Two sympatric species of *Cyanea* (Scyphozoa) from Arctic seas distinguished by the molecular methods

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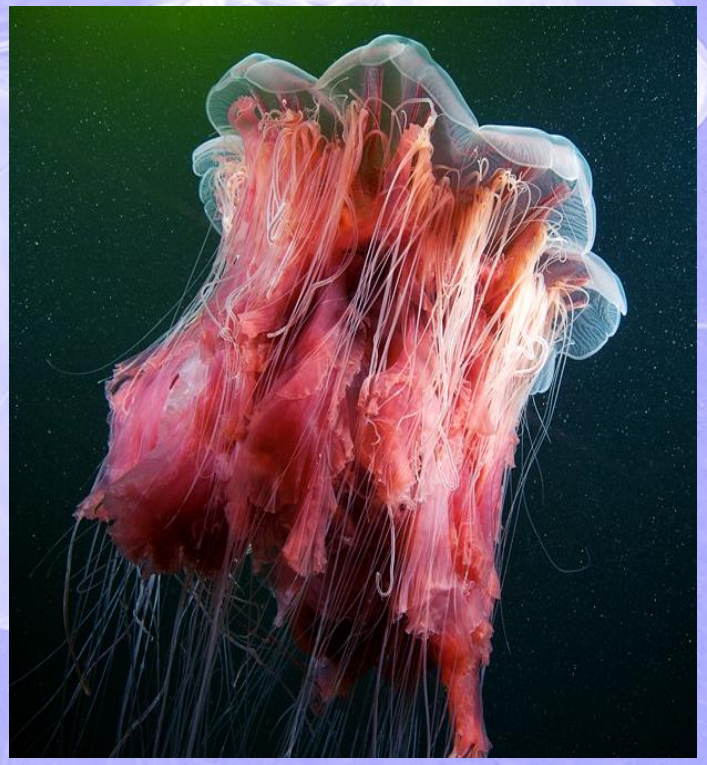
The genus *Cyanea*

- Populations of pelagic animals are often depleted in barriers to reproduction and dispersal, and therefore have a high proportion of widespread or cosmopolitan species

- One remarkable example is *Cyanea*, a genus of majestic bloom-forming scyphozoans which is widely distributed around the world, from the temperate to boreal and polar waters, and includes the notorious lion's mane *Cyanea capillata* (Linnaeus 1758)



The genus *Cyanea*

- *Cyanea annaskala* von Lendenfeld, 1884
- *Cyanea citrae* (Kishinouye, 1910)
- *Cyanea ferruginea* Eschscholtz, 1929
- *Cyanea lamarckii* Péron & Lesueur, 1810
- *Cyanea nozakii* Kishinouye, 1891
- *Cyanea postelsi* Brandt, 1838
- *Cyanea purpurea* Kishinouye, 1910
- *Cyanea rosea* Quoy & Gaimard, 1824
- *Cyanea annasethe* Haeckel, 1880
- *Cyanea fulva* Agassiz, 1862
- *Cyanea arctica* Peron & Lesueur
- *Cyanea nozakii* Kishinouye, 1891

Cyanea: high morphological variability

- Several *Cyanea* species described in the 1700–1900s have been synonymized in 1910 as *C. capillata* due to high morphological plasticity of the color, size, and organization of muscular and gastrovascular systems

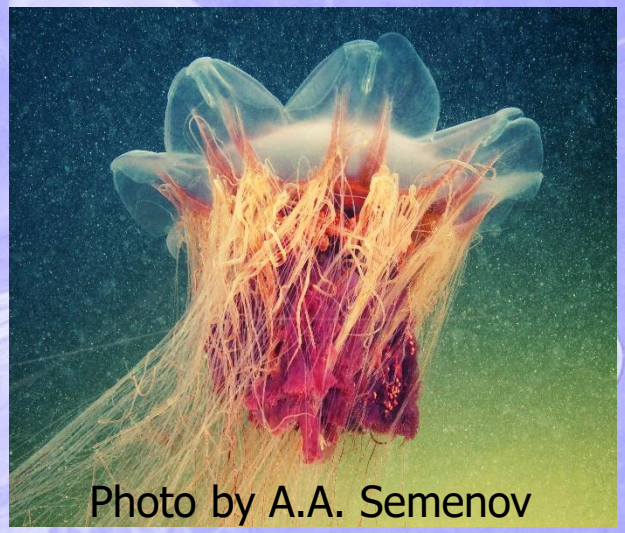


Photo by A.A. Semenov

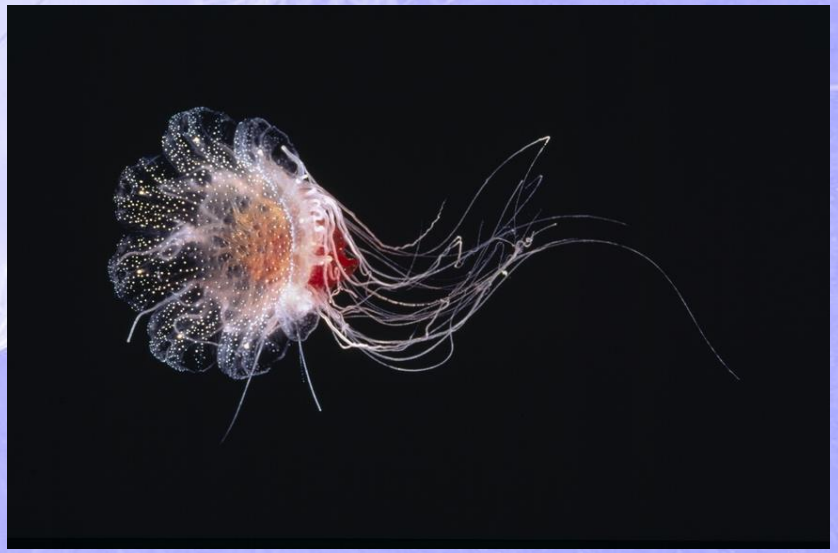
From: S.F. Sparmann 2013

Photo by A.A. Semenov

Cyanea: high morphological variability

- *Cyanea capillata* is considered as almost cosmopolitan in arctic and temperate seas (Kramp 1961)

- *Cyanea capillata* is not a cosmopolitan species: morphological and molecular evidence for *C. annaskala* and *C. rosea* in south-eastern Australia (Dawson 2005)



Cyanea annaskala
Image by: David Paul

Cyanea species from the North Atlantic and North Pacific

Apart of *C. capillata*, four valid *Cyanea* species inhabit the North Atlantic and North Pacific (Thiel 1962, Russell 1970, Holst and Laakmann 2014, Sparmann 2013):

- *C. lamarckii* Peron and Lesueur 1810 **North Atlantic**

- *C. citrea* Kishinouye 1910
- *C. ferruginea* Eschscholtz 1929
- *C. postelsii* Brandt 1838

