

# Precautionary Management of Jellyfish Bloom by Polyp Elimination

Gusung Lee<sup>1</sup>, Sunwoo Kim<sup>1</sup>, Hojung Song<sup>1</sup>, Inseo Hwang<sup>1</sup>, Jinho Chae<sup>2</sup>, Wonduk Yoon<sup>2</sup>,

<sup>1</sup>Korea Marine Environment Management Corporation (KOEM), Seoul 05718, Republic of Korea

<sup>2</sup>Marine Environmental Research and Information Laboratory (MERIL), Gunpo 15850, Republic of Korea

<sup>3</sup>Human & Marine Ecosystem Research Laboratory (HuMER), Gunpo 15850, Republic of Korea

3~5 December 2019, Busan, Korea



Ministry of Oceans  
and Fisheries



Korea Marine Environment  
Management Corporation

# Ways and means?

- research, modeling...

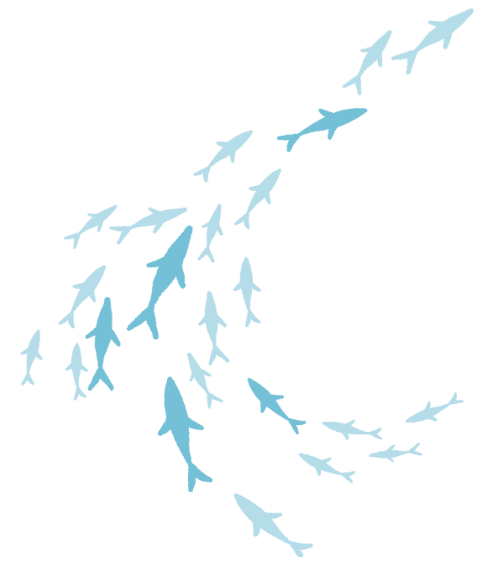


## Achieve goals!

- control jellyfish bloom



# CONTENTS



- I. Background**
- II. Jellyfish Polyp Management Program of Korea**
- III. Achievements of Jellyfish Polyp Management Program**
- IV. Conclusion**

# I . Background

---



# I. Background



## Harmful Jellyfish in Korea

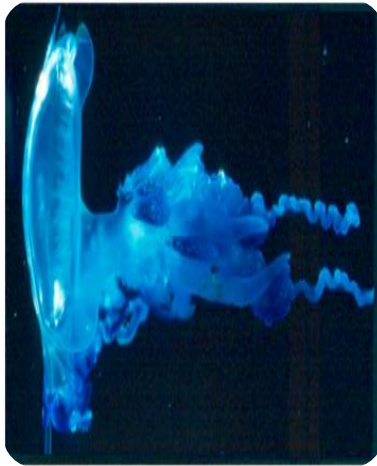
- ✓ Five species (*Aurelia coerulea*, *Nemopilema nomurai*, *Physalia physalis*, *Carybdea brevipedalia*, *Chrysaora pacifica*) have been designated as harmful marine species by the Act on “Conservation and Management of Marine Ecosystem” in Korea



» *Aurelia coerulea*



» *Nemopilema nomurai*



» *Physalia physalis*



» *Carybdea brevipedalia*



» *Chrysaora pacifica*



# I. Background



## Jellyfish blooms in Korea

- ✓ Causing socio-economic damages → Annually USD 260 million(NIFS, 2009)
  - Fisheries (USD193million), Power station (USD 50million), Recreation industry( USD14million), etc.
- ✓ Fisheries economic damages → Annually USD 6 ~ 11 million(NIFS, 2018)



# I. Background



## Moon Jellyfish in Korea

- ✓ *Aurelia coerulea* (Moon jellyfish) blooms occurs almost every year
- ✓ Major jellyfish species causing damages to fisheries and swimmers in the sea
- ✓ Born and grown up in Korean coastal waters
- ✓ Target species for controlling population size of polyps in Korea



