish the larval
74 stages which require expert microscopic identification. Knowledge of larval distribution and
75 temporal dynamics is important for several reasons. First, in good spawning years these
76 stages are exceptionally abundant and important in the food web (Pakhomov et al., 2004;
77 Rombolá et al., 2019; Kasyan, 2022). Second this information is crucial to model the life
78 cycle and to better understand where the species spawns and what causes the major inter-
79 annual variation in recruitment seen in this species (Atkinson et al., 2019). Knowledge of the



80 complete krill life cycle is essential to understand krill population dynamics and thus manage
81 the fishery under climate change (Kawaguchi et al., 2024).

82 While much net-based data on krill abundance and population structure exist, from the
83 Discovery Expeditions to the present day, most of these are scattered, often in notebooks,
84 institutional databases or appendices of publications. To rectify this, the KRILLBASE project
85 started over 25 years ago, initially to create a central database of abundance of postlarval *E.*
86 *superba* and salps based on all available net sampling records (Atkinson et al., 2017). This
87 is known as *KRILLBASE-abundance* and was followed by *KRILLBASE-length-frequency*
88 (Atkinson et al., 2020a), a larger database on postlarval krill length, sex and maturity stage.
89 The present paper completes the trio with *KRILLBASE-larvae*, a circumpolar database of
90 abundances of krill eggs, nauplii, metanauplii, calyptope and furcilia larval stages. Here we
91 describe this third database. Users of *KRILLBASE-larvae* are requested to first read this
92 data paper to correctly screen and interpret the data and to cite this data paper as the
93 source of the data.

94

95 **2. Data and methods**

96 **2.1 KRILLBASE overview**

97 The three KRILLBASE databases (*KRILLBASE-abundance*, *KRILLBASE-length frequency*
98 and *KRILLBASE-larvae*) represent a compilation of all accessible data spanning from 1926.
99 The data have all been collected with nets and analysed by taxonomists and the only krill
100 species included is *E. superba*. The basic structure and field naming conventions have been
101 kept as similar as possible between all three databases. Records for these databases have
102 been collated from a variety of sources, including transcription from sampling log-sheets,
103 transcription from published tables or figures, obtained from national databases or sent by
104 co-authors or data originators. The data sources for *KRILLBASE-larvae*, reported here, are
105 summarised in **Table 1**. While the data span 1926-1937 (hereafter called the *Discovery era*)
106 and 1976-2024 (called the *modern era*) the data are not a true time series since they have
107 been collected with a variety of different net types around the Southern Ocean with different
108 net meshes, sampling depths, times of the day and times of year. Likewise, distribution maps
109 presented here may not represent synoptic snapshots of distribution. The version of the
110 *KRILLBASE-larvae* database that we present here represents the first published version of
111 this database and we anticipate that subsequent data updates will build on this.

112

113 **2.2 KRILLBASE-larvae: relationships with other databases**

114 *KRILLBASE-larvae* provides numerical abundances (no. m⁻² within the depth range
115 sampled by the net) of eggs, nauplii, and individual calyptope and furcilia stages. By contrast
116 *KRILLBASE-abundance* provides numerical abundance of postlarval krill (alongside that of
117 salps) without any attribution of length or maturity stage. This information for postlarvae is
118 presented by *KRILLBASE-length-frequency*. There is a degree of life-stage ambiguity in the



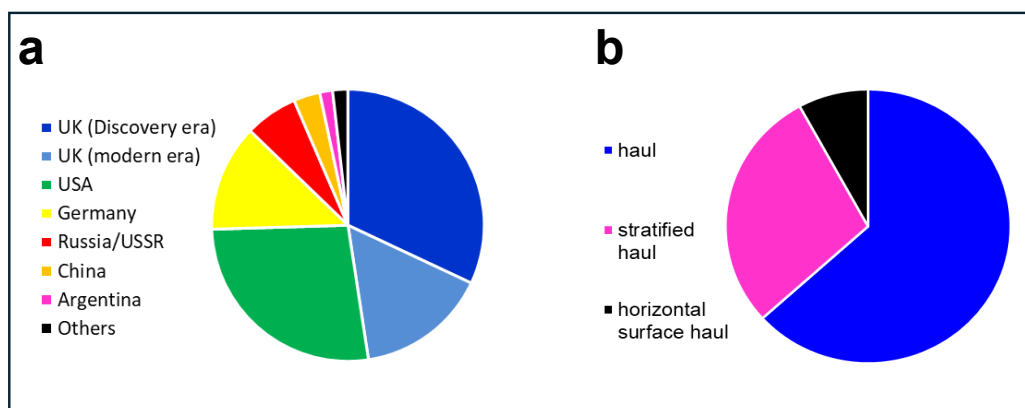
119 size range 15-20 mm spanning late stage furcilia and the smallest juveniles. This size range
120 appears to be under-represented in net surveys (and poorly resolved by acoustics) with
121 numbers much lower than would be expected based on simple population dynamics models
122 that include mortality (Atkinson et al., 2009). Some of the smallest individuals in
123 *KRILLBASE-length frequency* are probably furcilia stages. Likewise, for *KRILLBASE-*
124 *abundance*, a threshold of 19 mm was used for inclusion as postlarvae during the Discovery
125 era.

126 To our knowledge, *KRILLBASE-larvae* is the first large database specific to larval stages
127 of *E. superba*. The Southern Ocean Continuous Plankton Recorder (CPR) has records of *E.*
128 *superba* larvae but these are not included here, since the CPR records are well documented
129 and available (Kitchener and Hosie, 2024) and in any case the very different method of
130 sampling makes comparison of numerical abundances with vertically integrating samples
131 difficult. Other large portals such as OBIS (OBIS, 2026) or SOOS (ten Hoopen et al., 2025)
132 contain krill data (including *KRILLBASE-abundance* in various versions) and may include
133 larvae, but to our knowledge the data are not assigned to quantitative counts for individual
134 maturity stages.

135

136 2.3 Overview of the structure of *KRILLBASE-larvae*

137 The database is available as a single CSV file with rows representing individual net
138 hauls and columns being data attributes. The data are archived at the UK Polar Data Centre
139 hosted at British Antarctic Survey, Cambridge, UK. For consistency throughout this paper,
140 upper case labels (e.g. BOTTOM_SAMPLING_DEPTH_M) are field names within the
141 database (i.e. column headings) whereas searchable terms (e.g. *stratified haul*) are
142 italicised. **Table 1** describes the data sources that comprise *KRILLBASE-larvae*, while **Table**
143 **2** describes in detail the information recorded in each field. The data were entered typically
144 in batches listed in the second column (called RECORD_GROUP) with these typically being
145 a single cruise, publication that was transcribed, or single block of data submitted by one of
146 the contributors. The database is circumpolar in extent and is a multinational collaboration
147 (**Fig. 1a**). It comprises three basic net types defined in the RECORD_TYPE field, namely



148 **Fig. 1.** Distribution of sample records. Panel (a) Origin by country. The “others” category
149 includes Ukraine (51 records), Chile (40 records), Poland (37 records), Japan (36 records),
150 and Norway (31 records). Panel (b) distribution of haul types (see Table 2 for haul
151 designations). The stratified pooled hauls are not included here as these contain the summed
152 data from the component stratified hauls.