North Pacific

Cyanea tzetlinii Kolbasova & Neretina 2015

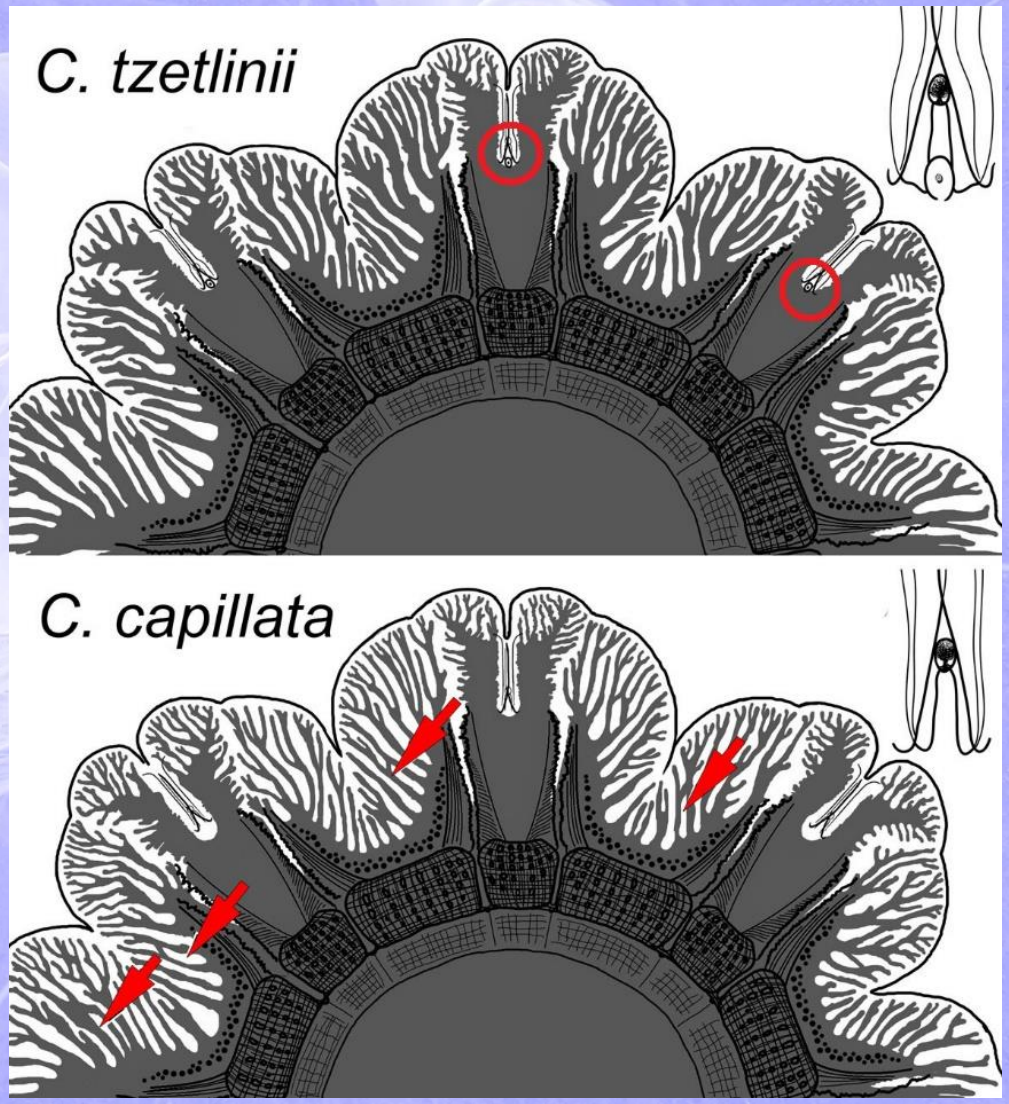
Photo by A.A. Semenov

- In 2015 we describe a new *Cyanea* species from the White Sea

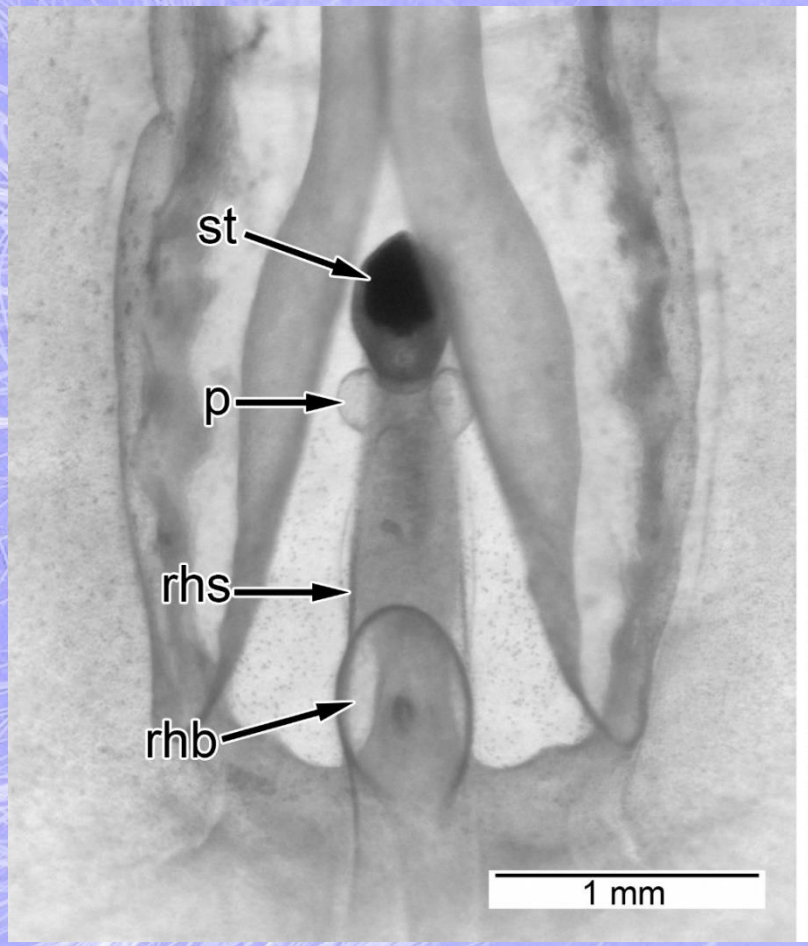
Cyanea tzetlinii and *C. capillata*: main morphological differences

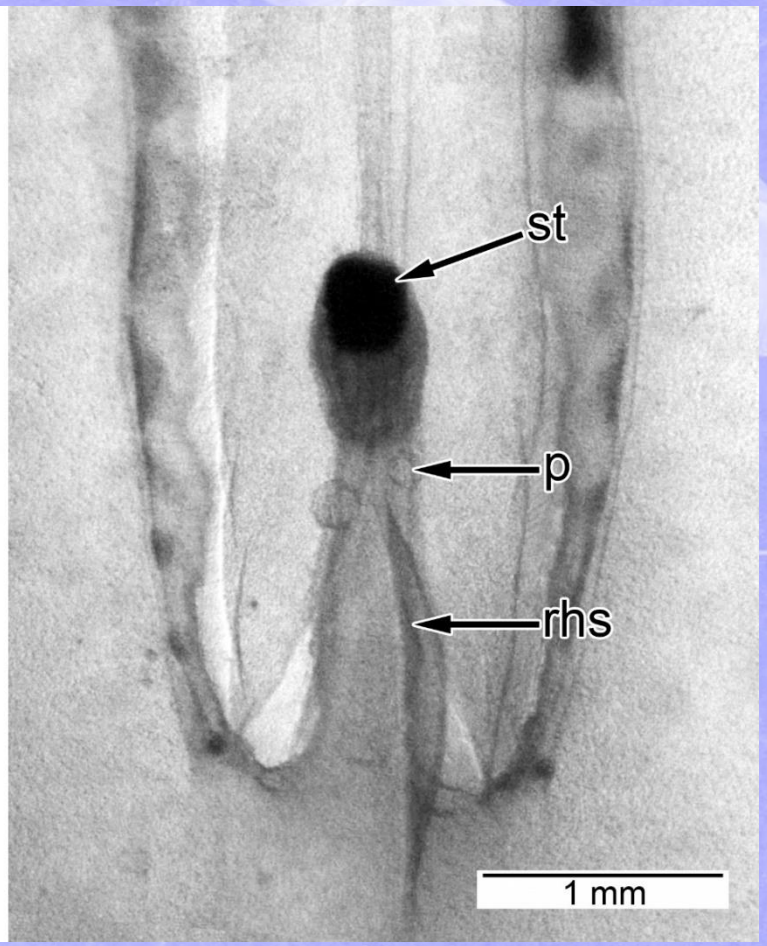
- Rhopalial bulbs are present
- Anastomoses in the gastrovascular system are absent
- The smaller bell size

