



Social Organization Standard

T/CAOE 20.2-2020

Technical guideline for investigation and assessment of coastal ecosystem —

Part 2:

Remote sensing identification and results verification of the coastal ecosystem

海岸带生态系统现状调查与评估技术导则 第2部分：海岸带
生态系统遥感识别与现状核查

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Foreword

The T/CAOE 20 *Technical guideline for investigation and assessment of coastal ecosystem* consists of the following ten parts:

- Part 1: *General*;
- Part 2: *Remote sensing identification and results verification of the coastal ecosystem*;
- Part 3: *Mangroves*;
- Part 4: *Salt marshes*;
- Part 5: *Coral Reefs*;
- Part 6: *Seagrass bed*;
- Part 7: *Oyster Reef*;
- Part 8: *Sandy Coast*;
- Part 9: *Estuary*;
- Part 10: *Bay*.

This is part 2 of the T/CAOE 20, which is used together with Part 1.

This part is drafted in accordance with the rules given in the GB/T 1.1-2009.

This part was proposed by the *Marine Early Warning and Monitoring Division, Ministry of Natural Resources*.

This standard was prepared by *China Association of Oceanic Engineering*.

This part was drafted by *National Marine Data and Information Service; North China Sea Environment Monitoring Center of State Oceanic Administration; East China Sea Environment Monitoring Center of State Oceanic Administration; South China Sea Institute of Planning and Environmental Research, State Oceanic Administration*.

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Technical guideline for investigation and assessment of coastal ecosystem —

Part 2: Remote sensing identification and results verification of the coastal ecosystem

1 Scope

The methods, processes, requirements and contents of remote sensing identification, status verification, results compilation and archiving of the coastal ecosystem are specified in this part of T/CAOE 20.

This part is available for the work of remote sensing identification and status verification of coastal ecosystem.

2 Normative References

The following documents are essential for the application of this part. For the dated references, only the dated version is applicable to this document. For the others, the latest versions (including all amending lists) are applicable to this document.

GB/T 13990-2012, *Specification for aerophotogrammetric office operation of 1:5000 1:10000 topographic maps*

GB/T 32067-2015, *Map legends and symbols for marine features*

HY/T 147.7-2013, *Code of practice for marine monitoring technology—Part 7: Satellite remote sensing technical methods*

TD/T 1055-2019, *Technical regulation of the third nationwide land survey*

T/CAOE 20.1-2020, *Technical guideline for investigation and assessment of coastal ecosystem—Part 1: General*

3 Terms and Definitions

The following terms and definitions are available for the document.

3.1

spatial resolution

the smallest unit can be distinguished in detail on a remote sensing image which is used to characterize the resolution of ground target details as an index

3.2

atmospheric correction

the process of eliminating the effects of atmospheric absorption and scattering by satellite remote sensors

3.3

radiometric calibration

the process of converting the brightness gray value recorded by the sensor into absolute radiance or reflectivity

3.4

geometric correction

the process of eliminating or correcting the image distortion caused by the sensor itself
3.5

image registration

the process of matching and superposing two or more images at different time, different sensors or different conditions (climate, illumination, camera location and angle, etc.)

3.6

image mosaic

the process of splicing multiple adjacent images into images with larger range under the control of a certain mathematical basis

3.7

image data fusion

the process of generating composite images with new spatial, spectral, and temporal features from redundant or complementary multi-source data in space or time by the certain rules or algorithms

3.8

habitat map delineation

the area formed by remote sensing images with distribution ranges of the same coastal ecosystem types

4 Basic requirements

4.1 Basis of mathematics

4.1.1 Plane coordinate system

The China Geodetic Coordinate System 2000 is adopted.

4.1.2 Projection

Gauss Kruger projection is adopted and the zone is divided by 3 degrees.

4.1.3 Depth datum

Use the theoretical depth datum.

4.1.4 Elevation datum

Use the 1985 National Elevation Datum.

4.1.5 Unit of measure

The unit of measure requirements is as follows:

- a) The area unit is m^2 , which keeps two decimal places.
- b) The unit of area statistics collection is hm^2 , which keeps four decimal places.

