PICES-MAFF PST final meeting

Distribution of CFP(ciguatera fish poisoning) dinoflagellate in Korea.

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1. Introduction

- Recently, toxic plankton that causes CFP(ciguatera fish poisoning) have been found in the coastal and southern coastal areas of Jeju.
- **Epiphytic or benthic dinoflagellate that cause CFP include genera Genus *Gambierdiscus*, *Ostreopsis* , *Prorocentrum*, *Coolia*, *Amphidinium*.**
- Physiological and ecological research of CFP dinoflagellate.

1. Introduction

❖ **Causative species of CFP and identified species in Korea.**

Genous	Toxin	Toxic species	Identified species
Gambierdiscus	ciguatoxin (Caribbean Sea CTXs_C-CTX, Pacific Ocean CTXs_P-CTXs), mitoxin	*G. australes, G. balechii, G. belizeanus, G. caribaeus, G. carolinianus, G. carpenteri, G. excentricus, G. jejuensis G. pacificus, G. polynesiensis, G. scabrosus, G. silvae,*	*G. caribaeus G. jejuensis G. yasumotoi Gambierdiscus* spp.
Ostreopsis	palitoxin	*O. ovata*	*O. cf. ovata Ostreopsis* spp.
Coolia	cooliatoxin (yessotoxin-like)	*C. malayensis, C. monotis, C. tropicalis*	*C. cf. malayensis C. canariensis*
Prorocentrum	okadaic acid, dinophysistoxin-11	*P. belizaneum, P. concavum, P. faustiae, P. hoffmannianum, P. leve, P. lima, P. maculosum, P. rhathymum, P. texanum*	*P. concavum P. lima P. rhathymum*
Amphidinium	chloline-like	*A. caterae*	*A. caterae*

2. Objective

Establishment of a management for the dinoflagellate that is the cause of CFP, through monitoring and culture of target species.

Management system of CFP dinoflagellate

Physiological and ecological characteristics of CFP dinoflagellate

Monitoring

- ◆Spring & autumn, 12 stations in Korea.
- ◆List up the dominance species for CFP
- ◆Environmental factors(T, S, pH, DO) and identifying of the CFT dinoflagellate

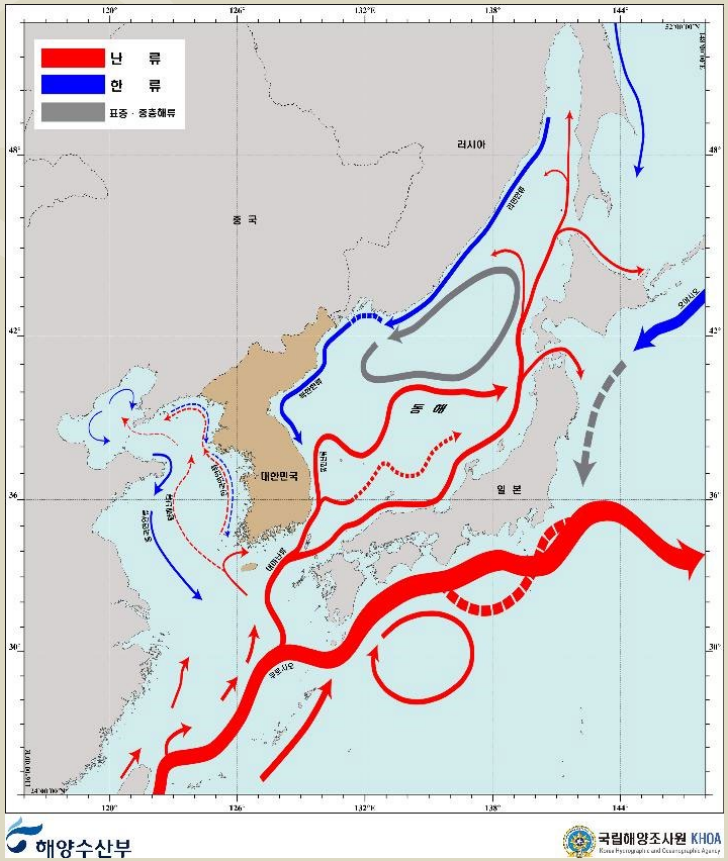
Culture & identification

- ◆Seaweed specimen and identification
- ◆Identification and isolation of CFP dinoflagellate
- ◆Physiological study of the each strains
- ◆Developing of mass culture technology

3. Material & Methods

1) Periods and stations

- ❖ Dinoflagellate which are the cause CFP, mainly appearing in subtropical environments, were introduced under the influence of the Kuroshio current
- ❖ Monitoring : Spring and autumn season at 12 stations in every year since 2020

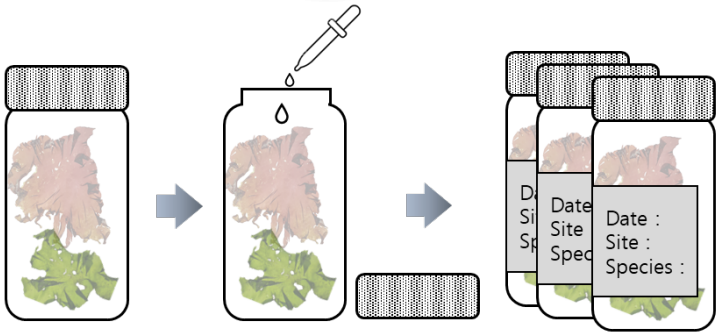


3. Material & Methods

2) Sampling and analysis

In field

(1) Sampling by scuba diving

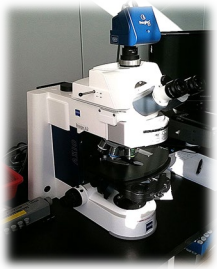


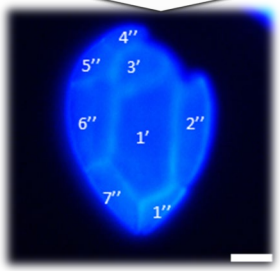
(2) 1~2% formalin seawater

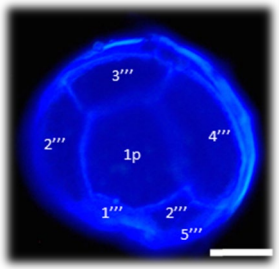
In Lab.