## II. Overview of Jellyfish Polyp Management Program

---



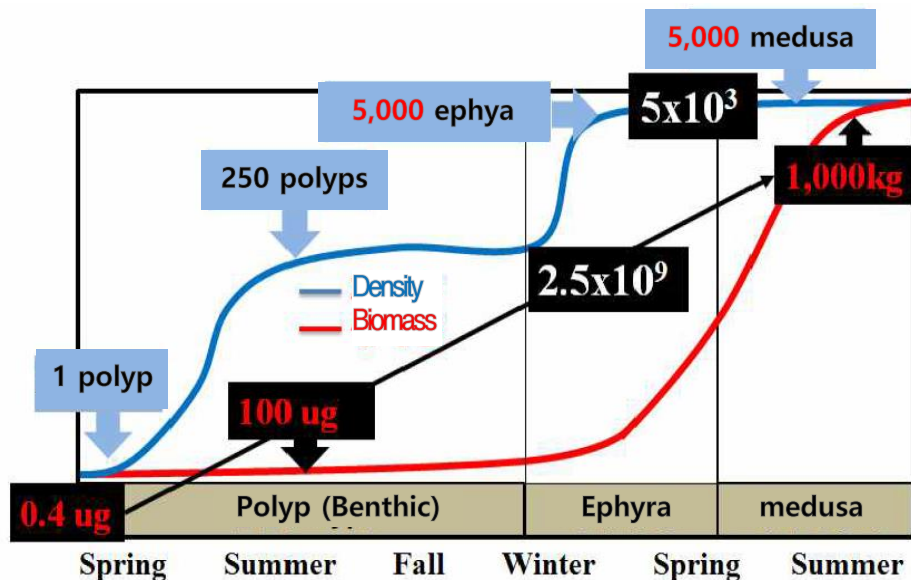


## II. Overview of Jellyfish Polyp Management Program



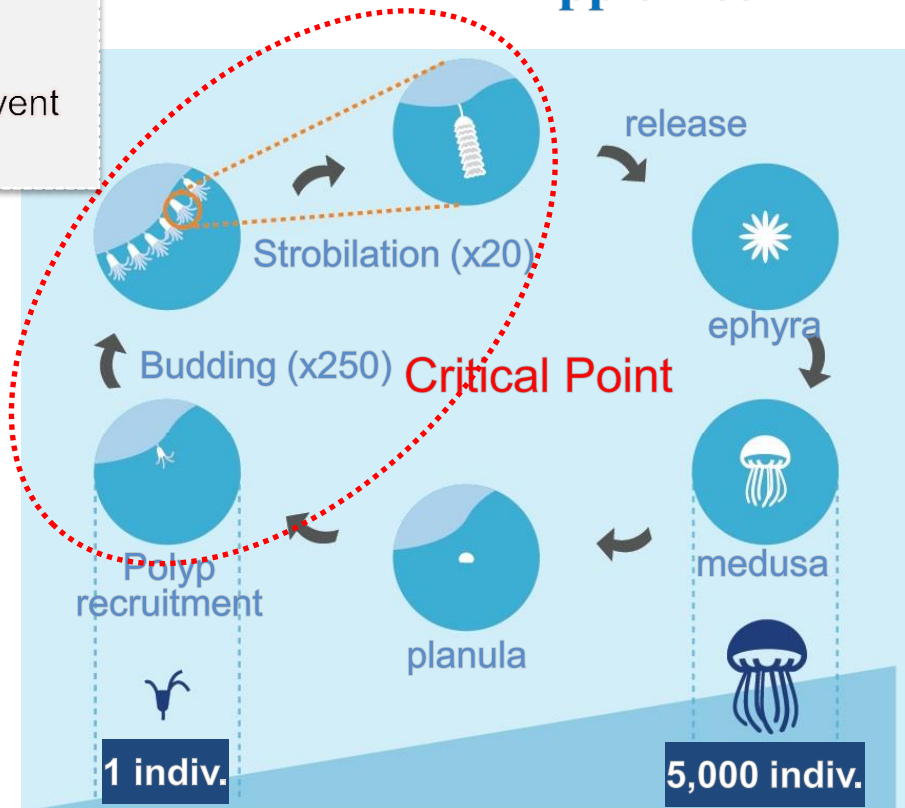
### Precautionary Management of Jellyfish Bloom

- ✓ **Benthic polyp stage is a critical point for controlling population size of medusa**
  - One polyp grows 5,000 adult jellyfish without consideration of natural mortality rate
- ✓ If we could **find the habitats of polyp** and remove them;
  - **Control population size of medusa** in advance and prevent blooms of jellyfish



Source: NIFS

**Precautionary approach  
like removing  
apple tree**



## II. Overview of Jellyfish Polyp Management Program



### Comparison between medusa elimination and polyp elimination



Medusa Elimination

- ✓ Blooms repeat every year and diffuse widely
- ✓ Might cause secondary pollution by cutting and grinding medusa
- ✓ Require a lot of manpower and budget for removing



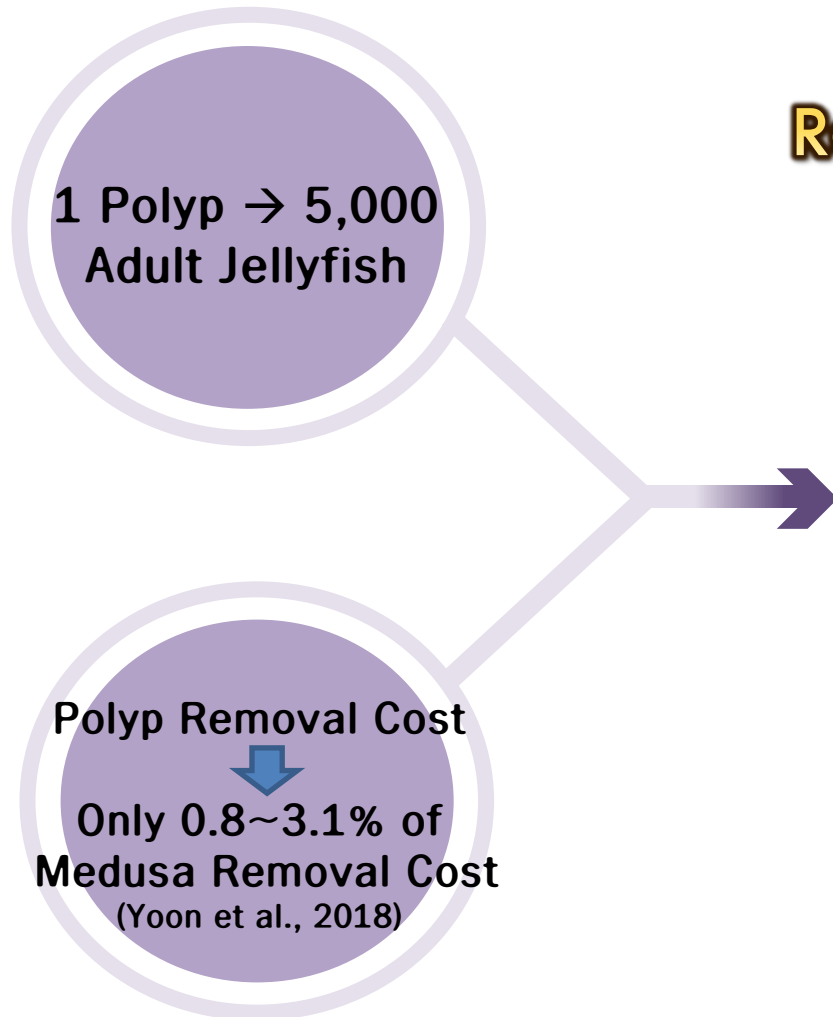
Polyp Elimination

- ✓ Elimination before blooming
- ✓ Eco-friendly elimination method (high press-water-jet)
- ✓ Concentrated in limited area