153

154 *hauls* (standard, vertical or oblique hauls are the most common type); *horizontal surface*
155 *hauls* (mainly from the Discovery era); and *stratified hauls*, where the haul is part of a
156 vertically integrating suite of hauls, (e.g. 0-50m, 50-100m, 100-250m etc). The abundances
157 per m² of each of these stratified hauls has been summed into a *stratified pooled haul*, the
158 fourth net category, with top and bottom sampling depths in the above example being 0 and
159 250 m respectively.

160 Importantly, initial screening of *KRILLBASE-larvae* should exclude either stratified hauls
161 or stratified pooled hauls to avoid double counting of the same data (see section 3.1 on data
162 screening and usage)

163 2.4 Data processing and error checking

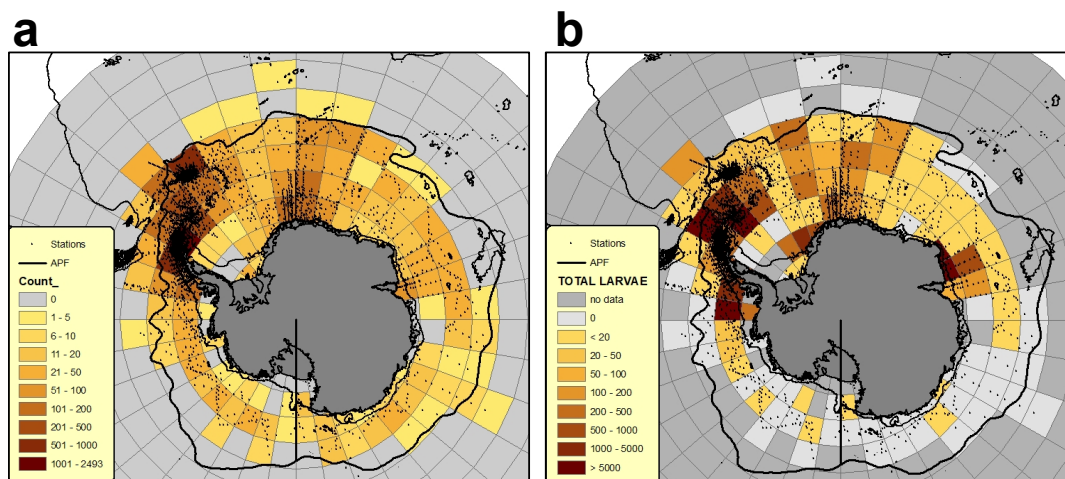
164 *KRILLBASE larvae* was constructed initially by building on a smaller larval dataset of
165 about 1000 records (i.e. RECORD GROUP nos 1-7,9-10, illustrated in Siegel and Watkins
166 2016). These data were compiled and kindly sent by Volker Siegel. Unfortunately, some of
167 the documentation for these records (e.g. exact date of sampling) is unknown, and overall,
168 this larval database tends to be less supported with sampling information than *KRILLBASE-*
169 *abundance*, particularly on the time of day of sampling. For this reason, we have provided
170 fairly extensive comments on the data in the final four fields. These provide separate
171 comments respectively on: net sampling details other than date or time of sampling;
172 comments on date or time of sampling; comments on the attribution of sampling as being in
173 day or night; and comments on the recording and transcription of the larval stages.



174 The latter issue, namely whether eggs, nauplii and metanauplii were recorded and
175 transcribed alongside the larger calyptope and furcilia stages, is probably the main single
176 source of uncertainty in this database. We have been conservative when there was
177 ambiguity (usually where data on abundances of calyptope and furcilia stages were provided
178 but there was no information on eggs or nauplii/metanauplii). Here we entered absent data
179 rather than zero values. An important additional caveat on the identification of eggs and early
180 larvae is that there is a considerable size overlap, particularly of eggs of Antarctic krill and
181 those of ice krill *Euphausia crystallophias* which also overlaps spatially with *E. superba* on
182 high-latitude shelves. This makes separation of the earliest stages problematic.

183 We performed basic error checking, for example by plotting RECORD_GROUP
184 individually to ensure latitude and longitudes were not transposed, the wrong sign or plotting
185 over land. Because the abundance data were often transcribed by us from publications or
186 provided with minimal supporting information, it was often not possible to double check the
187 detail, other than for internal consistency. Where the numbers of krill, n , were provided per
188 m^3 filtered, the density of larvae under 1 m^2 (N) was calculated based on top-sampling depth
189 t and bottom-sampling depth b in metres as $N = n \times (b - t)$.

190 2.5 Variation in sampling coverage and method



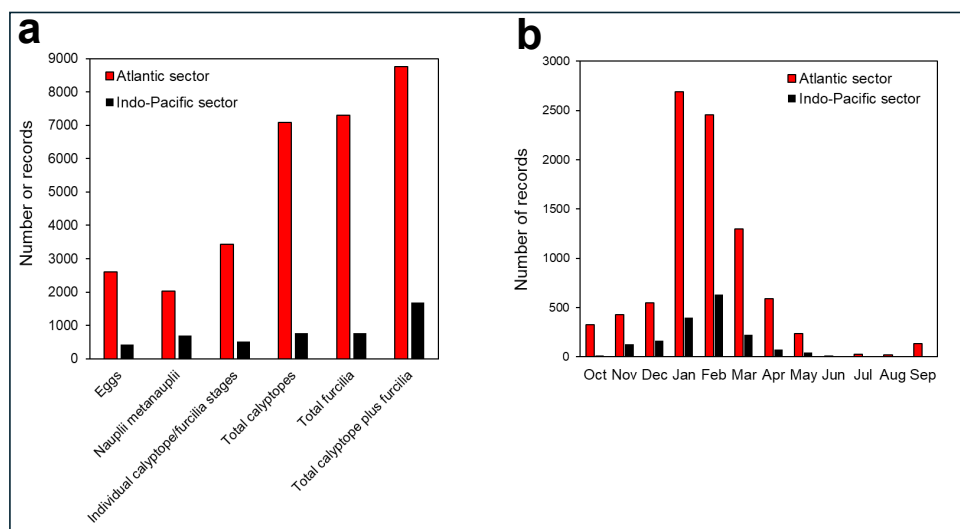
191 **Figure 2.** Coverage of all 7852 available sampling stations, 1926-2024, i.e. irrespective of time
192 of year or depth range. Panel (a) sampling density (i.e. number of stations summed for each
193 cell of a 5° latitude by 10° longitude grid). Please note that stratified hauls at a single station
194 only count as one station in this map (total number of records including stratified hauls is
195 10762). Panel (b) mean density of total larvae (calyptopes plus furcilia combined) within each
196 grid cell. Dots represent stations, and at the scale of this map adjacent very closely spaced
197 stations or those sampled multiple times only appear as one dot. The thin black line marks the
198 1000 m isobath.

