

DO NOT PRINT THIS PAGE

Maro Reef

Approximately 1200 km WNW of Kaua'i and 1000 km ESE of Midway lies Maro Reef at longitude 170 degrees 35 minutes W and latitude 25 degrees 22 minutes N. Maro Reef is a shallow-water reef ecosystem approximately 50 km long and 30 km wide and covering an estimated 1,856 sq. km It is one of the most ecologically rich locales in the Northwestern Hawaiian Islands. Only one small rock outcrop of this former island reportedly extends above the ocean surface, and then only at very low tide.

Much of the reef habitat at Maro Reef is composed of a series of intricate reticulated (forming a network) reef crests and surrounding lagoons. Many areas of Maro Reef appear quite similar to Pearl and Hermes, including a few small micro atolls. This reef may have the most coral cover in the Northwestern Hawaiian Islands. The shallow reef areas consist of numerous patch reefs, submerged pinnacles and elongate reticulate reef complexes. Channels of deep water with highly irregular bottom topography lie between the shallow reef structures.

Maro Reef is essentially an open atoll that lacks the typical protective outer ring of islands and ocean reefs that enclose a typical atoll lagoon. The outermost reefs of Maro Reef function as a broken fore reef-reef crest complex, and absorb the energy of ocean swells that travel toward the inner "lagoon" region. The innermost area of the reef complex lies within boundaries of reticulated reefs and aggregated patch reefs and has all the characteristics of a true lagoon, with little or no influence from large ocean swell.

In 1928, a mapping survey was conducted at Maro Reef. That survey described the placement of a tower on an emergent shallow-water coral reef platform. A survey in 2001 failed to locate the 1928 tower, but it did find the possible remnants. Coral at Maro Reef could grow fast enough to disguise a human-made feature.

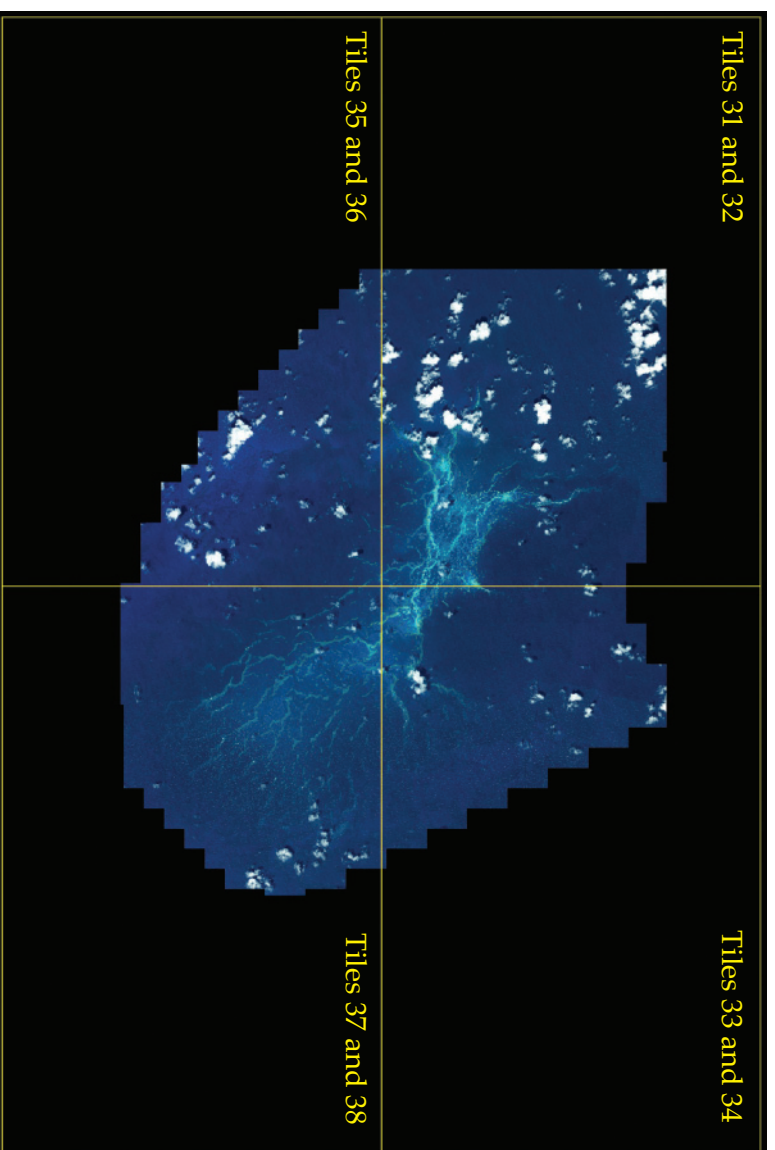
Due to its size, four map tiles are required to depict the 1:80,000 scale estimated bathymetry and aggregated habitat cover maps. Nine map tiles are required to depict the 1:40,000 scale detailed benthic habitats of Maro Reef. Two 1:175,000 scale map tiles are included to depict the extensive shallow-water bank area around Maro Reef. A one-square-kilometer grid is included with all maps of Maro Reef.

The area in square kilometers of aggregated benthic habitat cover types found at Maro Reef, Northwestern Hawaiian Islands.

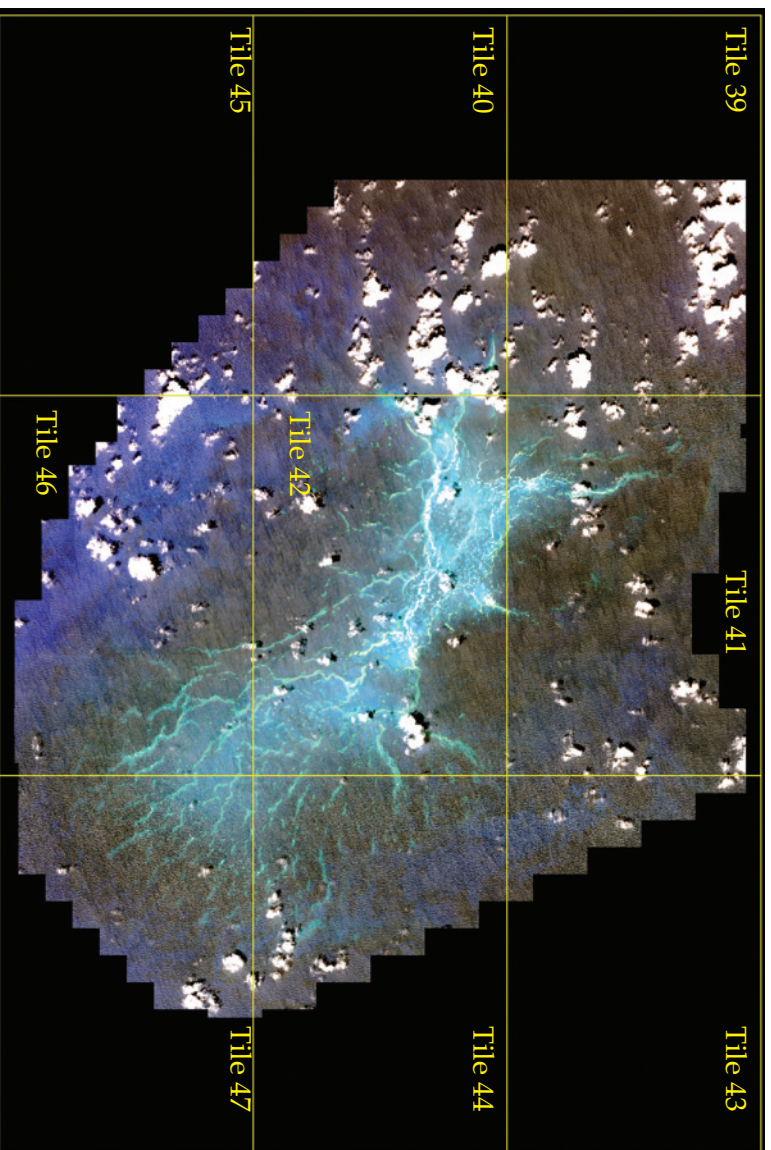
Hardbottom with >10% live coral	14.8
Hardbottom with >10% crustose coralline algae	1.3
Hardbottom (uncolonized)	6.8
Hardbottom with >10% macroalgae	0.4
Hardbottom with indeterminate cover	180.1
Unconsolidated with 10% or less macroalgae or seagrass	295.7
Unconsolidated with >10% macroalgae or seagrass	19.6
Total Habitat Area Classified	518.7

The area in square kilometers of benthic habitats found at Maro Reef, Northwestern Hawaiian Islands.

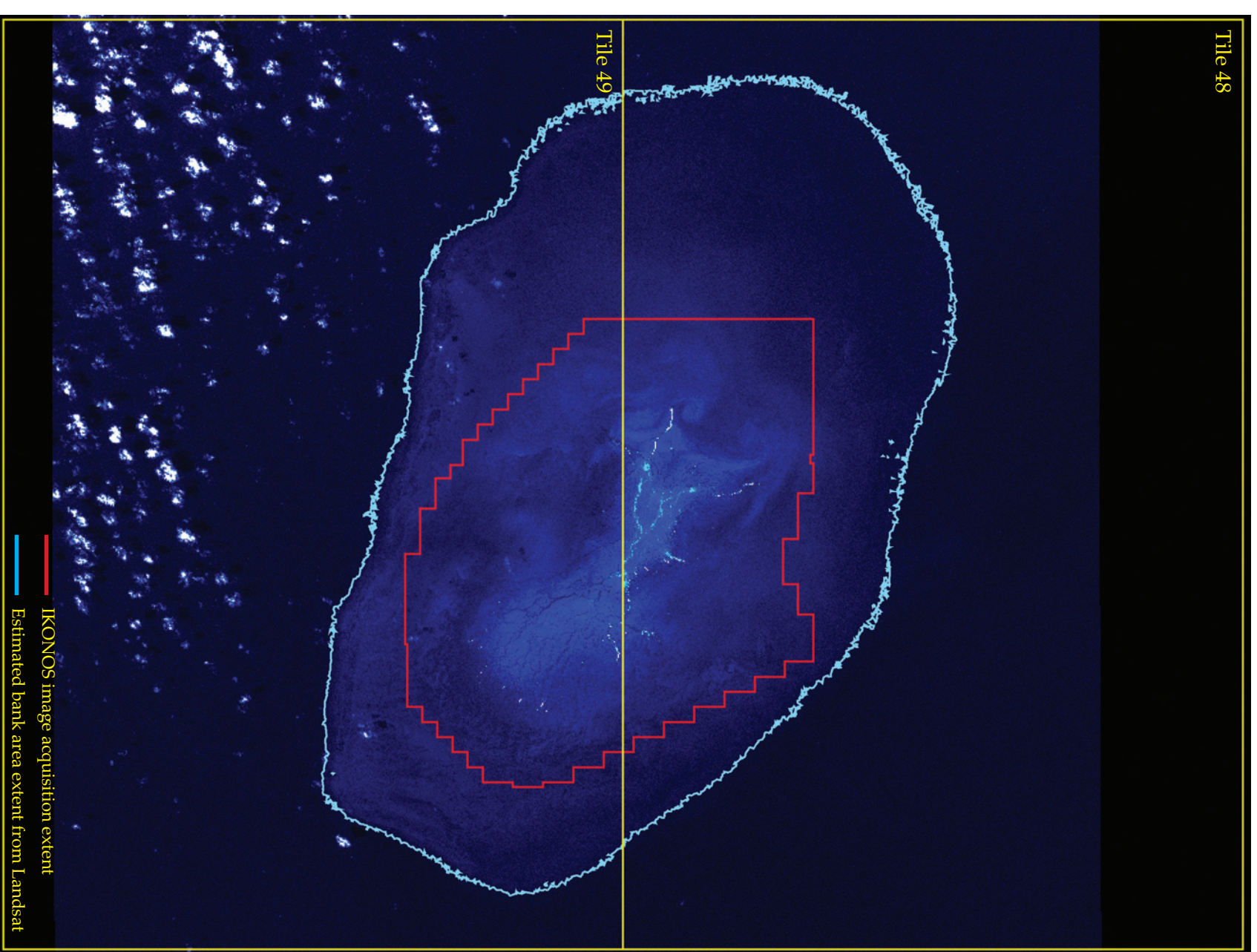
Unconsolidated (1000), refer to classification scheme for habitat description)	245.4
Sand (1100)	43.4
Sand with macroalgae (1120)	-
Sand with patchy (10-50% cover) (1121)	-
Sand with dense (>50% cover) macroalgae (1122)	-
Unconsolidated Rubble (1300)	6.9
Unconsolidated Rubble with sparse (10-50% cover) algae (1301)	19.6
Unconsolidated Rubble with dense (>50% cover) algae (1302)	-
Sand and Rubble (1400)	-
Groove (1500)	-
Hardbottom (2000)	176.4
Hardbottom with sparse (10-50% cover) algae (2001)	-
Hardbottom with live coral (>10% cover) (2010)	1.0
Hardbottom, uncolonized (2020)	<0.1
Hardbottom with crustose coralline algae (>10% cover) (2030)	<0.1
Linear Reef (2100)	0.1
Linear Reef with live coral (>10% cover) (2110)	10.5
Linear Reef, uncolonized (2120)	1.6
Linear Reef, uncolonized with sparse (10-50% cover) algae (2121)	0.2
Linear Reef with crustose coralline algae (>10% cover) (2130)	0.2
Aggregated Coral Heads with live coral (>10% cover) (2210)	-
Spur and Groove (2300)	-
Patch Reef (2400)	3.4
Patch Reef with live coral (>10% cover) (2410)	3.4
Patch Reef, uncolonized (2420)	5.2
Patch Reef, uncolonized with sparse (10-50% cover) algae (2421)	0.2
Patch Reef with crustose coralline algae (>10% cover) (2430)	0.1
Aggregated Patch Reef (2500)	-
Aggregated Patch Reef with live coral (>10% cover) (2510)	-
Scattered Coral/Rock in Sand with live coral (>10% cover) (2610)	-
Pavement (2700)	0.2
Pavement with sparse (10-50% cover) algae (2701)	-
Pavement with dense (>50% cover) algae (2702)	-
Pavement with live coral (>10% cover) (2710)	-
Pavement with live coral (>10% cover) with dense (>50% cover) algae (2712)	-
Pavement, uncolonized (2720)	-
Pavement, uncolonized with dense (>50% cover) algae (2722)	-
Pavement with crustose coralline algae (>10% cover) (2730)	-
Pavement with sand channels (2800)	-
Pavement with sand channels and live coral (>10% cover) (2810)	-
Pavement with sand channels, uncolonized (2820)	-
Volcanic Rock (2900)	-
Volcanic Rock with dense (>50% cover) algae (2902)	-
Volcanic Rock with live coral (>10% cover) (2910)	-
Volcanic Rock, uncolonized (2920)	-
Deep water (3010)	100.4
Reef crest (3020)	-
Dredged channel (3030)	-
Land (3100)	-
Cloud, Shadow, Surf, and No image data (3210, 3220, 3230, and 4000)	60.4
Unclassified (3300)	0.1
Total Habitat Area Classified	518.7
TOTAL Area in IKONOS image	679.6



Index of 1:80,000 tiles



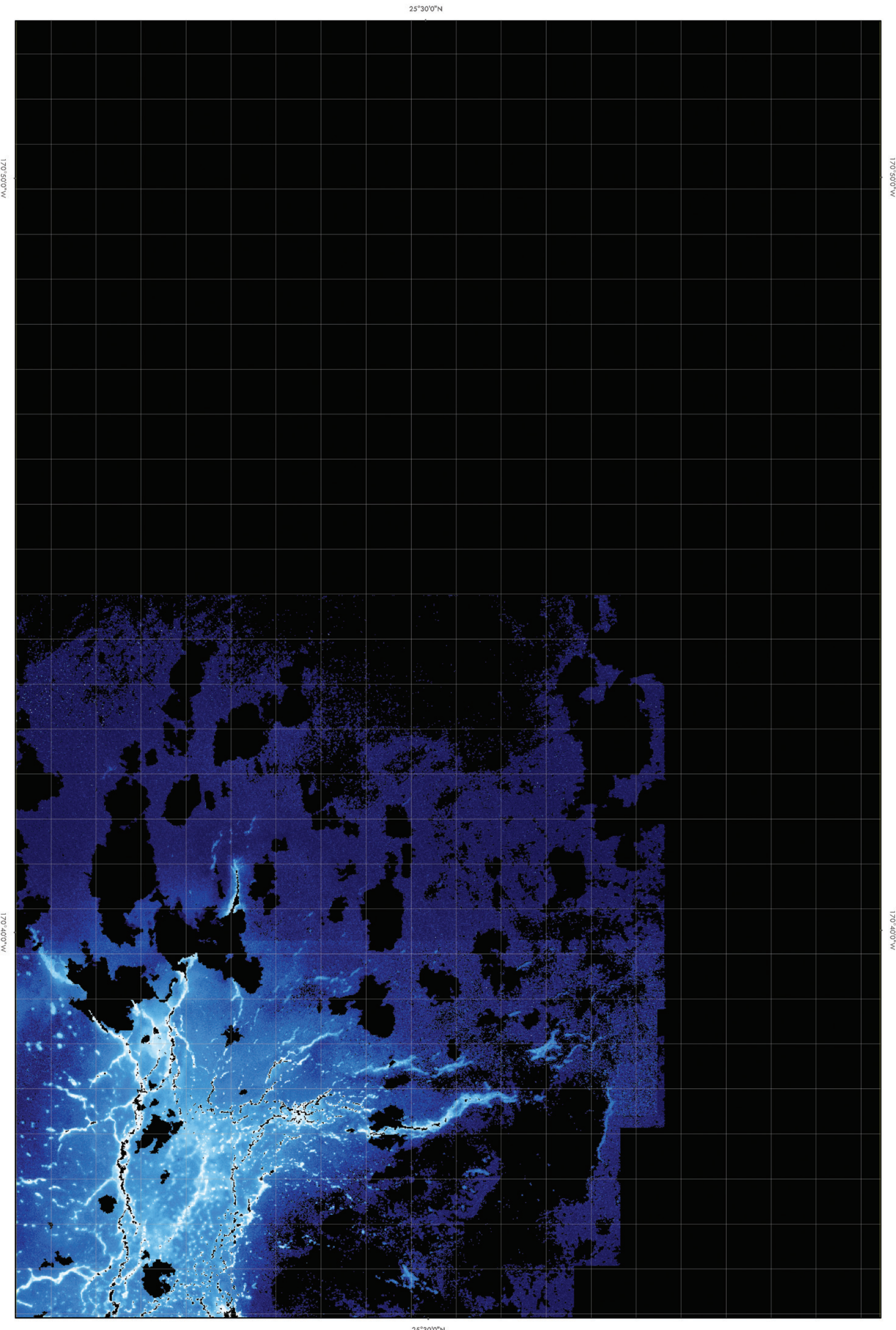
Index of 1:40,000 tiles



Index of 1:175,000 tiles

Index maps indicating the locations of map tiles for the 1:40,000 scale detailed habitat maps, the 1:80,000 scale aggregated cover and estimated bathymetry, and the 1:175,000 scale bank of Maro Reef, Northwestern Hawaiian Islands.

Tile 31. A 1:80,000 scale estimated bathymetry map of the northwest portion of Maro Reef, Northwestern Hawaiian Islands.



25°30'0"N

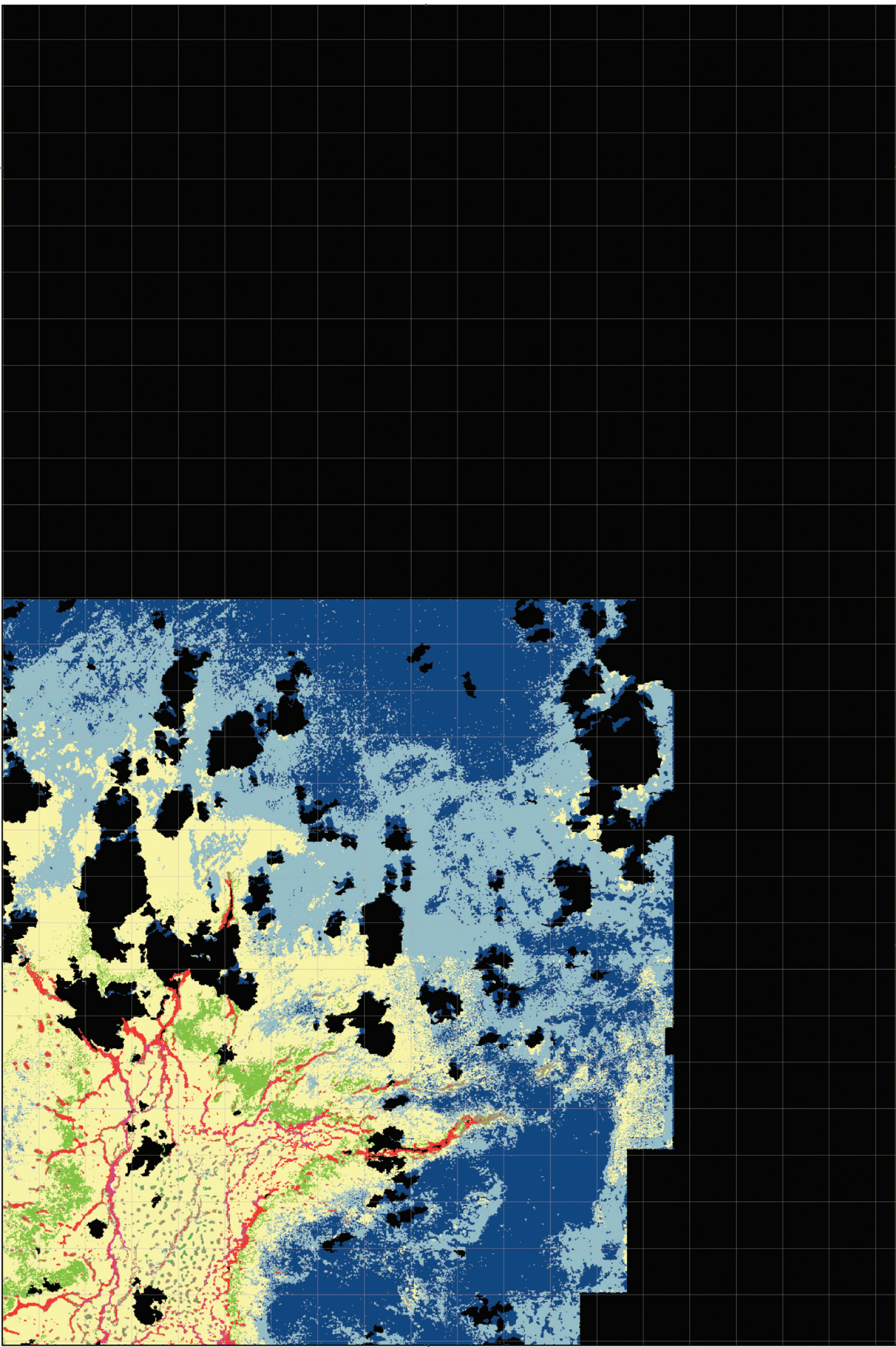
170°50'0"W

170°40'0"W

25°30'0"N

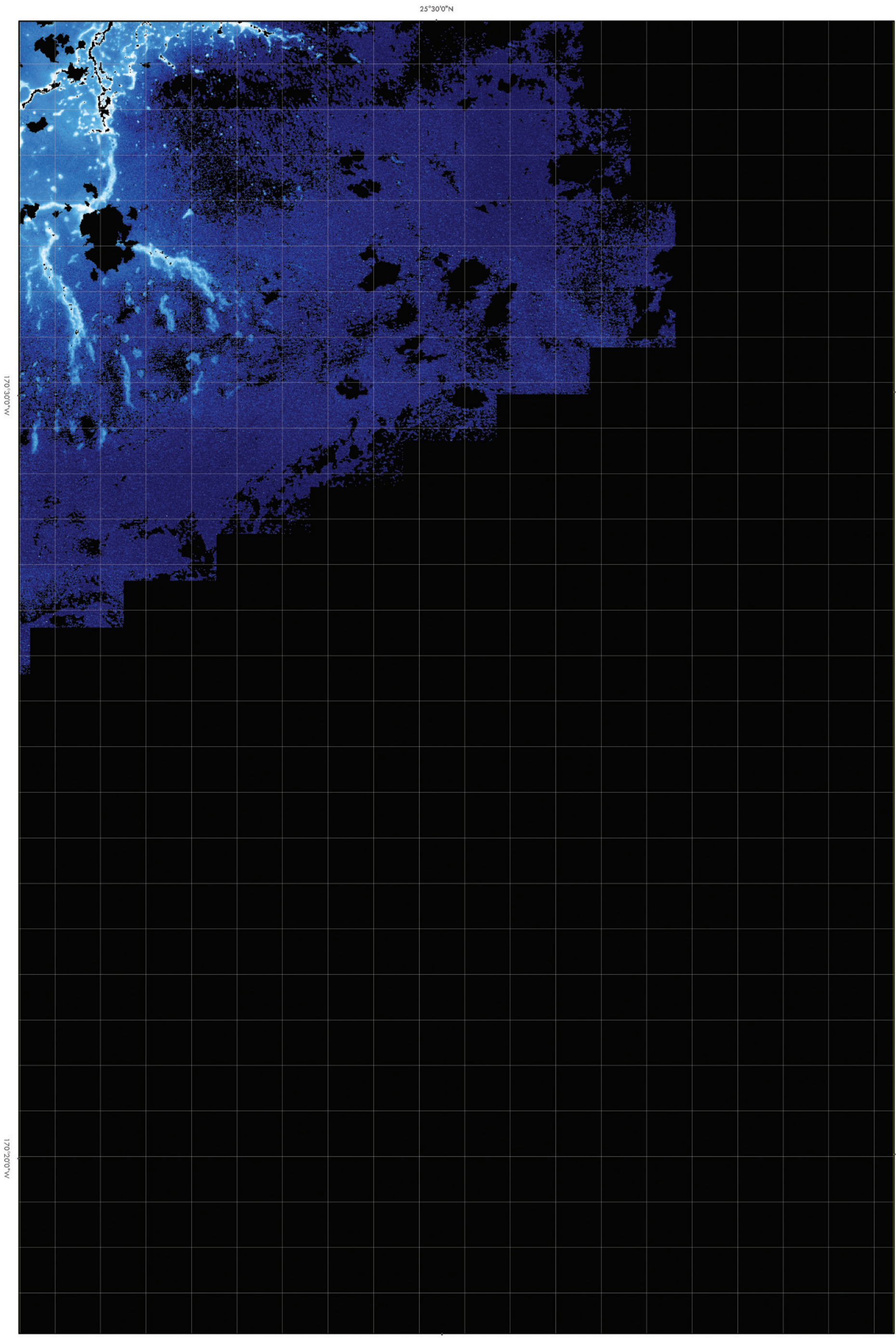
170°50'0"W

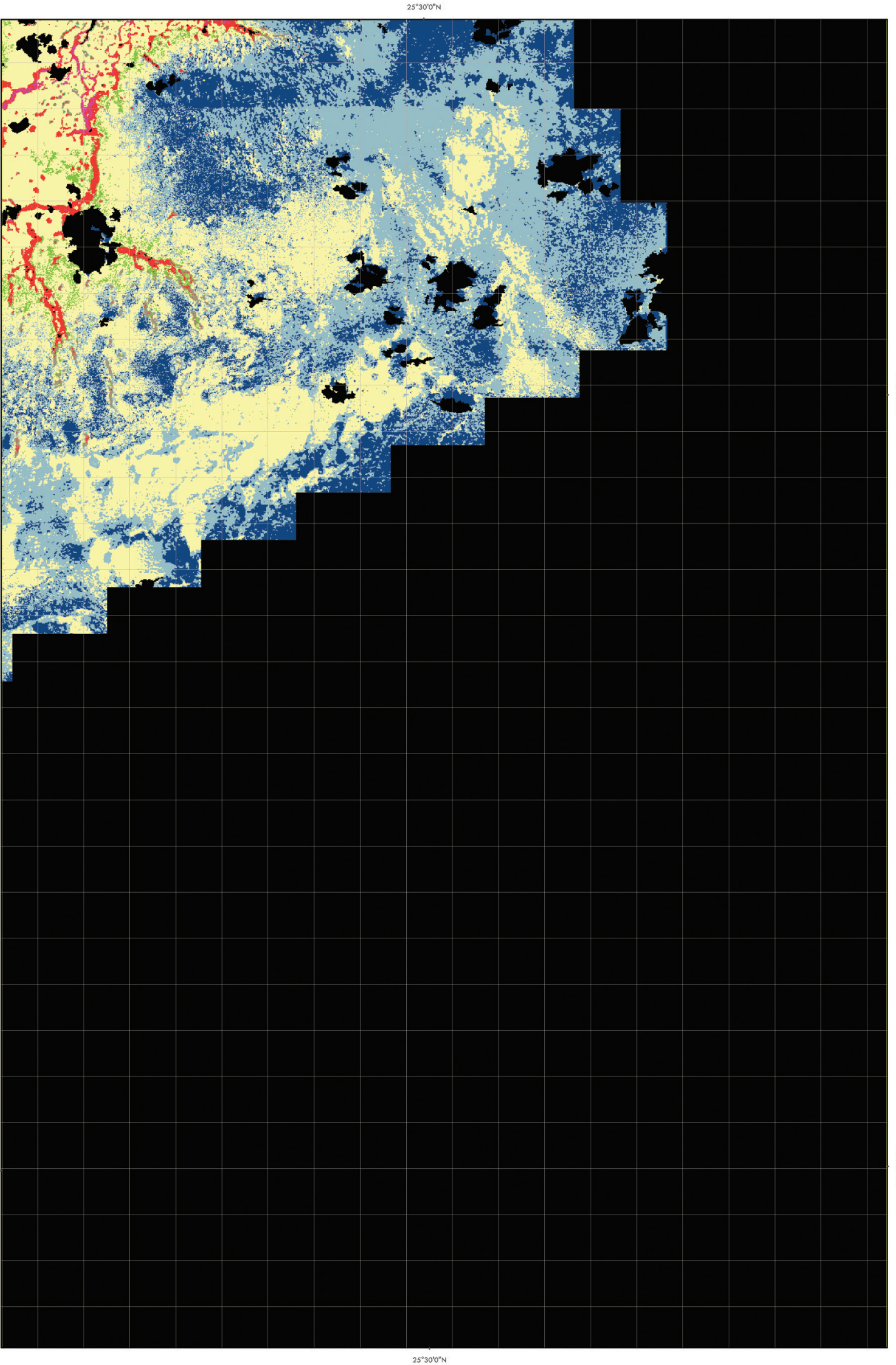
170°40'0"W



Title 32. A 1:80,000 scale aggregated cover map of the northwest portion of Maro Reef, Northwestern Hawaiian Islands.

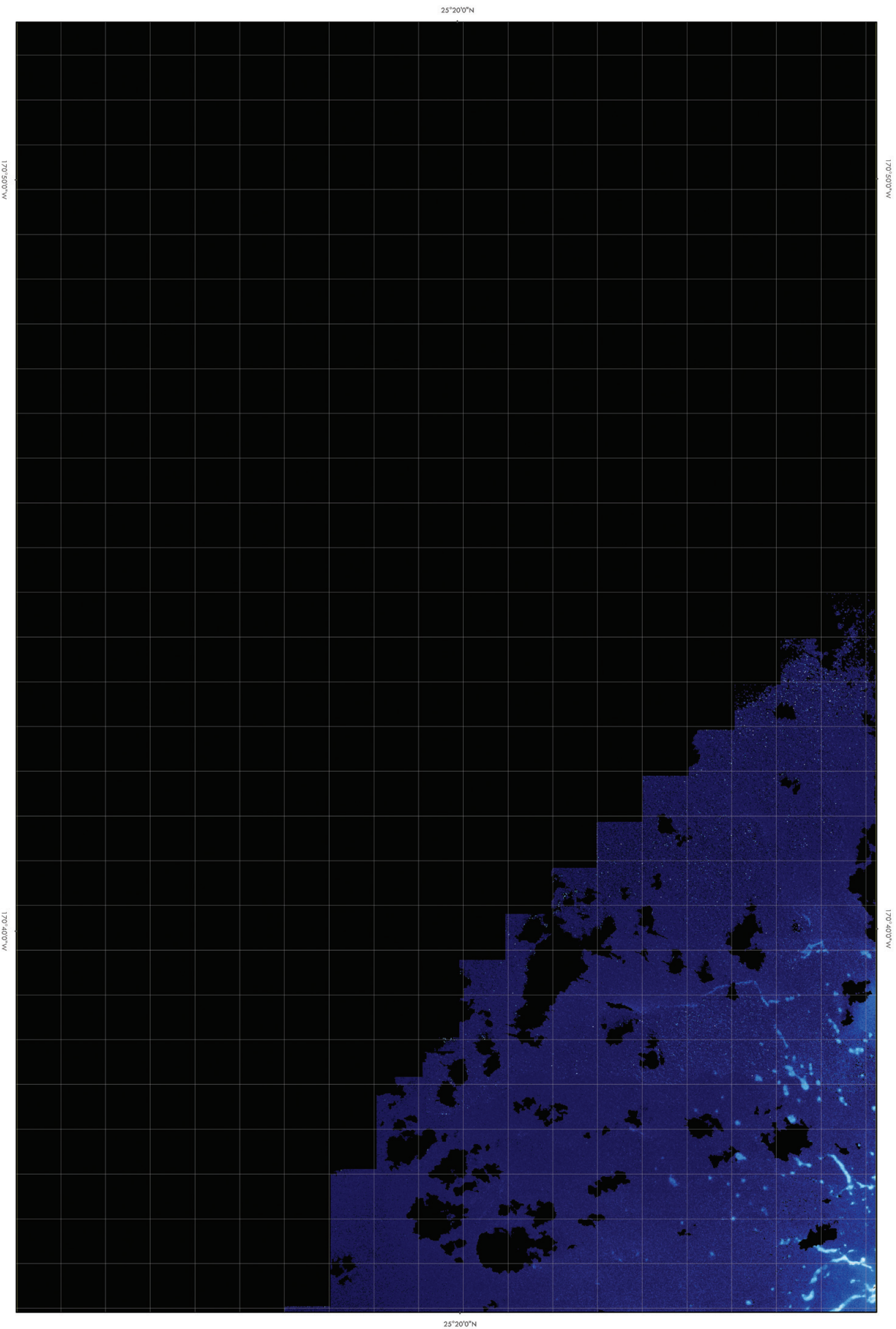
Tile 33. A 1:80,000 scale estimated bathymetry map of the northeast portion of Maro Reef, Northwestern Hawaiian Islands.

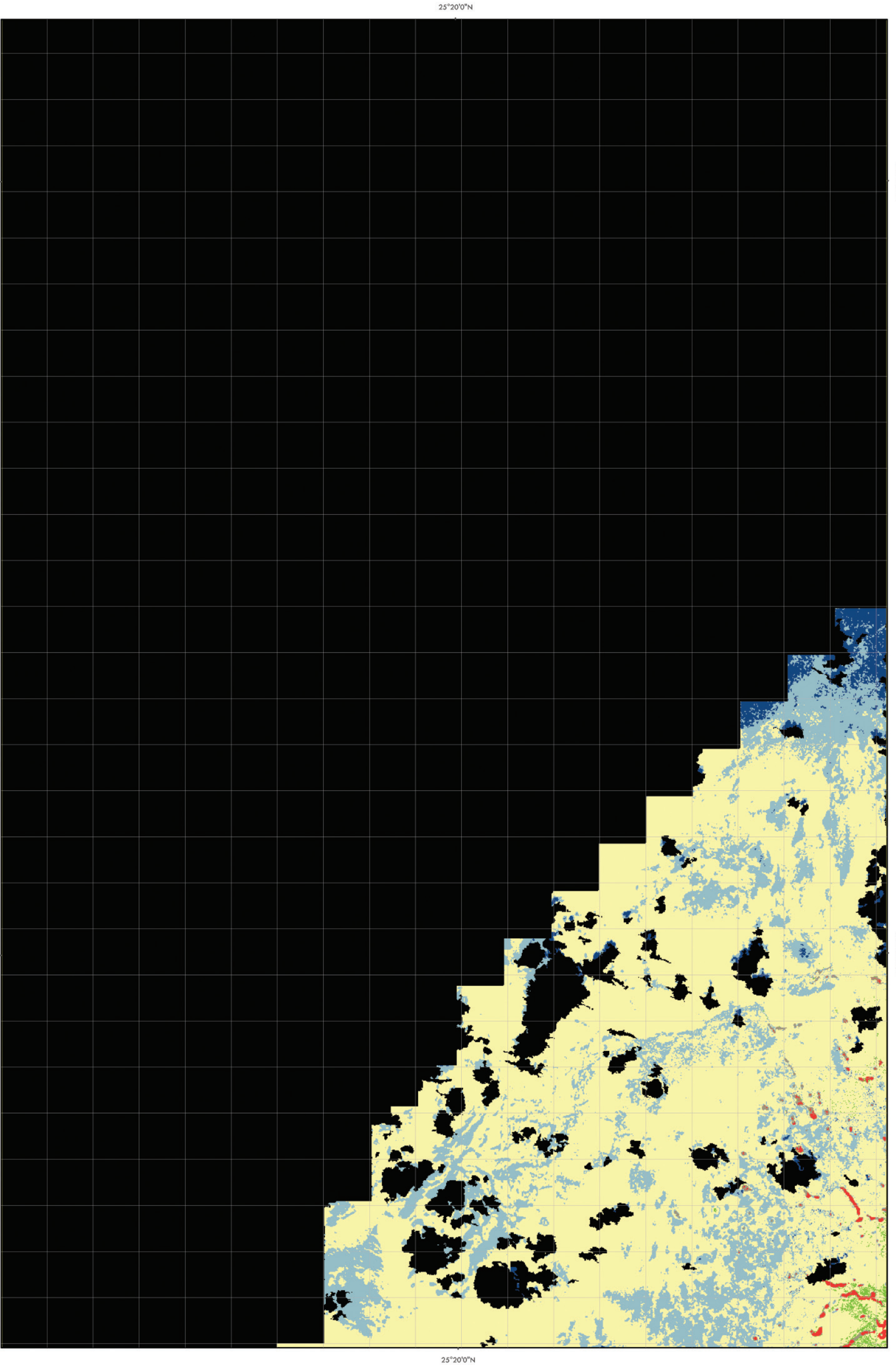




Tile 34. A 1:80,000 scale aggregated cover map of the northeast portion of Maro Reef, Northwestern Hawaiian Islands.

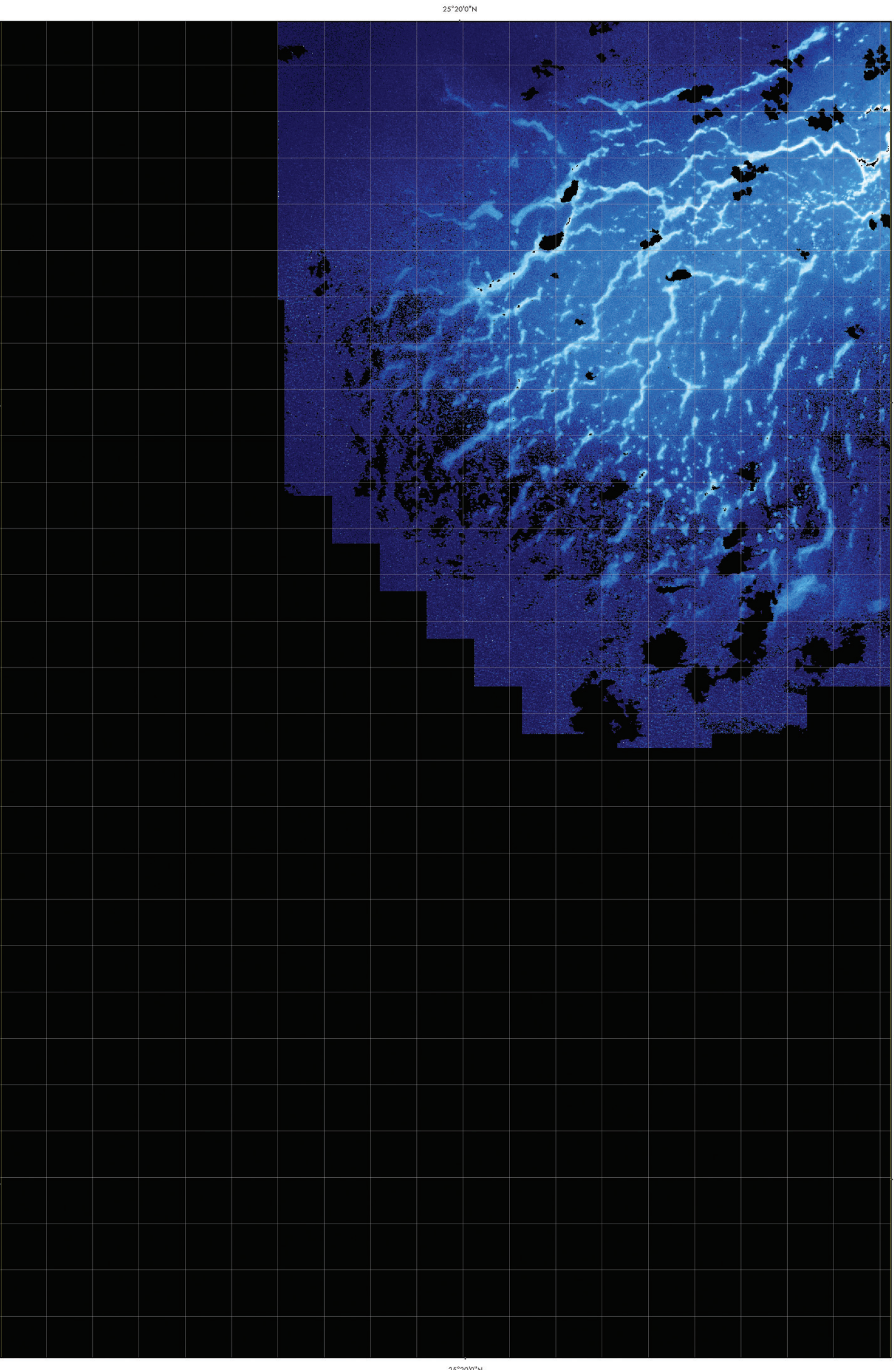
Tile 35. A 1:80,000 scale estimated bathymetry map of the southwest portion of Maro Reef, Northwestern Hawaiian Islands.

