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New Records of the Hydrozoan *Coryne hincksi* Bonnevie, 1898 on Red King Crabs in the Barents Sea

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Abstract: *Coryne hincksi* Bonnevie, 1898 (Cnidaria, Hydrozoa) is a rare corynid hydrozoan that was first found in the coastal Barents Sea on the surface of other hydrozoan species and on the body of spider crabs in 1913. After the introduction of red king crabs into the Barents Sea in the 1960s and their range expansion and population growth, colonies of *C. hincksi* were registered on this host as well. In this paper, we update a list of *C. hincksi* records on red king crabs and present a detailed description. Also, for the first time, we provide quality photographs of a living colony of this species. Despite relatively low prevalence rates (1.4–3.2% in certain years), currently in the Barents Sea, *C. hincksi* occurs on crustaceans thus exhibiting a predominantly symbiotic lifestyle.

Keywords: epibiosis; Corynidae; Capitata; *Coryne hincksi*; morphology; symbiosis; *Paralithodes camtschaticus*; Barents Sea

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Epibiosis is an association between two organisms: the epibiont (an organism that during the sessile phase of its life cycle is attached to the surface of a living substratum) and the basibiont (an organism that lodges the epibiont) [1]. The coexistence of marine animals with hard shells and their epibionts including both plants and animals and both sessile and mobile organisms is a very common phenomenon in the World Ocean [2–4]. Although the presence of symbiotic flora and fauna on crustaceans has long been known [5], it is only recently that a new perspective has been brought to their research [1,6] because epibiotic relationships can provide new insights into the biodiversity and conservation of marine provinces and eco-regions [7,8] as well as into biological aspects of species which form close symbiotic associations with their hosts and cannot be sampled by standard methods [5,9–17].

The red king crab, *Paralithodes camtschaticus* (Tilesius, 1815), is a well-known crustacean species that is highly appreciated by fishermen and consumers for its large size and excellent quality of its meat and by-products [18–23]. This species is native to the North Pacific, but currently, it also occurs in the Barents Sea after the transoceanic introduction from the Sea of Japan and Sea of Okhotsk conducted by Soviet scientists in the 1960s [24]. By the mid-1990s, the crab has formed a new self-sustaining population that currently supports both commercial and amateur fisheries in Russia and Norway [25,26]. Although some alterations in the structure of benthic communities have been reported after this introduction [27–29], the commercial fisheries of major fish and shellfish resources were not affected [24,26]. The coastal zone of the Barents Sea is a nursery and recruitment area for this king crab [30–33] whereas the open sea is occupied by large specimens [24,34].

Taking into account the invasive status of *Paralithodes camtschaticus* and its economical importance, monitoring of the Barents Sea population has been carried out by specialists from the Murmansk Marine Biological Institute in coastal waters of the Kola Peninsula since 2003 with a special focus on the epibiotic communities [12,16,35–38]. Previous studies have shown that the body surface and internal organs of red king crabs serve as habitats for various symbionts including amphipods, fish leeches, polychaetes, and copepods [13,16,37,39].

The most common epibiotic species are hydrozoans, mollusks, bryozoans, and echinoderms [35–37,39].

Coryne hincksi Bonnevie, 1898 (Cnidaria, Hydrozoa) is a colonial hydrozoan belonging to the order Anthoathecata and the family Corynidae. It occurs along the coasts of Norway, Canada (Hudson Bay), Greenland (west coast and Cape Farewell), and, probably, Iceland [40,41]. In the Barents Sea, this species was first documented 100 years ago by Scheuring [42] who found 1.0–1.5 cm colonies of *C. hincksi* (cited as *Coryne brevicornis*) on the surface of other hydrozoans, *Hydrallmania falcata* and *Pericladium mirabilis* (cited as *Selaginopsis mirabilis*) and on spider crabs *Hyas* during June–July 1913 at 5 stations located in the vicinity of Vardø, Kildin Island, Cape Kanin Nos, Sem Ostrovov Area and in the area lying roughly equidistant from Cape Svyatoy Nos and the Kanin Peninsula (Figure 1).

