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Characteristics of Long Term Shoreline Change on Misawa Coast

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Abstract*—After the breakwater of the Misawa fishery port had been constructed, the coastal drift to the north along the coast was blocked by breakwaters. Due to the blockage, severe beach erosion was caused on the north coast of the port. The present study aims to investigate the stabilization and the recovery of sands, and to clarify the feature of a long term shoreline change on the Misawa coast. By investigating the averaged shoreline from 2000 to April of 2018, the present study shows that the beach erosion stopped, and the coast is becoming steady because of the construction of the artificial headlands.

***Index Terms*-artificial headlands, averaged shoreline, beach erosion, coastal drift, shoreline change.**

I. INTRODUCTION

After the breakwater of the Misawa fishery port had been constructed, the coastal drift to the north along the coast was blocked by breakwaters. As a result, the remarkable advancement of the shoreline was caused on the south coast of the fishery port. And the severe beach erosion was caused on the north coast of the port. The artificial headland method was used by Aomori Prefecture as an industrial method of the countermeasures to prevent the beach erosion and to keep sand on beaches. In total 13 of the artificial headlands have been constructed 13 on Misawa coast. They are called in turn B1HL, B2HL, B3HL, so on, B12HL and B13HL from the south. Sasaki, Takeuchi and Fujita (2000) [1] have shown the beach deformation before and after the construction of the artificial headlands from 1987 to 1999. Sasaki, Takeuchi and Fujita (2002) [2] showed the characteristics of the shoreline changes from 1999 to 2001 by using the results of the shoreline observation by GPS. They also showed that the shoreline moves with a cycle of a year, advances in May to July, and retreats in winter, and that the position of the averaged shoreline moves within 40m. Sasaki, Takeuchi, Fujita and Ogasawara (2004) [3] have shown the characteristics of the shoreline changes from 1987 to 2003. In the present study, the shoreline changes from 2000 to 2018 are showing. The present study investigates the stabilization and recovery of the sandy coast and makes clear the characteristics of the long term shoreline change on the Misawa coast.

II. ARTIFICIAL HEADLANDS IN MISAWA COAST

The artificial headland method has been used in the Misawa coast.

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There are the total 13 artificial headlands on the north coast of the fishing port. The length of the artificial headland is 200m, and the installation interval is 1km in length.

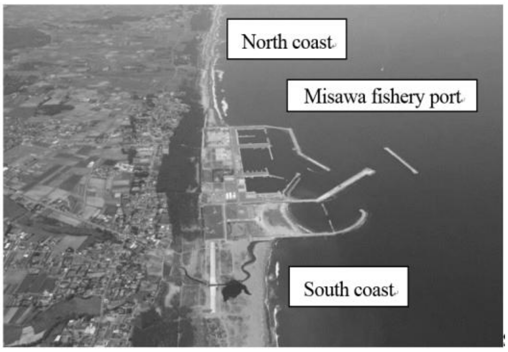

Fig. 1, North and south coasts of Misawa fishery port on 30 June, 2017

Fig. 1 shows the Misawa fishing port, the north coast of the port, and the south coast of the port. The south coast is wide as shown in Fig. 1 and the sand decreased by a large amount on the north coast.

Figs. 2, 3, 4, 5, 6, and 7 show the coasts between the artificial headlands from B1HL toB13HL. HL means the artificial headland. The installation interval of the artificial headlands is 1 km along to the coast.The artificial headlandB1 has constructed first in 1987. Now, Theartificial headland of 13 have been construction.Fig. 2 shows the artificial headlands B1HL, B2HL and B3HL. The coast between B1HL and B3HL is sand. The artificial headland B1HL was constructed with the length of 100 m in March, 1993. It was extended to the length of 200 m in August, 2003. The artificial headland B2HL was constructed with the length of 100 m in March, 1998.It was extended to the length of 200 m in 2009.The artificial headland B3HL was constructed with the length of 100 m in March, and 1996.It was extended to the length of 200 m in July, 2007.