4.2 Data requirements

4.2.1 Remote sensing image data

The requirements of remote sensing image data are as follows:

- a) Data type: satellite remote sensing image data or aerial remote sensing image data;
- b) Temporal image: select the remote sensing images of the coastal ecosystem in recent two years.
- c) Spatial resolution: the spatial resolution of satellite remote sensing image data should be

less than 2m, which of important ecosystem and features should be less than 1m. Aerial remote sensing image data with higher spatial resolution should be used for the ecosystem that couldn't be identified accurately;

- d) Positioning accuracy: the error of image location is less than 10m;
- e) Tide time: appropriately select the remote sensing image at low tide level;
- f) Quality: remote sensing images with rich levels and clear images should be selected, regional cloud coverage of which shouldn't be greater than 10% and the image overlap of which shouldn't be less than 5%.
- g) Format: GeoTIFF format.

4.2.2 Vector data

The vector data mainly include the habitat map delineation with remote sensing of the coastal ecosystem interpretation and the habitat map delineation with status verification, which are in the format of ESRI Shapefile.

4.2.3 Text data

Text data include the registration form of remote sensing interpretation marks, the summary table of coastal ecosystem current distribution area and the remote sensing identification report of coastal ecosystem distribution status. Data sheets are in the Microsoft XLSX format and files are in the Microsoft DOCX format.

4.2.4 Raster data

Raster data stores in TIFF format with a minimum resolution of 300dpi.

4.2.5 Table data

Table data stores in Adobe PDF format with a minimum resolution of 300dpi.

4.2.6 Multimedia data

The multimedia data include photos and videos taken in the field verification; the requirements of data are as follows:

- a) The photos store in JPEG format with no less than 10 million pixels;
- b) The videos store in MP4 format and the resolution is not less than 720P.

4.3 Quality control

The quality control is carried out according to 4.3 of T/CAOE 20.1-2020.

5 Remote sensing identification

5.1 Identification scope

The coastline is taken as the baseline, which extends 1km to the land (it could be adjusted in different areas) and extends 0m isobaths to the sea.

5.2 Identification objects

Identification objects are the typical ecosystems in internal waters and territorial sea in the coastal zone of China, including habitat map delineation of mangrove, salt marsh, sandy coast, muddy beach, bedrock beach, etc.

5.3 Content

5.3.1 Image acquisition and processing

5.3.1.1 Image acquisition

Remote sensing image of the coastal ecosystem should be acquired according to the requirements of section 4.2.1.

5.3.1.2 Image processing

The process of remote sensing image recognition of the coastal ecosystem is as follows:

—Satellite remote sensing image processing, including radiometric calibration, atmospheric correction, geometric correction, image registration, image mosaic, image data fusion, which is carried out in accordance with the provision of clause 6 of HY/T 147.7-2013. Digital Orthophoto Map (DOM) is produced in accordance with the provisions of chapter 7 of TD/T 1055-2019.

—Aerial remote sensing image processing: analytic aerial triangulation should be measured in accordance with the provisions of chapter 5 of GB/T 13990-2012. The production of photo plans and orthophoto maps should be implemented in accordance with the provisions of chapter 6 of GB/T 13990-2012.

—The processed remote sensing image data of the coastal ecosystem should be spliced and trimmed regionally as the basic identification unit.

5.3.2 Maps and data preparation

Relevant maps and data of the identified area should be acquired, including the topographic map, water system map, sea chart, shoreline revision and survey data, nature reserve data, ecological protection red line data, historical documents, and special investigation materials.

5.3.3 Objection classification and code

The classification and code of remote sensing identification objects of the coastal ecosystem are shown in table A.1 of Annex A.

5.3.4 Interpretation sign establishment

According to the regional physical geography, topography, vegetation types and the current situation of development and utilization, combined with field investigation and auxiliary data, the relationship between the shape, size, color or tone, shadow, position, structure, texture and other characteristics of the remote sensing image and corresponding interpretation types is established. A unified standard is formed for the description of the characteristics of each type reflected on the remote sensing image. The interpretation marks are determined and filled in the remote sensing interpretation mark table of coastal ecosystem (shown in table B.1 of Annex B). If the types of remote sensing image data are different or the imaging time, season, resolution, and geographical region of the same remote sensing image data are quite different, remote sensing interpretation marks should be established respectively.

5.3.5 Remote sensing interpretation

5.3.5.1 Interpretation requirements

According to the remote sensing interpretation signs, the target area of the coastal ecosystem is interpreted by recognition of human-computer interaction. The interpretation requirements are as follows:

a) The actual area of the smallest map delineation of salt marsh and mangrove is 2000 square meters. If the actual area of a single map delineation is less than 2000 square meters and the actual distance between map delineations of the same ecosystem type is less than 100 meters, these map delineations should be divided into the same map delineation.