## II. Overview of Jellyfish Polyp Management Program



### Effectiveness of Polyp Management



**Low Cost, High Efficiency  
Way for Preventing  
Jellyfish Blooms**

## II. Overview of Jellyfish Polyp Management Program



### Process of Jellyfish Polyp Management

#### Exploring Polyp Hotspots

##### Condition of Inhabitation

- Artificial Structures
- Weak current or tide
- Eutrophication

##### Procedures

- Survey of Artificial Coastal Structures
- Underwater Investigation
- Evaluate polyp density
- Selection of removal site
- Mapping of polyp distribution

#### Elimination

##### Removal

- High pressure seawater
- Brush
- Scraper, Shovels, etc.

##### Evaluation

- Comparison before ↔ after
- Calculate removal efficiency

#### Post-monitoring

##### Pelagic ecosystem

- Spatio-temporal distribution patterns of ephyra and young medusa
- Change in zooplankton, other jellyfish

##### Benthic ecosystem

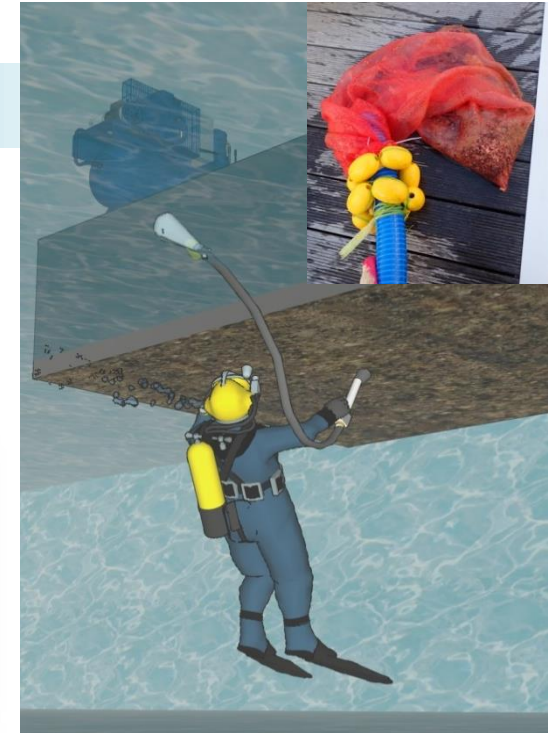
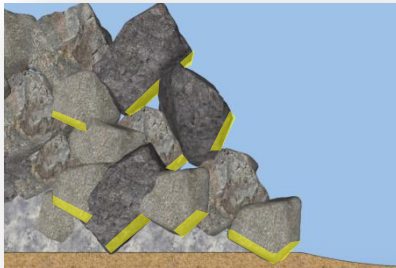
- Change in polyp population
- Compare polyp removal site with non-removal site
- Change in benthic ecosystem after polyp removal



## II. Overview of Jellyfish Polyp Management Program

### Removal Methods of Polyps

- Mostly using high pressure water jet (160 – 180 bar)
- Flat shovel, Scraper, Brush, etc, choose various different tools, occasion demands