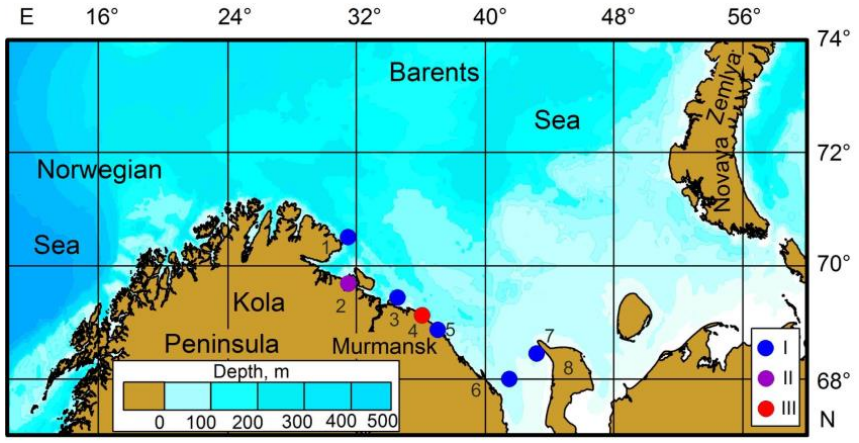

Figure 1. Locations in the coastal Barents Sea where *Coryne hincksi* hydrozoans were recorded. I—findings by Scheuring [42] in 1913, II—finding by Panteleeva [43] in 2002, III—present findings in Zelentskaya Bay during 2009–2022. 1—Vardø, 2—Ambarnaya Bay, 3—Kildin Island, 4– Zelenetskaya Bay, 5—Sem Ostrovov Area, 6—Cape Svyatoy Nos, 7—Cape Kanin Nos, 8—Kanin Peninsula.

In 2002, this species was found on red king crabs in Ambarnaya Bay [43]. During the period of 2004–2008, *C. hincksi* was also registered on mature red king crabs and great spider crabs (*Hyas araneus*) in Zelenetskaya Bay (= Dalnezelenetskaya Bay) with prevalence levels of 0.38% and 2.1%, respectively [35,37,44]. It should be noted that *C. hincksi* is not included in the known lists of hydrozoan species inhabiting Russian seas [45–48].

Our study aimed to report new findings of *C. hincksi* on red king crabs from the Barents Sea and present quality photographs of a living colony of this species.

Red king crabs were collected by divers according to standard protocols [35,36,39] during the period 2009–2022. Diving surveys were conducted in Zelenetskaya Bay (Figure 1), typical semi-closed small bay located 104 km east of Kola Bay (for a more detailed description, see [33,49,50]). In the coastal laboratory, each crab was examined for sex and shell condition, weighed, and measured for carapace length. Epibiotic species were collected from the crab body and then examined under a stereomicroscope MBS-10 [35,36,39].

During the study period, colonies of *C. hincksi* were recorded on 7 red king crabs (Table 1).

The numbers of red king crab analyzed were 62, 133, 77, 58, and 70, and the proportions of infested crabs were 3.2, 1.5, 1.3, 1.7, and 1.4% for 2009, 2010, 2011, and 2013, respectively. For the entire period (2009–2022), the prevalence of *C. hincksi* was calculated to be 0.6%. The majority of crabs were egg-bearing females with new shells, i.e., they had molted 4–5 months prior to being caught.

On 12 July 2022, a large colony of *C. hincksi* (age > 1 yr) was found on the membrane at the plane of severance of an autotomized limb (healed autotomy) of an old-shelled male red king crab (Figure 2).

Table 1. Information regarding findings and localization of *Coryne hincksi* on red king crabs in Zelenetskaya Bay, southern Barents Sea, 2009–2022. Biological data for crabs (size, weight, and shell condition) are provided.

Date	Latitude, N	Longitude, E	Depth	T, °C	Sex	CL, mm	Wet Weight, g	Shell Condition	Localization
07.07.2009	69°07′17″	36°04′32″	14	6.5	F	115.0	1380	Pre-ecdysis	Carapace
08.07.2009	69°07′07″	36°05′47″	16	5.5	F	123.1	1334	New	Limbs
03.07.2010	69°07′28″	36°04′59″	9	7.0	F	122.8	1479	New	Carapace
06.07.2010	69°07′43″	36°05′11″	20	7.0	M	120.0	1434	Very old	Limbs
11.07.2011	69°07′09″	36°05′45″	20	8.0	F	158.0	2309	New	Limbs
03.07.2013	69°07′03″	36°04′23″	15	5.0	F	127.9	1309	New	Limbs
12.07.2022	69°07′32″	36°04′47″	31	5.0	M	171.0	3832	Old	Limbs

Note: T—water temperature, CL—carapace length, F—female, M—male.