199

200 **Fig. 2 a** shows the density of sampling in KRILLBASE larvae, with a strong
201 concentration of sampling in the Atlantic sector, particularly in the main fishing grounds on



202 the fringes of the Scotia Sea. This reflects the main concentrations of high density of krill
203 larvae (**Fig. 2b**) although high densities are seen in other areas, such as the Bellingshausen
204 Sea and off Prydz Bay. Overall densities seem to be highest in the Atlantic sector and lowest
205 in the Pacific sector.



206 **Fig. 3** Sampling coverage according to sector, larval stage and time of year. Panel (a) number
207 of records in KRILLBASE-larvae with data (i.e. with zeroes or positive abundance values) for
208 various individual and pooled larval stages, from both the Atlantic sector (red bars, 10°E to
209 90°W) and the remaining Indo-Pacific sector (black bars). Panel (b) coverage by month in the
210 two sectors.

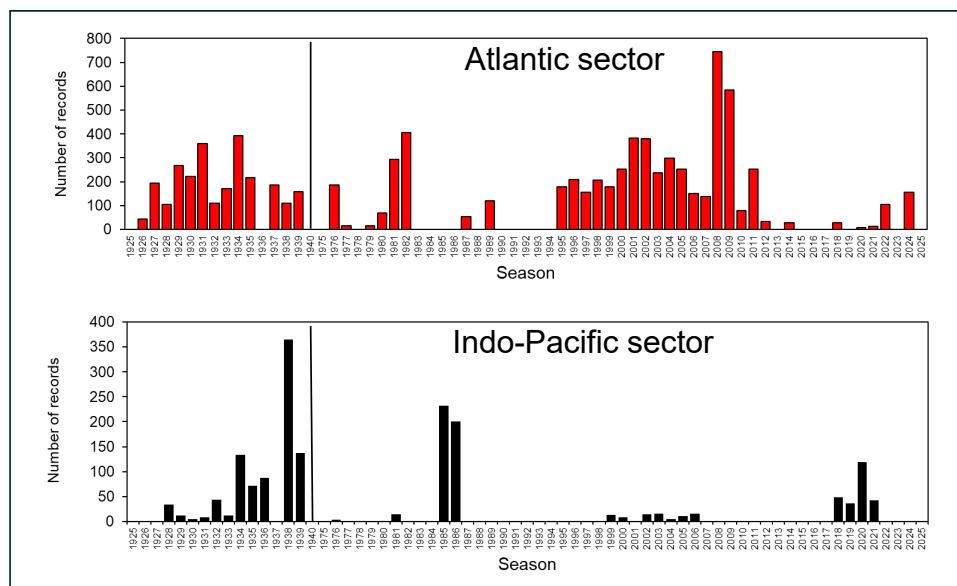
211

212 Overall distribution maps such as **Fig. 2b** are sensitive to the details of sampling, for
213 example with much more extensive information for the older larval stages (calyptopae and
214 furcilia) than the eggs, nauplii or metanauplii (**Fig 3a**). There are records in both sectors for
215 every stage (with the individual stages of calyptopae and furcilia fully resolved). However, in
216 most net hauls we only have totals for all calyptopae or furcilia stages combined, stages
217 combined and occasionally all larvae combined records only. The latter is the case for one of
218 the RECORD_GROUPS, namely No. 34, where we only have data within broad size ranges.
219 For this reason, we have provided a field entitled

220 PRESENCE_1_OR_ABSENCE_0_OF_CALYPTOPES_AND_FURCILIA where we have
221 simply scored presence or absence of calyptopae and furcilia, to maximise inclusion of data.

222 Antarctic krill spawn throughout the summer months, and accordingly most sampling is
223 in the second half of the austral summer from January onwards (**Fig. 3b**). Larval
224 abundances before then tend to be much lower.

225 **Fig. 4** shows the sampling coverage by year in the Atlantic and remaining sectors.
226 Coverage in the Discovery era of sampling (1926-1939) is relatively good in all sectors. In
227 the modern era there is a noticeable paucity of sampling particularly in the Pacific sectors, so



228

229 **Fig. 4.** Sampling coverage in the Atlantic (10°E-90°W) and remaining Indo-Pacific sectors
230 according to year. The respective panels show the total number of records within each austral
231 SEASON (i.e. spanning 1 October to 30 September – see Table 2).

232

233 apparently low densities of larvae in this sector need verification with modern sampling,
234 given the known relative redistribution of krill densities (Yang et al., 2021). In the Atlantic
235 sector and the modern era, the most extensive data coverage spans around 1985 to 2010.
236 After this period several important programs such as AMLR (Antarctic Marine Living
237 Resources) stopped sampling krill larvae and while many surveys have been conducted,
238 euphausiid larvae are not assigned to species as frequently as they used to be perhaps due
239 to lack of taxonomic expertise. This has led to a substantial decline in data volume available
240 from the last 10 years.

241 A key factor determining the densities of krill larvae recorded by the nets is the depth to
242 which they sample. Krill eggs sink and hatch to nauplii at substantial depths, usually >500 m,
243 with the subsequent larval stages moving progressively nearer the surface (Marr, 1962,
244 Siegel and Watkins (2016). This is well illustrated in KRILLBASE-larvae (**Fig. 5**) where the
245 blue histograms show deep distributions of eggs, nauplii and metanauplii, intermediate
246 distributions of the calyptope stages and the furcilia mainly within the top 200m. This poses
247 issues particularly for net sampling to faithfully portray distribution of the earlier stages since
248 most nets are only sampling the top few hundred meters (red histograms in **Fig. 5**).