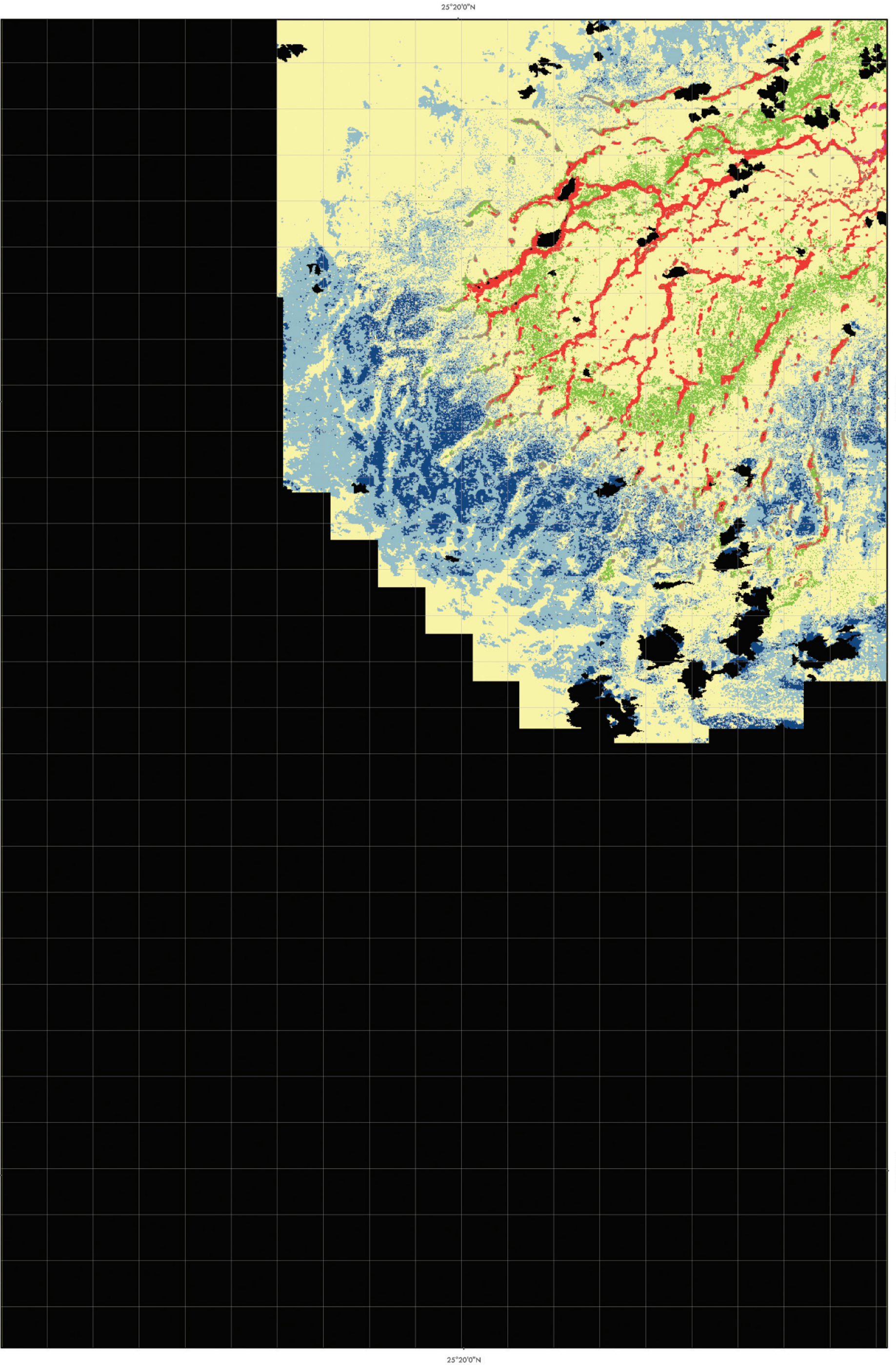




Tile 36. A 1:80,000 scale aggregated cover map of the southwest portion of Maro Reef, Northwestern Hawaiian Islands.

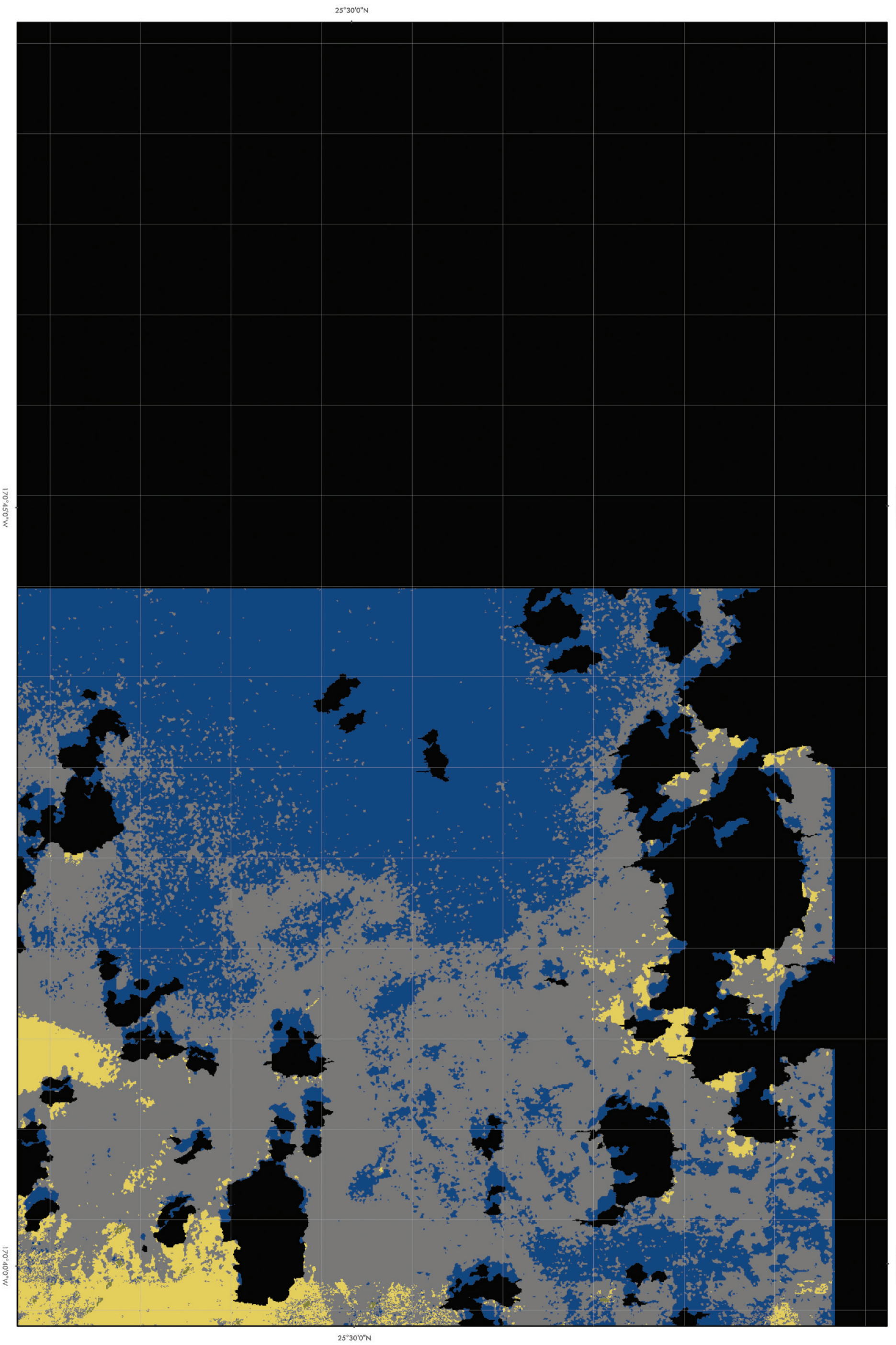
Tile 37. A 1:80,000 scale estimated bathymetry map of the southeast portion of Maro Reef, Northwestern Hawaiian Islands.





Tile 38. A 1:80,000 scale aggregated cover map of the southeast portion of Maro Reef, Northwestern Hawaiian Islands.

Tile 39. A 1:40,000 scale detailed habitat map of the northwest portion of Maro Reef, Northwestern Hawaiian Islands.



25°30'0"N

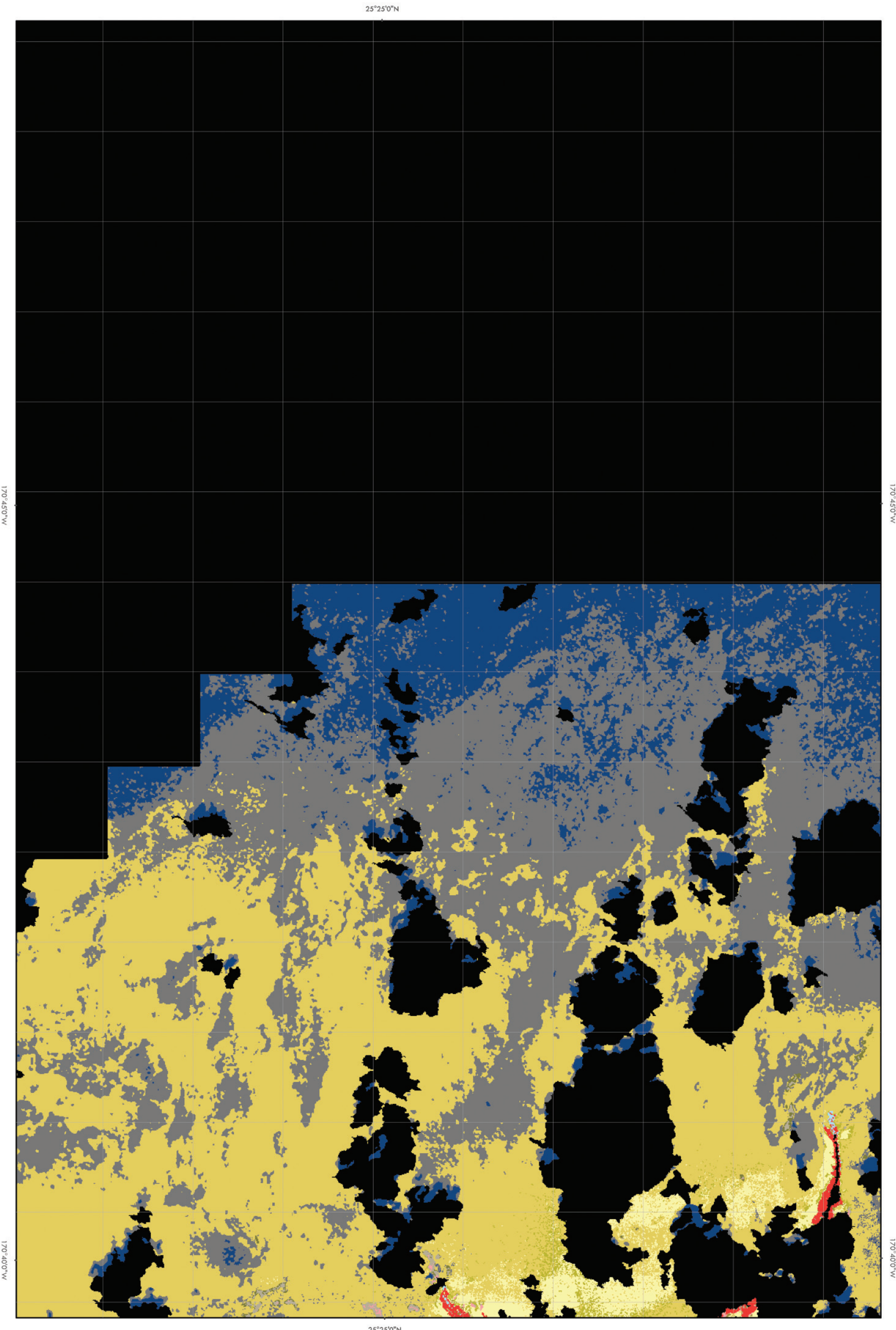
170°45'0"W

170°45'0"W

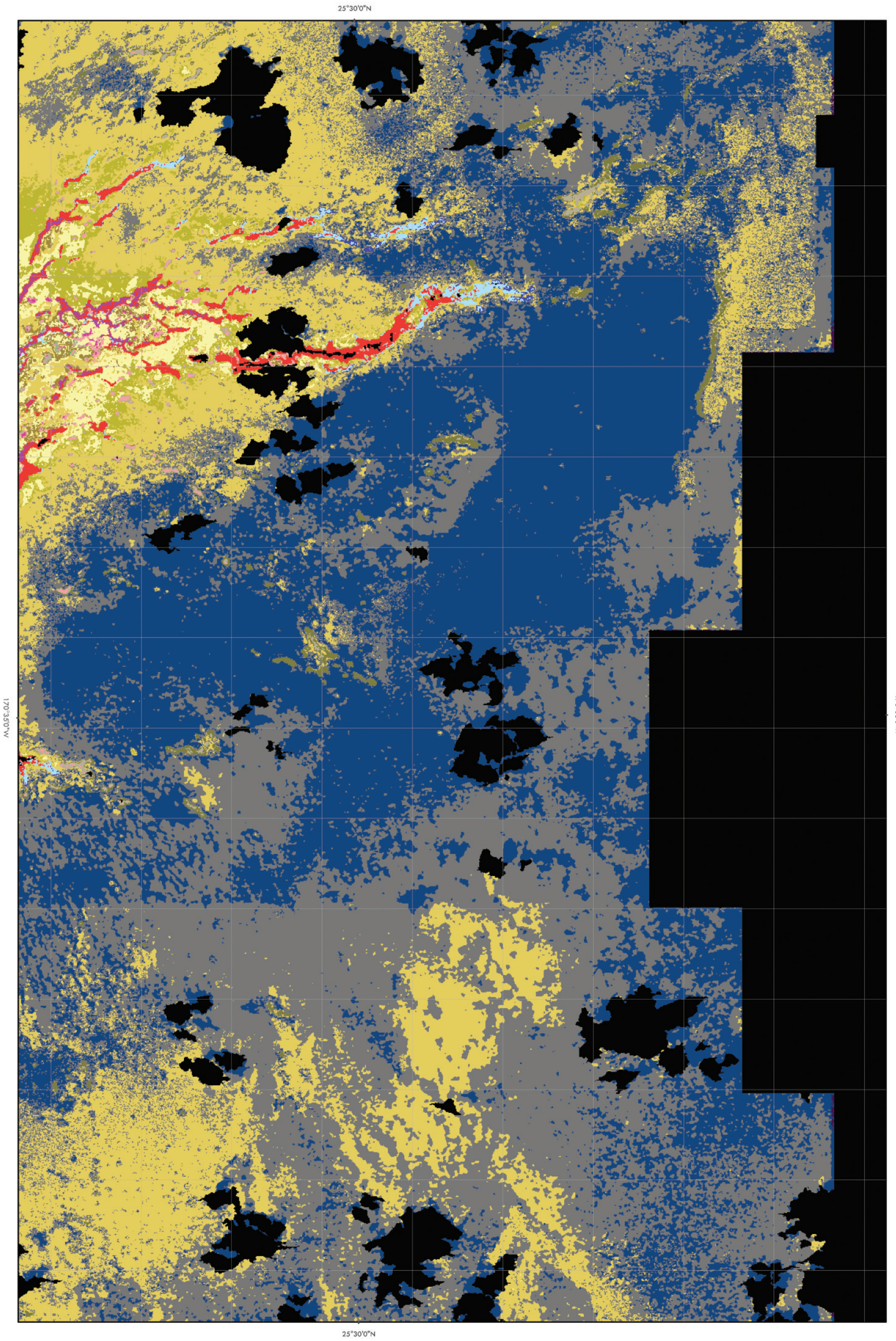
170°40'0"W

25°30'0"N

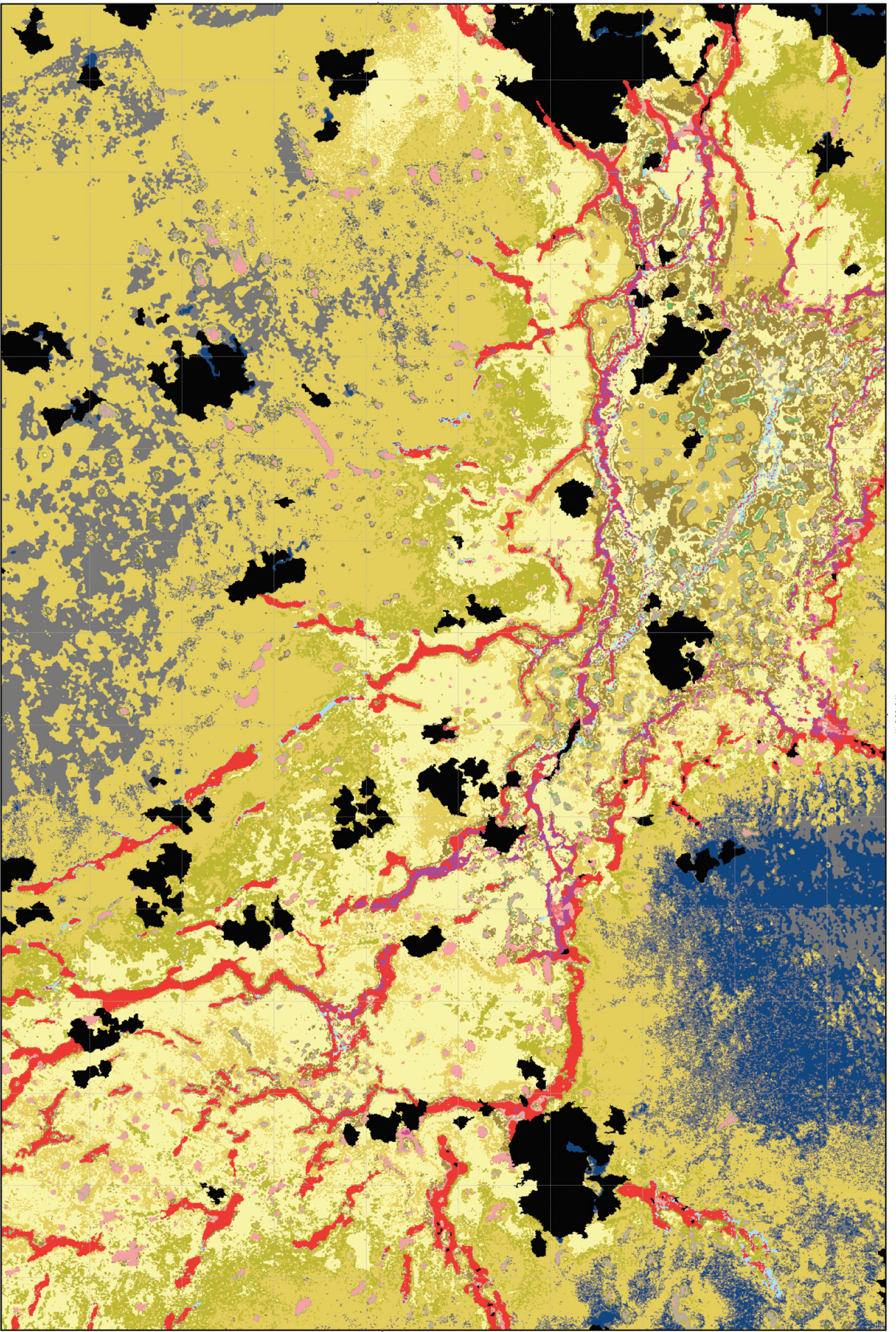
Title 40. A 1:40,000 scale detailed habitat map of the west central portion of Maro Reef, Northwestern Hawaiian Islands.



Tile 41. A 1:40,000 scale detailed habitat map of the north central portion of Maro Reef, Northwestern Hawaiian Islands.



25°25'0"N

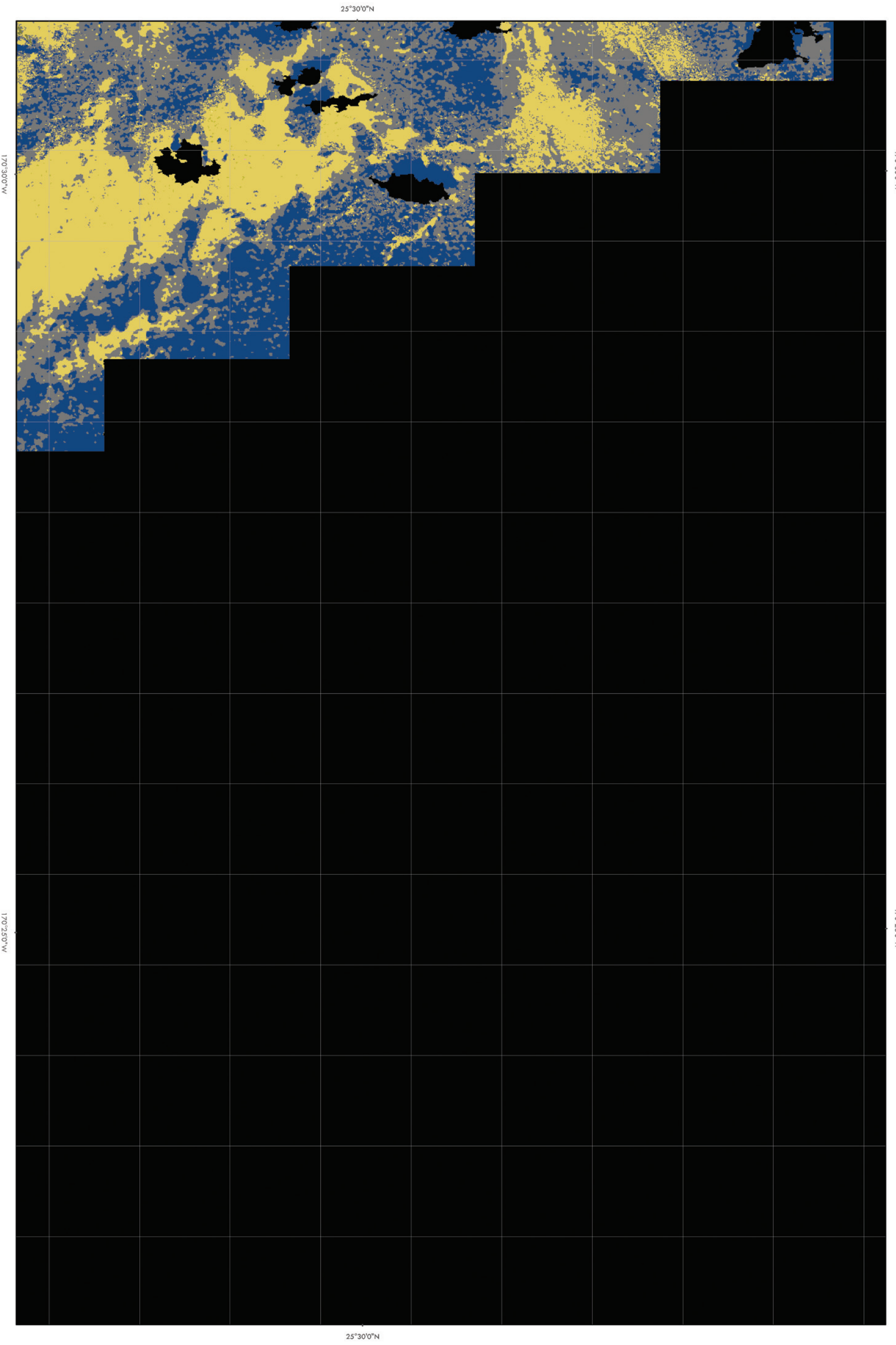


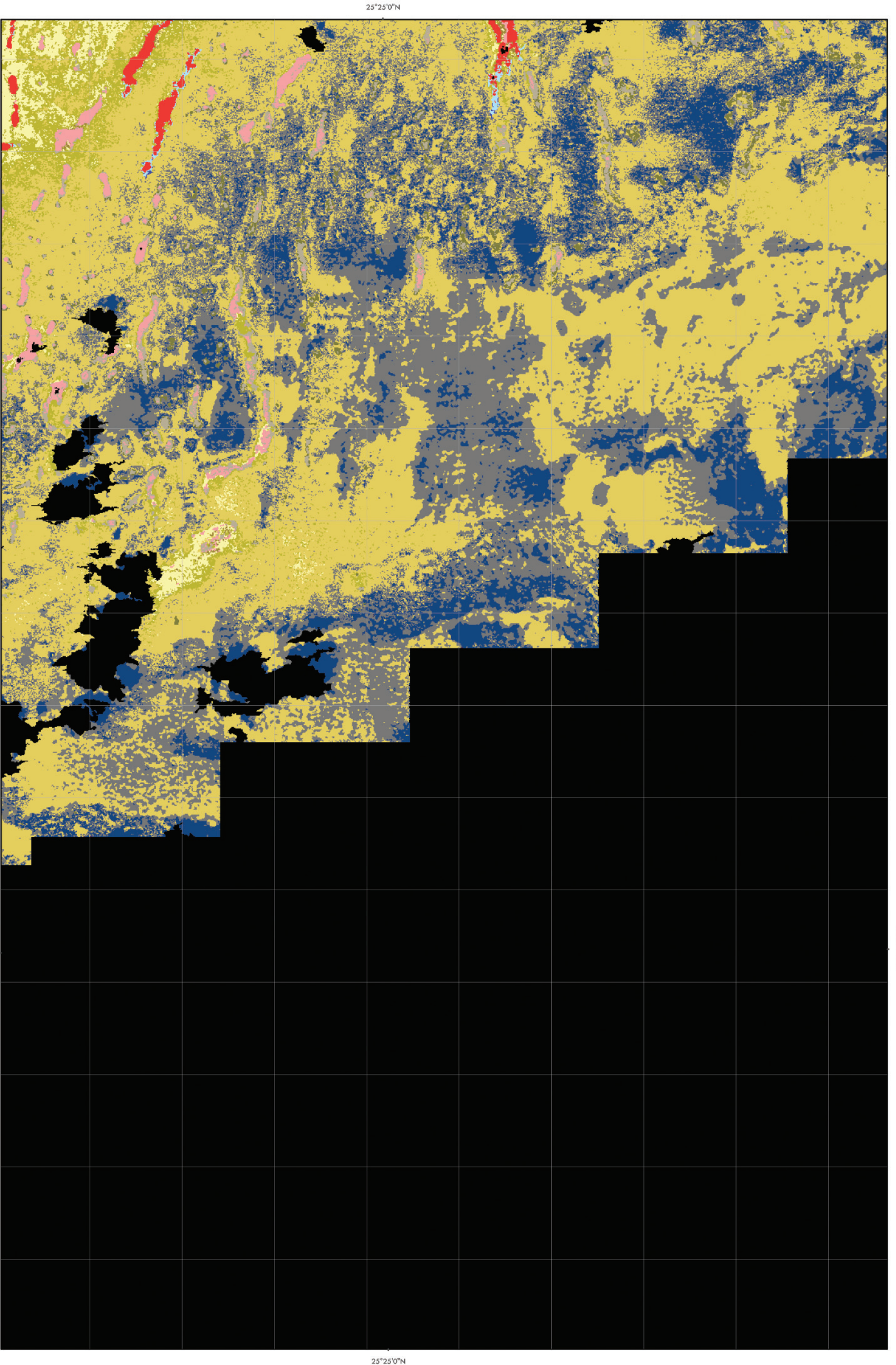
170°35'0"W

25°25'0"N

Title 42. A 1:40,000 scale detailed habitat map of the central portion of Maro Reef, Northwestern Hawaiian Islands.

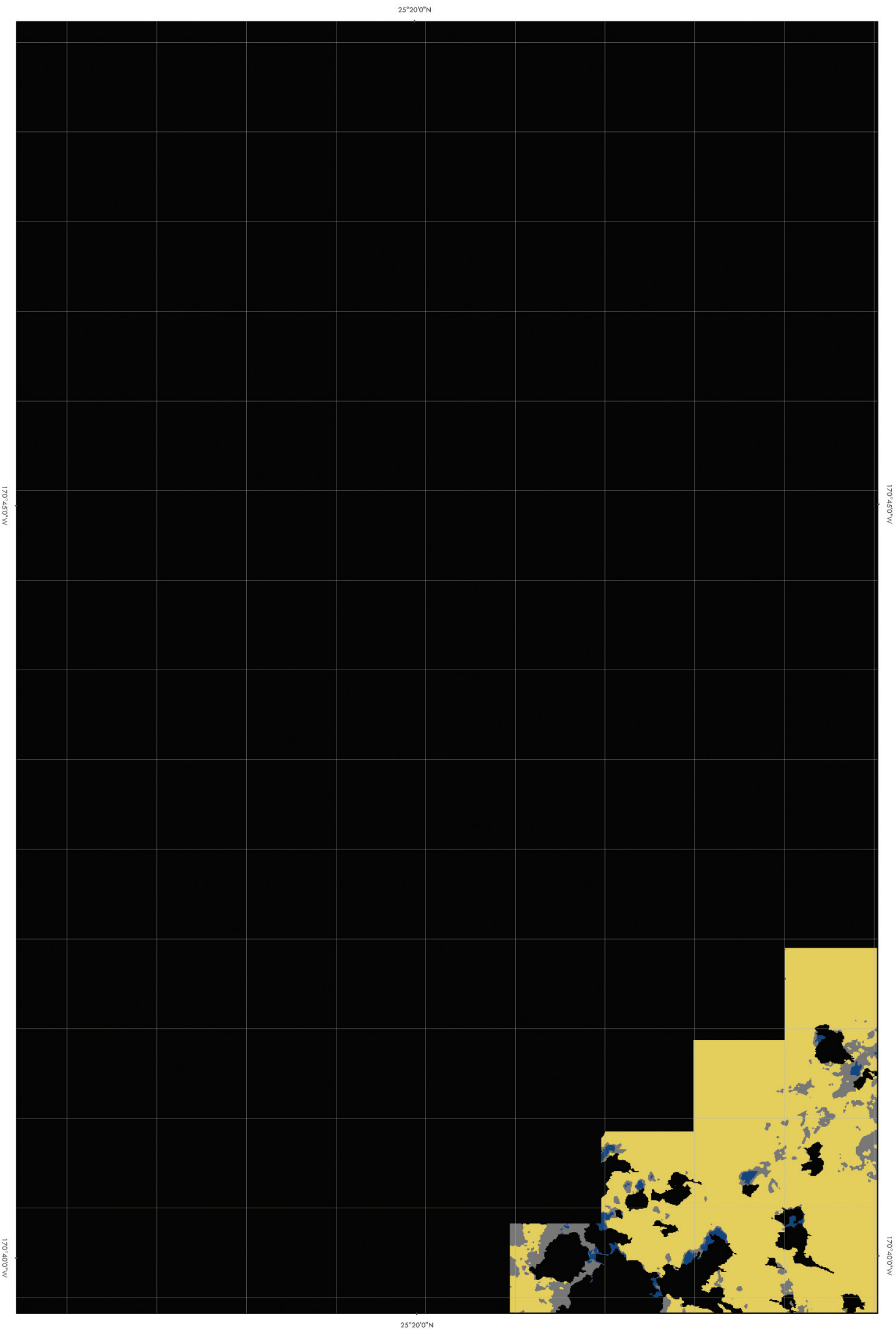
Tile 43. A 1:40,000 scale detailed habitat map of the northeast portion of Maro Reef, Northwestern Hawaiian Islands.





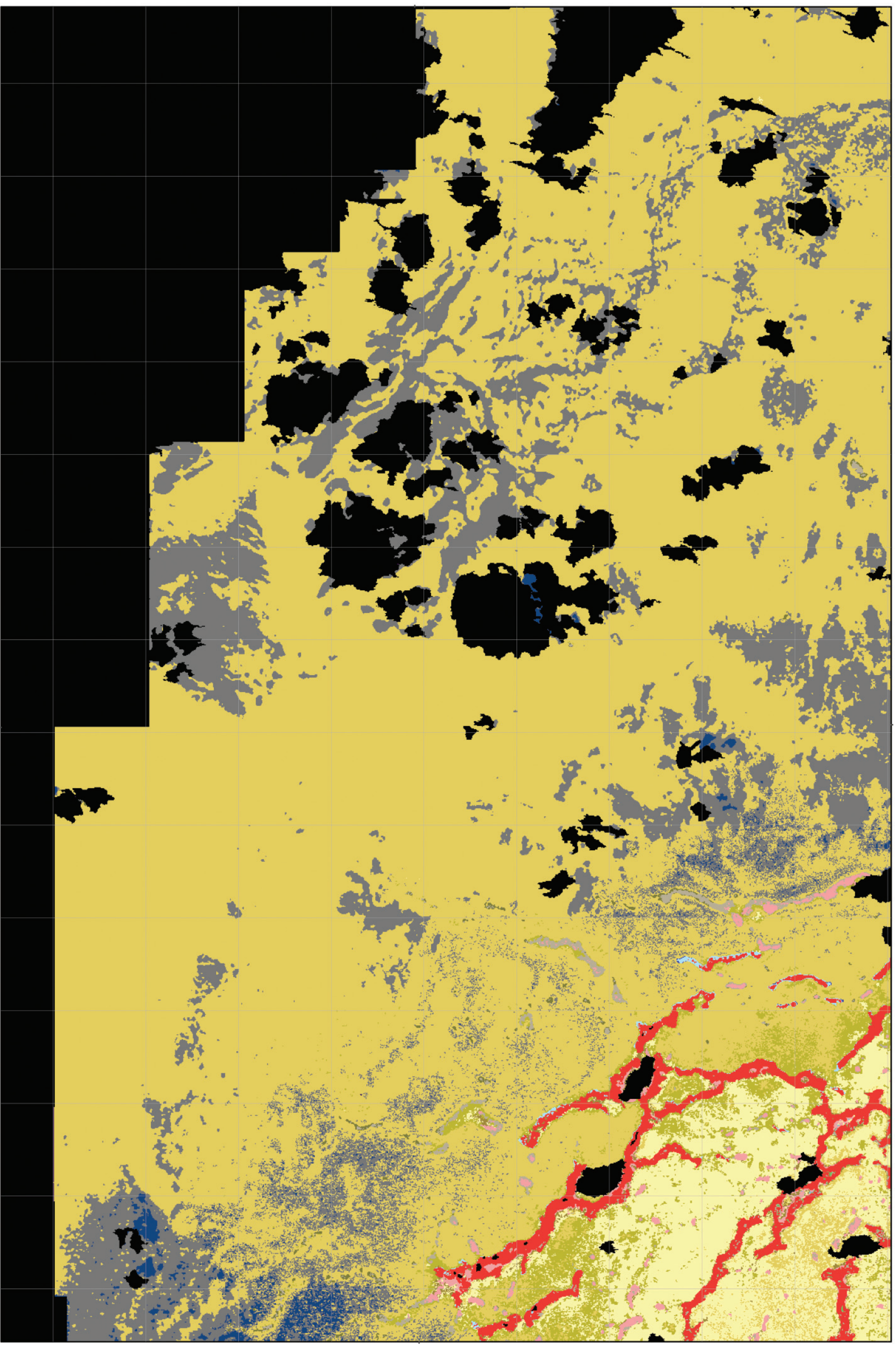
Tile 44. A 1:40,000 scale detailed habitat map of the east central portion of Maro Reef, Northwestern Hawaiian Islands.

Tile 45. A 1:40,000 scale detailed habitat map of the south central portion of Maro Reef, Northwestern Hawaiian Islands.



25°20'0"N

170°35'0"W

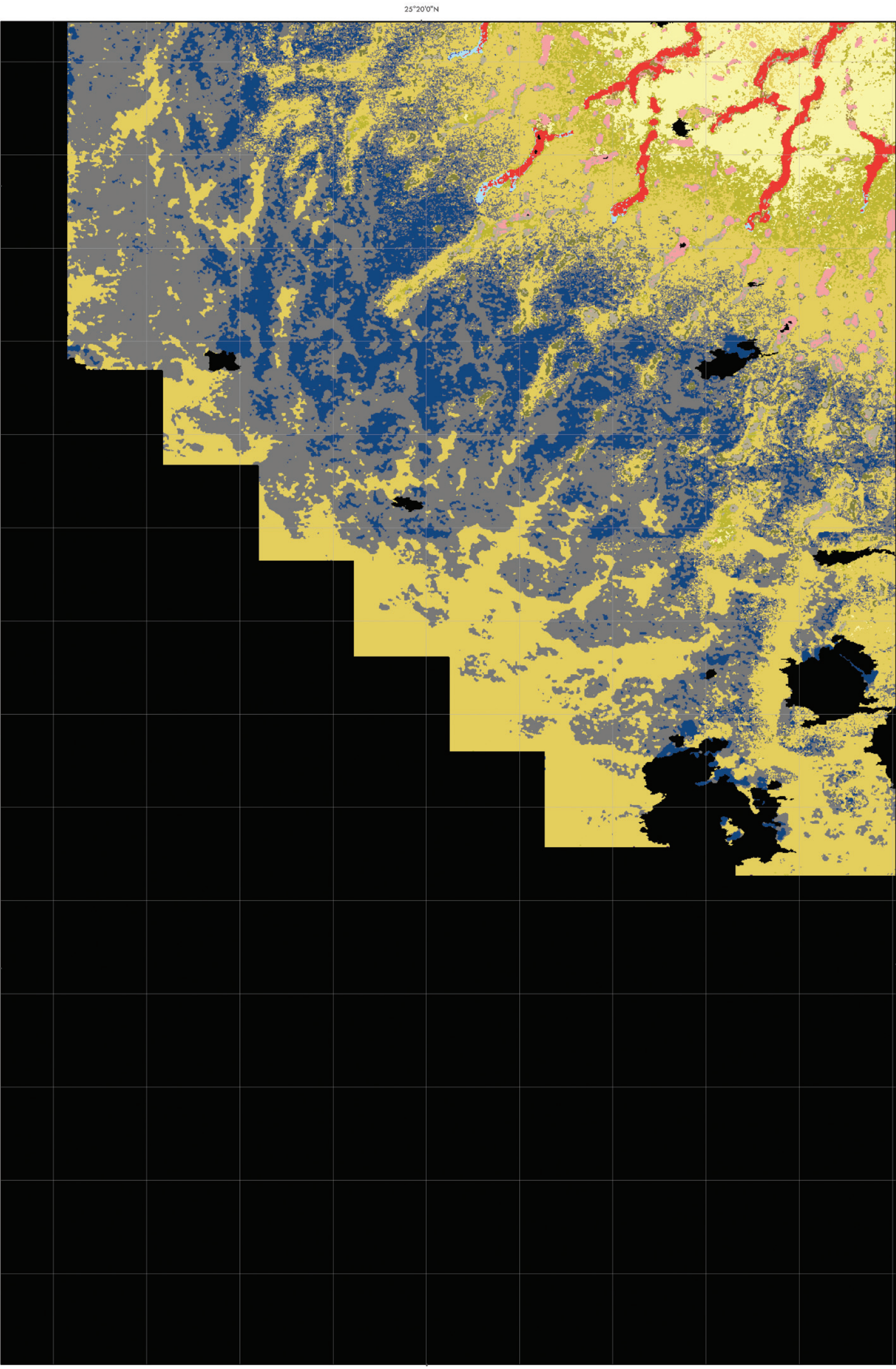


25°20'0"N

170°35'0"W

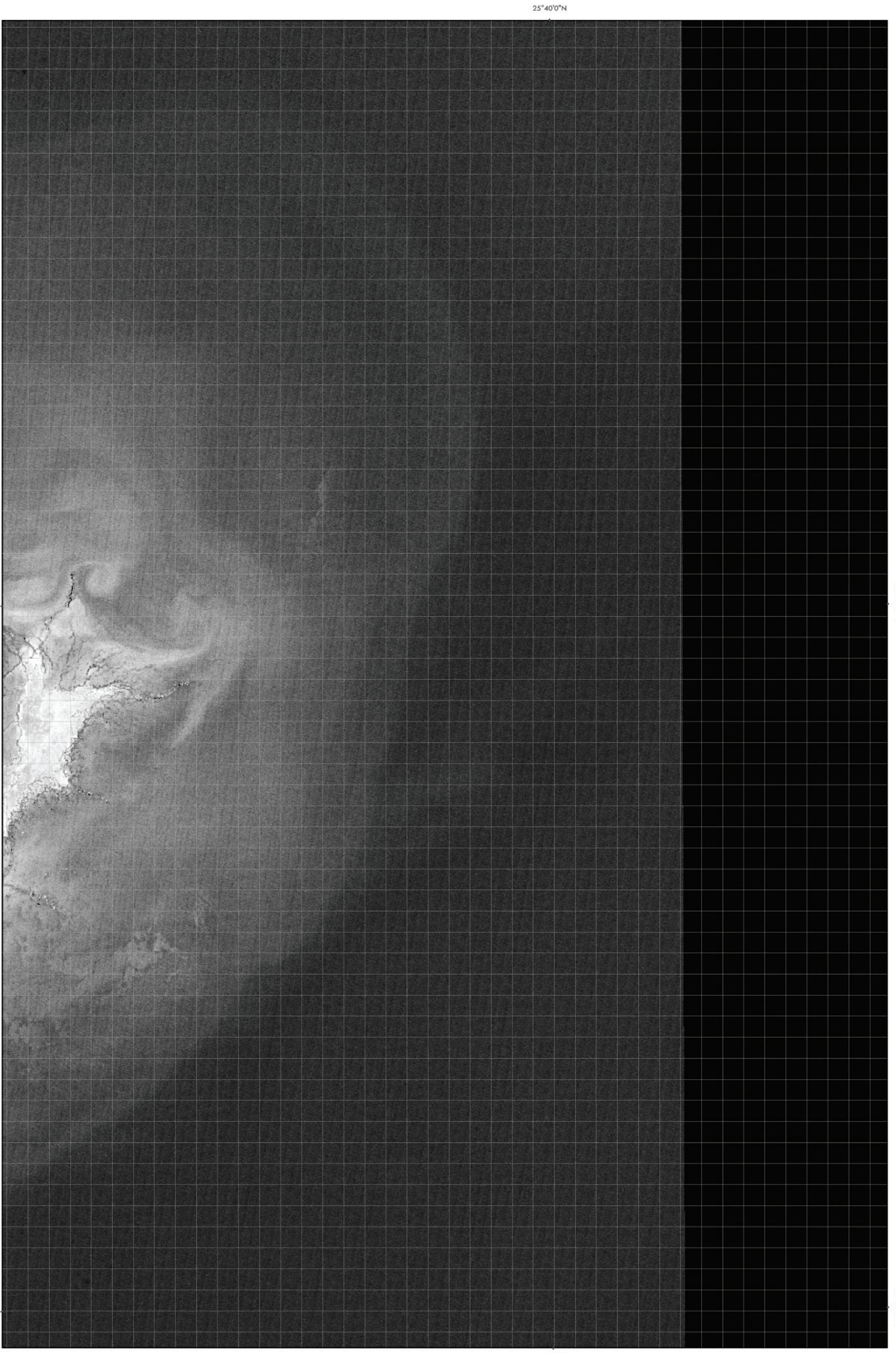
Tile 46. A 1:40,000 scale detailed habitat map of the southwest portion of Maro Reef, Northwestern Hawaiian Islands.

