JFY 2020
Dugong Protection Measure Project

(Report Summary)

March 2021

Okinawa Prefectural Government,
Department of Environmental Affairs,
Nature Conservation Division

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Preface

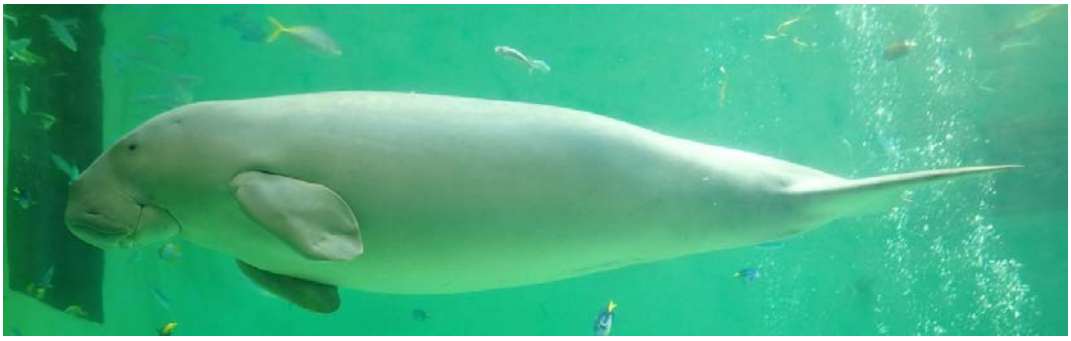
Dugong, *Dugong dugon* (Müller, 1776) (Sirenia: Dugongidae), is one of marine mammals. It inhabits the shallow waters of the Red Sea and the Indian and Western Pacific Oceans. Its population is estimated to be approximately 100,000 worldwide. Japan is the northern limit of the distribution in the western Pacific region, and very few cases of dugong being identified have been reported in regions around Okinawa Prefecture, Japan. Its population is assumed to be small.

"Revised, Threatened Wildlife in Okinawa, Third Edition (Animals) -Red Data Okinawa-", published by Okinawa Prefectural Government (OPG) in March of 2017 categorized dugongs as Class IA, critically endangered species that has a high risk to be extinct in the wild. An adult female dugong was found dead in Nakijin, Okinawa in March 2019. With the dugong population in Japan already at risk, the death of a mature female may have a negative impact on the natural growth rate for this species. During this situation, International Union for Conservation of Nature (IUCN) Red List of Threatened Species published on December 10th, 2019 evaluated the species is at high risk to be extinct by categorizing the population in Nansei Islands area as Class IA. Prior to IUCN evaluation, IUCN species survival commission committee (Sirenia Specialist Group) organized workshop (between 24th and 26th of September, 2019 at Toba Aquarium, Mie Prefecture). Later, statement and survey plans on conservation of the dugong population in Nansei Islands area were announced. Work toward dugong protection is required.

The species feeds on seagrass species, submerged aquatic vascular plants, and leaves trenches called "dugong trenches" after feeding on seagrass species. Therefore, conservation of seagrass beds as a feeding place for dugongs is an important task to study dugong conservation measures. In Okinawa Prefecture, seagrass beds consist of tropical seagrass species developing in coastal areas from intertidal zones to depth of 10 m (depending on species, distribution is found to be at an approximate depth of 40 m).

Seagrass beds not only serve as a feeding ground for dugongs but provide great benefits for us through other functions they provide and are important coastal ecosystems along with coral reefs and tidal flats. They serve as an area for primary production, water purification and bottom quality stabilization. Additionally, they serve as a nursery for many types of fish including those deemed to be useful fish species.

A rare marine mammal, dugongs are facing extinction crisis without any doubt. Just like other many rare animals, conserving dugong population in Okinawa is one of the important tasks from the aspect of conserving the ecosystem in seagrass beds.



Dugong (Serena, a female dugong at Toba Aquarium)

1. Project Overview

（1） Overall Project Plan (Fig. 1)

The previous project conducted “environmental protection in major regions”, “data collection from survey research from ecological aspects and others”, “public awareness on bycatch measures” as main dugong protection measures. The current project started in JFY 2018 to promote and study protection measures mentioned above, dugong status survey, public awareness promotion, information update and study on protection measures have been conducted in seven major regions around Okinawa Island (Fig. 2). As feeding place for dugongs, identifying important seagrass beds within these regions and promoting conservation effort of dugongs and seagrass beds effectively are going to be the core of the protection measure study.

(2) Project Period (Table 1)

This is a three-year project from JFY 2018 to JFY 2020.

(3) Scope

Dugongs used to maintain a certain number of population in a wide area ranging from Yaeyama Island Group to Okinawa Island, but its population had declined due to overfishing and such. Around Okinawa Island, observation of the species dropped to only a couple of dugongs. Based on dugong sighting information, a survey was conducted by Ministry of the Environment in 2020. Dugon trenches left by dugongs were identified around Hateruma and Irabu Islands. Even though the number of dugongs identified remains small today, it is assumed that the species inhabits wide range of Okinawa Prefecture.

The major regions (estimated seagrass bed areas that are used by dugongs) defined in JFY 2017 were the main scope in this program. At the same time, information was collected from all areas of Okinawa Prefecture.

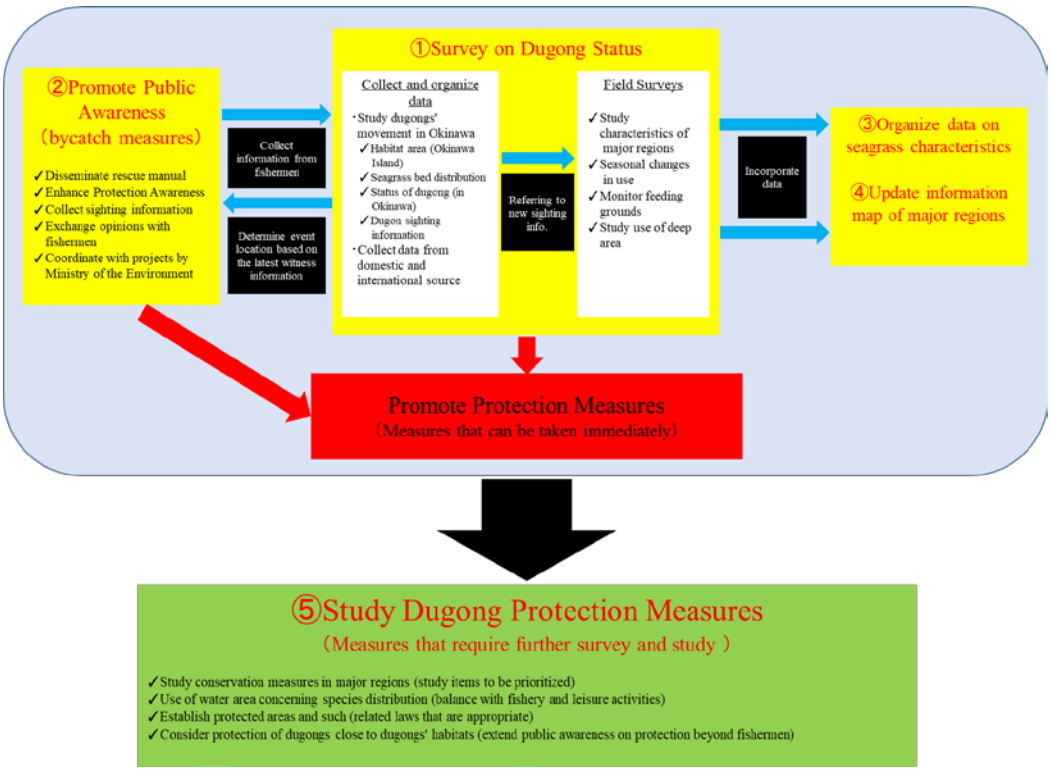


Fig.1. Overall project flow.

Table 1 Overall project schedule.

	JFY Heisei 30 (2018)										JFY Heisei 31 (2019)										JFY Reiwa 2 (2020)									
	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1. Plan Preparation																																		
1-1. Developing Project Planning Documents and others	●										●												●											
1-2. Meetings	●					●		●		●	●						●			●		●	●						●			●		●
2. Dugong Status Survey																																		
2-1. Collect and Organize Data																																		
2-2. Field Survey																																		
2-3. Using Drones	●		●	●			●					●			●																			
2-4. Identification of Dugong Feeding Grounds	●		●	●			●					●			●																			
3. Promote Public Awareness								●	●												●	●							●					
4. Organize Information on Seagrass Bed Characteristics																																		
5. Update Information Map on Major Regions																																		
6. Analysis of Dead Dugong																																		
7. Study Dugong Protection Measures																																		
8. Other Suggested Items (as necessary)																																		
9. Review Committee																																		
9-1. Coordinate committee members, prepare documents																																		
9-2. Review Committee Meetings			●						●												●								●				●	
9-3. Summarize Data from the Review Committee																																		
10. Summarize the Project																																		
10-1. Prepare Project Report																																		

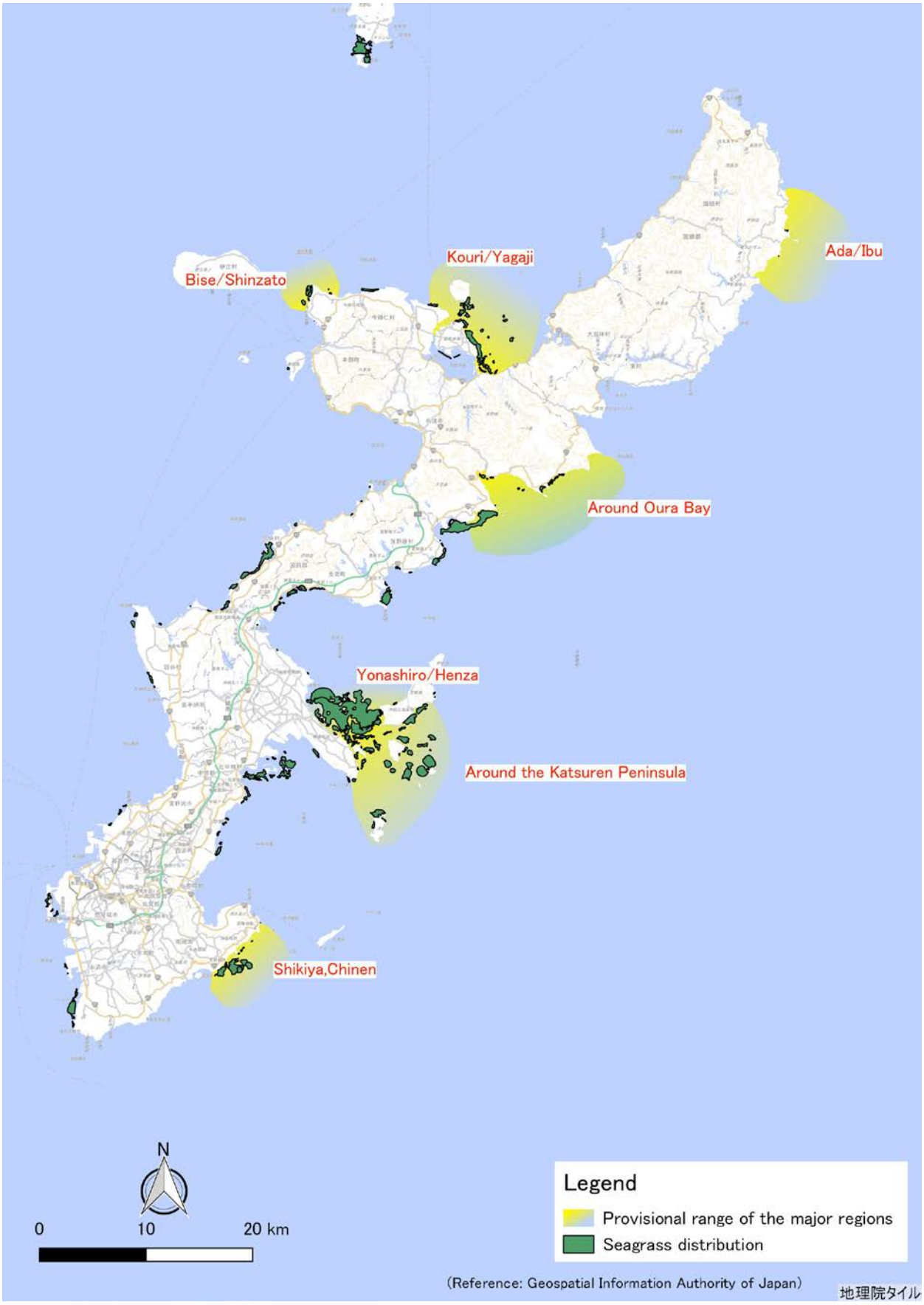


Fig. 2. Seven major regions around Okinawa Island.

2. Project in JFY 2020

(1) JFY 2020 Project Overview

This project has hosted study groups to promote public awareness and also conducted surveys on dugong status throughout major regions surrounding Okinawa Island. As 2020 was the last year of the project, results and future tasks were summarized while events hosted under the project were summarized. Table 2 shows the project schedule for JFY 2020.

Table 2 Project schedule for JFY 2020.

Item	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Dugong Status Survey (collect and organize data)	—	—	—	—	—	—	—	—	—	—	—	—
Dugong Status Survey (field survey)	—	—	—	—	—	—	—					
Dugong Status Survey (with drones)				•								
Promote Public Awareness							•					
Organize Data on Seagrass Bed Characteristics				—	—	—	—	—	—	—	—	
Update Information Map of Major Regions				—	—	—	—	—	—	—	—	
Study on Dugong Protection Measures			—	—	—	—	—	—	—	—	—	—
Other Suggested Items (as necessary)	—	—	—	—	—	—	—	—	—	—	—	—
Review Committee Meeting							•					•
Summary									—	—	—	—

1) Dugong status survey (Chapter 2, Main Volume)

Dugong status survey ("collecting and organizing data" and "field survey") was conducted to better understand the dugong status and other study methods to aid conservation of seagrass beds.

①Collecting and organizing data

In JFY 2020, information was collected using questionnaires, etc., asking for dugong sighting information including the past cases. Ten cases were found from the questionnaire survey. Among these cases, eight cases (one in Izena Island, two in Yaeyama area and five in Miyako Island area) occurred since 2010.

②Field surveys: Interactions between dugongs and seagrass beds (shallow and deep areas, drone and eDNA methods)

Field surveys were conducted by the following methods: surveys in shallow areas of 5 m depth or less; deep areas approximately depth of 5 to 20 m where identification of seagrass distributions was impossible via aerial photos. Surveys using a drone and eDNA were also conducted.