(1) Shaking
for cell separation

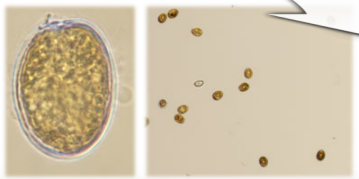
(2) Sieving →
Concentrarion







(4) Cells were stained with Calcofluor White
(final con. 10 μg ml^{-1})



(5) Identification & Count

3. Results

1) Seaweeds

❖ **Seaweed samples : Green 6, brown 21, red 47.**

Region	Apr. 2020	Apr. 2021	Apr. 2022
Gangjeung	*Schizymenia dubyi, Ulva ohnoi, Gracilaria vermiculophylla*	*Lomentariaceae, Padina arborescens, Gracilaria textorii, Ulva australis*	*Amphiroa beauvoisii, Gracilaria textorii, Lomentariaceae*
Namwon	*Amphiroa misakiensis, Amphiroa anceps, Amphiroa ephedraea*	*Grateloupia angusta, Dichotomaria falcata, Corallina crassisima, Amphiroa beauvoisii*	*Dichotomaria falcata, Martensia denticulata, Amphiroa beauvoisii*
Seongsan	*Corallina crassisima, Corallina pilulifera, Gelidium elegans*	*Dictyota dichotoma, Corallina pilulifera, Gelidium elegans, Hydroclathrus clathratus*	*Amphiroa beauvoisii, Dichotomaria falcata, Gelidium elegans*
Jochon	*Hypnea asiatica, Pterocladiella capillacea, Gelidium elegans*	*Pterocladiella capillacea, Dichotomaria falcata, Gelidium elegans, Champia recta*	*Pterocladiella tenuis, Dichotomaria falcata, Gelidium elegans*
Aewol	*Amphiroa ephedraea, Kallymenia crassiuscul, Carpopeltis*	*Amphiroa beauvoisii, Lomentariaceae, Gracilaria textorii, Ulva australis*	*Grateloupia asiatica, Lomentariaceae, Gracilaria textorii*
Shindo	*Corallina pilulifera, Corallina officinalis*	*Corallina pilulifera, Gelidium elegans, Carpopeltis, Ulva australis, Chondracanthus tenellus*	*Grateloupia jejuensis, Gracilaria textorii, Corallina pilulifera*

3. Results

Region	Apr. 2020	Apr. 2021	Apr. 2022
Goheung	*Gloiopeltis furcata, Chondrus ocellatus, Ulva ohnoi*	*Ulva australis, argassum fusiforme, Carpopeltis*	*Sargassum thunbergii, argassum fusiforme, Chondrus ocellatus*
Namhae	*Carpopeltis, Sargassum thunbergii, argassum fusiforme*	*argassum fusiforme, Sargassum thunbergii, Colpomenia peregrina*	*Colpomenia sinuosa, Sargassum horneri, Sargassum thunbergii*
Geoje	*Grateloupia chiangii, Gelidium elegans, Gracilaria textorii*	*Sargassum patens, Gracilaria textorii, Colpomenia peregrina*	*Sargassum piluliferum, Gracilaria textorii, Gelidium elegans*
Busan	*Amphiroa ephedraea, Padina arborescens, Sargassum thunbergii*	*Ulva australis, Sargassum thunbergii, Amphiroa beauvoisii*	*Sargassum thunbergii, Gloiopeltis tenax, Chondrus nipponicus*
Pohang	*Padina arborescens, Corallina pilulifera, Gloiopeltis tenax*	*Sargassum horneri, Corallina pilulifera, Gelidium elegans*	*Chondracanthus tenellus, Gelidium elegans, Corallina officinalis*
Uljin	*Padina arborescens, Gracilaria textorii, Grateloupia elliptica*	*Grateloupia elliptica, Undaria pinnatifida, Colpomenia peregrina*	*Grateloupia jejuensis, Gracilaria textorii, Padina arborescens*

3. Results

Region	Oct. 2020	Oct. 2021	Oct. 2022
Gangjeung	*Ecklonia cava, Ulva australis, Amphiroa ephedraea, Codium fragile, Martensia denticulata*	*Martensia elegans, Amphiroa anceps, Amphiroa beauvoisii*	*Amphiroa ephedraea, Martensia elegans, Amphiroa anceps*
Namwon	*Gelidium elegans,Plocamium telfairiae, Amphiroa beauvoisii, A. ancep, Corallina crassisima, Bryopsis ryukyuensis*	*Corallina crassisima, Cladophora wrightiana, Amphiroa anceps*	*Amphiroa ephedraea, Martensia elegans, Cladophorawrightiana*
Seongsan	*Gelidium elegans, Plocamium telfairiae, Corallina crassisima, Dictyopteris prolifera*	*Dictyota dichotoma, Amphiroa beauvoisii, Gelidium elegans*	*Amphiroa beauvoisii, Plocamium telfairiae, Amphiroa foliacea*
Jochon	*Gelidium elegans, Plocamium cartilagineum, Chondrus ocellatus, Ulva australis*	*Pterocladiella tenuis, Martensia elegans, Gelidium elegans*	*Gelidium elegans, Martensia elegans, Pterocladiella capillacea*
Aewol	*Amphiroa beauvoisii, Carpopelti, Ulva australi, Corallina crassisima, Grateloupia angusta*	*Amphiroa beauvoisii, Grateloupia elata, Corallina crassisima*	*Grateloupia elata, Amphiroa beauvoisii, Corallina crassisima*
Shindo	*Gelidium elegans, Corallina pilulifera, Bryopsis ryukyuensis,Codium contractum, Plocamium ovicorne*	*Amphiroa beauvoisii, Gelidium elegans, Martensia elegans*	*Gelidium elegans, Amphiroa beauvoisii, Grateloupia elata*