- b) The actual area of the smallest map delineation of sandy coast, muddy beach and bedrock beach is 10000 square meters. If the actual area of a single map delineation is less than 10000 square meters and the actual distance between map delineations of the same ecosystem type is less than 160 meters, these map delineations should be divided into the same map delineation.
- c) When there are different types of ecosystem, different county (District)-level administrative regions, or different protection levels (whether the area is ecological protection red line, various conservation areas, etc.), the map block should be divided separately.

5.3.5.2 Interpretation contents

According to the remote sensing interpretation signs, the coastal ecosystem in the basic identification unit is interpreted, the distribution of habitat map delineation could be extracted and interpreted. Then, the information table for the attributes of interpretation delineation and data of the coastal ecosystem remote sensing could be filled out (shown in table C.1 of Annex C). Compared with the historical data of coastal ecosystem in basic identification unit, if the distribution map delineation of habitat is inconsistent with the historical, the attribute information table of coastal ecosystem where remote sensing interpretation and historical distribution are different should be filled out (shown in table C.1 of Annex C).

5.3.6 State quo statistics

Vector superposition analysis is carried out on the habitat distribution map delineation data by remote sensing interpretation and the existing ecosystem distribution history data, to determine the distribution position of the ecosystem and calculate the area of each delineation. The area of each coastal ecosystem habitat map delineation type could be counted as the level of county (district), city (prefecture) and provincial. Then, the summary table of coastal ecosystem state quo distribution could be filled out (shown in table D.1 of Annex D). Among the table, the computing method of Normalized Difference Vegetation Index (NDVI) should be carried out according to the rules of chapter 6 of HY/T 147.7-2013.

6 State quo of verification

6.1 Verification elements

The verification elements mainly include the type, boundary and attribute annotation of habitat distribution map delineation of the coastal ecosystem, as shown in table C.1 and C.2 of Annex C for details.

6.2 Methods

6.2.1 Interior verification method

Satellite and aerial remote sensing images, historical investigation data (habitat distribution data, maps, field photos and videos, etc.) are superimposed on the remote sensing identification results to check for the consistency and accuracy of the habitat distribution map delineation with images and historical data.

6.2.2 On-site verification method

According to the results of remote sensing identification of the coastal ecosystem, part of the habitat distribution map delineations is selected, and the boundary and type of delineations are verified in the field by the means of this method.

6.3 Work

6.3.1 Interior verification

The work of interior verification mainly includes the following aspects:

- a) Check the completeness and integrity of the submitted remote sensing identification results.

b) Taking the county (District) administrative units as a unit, combined with historical investigation data, check the accuracy of habitat map delineation type, field, coordinate system, spatial topology, delineation area and attribute annotation of the coastal ecosystem, and fill in the map delineation verification table (shown as table E.1 in Annex E).

6.3.2 On-site verification

6.3.2.1 Verification object

The verification objects include the following aspects:

- a) Habitat map delineation of the coastal ecosystem;
- b) Habitat map delineation that couldn't be accurately judged in interior verification;
- c) Habitat map delineation which is quite different from historical data.

6.3.2.2 Verification method

According to the requirements of mapping the distribution boundary of mangrove, salt marsh, sandy coast, muddy beach, bedrock beach and other identified objects, the boundary check points of each habitat distribution map delineation should not be less than 5, and the verification amount of map delineation should not be less than 15%. All habitat distribution map delineations that can't be accurately judged or have great difference with historical data should be checked.

When on-site verification, GPS positioning, photography, UAV shooting and other technical means should be used to collect multimedia data from the verification site and make records (See table F.1 in Annex F).

After on-site verification, the records should be sorted out in time to correct the remote sensing identification results.

7 Results compilation and collection

7.1 Map compilation

7.1.1 Orthophoto map

The composition and specific requirements of orthophoto map elements are as follows:

7.1.1.1 Map feature

Orthophoto map elements included: map title, map id, coordinate system, scale, projection, internal and external map outline, longitude and latitude network and kilometer network, longitude and latitude and its annotation, image joint sketch, data source, data acquisition time and production department.