Fig. 3 shows the artificial headlands B3HL, B4HL and B5HL.The coast between B3HL and B5HL is also sand. The artificial headland B4HL was constructed with the length of 100 m in March, 1999. It was extended to the length of 200 m in 2009.The artificial headland B5HL was constructed with the length of 100 m in March; 1994.It was extended to the length of 200 m in August, 2004.

Fig. 4 shows the artificial headlands B5HL, B6HL and B7HL.The coast between B5HL and B7HL is sand.The artificial headland B6HL was constructed with the length of 100 m in March, 2000, and extended to the length of 200 m in

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2011.The artificial headland B7HL was constructed with the length of 100 m in March, 1997, and extended to the length of 200 m in May, 2008.

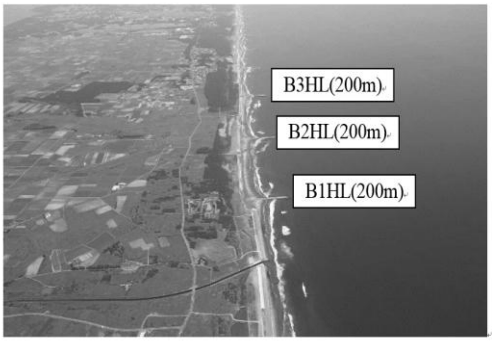

Fig. 2. Coast between B1 and B3 headland on 30 June, 2017

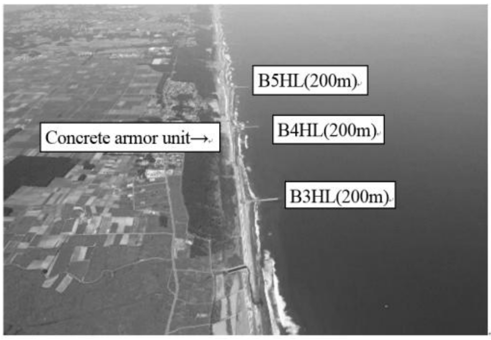

Fig. 3. Coast between B3 and B5 headland on 30 June, 2017

Fig. 5 shows the artificial headlands B8HL, B9HL and B10HL.The coast between B8HL and B10HL is also sand.

The artificial headland B8HL was constructed with thelength of 100 m in March, 2000, and extended to the length of 200 m in 2014.The artificial headland B9HL wasconstructed with the length of 100 m in June, 1995.It wasextended to the length of 200 m in March, 2006.The artificial headland B10HL was constructed with the length of 100 m in February, 2003.It was extended to the length of 200 m in 2014.

Fig. 6 shows the artificial headlands B11HL, B12HL and B13HL.The coast between B11HL and B13HL is sand.The artificial headland B11HL was constructed with the length of 100 m in March, 2001.It was extended to the length of 200 m in 2011.The artificial headland B12HL was constructed with the length of 100 m in April, 2003.It was extended to the length of 200 m in 2013

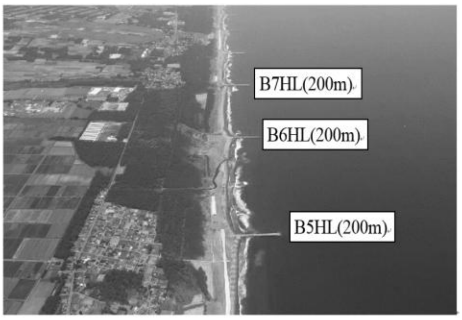

Fig. 4. Coast between B5 and B7 headland on 30 June, 2017

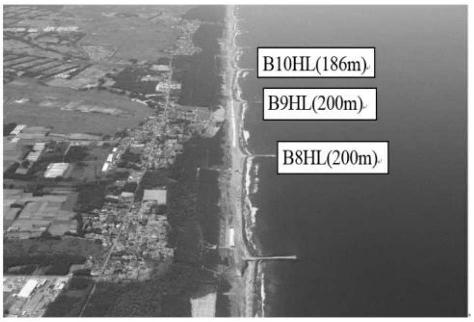

Fig. 5. Coast between B8 and B10 headland on 30 June, 2017

Fig. 7 shows the artificial headlands B12HL and B13HL.The coast between B12HL and B13HL is sands. There is the jetty of Takase river drainage waterway at 4km in the north coast of B13HL The coast also is sands.