- Rare anastomoses in the gastrovascular system
- Rhopalial bulbs are absent



Cyanea tzetlinii and *C. capillata*: main morphological differences



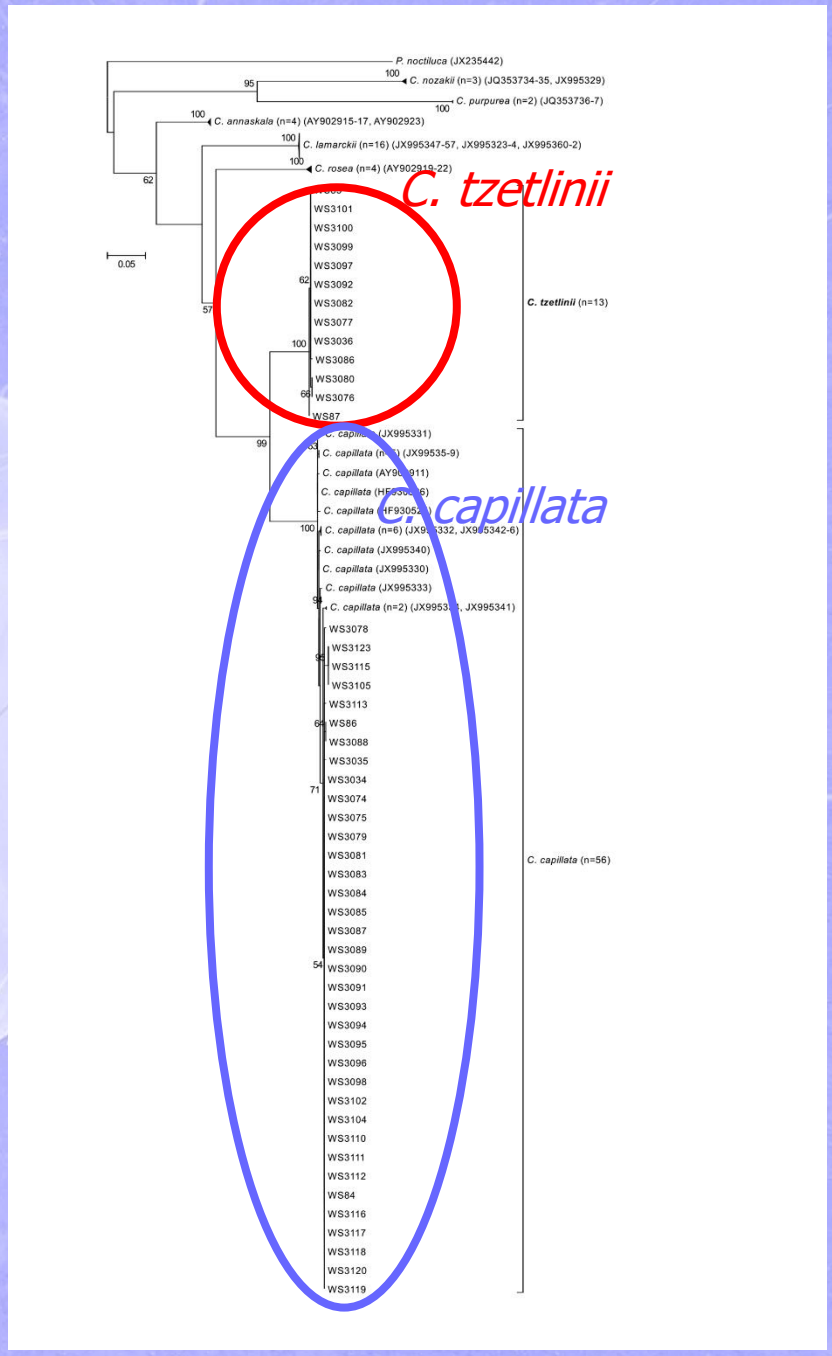


- *C. tzetlinii*
- *C. capillata*

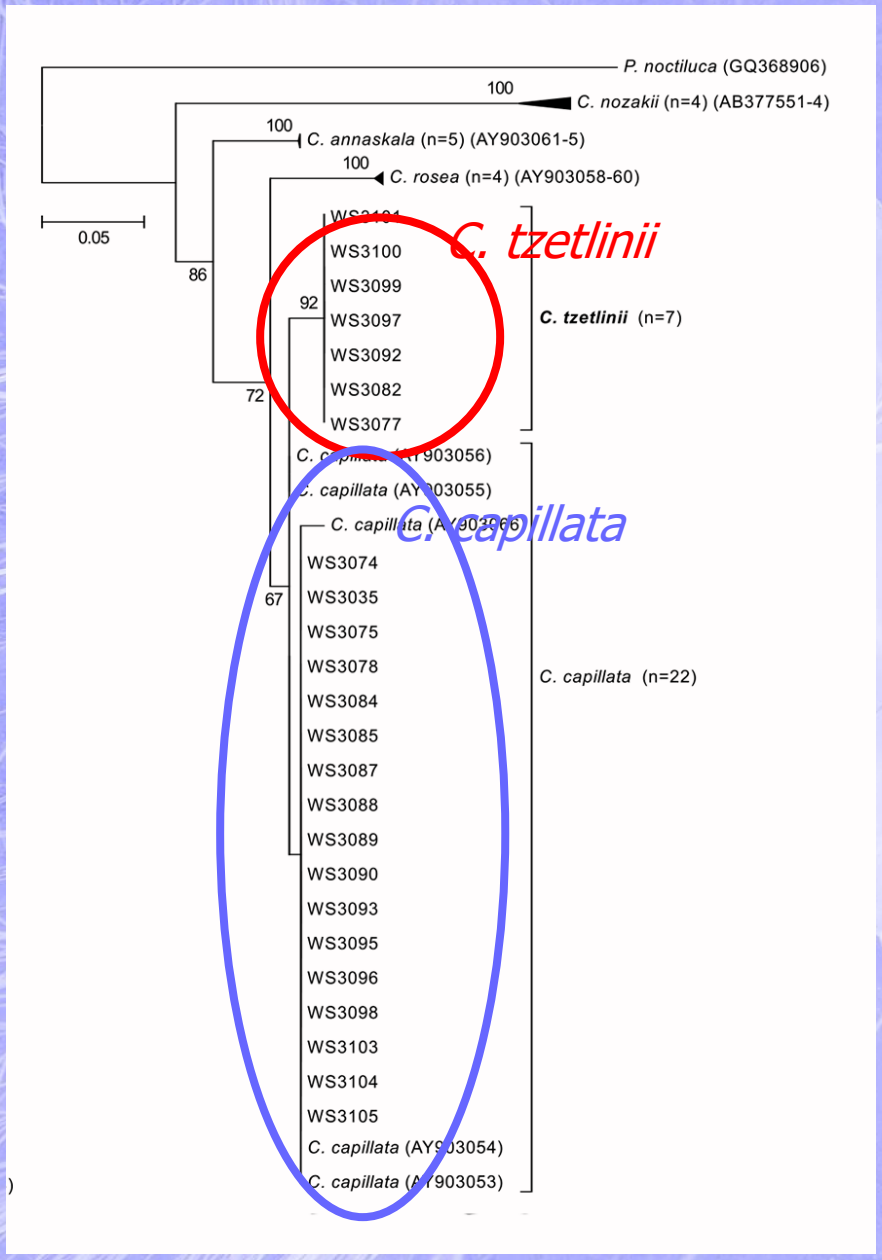
Abbreviations: rhb – rhopalial bulb, rhs – rhopalial stalk, st – statolytes, p - papillae