### **III. Achievements of Jellyfish Polyp Management Program**

---

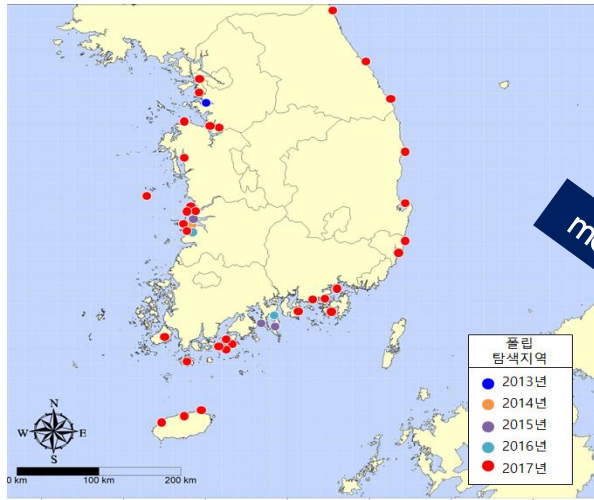


# III. Achievements of Jellyfish Polyp Management Program

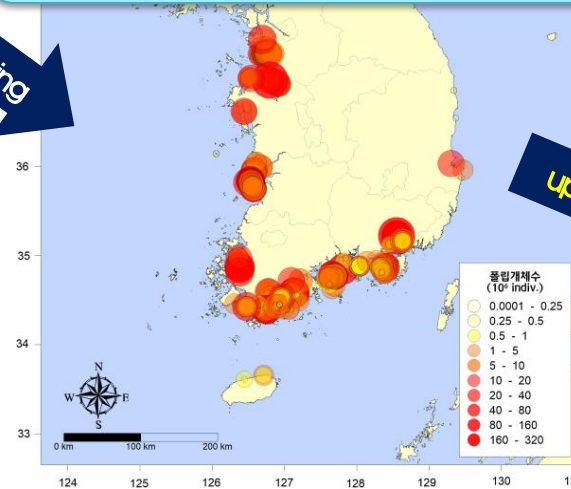


Development of polyp distribution map → update continuously

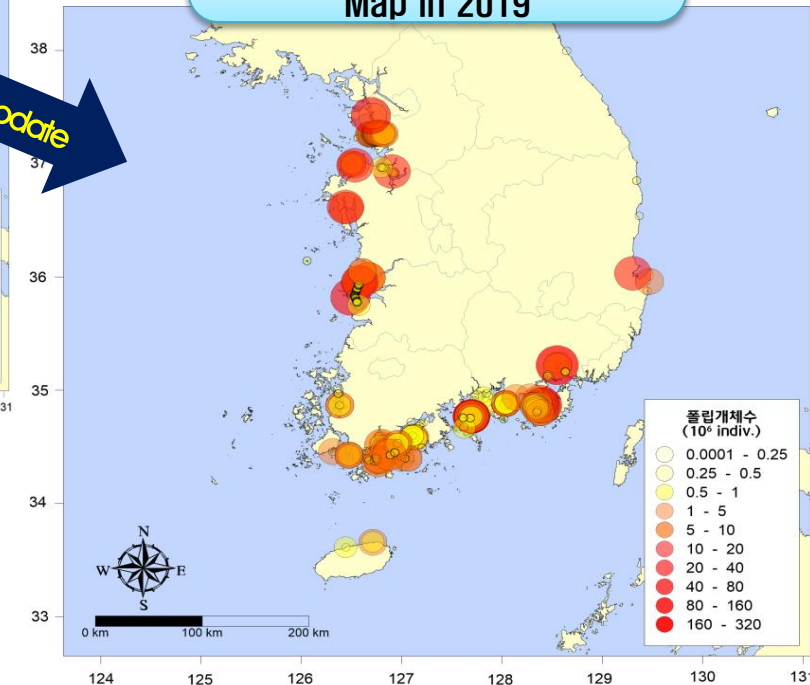
## Exploration of Polyps Nationwide in 2017



## Polyp Distribution Map



## Updated Polyp Distribution Map in 2019

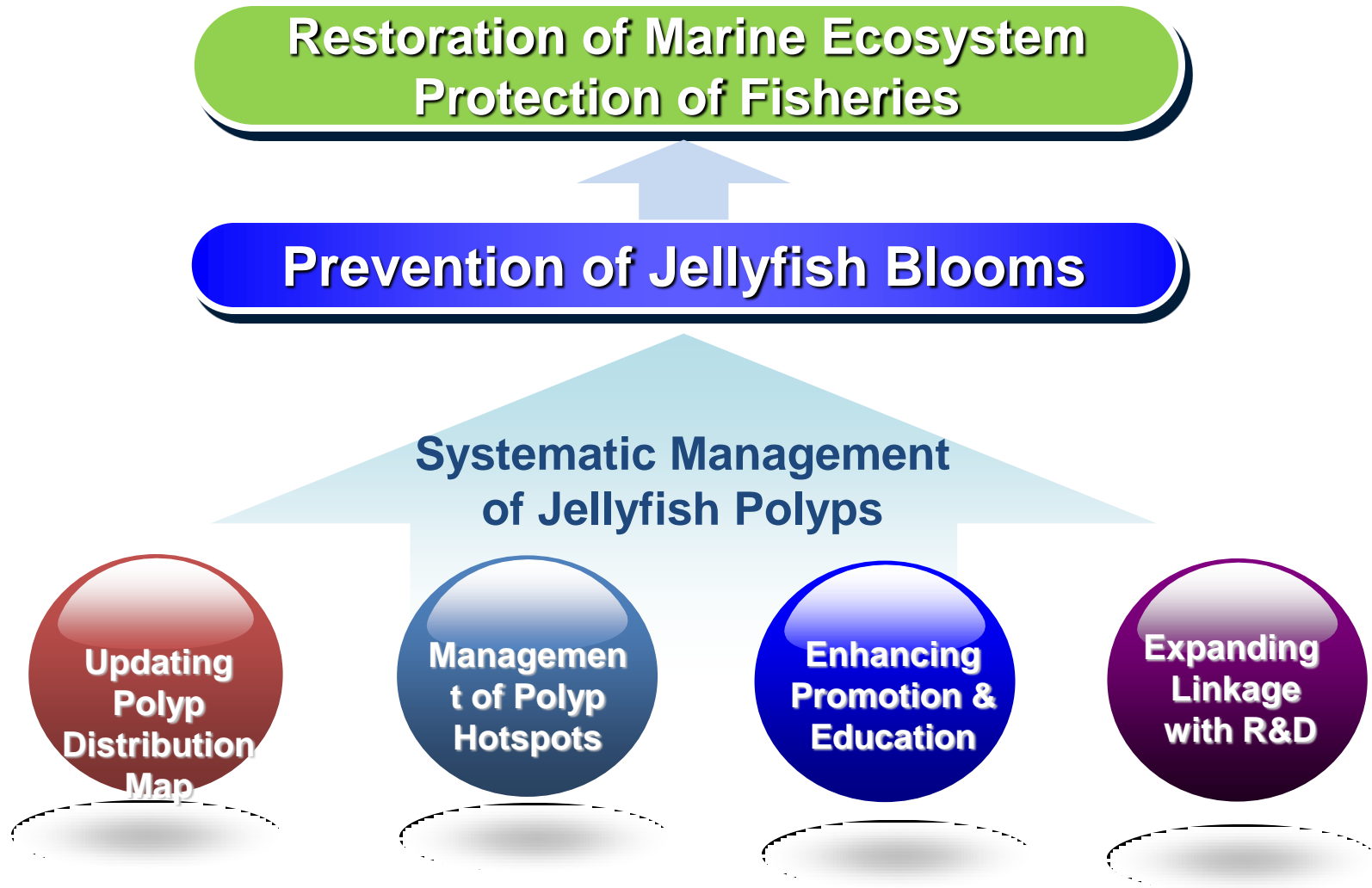


2017

Exploration	441 stations
Discovery	161 stations
Area	50,654m <sup>2</sup>
Population	498,582,544 indiv.