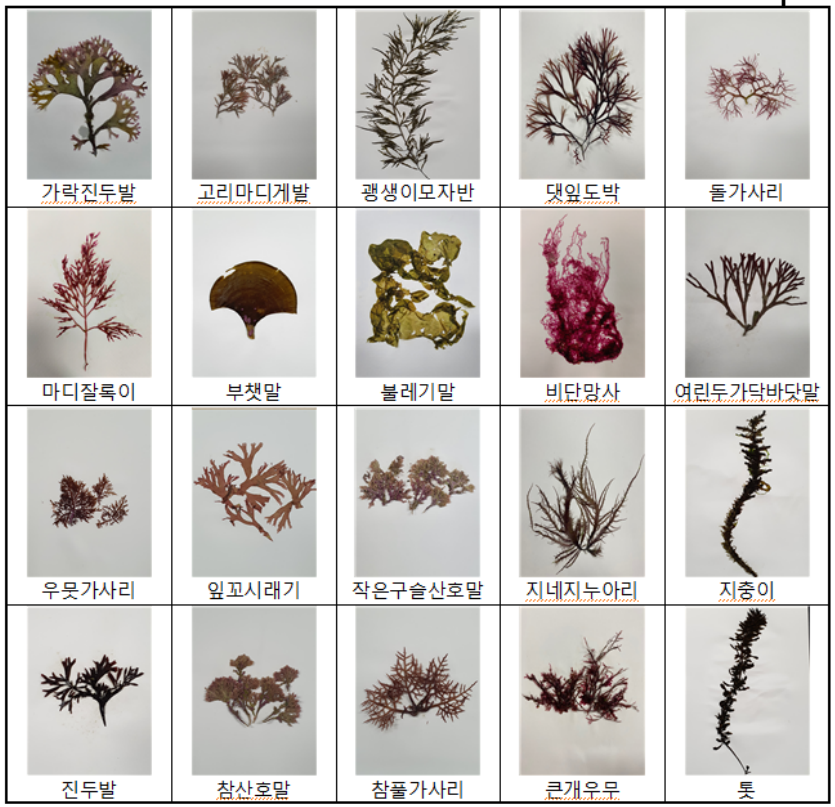
3. Results

Region	Oct. 2020	Oct. 2021	Oct. 2022
Goheung	*Hypnea asiatica, Grateloupia elata, Gelidium elegans, Sargassum thunbergii*	*Chondrus ocellatus, Gelidium elegans, Sargassum thunbergii*	*Sargassum thunbergii, argassum fusiforme, Ishige okamurae*
Namhae	*Ulva australis, Sargassum horneri, Calliblepharis saidana, Padina arborescens, argassum fusiforme*	*Sargassum thunbergii, Pterocladiella nana, argassum fusiforme*	*Rhodymenia intricata, Hypnea asiatica, Sargassum horneri*
Geoje	*Gelidium elegansa, Sargassum horneri, Ulva australis, Sargassum muticum*	*Sargassum piluliferum, Sargassum thunbergii, Sargassum horneri*	*Grateloupia elata, Gracilaria textorii, Sargassum muticum*
Busan	*Corallina pilulifera, Sargassum hemiphyllu, Sargassum thunbergii*	*Padina arborescens, Sargassum hemiphyllum, Sargassum thunbergii*	*Sargassum hemiphyllum, Padina arborescens, Chondrus ocellatus*
Pohang	*Corallina pilulifera, Sargassum confusum, Padina arborescens, Ulva australis*	*Plocamium cartilagineum, Corallina aberrans, Amphiroa beauvoisii*	*Amphiroa beauvoisii, Corallina pilulifera, Chondracanthus tenellus*
Uljin	*Sargassum patens, Padina arborescens, Grateloupia elata, Rhodymenia intricata*	*Gracilaria textorii, Grateloupia elliptica, Sargassum horneri*	*Grateloupia elata, Padina arborescens, Gracilaria textorii*

3. Results

Ex. 2022.

Apr.



July

※ except spring specimen

Nov.

※ except spring and summer specimen

- Apr. : 10 order 14 family 21 species
- July : 10 order 14 family 20 species
- Nov. : 12 order 15 family 24 species

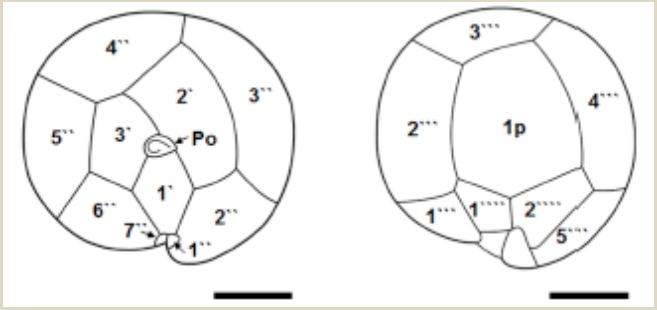
3. Results

2) Identified dinoflagellate

❖ Genus Gambierdiscus

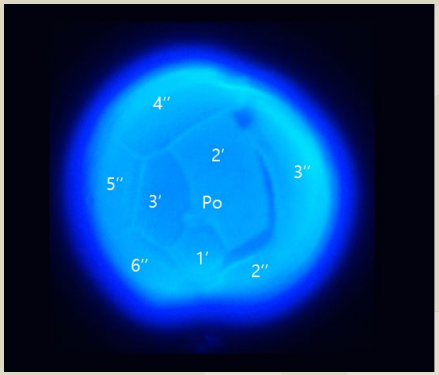
1. *G. jejuensis* S.H.Jang & H.J.Jeong 2018

- **length: 45.5~65.7㎛, width: 67.7~93.0㎛**
- **pore plate: hook shape, cingulum: deep & narrow in the center, wide sulcus**

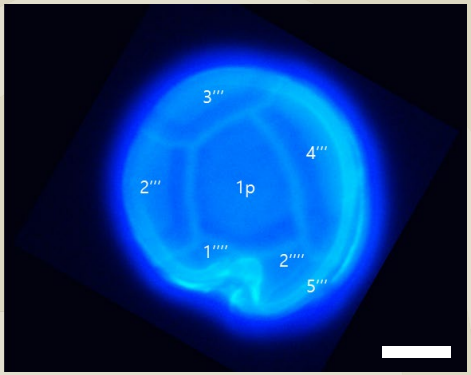


(Jang et al., 2018)

Apr. 2021_KJ



Oct. 2021_SS



(Scale bar = 10㎛)

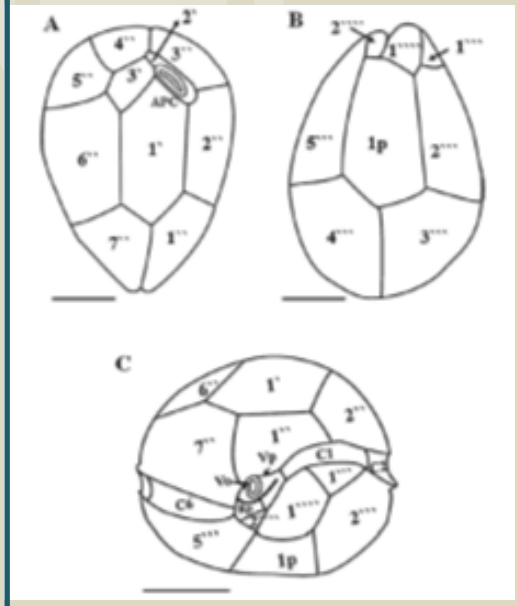
3. Results

2) Identified dinoflagellate

❖ Genus Ostreopsis

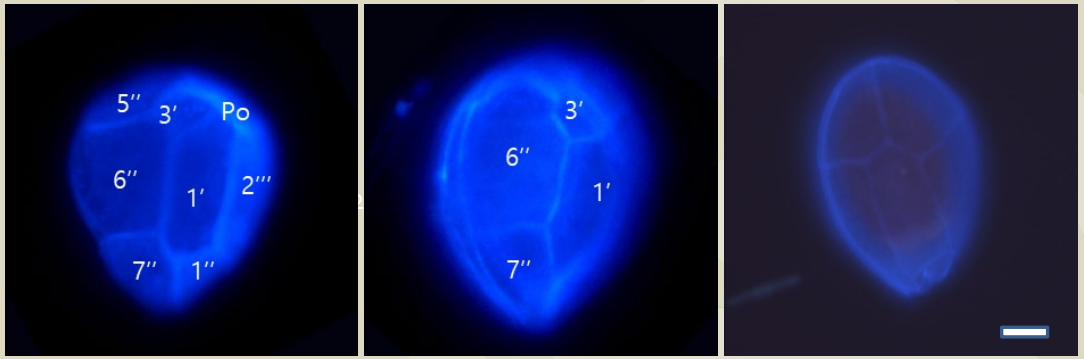
1. *Osteopsis* cf. *ovata* Y. Fukuyo 1981