Survey using a drone on July 12th, 2020 offshore of Yagaji Island found two dense areas of dugong Dugon trenches. Survey in shallow water areas on July 31st, 2020 in region of Kouri Island Bridge found one dense area of dugong trenches. Also, additional surveys conducted in region of Izena Island area found three dugong trails on the east side of Yanaha Island.

The survey in deep areas did not find any dugong trail, but as in the previous year, a *Halophila decipiens* community was identified offshore of *Chiri bishi*.

Water samples were collected during an underwater survey in Shikiya, Chinen region, Kouri/ Yagaji region, around the Oura Bay region (Kayo) and Izane Island. Dugong DNA could not be detected in

these samples.

2) Organizing Data on Seagrass Bed Characteristics and Updating Information Map of Major Regions (Chapter 3, Main Volume)

Using new information from fisheries and observation of red soil ranks, the new seagrass distribution data was overlaid onto historical data obtained from the previous project. The combination of these data sets was represented in updated maps of seagrass distribution within the target regions.

3) Raising Public Awareness of Protection, Mainly Bycatch Measures (Chapter 4, Main Volume)

Under JFY 2020 project, a study group was organized at Katsuren Fisheries Cooperative on October 29th, 2020 to promote public awareness of bycatch measures (animal rescue methods) and conservation of dugongs, seagrass beds and others.

4) Other Suggested Items (conducted as necessary)

During JFY 2020, new sighting information and such were reported. In response, additional surveys were conducted at inner-Oura Bay area and Izena Island. Survey results are shown in Chapter 2 in the main volume.

5) Review Committee Meetings (Chapter 5, Main Volume)

Two review committee meetings were organized during JFY 2020. The committee members commented on general project direction as well as protection measures.

6) Summary of the Project (Chapter 6, Main Volume)

Based on project implementation and information on recent dugong sightings in Okinawa Prefecture, summaries of information related to the program such as achievement of the three-year project and the direction of protection measures were made.

(2) JFY 2020 Project Achievement

In JFY 2020, the major regions around Okinawa Island and Izena Island were in the scope. Dugong status surveys, public awareness promotion (study groups), data updates, and program summary were conducted.

1) Dugong status survey

Dugong status surveys ("collecting and organizing data" and "field survey") were conducted to understand dugong status in the region around Okinawa Island and study seagrass bed conservation measures.

"Collecting and organizing data" was to conduct a questionnaire survey asking to fishery cooperatives, parties that use the regions. The latest data on dugong status and biology was collected and organized from the questionnaires.

Under "field survey", dugong trails were studied from surveys in shallow areas depth of 5 m and less, deep areas depth between 5 m and 20 m. Analysis of pictures taken by a drone was also conducted. Furthermore, water samples in the regions were collected during field surveys to detect presence of dugongs using eDNA method.

①Collecting and Organizing Data

Ten sightings occurred since 2000 were reported during JFY 2020 Project (Fig. 3). Sighting locations were Uruma city on Okinawa Island (Kaichu-doro marine road, around Ukibaru Island), off the southeastern coast of Izena Island, Iriomote Island in the Yaeyama Group, Hateruma Island, Irabu Island in Miyako Group, *Yae Bishi*, Kurima and Tarama Islands.

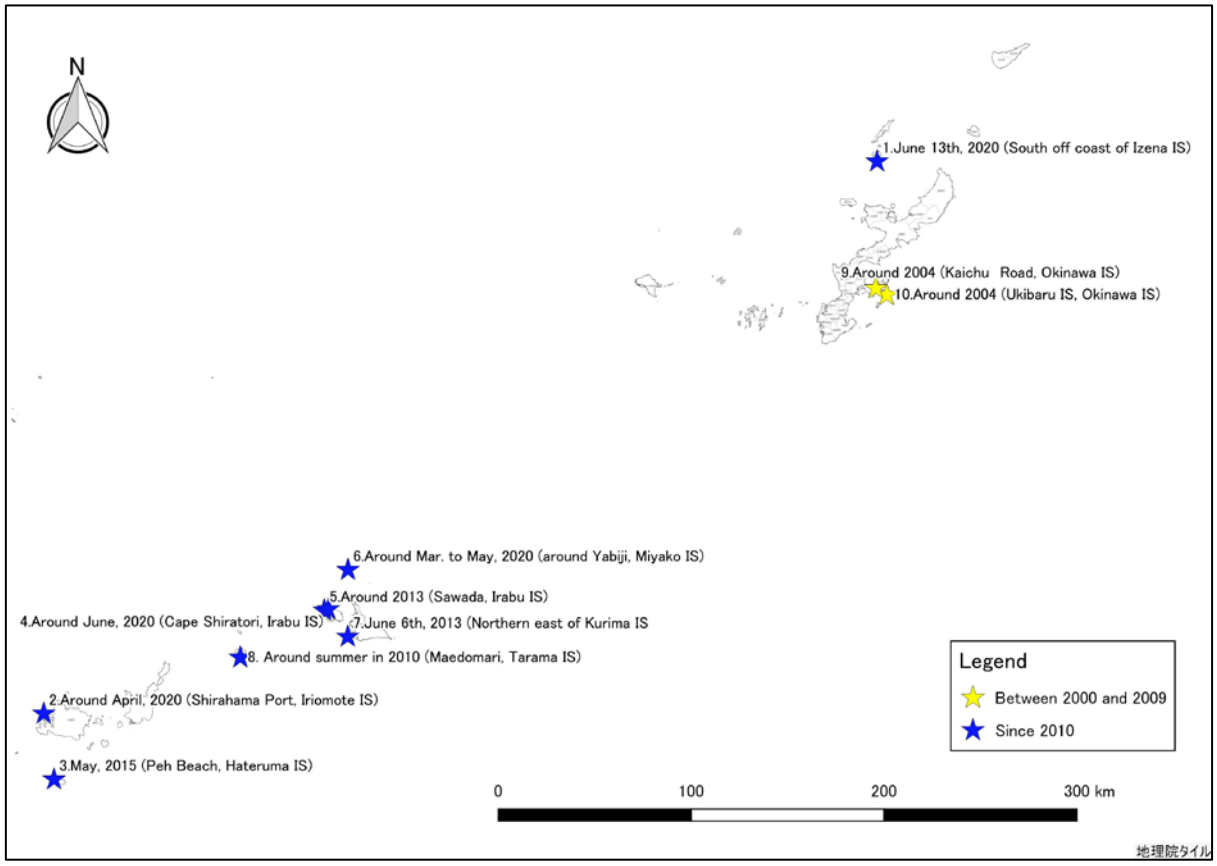


Fig. 3. Sighting locations reported in JFY 2020.

②Field surveys: Interactions between dugongs and seagrass beds (shallow and deep areas, drone and eDNA methods)

To understand dugong status and environment of each region (seagrass species composition, coverage and others), field surveys (shallow and deep area surveys, drone survey, and eDNA survey) were conducted.

Table 3　Summary of Field Survey.

Item	Purpose	Survey Method	Survey Location	Survey Time and Frequency	Remarks	Others
Shallow area（depth up to 5m）	・Researching for Dugong trenches ・Identifying seagrass bed environment (species compositions, red soil and others)	・Manta tow technique (where boat operation is possible) ・Underwater scooter (where boat operation is not successful) ・Survey on seagrass bed in wide ranges	・In areas where Dugong trenches were identified ・In areas not covered by existing surveys ・Mainly focusing on the latest sighting information (dugongs and Dugong trenches)	・Conducting survey referring to season dugongs were sighted in the past ・2-3 days/region ・Surveys conducted at different depth using manta tow and spot methods	Diving record was kept when trenches were identified during manta tow method	Interviewed boat captains for dugong sighting information and such when chartering boats
Deep area（depth range between 5 and 20 m）	・Researching for Dugong trenches ・Confirming seagrass bed availability (since no information available) ・Identifying seagrass bed environment (such as species composition, red soil and others)	・Survey area was approx. 400 m x 400 m ・Underwater scooter was utilized		・Conducting survey during growing season for annual seagrass (Caribbean seagrass) ・At some points, surveys were conducted during seasons when dugongs had been sighted.	For safety consideration, surveys were conducted with more than two members on one team	
Monitoring using a drone	・Identifying continuous use ・Researching for Dugong trenches, or areas of high density trails	Aerial image analysis	・Region around off coast of Yagaji Bridge ・Region around Kayo/Abu	Twice a year	Underwater survey was conducted if trenches were found.	Photo survey was conducted using a drone as needed in case new sighting information was obtained during the project period.
Environmental DNA	・Searching dugongs	Samples were collected in the field and analyzed in the laboratory	Following shallow area field survey	・As a general rule, samples were taken at the time of field surveys ・1 point/ 1 region	Water samples were taken by field surveyors and analysis was subcontracted to research institutes.	

※Shallow area：Up to 5 m depth where seafloor could be observed from the surface.
Deep area：Survey conducted by Ministry of the Environment between year 2001 and 2002 showed seagrass bed distribution around depth of 20 m, but no distribution was reported in areas deeper than 30 m. Therefore, deep area was defined to be 5 to 20 m in this survey.

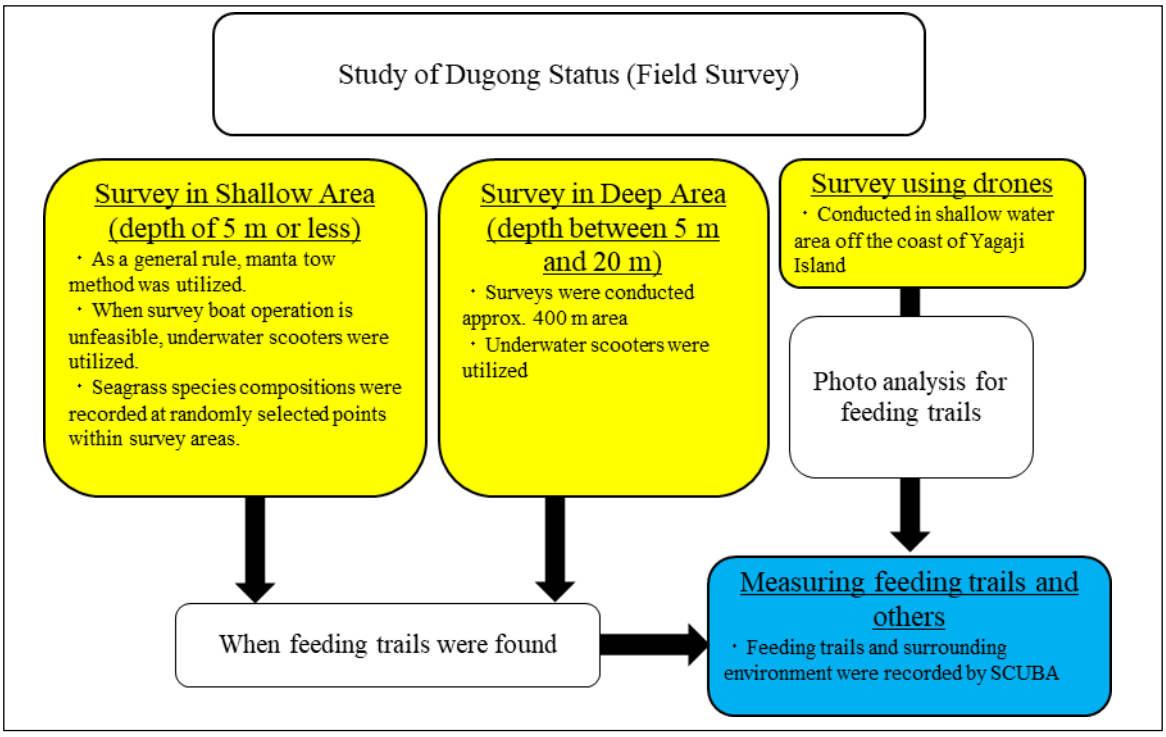


Fig. 4.　Flow of field survey.

Survey areas and summary of results in each region are shown in Table 4 and Figure 4.

Images obtained from drone surveys conducted off the coast of Yagaji Bridge on July 12th, 2020, indicated existence of trenches.　Field survey was conducted at the same location and dense trenches were confirmed at two points.　Furthermore, one dense trench was confirmed during a field survey around Kouri Bridge (Fig. 5).

After the death of female dugong found in Nakijin in March, 2019, confirmation of dugong trails in JFY 2020 as well as the last fiscal year in Kouri/Yagaji region indicated dugongs' inhabiting the surrounding regions even today.

At two locations on east side of Yanaha Island within Izena Island region, dugong trenches were found (Fig. 6). Identified trenches were considered relatively new since the seagrass roots and other parts recovery were not confirmed on seagrass in the trenches. About four months have passed since fishermen reported dugong-like animals in the area on June 13th, 2020 before confirmation of the trenches on October 17th. It can be assumed dugongs may have settled in the area.

Table 4 Survey scope of each region and summary of results.

Region	Shallow Water				Deep Water					Drone				
	Survey Locations	Survey Conducted on	Dugong trenches found	Seagrass beds found	Survey Locations	Survey Conducted on	#of Survey Points	Dugong trenches found	Seagrass beds found	Survey Locations	Photos taken on	Survey Conducted on	Dugong trenches found	Seagrass beds found
Ada/Ibu	Out of survey scope this JFY				Out of survey scope this JFY					Out of survey scope this JFY				
Kouri/Yagaji	Around Oura Bridge ☆	July 31st 2020	●	●						Around Yagaji IS	July 12th, 2020	July 30th, 2020	●	●
	East of Yagaji Island ☆	July 30th 2020	●	●										
Bise/Shinzato	Out of survey scope this JFY									Out of survey scope this JFY				
Around Oura Bay	Abu/Kayo☆	Apr. 30th Dec. 18th Mar. 5th	×	●	Oura Bay	Apr. 30th Dec. 17th Mar. 6th	1	×	●	Abu/Kayo	July 11th, 2020	-	×	●
	Inner-Oura Bay	June17th Dec.17th Mar. 6th	×	●										
Yonashiro/Henza Around Katsuren	Out of survey scope this JFY				Out of survey scope this JFY					Out of survey scope this JFY				
Shikiya, Chinen	Shikiya☆	Aug 19th, 2019	×	●										
Southeast of Izena Island	South of Izena IS and East of Yanaha IS☆	July 2nd, October 16th and 17th	●	●	South of Izena IS	July 2nd, October 16th and 17th	3	×	●	South of Izena IS and east of Yanaha IS	October 16th and 17th	-	-	-

Note 1：「☆」are water sampling locations for environmental DNA method to identify dugong' distribution.
Note 2：「×」are locations where no feeding trail was found.
Note 3：「●」are locations where Dugong trenches or seagrass beds were found.