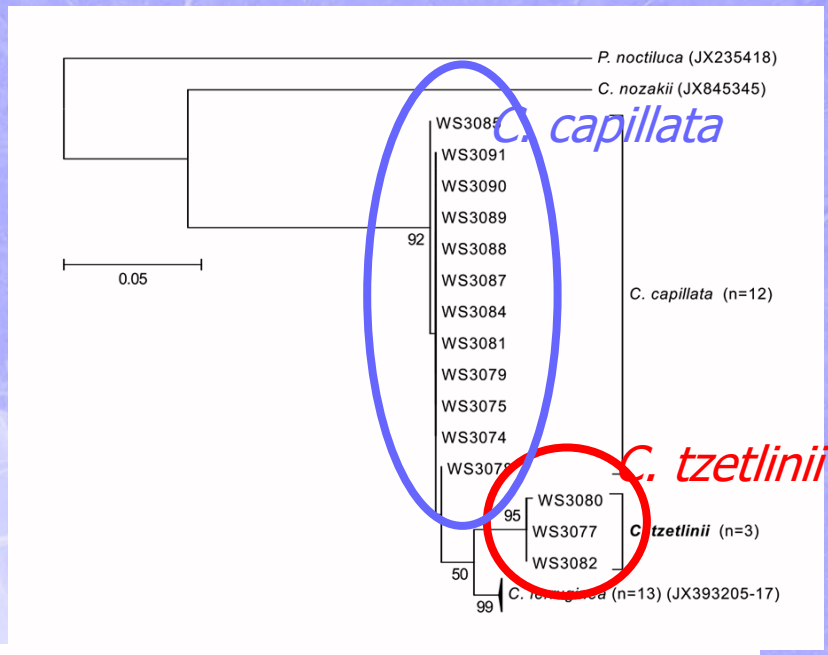
CO1 analysis of *Cyanea* from the White Sea

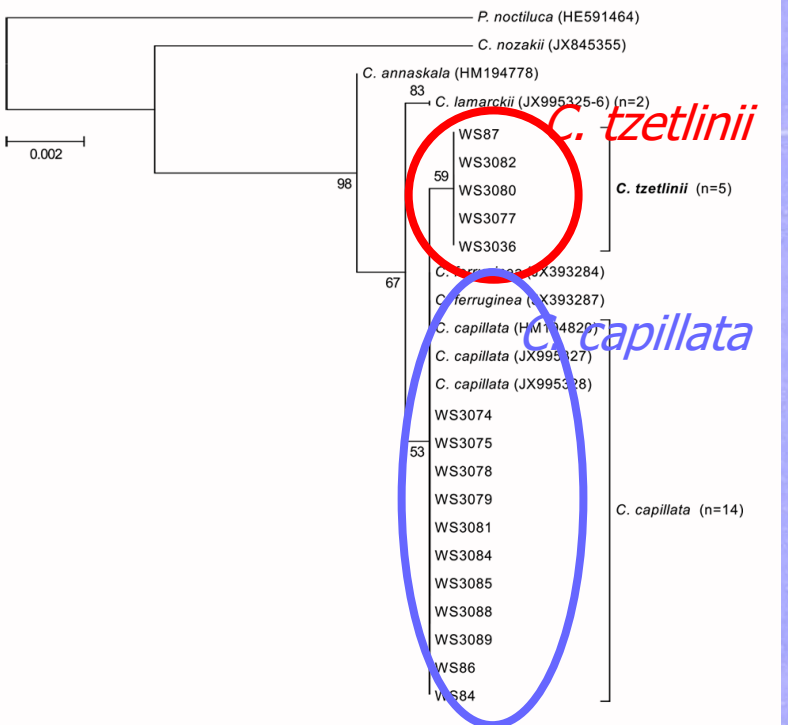
- Neighborjoining analysis of cytochrome oxidase subunit 1. Analysis was performed using model HKY+I+GK80 with 1000 bootstrap replication trials