- length: 30.0~64.0㎛, width: 20.0~58.0㎛, eye-drop shape, epitheca = hypotheca



(Kang et al., 2013)

Apr. 2021_JC | Oct. 2021_BS | Nov. 2022_NW



(Scale bar = 10㎛)

Nov. 2022_남원

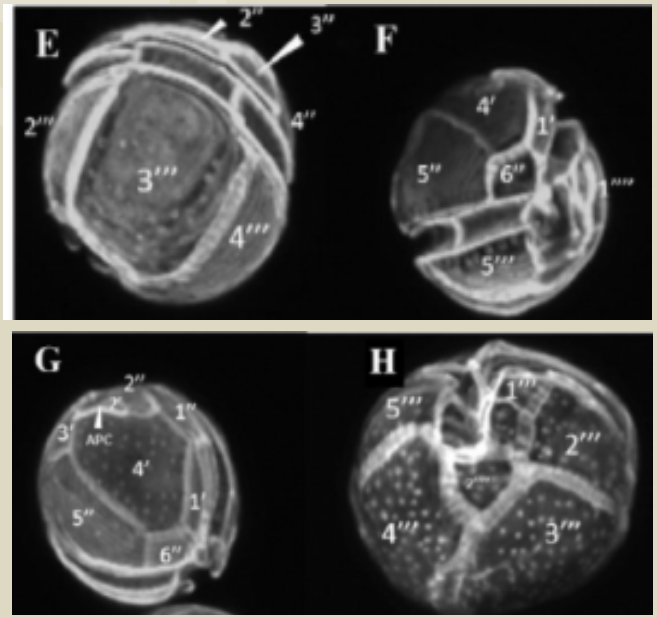
3. Results

2) Identified dinoflagellate

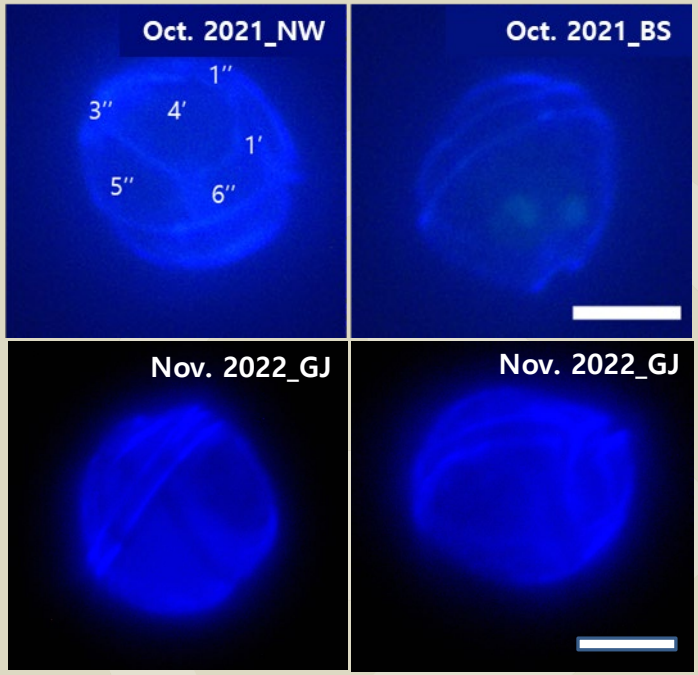
❖ Genus Coolia

1. *C. malayensis* Leaw, P.-T.Lim & Usup 2001

- length: 26.5~35.0㎛, width: 25.0~33.5㎛, rectangle shape and tilted cingulum



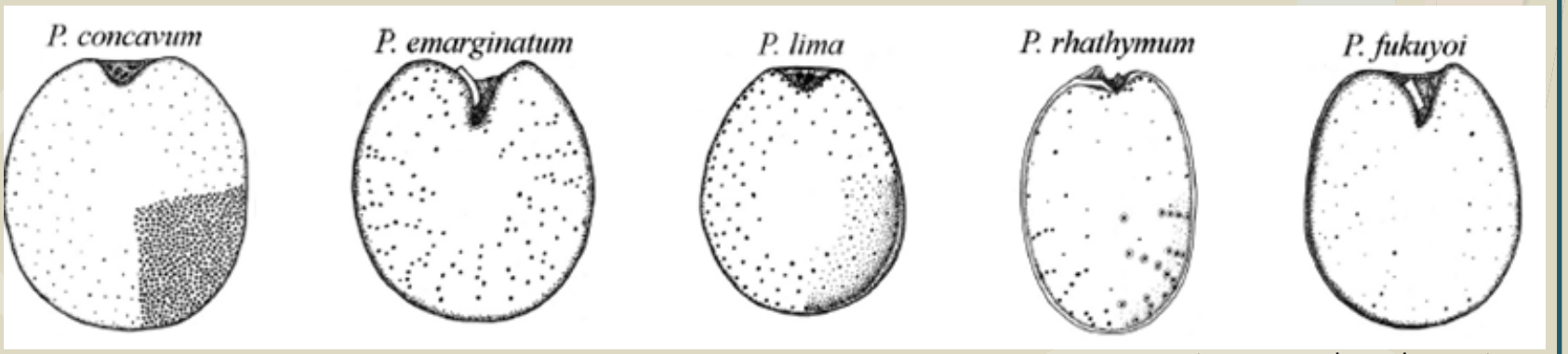
(Leung et al., 2017)



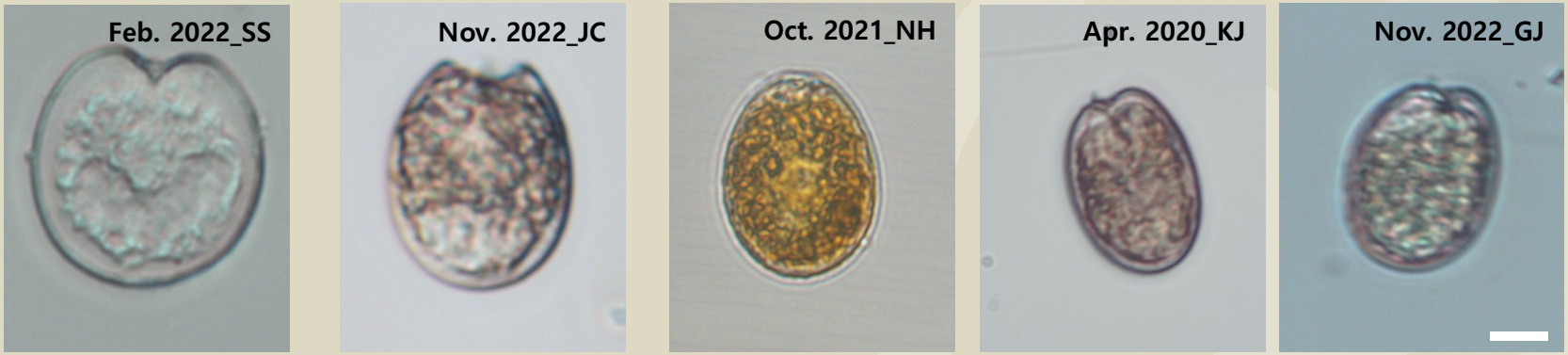
3. Results

2) Identified dinoflagellate

❖ Genus Prorocentrum



(Hoppenrath et al., 2013)