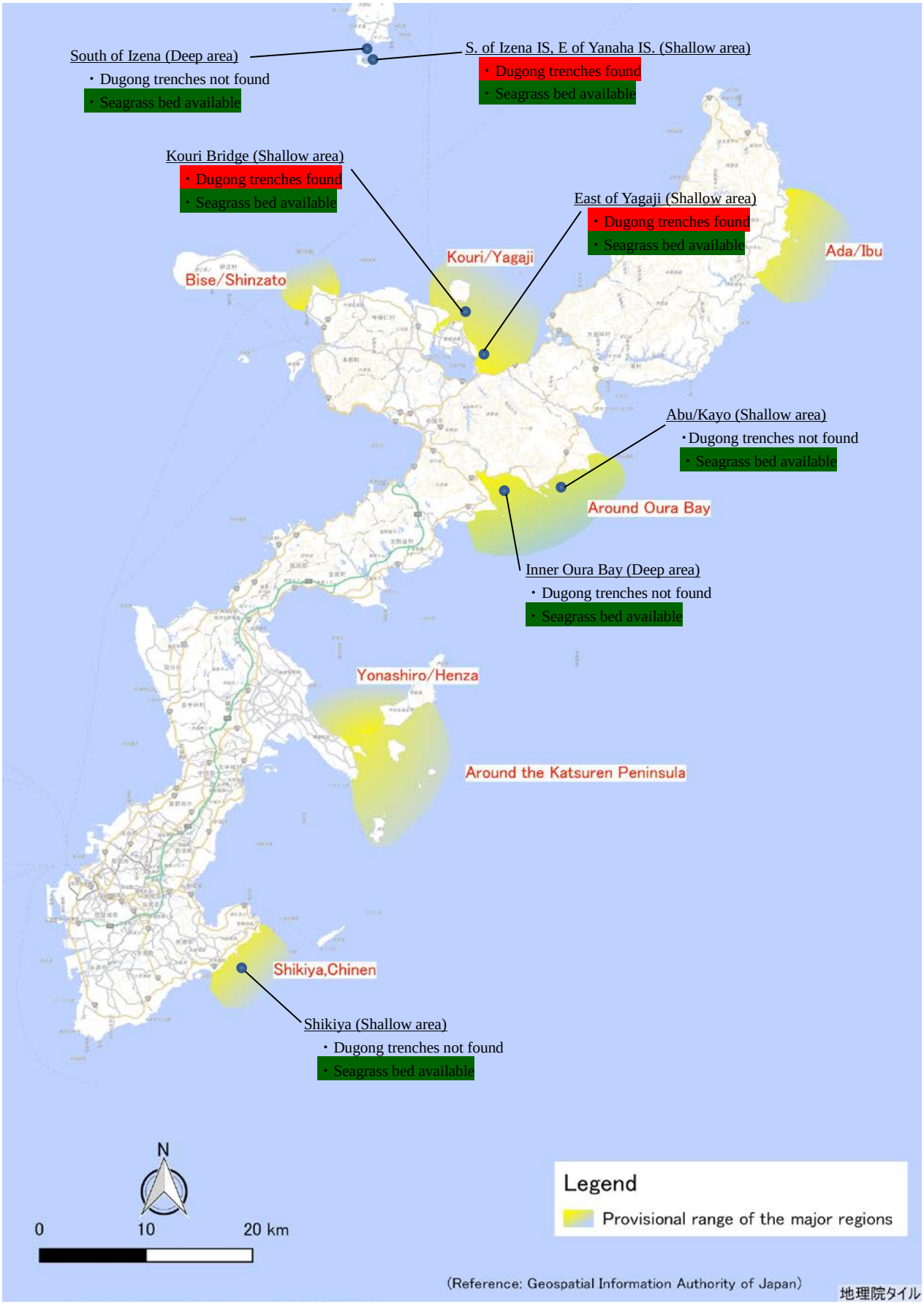


Fig. 4. Summary of survey results.

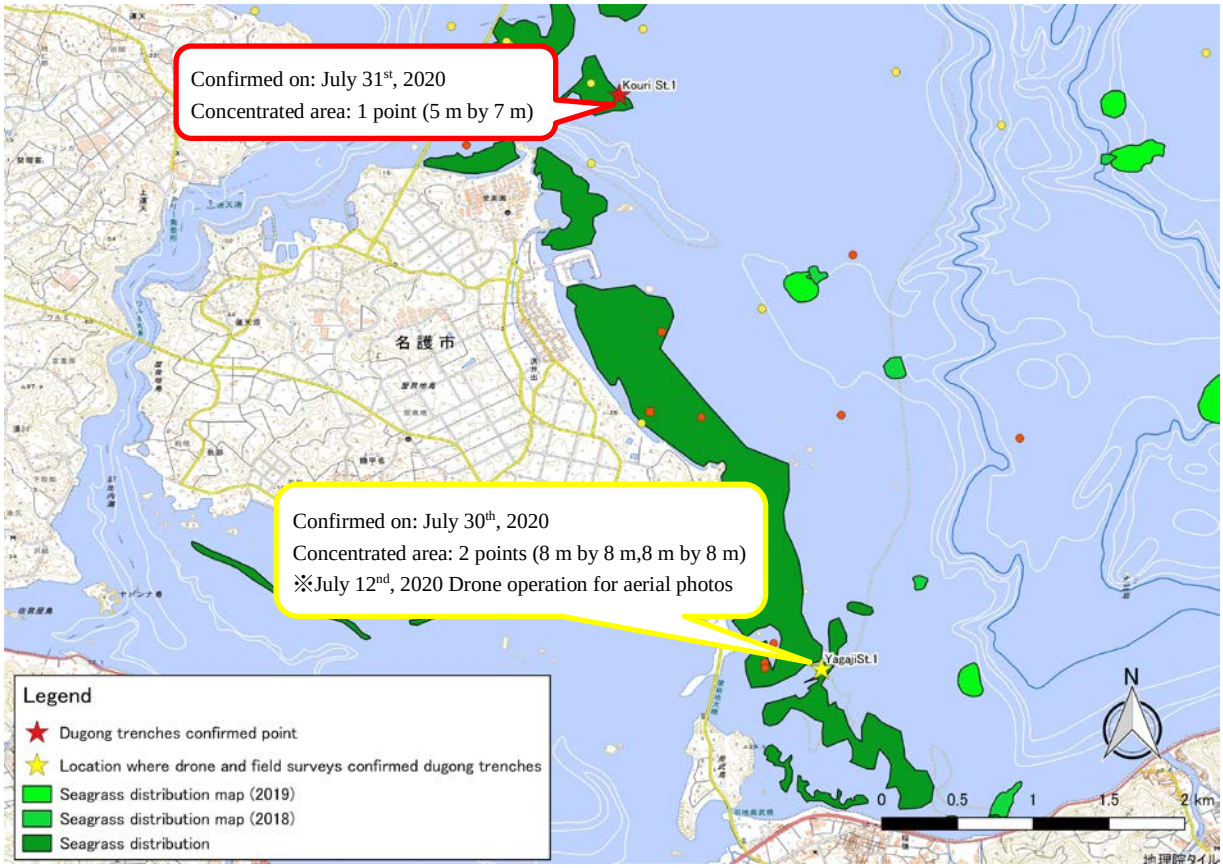


Fig. 5. Locations of trenches found in Kouri/Yagaji region.

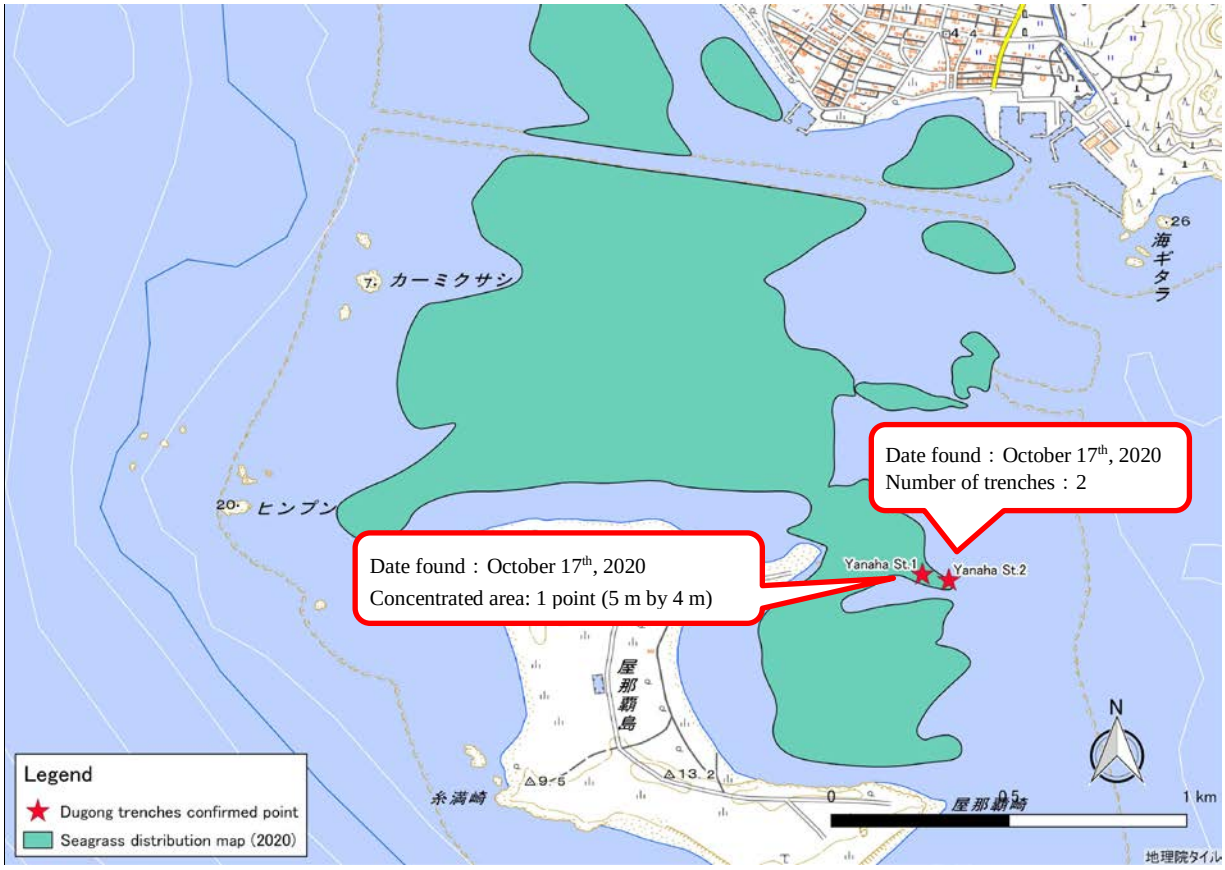


Fig. 6. Locations of trenches found east of Yanaha Island.

2) Seagrass bed distribution in the major regions

Based on findings from the current project, the data from the previous project was updated on seagrass bed characteristics with reference to information maps.

①Organizing data on seagrass bed characteristics

For items shown in Table 5, data was collected and updated accordingly. Table 6 shows data updated from the previous project. Furthermore, Table 7 shows the environmental conditions in the major regions. The data on seagrass bed area, species composition and others contains survey results from JFY 2020.

Table 5 List of data updated.

Items to Be Organized	Updated Contents
Sighting information	No update since no sighting information available in the major seven regions
Fishing rights (fixed nets, *mozuku* seaweed farming)	No update for this year
Number of fishery management units (gillnetting, underwater fishing, etc.)	Fishery Census (Ministry of Agriculture, Forestry and Fisheries) was released in 2018. Detailed information regarding fisheries in Okinawa was announced, so the data was updated.
Other type of use in the regions (leisure, U.S. Military activities, etc.)	Interviews were conducted to collect information related to leisure activities in the regions (no update)
Other human-activities (noise, coastal protection, red soil, development projects, etc.)	Red Soil Rank was updated for rivers running to major regions “Project Report JFY 2019, Monitoring Water Regions for Runoff Prevention Measures of Red Soil and Other Materials (Okinawa Prefectural Government, Department of Environment Affairs)
Protected areas	No update
Port areas	No update

Table 6　Anthropogenic impacts in major regions.