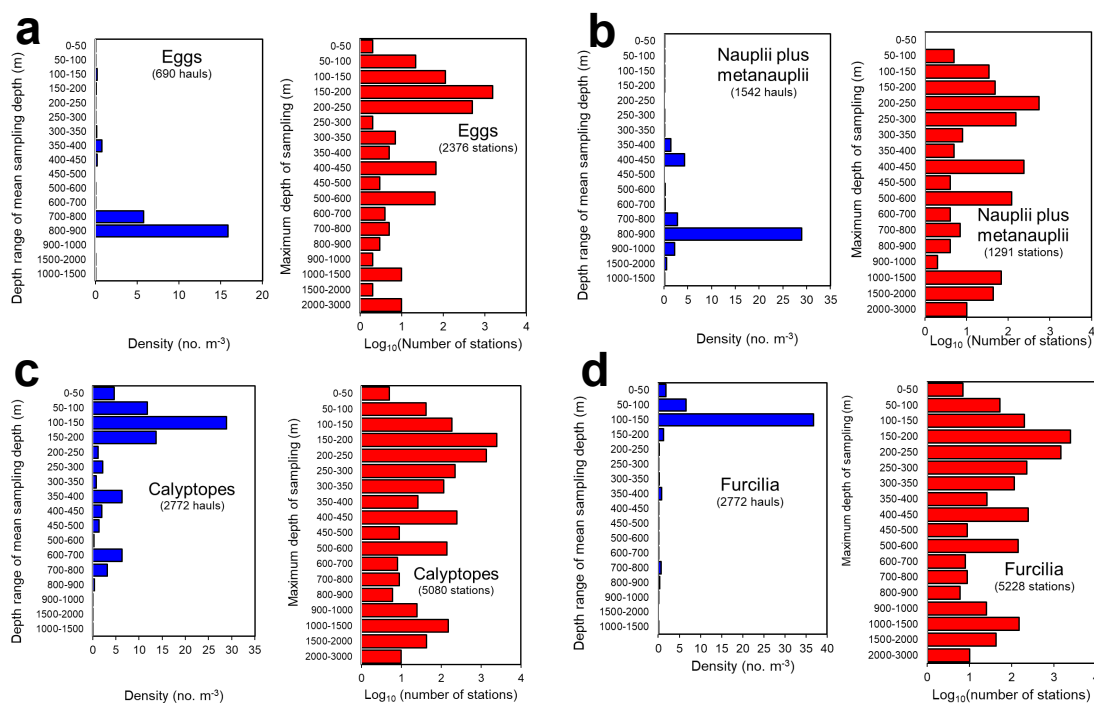
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251



252



253 **Fig. 5.** Vertical distribution of the larval stages in relation to the maximum depths reached by
 254 the nets. The data are presented separately for Panel (a) eggs, Panel (b) nauplii and
 255 metanauplii, Panel (c) calyptopes and Panel (d) furcilia larvae. Each panel comprises first a
 256 blue histogram, based on all available stratified hauls. The mean depth was calculated for
 257 each stratified haul and these were grouped into bins for plotting larval densities (no m⁻³). The
 258 red histograms comprise data from stratified pooled hauls and hauls only, and groups hauls
 259 according to the bottom sampling depth (the top sampling depth was usually the surface).

260 3. Results and Discussion

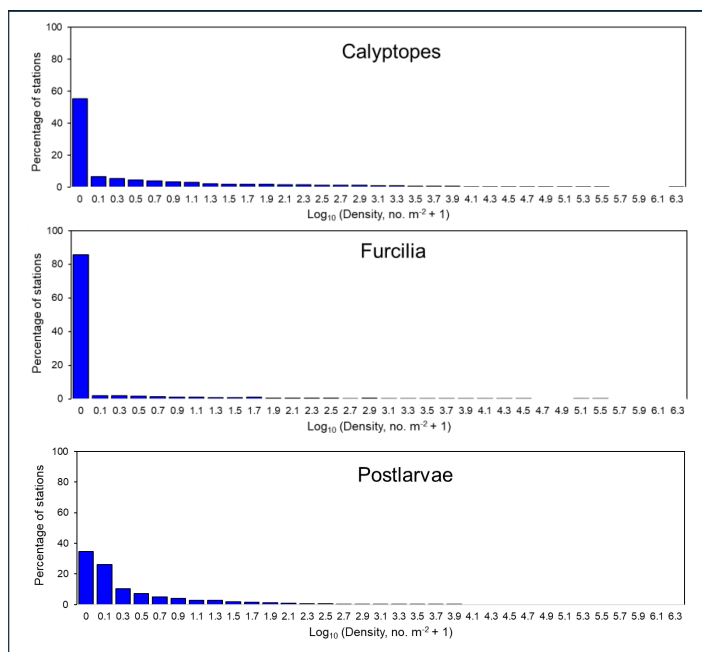
261 3.1 Suggestions for screening and using KRILLBASE-larvae

262 All uses of KRILLBASE will require some data screening, and this reflects a trade-off
 263 between the need to remove unrepresentative or misleading data and the need to retain a
 264 sufficient volume of data to be able to draw meaningful conclusions. We have already
 265 mentioned (Section 2.3) that an initial data screening should always be according to
 266 RECORD_TYPE. Larval abundance varies enormously from year to year and over small
 267 spatial scales and some stages live mainly at depth. Based on the authors' opinions, we
 268 suggest that some of the main factors (screen-able in KRILLBASE) include, for any given
 269 geographical area:

- 270 • Year of sampling
- 271 • Depth of sampling
- 272 • Time of year of sampling



273 Various other variables are available to screen these data, for example according to net
274 mouth area or mesh size but the large majority of nets used were of suitable diameters and
275 mesh size to capture the larval stages enumerated in them, so we consider that these have
276 less importance for most larval stages than the three factors listed above.

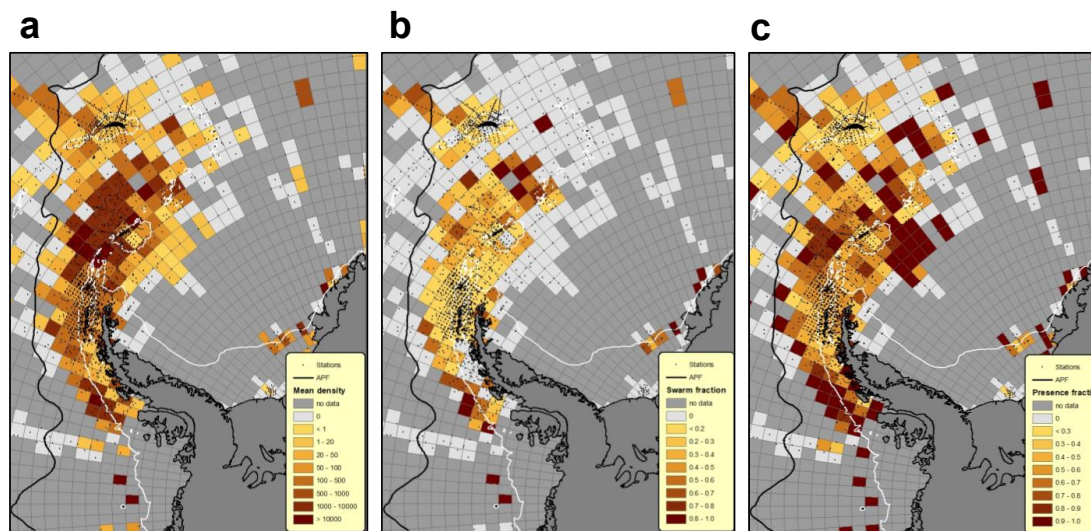


277 **Fig. 6.** Highly skewed frequency distribution of all krill life stage abundances. This plot is
278 based on HAUL TYPE comprising *hauls* and *stratified pooled hauls* only and based on 4970
279 stations for total calyptopes and 5118 stations for furcilia larvae. Data on postlarvae from
280 11611 stations from *KRILLBASE-abundance* is shown in the bottom panel for comparison. All
281 abundances were $\log(x+1)$ transformed and placed in equal 0.2 logarithmic bins with labels
282 marking the bin midpoints. Note the extreme right-skew distribution of larval stages even in
283 comparison to the highly patchy postlarval distribution.

