

6. Japanese Undersea Surveillance Systems, 1920–45

The Japanese navy began research on hydrophones in 1920, initially experimenting with foreign models, although it ‘failed to produce a workable copy’.¹ In the early 1930s, after further foreign purchases, it developed systems for installation aboard ships as well as on the sea bottom. The first ship-borne systems, the models 93 and 0, were based on the US MV-type hydrophone, which was imported in 1930; they were deployed aboard all Imperial Japanese Navy (IJN) battleships and destroyers until being superseded in 1943. Research and development was primarily undertaken by the Acoustic Department of the Second Naval Institute at Numazu, on the coast of Shizuoka Prefecture, about 130 kilometres south-west of Tokyo; it was destroyed by a US firebombing air raid in July 1945.²

The sea-bottom types could be used only in relatively shallow waters, but were useful for detection of submarine traffic in some of the Japanese straits and for harbour defence. By around 1937, ‘coastal hydrophones’ had been laid in the Tsugaru and Shimonoseki straits, both of which are narrow and shallow. It was reckoned that those in the Tsugaru Strait ‘could give ample warning of the appearance of a hostile submarine’; however, the hydrophone detection in the Shimonoseki (or Kanmon) Strait, between Honshu and Kyushu, would have been ‘imperfect ... due to domestic [shipping] traffic in these waters’.³

The first sea-bottom hydrophone system designed for harbour protection was the Type K, developed in 1935–36. It ‘was not used in practice’, however, and it could only be used in shallow waters of up to 40 metres: ‘the bearing accuracy was poor, and binaural reception made it difficult to train operators’.⁴ (Binaural reception required headphones with microphone recorders connected to the ear canals of the listener.)

1 Mark P. Parillo, *The Japanese Merchant Marine in World War II* (Naval Institute Press, Annapolis, Maryland, 1993), pp. 108–09.

2 US Naval Technical Mission to Japan, ‘Intelligence Targets Japan: Japanese Sonar and Asdic’, 14 December 1945, pp. 6, 57, at www.fischer-tropsch.org/primary_documents/gvt_reports/USNAVY/USNTMJ%20Reports/USNTMJ_toc.htm; Evans & Peattie, *Kaigun*, p. 440.

3 Albert Parry & Alexander Kiralfy, ‘Soviet Submarines in the Far East’, *Public Affairs* (Vol. 10, No. 1), March 1937, pp. 32–33.

4 US Naval Technical Mission to Japan, ‘Intelligence Targets Japan: Japanese Electronic Harbor Protection Equipment’, 14 February 1946, pp. 17–18, at www.fischer-tropsch.org/primary_documents/gvt_reports/USNAVY/USNTMJ%20Reports/USNTMJ_toc.htm

Two types of sea-bottom hydrophone arrays were developed for harbour defence in 1936–37, called types 97 and 1. The Type 1 had 10 microphones, arrayed in a circle just 1 metre in diameter; it had a frequency range of 500 to 3,500 hertz, and was able to determine the direction of sounds to an accuracy of about 10°. ⁵

The Type 97 hydrophone system, which came in four successive models (0, 1, 2 and 3), was produced in large numbers from 1937 to 1942. By 1944, 80 Type 97 models had been installed. The Model 1 could be used to a depth of up to 80 metres, the Model 2 up to 150 metres, and the Model 3 up to 250 metres. The Type 97 consisted of 13 microphones arranged in a 3-metre diameter circle, operated in the frequency range from 500 to 2,500 hertz, and provided an accuracy of about 5°. A postwar report by the US Navy reckoned that at the beginning of the war, the system could detect a US submarine running at 5 knots out to a range of about 5 kilometres. Another report stated that, later in the war, it could detect larger submarines travelling at 5 knots out to a range of about 10 kilometres, but against smaller submarines moving at under 3 knots, its range was less than a kilometre. The ‘sonic bearing evaluators’ for the Type 97s were manufactured by Oki Denki (Oki Electric Industry Company) and Nippon Denki Manufacturing companies. ⁶

The Type 97 hydrophones had a major weakness. The noise made by schools of ‘snapping shrimp’ feeding in the harbours obfuscated the sound of submarines. Indeed, ‘sometimes the noise of ships directly over the underwater phones was drowned out completely’. It was revealed after the war that US submarines had used the shrimp noise ‘as a screen to hide from’ the hydrophone detectors ‘many’ times when entering Japanese harbours in 1944–45. The Japanese navy ‘took more than a year to trace troubles in their own sound detectors to noisy fish’, and ‘not until 1944 did their biologists undertake a survey of these fish’. However, ‘the biologists were bombed out of every station they set up for this purpose’. ⁷

In addition to the hydrophones, the IJN also developed sea-bottom magnetic loop detectors for harbour defence. The Type 2 Model 1 system, produced in 1942, consisted of two oval loops, from about 1,500 metres to 3,000 metres in length and from 200 to 300 metres wide, depending on the local geography.