Area	Major regions	Sections of regions	Items related to fishery						Other Use of the Region						Other Anthropogenic Impacts							Protected area		Port Category (by type)
			Fixed nets			Gillnets (number of entities) ※2	Diving fishery (number of entities) ※2	Mozuku Seaweed Aquaculture※1	Marine leisure (power-driven vessel) ※3	Boat Operation (fishing and		US military training (Sea training) ※4	Coastal Structures (fishing port, etc.)	Development Plan	Noise		Seawall Development Status (coastal			Red Soil		River Inflow to Seagrass beds	・Wildlife protected area ・National park ・Okinawa Kaigan Quasi-National Park	
			Number of fixed nets (large size) ※1	Small size fixed nets (stopping nets included)	Fixed nets (number of entities) ※2					Fishing boats (boats access to seagrass beds)	Regular service route				US Aircrafts(confirming aircraft operation over seagrass beds) ※5	Distance between a major street and seagrass bed location (m)	Main Organization ※6	Structures on coasts ※7	The shortest distance from seashore	SPSS Rank ※8※9※10	Points under OPG Project ※8※9※11			
Southern Area of Okinawa IS	Shikiya, Chinen	-		4	4	8	29	●	●	・*Mozuku* seaweed ・Gillnet ・Fixed nets	Azama-Kudaka		Shikiya Port		●	106	・Rural Development Bureau ・Fisheries Agency	・Mainly natural ・half-natural ・Seawalls, etc.	within 100m	6	Ahji Island Region			
Middle Area of Okinawa IS	Yonashiro/ Henza	-		12	9	42	33	●	●	・*Mozuku* seaweed ・Fixed nets			・Oil terminal seabus ・Japanese Tiger Prawn Farm ・Kaichu-doro marine road		●	190	Bureau of Port and Harbor	Mainly semi-natural	within 100m	5b	-			
	Around Katsuren Peninsula	E. of Hamahiga IS			9	42	33	●	●	・*Mozuku* seaweed ・Fixed nets			Higa Port		●	67		・Mainly natural ・Artificial (port)	over 1 km	5b	Area adjacent to Higa			
		Around White Beach (Cape Kanna)		2					●				White Beach		●	150		・Mainly natural ・Artificial (port)	within 100m	5b	-			
		Ukibaru						●	●	*Mozuku* seaweed		Ukibaru IS Training Area (amphibious training)			●			Natural	within 100m	5b	Area adjacent to Higa			
		Tsuken IS	1	1				●	●	・*Mozuku* seaweed ・Fixed net	Tsuken-Heshikiya	Tsuken IS Training Area (amphibious training)			●	52		Half-natural	within 100m	2	-			
Northern Area of Okinawa IS (East Coast)	Around Oura Bay	Henoko			6	22	24	●	●	・*Mozuku* seaweed ・Diving fishery ・Gillnet		Camp Schwab (amphibious training	Henoko Port	●	●	101	・Rural Development Bureau ・Water and Disaster Management Bureau	Mainly natural	within 100m	5a	Mouth of Henoko River	●		
		Oura Bay							●	・Gillnets ・Diving fishery		Camp Schwab (Amphibious training)	Reclamation Work on Camp Schwab	●	●	346		Mainly natural	within 100m	6	Area adjacent to Futami	●		
		Abu													●	158		Mainly natural	within 100m	5a	Mouth of Abu River	●		
		Kayo													●	158		Mainly half-natural	within 100m	5a	Mouth of Abu River	●		
	Ada/Ibu	-	1		1	11	8	●		・*Mozuku* seaweed						115		Natural	within 100m	5a	Mouth of Abu River	●	Yambaru National Park	
Northern Area of Okinawa IS (West Coast)	Kouri/Yagaji	East Side of Nakijin Port			1	12	16		●	・Gillnets ・Diving fishing	・Unten-Iheya, Izena		Unten Port			41	Fisheries Agency	Mainly half-natural	within 100m	7	Mouth of Ooi River (Nakijin)		Okinawa Kaigan Quasi-National Park	Major port
		Around Kouri		2	1			●	●	・Diving fishing ・*Mozuku* seaweed ・Gillnet ・Fixed nets	・Unten-Iheya, Izena		・Kouri Port ・Kouri Bridge			Kouri Bridge	Rural Development Bureau	Mainly natural	300-400m	5a	East of Kouri IS water area		Okinawa Kaigan Quasi-National Park	Minor port(Kouri port)
		Around Yagaji		3	6	22	24	●	●	・Diving fishing ・*Mozuku* seaweed ・Gillnets ・Fixed nets ・Tuna farming			・Yagaji Port ・Submerged breakwater	●		54	・Rural Development Bureau ・Water and Disaster Management Bureau	・Mainly half-natural ・Breakwaters and others	within 100m	6	Mouth of Genga River Mouth of Henan River	●	・Yagaji Wildlife Protected Area ・Okinawa Kaigan Quasi-National Park	
	Bise/ Shinzato	-					10	●		・Diving fishing ・*Mozuku* seaweed			・Boat ramp at Bise ・Man-made beach ・Shinzato Port			123		・Mainly natural ・Half-natural ・Seawalls and such	within 100m	5a	Bisezaki	●		

Reference

※1　Fishery rights and fishing ground map (Fishery Division, Okinawa Prefectural Government)

※2　Year of 2013, Fishery Census by Ministry of Agriculture, Forestry and Fisheries

※3　Results of interviews with fishermen in the area, marina employees, and others.

※4　US Military Installations in Okinawa (Okinawa Prefectural Government, Executive Office of the Governor, Military Base Affairs Division, 2013)

※5　Okinawa Prefectural Government, Executive Office of the Governor, Military Base Affairs Division Website: Map of Designated Military Training water areas and air space

※6　Digital National Land Information: Data of Coastal Protection Facilities (2012)

※7　Data from the Program of Promoting the Biodiversity Okinawa Brand

※8　Subcontracted Project Report JFY 2016, Monitoring Water Regions for Runoff Prevention Measures of Red Soil and Other Materials (Okinawa Prefectural Government, 2017), excluding ※9 and ※10

※9　Subcontracted Project Report JFY 2019, Monitoring Water Regions for Runoff Prevention Measures of Red Soil and Other Materials (Okinawa Prefectural Government, 2019) Excluding Chinen, Shikiya, West Side of Nakijin Port and around Yagaji

※10　Based on data of visual observations during field surveys.　Yonashiro/Hanza, around White Beach (Cape Kanna), and Tsuken Island

※11　Monitoring location by Okinawa Prefectural Government with "-" means there are no applicable points.

Table 7　Current status of the environment in major regions.

Area	Region		Seagrass Area (ha)	Seagrass Bed Type	Seagrass Species Composition								Water Depth (m) ※4	Seafloor	Sighting Dugongs(from 2000)	Dugong trenches Found (from 2000)
					Pacific Turtlegrass	Noodle Seagrass	Serrated Ribbon Seagrass	Smooth Ribbon Seagrass	Narrowleaf Seagrass ※5	Needle Seagrass ※5	Japanese Eelgrass ※5	Dugong Grass※5				
Southern Area of Okinawa IS	Shikiya, Chinen		223.3	Shallow Area	●	●	●	●	●	●		●	2.7-3.7	Sand/sandy gravel	●	●
				Deep Area	No seagrass found								20.0-30.2	Sand/gravel/rock		
Middle Area of Okinawa IS	Yonashiro/Henza		1605.0	Shallow Are※2	●	●	●	●	●	●		●	1.5-5.5	Sand/sandy mud/ sandy gravel	●	●
				Deep Area	●	●	●		●	●		●	4.5-10.9			
	Around Katsuren Peninsula		474.8	Shallow Area※2	●	●	●	●	●	●		●	1.7-6.0	Sand/sandy gravel	●	
				Deep Area			●		●			●	4.5-20.1	Sand/sandy mud/sandy gravel		
Northern Area of Okinawa IS (East Coast)	Around Oura Bay	Henoko※1	387.2	Shallow Area	●	●		●	●	●		●	2.0-5.0	Sand/sandy gravel (partially bedrock)	●	●
		Oura Bay		Shallow Area	●	●	●	●	●	●		●	1.8-2.5	Sand	●	●
				Deep Area						●		●	13.3-20.1	Sand/sandy mud		
		Abu		Shallow Area	●	●	●	●	●	●		●	0.8-4.0	Sand/sandy gravel (partially bedrock)	●	●
		Kayo		Shallow Area	●	●	●	●	●	●		●	0.1-3.5	Sand/sandy gravel	●	●
				Deep Area※3	No seagrass found								23.9	Sandy gravel		
	Ada/Ibu		1.2	Shallow Area※1	●	●		●	●	●		●	1.0-2.0	Sand/sandy gravel	●	
				Deep Area※3	No seagrass found								8.4-30.2	Rock reef		
Northern Area of Okinawa IS (West Coast)	Kouri/Yagaji		311.3	Shallow Area	●	●	●	●	●	●	●	●	0.3-5.9	Sand/sandy gravel	●	●
				Deep Area	●	●			●	●	●	●	2.8-24.8	Sand/sandy gravel/sandy mud/mud		
	Bise/Shinzato		83.1	Shallow Area※3	●			●	●	●		●	0.7-2.5	Sand/sandy gravel	●	●
				Deep Area						●		●	9.4-36.7	Sand/rock		

※1：Survey in Wide Range for Dugongs and Seagrass Beds (Ministry of the Environment, 2002) and Environment Impact Statement of Futenma Replacement Facility Program (Okinawa Defense Bureau, 2011) and others were used as a reference.
It should be noted that a part of data on seagrass composition in shallow are of Ada/Ibu region referred to the project results of Dugong Protection Measure Project JFY 2018.
※2：Survey results from Project of Dugong Protection Measures JFY 2017 was used as a reference.
※3：Survey results from Project of Dugong Protection Measures JFY 2018 was used as a reference.
※4：Water depth was adjusted to tidal data by Japan Meteorological Agency based on the depth measured during surveys.
※5：For seagrass species, reevaluation of taxonomical study subdivided in detail. Those species group is indicated as "spp." in this table.

②Updating data on seagrass bed distribution

During JFY 2020, new areas of seagrass distribution were discovered as a result of field surveys conducted within the Oura Bay area. The area was not reported in Environmental Conservation Basic Survey (Ministry of the Environment) nor other studies in the past. The total area is estimated to be approximately 214.3 ha (inner-Oura bay: 15.9 ha and Izena Island: 198.4 ha, Fig. 7 and 8).

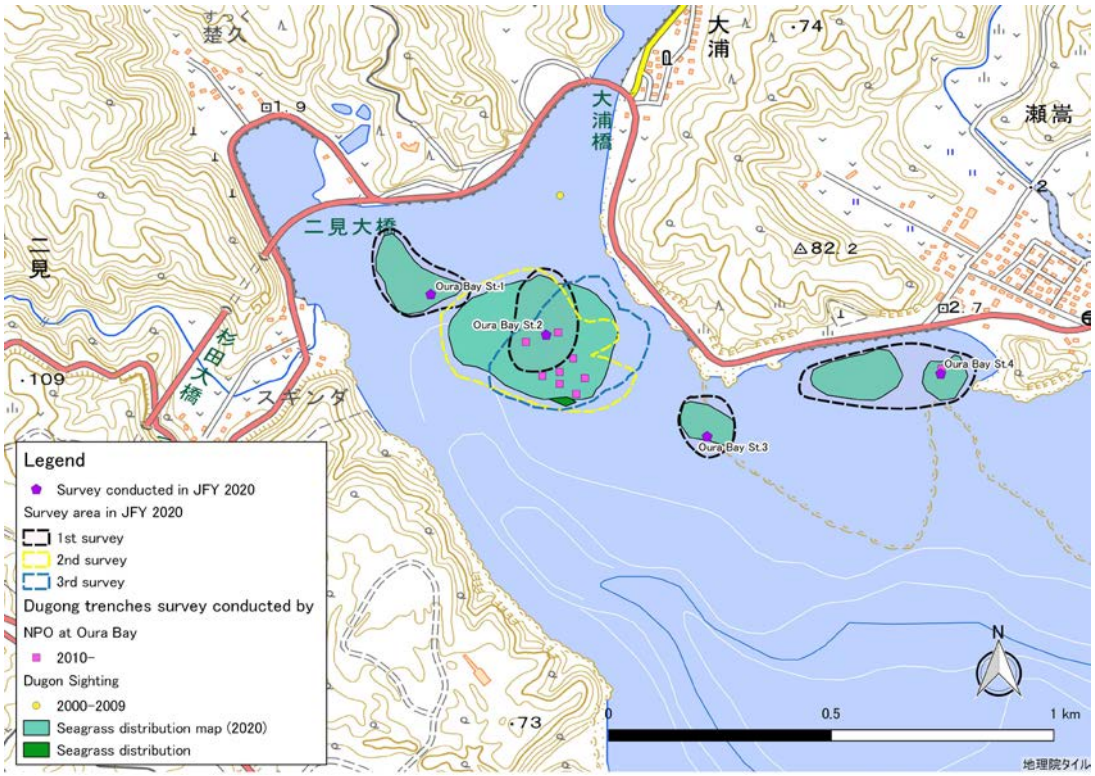


Fig. 7. Map of estimated seagrass distribution in the inner-Oura Bay.

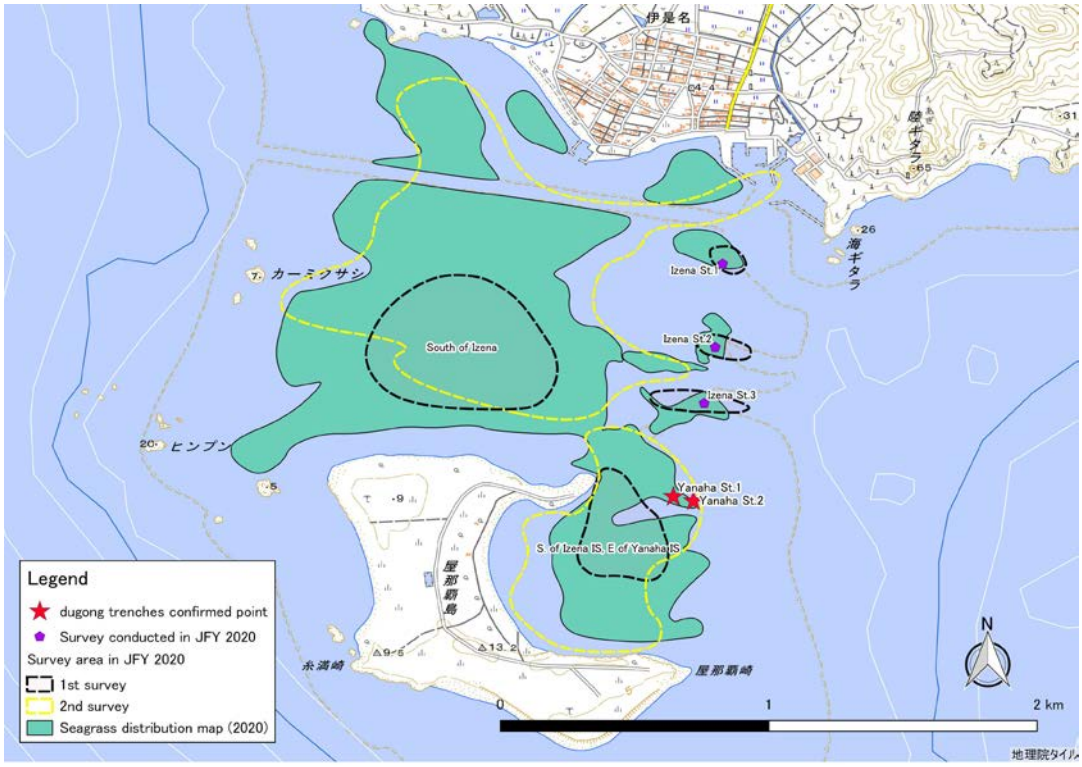


Fig. 8. Map of estimated seagrass distribution near the southern area of Izena Island.

③Updating Information Map of Major Regions

Based on results from “1. Organizing characteristics of seagrass bed”, the information map of the major regions was updated (Fig. 9 to Fig. 15).

Fig. 9. Surrounding environment of seagrass beds around Ada/Ibu.

※ In the terrestrial area, “Yambaru National Wildlife Protected Area” and “Yambaru National Park” are overlapped.