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Tile 47. A 1:40,000 scale detailed habitat map of the southeast portion of Maro Reef, Northwestern Hawaiian Islands.

Tile 48. A 1:175,000 scale bank map of the northern portion of Maro Reef, Northwestern Hawaiian Islands.



25°20'0"N

170°40'0"W

170°20'0"W

25°20'0"N

170°40'0"W

170°20'0"W

Tile 49. A 1:175,000 scale bank map of the southern portion of Maro Reef, Northwestern Hawaiian Islands.

Gardner Pinnacles

Located approximately 1300 km ESE of Midway and 900 km WNW of Kaula'i is Gardner Pinnacles at longitude 168 degrees 05 minutes W and latitude 25 degrees 02 minutes N. Gardner Pinnacles is composed of two volcanic islets. These islets are the remnant emergent portions of a large, 14 million-year-old shield volcano that has been eroded to produce an extensive shelf over 207 sq. km in size. The larger pinnacle is 55 m high and about 180 m in diameter. The smaller pinnacle is located about 100 m NW of the larger pinnacle.

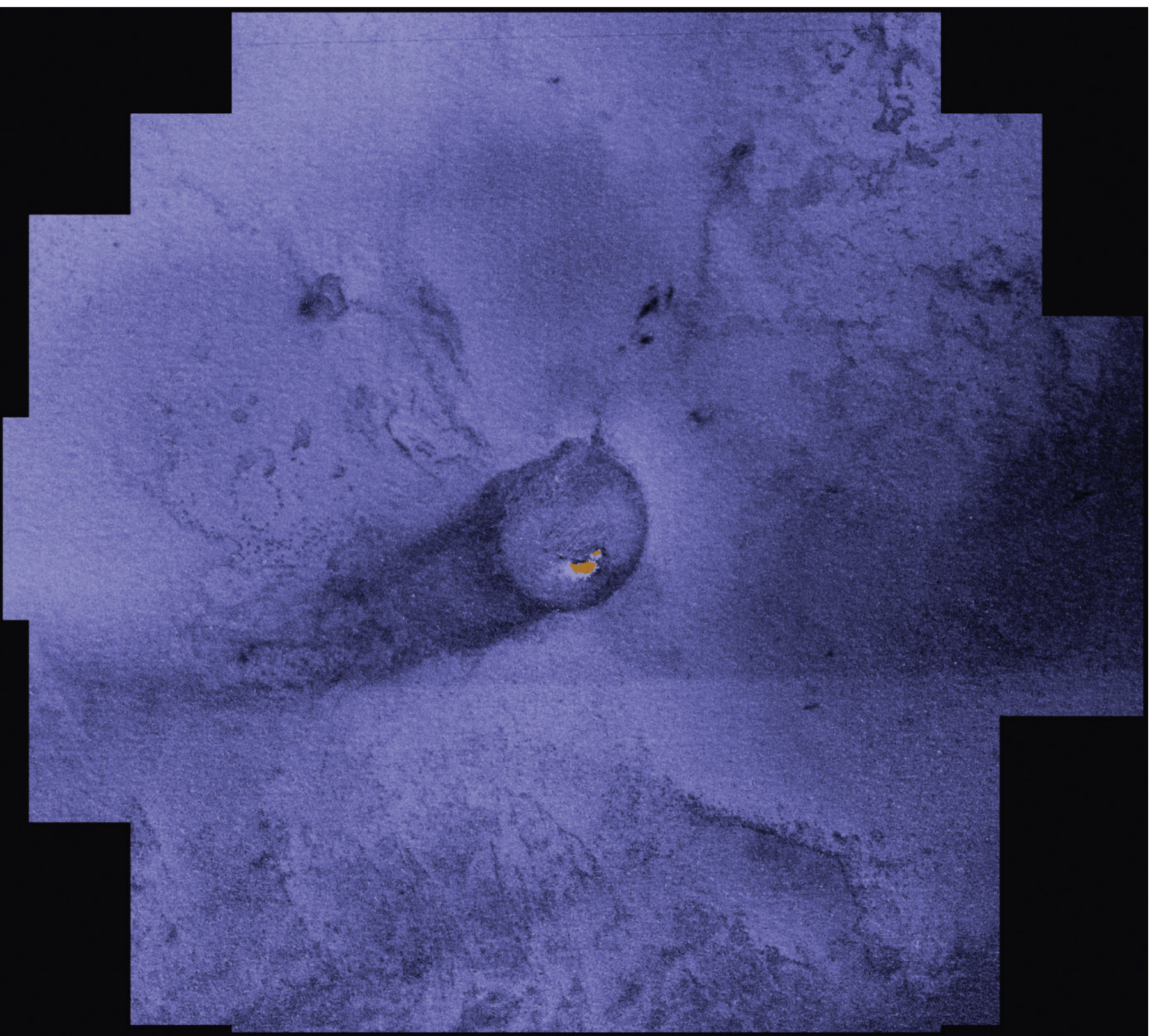
Gardner Pinnacles lie near the NE side of the extensive shelf, which is about 90 km long and from 10 km wide at the south end to 35 km wide at the north end.

The sheer basalt walls of the pinnacles extend down to about 12 m below the water surface. From the base of the walls, the shelf lies in water between 18 meters and 45 meters deep. The shelf is very flat and almost featureless for great distances.

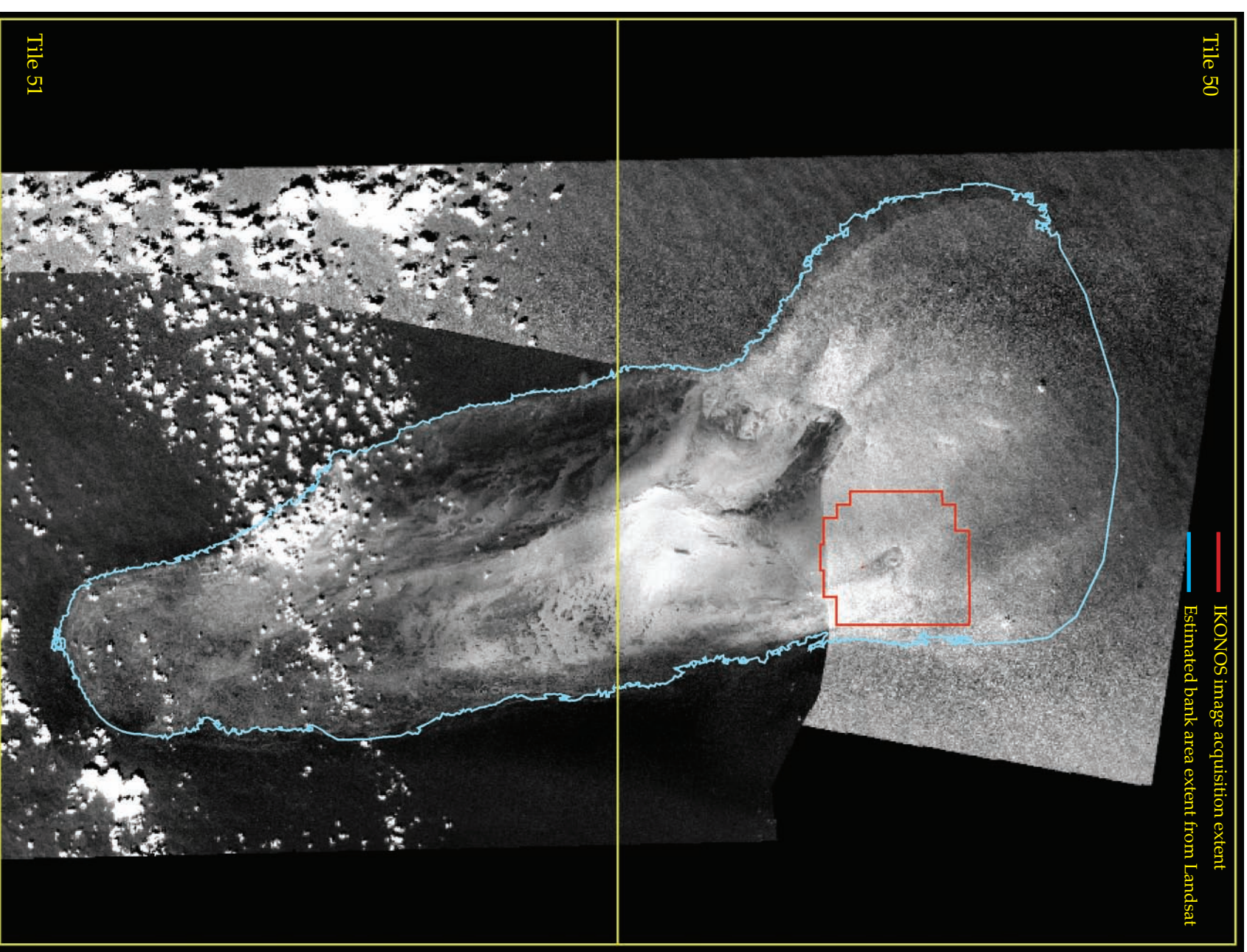
Due to the depth of water surrounding Gardner Pinnacles, very little characterization of the benthic habitats of Gardner Pinnacles was possible.

No 1:40,000 scale detailed habitat maps were generated from satellite imagery for Gardner Pinnacles. An enhancement of the water reflectance of the IKONOS satellite image depicting bright sand and dark hardbottom areas (1:40,000 scale) is provided.

Two 1:200,000 scale map tiles are included to depict the extensive shallow-water bank area around Gardner Pinnacles.

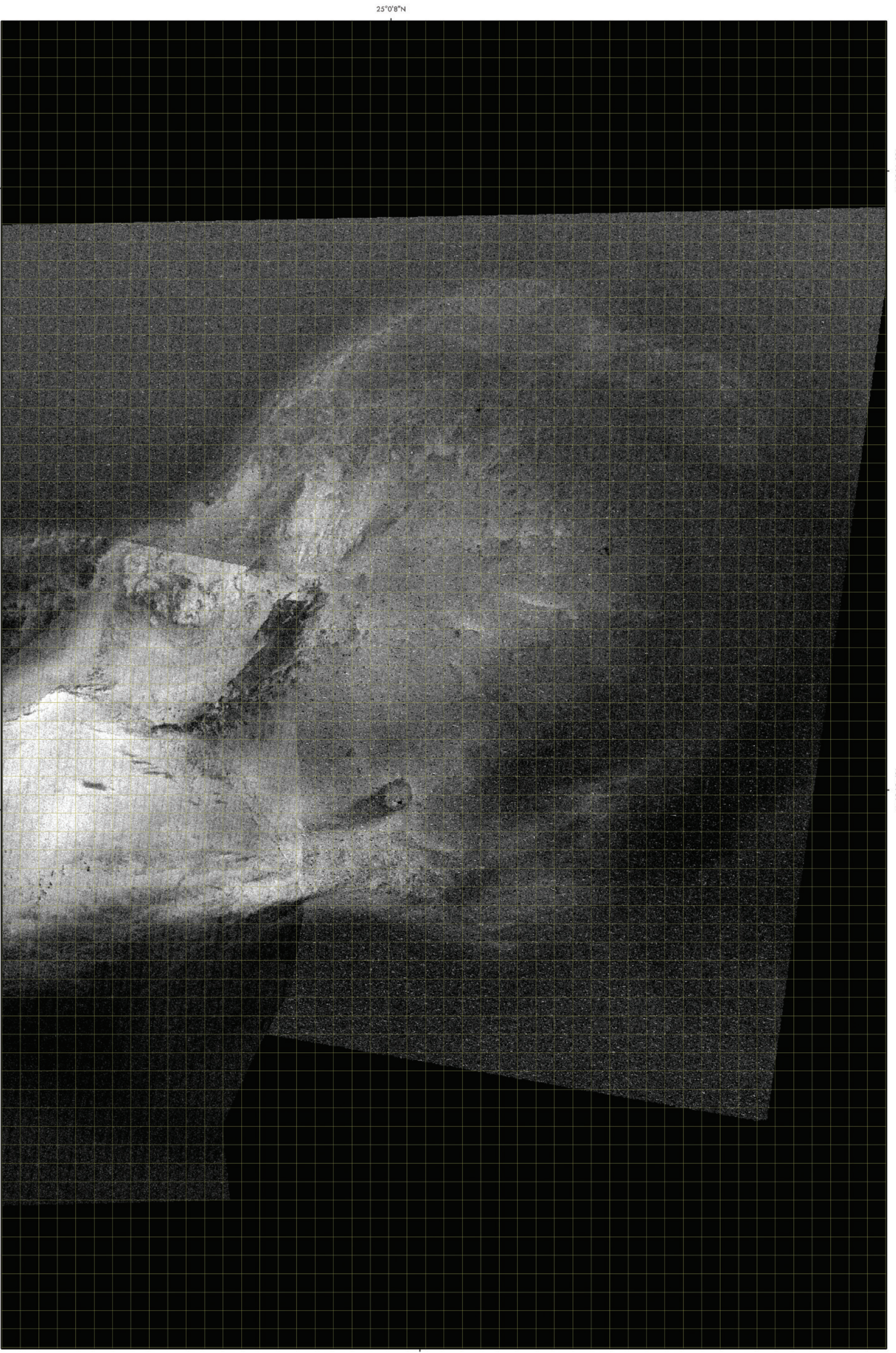


A 1:40,000 scale IKONOS satellite image depicting bright sand and dark hardbottom areas of Gardner Pinnacles, Northwestern Hawaiian Islands.



Index map indicating the locations of map tiles for the 1:200,000 scale bank of Gardner Pinnacles, Northwestern Hawaiian Islands.

Tile 50. A 1:200,000 scale bank map of the northern portion of Gardner Pinnacles, Northwestern Hawaiian Islands.



25°0'8"N

168°19'59"W

168°19'59"W

167°59'59"W

167°59'59"W

25°0'8"N

24°40'8"N

168°19'59"W

167°59'59"W

24°40'8"N

168°19'59"W

167°59'59"W

Title 51. A 1:200,000 scale bank map of the southern portion of Gardner Pinnacles, Northwestern Hawaiian Islands.

French Frigate Shoals

Approximately 1500 km ESE of Midway Atoll and 700 km WNW of Kaua'i lies French Frigate Shoals at longitude 166 degrees 10 minutes W and latitude 23 degrees 45 minutes N. French Frigate Shoals was formed approximately 13.8 million years ago as the Pacific Plate crossed over a “hotspot” in the earth’s mantle. The Pacific Plate continues to move WNW at about 9 cm each year.

French Frigate Shoals appears to be the remnant portion of an approximately 27 km-long crescent-shaped atoll. This atoll protects a 727 sq.-km shallow lagoon that is from two and 10 km wide. La Perouse Pinnacle, located at the southwest corner of the lagoon, is the major visual landmark in the area at French Frigate Shoals. La Perouse Pinnacle is the dense rock remnant of the central lava tube that formed the volcano. Everything else surrounding this central tube has been eroded. Numerous sand islets dot the lagoon area of French Frigate Shoals. Waves and currents constantly change the size and shape of these sandy islets.

French Frigate Shoals is the most important breeding and nesting area for the Hawaiian green sea turtle in the entire Hawaiian archipelago. As much as 80 percent of all green sea turtles in the entire Hawaiian archipelago return to French Frigate Shoals to nest and breed. The numerous shoals and sand bars offer perfect habitat in which these ancient creatures can reproduce. French Frigate Shoals also is home to millions of birds. On Tern Island alone, an estimated 1.5 million Sooty Terns nest and breed.

French Frigate Shoals presents a contrast in seabed habitats. Vast areas of many square kilometers are devoid of reef coral development, while other areas are among the richest reefs observed in the Hawaiian archipelago. Sand, rubble, uncolonized hard-bottom and crustose coralline algae dominate the lagoon and the windward reef. It appears that severe North Pacific Swells and NW Trade Wind Swells suppress reef coral development in major areas of the atoll. Large amounts of sand constantly move with shifting wave patterns and currents along the lagoon floor, periodically burying and uncovering large areas. As a result, the sand islands constantly change size and shape. In addition, the NE trade winds prevail throughout the year and drive lagoon circulation. The average wind velocity is 12 knots.

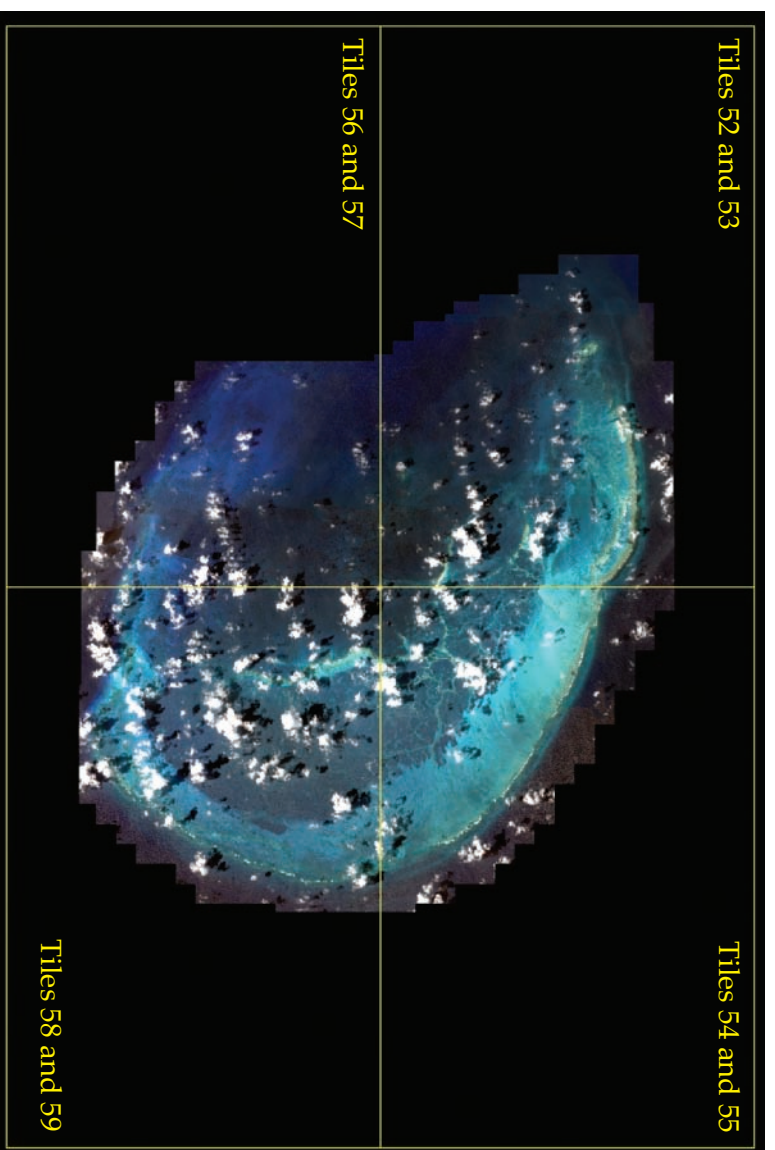
Due to its size, four map tiles are required to depict the 1:80,000 scale estimated bathymetry and aggregated habitat cover maps. Twelve map tiles are required to depict the 1:40,000 scale detailed benthic habitats of French Frigate Shoals. Two 1:100,000 scale map tiles are included to depict the extensive shallow-water bank area around French Frigate Shoals. A one-square-kilometer grid is included with all maps of French Frigate Shoals.

The area in square kilometers of aggregated benthic habitat cover types found at French Frigate Shoals, Northwestern Hawaiian Islands.

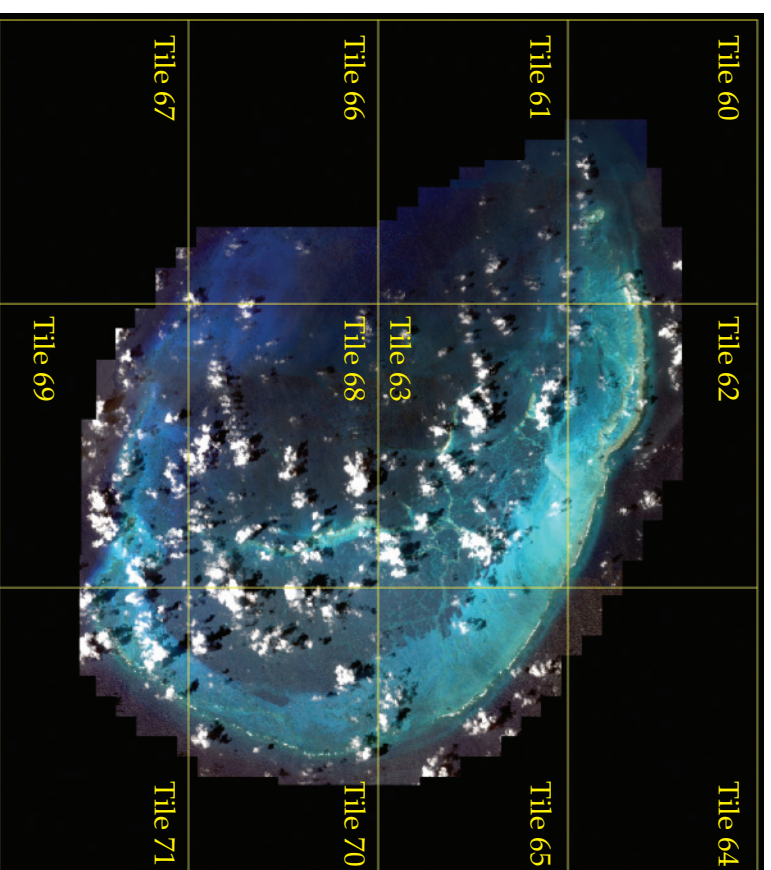
Hardbottom with >10% live coral	48.3
Hardbottom with >10% crustose coralline algae	4.7
Hardbottom (uncolonized)	49.9
Hardbottom with >10% macroalgae	3.7
Hardbottom with indeterminate cover	46.1
Unconsolidated with 10% or less macroalgae or seagrass	241.5
Unconsolidated with >10% macroalgae or seagrass	23.4
Total Habitat Area Classified	417.6

The area in square kilometers of benthic habitats found at French Frigate Shoals, Northwestern Hawaiian Islands.

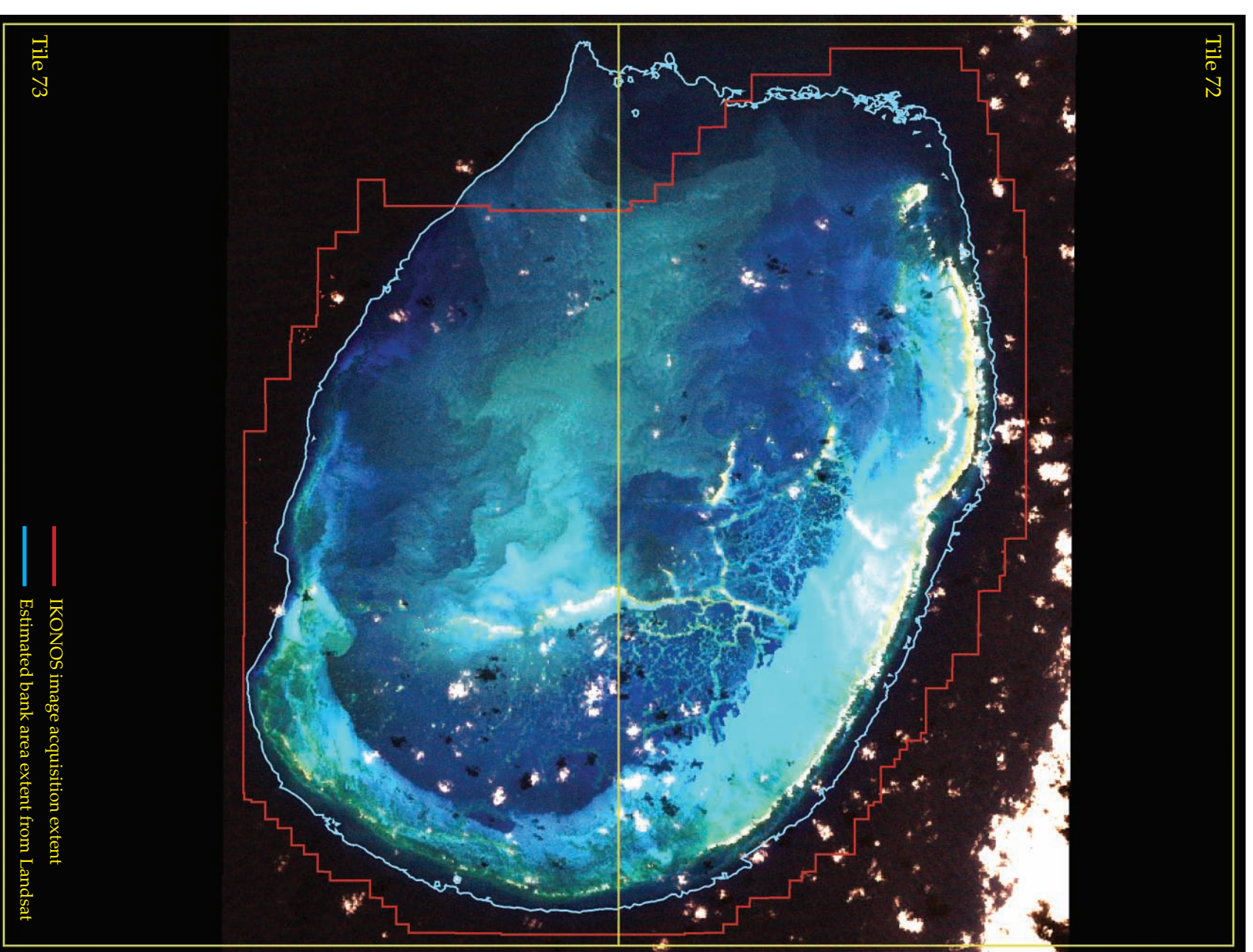
Unconsolidated (1000), refer to classification scheme for habitat description)	-
Sand (1100)	98.4
Sand with macroalgae (1120)	-
Sand with patchy (10-50% cover) (1121)	22.3
Sand with dense (>50% cover) macroalgae (1122)	1.0
Unconsolidated Rubble (1300)	0.3
Unconsolidated Rubble with sparse (10-50% cover) algae (1301)	-
Unconsolidated Rubble with dense (>50% cover) algae (1302)	-
Sand and Rubble (1400)	142.8
Groove (1500)	-
Hardbottom (2000)	-
Hardbottom with sparse (10-50% cover) algae (2001)	-
Hardbottom with live coral (>10% cover) (2010)	-
Hardbottom, uncolonized (2020)	-
Hardbottom with crustose coralline algae (>10% cover) (2030)	-
Linear Reef (2100)	3.9
Linear Reef with live coral (>10% cover) (2110)	-
Linear Reef, uncolonized (2120)	5.3
Linear Reef with crustose coralline algae (>10% cover) (2130)	3.4
Linear Reef with crustose coralline algae (>10% cover) (2130)	1.3
Aggregated Coral Heads with live coral (>10% cover) (2210)	1.6
Spur and Groove (2300)	-
Patch Reef (2400)	8.5
Patch Reef with live coral (>10% cover) (2410)	-
Patch Reef, uncolonized (2420)	-
Patch Reef with sparse (10-50% cover) algae (2421)	-
Patch Reef with crustose coralline algae (>10% cover) (2430)	0.3
Aggregated Patch Reef (2500)	-
Aggregated Patch Reef with live coral (>10% cover) (2510)	-
Scattered Coral/Rock in Sand with live coral (>10% cover) (2610)	2.0
Pavement (2700)	21.2
Pavement with sparse (10-50% cover) algae (2701)	-
Pavement with dense (>50% cover) algae (2702)	0.3
Pavement with live coral (>10% cover) (2710)	27.8
Pavement with live coral (>10% cover) with dense (>50% cover) algae (2712)	-
Pavement, uncolonized (2720)	44.5
Pavement, uncolonized with dense (>50% cover) algae (2722)	-
Pavement with crustose coralline algae (>10% cover) (2730)	3.1
Pavement with sand channels (2800)	12.4
Pavement with sand channels and live coral (>10% cover) (2810)	16.9
Pavement with sand channels, uncolonized (2820)	-
Volcanic Rock (2900)	-
Volcanic Rock with dense (>50% cover) algae (2902)	-
Volcanic Rock with live coral (>10% cover) (2910)	-
Volcanic Rock, uncolonized (2920)	-
Deep water (3010)	196.7
Reef crest (3020)	-
Dredged channel (3030)	-
Land (3100)	0.2
Cloud, Shadow, Surf, and No image data (3210, 3220, 3230, and 4000)	90.7
Unclassified (3300)	113.3
Total Habitat Area Classified	417.6
TOTAL Area in IKONOS image	818.3



Index of 1:80,000 tiles



Index of 1:40,000 tiles

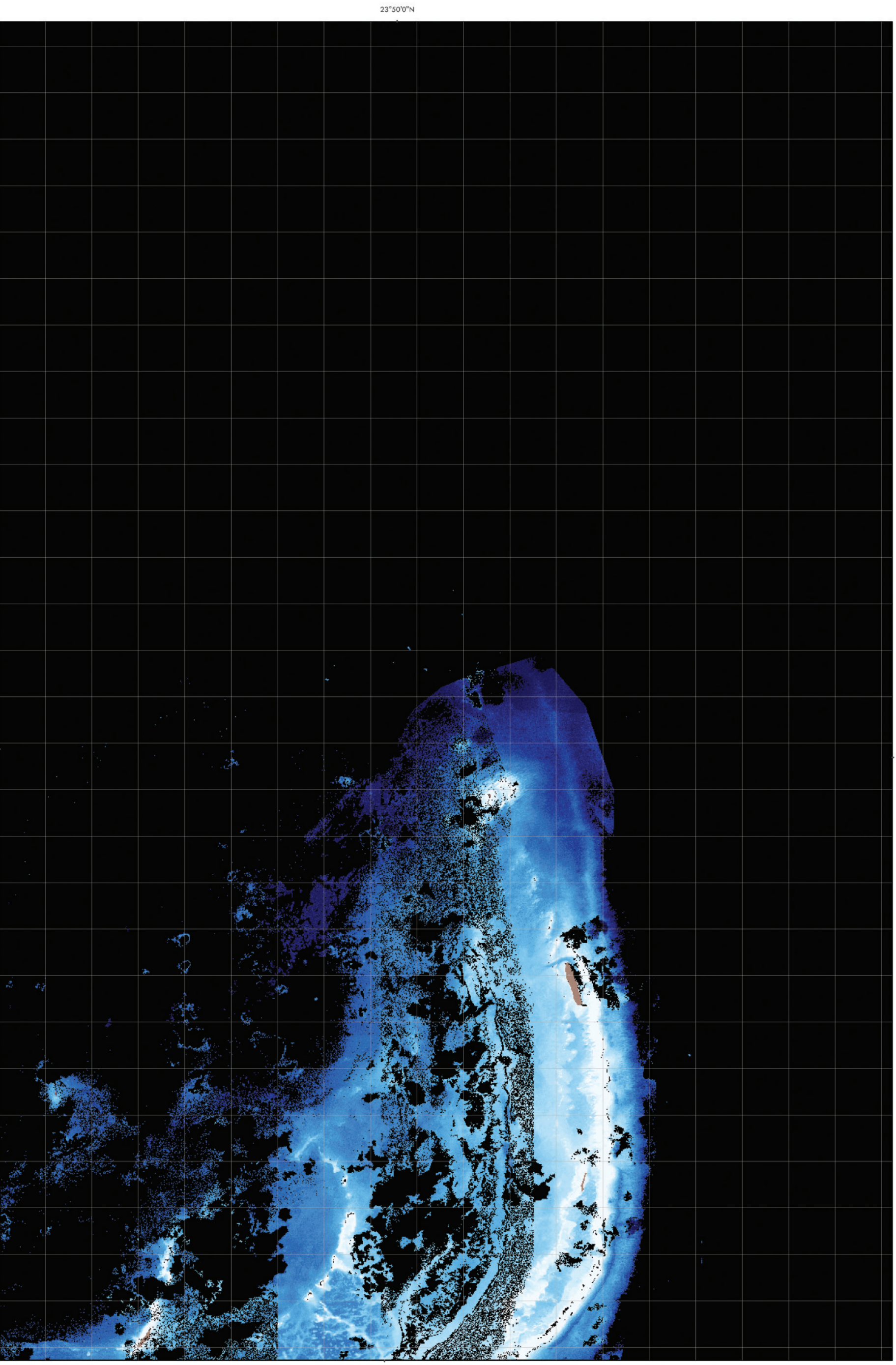


Index of 1:100,000 tiles

Index maps indicating the locations of map tiles for the 1:40,000 scale detailed habitat maps, the 1:80,000 scale aggregated cover and estimated bathymetry, and the 1:100,000 scale bank of French Frigate Shoals, Northwestern Hawaiian Islands.

Tile 52. A 1:80,000 scale estimated bathymetry map of the northwest portion of French Frigate Shoals, Northwestern Hawaiian Islands.