III. DEFINITION OF AVERAGED SHORELINE

The averaged shoreline y_{sm} is defined as follows.

$$y_{sm} = \frac{1}{B}\int_{x_1}^{x_2} y_s\, dx \quad (1)$$

Where B is the width of the coast between the artificial headlands, y is the distance from the shore to the offshore, y_s is the shoreline position, x is the distance along the coast, x_1 is the distance to the beginning of the coast from the coordinate origin which means the value of the x coordinate origin, and x_2 is the value ofthe x coordinate at the end of the coast. Fig. 8 shows the y coordinate, the x coordinate, the distance x_1, the distance x_2, the width of the coast B, the shoreline y_s and the averaged shoreline y_{sm} on the coast between the artificial headlands.

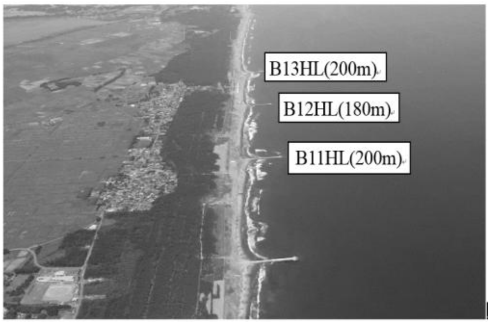

Fig. 6. Coast between B11 and B13 headland on 30 June, 2017

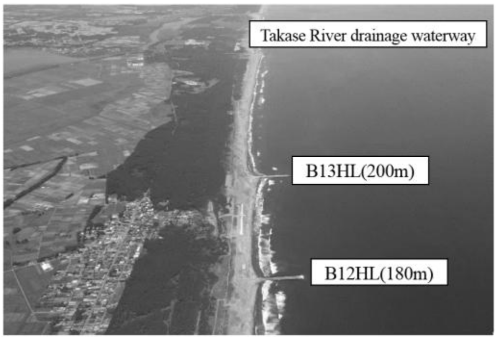

Fig. 7. North coast of B13 Headland on 30 June, 2017

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IV. LONG TERM TOPOGRAPHIC VARIATION IN AVERAGED SHORELINE

A. Long Term Geographical Features on the Coasts around the B1 Headland

Fig. 9 shows the averaged shoreline on the south coast of B1HL and on the north coast of B1HL. The average for the shoreline is taken along the coast between the artificial headlands. The figure shows the averaged shoreline from January of 2000 to April of 2018.The square means the averaged shoreline of the south coast.The triangle means the averaged shoreline of the north coast. On the south coast of B1HL, the averaged shoreline is retreats from January of 2000 to January of 2003. However, the averaged shorelineadvances from January of 2003 to April of 2018.On the north coast of B1HL, the averaged shoreline advances from January of 2012 to April of 2018.

B. Long Term Geographical Features on the Coasts around the B5 Headland

Fig. 10 shows the averaged shoreline on the south coast of B5HL and on the north coast of B5HL. The figure shows the averaged shoreline from January of 2000 to April of 2018.On the south coast of B5HL, the averaged shoreline retreats from January of 2000 to January of 2008. The averaged shoreline is an advancing from January of 2008 to April of 2018. On the north coast of B5HL, the averaged shoreline retreats from January of 2000 to January of 2003. The averaged shoreline was in the same position from January of 2003 to January of 2009.The averaged shoreline advances from January of 2009 to April of 2018.