### III. Achievements of Jellyfish Polyp Management Program

- ❖ Establishment of mid-term(2018–2022) strategy for systematic management in 2018





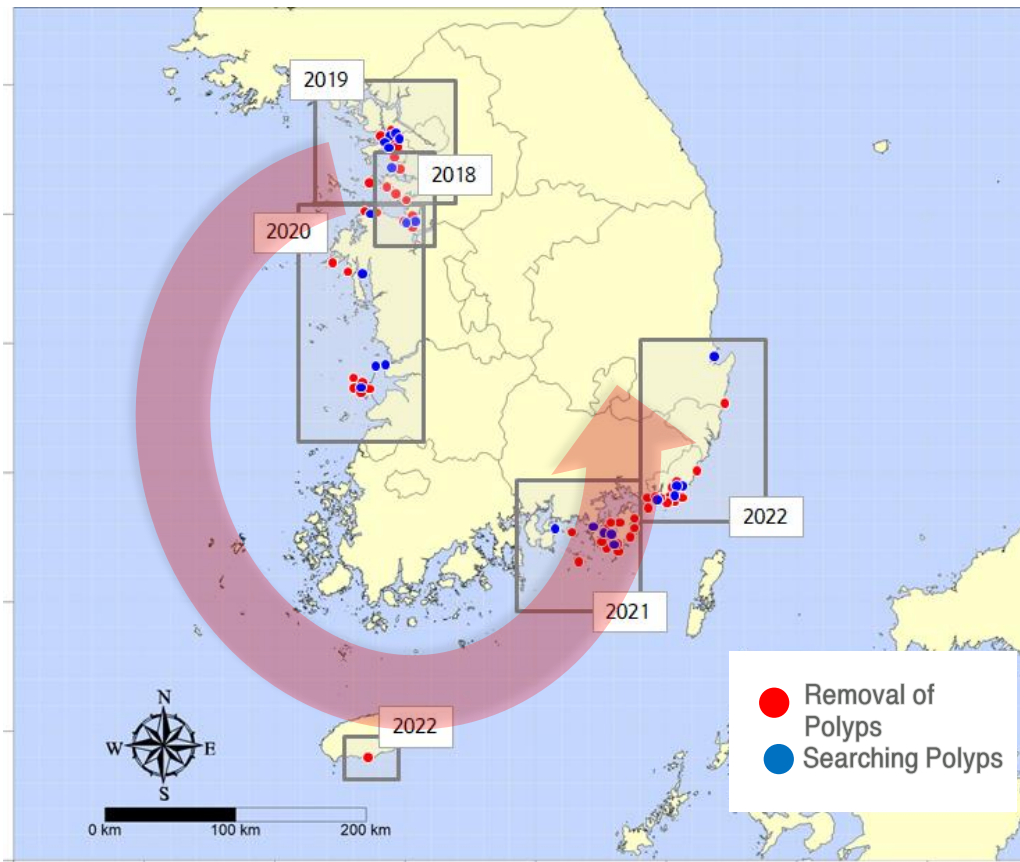
# III. Achievements of Jellyfish Polyp Management Program

	Objectives	Detailed Tasks
①	• Establishment of National Polyp Distribution Map	<ul style="list-style-type: none"> <li>• Continue to Update Polyp Distribution Map</li> <li>• Précising Polyp Distribution Map through Enhancing Reporting System</li> </ul>
②	• Polyp Management by Regional Coastal Waters	<ul style="list-style-type: none"> <li>• Strengthening Management of Polyp Hotspots</li> <li>• Expanding Polyp Searching</li> <li>• Analysis of Effectiveness of Polyp Removal</li> <li>• Standardizing Methods of Polyp Management</li> </ul>
③	• Enhancing Education, Public Awareness, International Network	<ul style="list-style-type: none"> <li>• Expanding Education and Promotion of National Polyp Management Program</li> <li>• Strengthening National/International Networks on Jellyfish Research and Management</li> </ul>
④	• Linking with R&D on Jellyfish and Developing New Technology	<ul style="list-style-type: none"> <li>• Enhancing Linkage between Polyp Management Program and R&amp;D on Jellyfish</li> <li>• Developing New Technology on Polyp Exploration &amp; Elimination</li> </ul>



### III. Achievements of Jellyfish Polyp Management Program

Removing Polyps → West Sea → South Sea → East Sea  
considering moving directions of littoral current