166°20'0"W

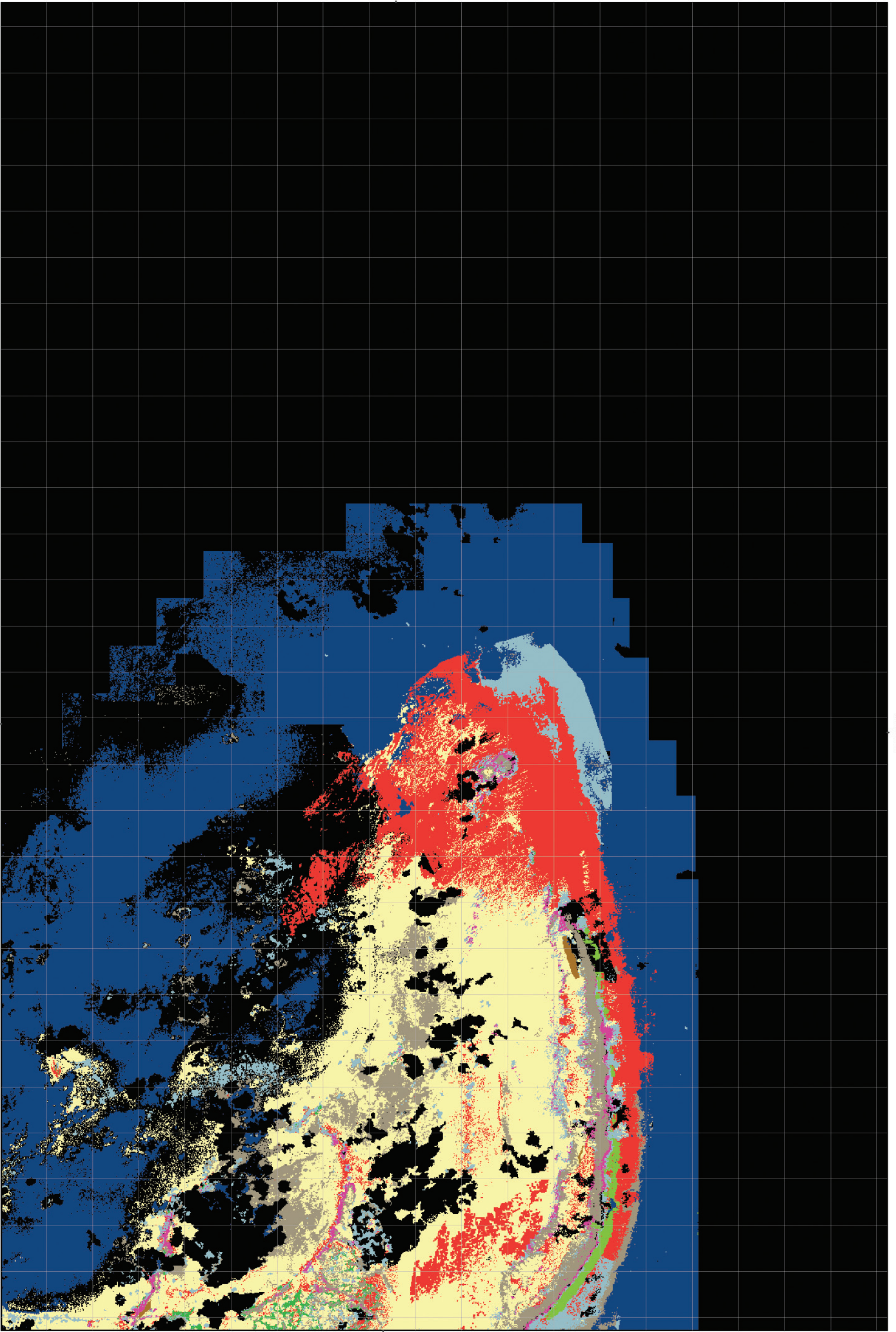


23°50'0"N

23°50'0"N

166°20'0"W

23°50'0"N



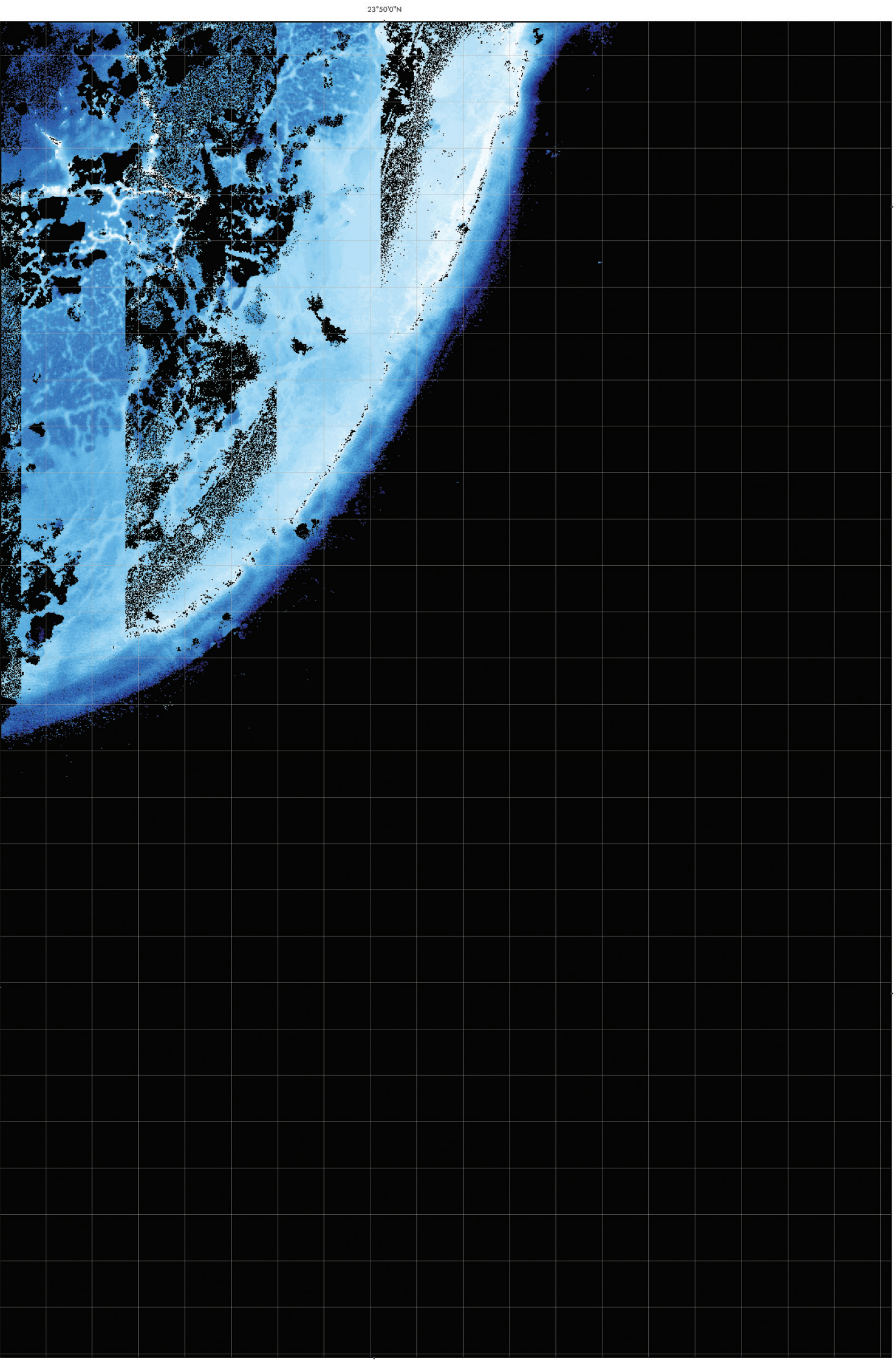
166°20'0"W

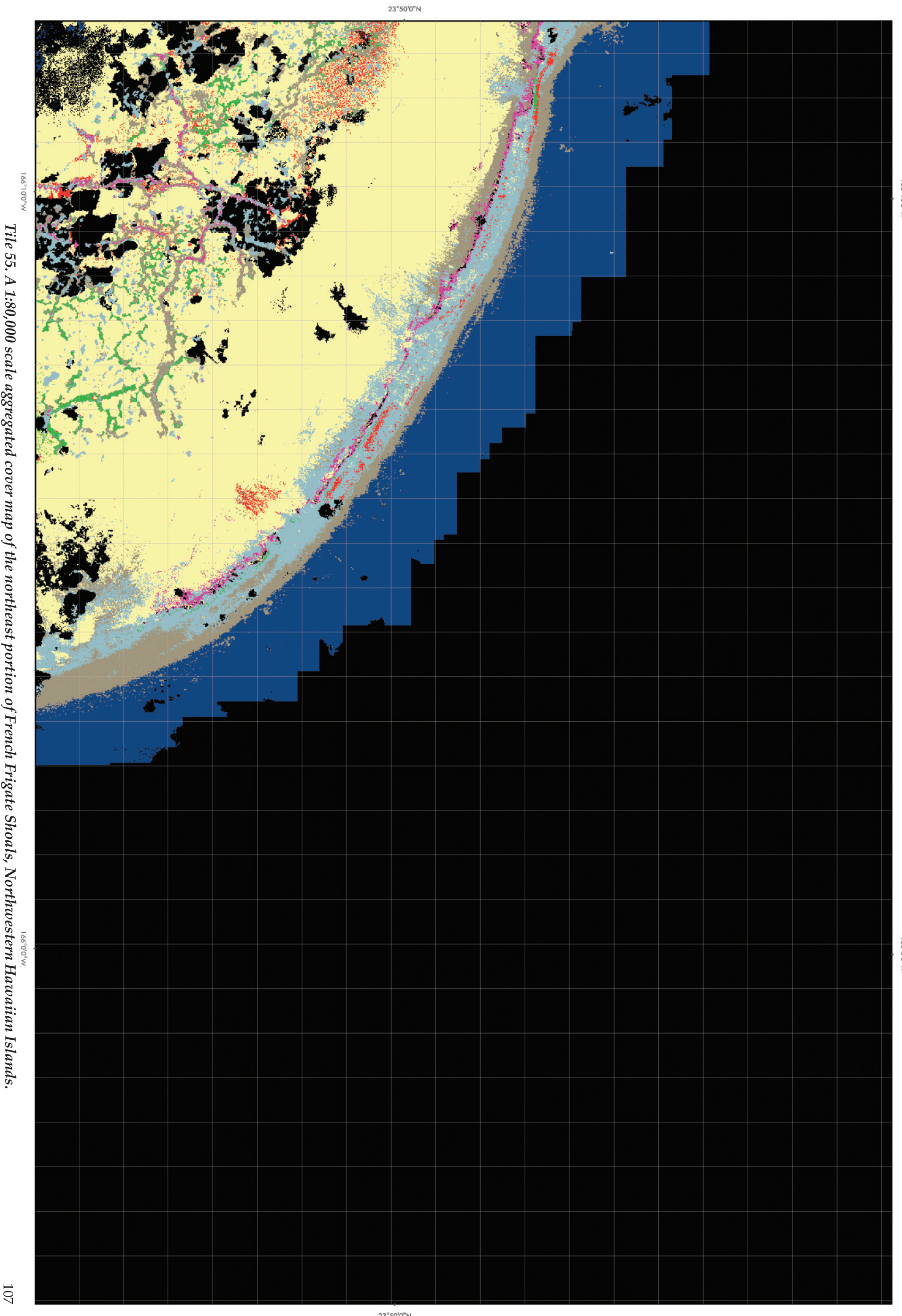
23°50'0"N

166°20'0"W

Title 53. A 1:80,000 scale aggregated cover map of the northwest portion of French Frigate Shoals, Northwestern Hawaiian Islands.

Tile 54. A 1:80,000 scale estimated bathymetry map of the northeast portion of French Frigate Shoals, Northwestern Hawaiian Islands.

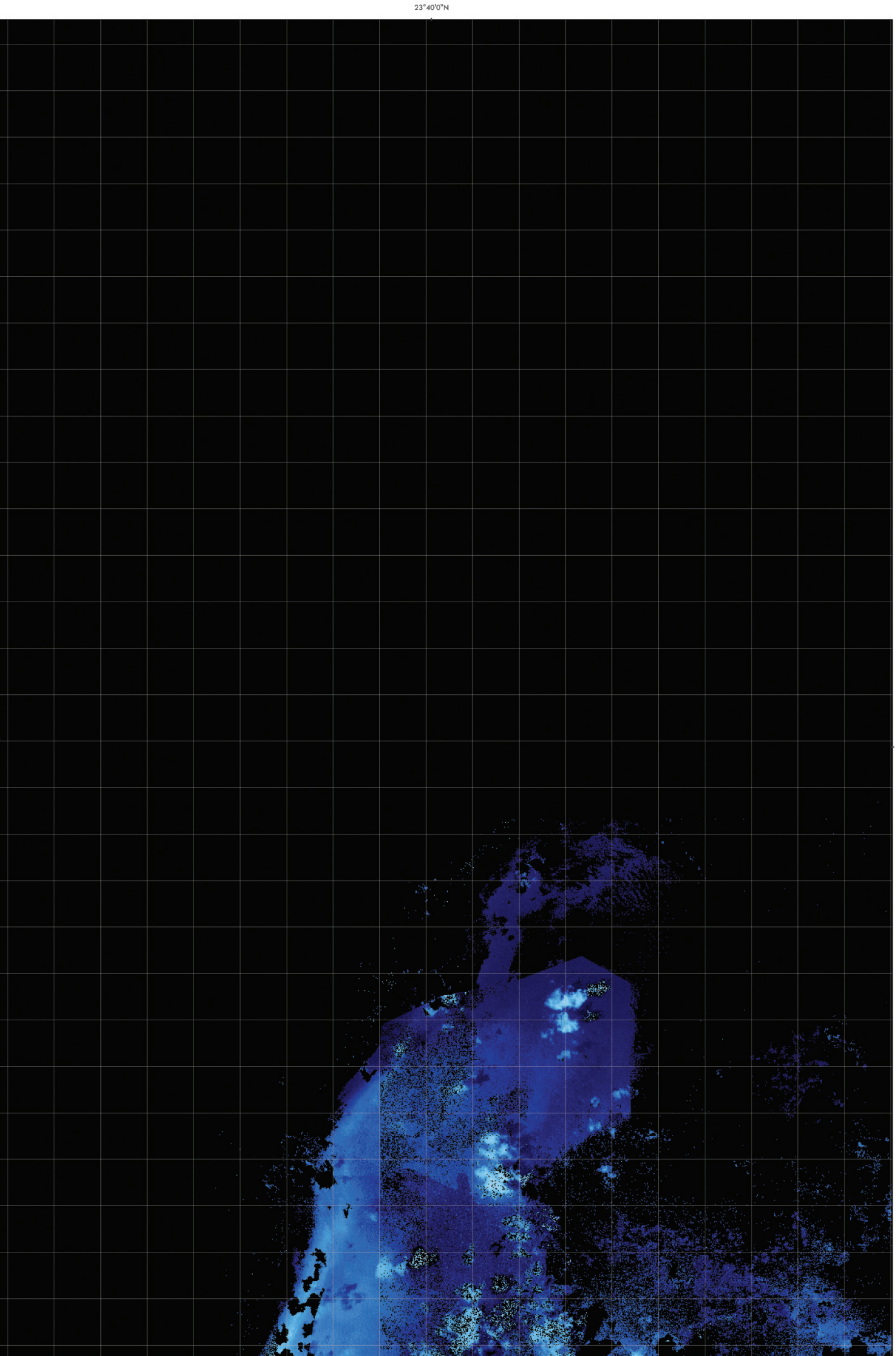




Tile 55. A 1:80,000 scale aggregated cover map of the northeast portion of French Frigate Shoals, Northwestern Hawaiian Islands.

Tile 56. A 1:80,000 scale estimated bathymetry map of the southwest portion of French Frigate Shoals, Northwestern Hawaiian Islands.

166°20'0"W

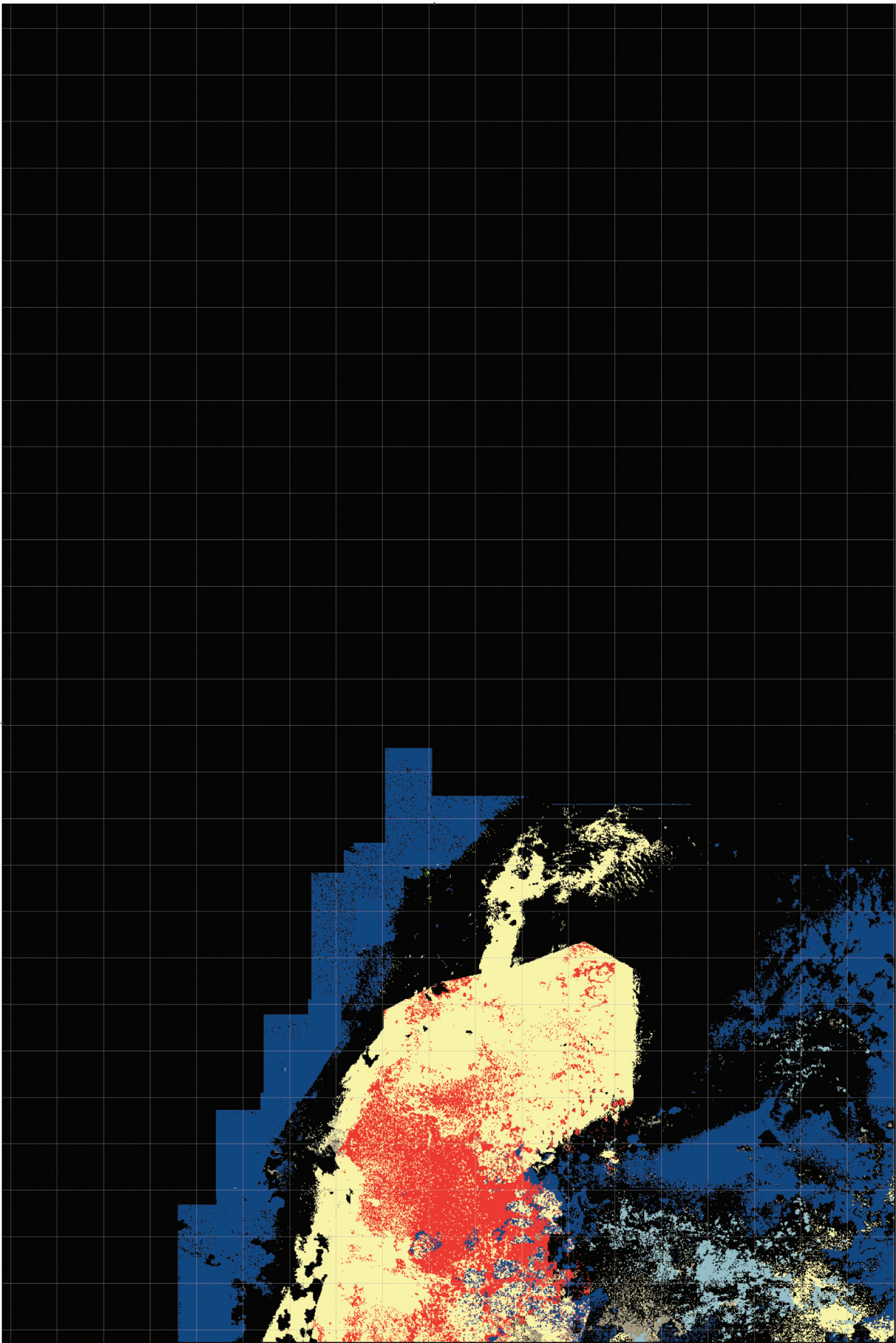


23°40'0"N

23°40'0"N

166°20'0"W

23°40'0"N



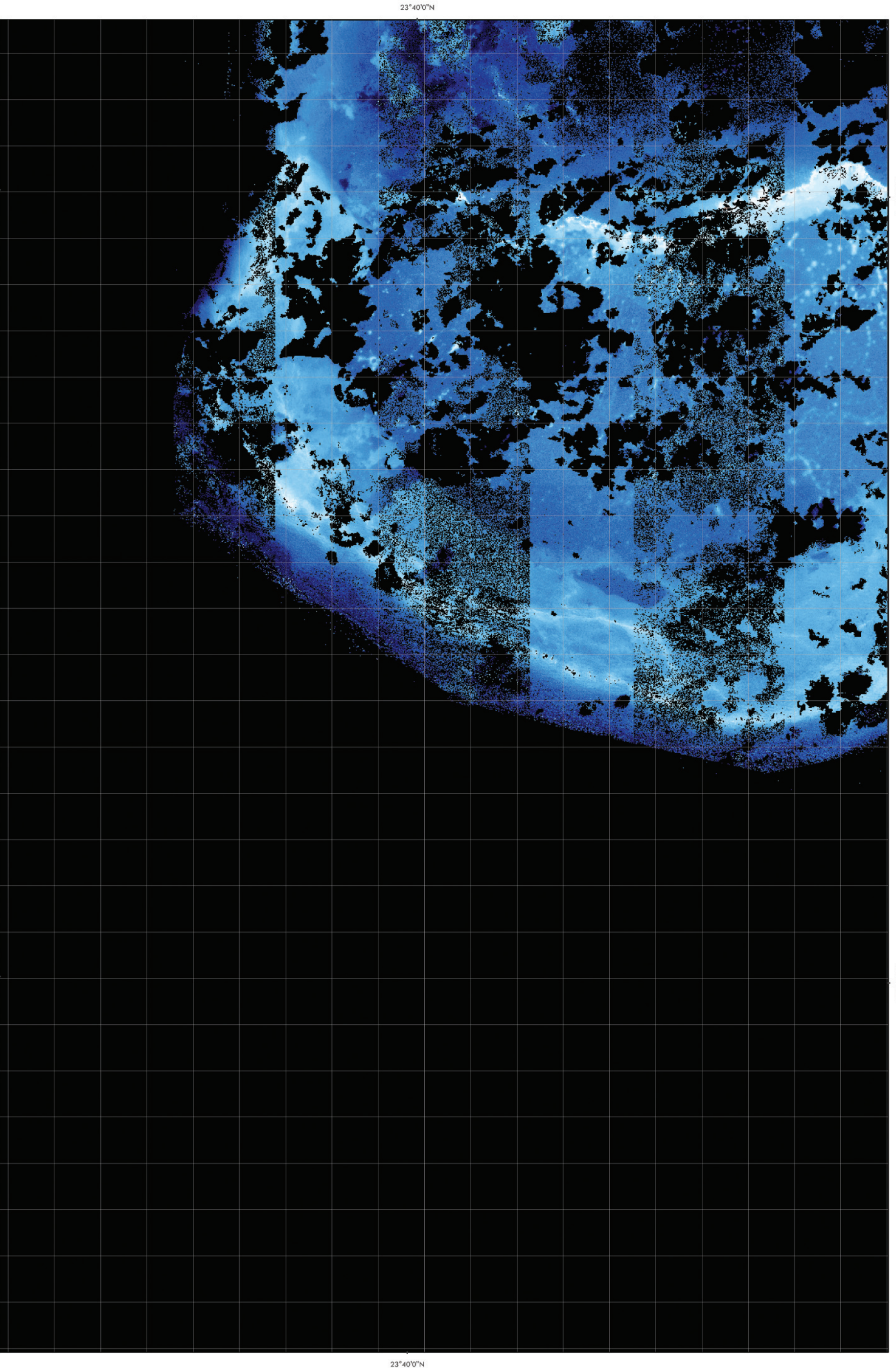
166°20'0"W

166°20'0"W

23°40'0"N

Title 57. A 1:80,000 scale aggregated cover map of the southwest portion of French Frigate Shoals, Northwestern Hawaiian Islands.

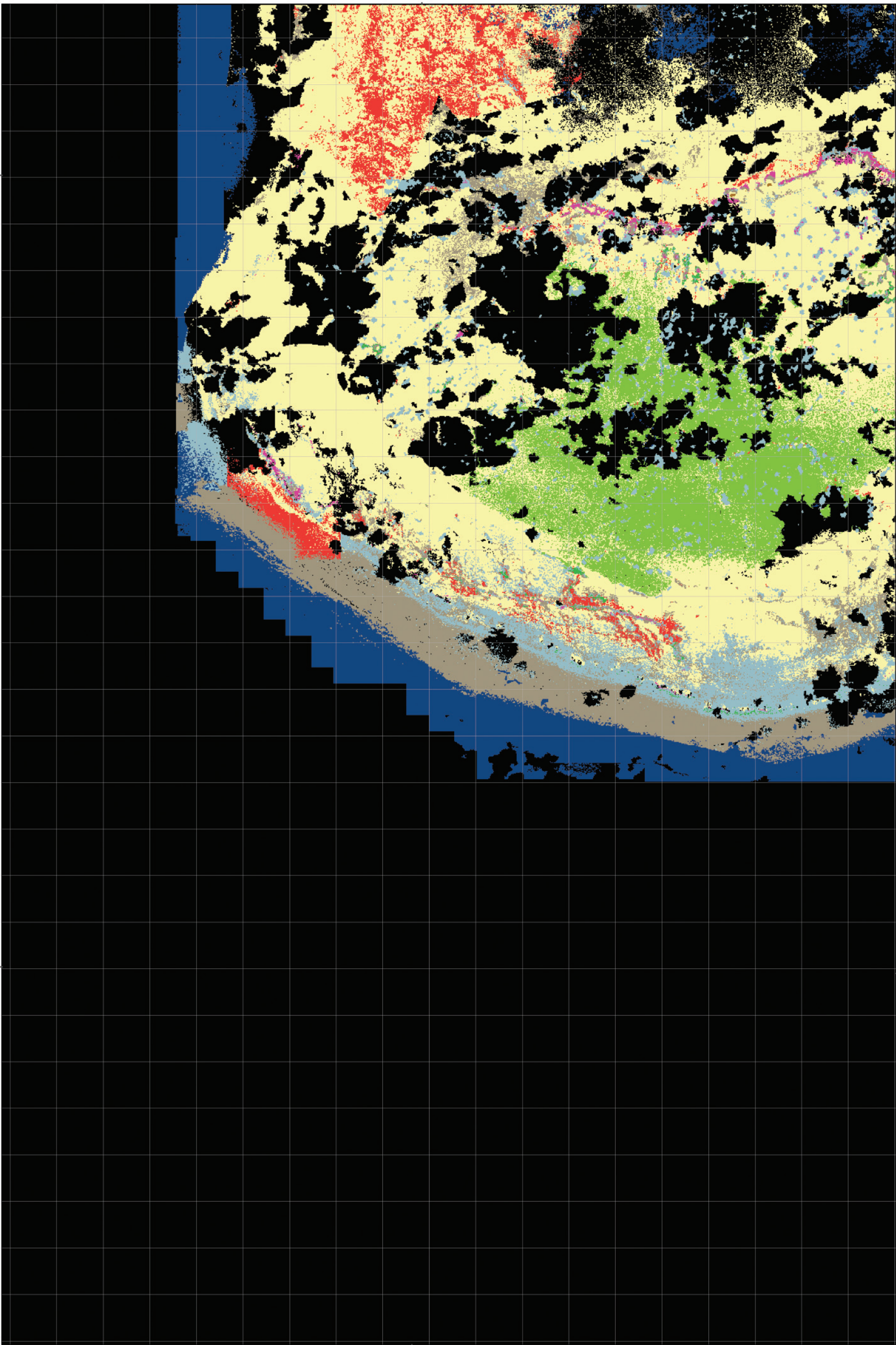
Tile 58. A 1:80,000 scale estimated bathymetry map of the southeast portion of French Frigate Shoals, Northwestern Hawaiian Islands.



23°40'0"N

166°10'0"W

166°00'0"W



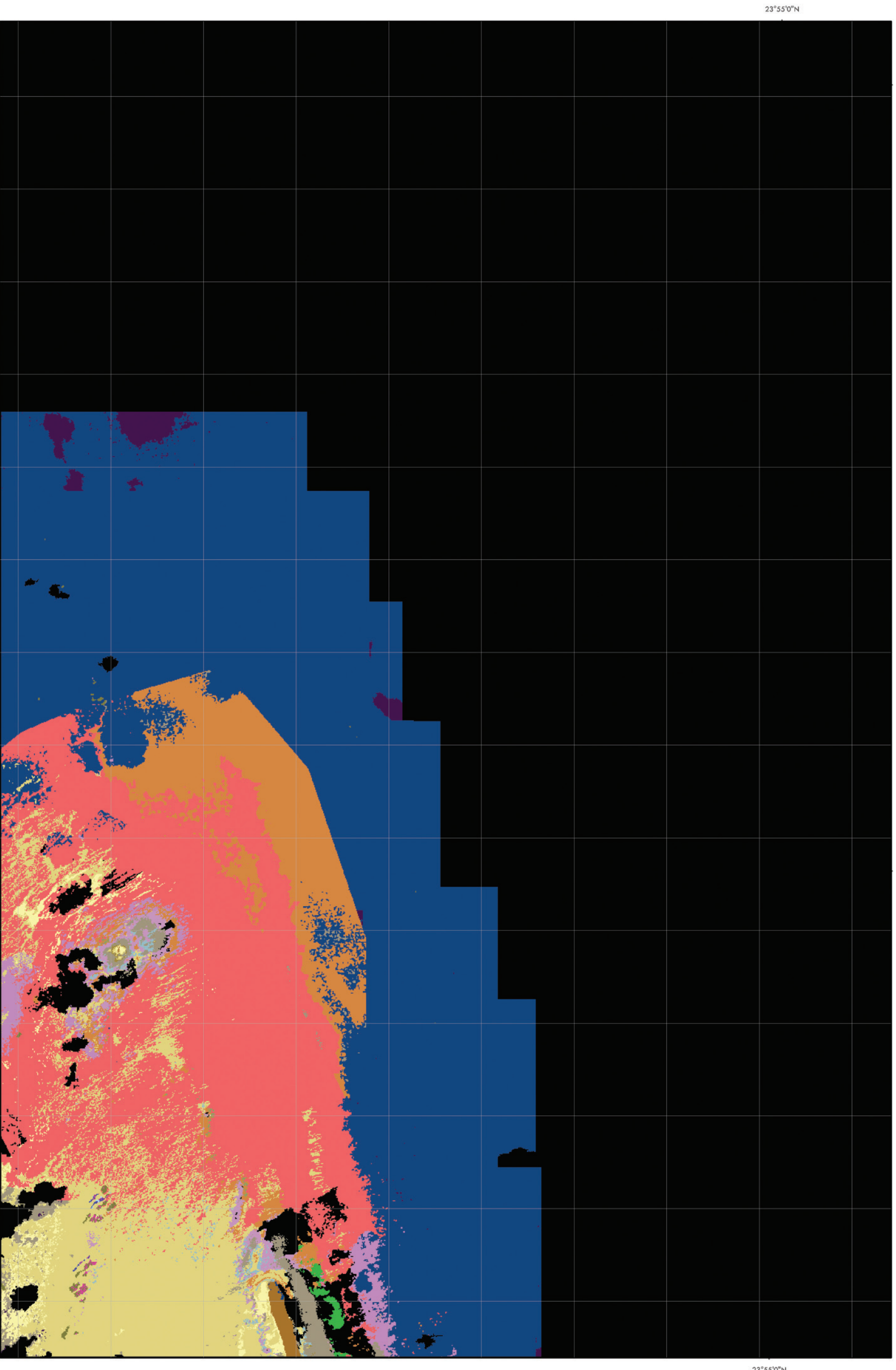
166°10'0"W

166°00'0"W

Title 59. A 1:80,000 scale aggregated cover map of the southeast portion of French Frigate Shoals, Northwestern Hawaiian Islands.

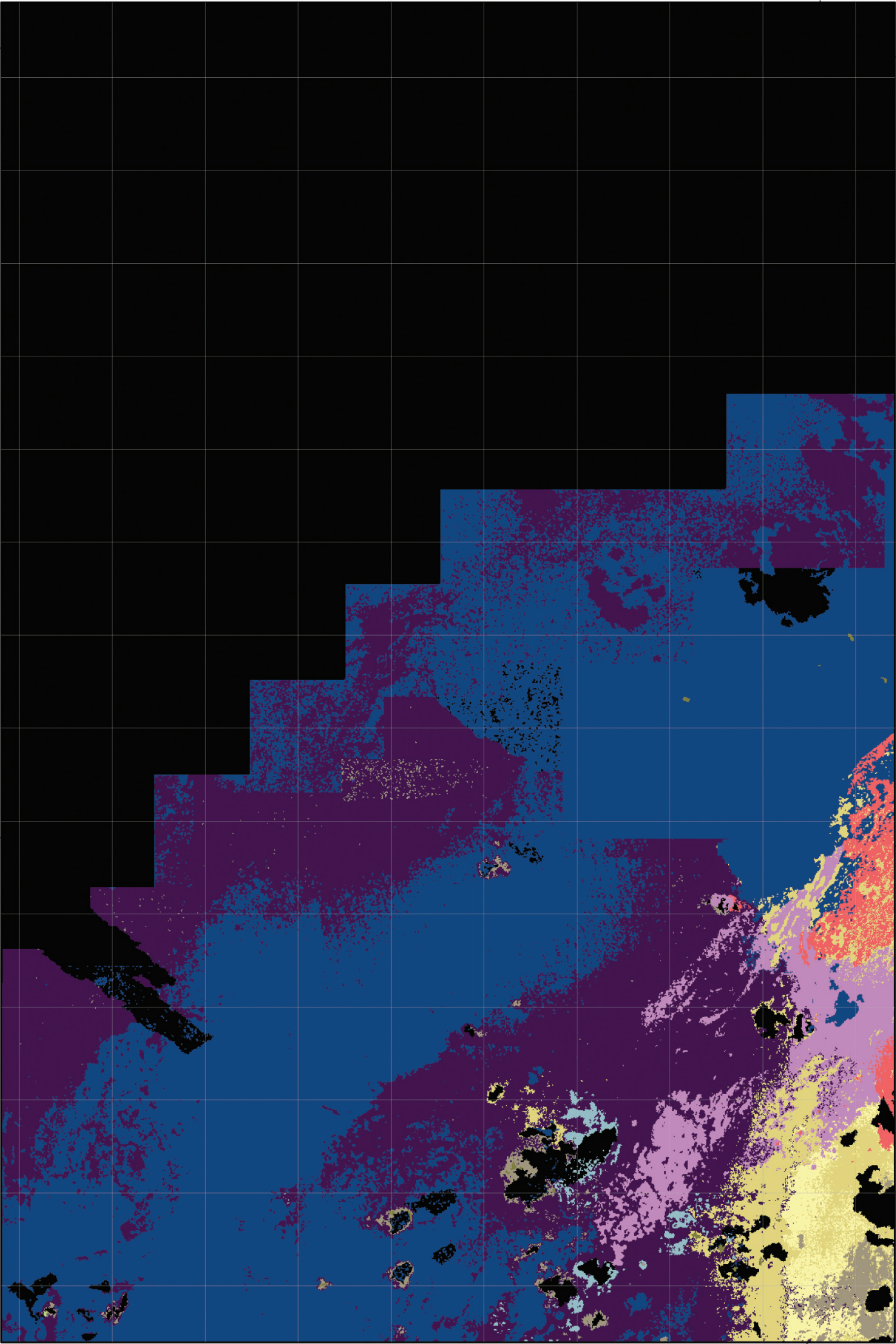
23°40'0"N

Tile 60. A 1:40,000 scale detailed habitat map of a portion of French Frigate Shoals, Northwestern Hawaiian Islands.



23°50'0"N

166°25'0"W



166°25'0"W

166°20'0"W

166°20'0"W

23°50'0"N

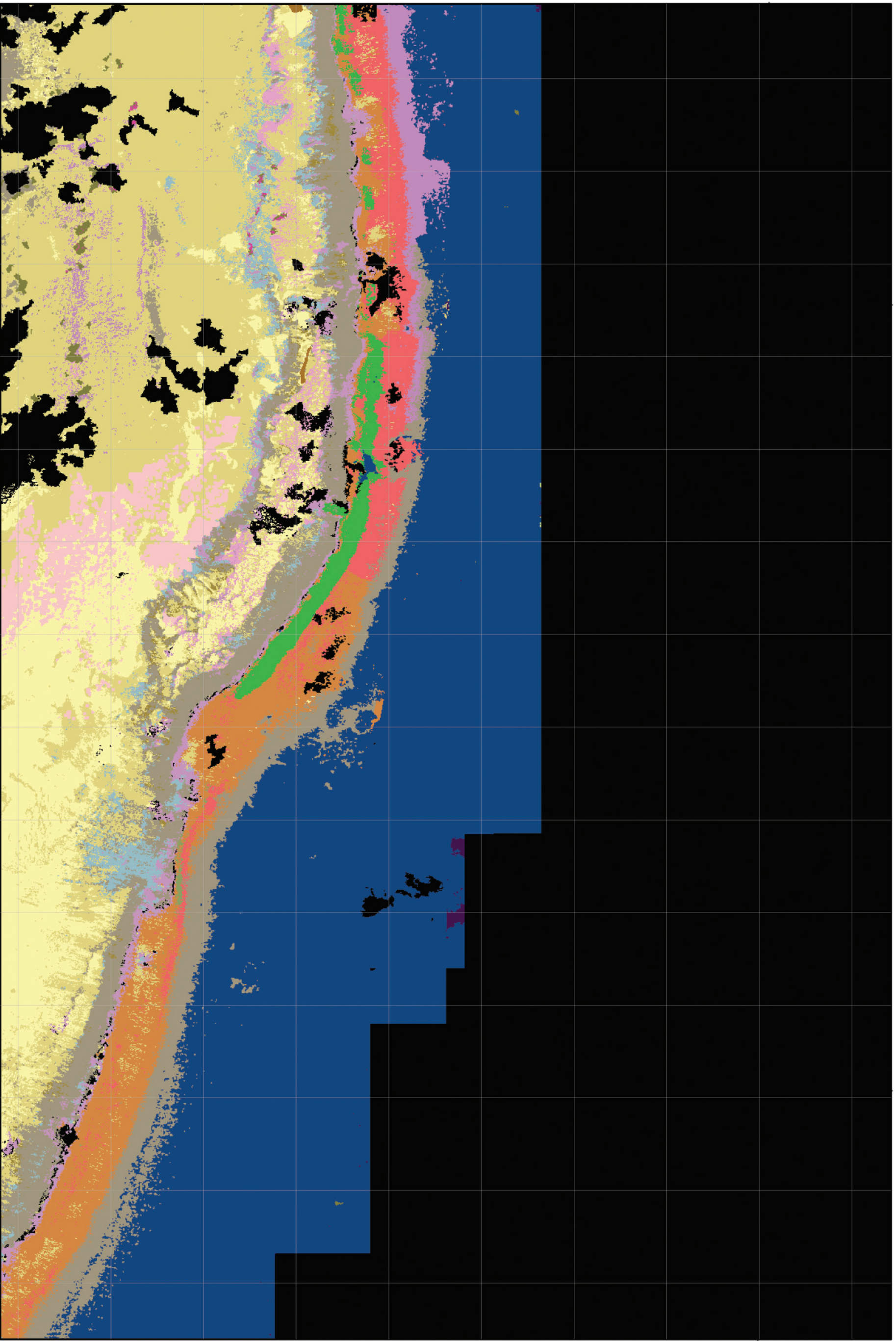
Tile 61. A 1:40,000 scale detailed habitat map of a portion of French Frigate Shoals, Northwestern Hawaiian Islands.

23°55'0"N

Tile 62. A 1:40,000 scale detailed habitat map of a portion of French Frigate Shoals, Northwestern Hawaiian Islands.

166°15'0"W

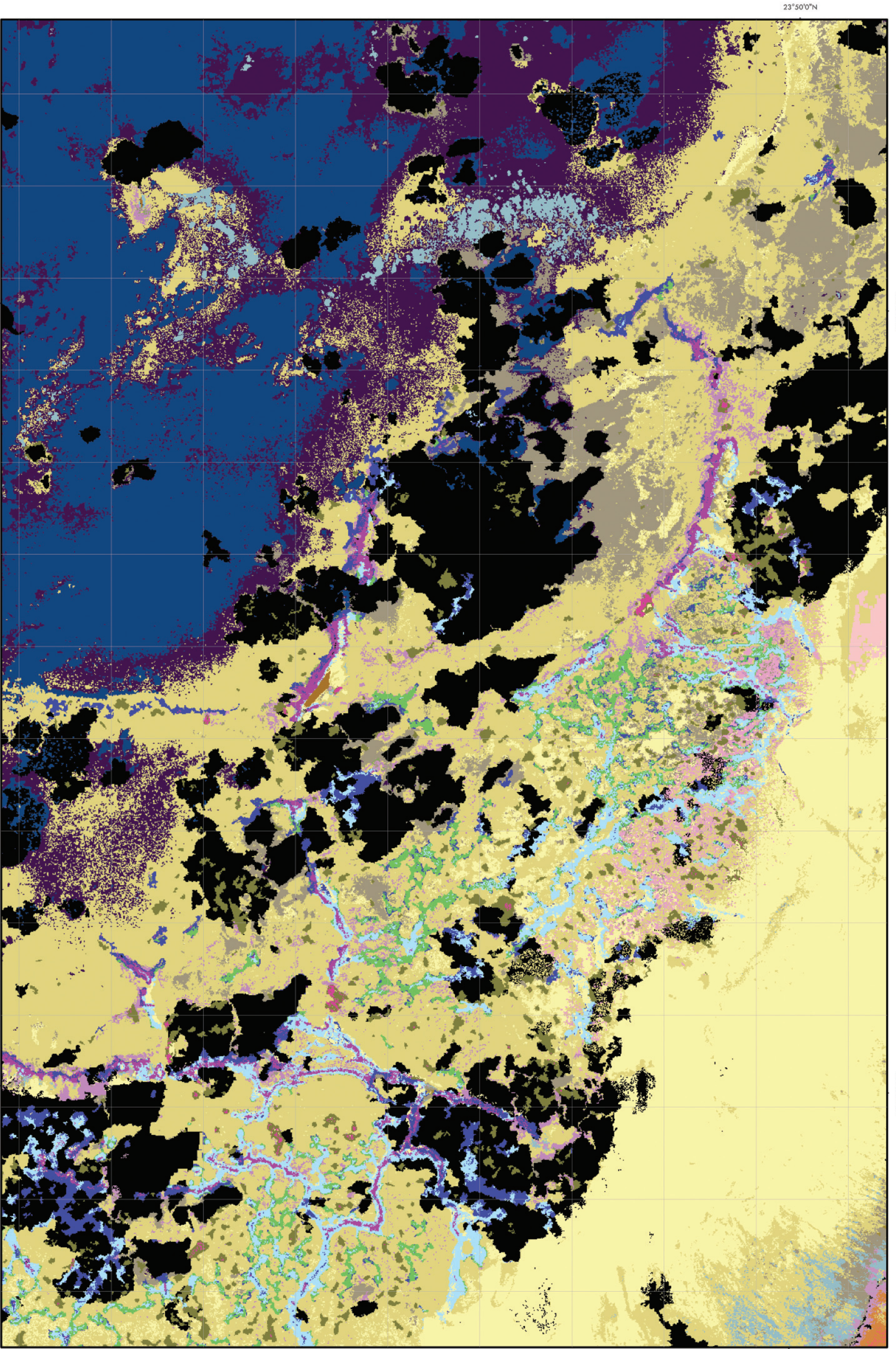
166°10'0"W



166°15'0"W

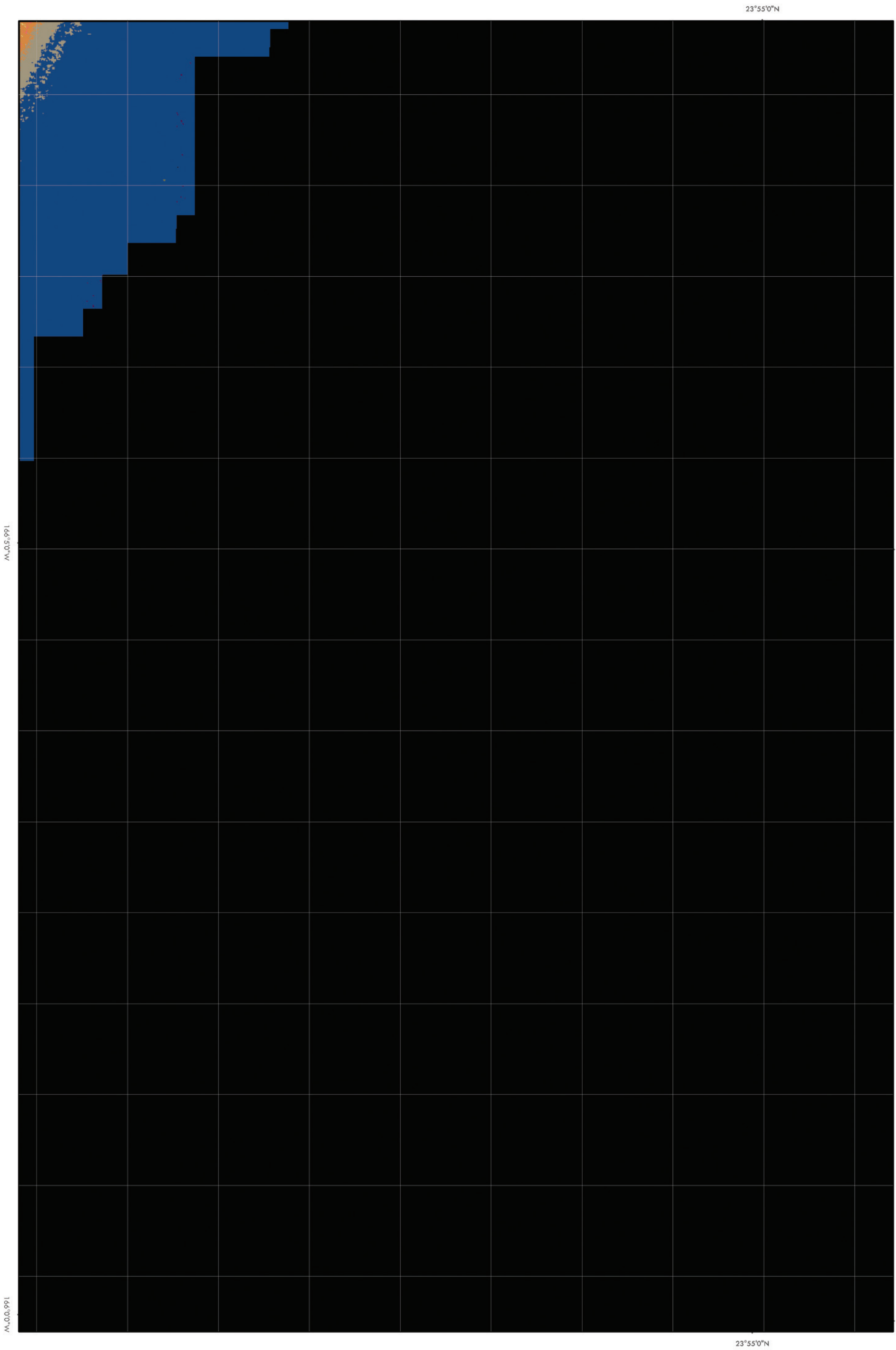
166°10'0"W

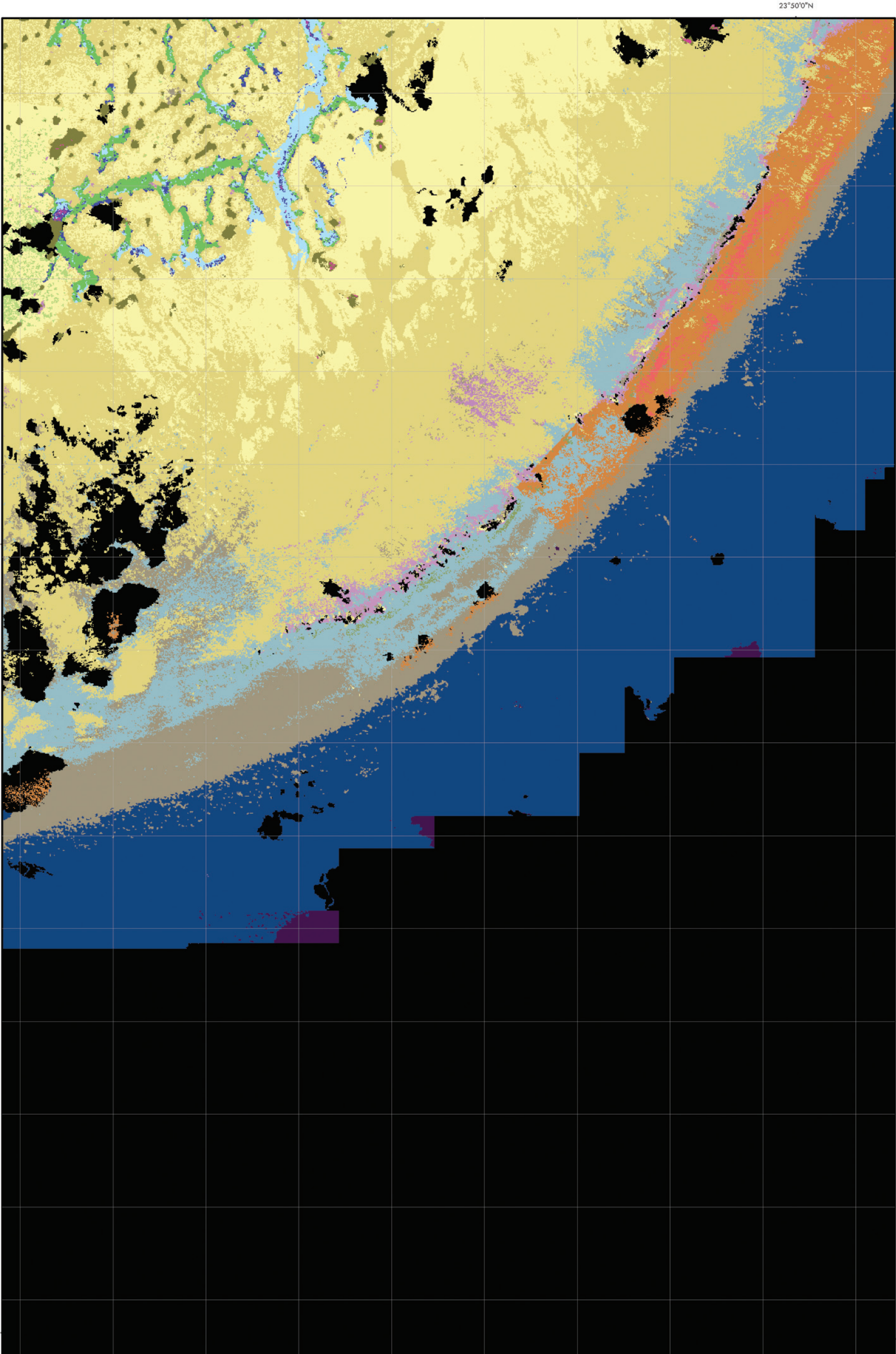
23°55'0"N



Tile 63. A 1:40,000 scale detailed habitat map of a portion of French Frigate Shoals, Northwestern Hawaiian Islands.