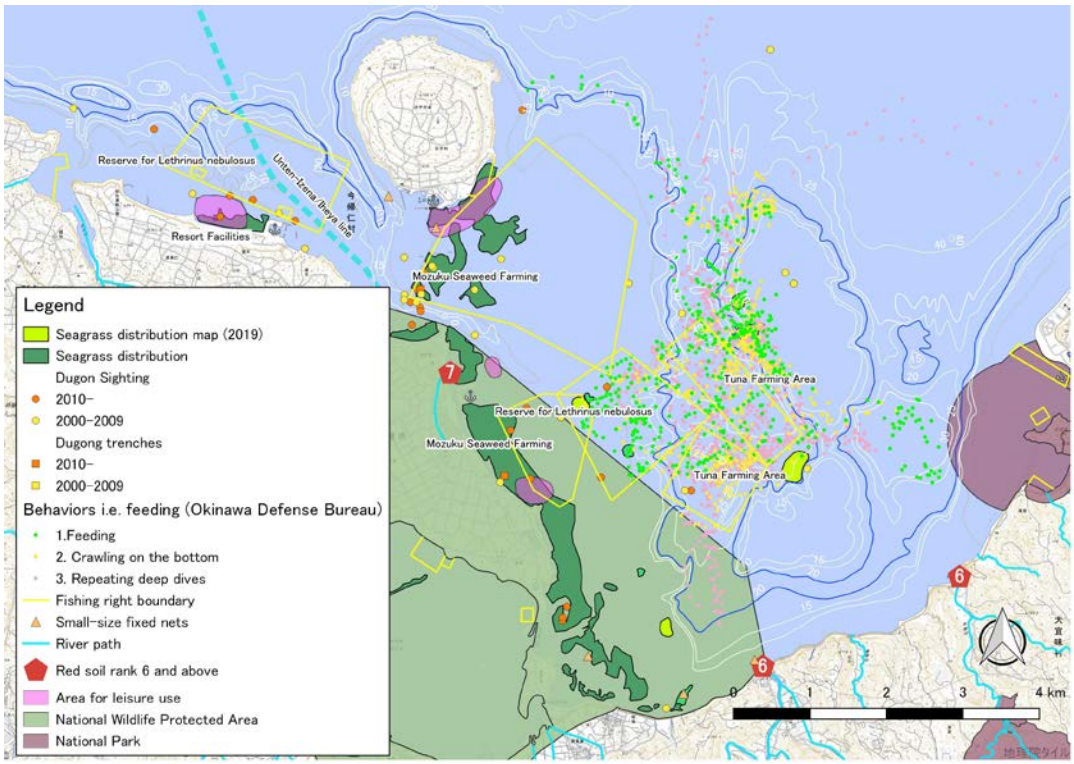


Fig. 10. Surrounding environment of seagrass beds around Kouri/Yagaji.

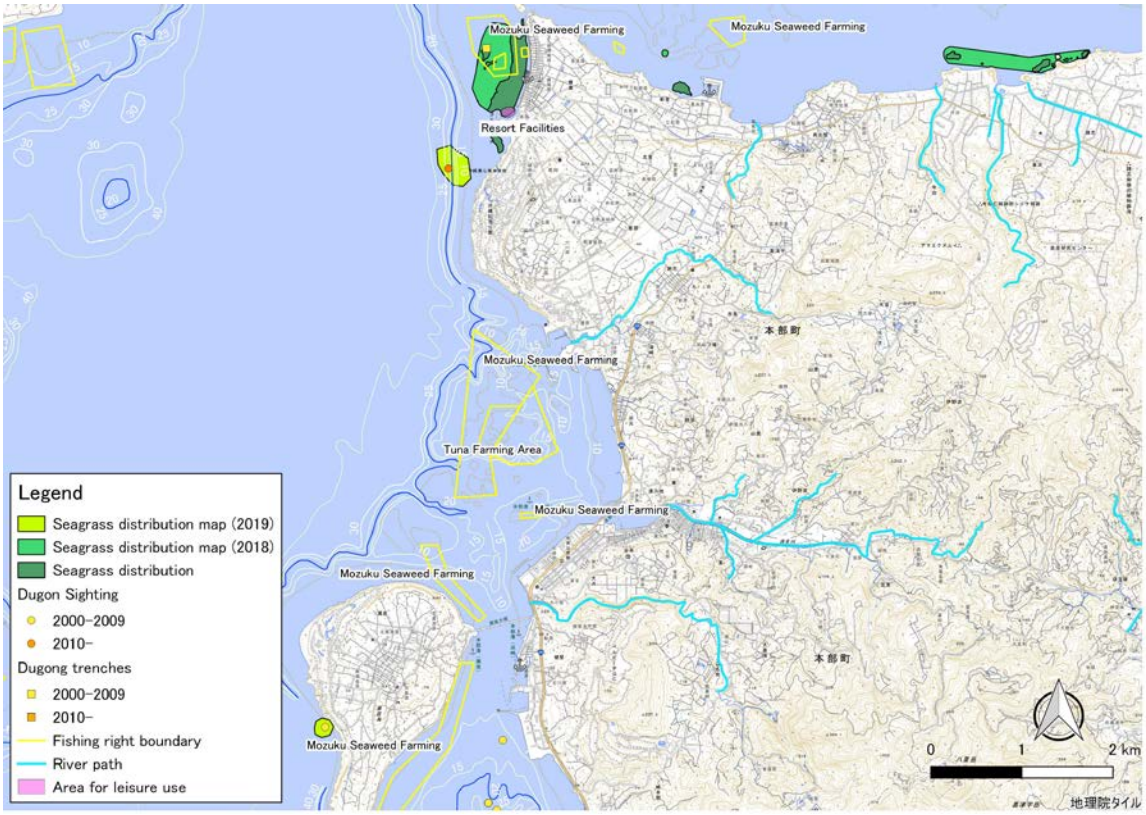


Fig.11. Surrounding environment of seagrass beds around Bise/Shinzato.

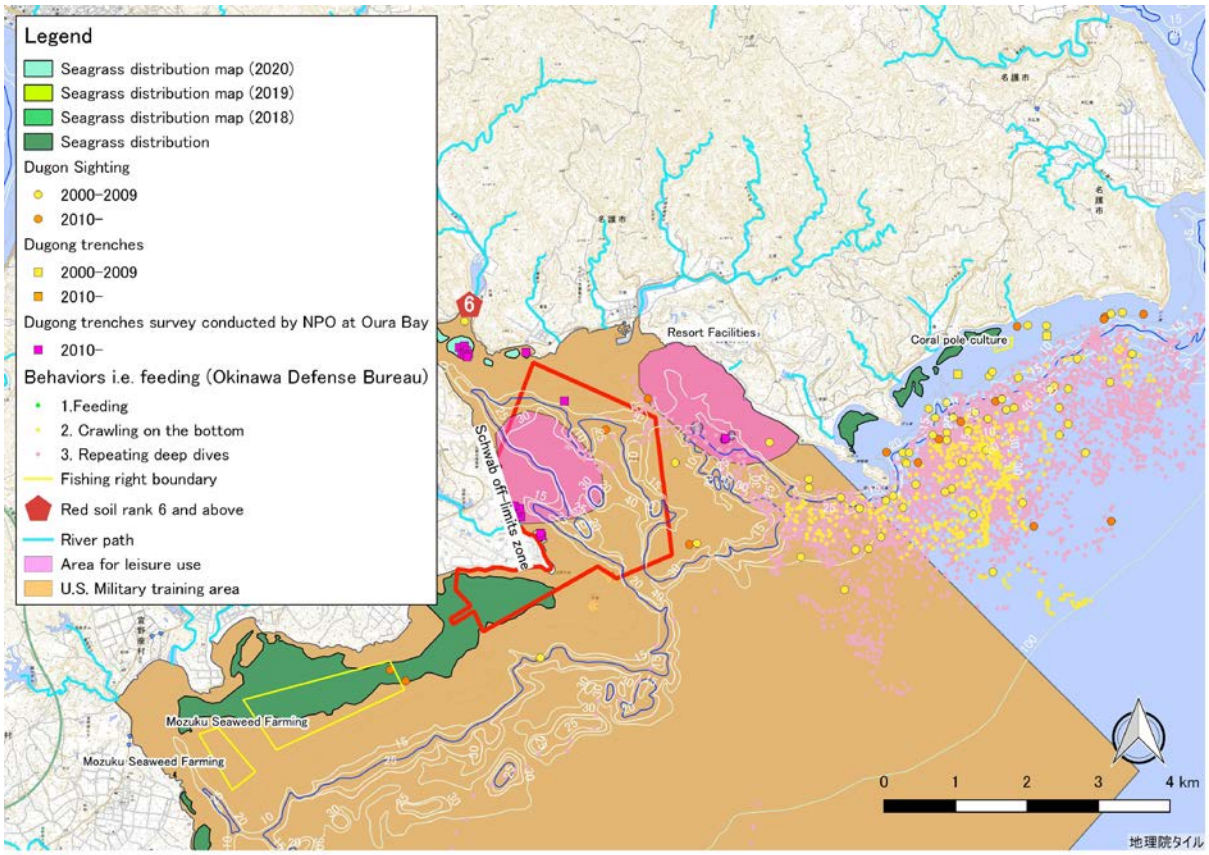


Fig. 12. Surrounding environment of seagrass beds around Oura Bay.

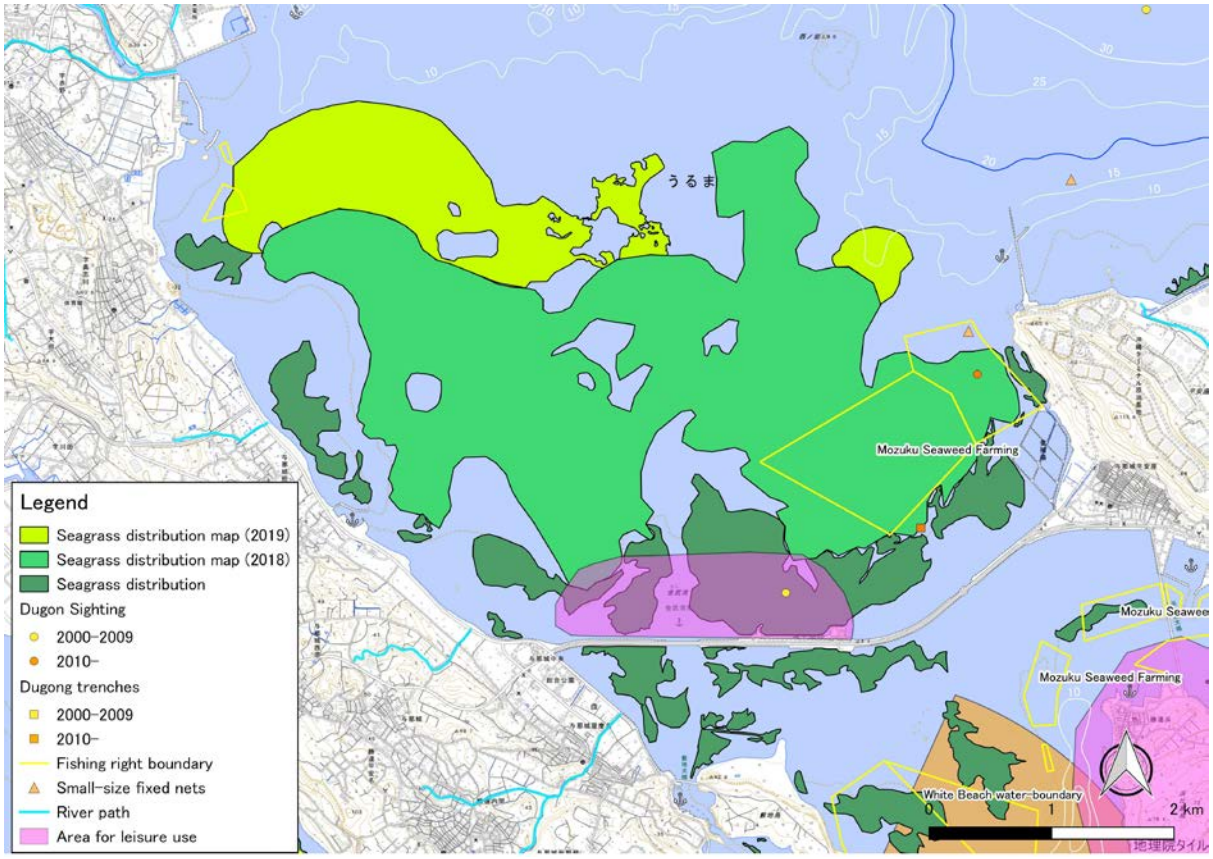


Fig. 13. Surrounding environment of seagrass bed around Yonashiro/Henza.

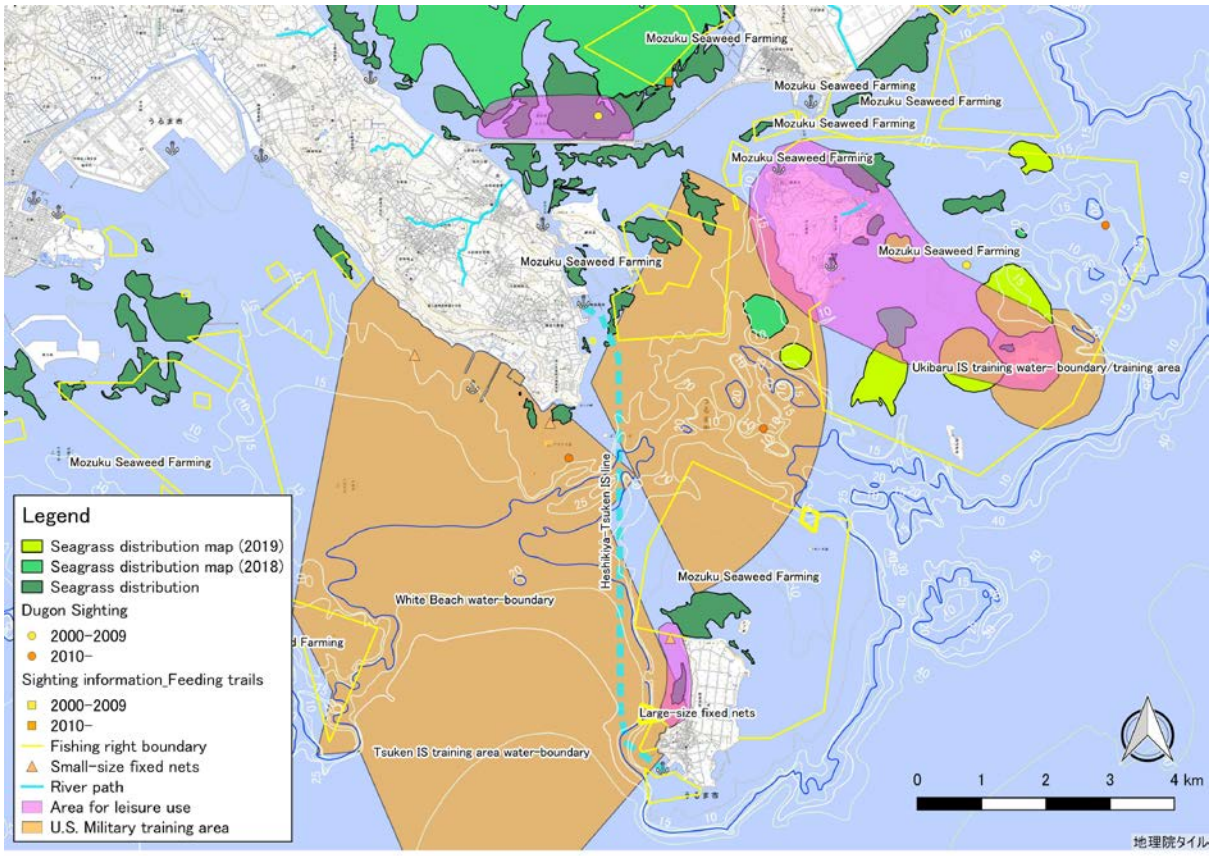


Fig. 14. Surrounding environment of seagrass beds around the Katsuren Peninsula.