284

285 To illustrate the extreme patchiness of larval krill records **Fig. 6** shows a frequency
286 distribution of abundance of calyptopes and furcilia, relative to a plot for the postlarvae
287 derived from *KRILLBASE-abundance*. The right skew for larvae (a few massively high
288 abundances and many zeroes) is very pronounced, even compared to the postlarvae which
289 are known for their swarming ability. This right skew likely reflects not only spatial patchiness
290 but enormous differences in abundance between years, related to the characteristic episodic
291 spawning of this species. Notwithstanding the cause, this highlights the major challenges in
292 portraying spatial and temporal distribution (Cox et al., 2018; Hill et al., 2019), where trends
293 found in the postlarvae are highly sensitive to the approach to data pooling and
294 transformation.

295

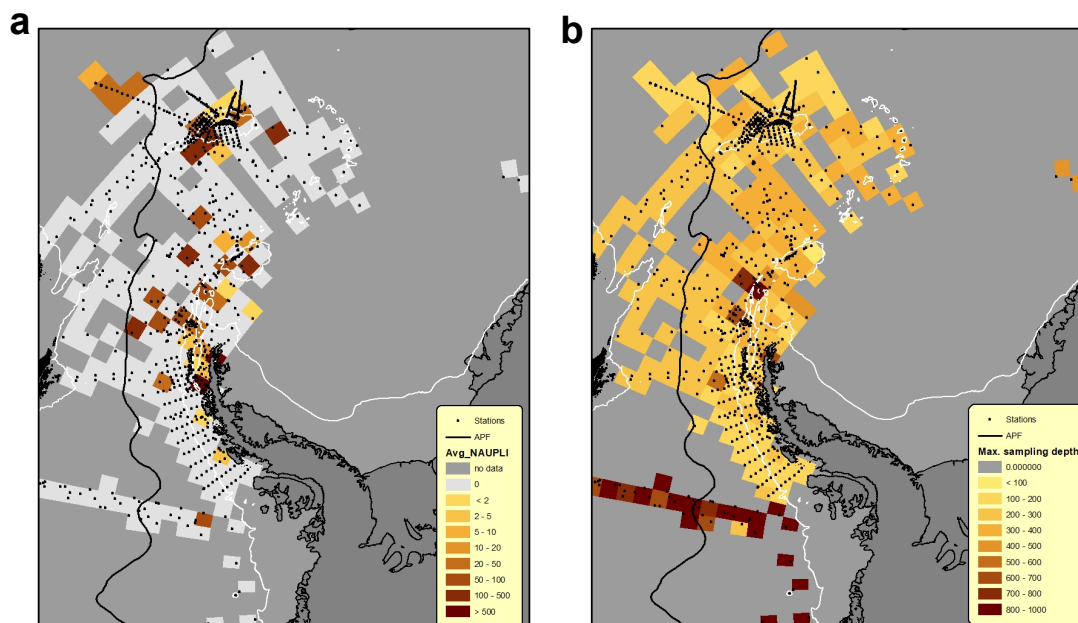


296 **Fig. 7.** Illustration of the impact of extreme data skewness on the plotting of larval
297 distribution. Distribution maps show slightly different hotspots of distribution according to the
298 metric used. The example here is the TOTAL_CALYPTOPES_UNDER_1M2 category, in
299 relation to the 1000 m isobath (white) and Antarctic Polar Front (black). The data were
300 screened to remove stratified hauls and horizontal surface hauls, then to remove all winter
301 hauls between May and September inclusive, then all hauls whose top sampling depth was
302 >20 m and bottom sampling depth < 50 m. This left 4775 stations, plotted here for the
303 Atlantic sector on a 1° degree latitude by 2° longitude grid. Panel (a) arithmetic mean krill
304 density. Panel (b) fraction of stations within the grid cell whose density was within the top
305 10% of observations (i.e. >121 inds. m⁻²; Atkinson et al. 2021). Panel (c) fraction of stations
306 with non-zero total calyptope densities.

307

308 We have illustrated the same problem of dealing with highly skewed data for
309 interpreting spatial distribution of larvae in **Fig. 7**. This figure shows the main distribution
310 centre of larvae in the SW Atlantic sector, with the same screened source dataset for
311 calyptopes (4775 stations) plotted in three different ways. If data are plotted as the arithmetic
312 mean value of stations within each grid cell (**Fig. 7a**) there are a series of clear, high-density
313 distribution hotspots just north of the south Scotia ridge. If the data are plotted as the fraction
314 of stations in each grid cell with very high densities (**Fig. 7b**) the pattern is very different,
315 being more dispersed without the high population centre evident in **Fig. 7a**. If, however, the
316 data are plotted simply as fraction of positive hauls the pattern is also different, with apparent
317 hotspots of occurrence in some fringing areas with lower sampling density. Because
318 presence-only data or presence-absence is a frequent measure in species distribution
319 models, we present this example where it can provide a potentially misleading picture of
320 population hotspot areas, with the pattern in **Fig. 7a** being a more common depiction of larval
321 nursery areas (Siegel et al., 2013; Rombolá et al., 2019; Perry et al., 2019).

322



323 **Fig. 8.** Illustration of the potential effect of sampling depth on early larval stage distribution.
324 Panel (a) mean density of nauplii and metanauplii, excluding horizontal surface hauls,
325 stratified hauls and hauls with bottom sampling depths < 50 m. Panel (b) average value of
326 the maximum sampling depth (i.e. value of `BOTTOM_SAMPLING_DEPTH_M`). Based on
327 the vertical distribution of these larval stages shown in Fig. 5b, most of the net sampling was
328 probably too shallow to provide a good quantitative picture of abundance of these stages.