Tile 64. A 1:40,000 scale detailed habitat map of a portion of French Frigate Shoals, Northwestern Hawaiian Islands.





Title 65. A 1:40,000 scale detailed habitat map of a portion of French Frigate Shoals, Northwestern Hawaiian Islands.

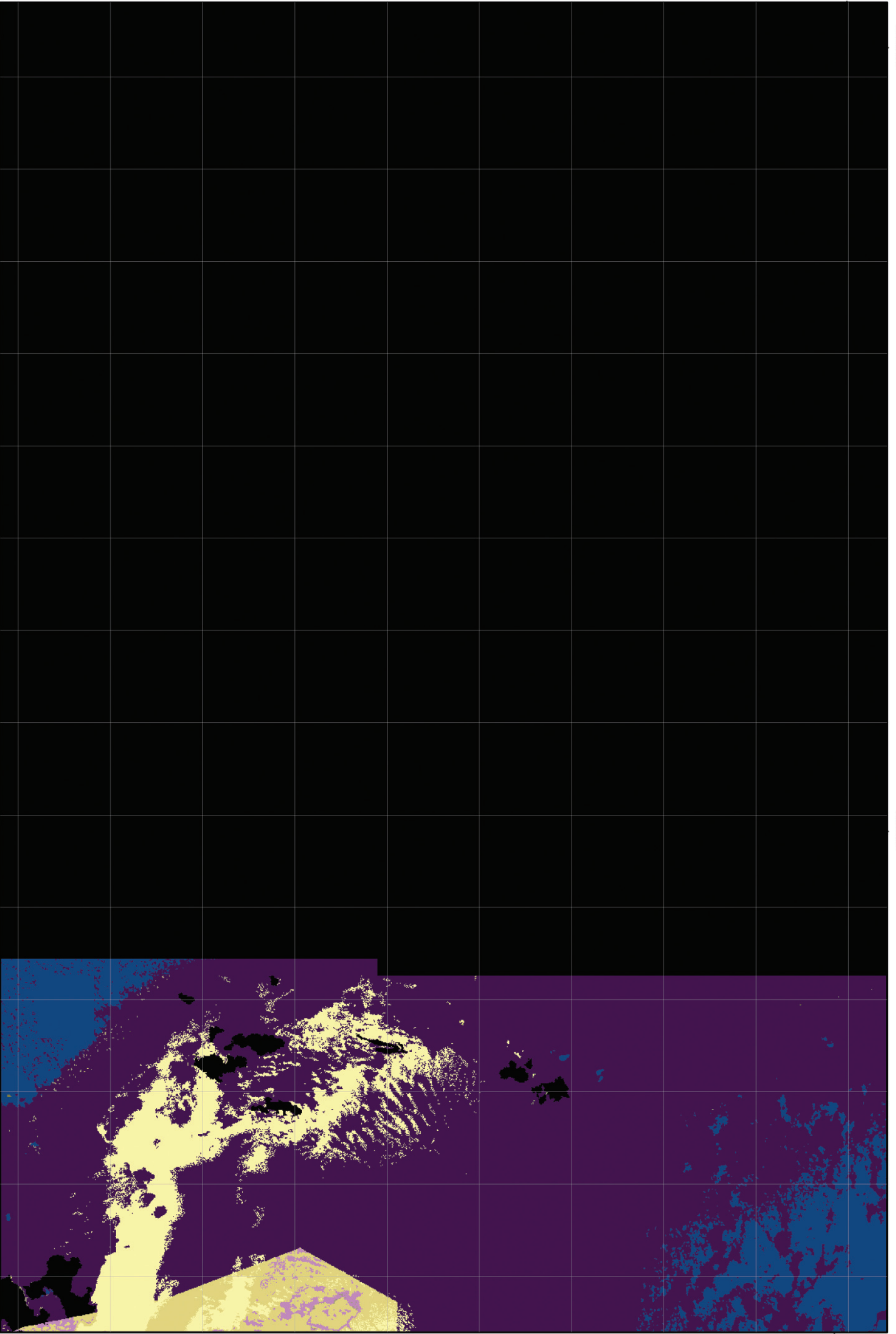
23°45'0"N

166°25'0"W

Tile 66. A 1:40,000 scale detailed habitat map of a portion of French Frigate Shoals, Northwestern Hawaiian Islands.

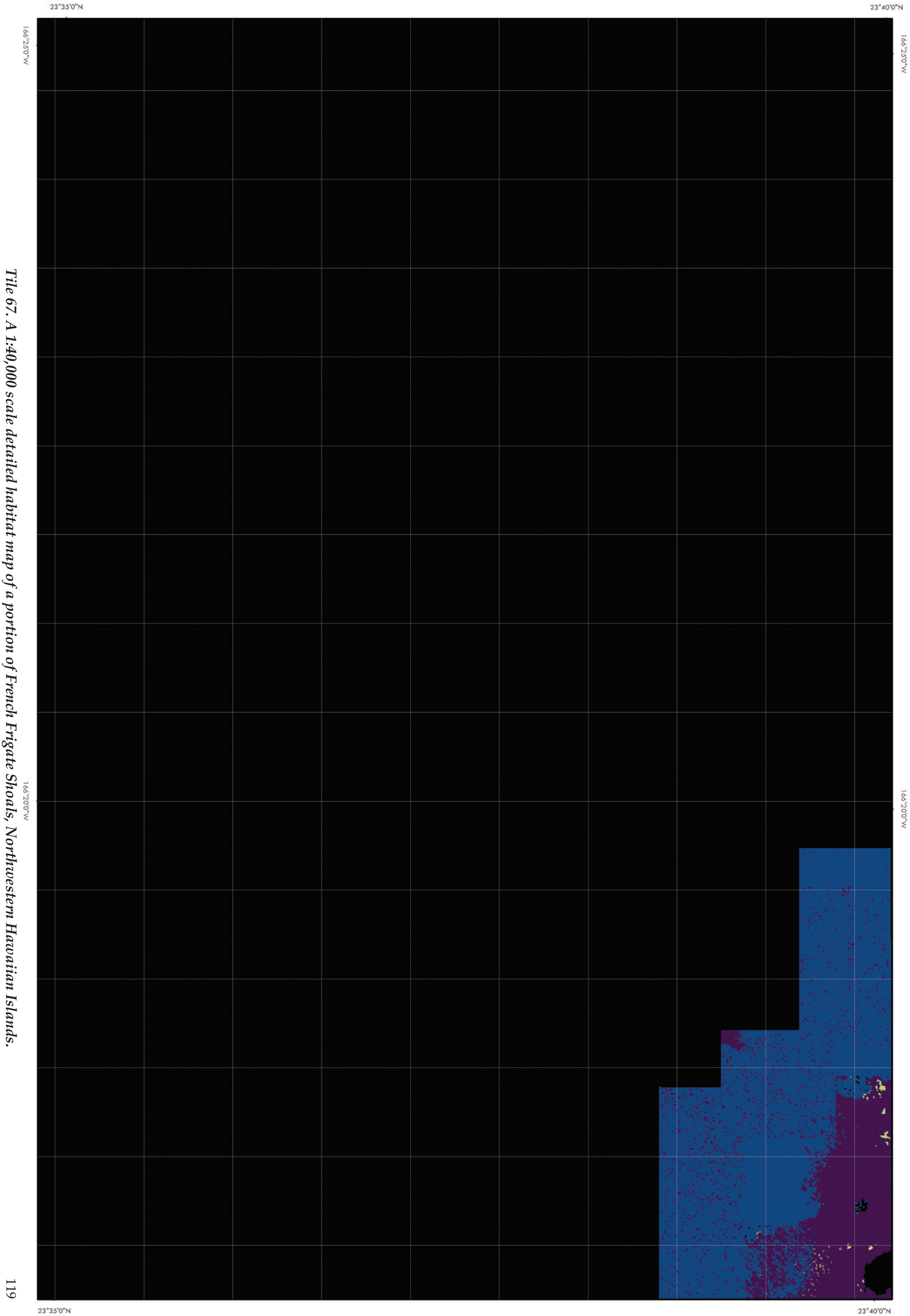
166°20'0"W

23°45'0"N



166°25'0"W

166°20'0"W



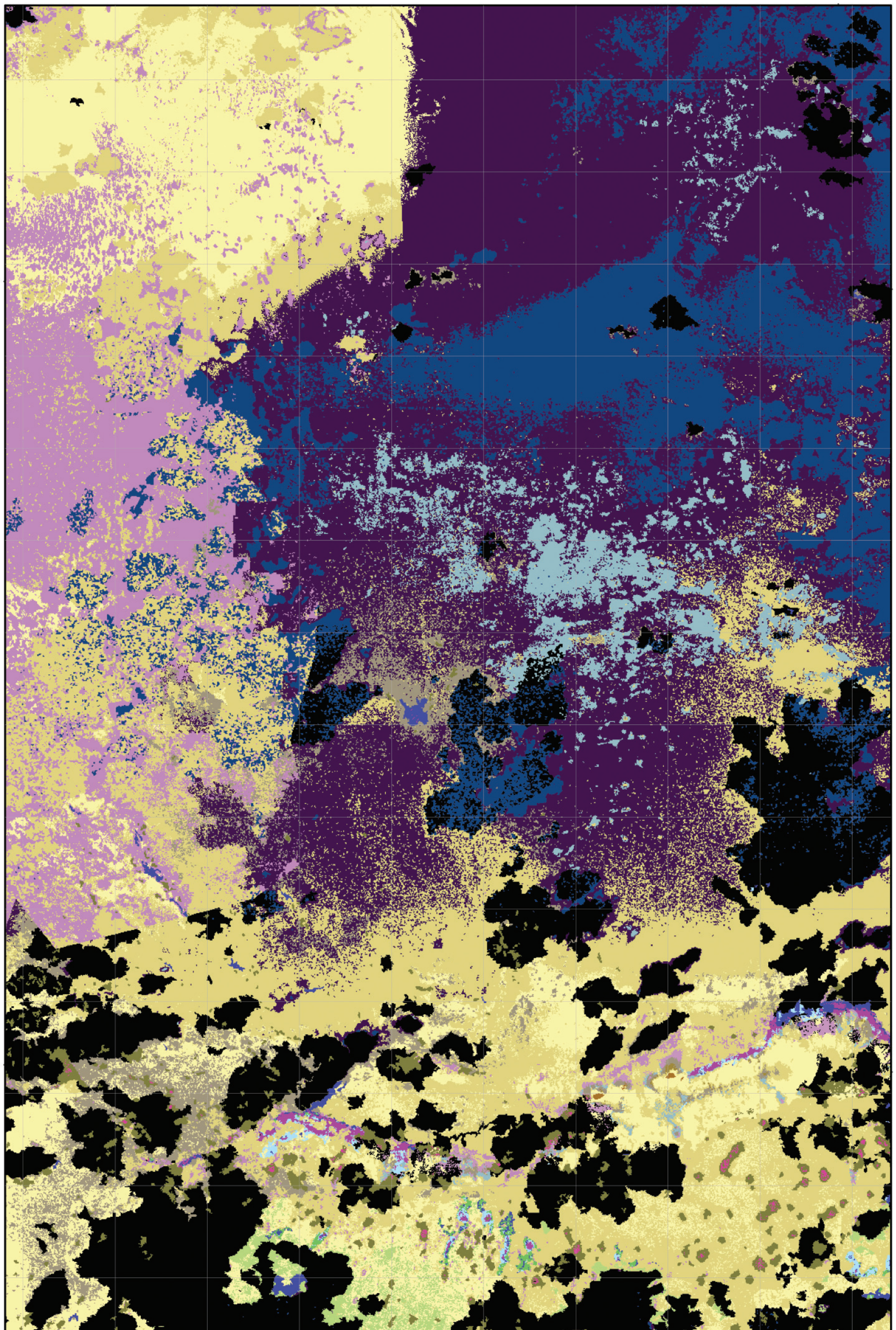
Tile 67. A 1:40,000 scale detailed habitat map of a portion of French Frigate Shoals, Northwestern Hawaiian Islands.

23°45'0"N

Tile 68. A 1:40,000 scale detailed habitat map of a portion of French Frigate Shoals, Northwestern Hawaiian Islands.

166°15'0"W

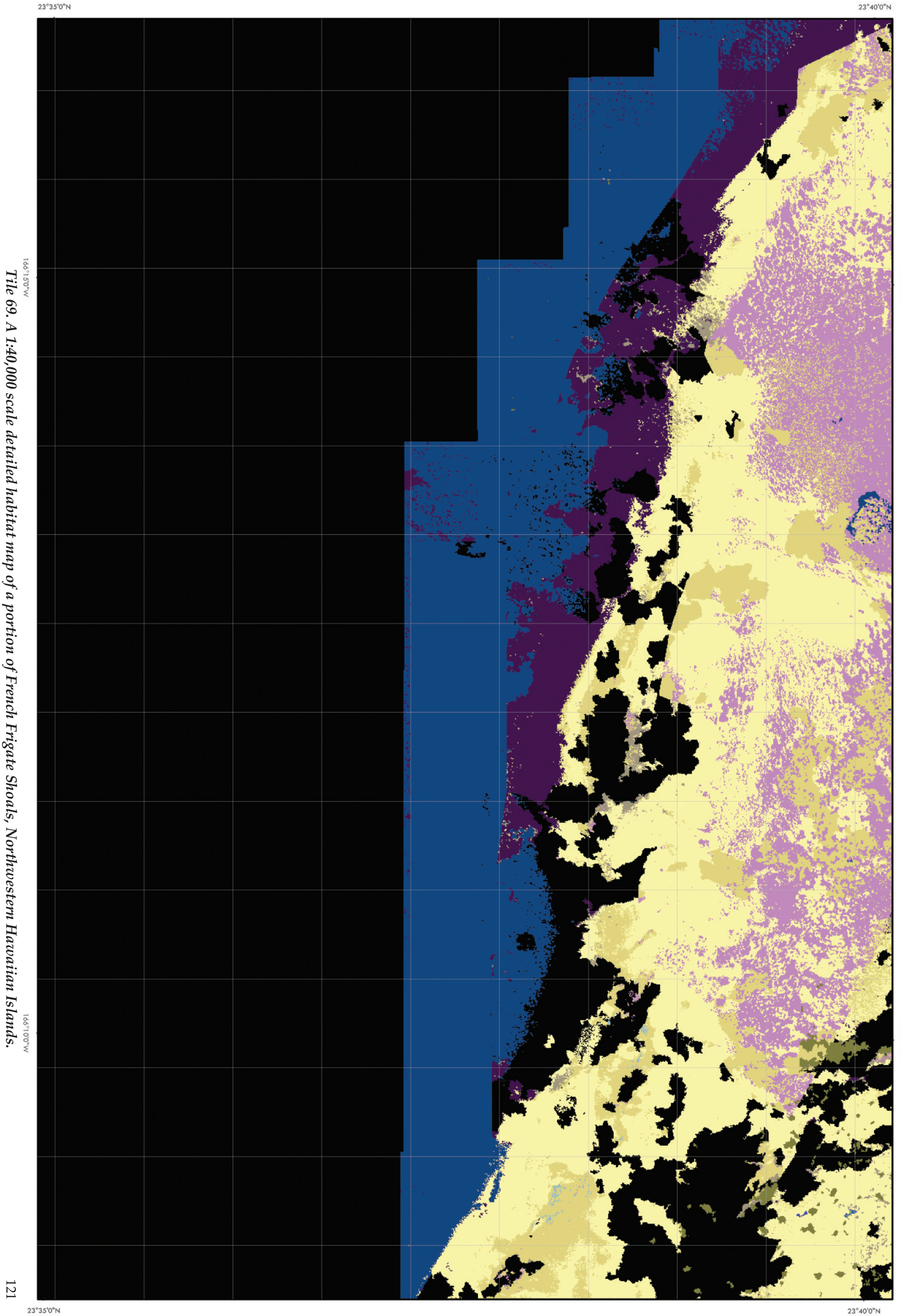
166°10'0"W



166°15'0"W

166°10'0"W

23°45'0"N



Tile 69. A 1:40,000 scale detailed habitat map of a portion of French Frigate Shoals, Northwestern Hawaiian Islands.

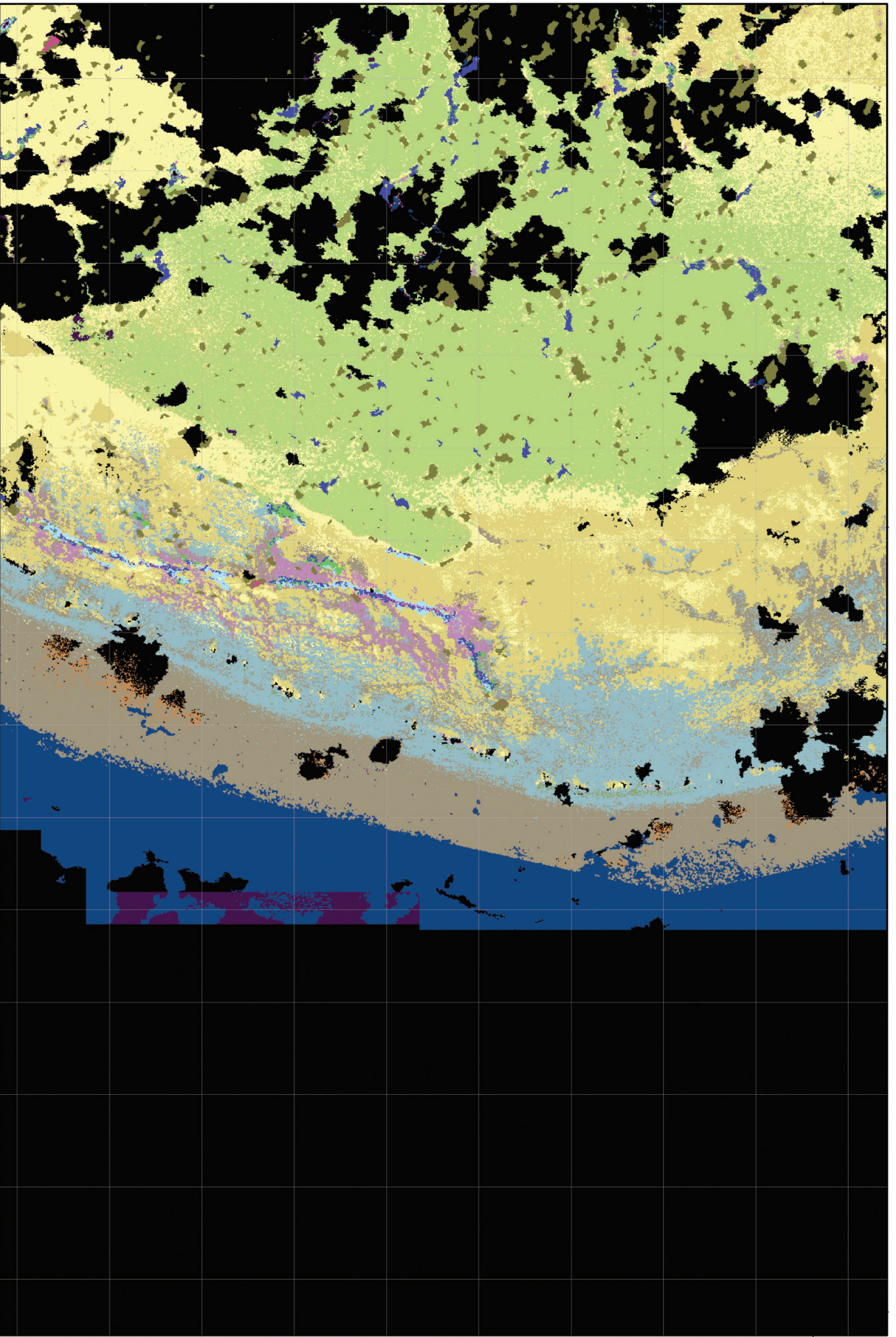
23°45'0"N

Tile 70. A 1:80,000 scale detailed habitat map of a portion of French Frigate Shoals, Northwestern Hawaiian Islands.

166°50'W

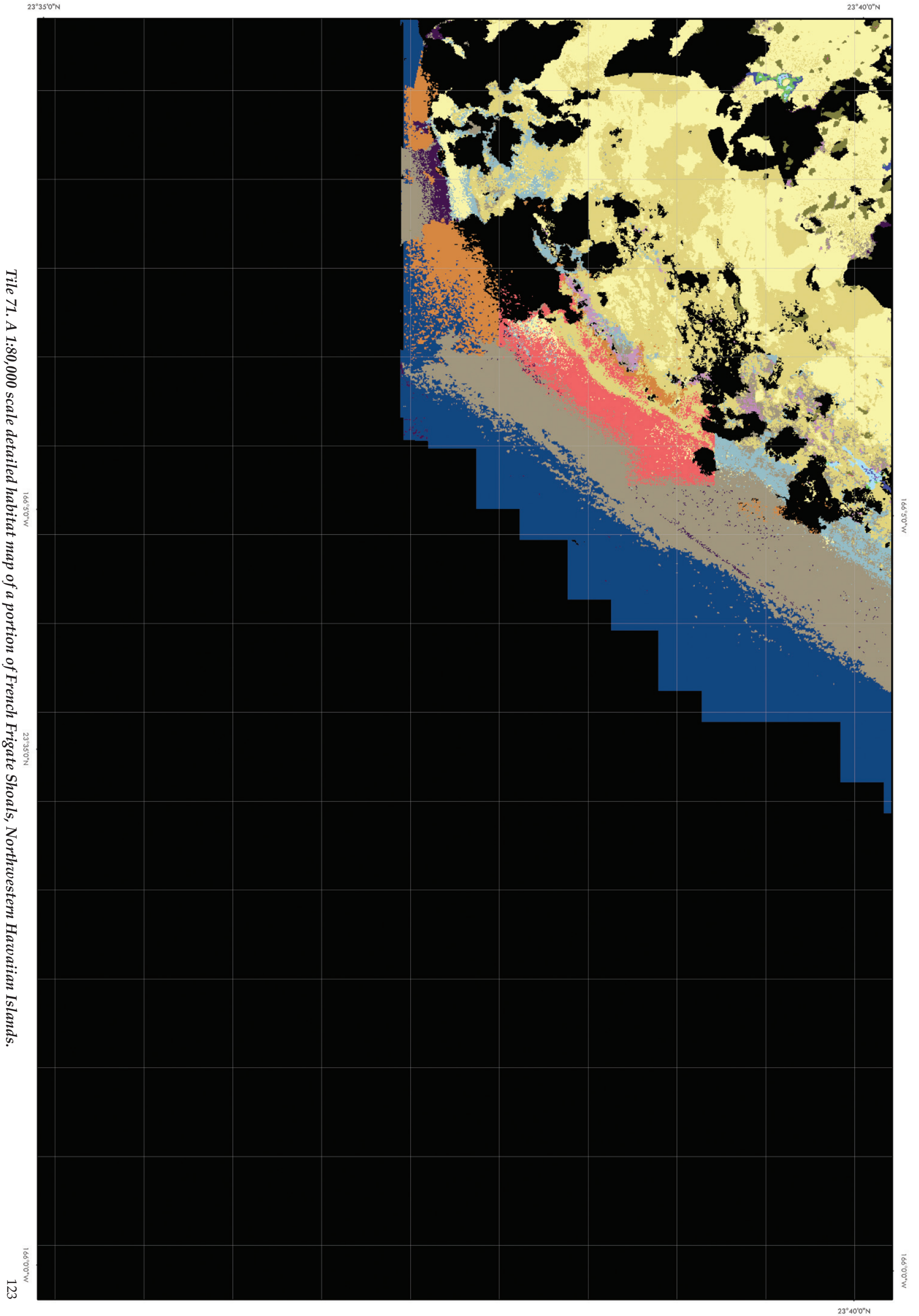
166°00'W

23°45'0"N



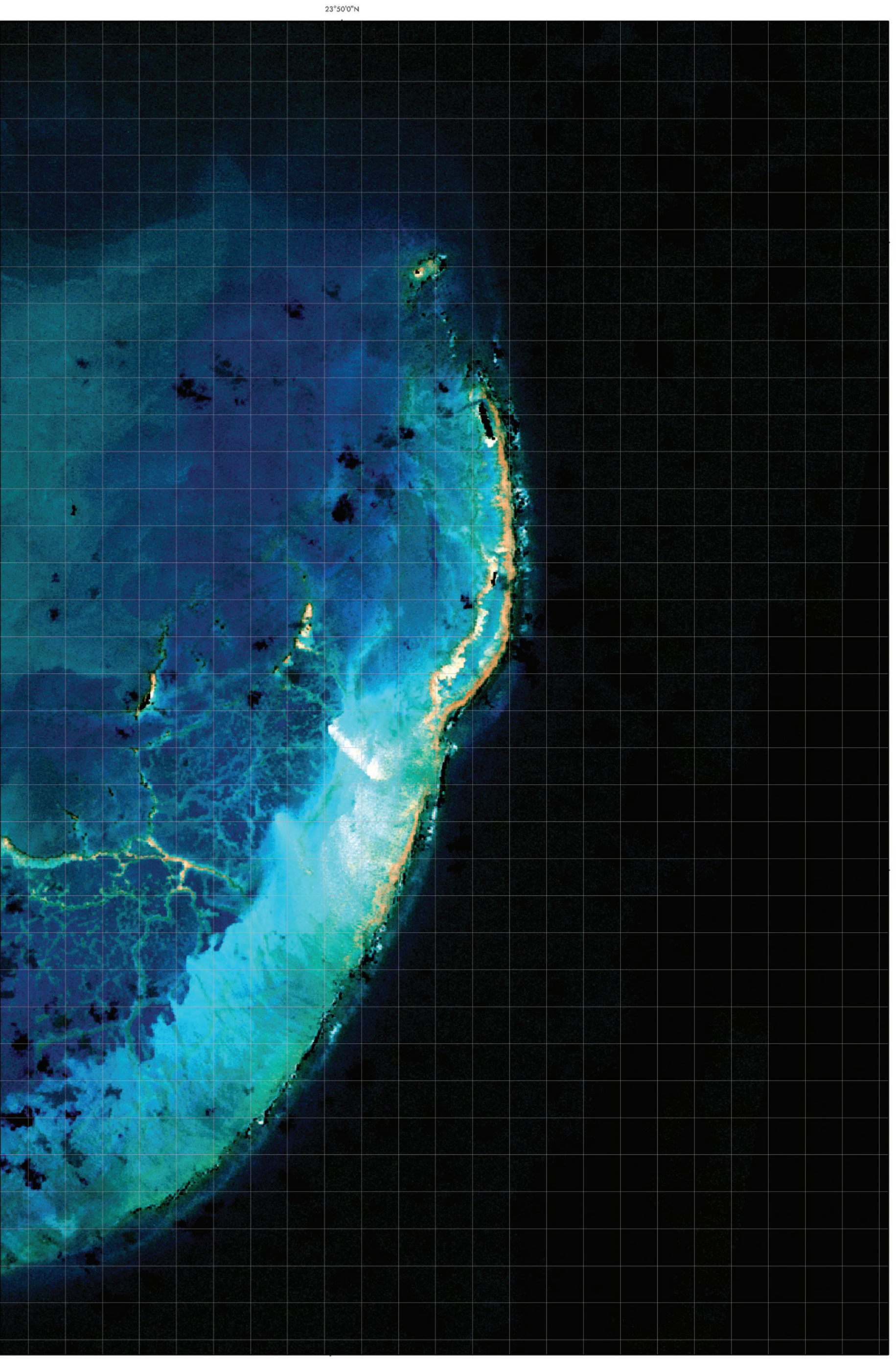
166°50'W

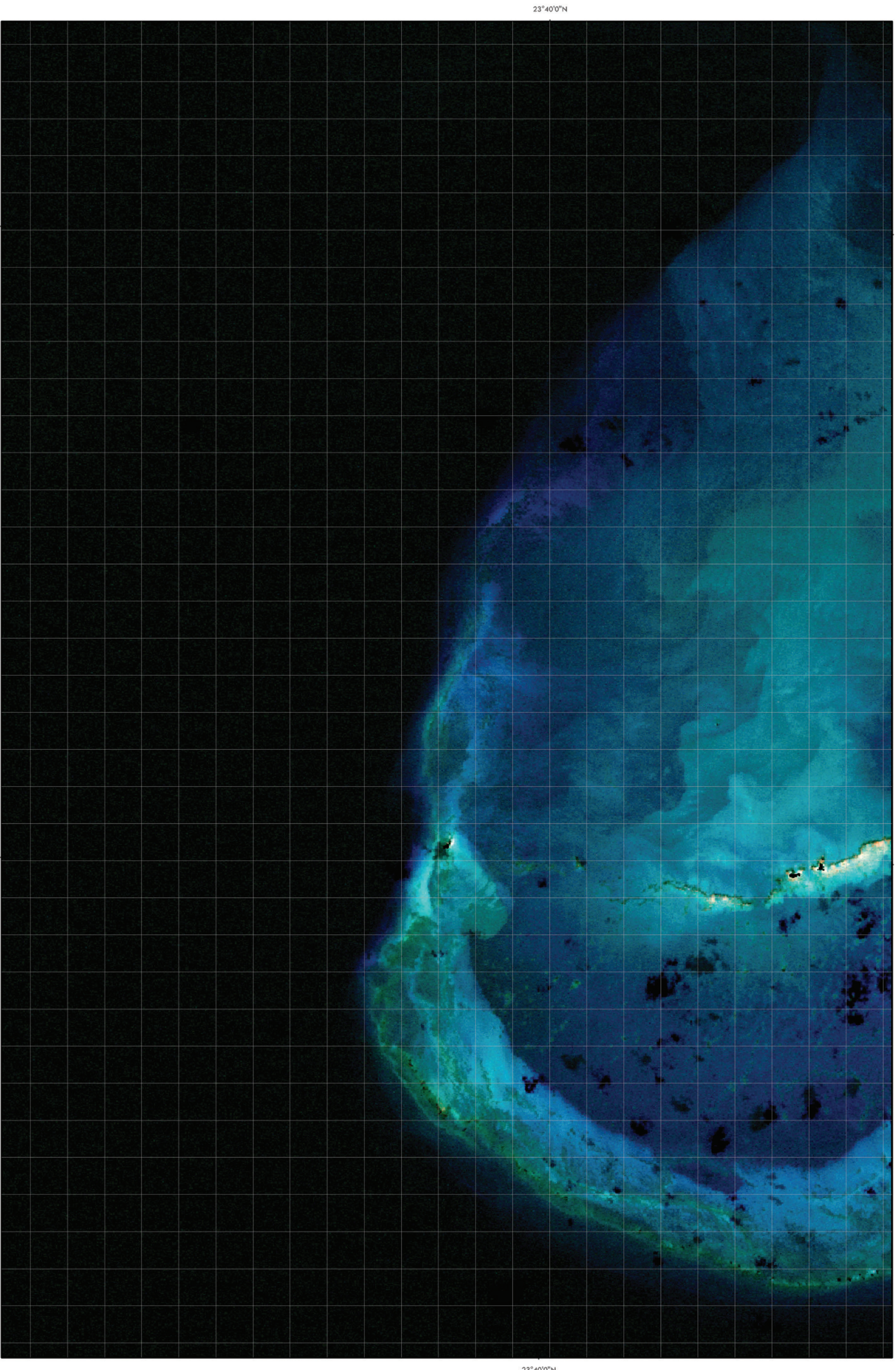
166°00'W



Tile 71. A 1:80,000 scale detailed habitat map of a portion of French Frigate Shoals, Northwestern Hawaiian Islands.

Title 72. A 1:100,000 scale bank map of the northern portion of French Frigate Shoals, Northwestern Hawaiian Islands.





Title 73. A 1:100,000 scale bank map of the southern portion of French Frigate Shoals, Northwestern Hawaiian Islands.

Necker Island (Moku Manamana)

Necker Island is all that remains of an estimated 10 million-year-old shield volcano. Geologists believe that the portion of the volcano above water was once as large as the current size of the island of O'ahu. Now, the highest point on Necker is about 112 m above sea level. Wave erosion has reduced the volcano to a submerged shelf about 65 km long in a NW-SE direction and about 24 km wide. Necker Island itself (164°45'W and 23°18'N) is about 1.1 km long and less than 0.3 km wide, with steep sea cliffs on all sides.

Necker Island is surrounded by a shallow (< 50 m) shelf, which covers an estimated 1,314 sq. km This shallow shelf is subjected to severe wave action throughout the year, which directly impacts the bottom and continually moves sand across the shelf areas. Abrasion and burial inhibit shallow-water coral reef development, so coral coverage is low. In deeper water, the shelf generally shows low relief and low slope. Sand covers the underlying volcanic basalt in many areas.

At least 52 archaeological sites have been identified on Necker Island. Many of these sites are Tahitian. Artifacts from some of these archeological sites are on display at the Bishop Museum in Honolulu. The spine of the island is dotted with 33 religious shrines, marae or ahū, unusually built with upright stones of thin basalt. The location and design of the shrines suggest that the island was visited in ancient times primarily for spiritual purposes. Various theories suggest that the shrines were built for rituals focused on birds, similar to the birdman cult of Rapa Nui (Easter Island). They also may be solar shrines focused on the travel of the sun because the island lies on the Tropic of Cancer. Similarly constructed shrines once existed at other remote, extreme locations in Hawai'i including Haleakala on Maui, and Mauna Loa and Mauna Kea on the Big Island.

Necker Island was “rediscovered” and named in 1786 by Jean Francois de Galaup. He reported that, due to the terrain and the strong waves and currents, landing was not possible on the island. Necker is essentially a barren island and supports only six known species of plants. Despite this, at least 60,000 birds of 16 species rest and nest there each year.

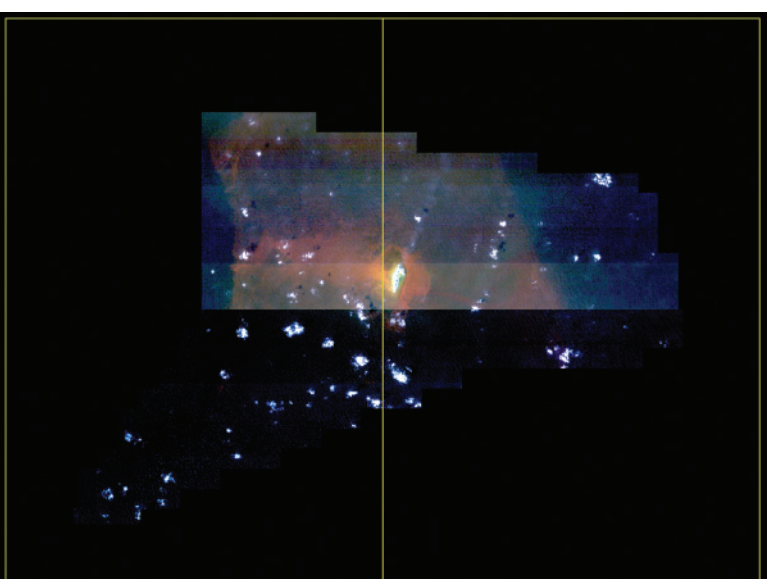
Due to its size, two map tiles are required to depict the 1:80,000 scale estimated bathymetry and aggregated habitat cover maps. Six map tiles are required to depict the 1:40,000 scale detailed benthic habitats of Necker Island. Two 1:175,000 scale map tiles are included to depict the extensive shallow-water bank area around Necker Island. A one-square-kilometer grid is included with all maps of Necker Island.