7.1.1.2 Production requirements

The production requirements of the orthophoto map are as follows:

- a) The image map should be rich in layers, clear and easy to read, uniform in color and moderate in contrast;
- b) When two images with large difference in hue are inlaid, the image hue should be adjusted. The gray level and hue of the image at the seam should be coordinated with the gray level and hue of the whole image;
- c) The map sheet configuration should be appropriate; the map surface should be uniform. The map range of different scales in the same bank section should be basically consistent;
- d) The map title should be located in the middle above the outer edge of the drawing;
- e) See Annex G for the other sheet finishing requirements

7.1.1.3 Drawing requirements

The orthophoto map adopted A3 format, which is freely divided according to the actual demand. The scale of orthophoto map of the salt marsh and mangrove ecosystem should not be less than 1:50000;

The scale of orthophoto map of sandy coast, muddy beach and bedrock beach ecosystem should not be less than 1:250 000.

7.1.2 Thematic map of remote sensing recognition

The composition and specific requirements of remote sensing thematic map are as follows:

7.1.2.1 Map elements

The elements of the thematic map of remote sensing recognition include: map title, map id, legend, coordinate system, scale, projection, internal and external map outline, longitude and latitude network and kilometer network, longitude and latitude and its annotation, image joint sketch, data source, data acquisition time and production department.

7.1.2.2 Production requirements

The requirements for the making thematic map of the remote sensing identification are as follows:

- a) Making use of all kinds of mapping materials correctly and fully;
- b) The relationship between the elements should be clear and reasonable;
- c) The map sheet configuration should be appropriate; the map surface should be uniform. The map range of different scales in the same bank section should be basically consistent;
- d) The map title should be located in the middle above the outer edge of the drawing;
- e) The legend is uniformly arranged in the drawing outline, and the position is selected according to the principle of 'from bottom to top, keep away from professional content' ;
- f) See Annex G for other sheet finishing requirements

7.1.2.3 Drawing requirements

The thematic map of remote sensing recognition adopted A3 format, which is freely divided according to the actual demands which can correctly display the habitat. The scale of the salt marsh and mangrove ecosystem should not be less than 1:50000; the scale of the sandy coast, muddy beach and bedrock beach ecosystem should not be less than 1:250000.

7.2 Report compilation

7.2.1 Compilation requirements

The compilation requirements of the remote sensing identification report include the following aspects:

- a) It should be compiled on the basis of in-depth analysis of existing literature, data and this remote sensing identification results and maps;
- b) It should be compiled in accordance with the work plan, implementation plan and the provisions of the remote sensing identification work;
- c) The contents are full and accurate, the key points are prominent, the arguments are sufficient and the words are concise.

7.2.2 Compilation format

The report format and chapter contents of the remote sensing identification report referred to Annex H for details.

7.3 Results submission and archiving

7.3.1 Requirements of results submission

The requirements for submission are as follows:

- a) Submission content: image data, vector data, text data, raster data, list data, multimedia data, result report and result map produced in the process of the remote sensing identification and current situation verification of the coastal ecosystem.

b) Submission form: The original paper data after sorting are submitted in the copy, the electronic data are submitted in the CD; the integrated data are submitted in the CD; the report results are submitted in the printed copy and the electronic document CD; the map results are submitted in the printed paper and the electronic data CD.

7.3.2 Requirements of results archiving

The results should be filed in accordance with the relevant regulations of chapter 10 of T/CAOE 20.1-2020.

Annex A
(annex normative)

Classification of remote sensing identification objects of coastal ecosystem

Table A.1 shows the classification of remote sensing identification objects of coastal ecosystem.

Table A.1 — Classification of remote sensing identification objects table of coastal ecosystem

Classification		Object Description
Code	Name	
101	Mangrove	Woody plant communities distributed in the intertidal zone of tropical and subtropical regions.
102	Bedrock beach	More than 75% of the bottom matrix is rock and gravel, including rocky coastal islands and sea rock cliffs
103	Sandy Coast	A loose beach composed of sand or gravel with vegetation coverage less than 30%.
104	Muddy Beach	A muddy beach composed of silt with vegetation coverage less than 30%.
105	Salt marsh	Wetlands with a lot of salt. Seashore salt marshes are distributed in estuaries or shoals, and are formed by seawater immersion or tidal alternation, the vegetation coverage $\geq 30\%$, Vegetation type <i>Phragmites australis</i> (code: 105-1), <i>Suaeda salsa</i> (code: 105-2), <i>Spartina</i> (code: 105-3), <i>Tamarix</i> (code: 105-4) and others (code: 105-5)

Annex B
(annex normative)

Remote sensing interpretation mark table of coastal ecosystem

Table B.1 shows the remote sensing interpretation signs table of the coastal ecosystem.