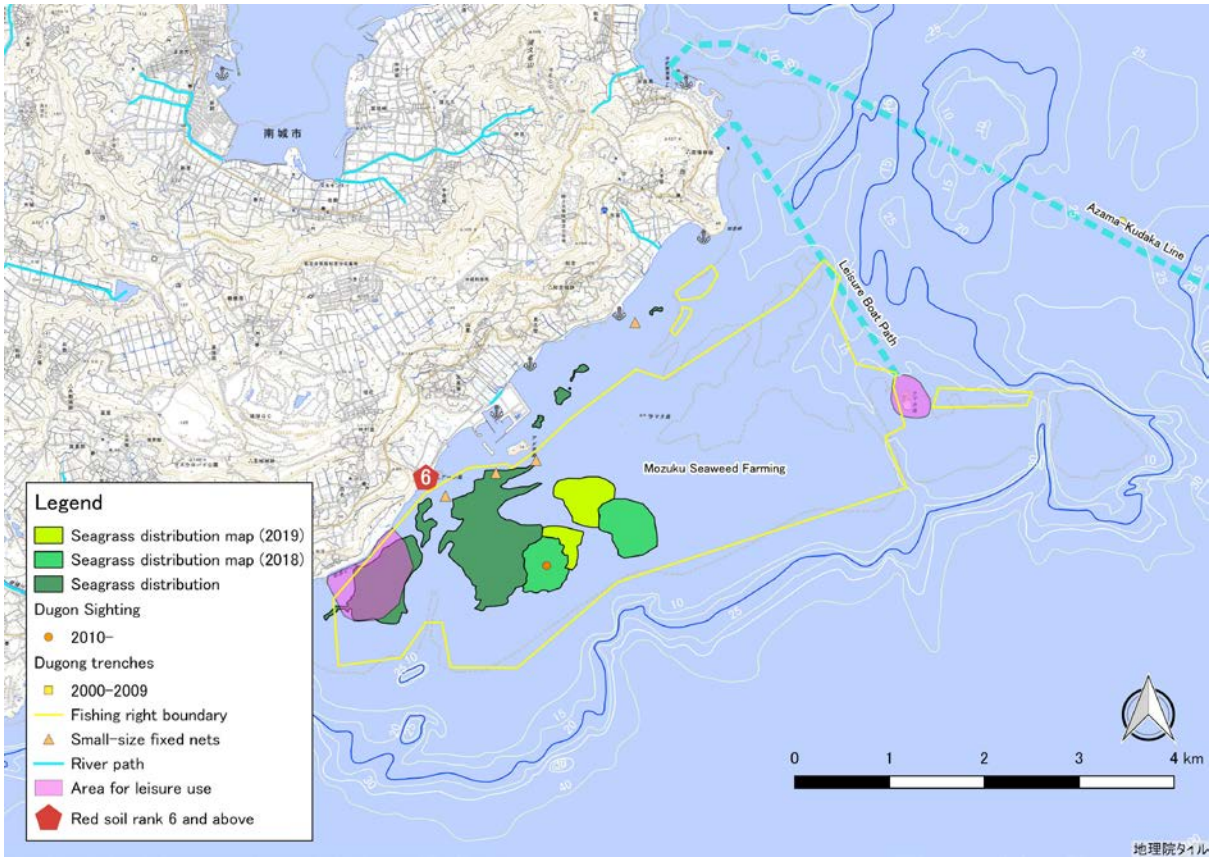


Fig. 15. Surrounding environment of seagrass beds around Chinen, Shikiya .

4) Raising Public Awareness on Protection -mainly focusing on bycatch measures

Study groups on biology of dugongs were arranged for fishermen and business affiliates related to marine leisure to understand how to respond in case of dugong bycatch (rescue methods), conservation of seagrass beds, etc. The study groups were hosted at two locations, the Chinen Fisheries Cooperative and the Yonashiro Town Fisheries Cooperative.

Table 8 shows contents of study groups

Table 8 Contents of study group.

Item	Details
Objectives	Explaining objectives of the study group, dugong sighting cases around Motobu peninsula, areas of fishery right, etc.
Lecture dugong biology, etc.	Introducing dugongs and rescue systems using movie products
Bycatch measures	Lecturing rescue dugong manual, confirming contact sheet for bycatch occasions, how to request support
Share information on dugong status	The latest dugong status based on the results from the projects in the past and importance of seagrass beds
Program Introduction	Introducing what has been accomplished in projects in the past
Exchange Opinions	Conservation of coastal area environment including dugongs and seagrass bed, fishery business tendency and others
Interviews	Sighting information on dugongs as well as dugong trenches

5) Review Committee

Dugong Protection Program Review Committee consisting of experts on dugongs and seagrass beds has been founded. The review committee was founded to gain advice on overall guidelines, evaluation, analysis, advice from academic or technical aspects on conservation measures. Expert opinions were obtained for this project.

【The First Committee Meeting Overview】

■Date and Time: 9:30-11:30, Friday, October 30th, 2020

■Location: Ginowan Seminar House

■Attended Committee Members: Shintoku KAMURA, Keiichi SATO, Makoto TSUCHIYA, Taro HOSOKAWA

■Observer: Yasuhiro KUBOTA (Professor, University of the Ryukyus)

■Agenda

（1）Comments from the members and corresponding guidelines (the first committee meeting in 2019)

（2）Outlines of JFY 2020 Program

（3）Report from Surveys and Others Conducted in JFY 2020

①Sighting Information and Results of Field Surveys

②Seagrass Bed Status in Major Regions (Organizing data on seagrass bed characteristics. Information map of the major regions)

③Raising Public Awareness

（4）Study Description

（5）Project Summary (Preliminary report)

■Meeting Documents

Document 1：Comments from Committee Members and Corresponding Actions (the first committee meeting in JFY 2019)

Document 2：Outlines of JFY 2020 Program

Document 3：JFY 2020 Survey Report

Document 4：Status of Seagrass Beds in Major Regions

Document 5：Raising Public Awareness

Document 6：Project Summary (Preliminary report)

■Handouts

①Meeting Agenda, Committee Member List, Seating Chart

②Guideline for Starting the Review Committee

③Definition of Dugong Feeding Trails

【The Second Committee Meeting Overview】

■Date and Time: 9:30-11:30, Friday, March 30th, 2021

■Location: First floor conference room, Incorporated Foundation Okinawa Prefecture Environment Science Center

■Attended Committee Members: Keiichi SATO, Makoto TSUCHIYA, Taro HOSOKAWA, Yoshihito WAKAI (online attendance)

■Observers：

Kazunori OKAJIMA (Deputy Head of Office for Conservation of Endangered Species, Wildlife Division, Nature Conservation Bureau, Ministry of the Environment, Japan) (online attendance)

Shizuka MUTO (first chief, Specialized Study, Office for Conservation of Endangered Species, Wildlife Division, Nature Conservation Bureau, Ministry of the Environment, Japan) (online attendance)

■Agenda

（1）Comments from Committee Members and Corresponding Actions (the first committee meeting in 2020) Document 1

（2）Outlines of JFY 2020 Program Document 2

（3）Report from Surveys and Others Conducted in JFY 2020

①Sighting Information and Results of Field Surveys Document 3

②Seagrass Bed Status in Major Regions (Organizing data on seagrass bed characteristics. Information map of the major regions) Document 4

③Raising Public Awareness Document 5

（4） Project Summary Document 6

■ Meeting Documents

Document 1：Comments from Committee Members and Corresponding Actions (the second committee meeting in JFY 2020)

Document 2：Outline of JFY 2020 Project

Document 3：JFY 2020 Survey Report

Document 4：Status of Seagrass Beds in Major Regions

Document 5：Raising Public Awareness

Document 6：Project Summary

■Handouts

①Meeting Agenda, Committee Member List, Seating Chart

②Outline of the Review Committee

3. Program Summary

(1) Preface

The objective of Dugong Protection Program is to conserve dugongs and seagrass beds in regions around Okinawa Island. Field surveys and public awareness promotion have been conducted in the major regions. The current project is a successive project from the one implemented between JFY 2016 and JFY 2017 (previous project). Under the previous project, the major regions were defined, and the current project focused on all these seven major regions to work on conservation measures for dugongs and seagrass beds.

Table 9 shows the program summary.

Table 9 Dugong Protection Program implementation (including data from the previous project) .

	Previous Project		Current Project		
	FY Heisei 28 (JFY 2016)	FY Heisei 29 (JFY 2017)	FY Heisei 30 (JFY 2018)	FY Heisei 31 (JFY 2019)	FY Reiwa 2 (JFY 2020)
Selecting Regions	―	―			
Status Survey (collecting and organizing sighting information)	―	―			
Status Survey (underwater survey)		―	―	―	―
Status Survey (using drones)		―	―	―	―
Status Survey (environmental DNA)				―	―
Raising Public Awareness			●●	●●	●
Developing and Updating Information Map of Major Regions	―	―	―	―	―
Analysis of the Dugong Found Dead				―	
Study on Duong Protection Measures	―	―	―	―	―
Review Committee	●	● ●	● ●	●	● ○
Project Effort (achievements)	・Dugong sighting information since the prewar years was collected and organized.	・Dugong trenches were found around Yagaji Island (July and September).	・Dugong trenches were found around Yagaji Island (June, August and September).	・Dugong trenches found around Yagaji Island (May).	・Dugong trenches assumed to be a high dense trail area was found (July). ・Dugong was sighted in south of Izena Island on June 13th.
Related Items			・Dugongs that appeared to be an adult and a child were witnessed at Hateruma in August (Ministry of the Environment). One dead female dugong was found in March.	・Study on the cause of death was conducted on dead female found in Nakijin, Okinawa. The result was announced. ・IUCN rank was revised and research plan was announced in December. ・It was announced that dugong Dugong trenches were found in places such as Irabu and Hateruma Islands in March (Ministry of	・Audio assumed to be dugongs was recorded from February to August at Oura Bay (Okinawa Defense Bureau).

1) Collecting and Organizing Data (Chapter 2, Main Volume)

Regarding dugong sighting, based on existing documents since the early 1900s, data containing total of 509 sighting cases (as of February 2021) was organized (see attached document). Including information from interview surveys conducted under the current project, a total of 23 cases of dugong sighting occurred since 2000 was obtained (Fig. 16). Since dugong sighting areas were wide in Okinawa Prefecture after 2010, it was understood that even today, the species may inhabit wide area in Okinawa Prefecture.

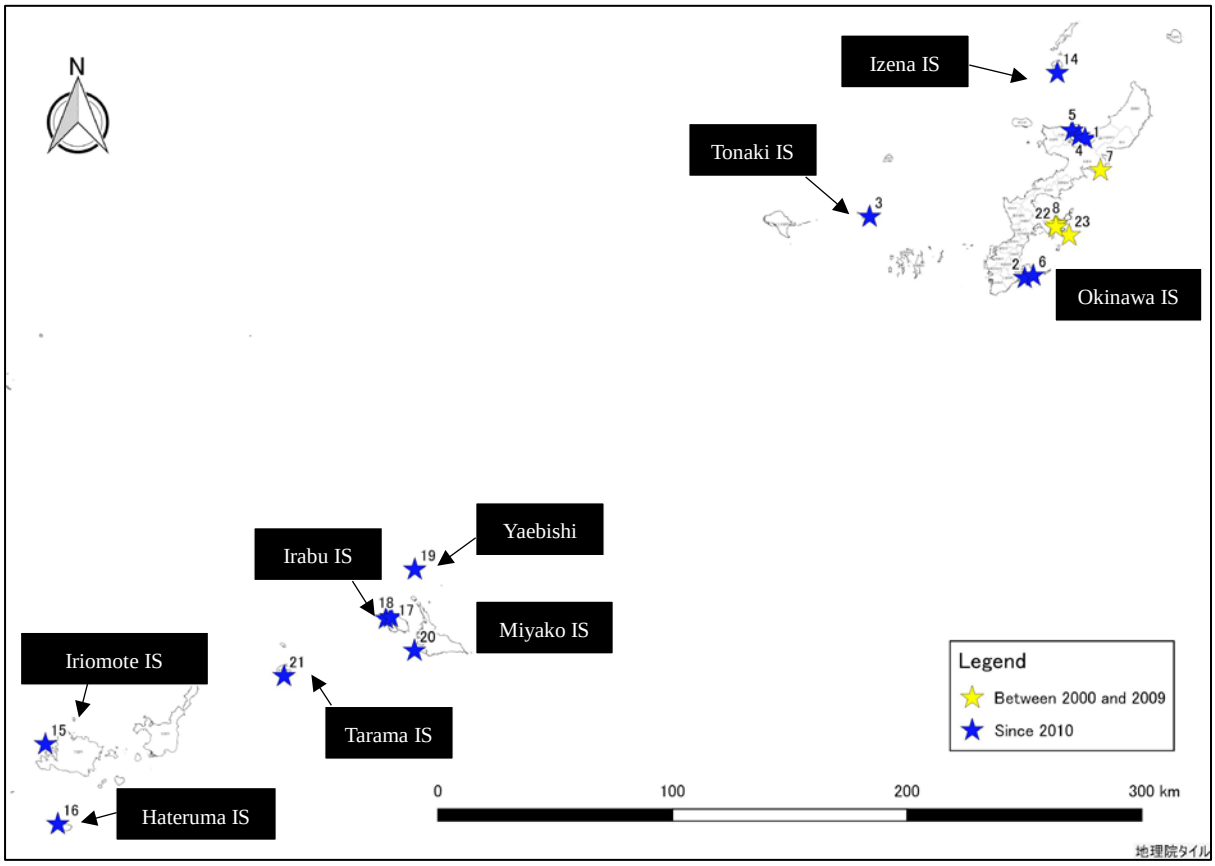


Fig. 16. Locations of dugong sighting occurrence since 2000 based on the information collected under the program.