The area in square kilometers of aggregated benthic habitat cover types found at Necker Island, Northwestern Hawaiian Islands.

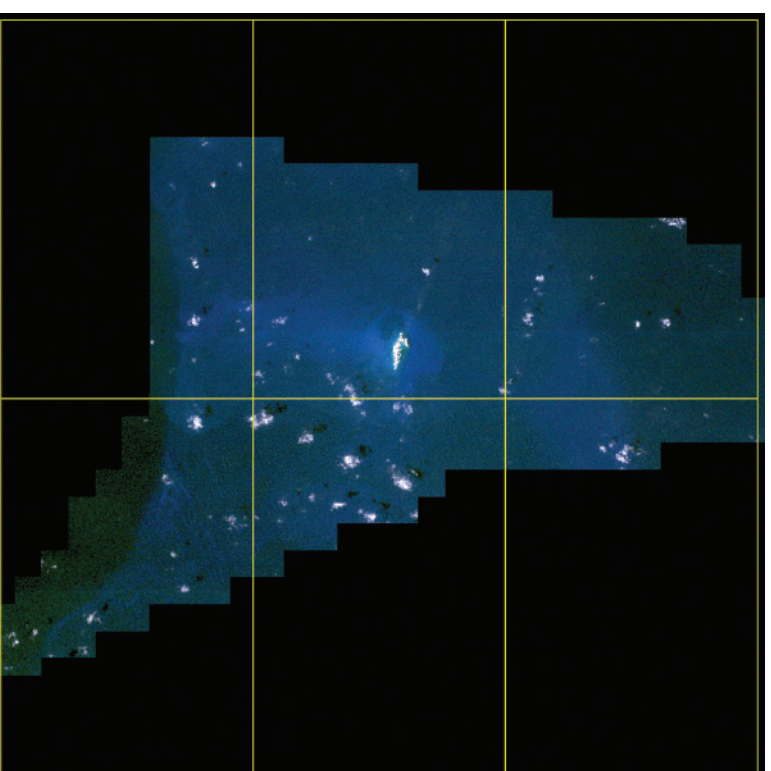
Hardbottom with >10% live coral	-
Hardbottom with >10% crustose coralline algae	-
Hardbottom (uncolonized)	-
Hardbottom with >10% macroalgae	-
Hardbottom with indeterminate cover	208.1
Unconsolidated with 10% or less macroalgae or seagrass	19.5
Unconsolidated with >10% macroalgae or seagrass	-
Total Habitat Area Classified	227.6

The area in square kilometers of benthic habitats found at Necker Island, Northwestern Hawaiian Islands.

Unconsolidated (1000), refer to classification scheme for habitat description)	-
Sand (1100)	19.5
Sand with macroalgae (1120)	-
Sand with patchy (10–50% cover) (1121)	-
Sand with dense (>50% cover) macroalgae (1122)	-
Unconsolidated Rubble (1300)	-
Unconsolidated Rubble with sparse (10–50% cover) algae (1301)	-
Unconsolidated Rubble with dense (>50% cover) algae (1302)	-
Sand and Rubble (1400)	-
Groove (1500)	-
Hardbottom (2000)	205.5
Hardbottom with sparse (10–50% cover) algae (2001)	-
Hardbottom with live coral (>10% cover) (2010)	-
Hardbottom, uncolonized (2020)	-
Hardbottom with crustose coralline algae (>10% cover) (2030)	-
Linear Reef (2100)	-
Linear Reef with live coral (>10% cover) (2110)	-
Linear Reef, uncolonized (2120)	-
Linear Reef with crustose coralline algae (>10% cover) (2121)	-
Linear Reef with crustose coralline algae (<10% cover) (2130)	-
Aggregated Coral Heads with live coral (>10% cover) (2210)	-
Spur and Groove (2300)	-
Patch Reef (2400)	-
Patch Reef with live coral (>10% cover) (2410)	-
Patch Reef, uncolonized (2420)	-
Patch Reef, uncolonized with sparse (10–50% cover) algae (2421)	-
Patch Reef with crustose coralline algae (>10% cover) (2430)	-
Aggregated Patch Reef (2500)	-
Aggregated Patch Reef with live coral (>10% cover) (2510)	-
Scattered Coral/Rock in Sand with live coral (>10% cover) (2610)	-
Pavement (2700)	-
Pavement with sparse (10–50% cover) algae (2701)	-
Pavement with dense (>50% cover) algae (2702)	-
Pavement with live coral (>10% cover) (2710)	-
Pavement with live coral (<10% cover) with dense (>50% cover) algae (2712)	-
Pavement, uncolonized (2720)	-
Pavement, uncolonized with dense (>50% cover) algae (2722)	-
Pavement with crustose coralline algae (>10% cover) (2730)	-
Pavement with sand channels (2800)	-
Pavement with sand channels and live coral (>10% cover) (2810)	-
Pavement with sand channels, uncolonized (2820)	-
Volcanic Rock (2900)	2.7
Volcanic Rock with dense (>50% cover) algae (2902)	<0.1
Volcanic Rock with live coral (>10% cover) (2910)	-
Volcanic Rock, uncolonized (2920)	-
Deep water (3010)	78.3
Reef crest (3020)	-
Dredged channel (3030)	-
Land (3100)	0.1
Cloud, Shadow, Surf, and No image data (3210, 3220, 3230, and 4000)	11.1
Unclassified (3300)	-
Total Habitat Area Classified	227.6
TOTAL Area in IKONOS image	317.2

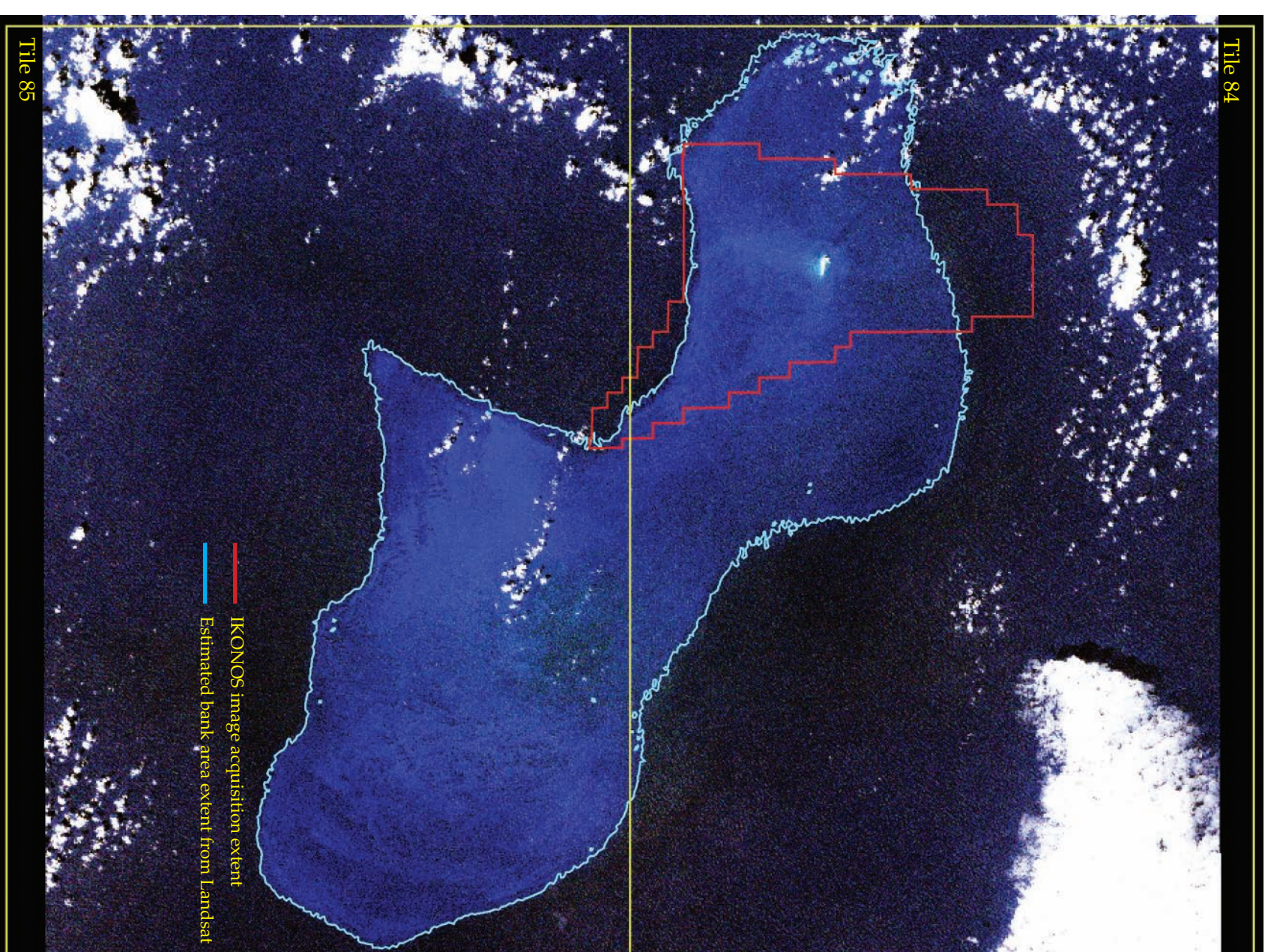


Index of 1:80,000 tiles



Index of 1:40,000 tiles

Index maps indicating the locations of map tiles for the 1:40,000 scale detailed habitat maps, the 1:80,000 scale aggregated cover and estimated bathymetry, and the 1:175,000 scale bank of Necker Island, Northwestern Hawaiian Islands.



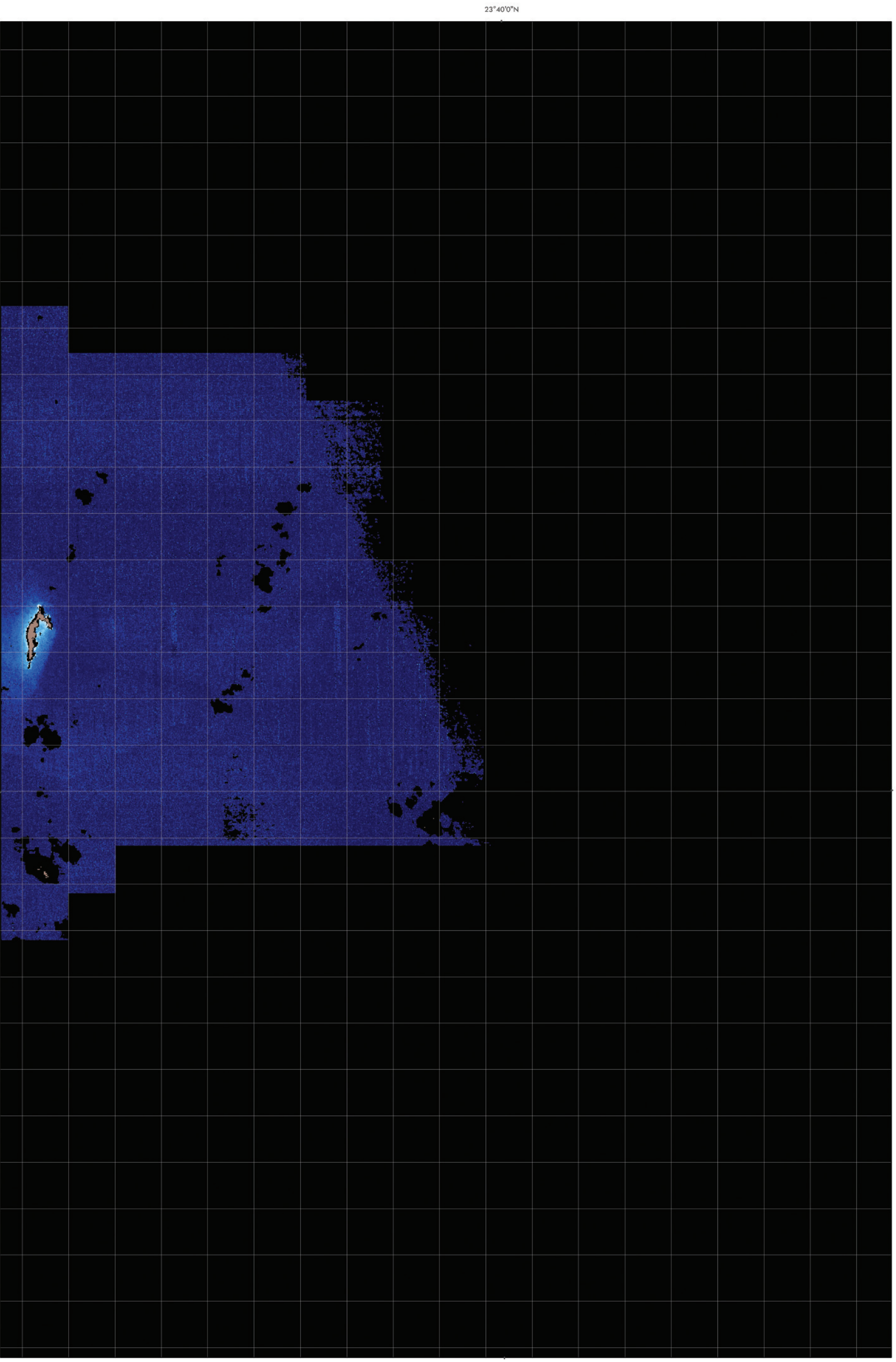
Tile 84

Tile 85

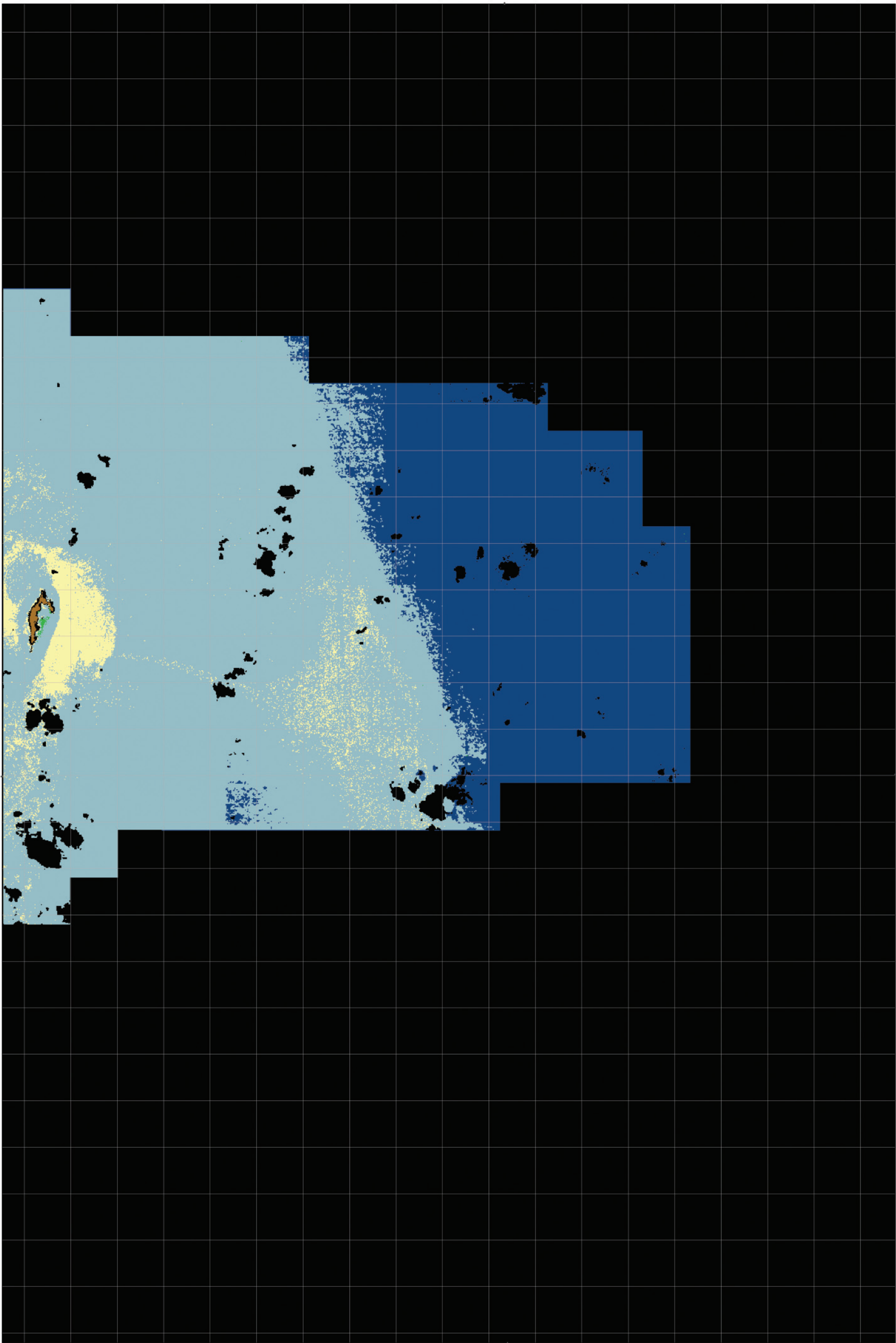
Index of 1:175,000 tiles

— IKONOS image acquisition extent
 — Estimated bank area extent from Landsat

Tile 74. A 1:80,000 scale estimated bathymetry map of the northern portion of Necker Island, Northwestern Hawaiian Islands.

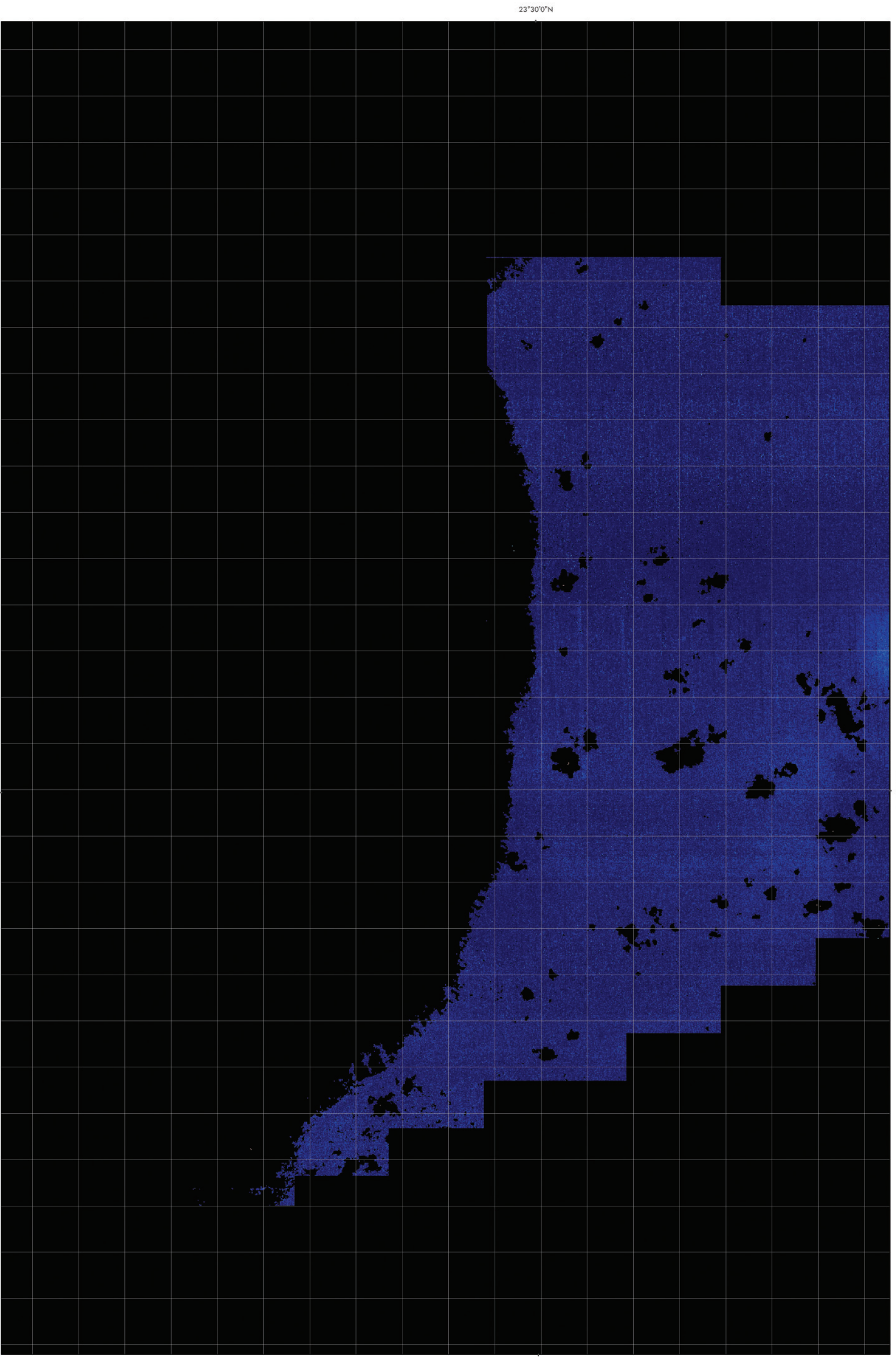


23°40'0"N



Title 75. A 1:80,000 scale aggregated cover map of the northern portion of Necker Island, Northwestern Hawaiian Islands.

Tile 76. A 1:80,000 scale estimated bathymetry map of the southern portion of Necker Island, Northwestern Hawaiian Islands.



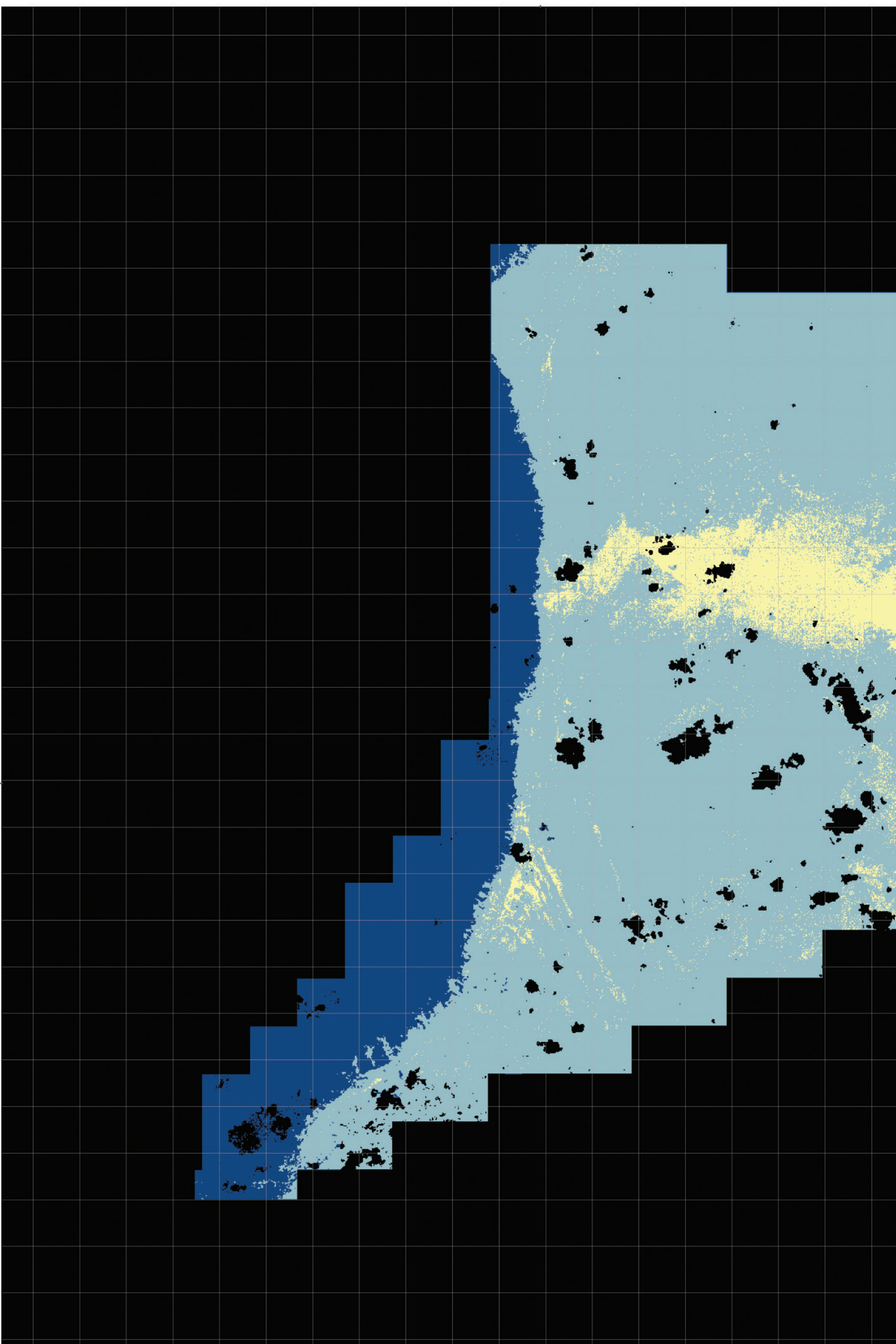
23°30'0"N

164°40'0"W

164°40'0"W

23°30'0"N

23°30'0"N

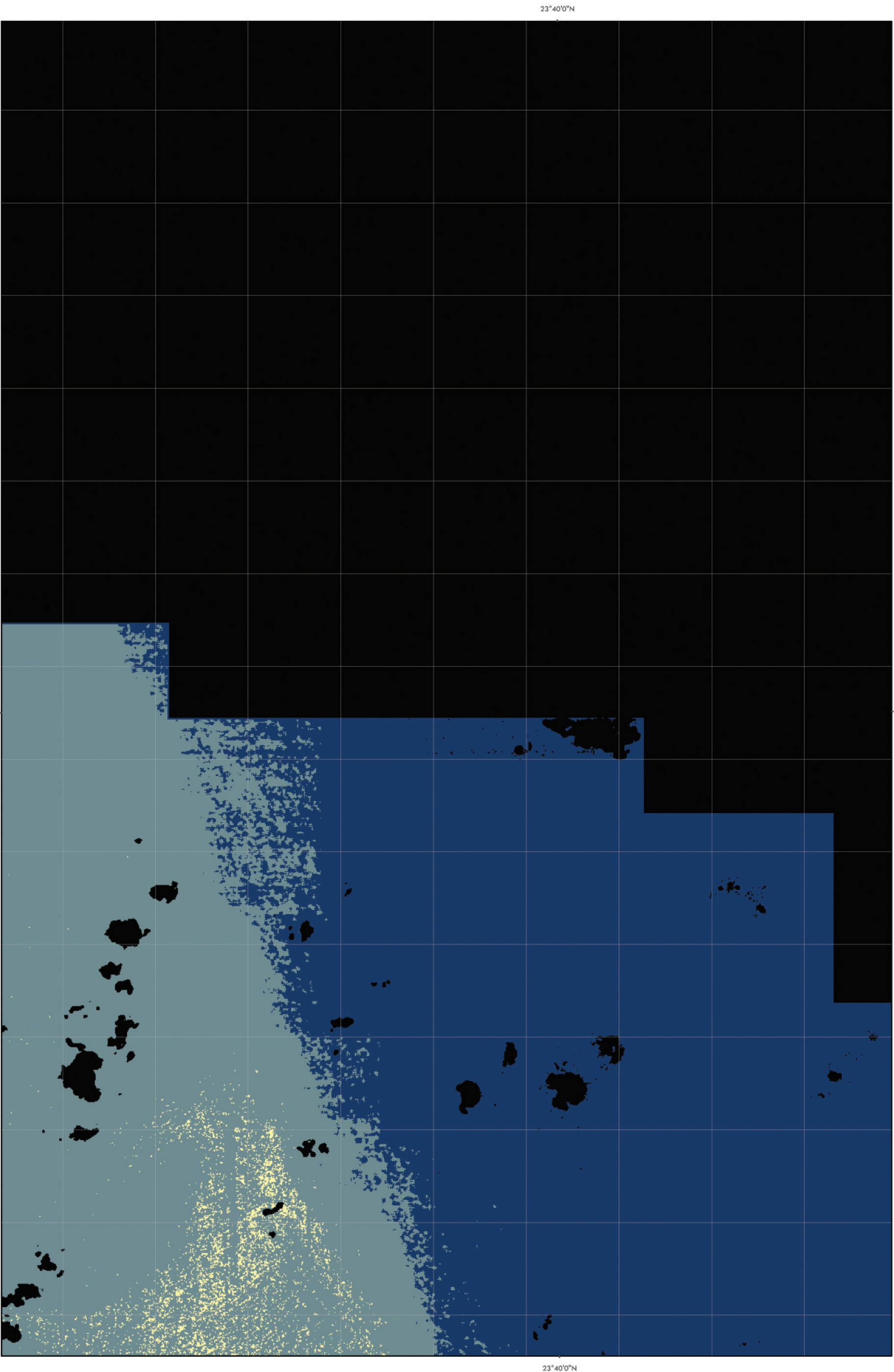


164°40'0"W

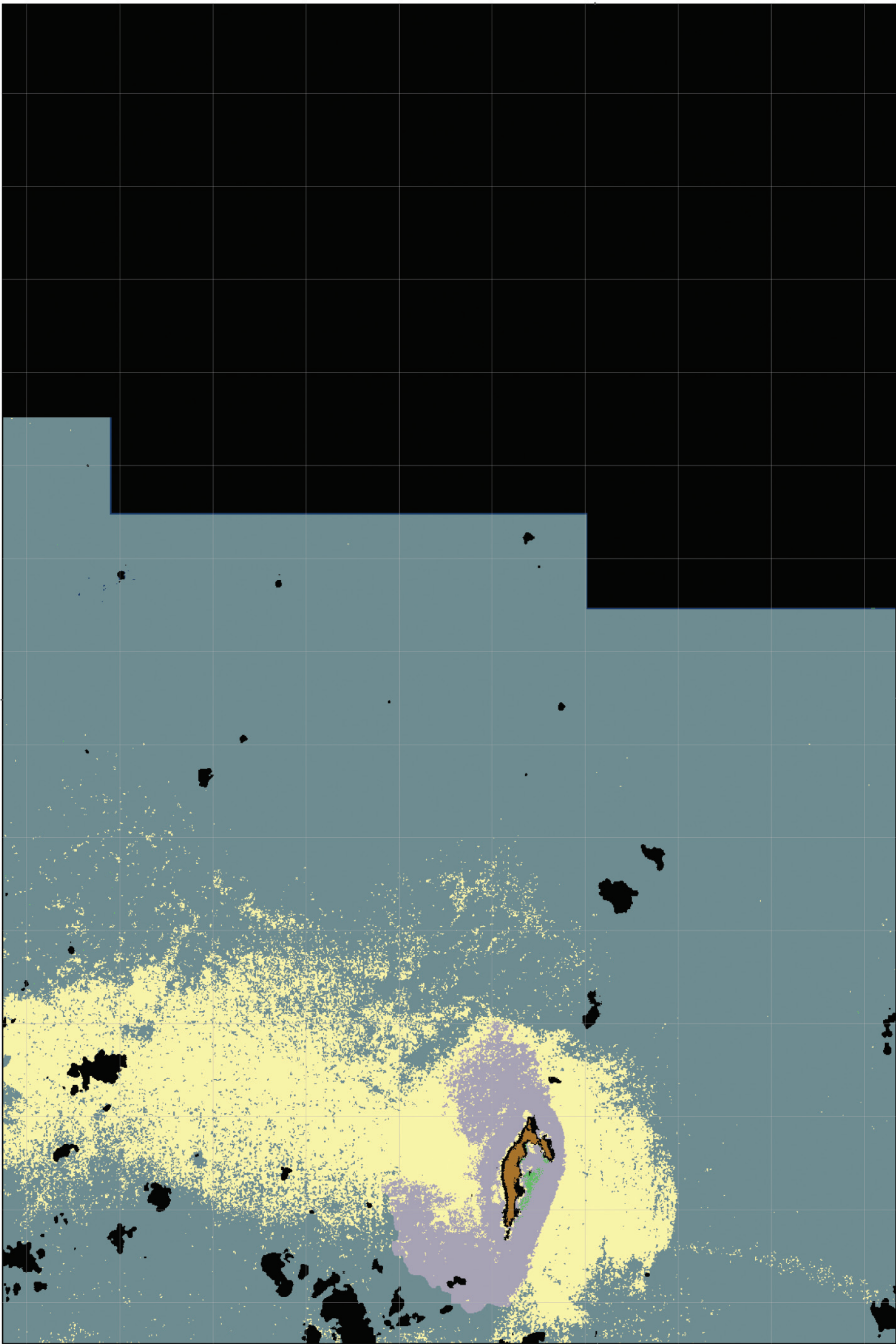
23°30'0"N

Title 77. A 1:80,000 scale aggregated cover map of the southern portion of Necker Island, Northwestern Hawaiian Islands.

Tile 78. A 1:40,000 scale detailed habitat map of the northwest portion of Necker Island, Northwestern Hawaiian Islands.



23°35'0"N

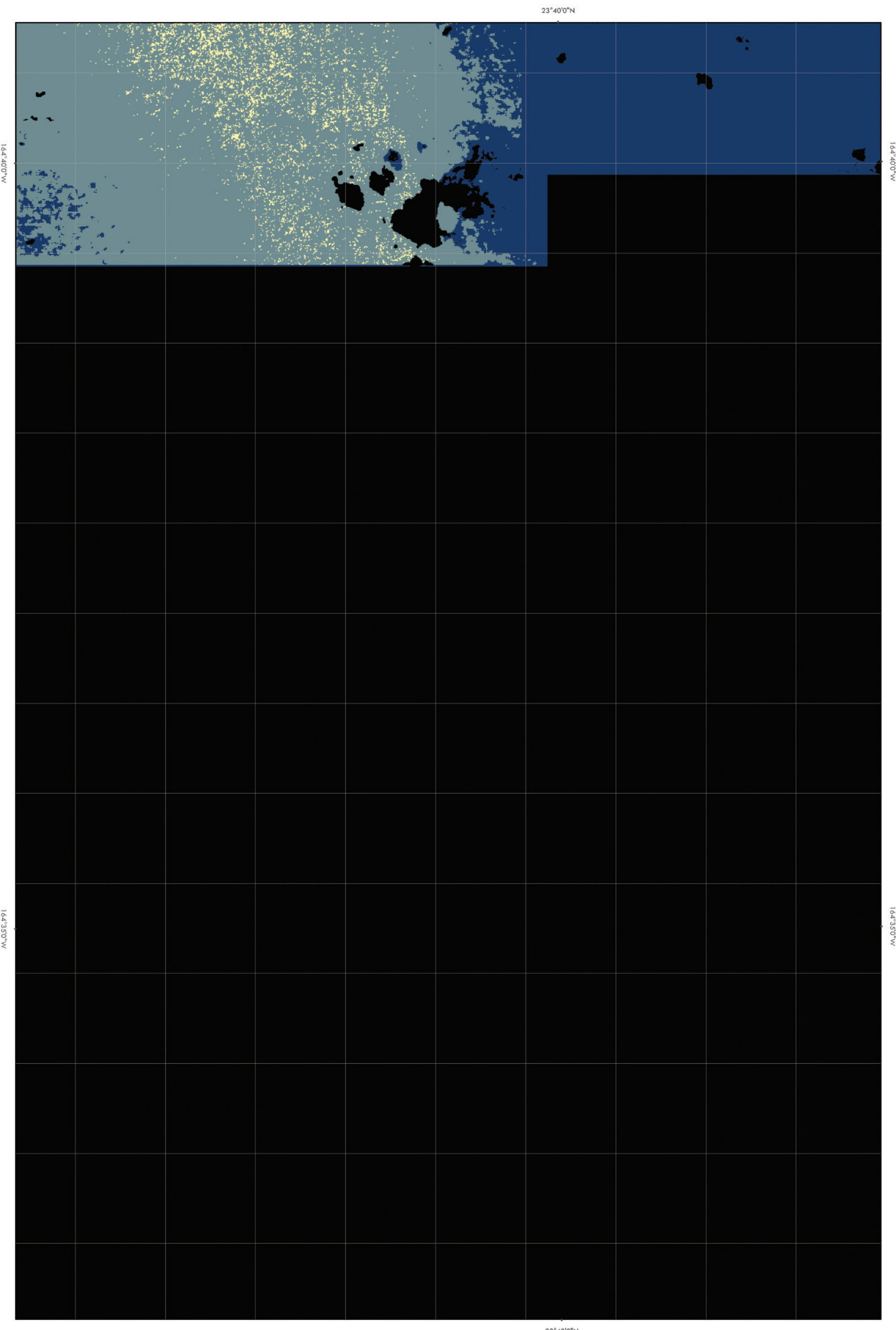


164°45'0"W

23°35'0"N

Tile 79. A 1:40,000 scale detailed habitat map of the west central portion of Necker Island, Northwestern Hawaiian Islands.

Tile 80. A 1:40,000 scale detailed habitat map of the northeast portion of Necker Island, Northwestern Hawaiian Islands.