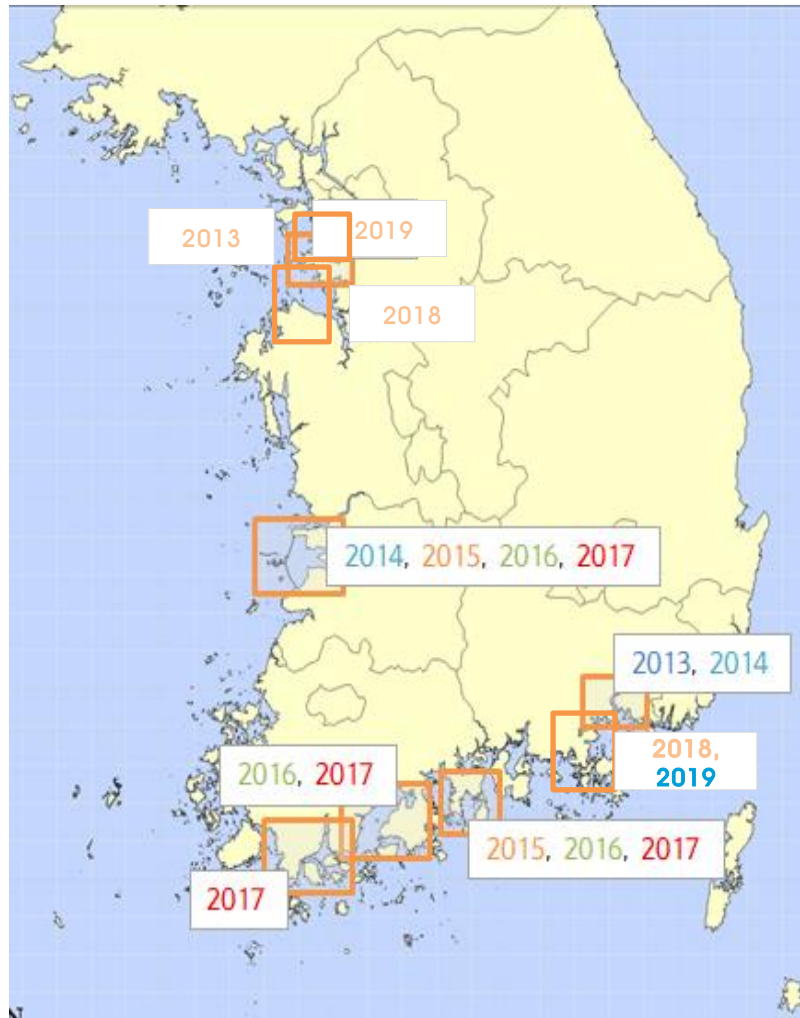


Year	original plan	amendment
2018	Incheon, Chungnam	Incheon, Chungnam
2019	Incheon	Incheon, Gyeonggi
2020	Chungnam, Jeonbook	Incheon, Gyeonggi
2021	Gyeongnam	Chungnam, Jeonbook, Gyeongnam
2022	Gyeongnam, Gyeongbuk, Jeju Island	Gyeongnam, Gyeongbuk, Jeju Island

# III. Achievements of Jellyfish Polyp Management Program



## Elimination of jellyfish polyps since 2013



- 2013-2017: focused on coastal waters, having high frequency of jellyfish blooms including Sihwa Lake, Masan bay, Saemangeum, Deukryang Bay
- 2018-2019 eliminate polyp habitats allocated under the mid-term strategy and update a polyp distribution map

# III. Achievements of Jellyfish Polyp Management Program



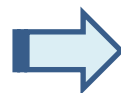
**Elimination of more than 3 billion indiv.**

【Funded by Ministry of Oceans and Fisheries】

Year	Region	Dimension	Indiv. of Polyp
2013	Shiwa Lake	20 power towers	160,000,000
	Masan Bay	500m²	75,000,000
2014	Masan Bay	15,500m²	230,000,000
	Saemangeum	2,000m²	25,000,000
2015	Saemangeum	64,977.5m²	220,000,000
	Gamak Bay	265.5m²	10,000,000
2016	Saemangeum	57,470m²	250,000,000
	Gamak Bay	4,470m²	290,000,000
	Yeosa Bay	93.0m²	930,000
	Deukryang Bay	2,597m²	38,000,000
2017	14 Areas of the country	26,036m²	600,000,000
2018	Incheon Songdo	6,800m²	41,000,000
	Dangjin Port	3,600m²	39,000,000
	Pyeongtaek port	4,800m²	64,000,000
	Jeongok Port	400m²	23,000,000
2019	Incheon Harbor	10,040m²	365,000,000
	Jeongok Port	4,140m²	171,000,000
	Pyeongtaek port	300m²	5,000,000
<b>Total</b>			<b>2,581,000,000</b>

【Funded by local governments】

Year	Region	Dimension	Indiv. of Polyp
2014~2015	Deukryang Bay	2,604m²	364,000,000
2015~2016	Aphaedo	1,551m²	21,000,000
	Mokpo Harbor	1,966m²	122,000,000
2015	Jindong Bay	2,794m²	19,000,000
2016	Maekjeon Prot	90m²	2,000,000
2018	Sujeong Bay	1,094m²	10,000,000
2019	Jangpo Port	431m²	11,000,000
	Jindong Bay	1,231m²	15,000,000
	Sanyang	497m²	17,000,000
	Gujae	1,877m²	35,000,000
	Gosung Jaran Bay	2,741m²	47,000,000
<b>Total</b>			<b>663,000,000</b>