2) Field Survey (Chapter 2, Main Volume)

【Surveys using new methods】

During the project, a drone was used to take photographs of seagrass beds to capture surface images. Traces seeming to be dugong trenches were extracted from image data, then these locations were visited by surveyors to determine if these were dugong trenches or not. Of the 17 locations with dugong trenches found under the overall program, seven were identified using images taken with a drone. Despite limitations inherent to the use of drone technology such as their inability to identify seagrass beds beyond a certain depth or during poor sea conditions, it was confirmed that the use of drones is an effective method to detect where dugongs have been feeding within the region.

To confirm dugong status, PCR primer set for dugong eDNA that was released in February 2020 was used since JFY 2020. As of today, no dugong DNA is detected yet. The study of detection limitations and other problems is an on-going effort.

【Confirming Dugong Feeding Trails】

Under the program, traces were found at 17 locations that assumed to be dugong trenches in Kouri/Yagaji region and Izena Island region (Fig. 17, Table 10). Since no dugong has been sighted around Okinawa Island since female dugong was found dead in Nakijin, Okinawa in 2019, dugong trenches found under this program is an important finding that indicate possibility of dugongs inhabiting the northwestern region of water around Okinawa Island today.

Also, the field survey immediately conducted in Izane Island region, responding to dugong sighting information, confirmed trenches for the first time in the region. Where trenches were confirmed in Izena Island region, neither field survey records nor seagrass bed distribution records were available. Under JFY 2020 project, along with confirming dugong trenches, data on seagrass bed distribution in the surrounding areas, seagrass species compositions and such was obtained, too. Continuous field survey on dugong interaction with seagrass beds as a feeding ground and study on promoting public awareness especially in fishermen community are required as future work.

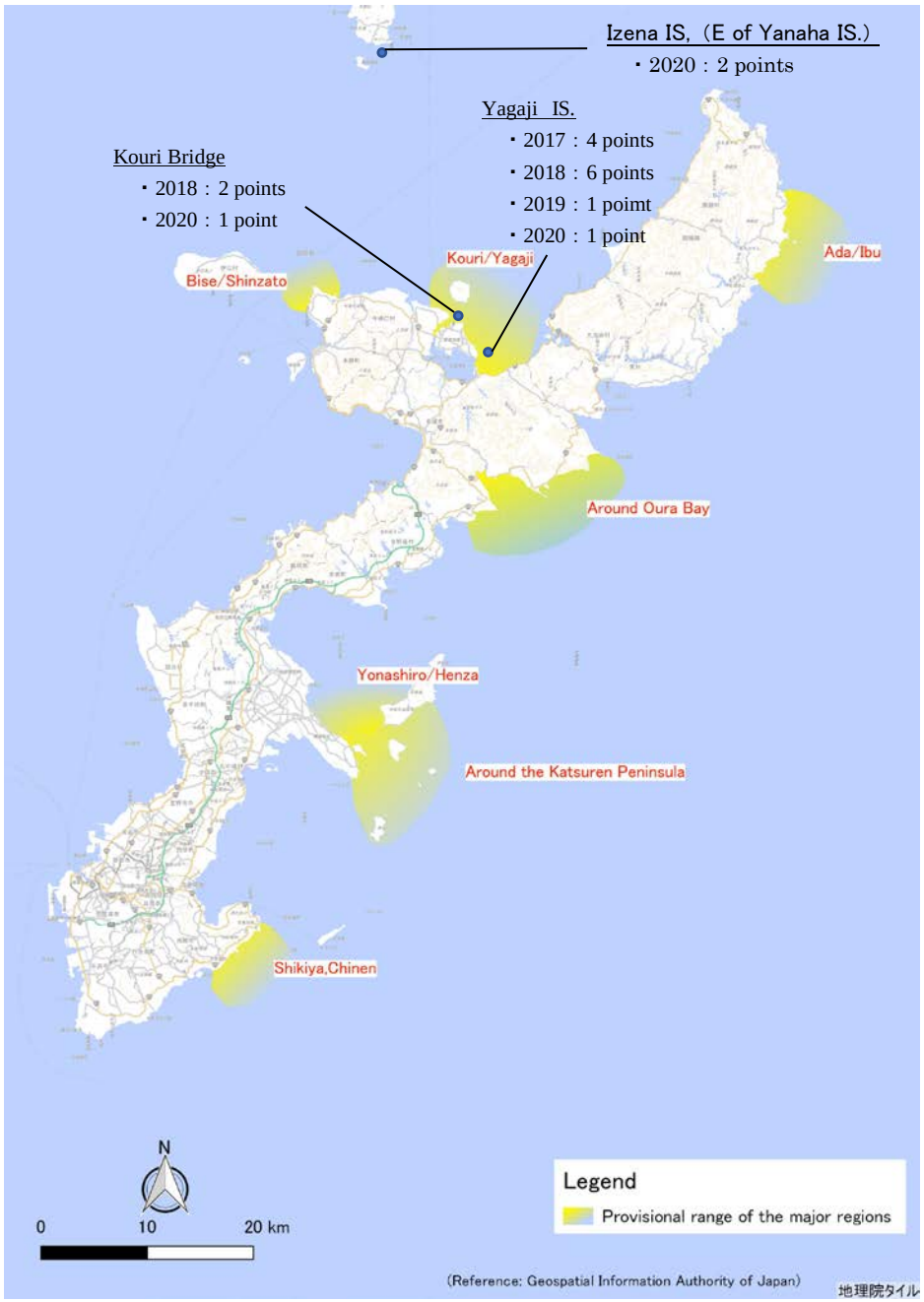


Fig. 17. Dugong trenches confirmed under program (including data from projects in the past).

Table 10 Found traces under program assumed to be dugong trenches (including data from the project in the past).

No.	Date Identified	Region	# of locations	Status of Feeding Trails
1	July 21st & Sep. 27th, 2017	Kouri/Yagaji IS	4(2)	Trenches：22、dense area：2
2	Aug. to Oct., 2018	Kouri/Yagaji IS	8(3)	Trenches：33、dense area：4
3	May 15th, 2019	Kouri/Yagaji IS	1(1)	Trenches：1
4	July 30th, 31st. 2021	Kouri/Yagaji IS	2(1)	Dense area：3
5	Oct. 17th, 2020	Around Izena IS	2	Trenches：2、dense area：1
Total			17(7)	Trenches：58、dense area：10

Note: (number) shown in the column “#of location” are numbers of identified locations with images taken during drone surveys

【Characteristics of Seagrass Bed Environment】

Regarding dugong trenches and dense trench areas found under the current project, data on items such as seagrass species composition and characteristics of surrounding environment including seafloor type was organized.

From seagrass species composition study, it was confirmed that from large species such as Pacific Turtlegrass to small species such as *Halophila* spp. were consumed by dugongs (Table 11). In addition, consumption of Japanese Eelgrass, *Zostera japonica*, was confirmed for the first time. There was no report regarding dugongs feeding on Japanese Eelgrass from study conducted in Japan in the past.

The seafloor was sandy with few sandy gravels based on the obtained data on the surrounding environment of seagrass beds (Table 11). Surveys in the past have identified trenches on gravel bottoms. Also, development of sand and gravel seafloor was confirmed in regions around Yagaji Island, around Izena Island and other areas. It was indicated that dugongs that inhabit the areas may prefer seagrass beds with sandy bottoms as feeding grounds.

Furthermore, the water depth of trenches found was approximately 5 m or less; however, trenches were confirmed at the location deeper than 5 m offshore of Yagaji Island (Table 12). Regarding depth of dugong trench locations in Okinawa Prefecture, many trenches had been reported in a community of *Halophila decipiens* at a depth of 18 m around *Chiri bishi*, Oura Bay in the past. Considering these facts, the current project studied trenches and seagrass bed distribution in deep water during surveys in each region. In case similar surveys are conducted in the future, seagrass bed development in deep areas as well as shallow areas needs to be paid attention to try to build data.

Table 11 Species composition of seagrass where trenches were confirmed under the program and seafloor type in the surroundings (including data from the project in the past).

		Seagrass Species Composition of Feeding Trails										Main Seafloor
		Pacific Turtlegrass	Noodle Seagrass	Serrated Ribbon Seagrass	Smooth Ribbon Seagrass	Narrowleaf Seagrass	Needle Seagrass	Dugong Grass	Tape-grass	Caribbean Seagrass	Japanese Eelgrass	
		T. hemprichii	*S. isoetifolium*	*C. serrulata*	*C. rotundata*	*H. uninervis*	*H. Pinifolia*	*H. ovalis*	*H. major*	*H. decipiens*	*Z. japonica*	
Survey Region	Kouri/Yagaji	●	●			●	●	●			●	Sand
	Izena IS	●				●						Sand

Table 12 Depth of trenches confirmed under the program (including data from the project in the past).

		Seagrass Species Composition of Feeding Trails									
		Pacific Turtlegrass	Noodle Seagrass	Serrated Ribbon Seagrass	Smooth Ribbon Seagrass	Narrowleaf Seagrass	Needle Seagrass	Dugong Grass	Tape-grass	Caribbean Seagrass	Japanese Eelgrass
		T. hemprichii	*S. isoetifolium*	*C. serrulata*	*C. rotundata*	*H. uninervis*	*H. Pinifolia*	*H. ovalis*	*H. major*	*H. decipiens*	*Z. japonica*
Seagrass Bed Found	Depth 5-10 m （Off the Coast of Yagaji Island）						●	●			
	Depth 5 m and less	●	●			●	●	●			●

【Anatomical Study of Dead Dugong】

The dead dugong drifted to the coast of Unten Fishing Port, Nakijin Village on March 18, 2019. The body was dissected on July 17th, 2019 to find a cause of death. The results showed it was likely the cause of death was from a stingray's (*Himantura fai*) barb that penetrated the dugong's small intestine.

The eating habits of dead dugong were analyzed using gastric content samples collected at the time of dissection. Two types of seagrass, *Halodule* spp. and *Halophila major* were found. Quantity of *Halodule* spp. exceeded to the others; hence, it was assumed that short period of time before the dugong's death, it was feeding on seagrass beds where *Halodule* spp. dominantly grow. Microplastics were not identified in the gastric content samples.

3) Environmental Data on Seagrass Beds (Chapter 3, Main Volume)

For the major regions, information map was developed to understand the relationship between dugongs and anthropogenic impacts by overlaying seagrass bed distribution data obtained from field surveys under this project onto the existing data (distribution of seagrass beds, sighting information, fishery rights area map and others).

From the analysis results, area reduction of seagrass beds was not confirmed during the project period, but the seagrass beds around Henoko region had disappeared. As described earlier, seagrass beds were confirmed in deep areas where none had been reported before. Overall, the area of confirmed seagrass beds increased compared with previously known distribution areas.

4) Promoting Public Awareness (Chapter 4, Main Volume)

During the project implementation, study groups were organized in five regions to discuss items such as dugong protection and rescue methods under the project (Fig. 18). For those regions where study group was not organized among major regions, similar activities have been conducted by Ministry of the Environment to promote public awareness on dugong protection, rescue methods and such (Ministry of the Environment 2019). That means during the project implementation, actions on promotion of public awareness have been taken in all the major regions.

The total number of participants in the study groups under this project was 135 (Table 13). The main target participants were fishermen who operate boats in the coastal areas. People who are involved in marine leisure activities in major regions also joined study groups. During these study groups, dugongs rescue methods (bycatch measures) were introduced using information from instances in the past. Need of dugong protection and importance of seagrass conservation from the aspect of fisheries science were explained during the study groups.

At study groups at each region, the majority of the participants were fishermen involved in coastal fisheries such as *Mozuku* farming. Since *Mozuku* farms overlap with seagrass beds, participants seemed to be highly interested in conservation of dugongs and seagrass beds from conservation points of view. It was confirmed that it is important to keep public awareness effort to broaden the idea of importance of conservation of seagrass bed environment from aspects of conservation of fishery environment

While opinions were exchanged at the study groups, 16 new sightings of dugongs and others were obtained. Dugong morphology (what it looks like when sighted from boats), forms of trenches, recent information on dugong sighting and others are going to be discussed during study groups from now on. By organizing communication occasions like this, more sighting information is expected to be collected.

Table 13 Number of participants (between JFY 2018- JFY 2020).