329

330 We have illustrated the importance of sampling depth for nauplii and meta-nauplii
331 distribution in the SW Atlantic sector (**Fig. 8a**). These stages are found very sporadically
332 over wide areas of the SW Atlantic sector including near South Georgia, and high
333 abundances are found in shelf waters as well as oceanic waters, supporting recent
334 suggestions that the species spawns successfully over shelf waters (Perry et al., 2025).
335 However, **Fig 8b** shows that the large majority of net sampling is to relatively shallow depths
336 (median sampling depth is 250m for **Fig. 8**). Based on **Fig. 5b**, this sampling depth will only
337 catch a minority of these stages.

338 3.2 Data availability and use

339 To make *KRILLBASE-larvae* easier to use, we have provided several combinations of
340 the abundance fields, for example larval stages individually and pooled, as well as presence-
341 absence data which captures most data records but has the important caveat that presence-
342 absence metrics may not capture distribution hotspots (**Fig. 7**). We have also included
343 concurrently-measured surface temperature data where available, but because neither
344 temperature or water depth were commonly available with the records we have added
345 GEBCO-derived water depths to each record, alongside a long-term climatological mean



346 summer water temperature. Both of these environmental data were added to KRILLBASE-
347 larvae in exactly the same way as they were from *KRILLBASE-abundance*, allowing a broad
348 scale environmental context for these observations.

349 The KRILLBASE-larvae database is available here for reviewers:

350 [http://ramadda.data.bas.ac.uk/repository/entry/show?entryid=946546c8-b24f-422f-96e1-](http://ramadda.data.bas.ac.uk/repository/entry/show?entryid=946546c8-b24f-422f-96e1-3bd872506c5f)

351 [3bd872506c5f](http://ramadda.data.bas.ac.uk/repository/entry/show?entryid=946546c8-b24f-422f-96e1-3bd872506c5f) (Atkinson et al., 2026) with user id [reviewer_02221](#) and password

352 [VchJWSANpH1T5Wpj](#) with instructions [https://www.bas.ac.uk/data/polar-data-](https://www.bas.ac.uk/data/polar-data-centre/reviewer-access/)

353 [centre/reviewer-access/](https://www.bas.ac.uk/data/polar-data-centre/reviewer-access/) [Pending publication and any subsequent amendment on review,

354 the final dataset will be freely available with a doi and single click to download]. When using

355 these data, please first consult the metadata in this data paper, particularly **Table 2** as well

356 as our suggestions on data screening which is essential at some level for all uses of these

357 data. We request that data users please cite the original data source by citing this data

358 paper. Citing the original data source (even if the data become ingested at some later stage

359 into OBIS or similar global portals) is important for two reasons. First, it allows correct

360 traceability and version control of the data actually used. Second it allows us to trace data

361 use, potentially enabling us to justify future funding for subsequent updates. Data from

362 outside of the Atlantic sector (for example Australian data) were not available in time for this

363 initial version of *KRILLBASE-larvae*, and we hope to provide periodic updates to all three

364 *KRILLBASE* databases to improve their wider utility for krill research and fisheries

365 management.

366 Earlier versions of *KRILLBASE-larvae* have already been used in several

367 publications. Perry et al. (2019) combined all three *KRILLBASE* databases to examine

368 spawning hotspots and nursery areas in the SW Atlantic, and Green et al. (2021) used these

369 distributions in modelling circumpolar spawning habitat suitability. A later prototype of

370 *KRILLBASE-larvae* was then used to examine stepwise shifts in the distribution and

371 spawning sites of krill (Atkinson et al., 2021). Uptake and usage of *KRILLBASE-abundance*

372 increased rapidly after producing a data paper and we hope the same will occur for

373 *KRILLBASE-larvae*.

374 **4. Conclusions**

375 In conclusion, the *KRILLBASE* project is a work in progress to make krill data from a

376 variety of sources more easily available to help research and management. Funding for

377 many national Southern Ocean programs and time series is diminishing, krill sampling is

378 becoming more acoustics and imaging based, and scientists are becoming less able to

379 identify krill larval stages (Hill et al., 2025). Due to these three factors, we will rely

380 increasingly on data compiled from net samples to infer on recruitment drivers, spawning

381 hotspots and other factors relevant to understanding their life cycle and population

382 dynamics. If users find any errors or have suggestions to make the data more user-friendly,



383 please report these to the authors. Our final request is to cite the data paper when these
384 data are used, as this will help justify updating the KRILLBASE databases.

385

386

387 **Author contributions**

388 Original concept, data collation and initial drafting: AA. Supply and checking of datasets: AA,
389 EP, GY, ER, PW, CR, KS, VK, CL, LS. Contribution to manuscript: all. Final formatting: PH.

390 **Competing interests**

391 The authors declare that they have no conflicts of interest.

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396 samples from the Ukrainian longline fishery. The underpinning data span nearly 100 years
397 and this database would not be possible without much painstaking work by a large number
398 of crews and scientists to collect, preserve, sort and identify the larval stages. The final data
399 calls for completing the database were done through the KRILLBASE task team of the
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404 **References (to both the data paper and the source data in the database)**

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597 **Table 1. Summary of the data sources and types that have been compiled into**
 598 ***KRILLBASE-larvae***. Data are arranged in order of RECORD_GROUP_NUMBER (see Table
 599 2) that are blocks of data often representing discrete cruises or groups of cruises.

RECORD GROUP NUMBER	Source	Number of records	Austral summer seasons	Net types	Main top depth of net (m)	Mean bottom depth (m)	Are some/all net hauls stratified?	Average of Latitude	Min of Longitude	Max of Longitude	Months
1	CCAMLR 2000 Synoptic Survey Siegel et al. (2004) Ward et al. (2004)	121	2000	RMT1	0	200	No	-58	-69	-23	1
2	Fevolden (1979) Weddell data sent by VS	15	1977	Juday	0	200	No	-74	-42	-16	1, 2
3	Fevolden (1980) Weddell data sent by VS	16	1979	Nansen	0	300	No	-74	-39	-1	1, 2
4	Published Weddell data sent by VS	55	1989	RMT 1	0	274	YES	-75	-30	-26	1, 2
5	Hempel & Hempel (1982) data sent by VS	69	1980	Bongo	0	154	No	-74	-61	-2	12, 1, 2,
6	Siegel (2012) Lazarev LAKRIS data sent by VS	92	2004	RMT 1	0	199	No	-66	-6	0	4
7	Siegel (2012) Lazarev LAKRIS data sent by VS	52	2006	RMT 1	0	200	No	-65	-3	3	6, 7, 8
8	Menshenina (1992) Atlantic sector transcribed by AA	66	1989	Multinet Bongo	0	881	No	-67	-45	-4	9, 10
9	FIBEX multinational Atlantic sector data sent by VS Rakusa-Suszczewski (1984)	228	1981	Nansen, RMT 1	0	216	No	-61	-66	-36	2
10	AP (furcilia-only) data sent by VS. Siegel & Watkins (2016)	150	1985	?	0	182	No	-63	-72	-54	1
11	Marin (1981) data from AP area transcribed by AA	54	1987	1 m ring net	0	526	YES	-63	-62	-61	12, 1, 2, 3
12	AMLR AP data sent by VS Siegel et al. (2013)	96	2011	IKMT	0	167	No	-62	-63	-54	1, 2