Figure 2. *Coryne hincksi* on the membrane at the plane of severance of an autotomized limb of a male red king crab, *Paralithodes camtschaticus.* Zelentskaya Bay, Barents Sea, July, 2022. (**a**) scale bar 50 mm, (**b**) scale bar 10 mm. Photo by Dvoretsky, V.G.

After being collected, this colony was placed into a 80-mL plastic container with cooled seawater (temperature 5 °C, salinity 34 psu) and then observed for morphological features [40,41,51], photographed, and video recorded under a stereomicroscope equipped with a camera.

The colony is pinkish in color, 2.3 cm in height with long, thin, and irregularly branched hydrants (Figure 3a). Both Calder [40] and Schuchert [41] reported *C. hincksi* colonies reaching 2 cm while Bonnevie [51] presented evidence that colonies of this species from Hammerfest, Norway, can reach 4 cm.

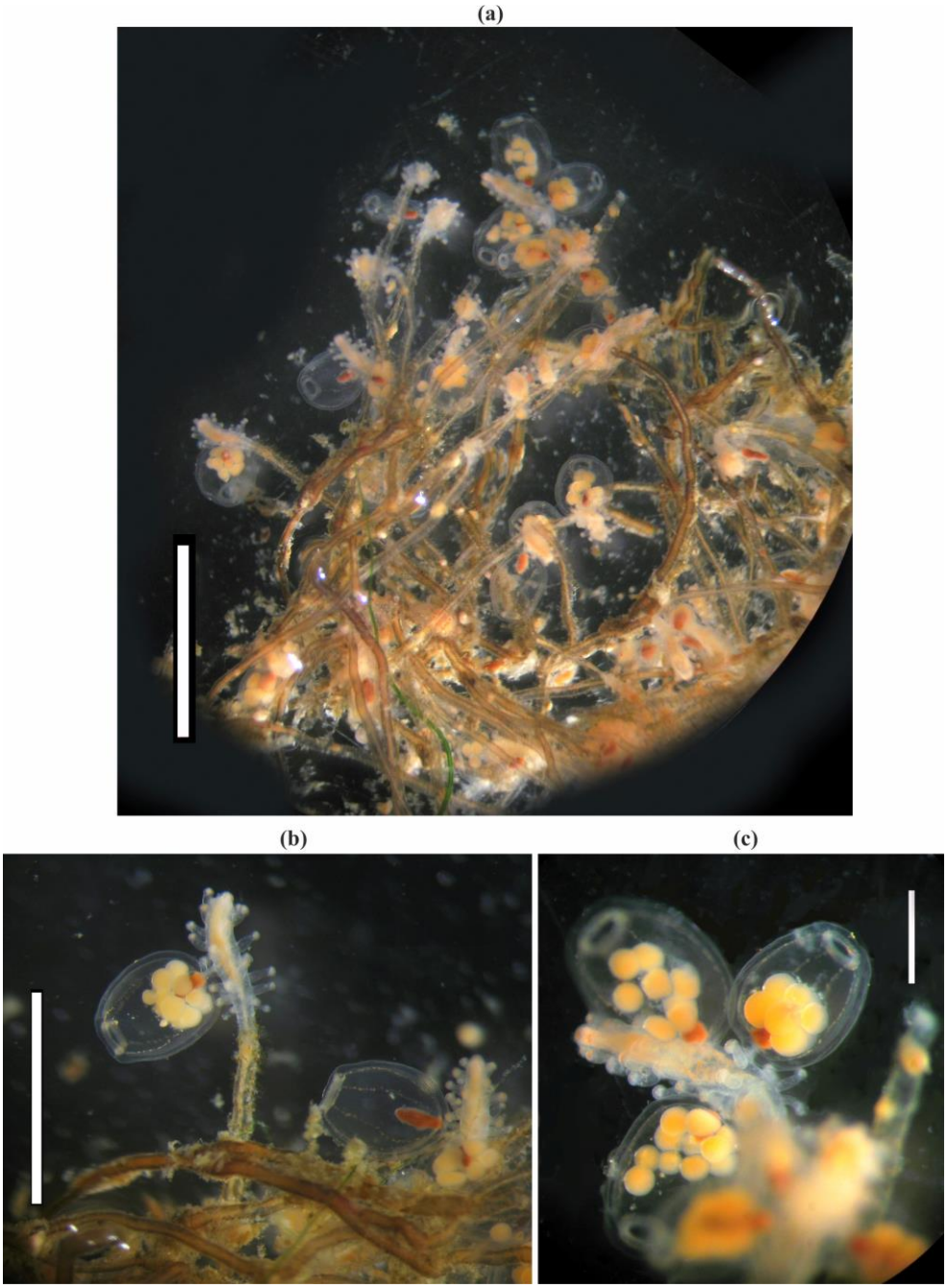

Figure 3. *Coryne hincksi* from the Barents Sea. (**a**)—overall view of a colony, scale bar 5 mm, (**b**)—female sporosacs, scale bar 3 mm, (**c**)—female sporosacs, scale bars 1 mm. Photo by Panteleeva, N.N.

The maximum steam diameter in their distal part is up to 0.27 mm. This diameter falls within the range reported by Schuchert [41] (0.25–030 mm) for Western Greenland. Young stems have transparent perisark, while in old stems, perisark is translucent, brown in color, smooth-walled, and annulated with annulations being present in the proximal parts of the stems. Polyps are highly contractible, from cylindrical to spindle- or round-shaped, with rounded hypostome. The polyps of *C. hincksi* in the extended state can reach 2.4 mm in

height and 0.5 mm in diameter. The Barents Sea polyps were greater in size than reported by Schuchert [41] (height 1.5–2.2 mm, diameter 0.4 mm) but similar with the height reported by Calder [40] (2.5 mm) for shelf waters of Northern Canada.

There are 14–24 short (0.33–0.50 mm length) and thick (0.14–0.20 mm diameter) club-shaped capitate tentacles scattered almost over the entire surface of the polyp with one oral set whorl around the mouth (4–5 oral tentacles) and about 5 aboral irregular whorls below (towards the aboral end). For comparison, Calder [40] reported about 20 tentacles, while Schuchert [41] reported 16–22 scattered capitate tentacles and 4–6 oral tentacles. A distinct terminal swelling of capitate tentacles, where the stinging capsules (nematocysts) are concentrated, is 0.17–0.22 mm in diameter. There are no filiform tentacles. This feature was also