Date	Main Participants (location)	Participants
Jan. 26th, 2019	Motobu Fisheries Cooperative (Conference room)	26
Feb. 8th, 2019	Haneji Fisheries Cooperative (Sumuide Community Center)	35
Dec. 13th, 2019	Chinen Fisheries Cooperative (Umino Seri Ichiba)	36
Jan. 27th, 2020	Yonashiro Town Fisheries Cooperative (Henza Jichi Hall)	27
Oct. 29th, 2020	Katsuren Fisheries Cooperative (Heshikiya Community Center)	11
Total		135

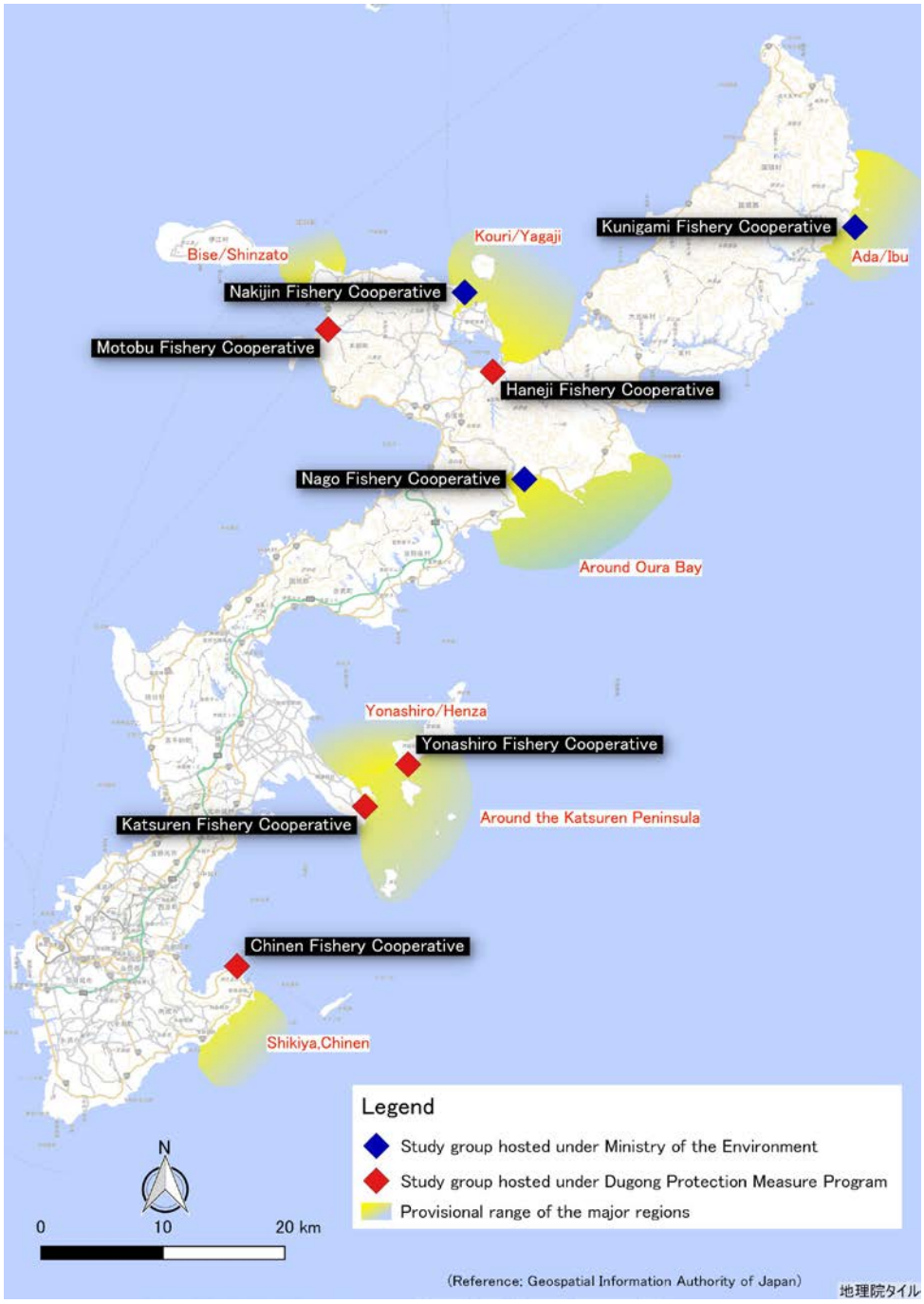


Fig. 18. Locations where public awareness promotion activities were organized (JFY 2018 – JFY 2020).

(2) Project Summary

As a project summary, the results of this project, tasks and the direction of future conservation measures based on the tasks were studied (Fig. 19)

1) Results and Tasks of the Project

First, the possibility of dugongs' inhabitation was confirmed from dugong's trenches. Recently, Okinawa Defense Bureau conducted surveys around Okinawa Island not identifying any dugongs after September 2018 in Oura Bay region. Also, a female adult was found dead in Nakijin, Okinawa; there are concerns regarding dugong population reduction. The results of this project indicate that the species still inhabit regions around Okinawa Island.

In this project, the information map of the major regions within the context of dugong sighting locations, seagrass bed distributions, and status of fishery rights was developed based on results from field surveys and environmental characteristics obtained on the target regions. This effort requires continuous updates incorporating additional information, dugong sighting reports, and changes in fishery right areas. Also, by actively utilizing the information map of the major regions, effective promotion of public awareness and information share on dugong habitats are highly anticipated among nearby organizations such as fishery cooperatives and local authorities.

In April 2020, confirmation of dugong trenches in Sakishima Islands region was publicly announced (Ministry of the Environment, April 2020). It was indicated that today's dugong habitat is wider than previously thought. Dugongs move in Japan has few information by now. Existing seagrass bed conservation is important from the point of conservation of dugong habitat due to the likelihood of wider range of dugongs' habitation. It can be concluded that disseminating information on protection measures in further areas including Okinawa Island is necessary.

The project worked on promotion of public awareness mainly focusing on the major regions. The reported case of dead female dugong in Nakijin Village is thought to be an outcome of over 10-year long effort providing study groups, monitoring and such under projects by Ministry of the Environment. The reason is that fisherman found the dead dugong and judged its life condition while on water and reported to the point of contact. Such as Nakijin Fisheries Cooperatives, some fisheries cooperatives seem to understand topics related to dugong protection and importance of seagrass beds. However, regions where no study group is organized seem to be requiring such occasion to enhance awareness on importance of conservation. Especially given that new fishermen have been involved in most fisheries and their rights have been updated by today, organizing study groups in those regions is necessary to maintain rescue systems in the future. Also, since possible dugong habitat was indicated in Izena Island region, it is thought to be an urgent task to construct communication network with the fishery cooperatives to establish reporting system and exchanging dugong sighting information by organizing a study group involving fishermen in the region.

In 2020, Ministry of the Environment had reported that dugong trenches were confirmed in areas such as Hateruma Island in Yaeyama Group and Irabu Island in Miyako Group. In these regions, too, mainly with fishermen, organizing occasions to disseminate rescue methods and to promote public awareness on dugong conservation are urgent tasks. By collaborating authorities such as Ministry of the Environment, coordination is required to disseminate protection measures in Sakishima Islands area.

2） Direction of Protection Measures in the Future

The direction of future protection measures are as follows: (1) Collecting information for the purpose of determining the dugong distribution; (2) continuous effort on promoting public awareness in wide areas for the purpose of raising awareness on conservation as whole societies; (3) enlarging areas to disseminate dugong rescue method targeting fishermen, and maintaining the emergency contact lists. Ministry of the Environment has also been conducting surveys on dugong biology. Recently, a new case of possible dugong habitation in Sakishima Islands area was reported. Knowing that dugongs in Japan is at risk of extinction, reconfirmation of dugongs in Sakishima Islands area is encouraging information in terms of maintaining the dugong population in the future. Even though dugongs' long-distance dispersion (i.e. from Sakishima Islands area to regions around Okinawa Island) is still unknown, to protect dugongs and to conserve seagrass beds dugongs in entire Okinawa Prefecture area, related organizations are required to make an effort to work together implementing unified work ((4) cooperation among related organizations).

Regarding data collection, a continuous effort needs to be maintained by monitoring in regions around Kouri/Yagaji, Izena Island and such, where trenches were identified under the current project, while sighting information is collected from fisheries cooperatives and others. Especially for the regions around Izena Island and other places where dugong trenches were confirmed for the first time, it is urgent to gain insights to determine whether dugong habitation is continuous or temporary and to confirm seagrass distributions that are important feeding places for dugongs in the regions.

Regarding public awareness promotion, this project has been targeting personnel related to fisheries in the major regions; however, considering reconfirmation of trenches in Sakishima Islands area, work to enhance protection awareness as an entire society is necessary in the future adding to lecturing rescue methods to personnel related to fisheries. Considering there is likelihood that dugongs' inhabiting wide range in Okinawa Prefecture, the future task will be that people in the prefecture need to enlarge knowledges through public awareness on meaning in seagrass bed conservation as these areas are feeding dugongs.

Hosting study groups to disseminate rescue methods to fishermen gained meaningful results by collecting sighting information and developing a dugong rescue system. In the future, the task is to prioritize hosting study groups in areas where study groups have not recently been hosted and areas such as Izena Island where no study group has been organized but recent sighting reports

including trenches is received. Regarding Sakishima Islands area, not limiting fishermen but enlarging targets for public awareness is necessary with plans of collaboration effort with the preceding work by Ministry of the Environment.

Some unexpected events such as studying dead dugong in Nakijin Village and receiving sighting information report to Okinawa Prefecture occurred during the project implementation period. For these cases, efforts to build collaboration systems with related organizations were made. Especially in the region around Izena Island, trenches were confirmed after receiving sighting information; new dugong habitation areas were confirmed. With recently confirmed dugong habitation in Sakishima Islands area and public awareness promotion in the future, the amount of information on dugong status and confirmation of animals is expected to be increased. Responding systems need to be ready for such conditions.

Achievement of the Program (past projects included)

① **Field Survey of Dugongs and Seagrass Beds**

- Dugong status tendency focusing on major regions: confirming trenches in regions around Yagaji Island (including deep area) and Izena Island
- Establish new survey methods: establish efficient survey methods using drones and through application of eDNA method (improvement may be made to eDNA method as needed)
- New findings regarding seagrass bed distributions: seagrass bed development in areas deeper than 5 m was confirmed
- Anatomical study on dead dugong: new findings on feeding habits (manuscript in preparation)
- Sighting information: collecting and organizing recent new sighting cases and others
- Organize information obtained in the major regions: developing information map for regions based on results of field survey and such.

② **Public Awareness Promotion**

- Host study groups in five areas of Okinawa Island (Fisheries Cooperative of Chinen, Yonashiro Town, Katsuren, Motobu and Haneji) mainly focusing on bycatch measures (disseminating dugong rescue manual)
- Collect information from fishery cooperatives and fisherman during field survey and promoting public awareness on protection

③ **Coordination with related local government**

- Share information: sharing information on protection measures through study groups
- Measures against unexploded bomb disposal: confirming and reinforcing contact network

Related Information During Program Implementation

① Dugongs confirmed in Yaeyama and Miyako Regions

- In April 2020, trenches in regions of Yaeyama (Hateruma Island) and Miyako area (Irabu Island) were confirmed. Sighting information was also received by Okinawa Prefectural Government and attention was brought to this matter in each area.
- Possibility of widely ranged dugongs habitation in Okinawa prefecture is also supported by study by KUBOTA Yasuhiro, Professor, University of the Ryukyus.

②IUCN Statement and Announcement of Research Plan

- Necessity of conducting diverse survey such as dugong status in overall Nansei Islands

③Ministry of the Environment

- Conducting dugong habitat surveys in Sakishima Islands area, continuing monitoring effort by fishermen in Okinawa Island.

Work Continuous Effort Is Expected

① **Continuous effort to collect information on dugongs**

- Collect sighting information from wide areas as well as information on international conservation efforts
- Understand current status by monitoring regions where trenches were confirmed.

② **Promoting public awareness in wide area**

- **Further dissemination of information such as dugong status and importance of dugong protection and seagrass bed conservation**
- Provide information in wider areas

③ **Responding to unpredictable events (bycatch, stranding, etc.)**

- Mainly working with personnel related to fishery industries, develop and maintain network to respond and rescue dugongs
- Cost for responding bycatch and stranding

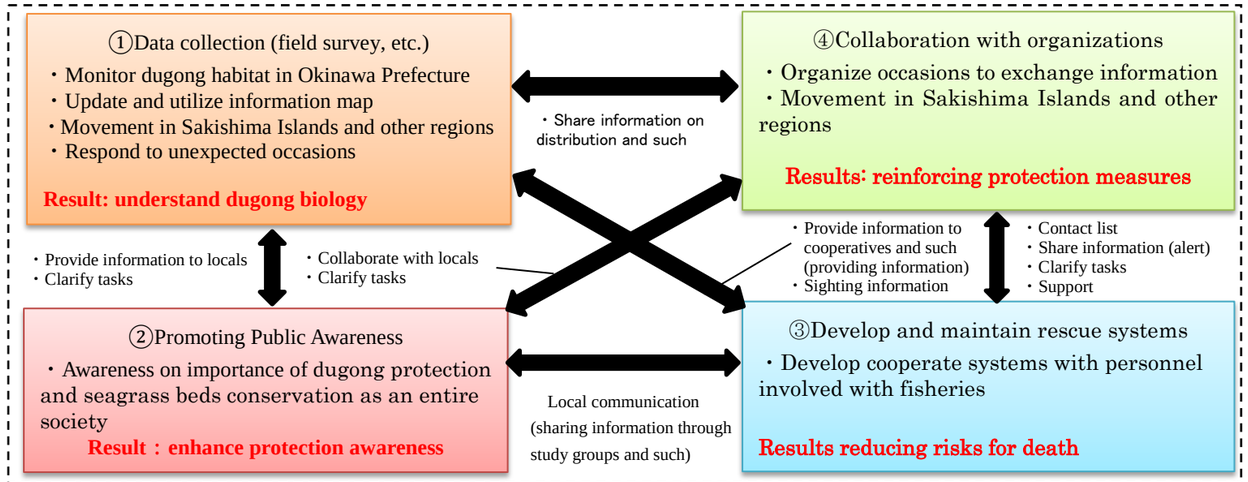
④ **Sharing information among related organizations**

- Collaboration with Ministry of the Environment, municipalities, aquariums, research institutes and others

⑤ **Working on the new regions: Yaeyama and Miyako**

- Promotion of ① to ④ above in surrounding areas of dugong habitats

Directions of Future Protection Measures



The primary chore of protecting the future of the dugong is to understand its status in the present. Critical to this effort is a persistent accumulation of scientific data. Information obtained will be shared in a timely manner with related organizations. Also, the data will inform work initiatives for locals such as promotion of public awareness. The result will broaden societal understanding in matters such as rescue methods, necessity of dugong protection, and the importance of seagrass bed conservation. Adding to this, in regions where dugong habitats are newly identified, collaboration is required with related organizations, such as Ministry of the Environment with the vision of protective measures for dugong population within the Nansei Islands area.

Fig. 19 Program achievement and directions of future protection measures

JFY 2020 Report Summary on Dugong Protection Measure Project

March 2021

Okinawa Prefectural Government, Department of Environmental Affairs, Nature Conservation Division

1-2-2 Izumizaki, Naha,
900-8570 Okinawa Japan
TEL 098-866-2243
FAX 098-866-2240

［Project Contractor］

Dugong Protection Measure Project Joint Venture
Incorporated Foundation Okinawa Prefecture Environment Science Center
And Natural Parks Foundation
Main Address: 720 Aza Kyoduka, Urasoe 901-2111 Okinawa, Japan

TEL 098-875-1941
FAX 098-875-5702