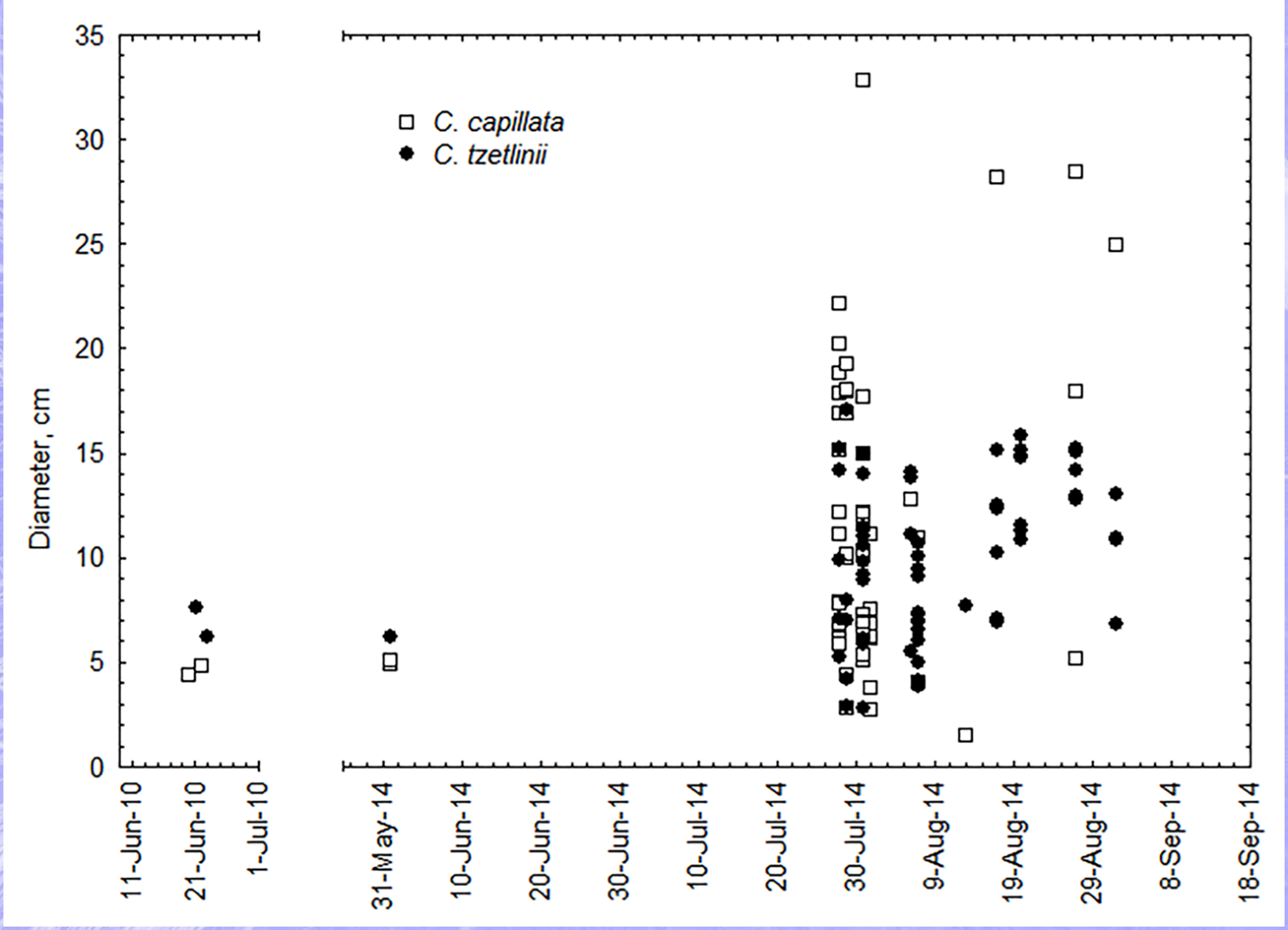
16S, 18S and ITS







The bell diameter: *Cyanea tzetlinii* is smaller than *C. capillata*



White Sea

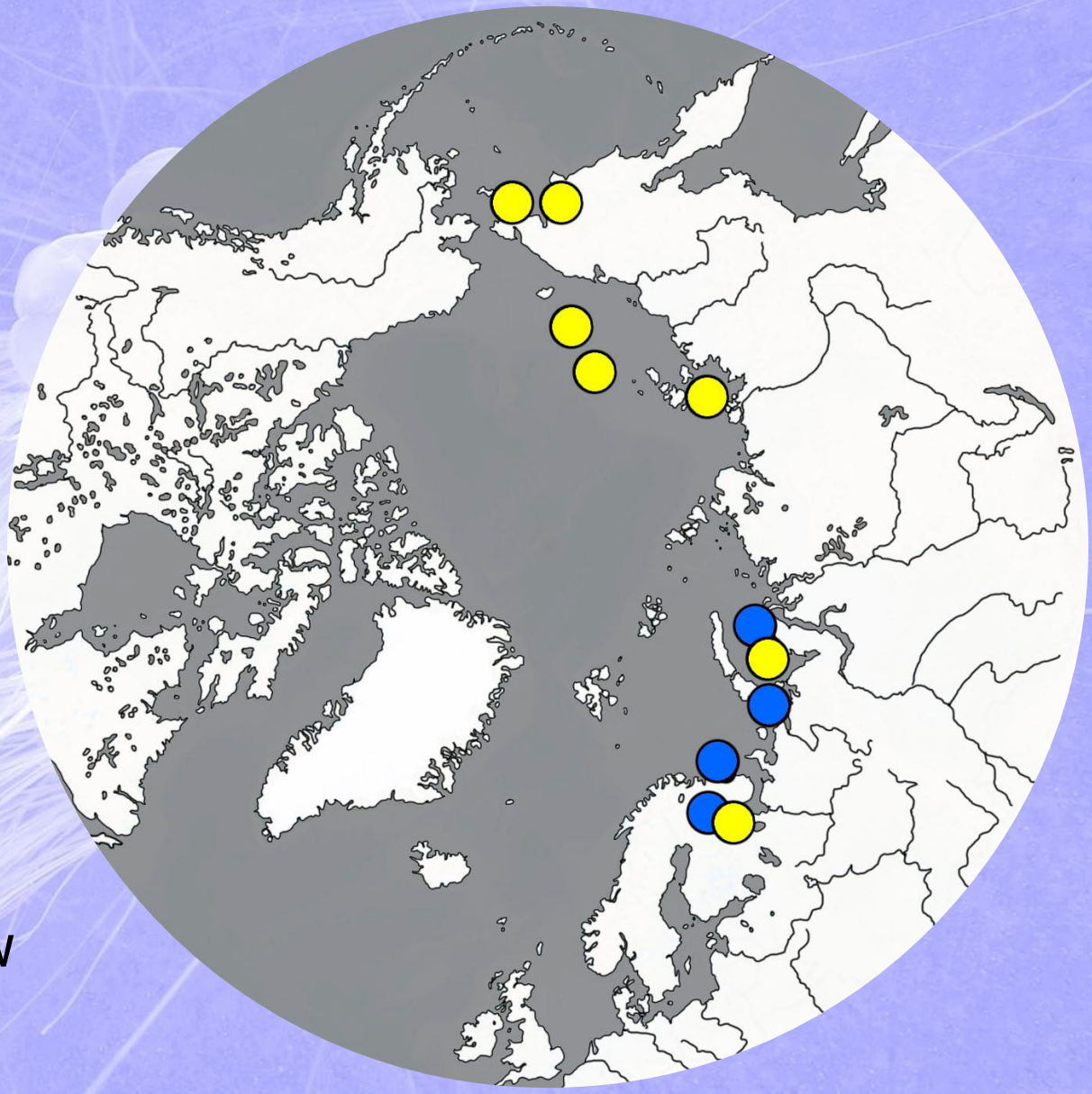
- Young geological age since the end of the latest glaciation (*10,000 years)
- High degree of isolation, with dispersal into the Barents Sea limited by the narrowness of the Gorlo strait
- Low level of species diversity as well as within-species genetic diversity within its boundaries