**Eliminated more than 3billion polyps in 2013~2019**

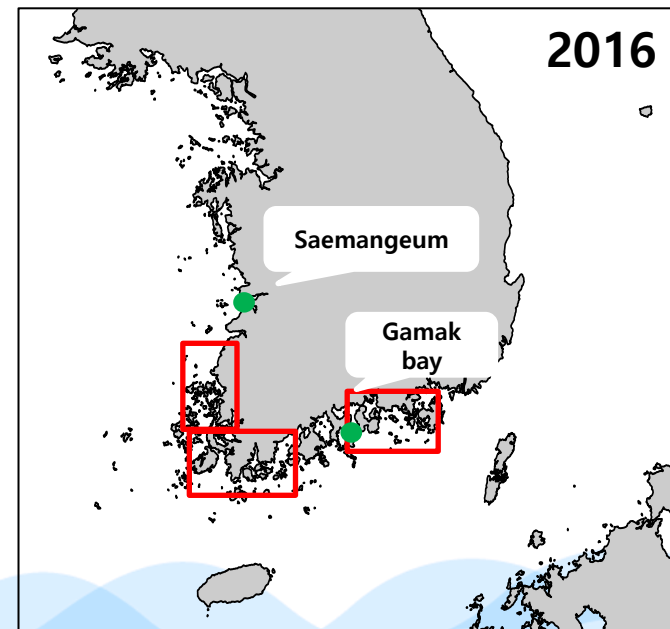
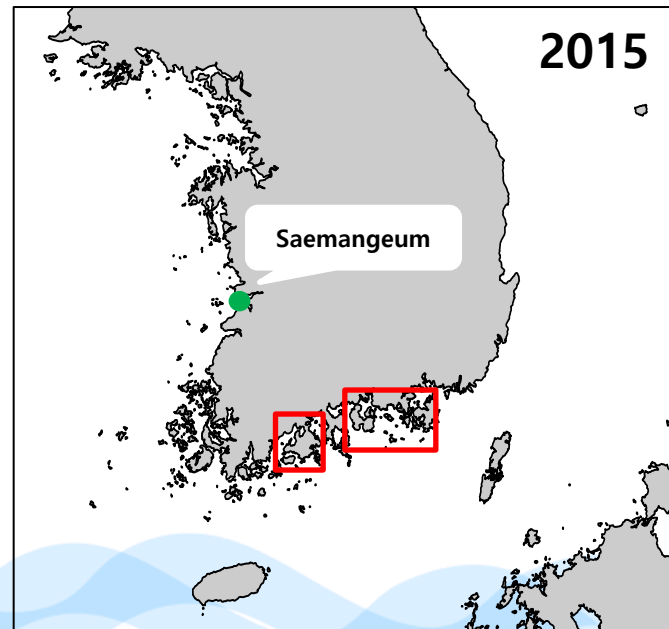
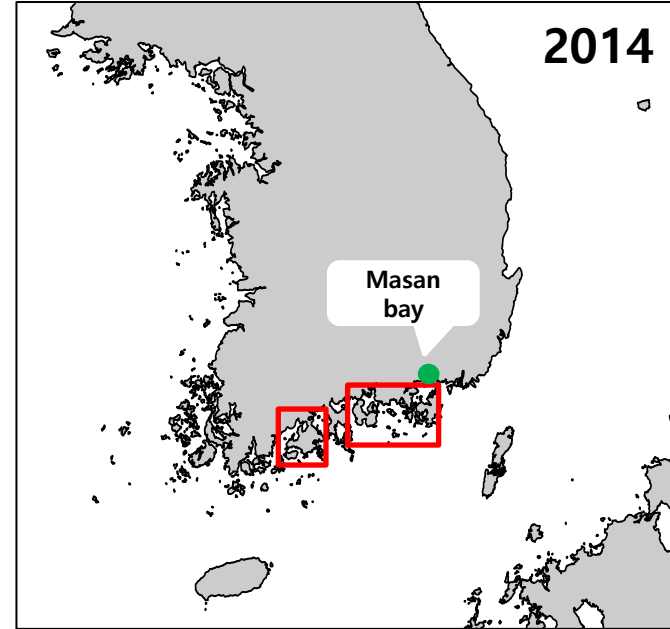
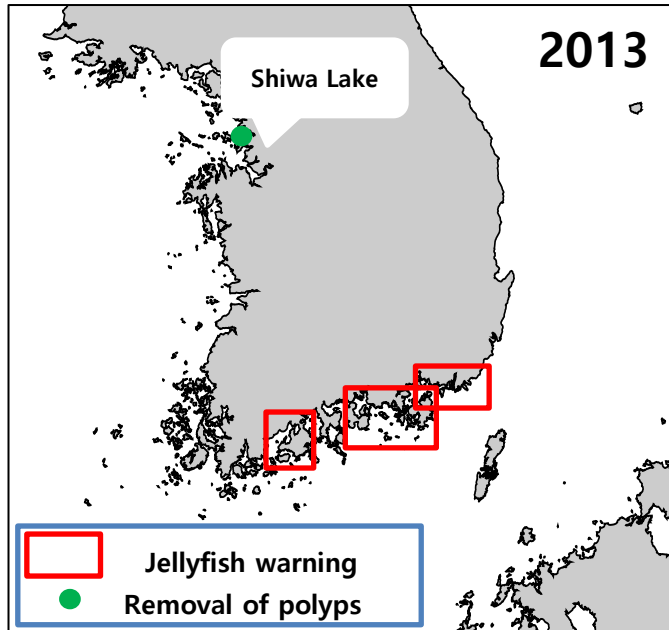