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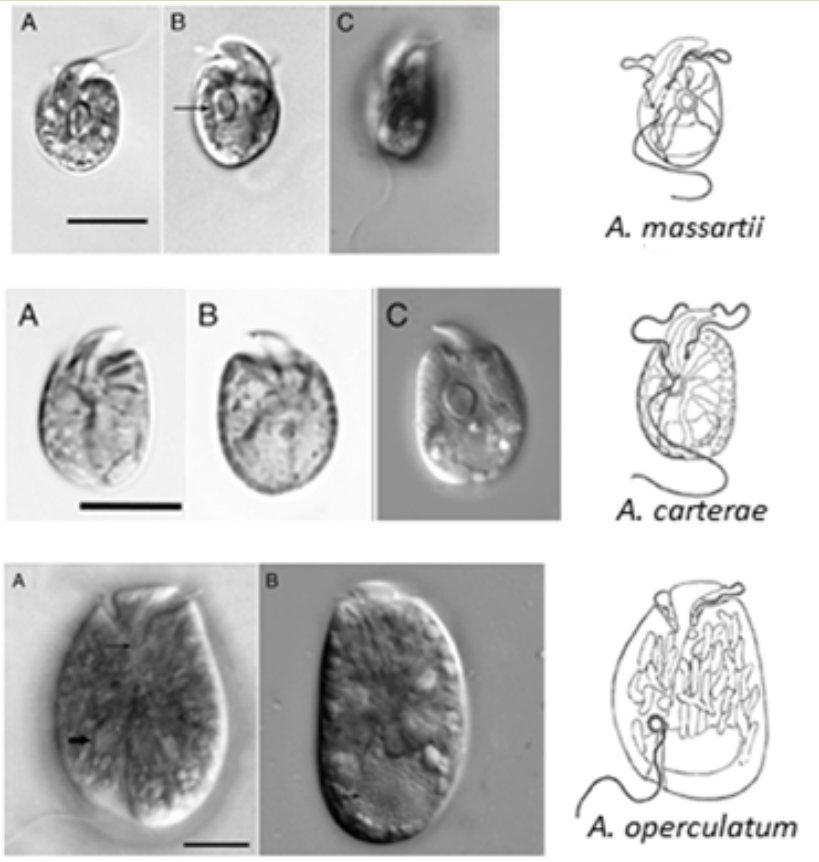
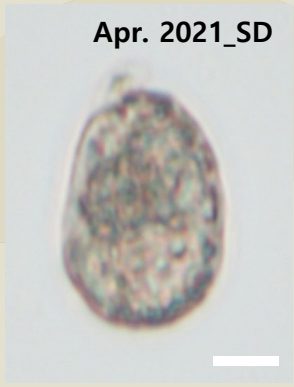
3. Results

2) Indentified dinoflagellate

❖ Genus Amphidinium



(Murry et al., 2004)

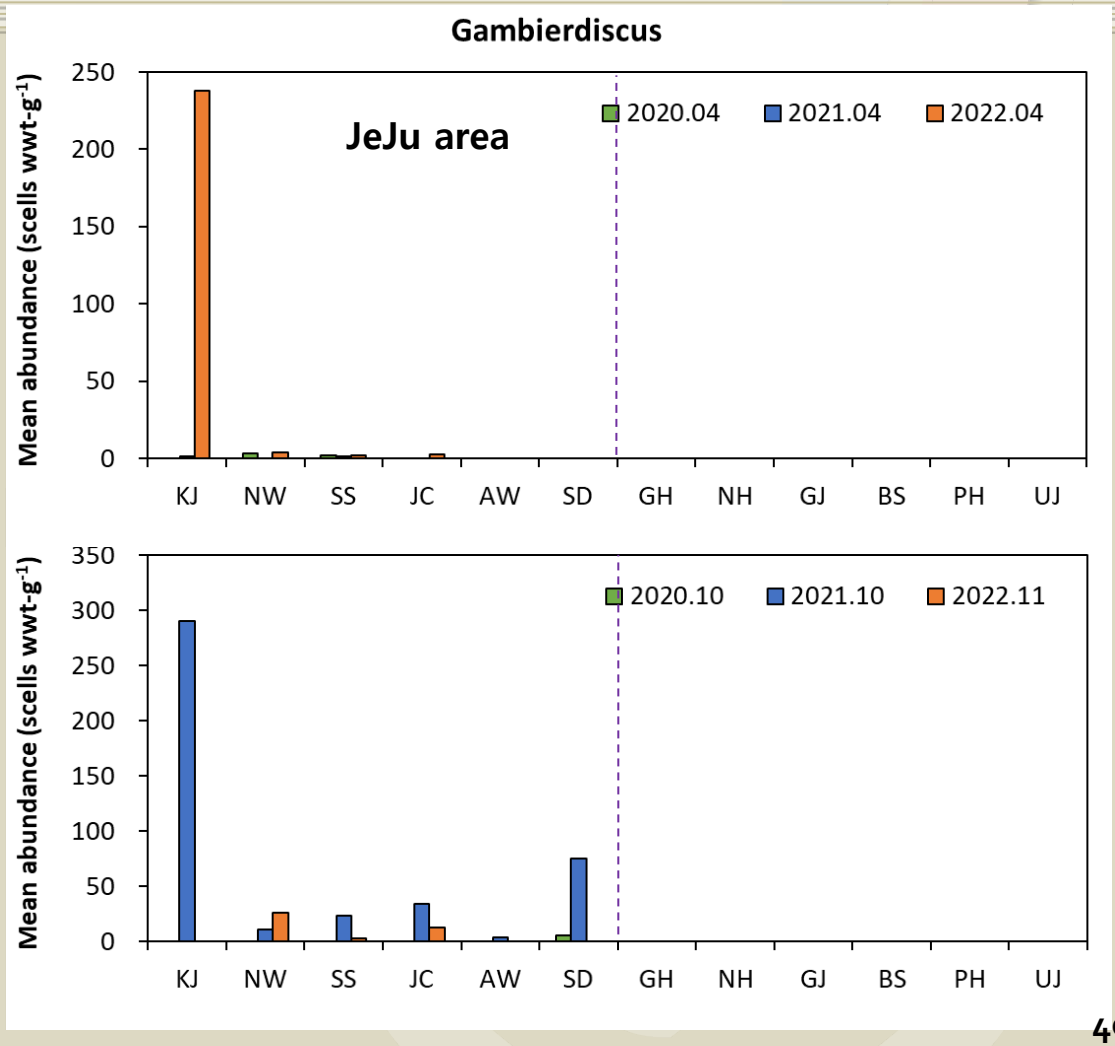


(Scale bar = 10㎛)