C. capillata and *C. tzetlinii*: collection data

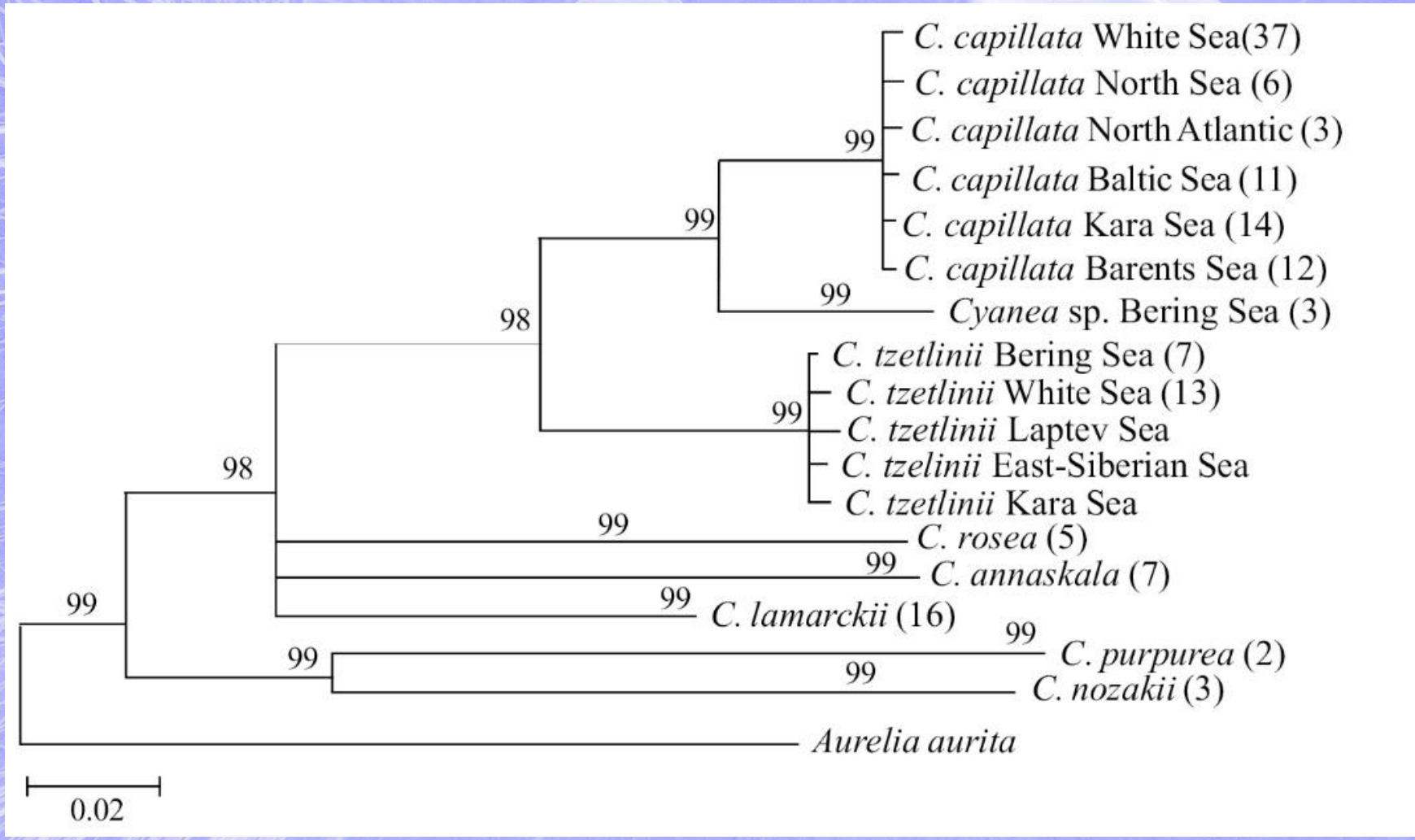
- We tried to detect *C. tzetlinii* outside the White Sea in other Arctic seas:

- Barents Sea
- Kara Sea
- East-Siberian Sea
- Laptev Sea
- Bering Sea

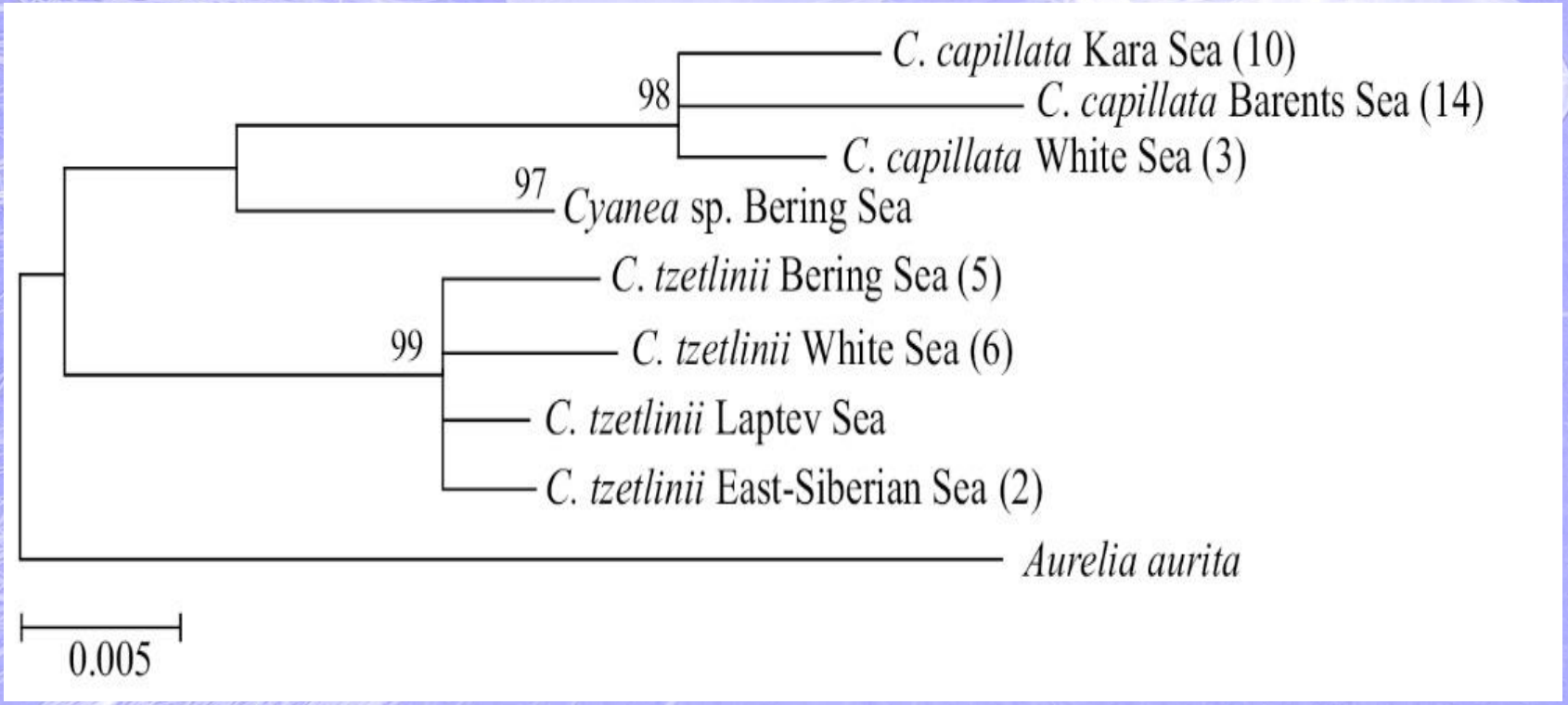
C. tzetlinii – yellow
C. capillata – blue