present in the description by Schuchert [41]. Gonophores are attached medusoids reduced to sessile sporosacs. The medusoids (up to 3 sporosacs per hydranth) sit on thin long stalks (stalk length is twice as greater as thickness, 0.19–0.22 × 0.08–0.10 mm) and develop independently of the tentacles in the center and lower half of the hydranth. Schuchert [41] also found up to 3 sporosacs while Calder [40] reported 2–5 sporosacs, and Bonnevie [51] registered up to 8 sporosacs per hydranth. Sporosacs are spindle-shaped, rounded when fully developed, with 4 narrow radial canals and a clearly visible wide ring canal (0.10–0.15 mm wide) located at the distal end, around a small circular hole (0.46–0.61 mm diameter) (Figure 3b), without bulbs or tentacle rudiments. A similar description but without size measurements is present in Schuchert [41]. Developed sporosacs are oval (2.2 × 1.6 mm), transparent, and thick-walled with brown spadix surrounded by mature sexual products. Our size characteristics of fully developed sporosacs are greater when compared to Schuchert [41] and Calder [40] who reported the presence of oblong sporosacs 0.95–1.04 mm length and 0.70–0.75 mm width. Finally, we found in sporosacs of the female colony, 8–15 large (up to 0.38 mm diameter) 8–15 yellow-orange eggs (Figure 3c).

Under the stereomicroscope, we observed weak and barely noticeable pulsation of female sporosac (Supplementary Video S1). This pulsation seems to promote/stimulate the release of ripe eggs. This colony was then fixed with 96% alcohol for molecular genetic analysis.

As *C. hincksi*, in contrast to other corynids from the Barents Sea, has been found mostly on the body of spider and king crabs, this species seems to exhibit a predominantly symbiotic lifestyle. Living on the crabs, this hydrozoan species may derive a variety of benefits from its hosts including protection from predators and increased mobility contributing to more successful settlement. A high abundance of potential hosts and regular findings of *C. hincksi* on red king crabs indicate the pervasive nature of this symbiotic association. Furthermore, in this case, the crabs act as "natural traps" for *C. hincksi* colonies, thus allowing researchers to collect this hydrozoan for morphological, physiological, and genetic studies.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/d15010100/s1, Video S1: Pulsating female sporosac of *Coryne hincksi* from the Barents Sea.

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