Table B.1 — Remote sensing interpretation mark table of coastal ecosystem

Ecosystem types	Image	Description of mark						Example of mark	
		Color or hue	Shape	Texture	Structure	Geographical area description	Other	Sign image	Site photos
	Including type, imaging time, season, resolution, etc.						Remarks on the synthetic band (RGB)		

Annex C
(annex normative)

Attribute information table for remote sensing interpretation of coastal ecosystem

Table C.1 shows the attribute information table of the remote sensing interpretation of habitat distribution map delineation for coastal ecosystem.

Table C.2 shows the attribute information table of inconsistencies between remote sensing interpretation and historical distribution of coastal ecosystem patches.

Table C.1 — Attribute information table of the remote sensing interpretation of habitat distribution map delineation of coastal ecosystem

Map delineation Serial number ^a	Geographical description			Administrative area code ^b	Ecosystem type		Coordinate (Degree) ^c		Area (ha)	Shoreline type	Image date (yyyymmdd)	Name of the original image file	Identification department	Identification people	Identification date	Other instructions	
	Province	City	County (District)		Code	Name	Longitude	Latitude									
					101	Mangrove											Located in estuary/bay (name), plantation/natural forest

^a Map delineation number: Within the county (district) level administrative area, the map delineation number shall be numbered from left to right and from top to bottom by "1". The number of each map delineation shall be unique.

^b The administrative area code appear here and hereafter shall be filled in according to the latest regulations of the Ministry of Civil Affairs, PRC.

^c The coordinates appear here and hereafter are the central latitude and longitude of the plot, with 6 decimal places reserved.

Table C.2 — Attribute information table of inconsistencies between remote sensing interpretation and historical distribution of coastal ecosystem patches

Map delineation Serial number	Geographical description			Administrative area code	Ecosystem type		Coordinate (Degree)		Area (ha)	Image date (yyyymmdd)	Name of the original image file	Historical distribution		Identification department	Identification people	Identification date	Description of change
	Province	City	County (district)		Code	Name	Longitude	Latitude				Ecosystem type	Area				
					101	Mangrove											Trends in area change (amount of increase/decrease), historical sources

^a The map delineation number is consistent with that in Table C.1.

Annex D
(annex normative)

The summary table of the current distribution area of coastal ecosystem

Table D.1 shows the summary table of the current distribution area of the coastal ecosystem.

Table D.1 the summary table of the current distribution area of the coastal ecosystem

Area unit: ha

Administrative areas			Administ rative area code	Total	Among them											
Province	Cit y	County (distric t)			Mangrove area	Bedrock beach area	Sandy coast area	Muddy beach area	Salt marshes							
									Salt marsh area	Tamarix chinensi s area	Reed area	Spartina grass area	The alkaline area	Other types of area	Normalized differential vegetation index (NDVI)	

Completed by

Date of completion:

Inspector:

Date of inspection:

Annex E (annex normative)

The table of habitat distribution map delineation verification for coastal ecosystem

Table E.1 shows the table of habitat distribution map delineation verification for coastal ecosystem.

Table E.1 the table of habitat distribution map delineation verification for coastal ecosystem

Map delineation Serial number ^a	Geographical description			Administrative area code	Ecosystem type		Coordinate (Degree)		Area (ha)	Shoreline type	Verification basis	Verification department	Verification people	Verification date	The verification results	The result shows that
	Province	City	County (District)		Code	Name	X	Y								
					101	Mangrove					Video information/historical survey information, etc.				Accurate/inaccurate/wrong	Point out the cause of inaccuracy/error and propose rectification requirements; Salt marsh ecosystems require description of vegetation types

*The map delineation number in figure is consistent with that in Annex C (Attribute Information Table of remote sensing interpretation of coastal ecosystem).

Annex F
(annex normative)
The on-site verification record of coastal ecosystem

Table F.1 shows the on-site verification record of coastal ecosystem.

Table F.1 the on-site verification record of coastal ecosystem

Map delineation Serial number ^a		Location	
Indoor interpretation results ^b			
Ecosystem type			
The use of the sea around the present situation			
Verification time		Scene photo/video number ^c	
Verification equipment (model + Verification information)			
Boundary inflection point coordinates (degree) ^d			
Ecosystem map area		The verification results	Accurate/inaccurate /wrong
Ecosystem distribution			
On-site inspector		The reviewer	
^a The map delineation number in figure F is consistent with that in Annex C (Attribute Information Table of remote sensing interpretation of coastal ecosystem). ^b Indoor interpretation results including the areas and ecosystem types of the patches of the coastal ecosystem habitat distribution map obtained by remote sensing interpretation ^c The photo/video number shall be the same as the map delineation number and be submitted together with the record form in the same electronic folder. ^d Boundary inflection point is the coordinate information of boundary inflection point of coastal ecosystem habitat distribution map delineation.			