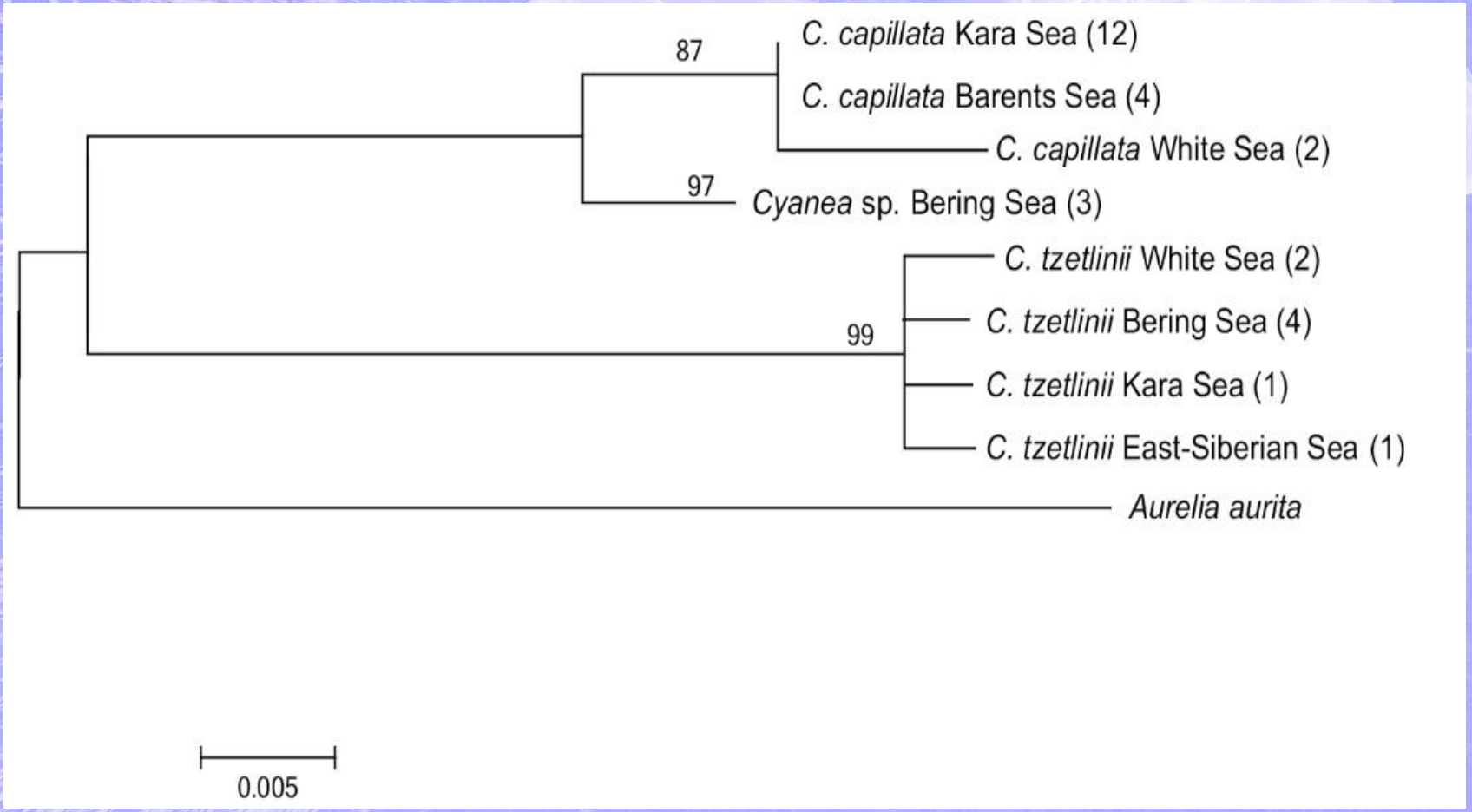
Neighbor-joining analysis of cytochrome oxidase subunit 1