23°35'0"N

164°40'0"W

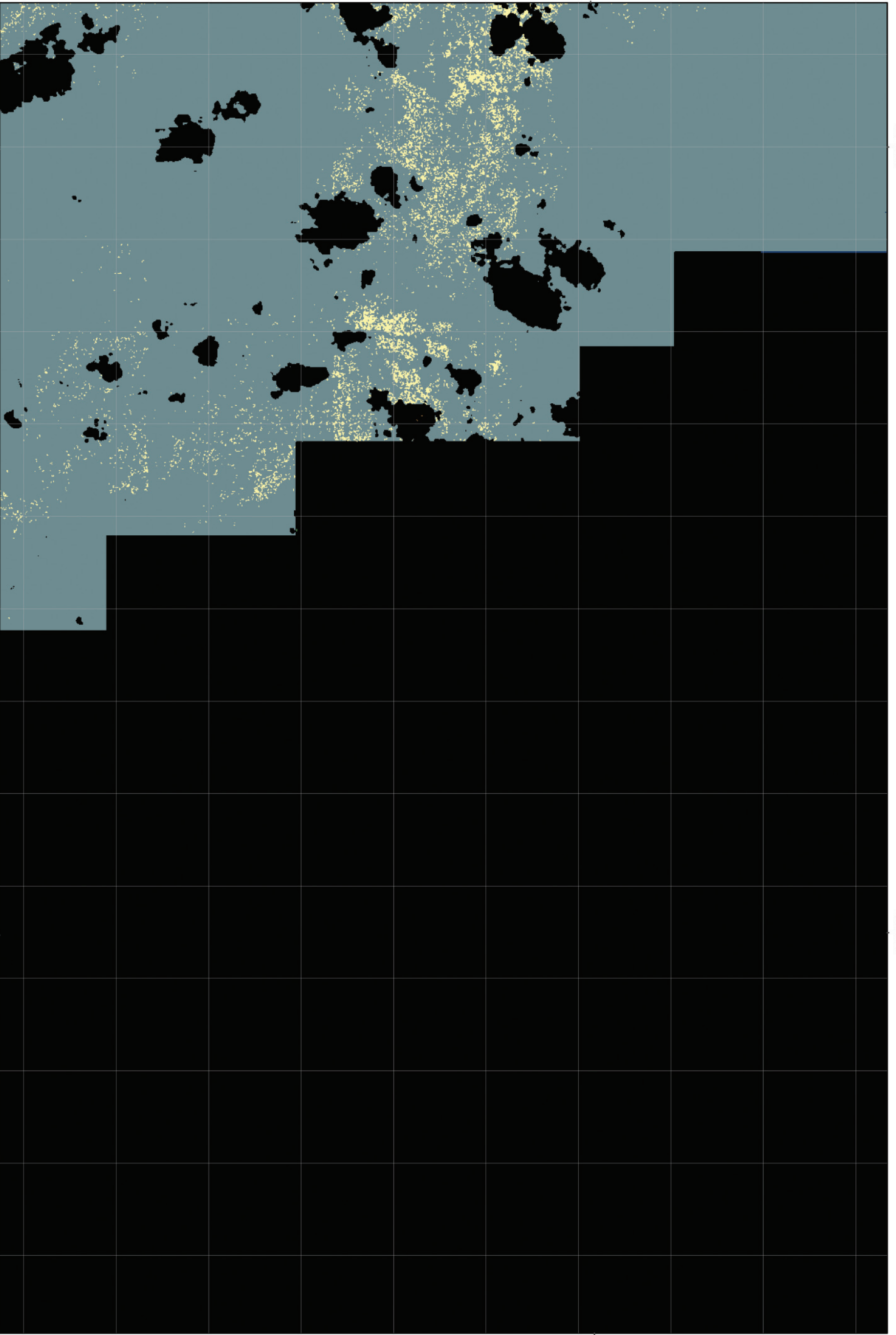
164°35'0"W

23°35'0"N

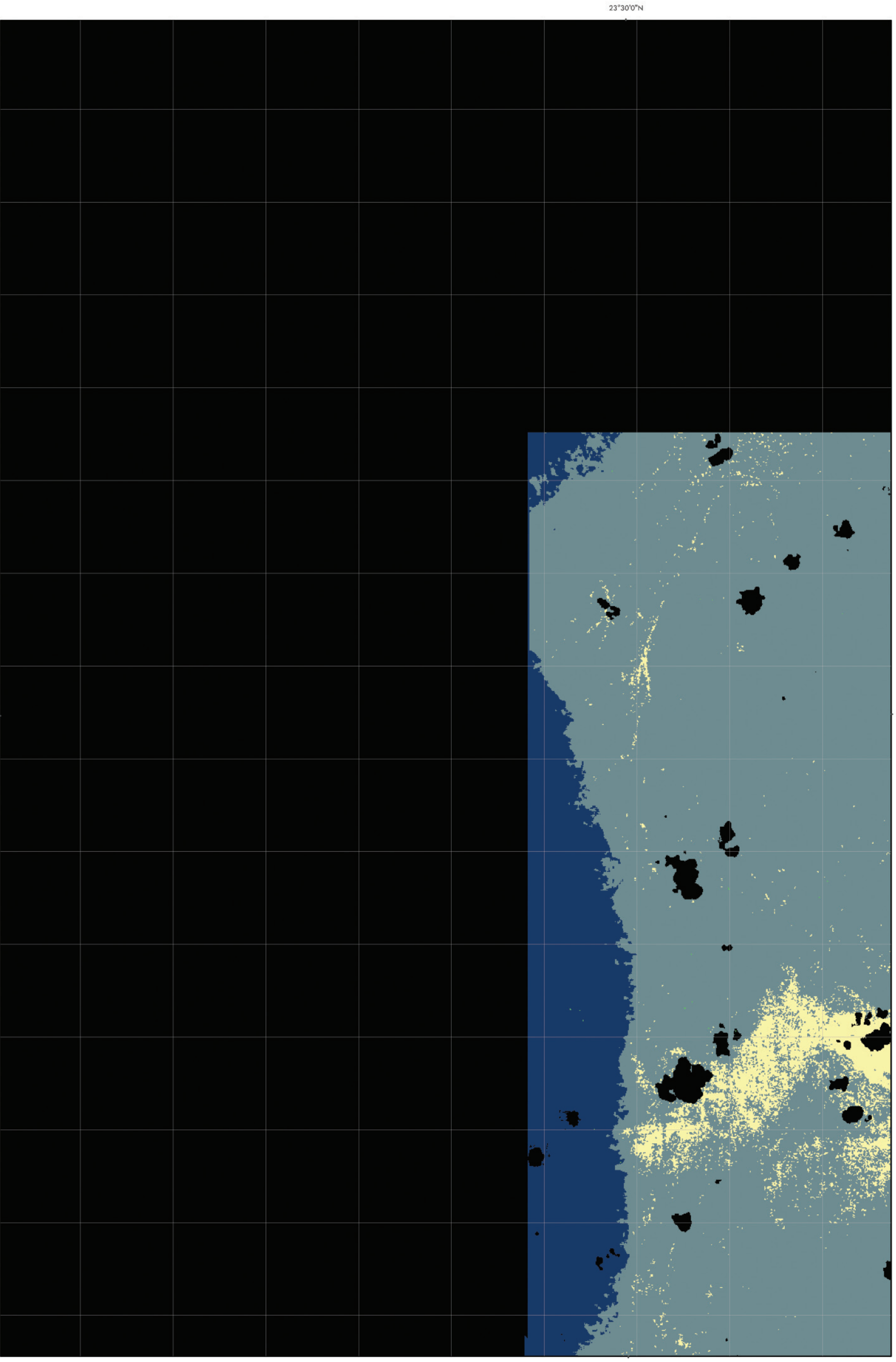
164°40'0"W

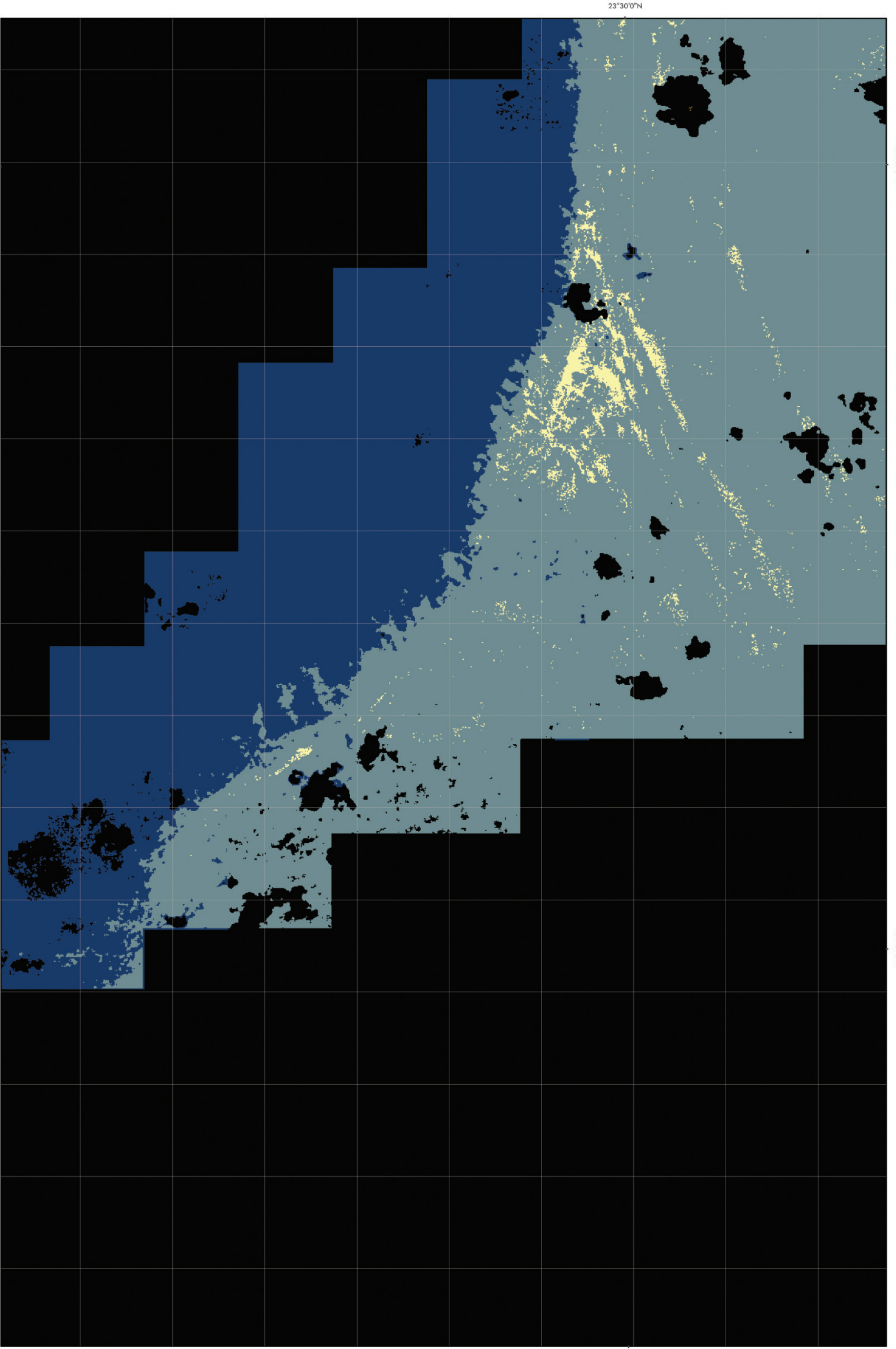
164°35'0"W

Title 81. A 1:40,000 scale detailed habitat map of the east central portion of Necker Island, Northwestern Hawaiian Islands.



Tile 82. A 1:40,000 scale detailed habitat map of the southwest portion of Necker Island, Northwestern Hawaiian Islands.





Tile 83. A 1:40,000 scale detailed habitat map of the southeast portion of Necker Island, Northwestern Hawaiian Islands.

Tile 84. A 1:175,000 scale bank map of the northern portion of Necker Island, Northwestern Hawaiian Islands.

164°40'0"W

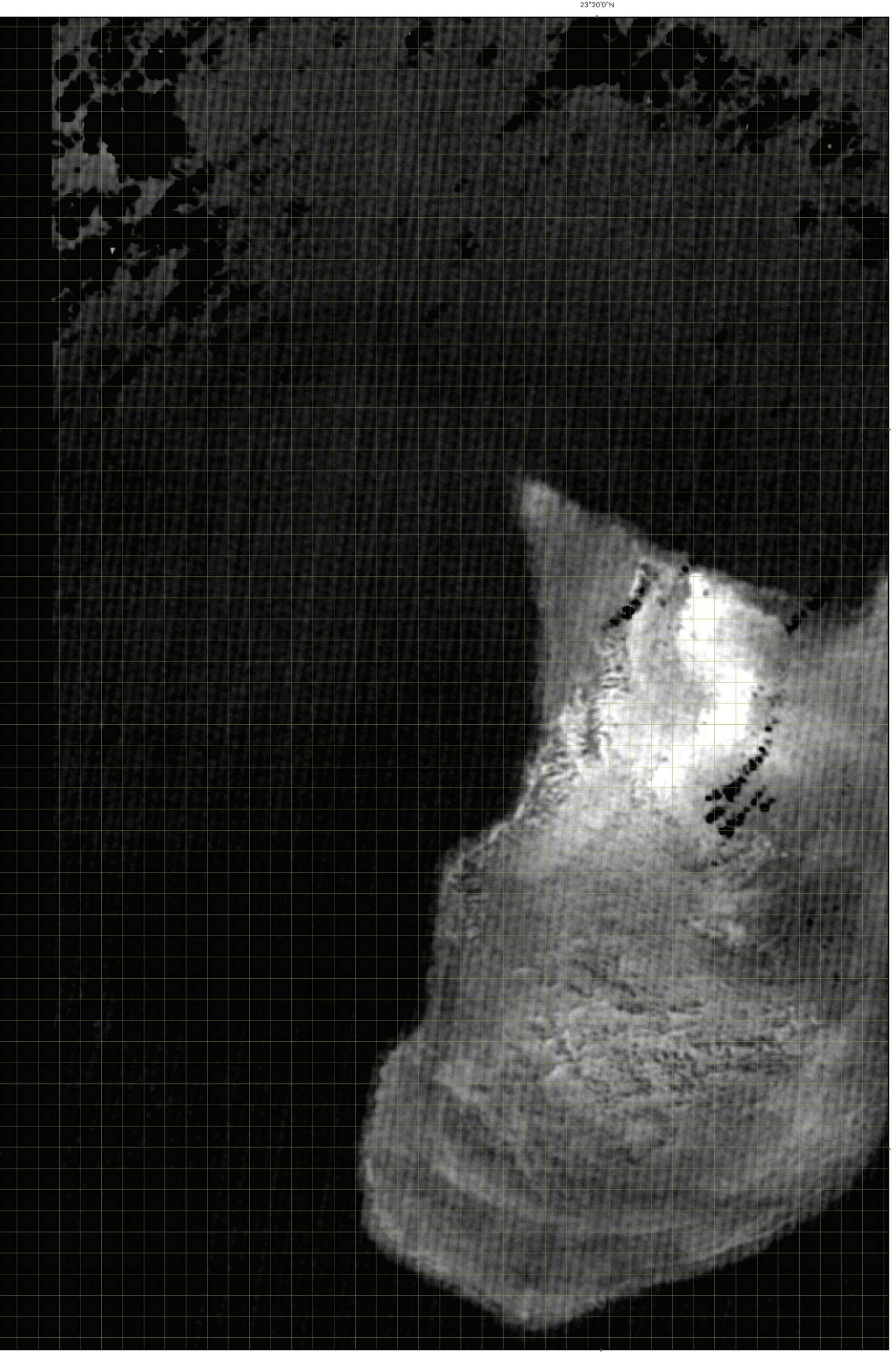
164°20'0"W

23°40'0"N

23°40'0"N

164°40'0"W

164°20'0"W



Tile 85. A 1:175,000 scale bank map of the southern portion of Necker Island, Northwestern Hawaiian Islands.

Nihoa Island

Approximately 250 km WNW of Kaua'i and 1975 km ESE of Midway lies Nihoa Island at longitude 161 degrees 56 minutes W and latitude 23 degrees 03 minutes N. Nihoa is estimated to be 7.2 million years old. Erosion has left only about 0.6 sq. km of what was once a large island. The sheer cliffs of the island jut up to as high as 215 m.

Nihoa Island is the emergent portion of a large basaltic shelf that measures about 29 km long in a NE-SW direction 16 km wide. The depth of the shelf is typically between 34 and 66 m. In total, the shallow water shelf surrounding Nihoa covers an estimated 487 sq. km.

Nihoa is considered to be the best example of a nearly undisturbed coastal ecosystem in the entire Hawaiian archipelago. An estimated 500,000 birds of 17 species regularly breed on the island. The Nihoa Finch and the Nihoa Millerbird are found nowhere else on earth.

Sheila Conant, an ornithologist at the University of Hawai'i, began studies of the Nihoa Finch and the Laysan Finch in 1980. Her research revealed that food type and availability has influenced the evolution of the size and shape of the beaks of these birds. Dr. Conant's findings confirm that these birds can adapt rapidly (produce offspring with more appropriate beaks) to changes in food type and availability. For many years, similar research was conducted on the Galapagos Islands by Peter and Rosemary Grant of Princeton University.

The shallow-water coral reef communities found at Nihoa are the result of constant wave action. Throughout the year, Nihoa is constantly awash in powerful oceanic waves. Northeasterly Trade Wind-generated waves occur throughout the year with major impact from North Pacific swell during the winter. As a result, sand shifting on the shelf tends to inhibit coral settlement and growth.

Nihoa has a rich cultural heritage. The island has 88 Polynesian archaeological sites. Polynesians inhabited the island between 1000 and 1700 A.D. House sites, sweet potato terraces and religious sites still remain from these early settlers who had vanished from the island by the time Western ships arrived.

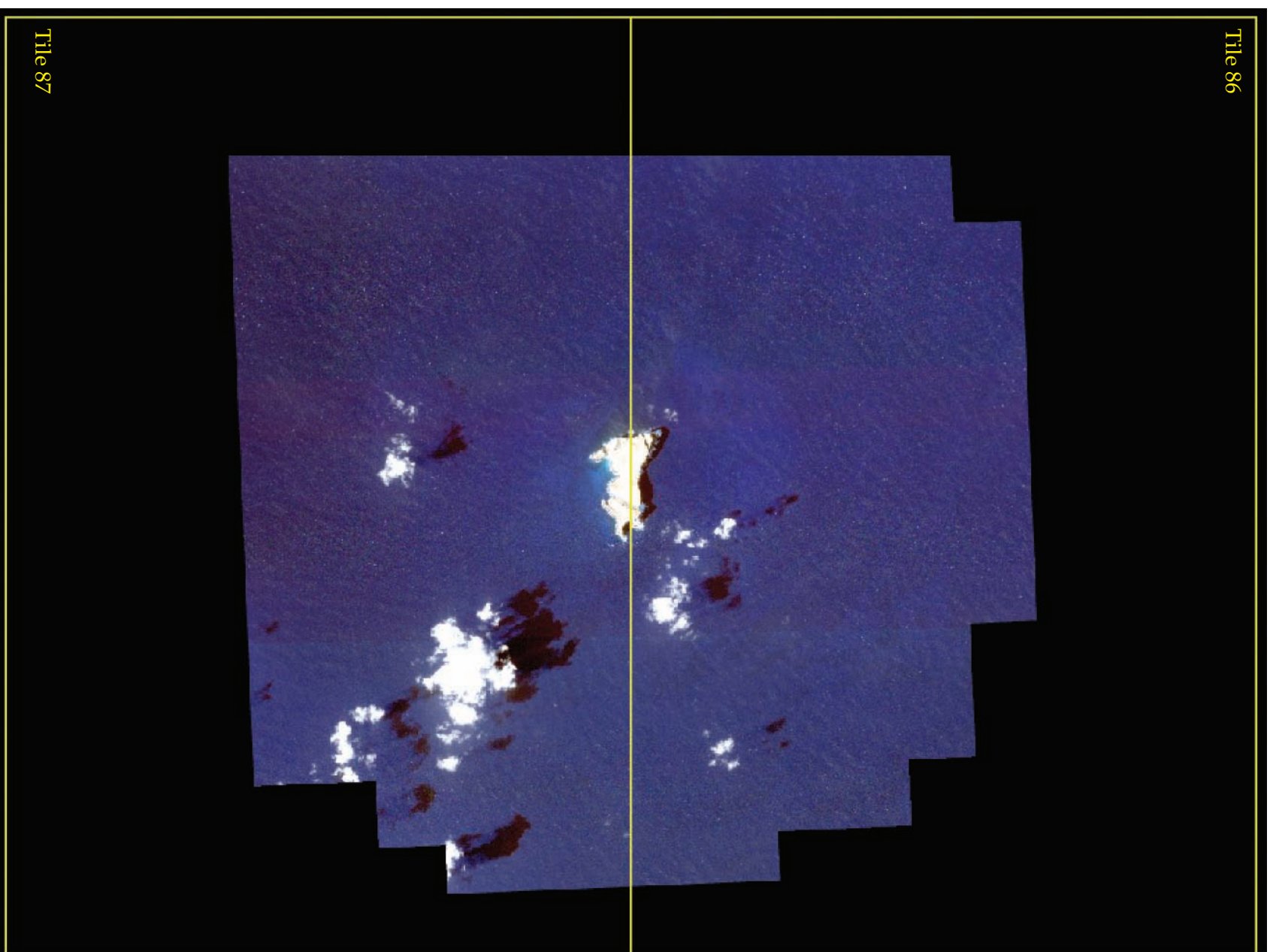
Due to its size, two map tiles are required to depict the 1:40,000 scale detailed benthic habitats. Maps of 1:80,000 estimated bathymetry, 1:80,000 scale aggregated habitat cover, and 1:80,000 scale banks are provided for Nihoa Island. A one-square-kilometer grid is included with all maps of Nihoa Island.

The area in square kilometers of aggregated benthic habitat cover types found at Nihoa Island, Northwestern Hawaiian Islands.

Hardbottom with >10% live coral	<0.1
Hardbottom with >10% crustose coralline algae	-
Hardbottom (uncolonized)	0.7
Hardbottom with >10% macroalgae	4.5
Hardbottom with indeterminate cover	58.9
Unconsolidated with 10% or less macroalgae or seagrass	10.0
Unconsolidated with >10% macroalgae or seagrass	-
Total Habitat Area Classified	74.1

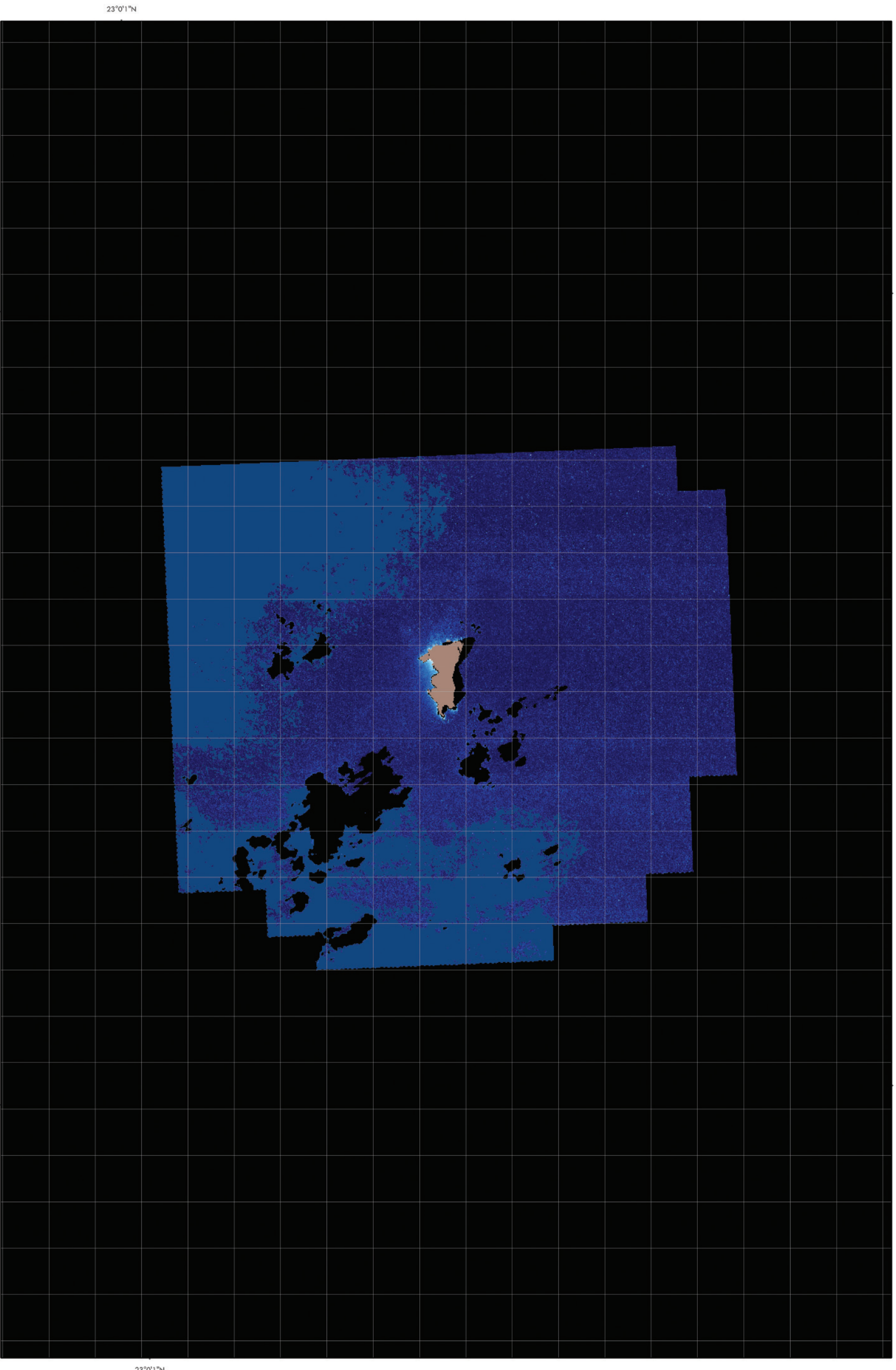
The area in square kilometers of benthic habitats found at Nihoa Island, Northwestern Hawaiian Islands.

Unconsolidated (1000, refer to classification scheme for habitat description)	7.2
Sand (1100)	2.8
Sand with macroalgae (1120)	-
Sand with patchy (10-50% cover) (1121)	-
Sand with dense (>50% cover) macroalgae (1122)	-
Unconsolidated Rubble (1300)	-
Unconsolidated Rubble with sparse (10-50% cover) algae (1301)	-
Unconsolidated Rubble with dense (>50% cover) algae (1302)	-
Sand and Rubble (1400)	-
Groove (1500)	-
Hardbottom (2000)	58.3
Hardbottom with sparse (10-50% cover) algae (2001)	-
Hardbottom with live coral (>10% cover) (2010)	-
Hardbottom, uncolonized (2020)	-
Hardbottom with crustose coralline algae (>10% cover) (2030)	-
Linear Reef (2100)	-
Linear Reef with live coral (>10% cover) (2110)	-
Linear Reef, uncolonized (2120)	-
Linear Reef, uncolonized with sparse (10-50% cover) algae (2121)	-
Linear Reef with crustose coralline algae (>10% cover) (2130)	-
Aggregated Coral Heads with live coral (>10% cover) (2210)	-
Spur and Groove (2300)	-
Patch Reef (2400)	-
Patch Reef with live coral (>10% cover) (2410)	-
Patch Reef, uncolonized (2420)	-
Patch Reef, uncolonized with sparse (10-50% cover) algae (2421)	-
Patch Reef with crustose coralline algae (>10% cover) (2430)	-
Aggregated Patch Reef (2500)	-
Aggregated Patch Reef with live coral (>10% cover) (2510)	-
Scattered Coral/Rock in Sand with live coral (>10% cover) (2610)	-
Pavement (2700)	0.5
Pavement with sparse (10-50% cover) algae (2701)	-
Pavement with dense (>50% cover) algae (2702)	-
Pavement with live coral (>10% cover) (2710)	-
Pavement with live coral (>10% cover) with dense (>50% cover) algae (2712)	-
Pavement, uncolonized (2720)	-
Pavement, uncolonized with dense (>50% cover) algae (2722)	4.5
Pavement with crustose coralline algae (>10% cover) (2730)	3.1
Pavement with sand channels (2800)	12.4
Pavement with sand channels and live coral (>10% cover) (2810)	16.9
Pavement with sand channels, uncolonized (2820)	-
Volcanic Rock (2900)	<0.1
Volcanic Rock with dense (>50% cover) algae (2902)	-
Volcanic Rock with live coral (>10% cover) (2910)	<0.1
Volcanic Rock, uncolonized (2920)	0.7
Deep water (3010)	39.1
Reef crest (3020)	-
Dredged channel (3030)	-
Land (3100)	0.7
Cloud, Shadow, Surf, and No image data (3210, 3220, 3230, and 4000)	6.3
Unclassified (3300)	113.3
Total Habitat Area Classified	74.1
TOTAL Area in IKONOS image	120.2



Index map indicating the locations of map tiles for the 1:40,000 scale detailed habitat maps of Nihoa Island, Northwestern Hawaiian Islands.

A 1:80,000 scale estimated bathymetry map of Nihoa Island, Northwestern Hawaiian Islands.



23°0'1"N

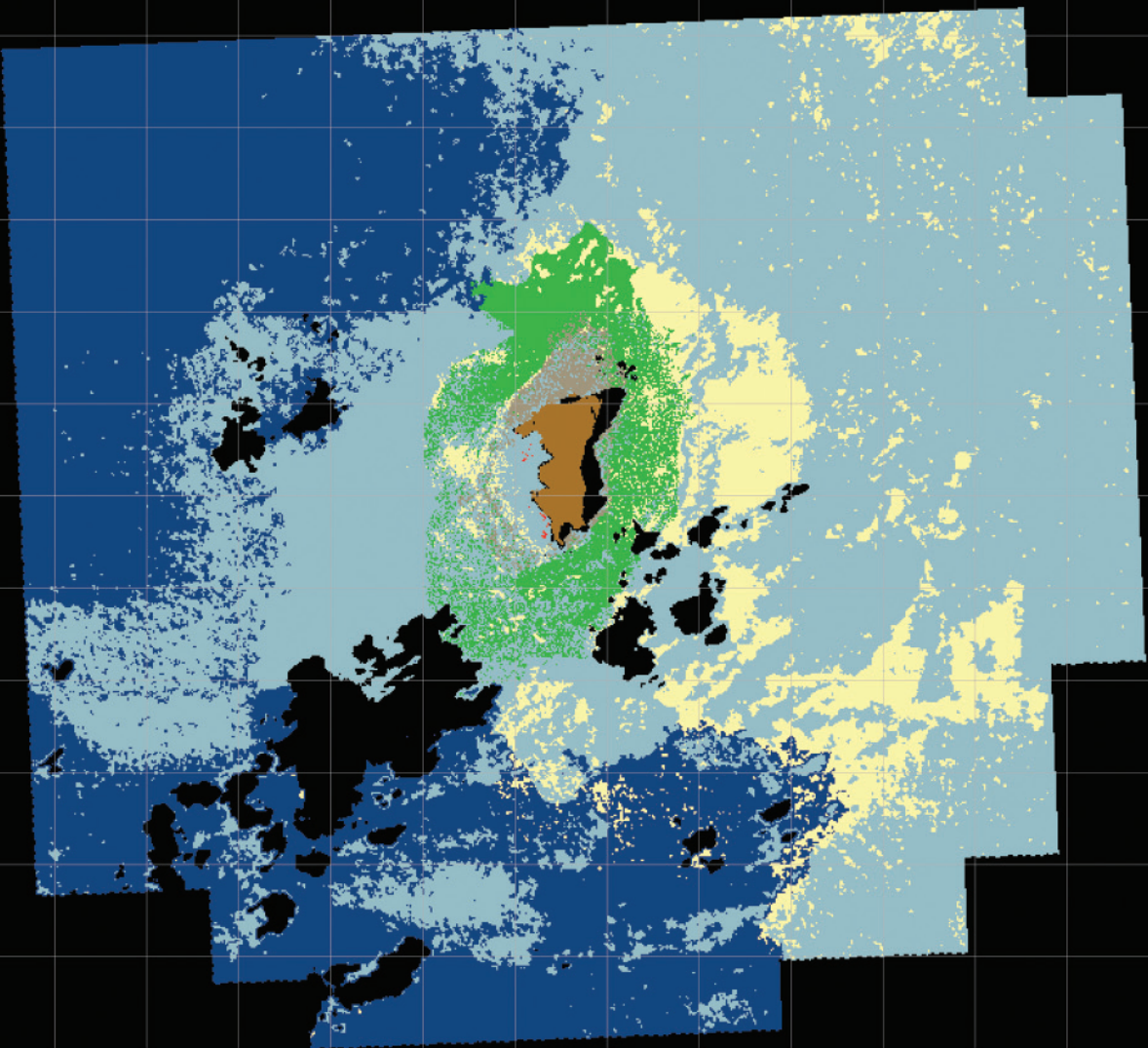
162°6'0"W

162°6'0"W

A 1:80,000 scale aggregated cover map of Nihoa Island, Northwestern Hawaiian Islands.

161°5'0"W

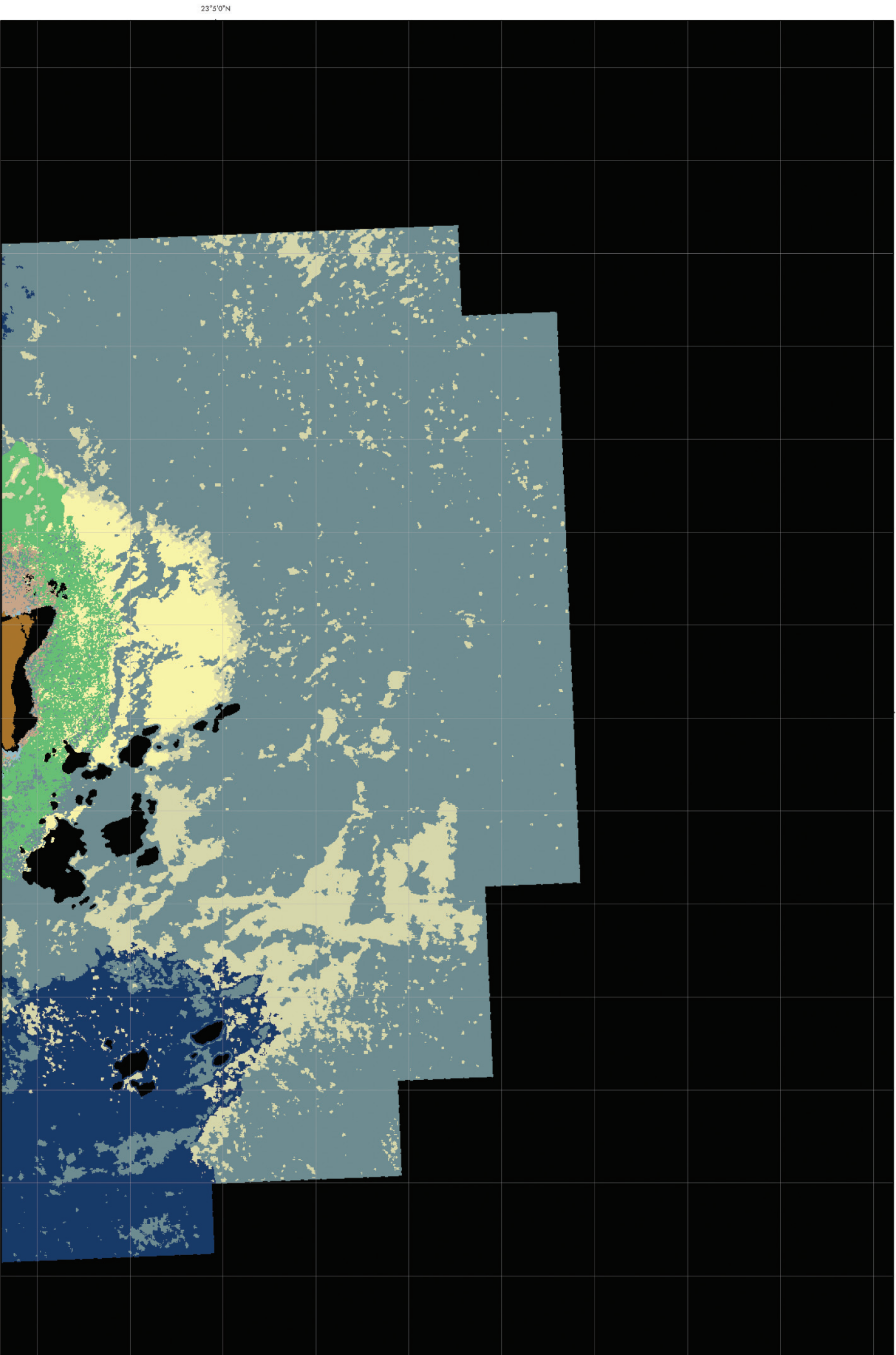
161°5'0"W



23°0'1"N

Tile 86. A 1:40,000 scale detailed habitat map of the northern portion of Nihoa Island, Northwestern Hawaiian Islands.

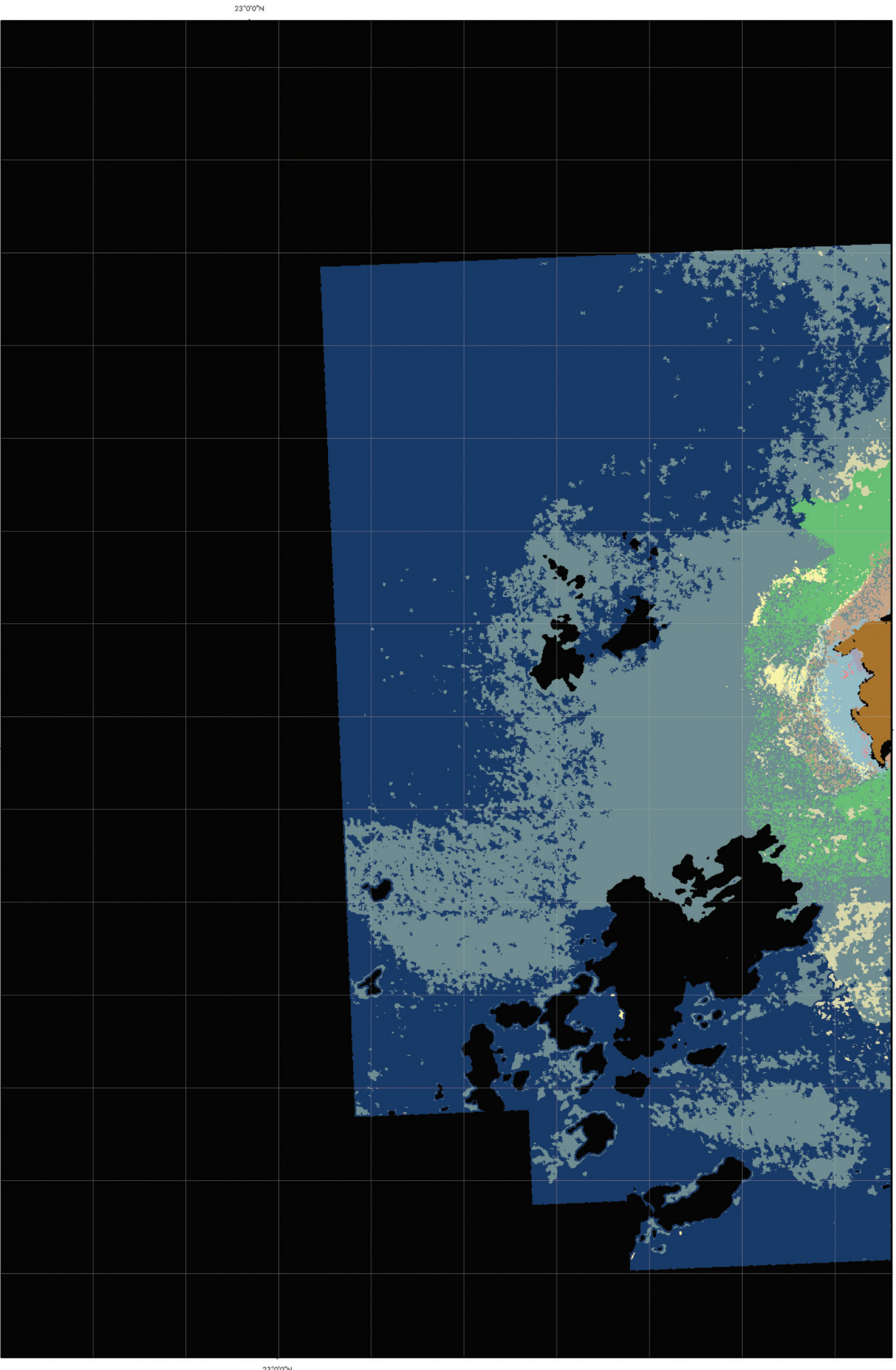
161°55'0"W



23°5'0"N

161°55'0"W

23°5'0"N



23°0'0"N

161°55'0"W

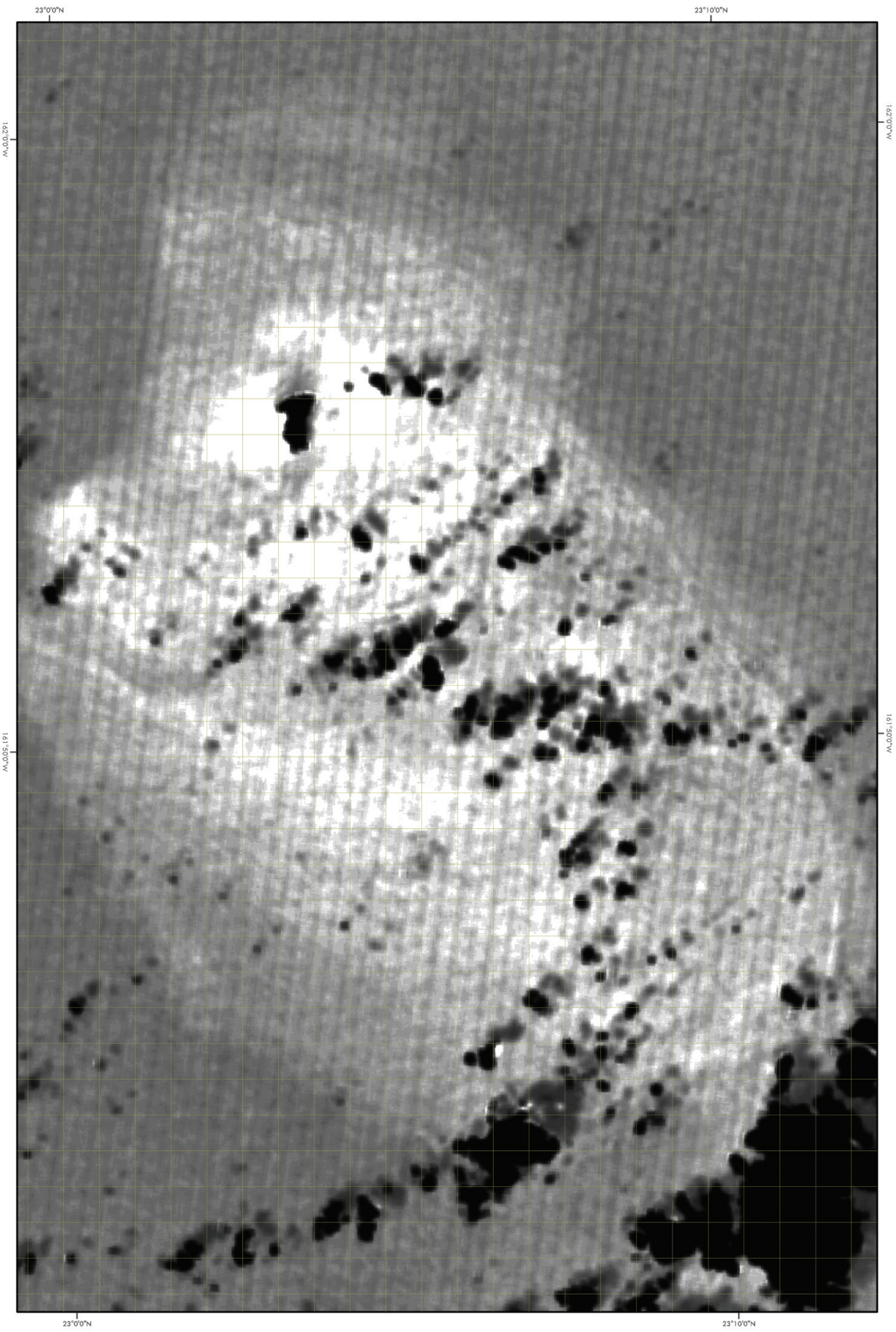
161°55'0"W

23°0'0"N

Tile 87. A 1:40,000 scale detailed habitat map of the southern portion of Nihoa Island, Northwestern Hawaiian Islands.