5 US Naval Technical Mission to Japan, ‘Japanese Sonar and Asdic’, 14 December 1945, pp. 12, 33, at www.fischer-tropsch.org/primary_documents/gvt_reports/USNAVY/USNTMJ%20Reports/USNTMJ_toc.htm

6 Norman Friedman, *U.S. Submarines Through 1945: An Illustrated Design History* (Naval Institute Press, Annapolis, Maryland, 1995), p. 247; US Naval Technical Mission to Japan, ‘Japanese Sonar and Asdic’, 14 December 1945, pp. 12, 33, at www.fischer-tropsch.org/primary_documents/gvt_reports/USNAVY/USNTMJ%20Reports/USNTMJ_toc.htm; US Naval Technical Mission to Japan, ‘Japanese Electronic Harbor Protection Equipment’, 14 February 1946, pp. 11, 17–18, 27, 31, at www.fischer-tropsch.org/primary_documents/gvt_reports/USNAVY/USNTMJ%20Reports/USNTMJ_toc.htm

7 ‘Shrimp Aided Submarines: Yankee U-boats Used Snapping Sounds to Foil Jap Detectors’, *Reading Eagle*, 16 March 1947, at news.google.com/newspapers?nid=1955&dat=19470316&id=clgrAAAIBAJ&sjid=pwFAAAAIBAJ&pg=4836,4206655

Ships or submarines passing overhead affected the magnetic fields in the area, which were monitored by galvanometers in the shore-based guard stations.⁸ The Magnetic Detection Department of the Second Naval Research Institute conducted research on 'magnetic apparatus' for submarine detection at a facility at Hayama, near Yokosuka, in Kanagawa Prefecture.⁹

The combination of Type 97 hydrophones and Type 2 Model 1 magnetic loop detectors were used to protect Tokyo Bay and all of the entrances to Setonaikai (Inland Sea). The standard practice was to lay a network of Type 93 contact mines at the mouth of the harbour or strait (with 'approximate provisions for safety channels'), with a Type 2 Model 1 or Model 4 magnetic loop detector laid inside the minefield, and then 'a number of Type 97 hydrophones', with a last line of Type 92 controlled mines.¹⁰

In the case of the Inland Sea, the narrow Shimonoseki (or Kanmon) Strait at the western entrance was easily covered, while Awaji Island blocked the south-eastern entrance. The Bungo Strait, however, between Kyushu and Shikoku Islands and providing the south-western entrance to the Inland Sea, was mostly wider and deeper; at its narrowest part, between Sada-misaki and Saganoseki, there is a 5-knot tidal current which 'masked any received signal'. According to a postwar technical assessment by the US Navy, the Bungo Strait was 'the major harbour defence problem in Japan'.¹¹ It was the responsibility of the IJN Defense Unit at Saeki, on the Kyushu side; it commanded 11 guard stations (Bobi-sho) located on both sides of the Strait (at Saeki, Seri Zaki, Hiburi, Yura, Hodo, Oshima, Tsurumi-zaki, Komo, Ukuru, Oki and Fuka-shima), which had a total of 45 Type 97 hydrophones and seven Type 2 Model 1 magnetic loop detectors (see Map 2). The Type 97 hydrophone arrays controlled from Oshima on the Kyushu side and Yura on the Shikoku side came together in the middle of the Strait, forming a single field; it 'was of such a width that it took a ship travelling at two knots 30 minutes to traverse it'.¹² The arrays controlled from Hodo and Hiburi formed a similar field about 10 kilometres inside the Oshima-Yura field. At the outer entrance, hydrophones controlled from Seri Zaki and