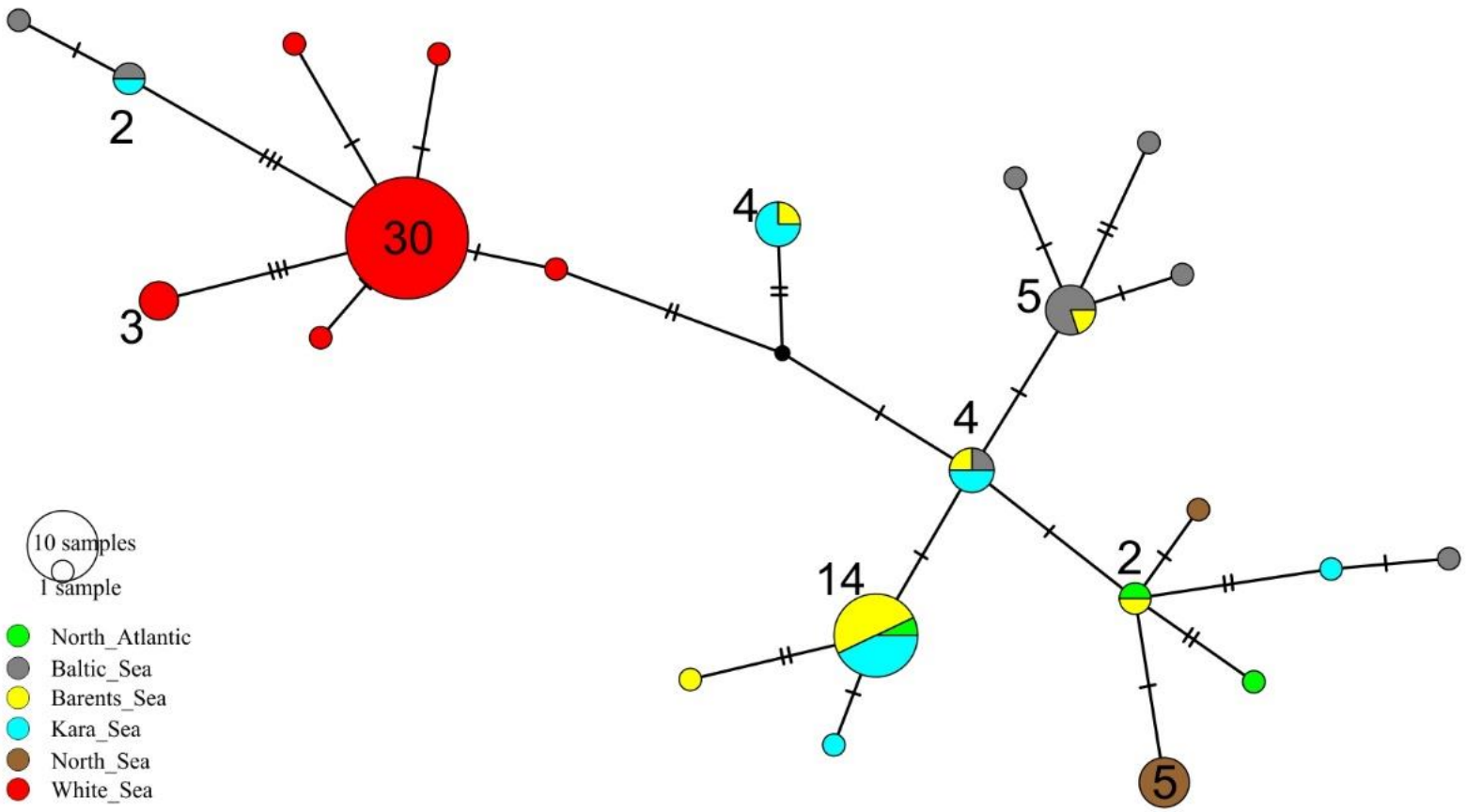
Maximum likelihood analysis of 16S rDNA

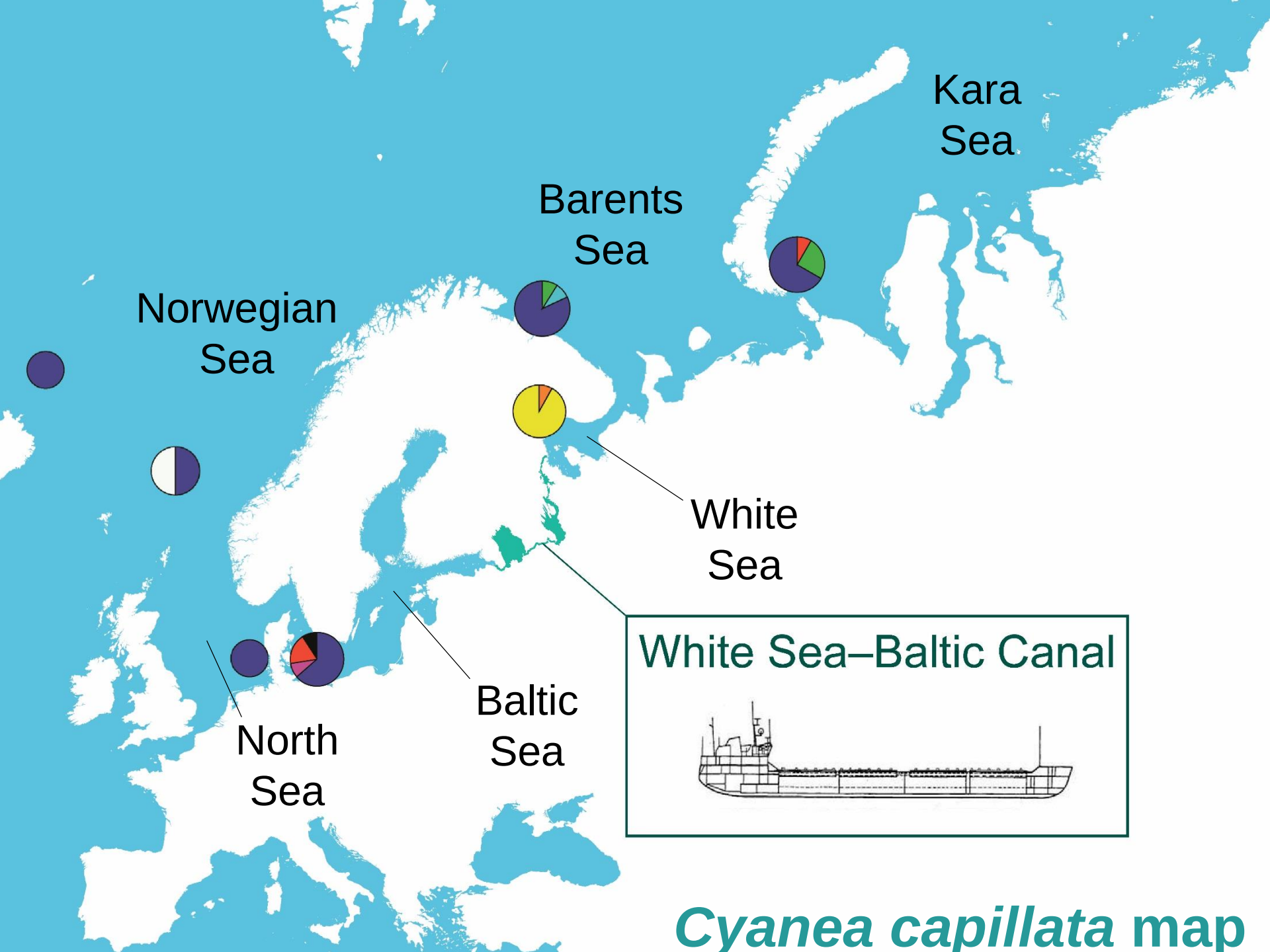


Maximum likelihood analysis of internal transcribed spacer (ITS)



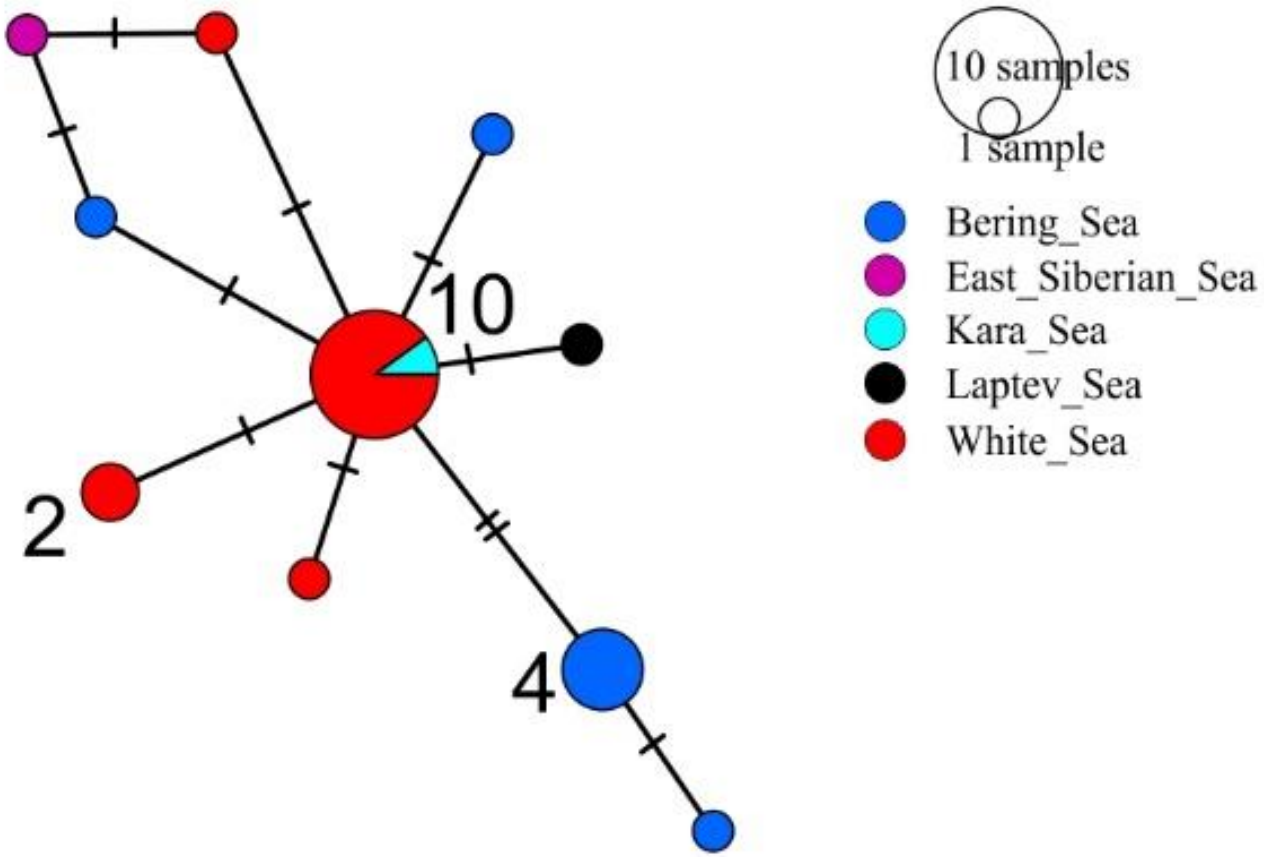
Gaplotype map of *C. capillata*





Cyanea capillata map

Gaplotype map of *C. tzetlinii*



Cyanea tzetlinii map

Conclusions

…But there is neither East nor West, Border, nor Breed, nor Birth,
When two strong men stand face to face,

though they come from the ends of the earth!

R. Kipling


Thank you for your attention!