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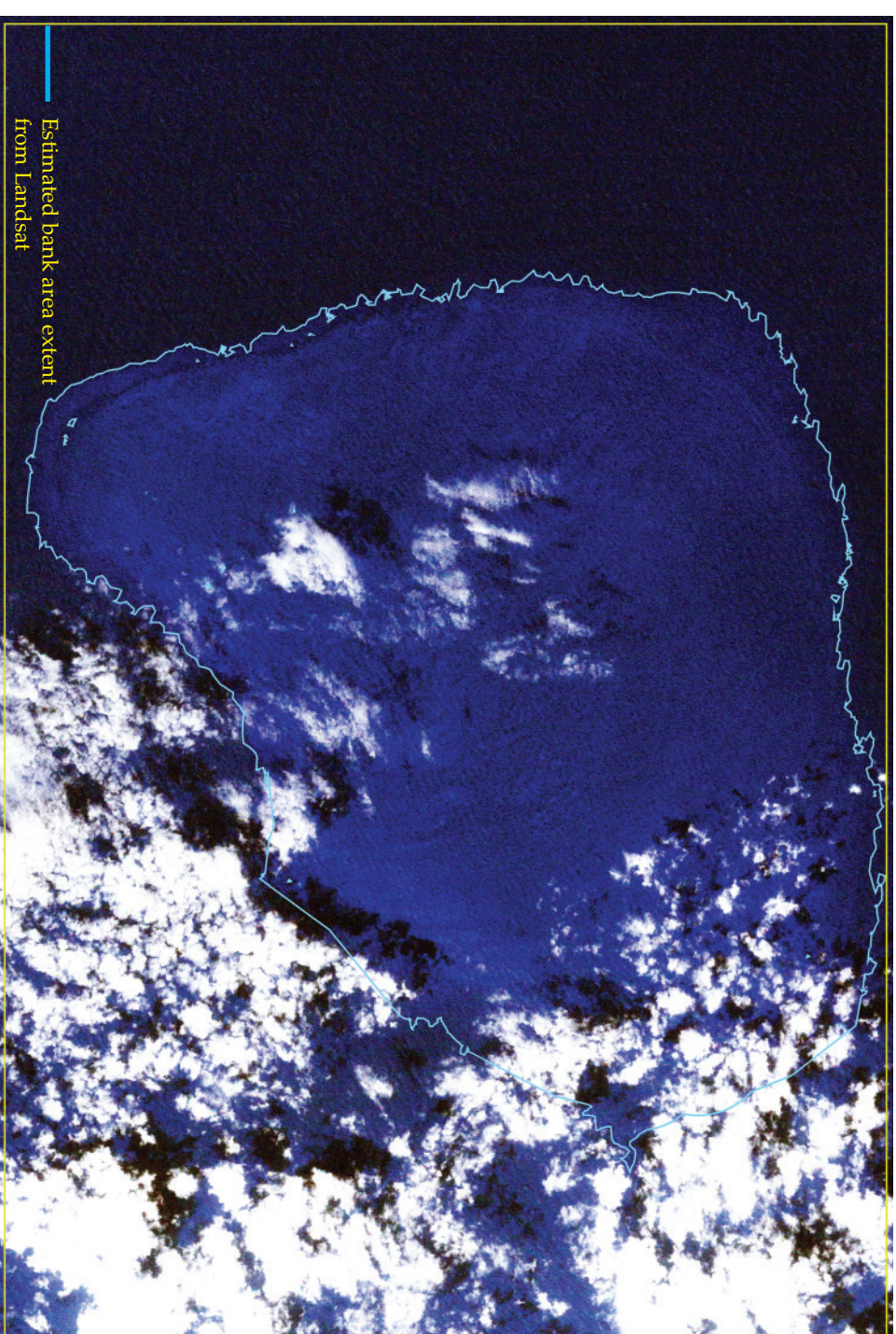
A 1:80,000 scale bank map of Nihoa Island, Northwestern Hawaiian Islands.

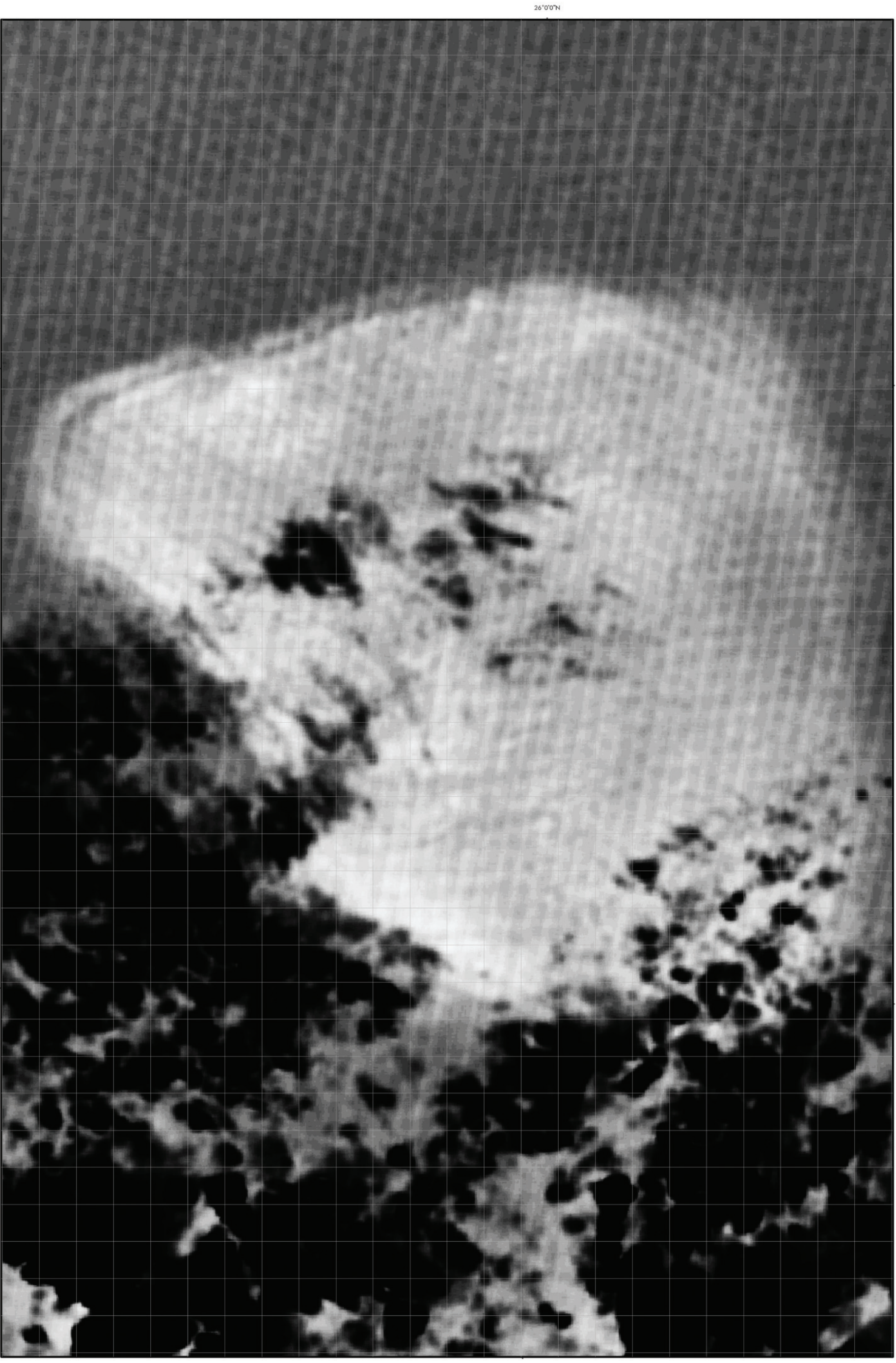


Pioneer Bank

An enhancement of the Landsat satellite's blue channel was used to generate the bank map of Pioneer Bank (173°25' W and 26°0' N). Due to the depth of the water at Pioneer Bank, no characterization of the benthic habitats from satellite imagery was possible.

A 1:100,000 scale map is included to depict the shallow-water bank area around Pioneer Bank.





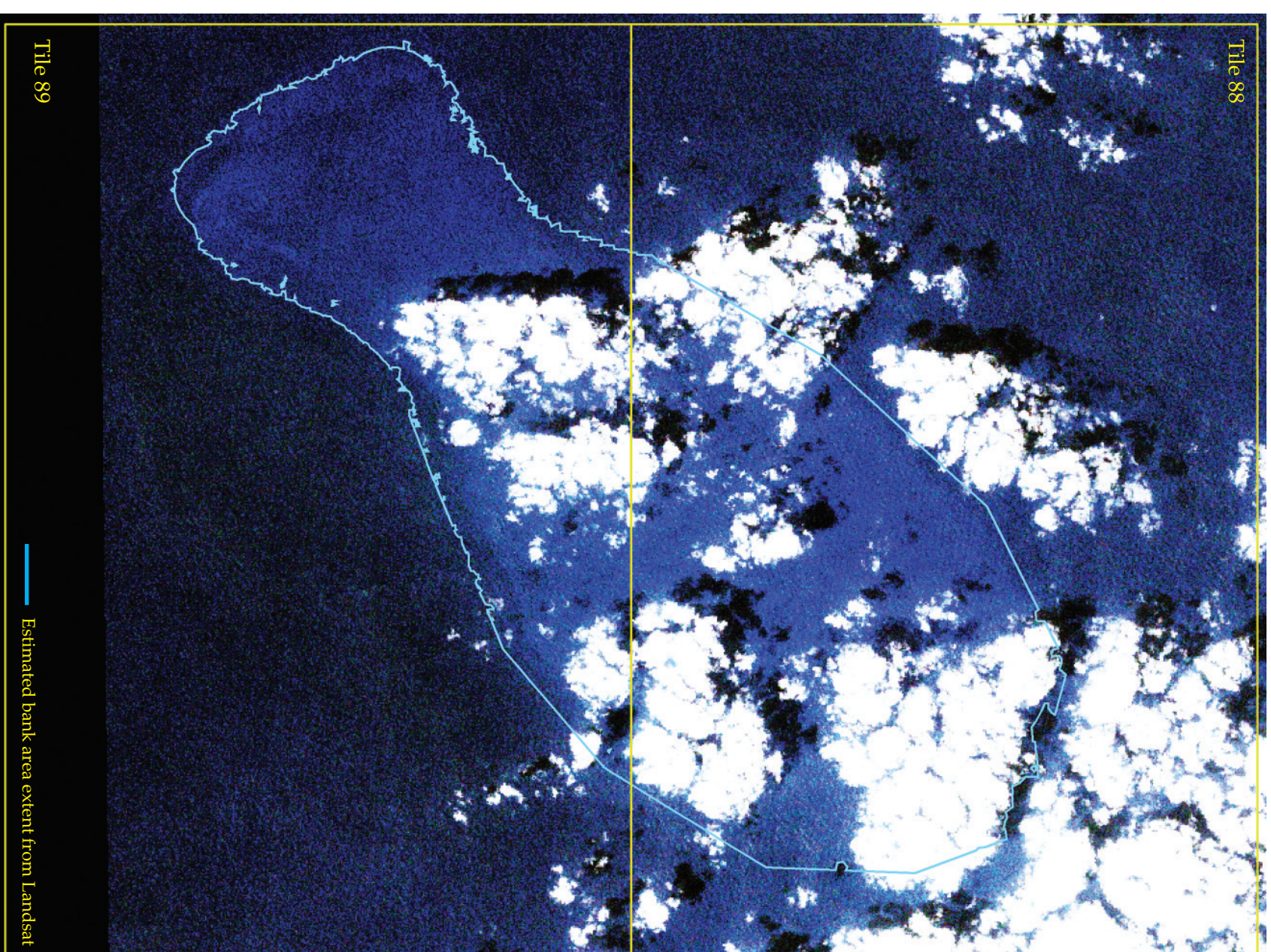
A 1:100,000 scale map of Pioneer Bank, Northwestern Hawaiian Islands.

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Raita Bank

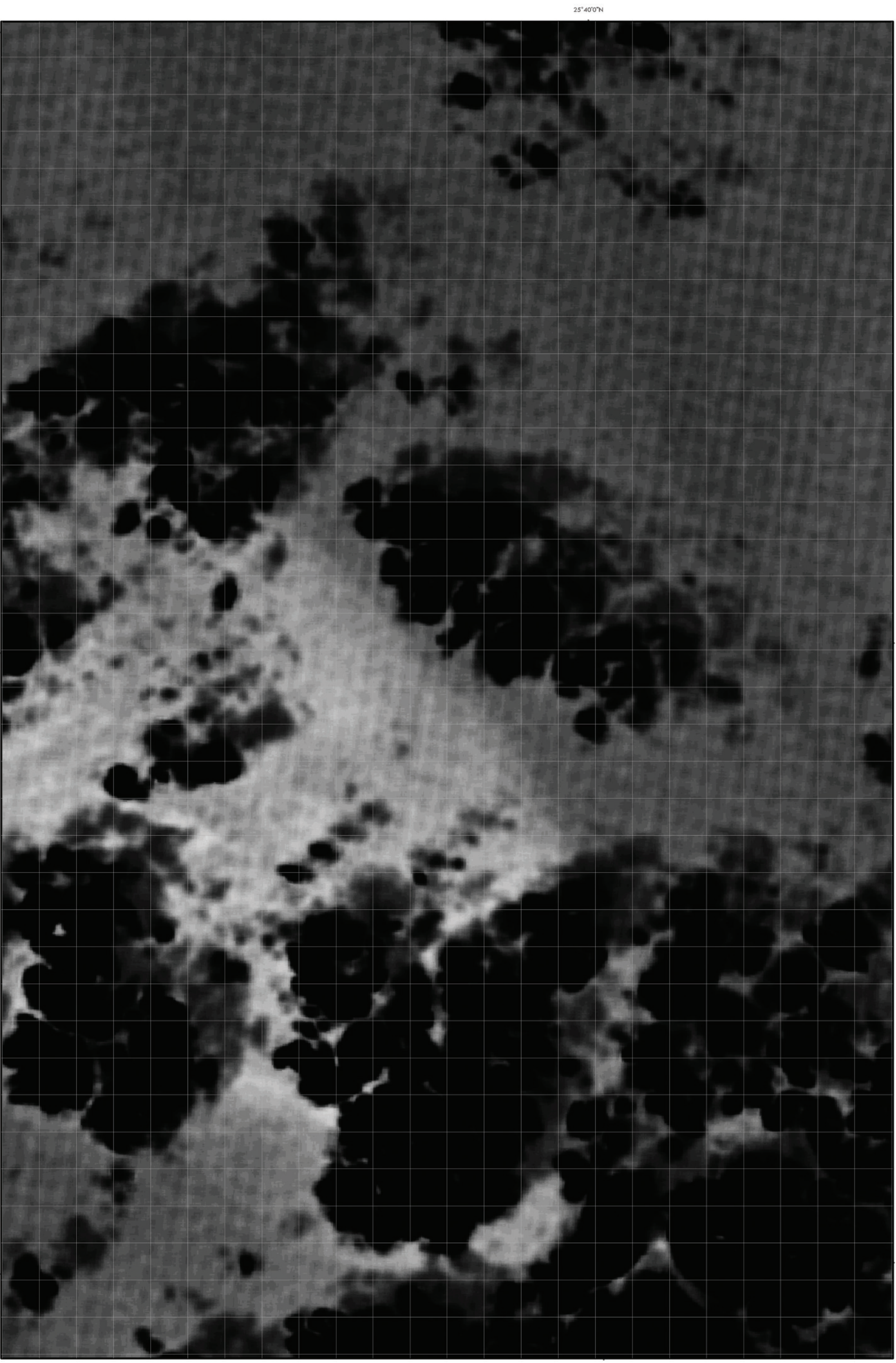
An enhancement of the Landsat satellite's blue channel was used to generate the bank map of Raita Bank (169°30' W and 25°30' N). Due to the depth of the water at Raita Bank, no characterization of the benthic habitats from satellite imagery was possible.

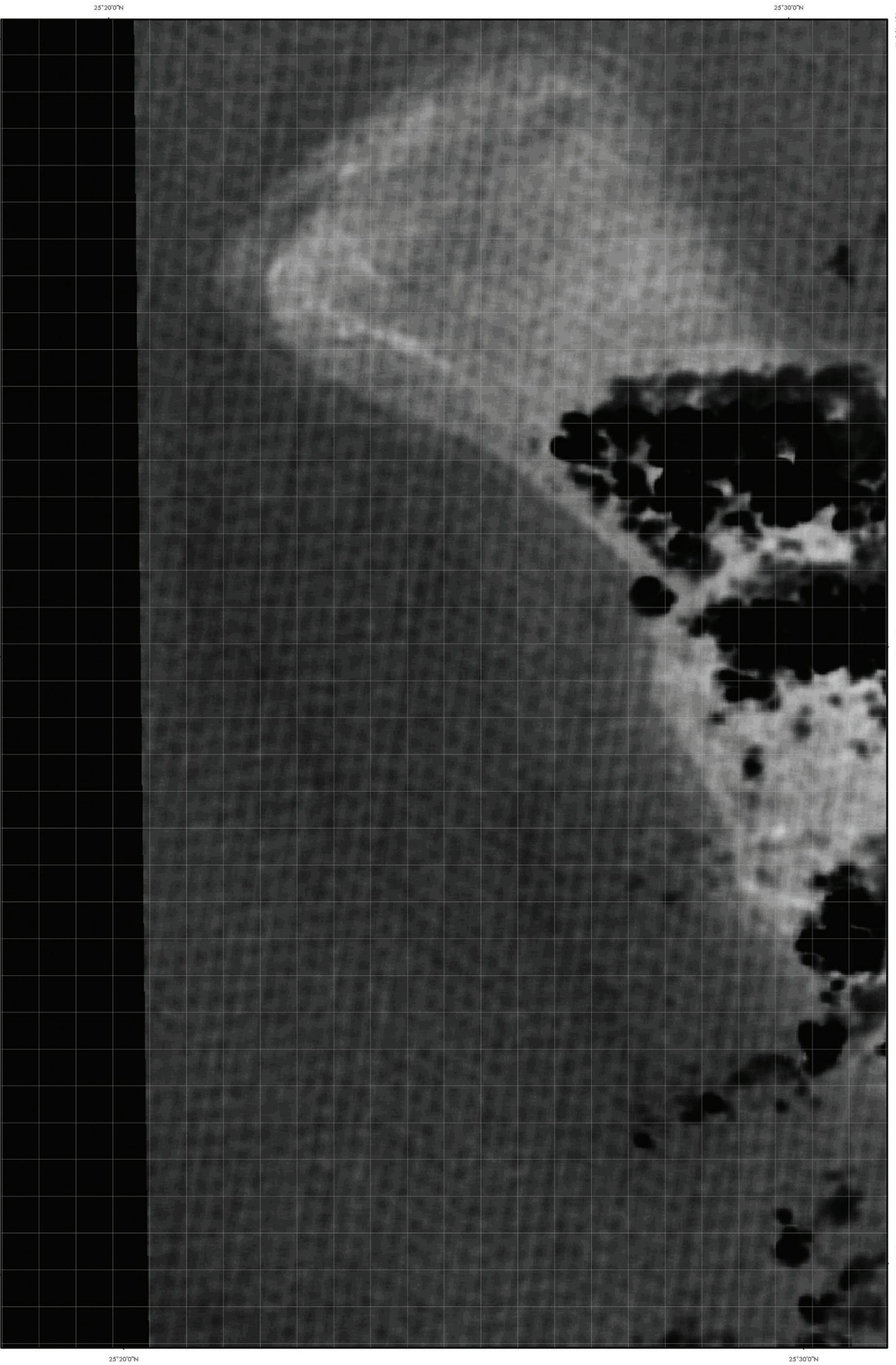
Two 1:100,000 scale map tiles are included to depict the shallow-water bank area around Pioneer Bank.



Index map indicating the locations of map tiles for the 1:100,000 scale bank of Raita Bank, Northwestern Hawaiian Islands.

Tile 88. A 1:100,000 scale map of the northern portion of Raiia Bank, Northwestern Hawaiian Islands.





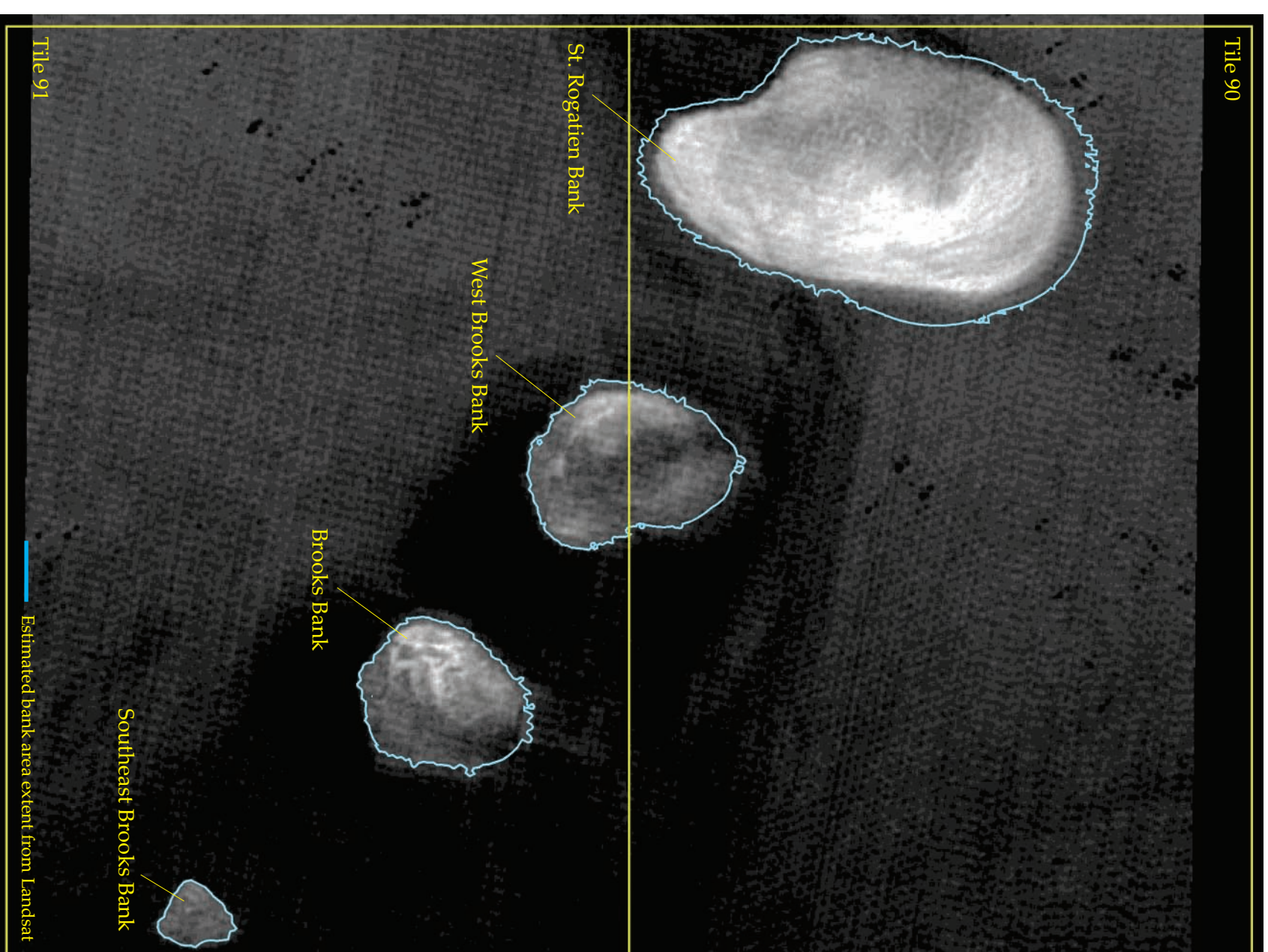
Tile 89. A 1:100,000 scale map of the southern portion of Raita Bank, Northwestern Hawaiian Islands.

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Southwest Brooks Bank, Brooks Bank, West Brooks Bank, and St. Rogatien Bank

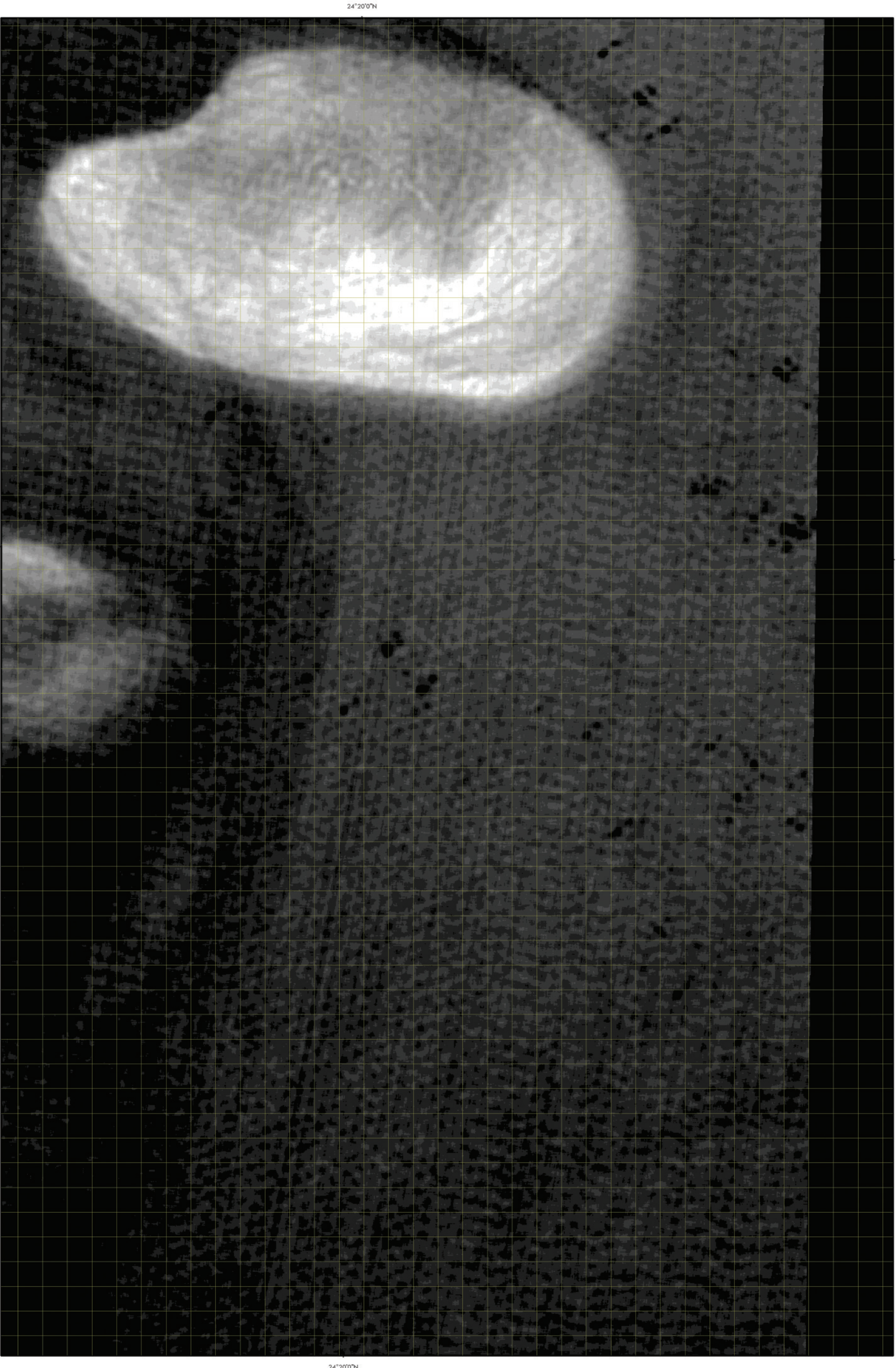
An enhancement of the Landsat satellite's blue channel was used to generate the bank map of Southwest Brooks Bank, Brooks Bank, West Brooks Bank, and St. Rogatien Bank (approximate center of line drawn through chain of banks: 167°52' W and 24°40' N). Due to the depth of the water at these banks, no characterization of the benthic habitats from satellite imagery was possible.

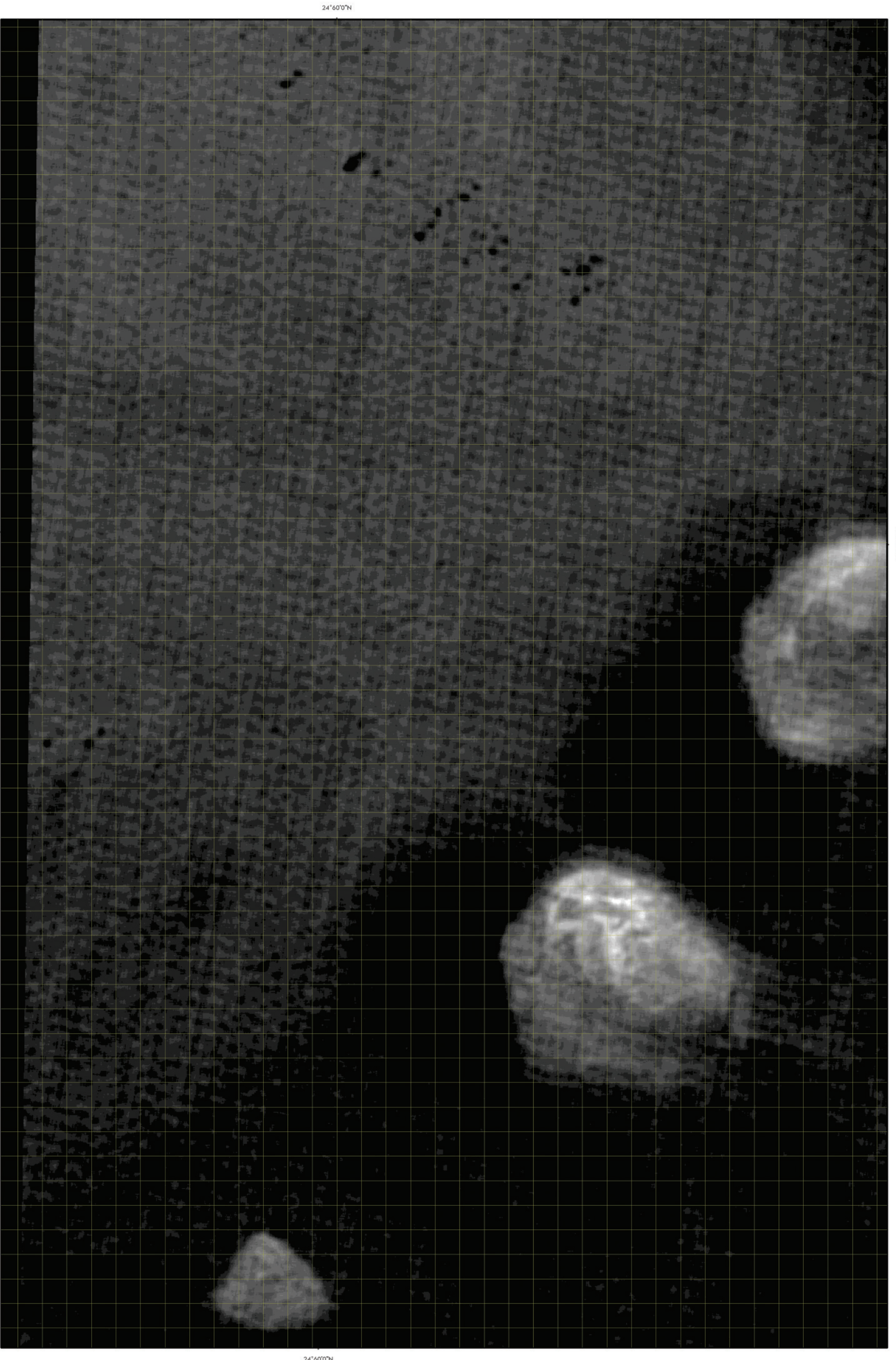
Two 1:150,000 scale map tiles are included to depict the extensive shallow-water bank area around Southwest Brooks Bank, Brooks Bank, West Brooks Bank, and St. Rogatien Bank.



Index map indicating the locations of map tiles for the 1:150,000 scale bank of Southwest Brooks Bank, Brooks Bank, West Brooks Bank, and St. Rogatien Bank, Northwestern Hawaiian Islands.

Tile 90. A 1:150,000 scale bank map of the northern portions of Southeast Brooks Bank, Brooks Bank, West Brooks Bank, and St. Rogatien Bank, Northwestern Hawaiian Islands.



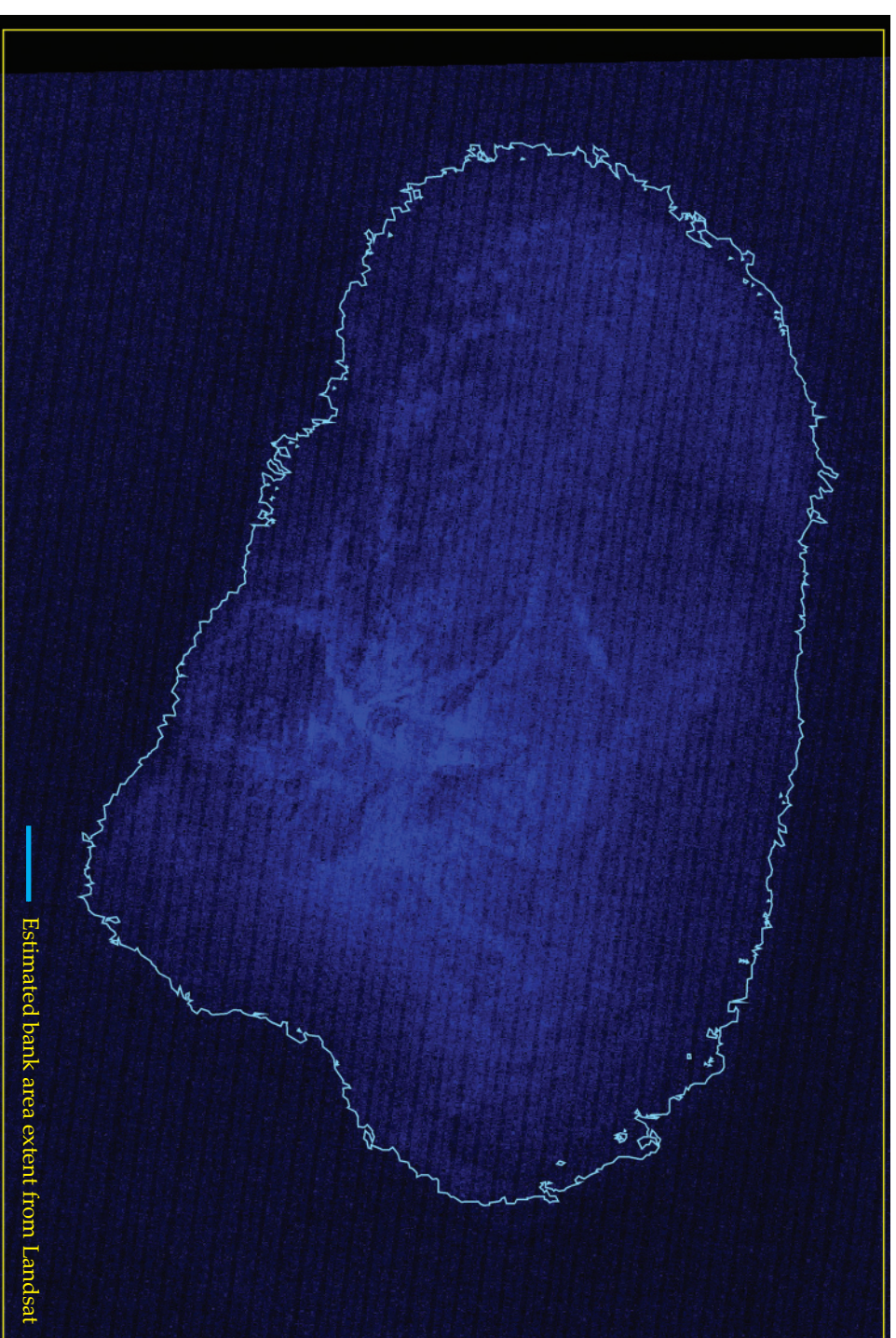


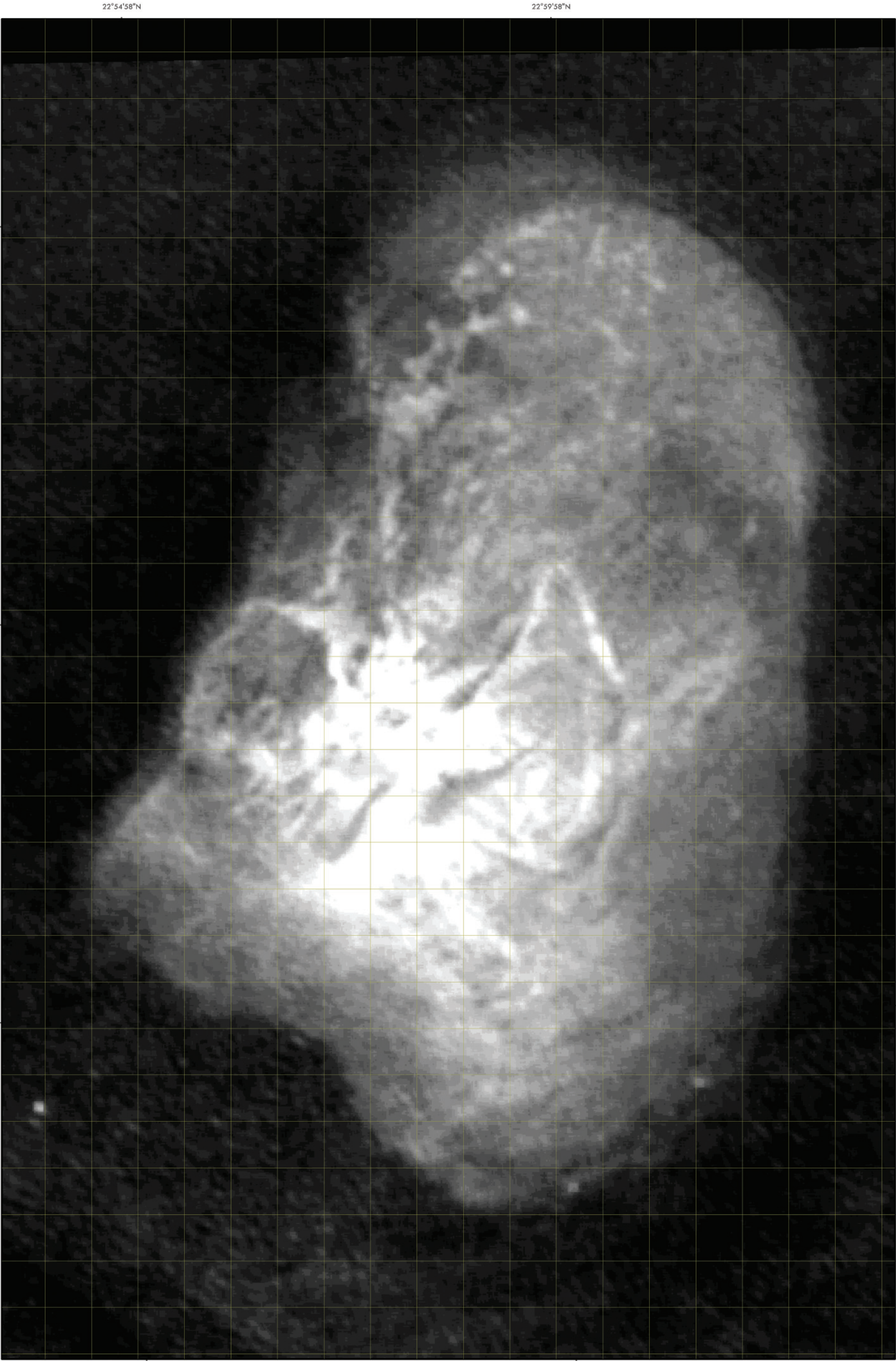
Title 91. A 1:150,000 scale bank map of the southern portions of Southeast Brooks Bank, Brooks Bank, West Brooks Bank, and St. Rogatien Bank, Northwestern Hawaiian Islands.

Bank West of Nihoa Island

An enhancement of the Landsat satellite's blue channel was used to generate the bank map of the Bank West of Nihoa Island. Due to the depth of the water at these banks, no characterization of the benthic habitats from satellite imagery was possible. The Bank West of Nihoa Island lies at longitude 162 degrees 14 minutes W and 22 degrees 57 minutes N.

A 1:80,000 scale map is included to depict the shallow-water bank area around the Bank West of Nihoa Island.





A 1:80,000 scale bank map of the Bank West of Nihoa Island and the Bank East of Nihoa Island (plus Nihoa Island), Northwestern Hawaiian Islands.