3. Results

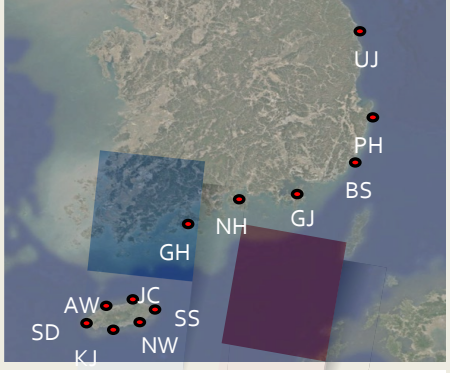
3) Distributions of CFP dinoflagellate

- *Gambierdiscus*
- **Spring**
  1. South and southeast in Jeju
  2. '22, KJ St., 237 cells wwt-g^{-1}
- **Autumn**
  1. Arround Jeju
  2. '21, KJ St., 290 cells wwt-g^{-1}

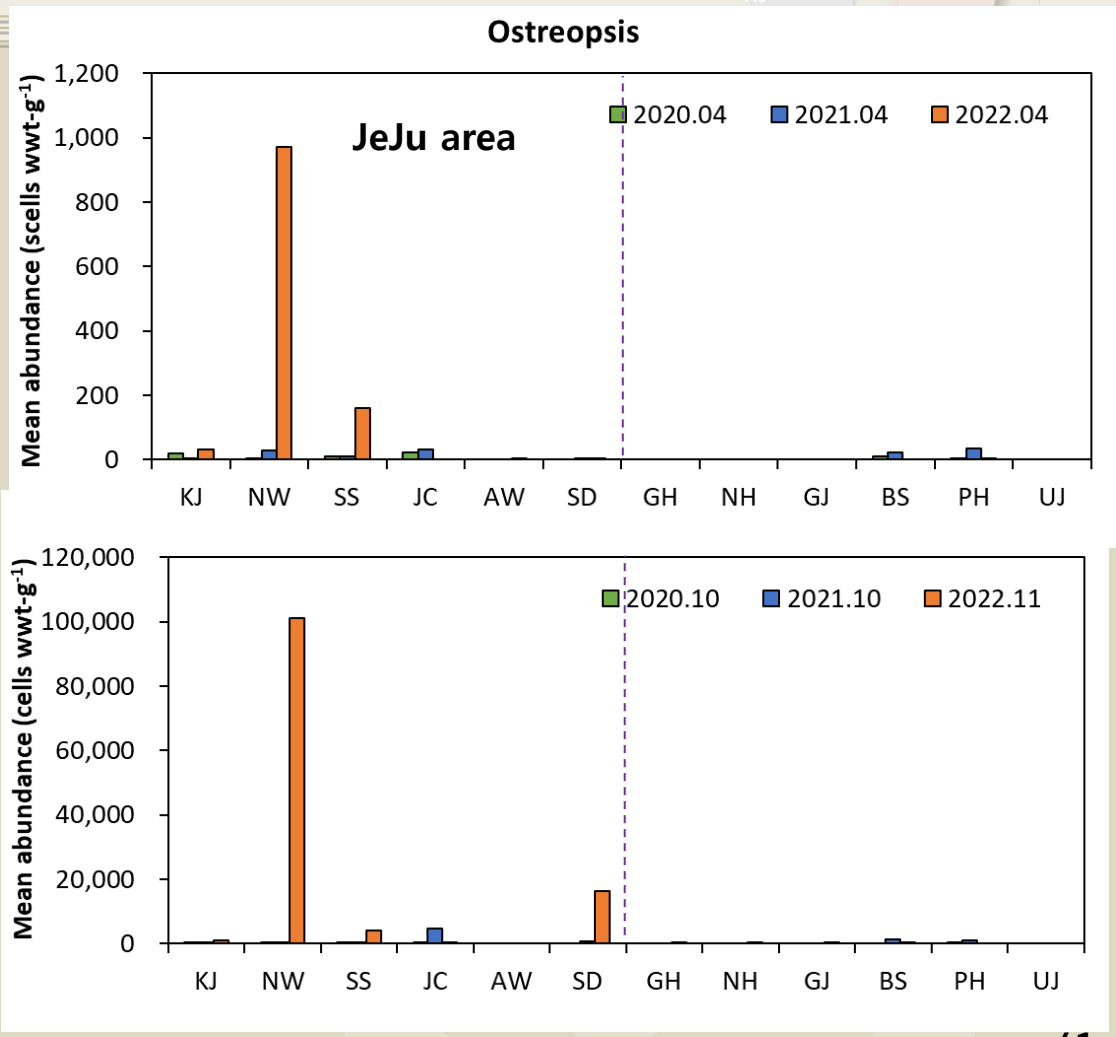


3. Results

3) Distributions of CFP dinoflagellate

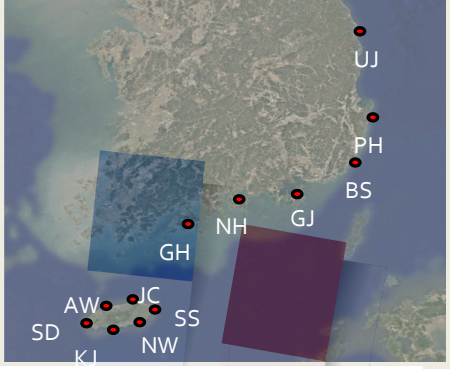


- *Ostreopsis*
- **Spring**
  1. Mainly Around Jeju
  2. '22, NW St., 971 cells wwt-g^{-1}
- **Autumn**
  1. Mainly Around Jeju
  2. '22, NW St., 101,000 cells wwt-g^{-1}