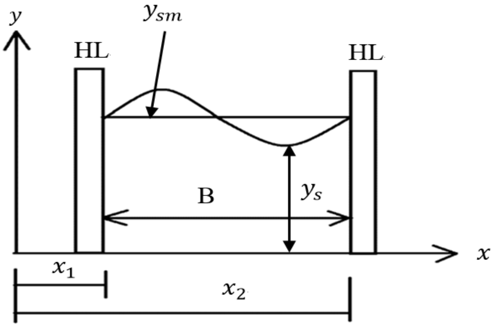

Fig. 8. Definition of averaged shoreline

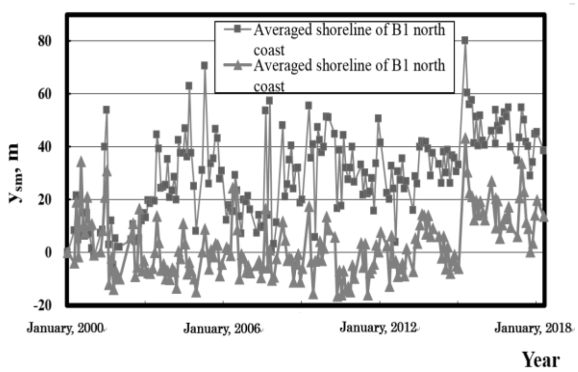

Fig. 9.The south and north coasts of B1HL

C. Long Term Geographical Features on the Coasts around the B7 Headland

Fig. 11 shows the averaged shoreline on the south coast of B7HL and on the north coast of B7HL. The figure shows the average shoreline from January of 2001 to April of 2018. On the south coast of B7HL, the averaged shoreline retreatsfrom January of 2000 to January of 2010. The averaged shoreline advances from January of 2010 to January of2013. However, the averaged shoreline retreats from January of 2013 to April of 2018.On the north coast of B7HL, the averaged shoreline retreats from January of 2015 to April of 2018.

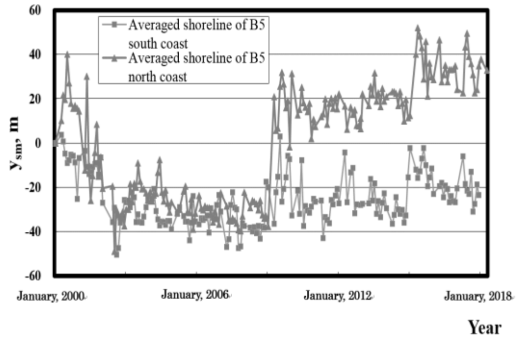

Fig. 10.The south and north coasts of B5HL

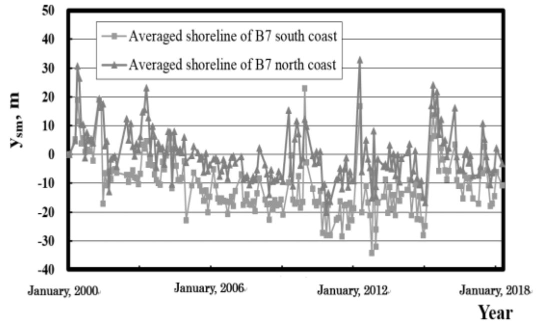

Fig. 11.The south and north coasts of B7HL

D. Long Term Geographical Features on the Coasts around the B9 Headland

Fig. 12 shows the averaged shoreline on the south coast of B9HL and on the north coast of B9HL.The figure showsthe average shoreline from January of 2001 to April of 2018. On the south coast of B9HL, the averaged shoreline retreatsfrom January of 2000 to January of 2015. However, the averaged shoreline advances from January of 2015 toJanuary of 2016. The averaged shoreline retreats fromJanuary of 2016 to April of 2018.On the north coast of B9HL, the averaged shoreline retreats from January of 2003 to January of 2014. The averaged shoreline advances from January of 2014 to January of 2015. However, the averaged shoreline retreats from January of 2014 to January of 2015. After that, the averaged shoreline advances from January of 2015 to April of 2018.

E. Long Term Geographical Features on the Coasts around the B11 Headland

Fig. 13 shows the averaged shoreline on the south coastof B11HL and on the north coast of B11HL. The figure shows

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the average shoreline from April of 2001 to April of 2018. On the south coast of B11HL, the averaged shoreline retreats from April of 2001 to January of 2011.The averaged shoreline advances from January of 2011 to January of 2015.However, the averaged shoreline retreats from January of 2015 to April of 2018.On the north coast ofB11HL, the averaged shoreline retreats from January of 2015 to April of 2018.