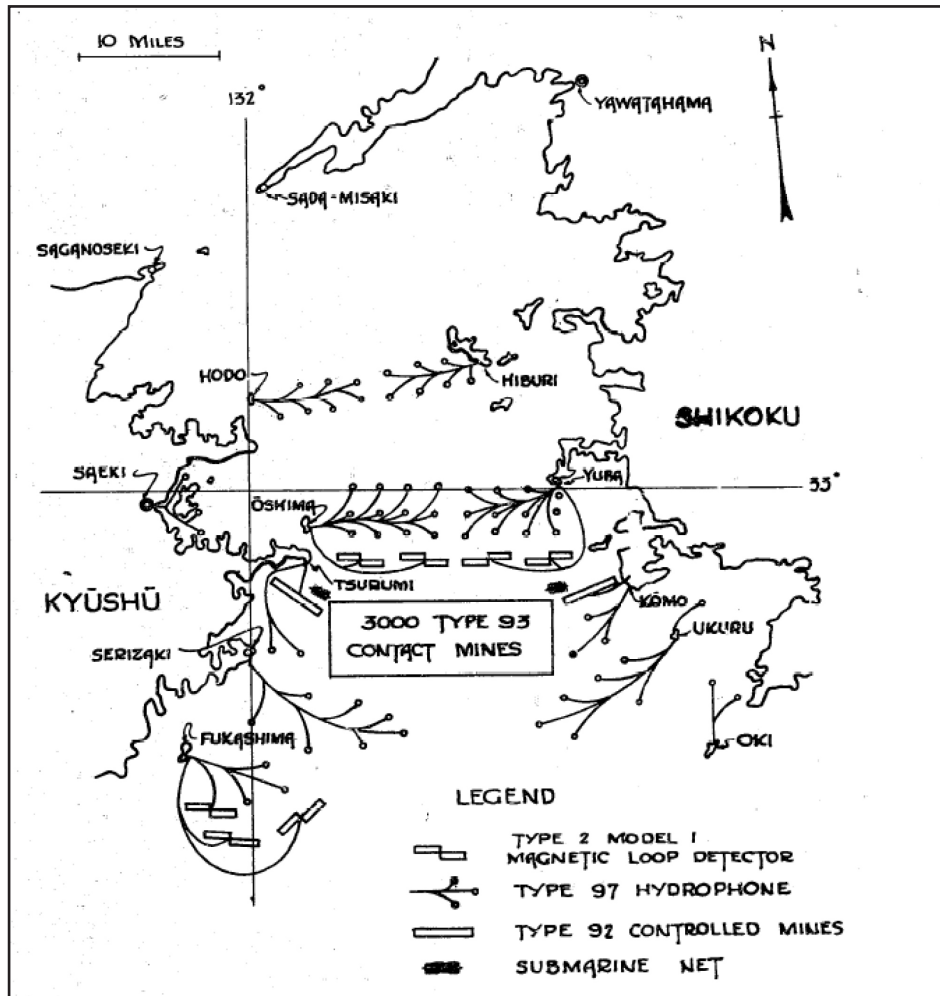
8 US Naval Technical Mission to Japan, 'Japanese Electronic Harbor Protection Equipment', 14 February 1946, pp. 13–14, at www.fischer-tropsch.org/primary_documents/gvt_reports/USNAVY/USNTMJ%20Reports/USNTMJ_toc.htm

9 US Naval Technical Mission to Japan, 'Intelligence Targets Japan: Japanese Electronics – General', 29 December 1945, p. 8, at www.fischer-tropsch.org/primary_documents/gvt_reports/USNAVY/USNTMJ%20Reports/USNTMJ_toc.htm

10 US Naval Technical Mission to Japan, 'Japanese Electronic Harbor Protection Equipment', 14 February 1946, p. 7, at www.fischer-tropsch.org/primary_documents/gvt_reports/USNAVY/USNTMJ%20Reports/USNTMJ_toc.htm

11 *ibid.*

12 *ibid.*, pp. 7–10.



Map 2. Plan of Imperial Japanese Navy (IJN) defences of the Bungo Channel between Kyushu and Shikoku, 1945

Source: US Naval Technical Mission to Japan, 'Japanese Electronic Harbor Protection Equipment', February 1946, p. 8, at www.fischer-tropsch.org/primary_documents/gvt_reports/USNAVY/USNTMJ%20Reports/USNTMJ-200B-0692-0725%20Report%20E-26

Fuka-shima extended from the south-western side, and arrays controlled from Komo, Ukuru and Oki extended from the south-eastern side. The system was supposed to work as follows:

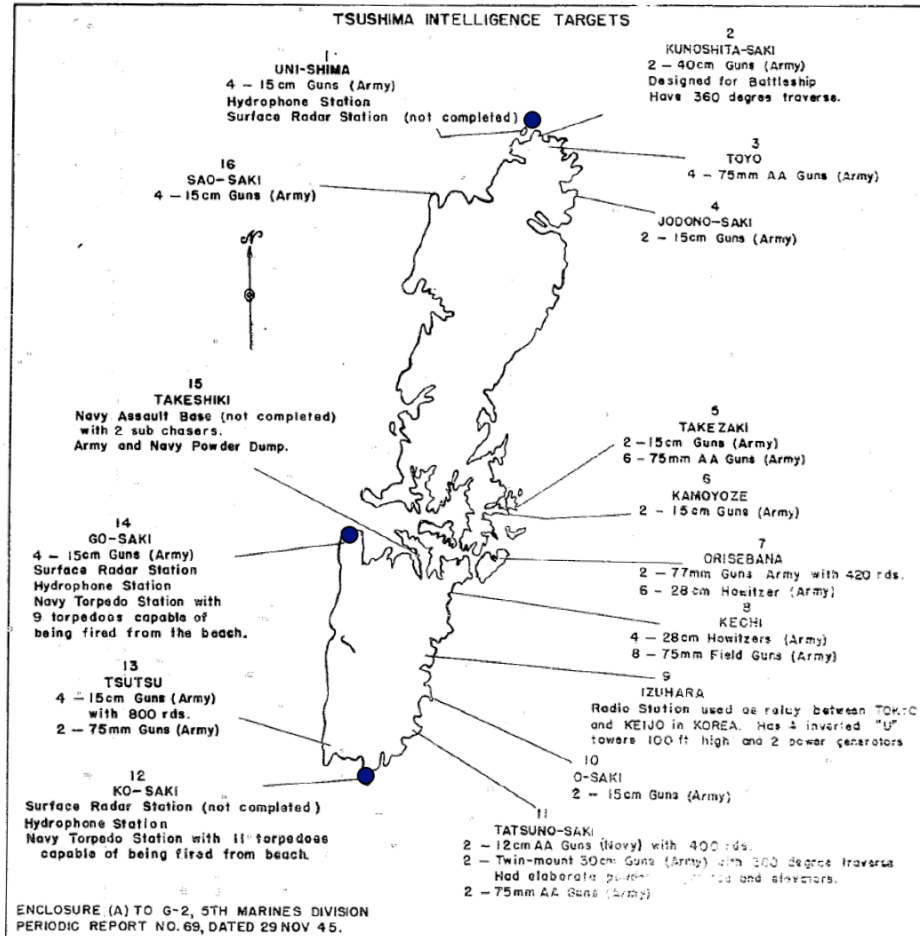
If, for example, an incoming target was detected by the Seri Zaki Guard Station hydrophones, the Defense Unit at Saeki and the Guard Station at Tsurumi were to be immediately informed by radio ... The Guard Station at Tsurumi was expected to be able to track the target in on

its hydrophones and destroy it when it passed through the Type 92 controlled mine field. If by some chance a target succeeded in passing through either the Type 92 or Type 93 mines, it was to be further tracked by the magnetic loops and hydrophones at Oshima, Yura, Hodo and Hiburi, and all information transmitted to the Defense Unit [at Saeki] which plotted all incoming data ... Sub-chasers and patrol boats were [then] to be dispatched to drop depth charges.¹³

Three hydrophone fields were connected to shore stations on the Tsushima Islands to monitor submarine traffic through the Korea/Tsushima Strait and the southern entrance of the Sea of Japan (see Map 3). The shore stations were located on Uni-shima, the small island just off the northern point of the northern part of Tsushima Island, from which hydrophone arrays could be extended both westwards towards the Korean Peninsula and eastwards towards south-western Honshu; Go-saki, on the north-western point of the southern part of Tsushima, from which hydrophone arrays extended westwards; and at Ko-saki, at the southern point of the southern part of Tsushima Island, from which arrays again extended both westwards and eastwards.¹⁴

¹³ *ibid.*, p. 7.

¹⁴ US Naval Technical Mission to Japan, 'Intelligence Targets Japan: Defenses of Tsushima and Entrance to Sea of Japan', 11 January 1946, at www.fischer-tropsch.org/primary_documents/gvt_reports/USNAVY/USNTMJ%20Reports/USNTMJ_toc.htm



Map 3. IJN defences of Tsushima Island, 1945

Source: Adapted from US Naval Technical Mission to Japan, 'Defenses of Tsushima and Entrance to Sea of Japan', January 1946, p. 13, at www.fischer-tropsch.org/primary_documents/gvt_reports/USNAVY/USNTMJ%20Reports/USNTMJ-200F-0725-0738%20Report%200-55%20N

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