13	German WAP cruise data sent by VS Siegel et al. (2013)	81	2011	RMT 1	0	198	No	-65	-75	-60	1
14	Atlantic sector data transcribed by AA from Hempel and Hempel (1977)	191	1976	RMT 1 and Bongo	0	200	No	-58	-62	14	12, 2, 4
15	BAS Scotia Sea area Bongo data (Ward et al. 2006)	61	2003	Bongo	0	400	No	-58	-56	-26	1, 2
16	BAS Scotia Sea area Bongo data (Ward et al. 2003)	33	1996	Bongo	0	200	No	-52	-43	-35	1
17	BAS Scotia Sea area Bongo data (Ward et al. 2003)	35	1997	Bongo	0	200	No	-52	-43	-35	12, 1
18	BAS Scotia Sea area Bongo data (Ward et al. 2003)	39	1999	Bongo	0	200	No	-52	-43	-34	12, 1
19	BAS Scotia Sea area Bongo data (Tarling et al. 2007)	32	2001	Bongo	0	200	No	-54	-39	-34	12, 1
20	BAS Scotia Sea area Bongo data (Tarling et al. 2007)	59	2002	Bongo	0	200	No	-53	-40	-33	1, 2
21	BAS Scotia Sea area Bongo data (Ward et al. 2008)	19	2004	Bongo	0	200	No	-54	-43	-37	3
22	BAS Scotia Sea area Bongo data (Ward et al. 2008)	57	2005	Bongo	0	200	No	-54	-41	-36	12, 1
23	BAS CCAMLR 2000 data	37	2000	Bongo	0	200	No	-59	-69	-29	1, 2
24	Transcribed by AA from Makarov and Menshenina (1992)	79	1981	Juday	0	635	No	-67	-10	14	3
25	Polarstern Marguerite Bay data from EP	14	2001	Bongo	0	279	No	-67	-86	-69	4, 5
26	Transcribed by AA from Marshall and Mizdalski	407	1982	Nansen and RMT 1	0	372	YES	-62	-68	-39	2, 3
27	BAS Scotia area data	40	2007	Bongo and miniBongo	0	400	No	-56	-50	-38	10, 11
28	BAS Scotia area data (Bongos and LHPR)	551	2008	Bongo, MiniBongo, LHPR	0	517	YES	-57	-48	-39	1, 2
29	BAS Scotia area data (Bongos and LHPR)	467	2009	Bongo, MiniBongo, LHPR	0	537	YES	-56	-50	-34	3, 4
30	AP: US SO-GLOBEC data from SO GLOBEC database	272	2001, 2002	MOCNESS	0	216	YES	-68	-72	-67	4, 5
31	Discovery N70V samples re-analysed by PW	578	1928-1937	N70V	0	164	YES	-57	-80	-31	Year-round
32	Discovery N70V samples re-analysed by PW	254	1934, 1935	N70V	0	518	YES	-61	-81	-78	Year-round
33	South Georgia data transcribed by PW from	41	1927	N100	0	195	YES	-54	-39	-35	Year-round



	Hardy and Gunther (1935)										
34	Transcribed circumpolar data by AA from original Discovery notebooks	2578	1926-1939	N100	0	138	YES	-60	-171	180	Year-round
35	Scotia area data sent by ER	138	2011, 2012, 2014	WP2, Bongo	0	284	No	-61	-67	-41	1, 2, 3
36	AMLR data from AP area sent by CR, with zero records infilled by AA	2450	1995-2010	IKMT	0	168	No	-61	-63	-43	1, 2, 3
37	SIMIEZ data from S. Orkneys area sent by EP	29	2018	Juday	0	109	No	-61	-41	-34	2,3,4
38	Prydz Bay area data sent by EP	433	1985, 1986	Juday	73	169	No	-64	45	80	2, 3
39	CHINARE Norpac net Indian sector data sent by GY	81	1999-2006	Norpac	0	200	No	-67	70	73	12, 1, 2
40	CHINARE Circumpolar Multinet stratified data sent by GY	257	2018-2021	Multinet	297	795	No	-68	-150	69	12, 1, 2, 3
41	Russian data from SW Atlantic sector provided by VK	113	2020, 2022	WP2, Multinet	0	1000	YES	-62	-61	-42	1,2
42	UK winter krill project data provided by CL	57	2022-2023	RMT 1	0	25	No	-54	-38	-36	3-9
43	UK PICCOLO cruise to NW Weddell Sea analysed by KS	155	2024	Mammoth net	0	1000	YES	-65	-60	-48	2,3
44	Ukrainian longline fishery data from EP and LS	22	2021	Juday net	0	116	No	-68	-178	-50	11-2
45	LAKRIS cruise data sent by EP	88	2006, 2008	RMT 1	0	200	No	-65	-3	3	12-1

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621 **Table 2. Detailed description of all the respective fields in KRILLBASE-larvae.**