Annex G
(annex normative)
Requirements for thematic map production

G. 1 Title

The font should be bold and the style should be "Area name + Ecosystem name + Remote sensing recognition distribution map".

G. 2 Graticule

The font of longitude and latitude note should be Times New Roman. The left and right longitude and latitude of the figure should be displayed vertically and set not to display the latitude and longitude lines.

G. 3 Compass

The compass should be in the upper left corner of the image. The ESRI North 1 style should be adopted and it should be black.

G. 4 Scale

A Scale is right below the middle of a map. Use Alternating Scale Bar1. The unit should be km.

G. 5 Legend

The caption should be in Song typeface. The color of the legend should be strictly consistent with the symbol of the main picture and generally placed in the lower right part of the picture. The schematics and symbols shall be executed in accordance with the provisions of Chapters 4, 5 and 10 of GB/T 32067-2015.

Annex H (annex normative)

Report format and chapter contents of remote sensing identification report on coastal ecosystem distribution

H.1 Text specification

The outline size of the remote sensing identification report on the distribution of coastal ecosystem is A4 (210mm×297mm).

H.2 Cover format

The cover format of the remote sensing identification report on the distribution of coastal ecosystem is as follows:

The first line of writing: the name of the remote sensing identification area: XXXX area (No. 1 Song Style, bold, center);

The second line of writing: Remote sensing Identification report on the distribution of ecosystem in the coastal zone (No.1 Song Style, bold and centered);

The third line of sign-off writing: the full name of the compilation unit (No.3 Song Style, bold, in the middle);

The fourth line of writing: XX Month XXXX (small number 3 song Style, bold, center).

The spacing between the above rows should be appropriate to beautify the entire cover.

H.3 Contents of the report on remote sensing identification of coastal ecosystem distribution

The remote sensing identification report of coastal ecosystem distribution should include all or part of the chapters in Table H.1. According to the identification of regional coastal ecosystem types by remote sensing, the following chapters can be added or deleted appropriately, among which the key area is the concentrated distribution area of coastal ecosystem.

Table H.1 contents of remote sensing identification report on coastal ecosystem distribution

1. Overview
2. Data preparation and remote sensing identification
2.1 Identification range
2.2 Identification of Objects
2.3 Data preparation
2.4 Identification method
3. Analysis of remote sensing identification results of coastal ecosystem
3.1 Mangrove
3.1.1 Map delineation statistics
3.1.2 Area statistics
3.1.3 Comparison and analysis of map delineation history in key areas
3.2 Salt marsh
3.2.1 Map delineation statistics
3.2.2 Area statistics
3.2.3 Comparison and analysis of map delineation history in key areas
3.3 Sandy coast
3.3.1 Map delineation statistics
3.3.2 Area statistics
3.3.3 Comparison and analysis of map delineation history in key areas
3.4 Muddy beach
3.4.1 Map delineation statistics
3.4.2 Area statistics
3.4.3 Comparison and analysis of map delineation history in key areas

Table H.1 (*continued*)

3.5 Bedrock beach
3.5.1 Map delineation statistics
3.5.2 Area statistics
3.5.3 Comparison and analysis of map delineation history in key areas
4. On-site verification
4.1 Verification area
4.2 Verification method
4.3 Verification Conclusion
5. Distribution of coastal ecosystem
5.1 Current status of mangrove distribution
5.1.1 Distribution characteristics of sea area
5.1.2 Distribution characteristics of provinces and cities
5.1.3 Distribution characteristics of key areas
5.2 Salt marsh distribution status
5.2.1 Distribution characteristics of sea area
5.2.2 Distribution characteristics of provinces and cities
5.2.3 Distribution characteristics of key areas
5.3 Current distribution of sandy beach
5.3.1 Distribution characteristics of sea area
5.3.2 Distribution characteristics of provinces and cities
5.3.3 Distribution characteristics of key areas
5.4 Current distribution of silt beaches
5.4.1 Sea area distribution characteristics
5.4.2 Distribution characteristics of provinces and cities
5.4.3 Distribution characteristics of key areas
5.5 Current distribution of bedrock beaches
5.5.1 Distribution characteristics of sea area
5.5.2 Distribution characteristics of provinces and cities
5.5.3 Distribution characteristics of key areas
6. Conclusions and recommendations