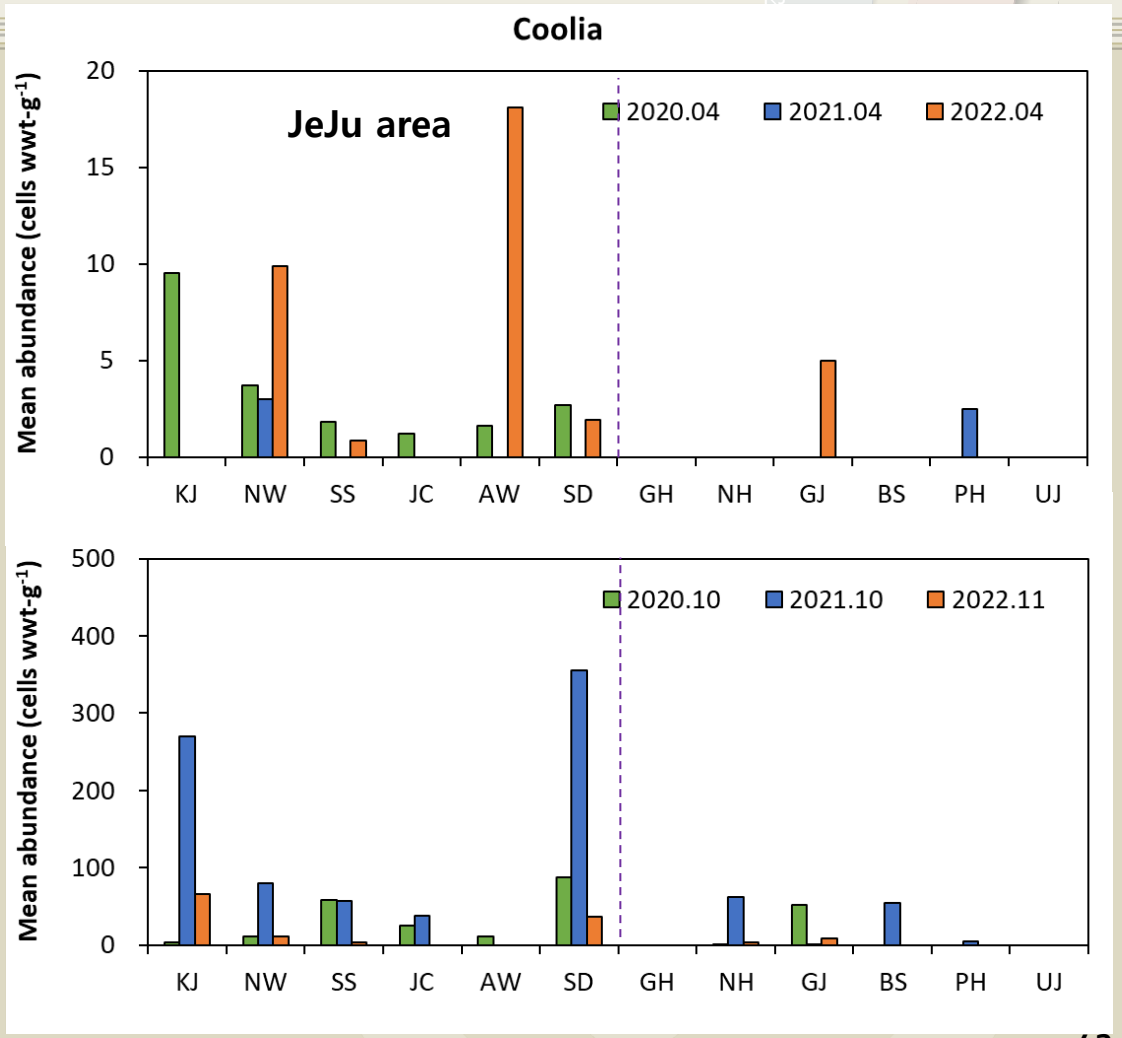


3. Results

3) Distributions of CFP dinoflagellate

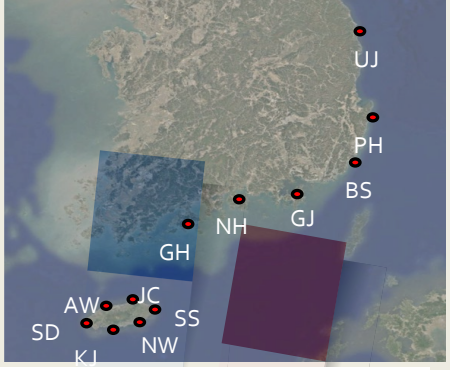


- *Coolia*
- **Spring**
  1. Mainly Around Jeju, occasionally south and east area.
  2. '22, AW St., 18 cells wwt-g^{-1}
- **Autumn**
  1. Mainly Around Jeju, occationally south and east area.
  2. Abundance: Higher than spring.
  3. '21, SD St., 370 cells wwt-g^{-1}