# III. Achievements of Jellyfish Polyp Management Program

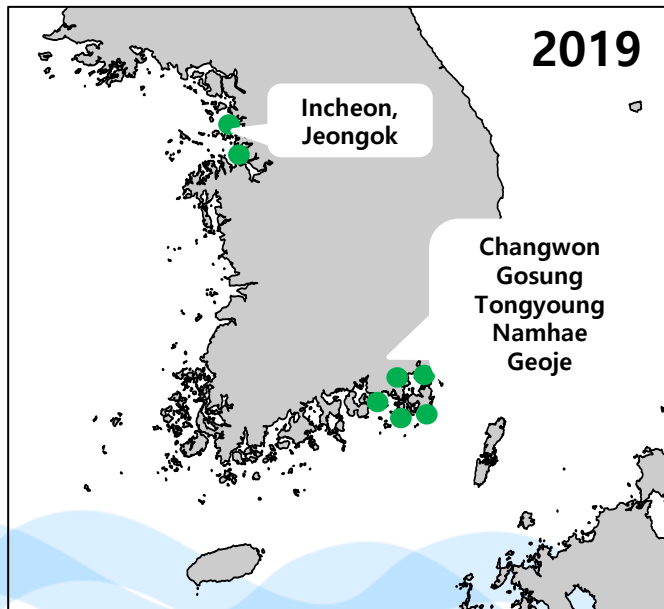
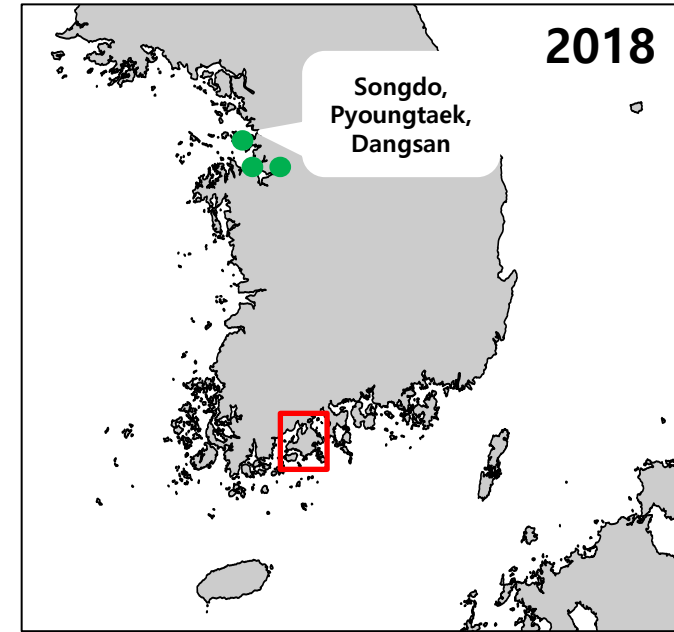
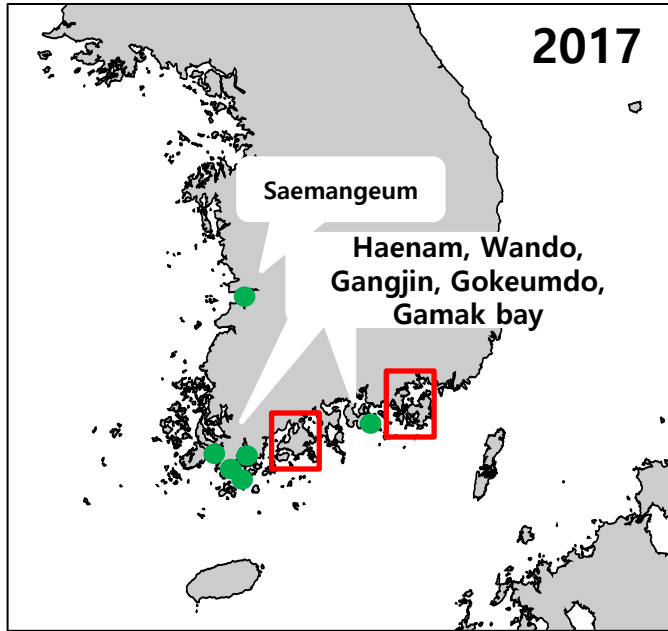
- How to prove whether polyp removal contributes to the prevention of jellyfish bloom? → Identify relationship between polyp removal and jellyfish warning

Region	Areas of Polyp Removal	Jellyfish warning after polyp removal
Incheon · Gyeonggi	Sihwa Lake(2013)/Closed	• No warning in 2014~2019
Jeonbuk	Saemangeum(2014–2017)	• No warning in 2015~2019
Jeonnam	Southern parts of Jeonnam (2017)	No warning
Deukryang bay	Deukryang bay(2015–2017)	warning days reduced by 68% (2015: 147 days → 2018: 47 days)
Gamak bay	Gamak bay(2016)	• No warning in 2017~2019
Gyungnam	Seosang Port(2017)	• warning days reduced by 74% in 2017 (2016: 84 days→ 2017: 22days) • No warning in 2018~2019
	Mansan bay(2013–2014)	• No warning in 2015~2019
	Changwon(2018~2019)	• No warning in 2018~2019
	Gosung, Geoje, Namhae, Tongyoung(2019)	• No warning in 2019

### III. Achievements of Jellyfish Polyp Management Program



### III. Achievements of Jellyfish Polyp Management Program



No warning for moon jellyfish bloom in 2019



First time since the adoption of monitoring and early-warning system(2011, NIFS)

## IV. Conclusion

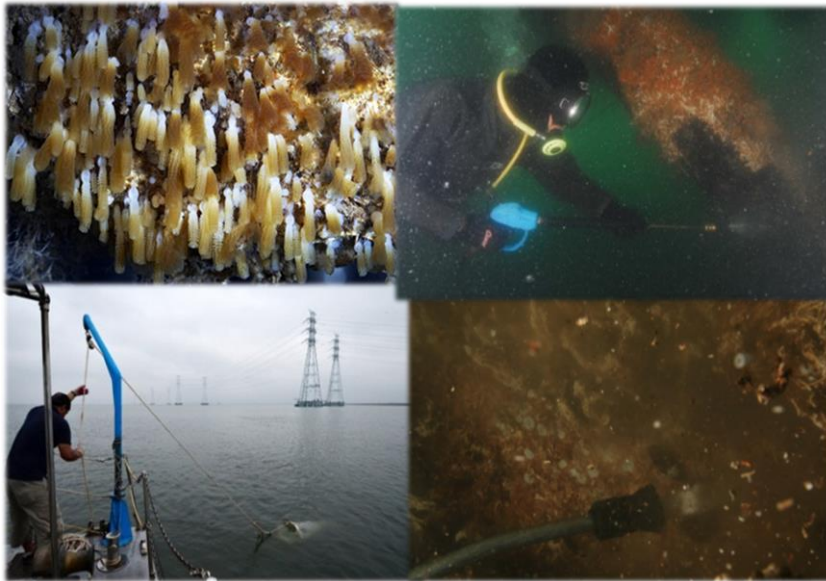
---





# IV. Conclusion

- ✓ Elimination of polyps contributes to prevention of jellyfish blooms
    - Examine the occurrence of jellyfish bloom in the areas of poly removal
- ➡ Results show that no jellyfish warning, or reducing days of warning after removal of polyps



# IV. Conclusion

## ✓ Suggestion for Further Studies

- Develop & conduct a research on natural mortality of jellyfish in the areas of polyp elimination
- For drawing more science-based findings, include variation in physical oceanographic conditions(seawater temperature, DO, nutrients, etc.,) in the areas of polyp removal to figure out correlation between poly removal and jellyfish bloom



**THANK YOU**  
FOR YOUR ATTENTION