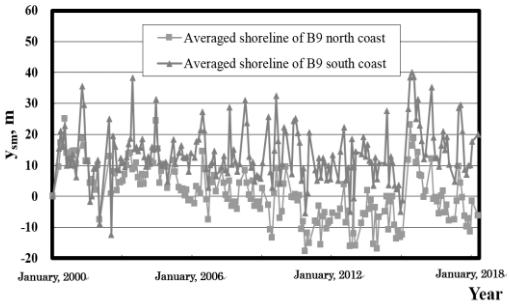

Fig. 12,The south and north coasts of B9HL

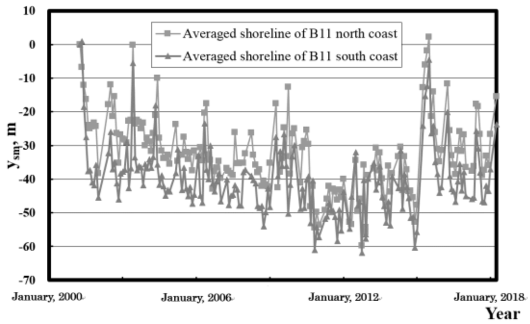

Fig. 13,The south and north coasts of B11HL

F. Long Term Geographical Features on the Coasts around the B13 Headland

Fig. 14 shows the averaged shoreline on the south coast of B13HL and on the north coast of B13HL. The figure shows the average shoreline from July of 2002 to April of2018. On the south coast of B13HL, the shoreline retreats gradually from July of 2002 to January of 2009. The averaged shoreline advances from January of 2009 to April of 2018. On the north coast of B13HL, the averaged shoreline advances from January of 2009 to January of 2015. However, the averaged shoreline retreats from January of 2015 to January of 2017. After that, the averaged shoreline advances from January of 2017 to April of 2018.

V. DISCUSSION

When we see the shoreline position one by one, it is difficult for us to understand easily whether the shoreline is advanced or is backward as a whole. However, by averaging the shoreline, a spatial change disappears. The averaged shoreline indicates clearly whether the entire shoreline advances or retreats. There is a seasonal movement in the averaged shoreline, the shoreline advances in spring, and retreats from autumn to winter and, investigating a long-term geomorphic change in the averaged shoreline, the averaged shoreline shows clearly that the coastline position is gradually advancing from the land to the sea because of the construction of an artificial headland though the beach erosion happened in the past. When we investigate a long-term geographical features change, the research method of using the average shoreline is an effective method, and it is useful very much in other coasts.

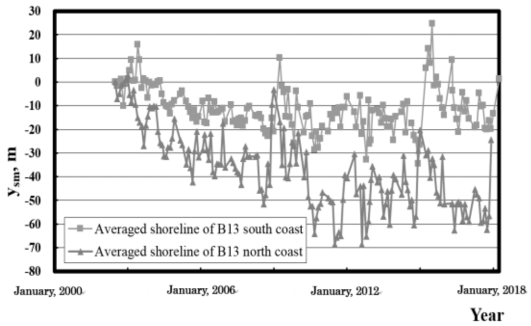

Fig. 14, The south and north coasts of B13HL

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REFERENCES

[1] Mikio Sasaki, Takahiro Takeuchi and Yutaka Fujita, 2000, "Characteristics of shoreline changes around headlands in Misawa coast, Japan", Proc. 12th Congress of the APD-IAHR, Bangkok, Thailand, pp.491-499.

[2] Mikio Sasaki, Takahiro Takeuchi and Yutaka Fujita, 2002, "Shoreline changes in Misawa coast, Japan", Proc. 13th IAHR-APD Congress, Singapore, pp.842-846.

[3] Mikio Sasaki, Takahiro Takeuchi, Yutaka Fujita and Kenichi Ogasawara, 2004, "Beach deformation and erosion measures in Misawa coast, Japan", Proc. 14th IAHR-APD Congress, Hong Kong, pp.1121-1126.

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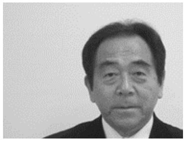

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University in 1978 after graduating from Akita University in 1972. Publications: “Coastal Engineering” (in Japanese) by Morikita Publication Ltd. Research fields: river & coastal science and environmental sciences. Membership: Member of the International Association for Hydro-Environment Engineering and Research (IAHR), Member of Japan Society of Civil Engineers (JSCE). Achievements: a lot of papers concerning coastal engineering, river engineering, and environmental engineering.

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