3. Results

3) Distributions of CFP dinoflagellate



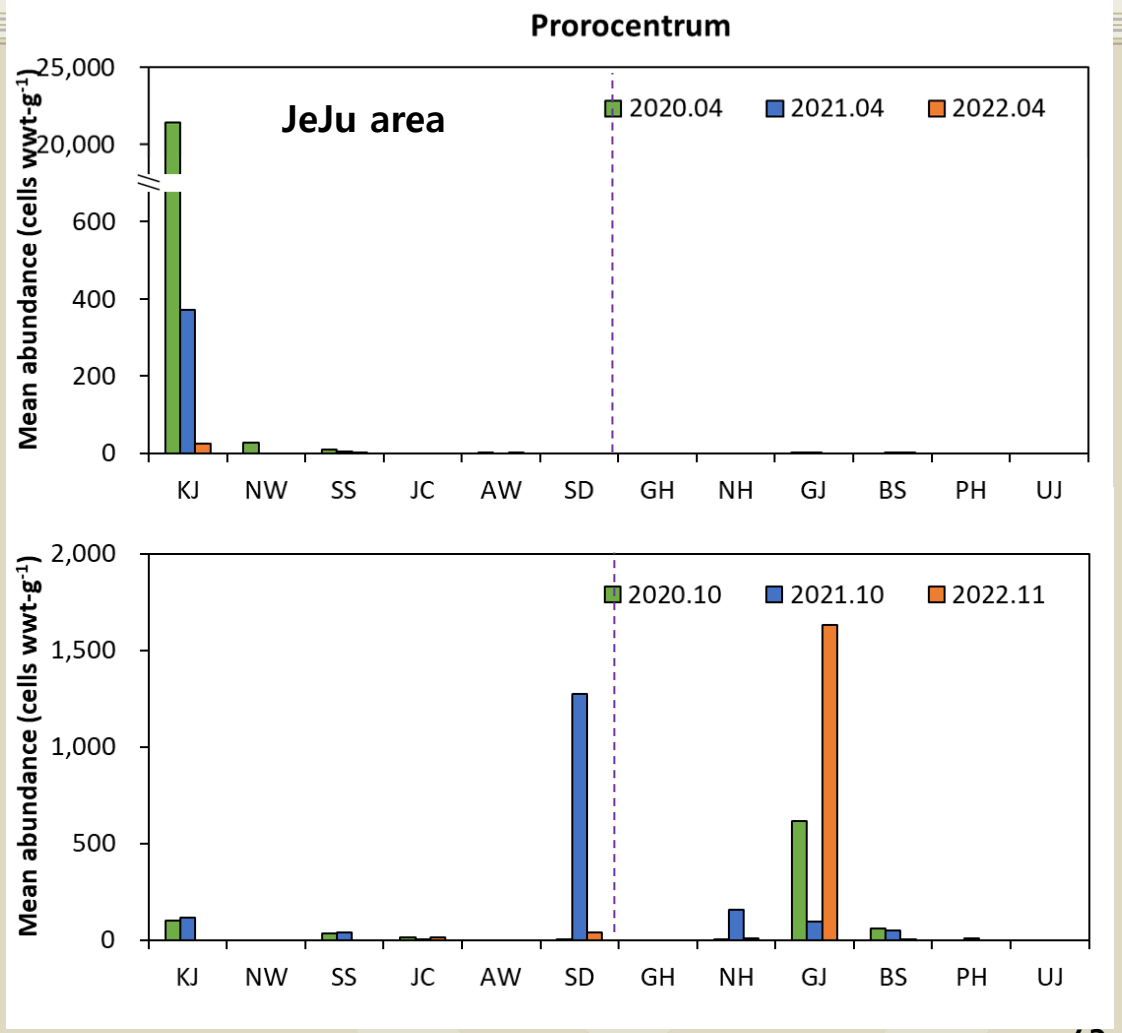
❖ *Prorocentrum*

❖ **Spring**

1. **Temporary occurrence in Jeju**
2. **Dominant species : *P. rathymum***
3. **'20, KJ St., >20,000 cells wwt-g^{-1}**

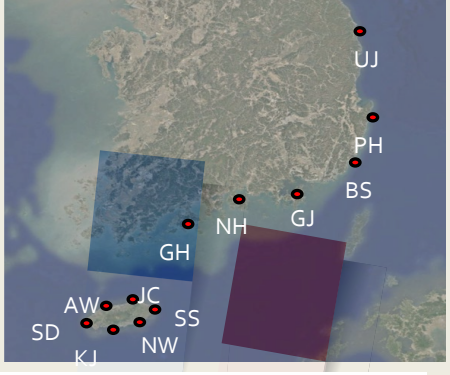
❖ **Autumn**

1. **East area in Jeju, south and east area.**
2. **Dominant species : *P. rathymum***
3. **'22, GJ St., >1,500 cells wwt-g^{-1}**

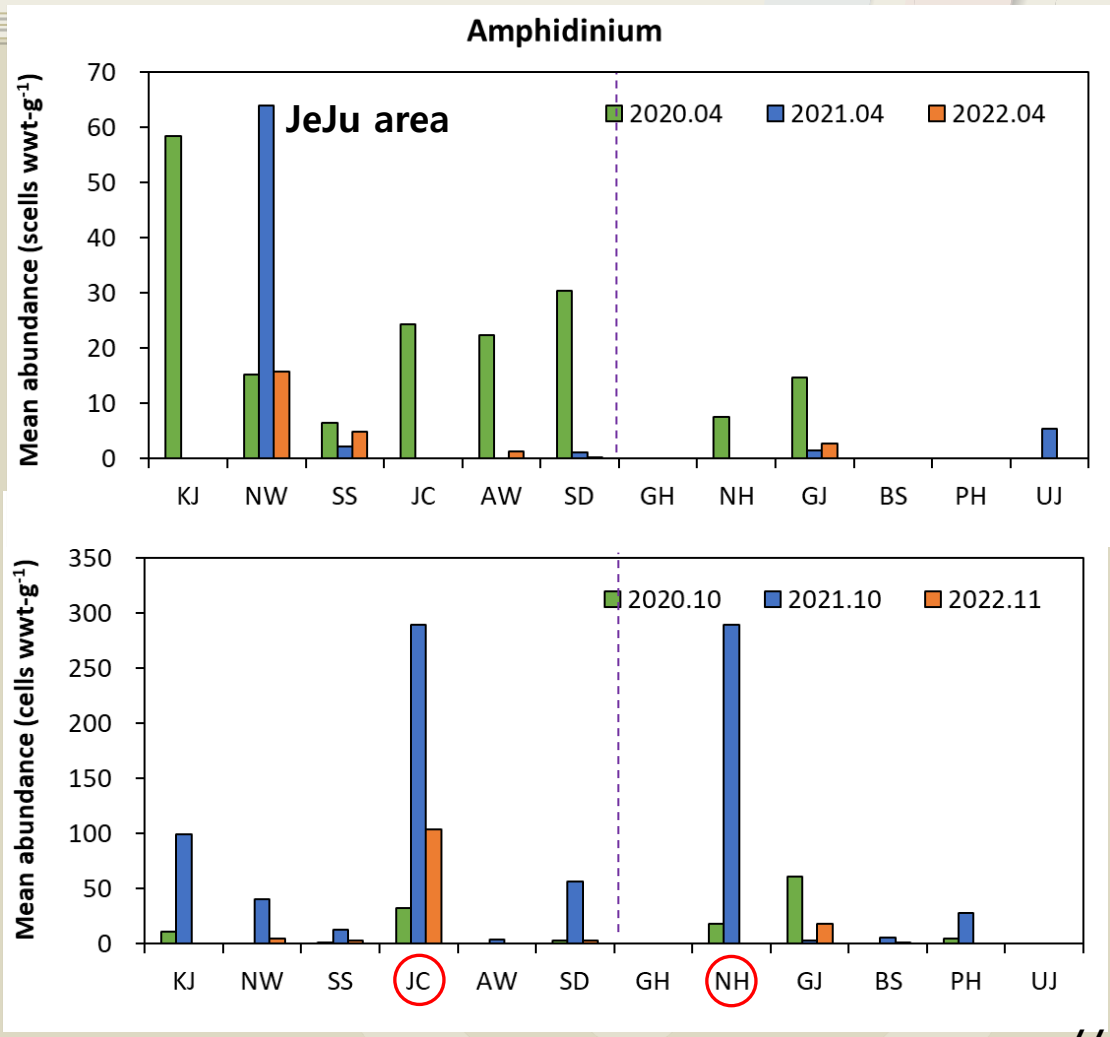


3. Results

3) Distributions of CFP dinoflagellate



- ❖ *Amphidinium*
- ❖ No seasonal variation
- ❖ A. carterae
  1. ’21, Autumn
     : JC St., 103 cells wwt-g^{-1}
     : NH St., 108 cells wwt-g^{-1}



4. Further study

1) Monitoring (‘23~)

❖ 12 stations, spring and autumn (if possible, including summer)

2) Isolation and culturing (‘23~’25)

❖ Study of growth rate at Temp., Sal., and nutrients with each strains

3) Indigenization and Toxin standard (’25~’27)

❖ Identify the possibility of indigenization by sea area

❖ Study of environmental conditions for toxin production and mass culture.