Field Name	Description
RECORD_INDEX-NUMBER	Incremental and unique index number to identify the record
RECORD_GROUP_NUMBER	This groups the batches of data that were compiled in a single block, often pertaining to a single cruise, publication or sampling method
FILE_SOURCE	Information on where or who the data came from
REFERENCE	Relevant reference that may provide more about sampling details or larval distribution patterns
SHIP_AND_COUNTRY	Name of ship and name of country originating the data
RECORD_TYPE	This is an important field that will need screening before any use of the database. Records labelled "haul" are the usual situation meaning that the record refers to a single net haul. "Stratified haul" represents a haul, usually within the top 200 m, which forms part of a stratified series (e.g. 0–50, 50–100, 100–200 m). "Stratified pooled haul" represents a record that integrates these respective stratified hauls, whereby the larval stage densities from the component nets have been summed (in this example into an equivalent 0–200 m haul). Thus, to avoid double counting, any use of the data should sift out either stratified hauls or stratified pooled hauls. These categories are the same as in KRILLBASE-abundance except for a "horizontal surface haul" category for two of the data blocks.
STATION	This keeps the same station numbers as supplied with the data. Where these were not available they have been made up, as described in the field COMMENTS_ON_SAMPLING_STATIONS_NETS_DEPTHS_ETC
LATITUDE_DEGREE_NORTH	South is negative. Units are decimal degrees.
LONGITUDE_DEGREE_EAST	West is negative. Units are decimal degrees.
SEASON	This is the austral "summer" season of sampling. For example, the 1926 season spans all data from 1 October 1925 through to 30 September 1926
YEAR	Year of sampling
MONTH	Month of sampling. Please refer to COMMENTS_ON_SAMPLING_DATES_AND_TIMES for information on months and days of sampling, including inferences when exact dates of sampling were not available
DAY	Day of sampling. Please refer to COMMENTS_ON_SAMPLING_DATES_AND_TIMES for information on months and days of sampling, including inferences when exact dates of sampling were not available
NET_TIME	Time of day of sampling. Please refer to COMMENTS_ON_SAMPLING_DATES_AND_TIMES for information on whether times were in GMT or local
DAY_NIGHT	Data RECORD_GROUP_NUMBER # 34 and #36 were provided with assignments of whether the net sampling was in daytime (coded D) or night (N), with an additional category in group number 36 as twilight (T). No record is available for the basis of this classification.
NET_TYPE	A brief description of the sampling gear used
MOUTH_AREA_OF_NET_M2	Mouth area of the net mouth opening in m ²
NET_MESH_SIZE_MICRONS	Width of the mesh size in microns. See COMMENTS_ON_SAMPLING_STATIONS_NETS_DEPTHS_ETC for more information on the derivation of net mesh size when this information was not provided



TOP_SAMPLING_DEPTH_M	Topmost depth sampled in m. This is usually the surface except in the case of stratified hauls. The field COMMENTS_ON_SAMPLING_STATIONS_NETS_DEPTHS_ETC provides a variety notes on net sampling information not related to time of sampling.
BOTTOM_SAMPLING_DEPTH_M	The bottom net sampling depth. There is not a net trajectory field and hauls are generally oblique or vertical. Two groups of data have horizontal surface hauls. Numbers of larvae per m2 for these hauls have been computed by calculating the numbers per M3 and then multiplying this by the difference between the top and bottom sampling depths
VOLUME_FILTERED_M3	This information was retained in the relatively rare groups of data where it was provided.
MEASURED_SURFACE_TEMPERATURE_CEL	This information was retained in the relatively rare groups of data where it was provided.
CLIMATOLOGICAL_TEMPERATURE_CEL	Long-term average February sea-surface temperature for the sampling location. This is not the actual sea temperature at the time of sampling but a climatological mean sea-surface value for February, averaged over the years 1979 to 2014, based on data downloaded July 2016 from http://apps.ecmwf.int/datasets/data/interim-full-mode/levtype=sfc/ . Data were provided on a 0.75° by 0.75° grid and we extracted mean values using the same 10km buffer method used for the bathymetry. These values may indicate a relative thermal regime as a basis for station characterisation.
WATER_DEPTH_WITHIN_10_KM_M	Mean water depth within a 10 km radius. In South Polar Stereographic projection, the stations were superimposed on the Gebco 2014 Grid bathymetry (http://www.gebco.net) and all pixels within a 10 km radius of the station were extracted. After removing data above sea level, the remaining pixel value for water depth was averaged
EGGS_UNDER_1M2	Number of <i>Euphausia superba</i> eggs recorded under 1 m ²
NAUPLII_PLUS_METAUPLII_UNDER_1M2	Number of <i>Euphausia superba</i> nauplii plus metanauplii recorded under 1 m ²
CALYPTOPE_1_UNDER_1M2	Number of <i>Euphausia superba</i> calyptope stage 1 recorded under 1 m ²
CALYPTOPE_2_UNDER_1M2	Number of <i>Euphausia superba</i> calyptope stge 2 recorded under 1 m ²
CALYPTOPE_3_UNDER_1M2	Number of <i>Euphausia superba</i> calyptope stage 3 recorded under 1 m ²
FURCILIA_1_UNDER_1M2	Number of <i>Euphausia superba</i> furcilia stage 1 recorded under 1 m ²
FURCILIA_2_UNDER_1M2	Number of <i>Euphausia superba</i> furcilia stage 2 recorded under 1 m ²
FURCILIA_3_UNDER_1M2	Number of <i>Euphausia superba</i> furcilia stage 3 recorded under 1 m ²
FURCILIA_4_UNDER_1M2	Number of <i>Euphausia superba</i> furcilia stage 4 recorded under 1 m ²
FURCILIA_5_UNDER_1M2	Number of <i>Euphausia superba</i> furcilia stage 5 recorded under 1 m ²
FURCILIA_6_UNDER_1M2	Number of <i>Euphausia superba</i> furcilia stage 6 recorded under 1 m ²
TOTAL_EGGS_NAUPLII_METANAUPLII_UNDER_1M2	Total number of <i>Euphausia superba</i> eggs, nauplii plus metanauplii recorded under 1 m ²
TOTAL_CALYPTOPES_UNDER_1M2	Total number of <i>Euphausia superba</i> calyptopes recorded under 1 m ²
TOTAL_FURCILIA_UNDER_1M2	Total number of <i>Euphausia superba</i> furcilia recorded under 1 m ²
TOTAL_CALYPTOPES_PLUS_FURCILIA_UNDER_1M2	Total number of <i>Euphausia superba</i> calyptopes plus furcilia recorded under 1 m ²
NUMBER_OF_LARVAE<=10MM-UNDER_1M2	Total number of <i>Euphausia superba</i> up to 10 mm in length recorded under 1 m ² (just recorded for Discovery ring nets in RECORD_GROUP_NUMBER = 34)
NUMBER_OF_LARVAE_11_TO_15MM_UNDER_1M2	Total number of <i>Euphausia superba</i> between 10-15 mm length inclusive, recorded under 1 m ² (just recorded for Discovery ring nets in RECORD_GROUP_NUMBER = 34)
PRESENCE_1_OR_ABSENCE_0_OF_CALYPTOPES_AND_FURCILIA	Entered as 0 if abundance of both calyptopes or furcilia was zero and 1 if positive abundances of calyptopes, furcilia or both were recorded. Please note the difference between absent data and zeroes (see field COMMENTS_ON_DATA_ENTRY_FOR_LARVAL_STAGES)
COMMENTS_ON_SAMPLING_STATIONS_NETS_DEPTHS_ETC	All comments on sampling and data transcription other than that applying to sampling times.
COMMENTS_ON_SAMPLING_DATES_AND_TIMES	All comments on sampling dates and times and how they were transcribed
COMMENTS_ON_DAY_NIGHT_ATTRIBUTION	Explanation of data transcription for the DAY_NIGHT field
COMMENTS_ON_DATA_ENTRY_FOR_LARVAL_STAGES	Comments on how larval stage data abundances were described, particularly in relation to the differentiation of absent data and zeroes

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