

## **Proposed Otolith Marks for Brood Year 2012 Salmon in Japan**

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## Abstract

Japan plans to mark approximately 252 million salmon of 2012 brood year (225 million chum, 23.2 million pink, 3.3 million masu, and 150 thousand sockeye salmon) using 47 discrete thermal patterns and two ALC (alizarin complexone) patterns at 40 hatcheries. Two thermal rings in the first band are adopted as the base mark to distinguish Japanese chum and pink salmon from other stocks.

## Background

In Japan, thermal otolith marks have been used for migration, growth and survival surveys of juvenile salmon in the coastal waters, and for offshore migration surveys in the Okhotsk Sea, North Pacific Ocean and Bering Sea (Kawana et al. 1999; Urawa et al. 2000a, 2004, 2006, 2009; Sato et al. 2009). In addition, otolith marking is expected as a tool to evaluate accuracy of homing migration and abundance of hatchery and natural spawning stocks.

## Mark Plan

The proposed otolith marks for the 2012 brood year salmon include 47 discrete thermal patterns and two ALC (alizarin complexone) patterns (Table 1). We plan to mark approximately 225 million chum, 23.2 million pink, 3.3 million masu, and 150 thousand sockeye salmon at 40 hatcheries (Fig. 1).

The thermal marking pattern is presented as the hatch code notation (Hagen et al. 2000; Josephson et al. 2006). As the base mark, two rings in the first band have been adopted to distinguish Japanese chum and pink salmon from other stocks since 1999 brood year stock (Urawa et al. 2000b). All thermal rings are induced by cooler temperature exposures.

Three patterns of ALC mark (Fig. 2) are used for chum salmon surveys by the Hokkaido Salmon and Freshwater Fisheries Research Institute, Hokkaido Research Organization (HOKK) and the Yamagata Prefectural Inland Water Fisheries Experimental Station (YIE).

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**Table 1.** Proposed otolith mark releases from Japan for 2012 brood year stocks of chum, pink, masu and sockeye salmon. TM, otolith thermal marking; ALC, alizarin complexone; FRA, Fisheries Research Agency; HOKK, Hokkaido Research Organization; IFTC, Iwate Fisheries Technology Center; YIE, Yamagata Prefectural Inland Water Fisheries Experimental Station; NPH, non-profit private hatchery. Mark plans updated on September 4, 2012 are indicated by red texts.

No	Mark Type	Brood Year	Year of Release	Species	Country	State/Province	Region	Agency	Facility	Stock	Final Release Site
JP12-01	TM	2012	2013	CHUM	JAPAN	HOKKAIDO	Japan Sea coast	FRA	Chitose Hatchery	Ishikari River	Ishikari River
JP12-02	TM	2012	2013	CHUM	JAPAN	HOKKAIDO	Japan Sea coast	FRA	Chitose Hatchery	Ishikari River	Ishikari River
JP12-03	TM	2012	2013	CHUM	JAPAN	HOKKAIDO	Japan Sea coast	FRA	Chitose Hatchery	Ishikari River	Ishikari River
JP12-04	TM	2012	2013	CHUM	JAPAN	HOKKAIDO	Japan Sea coast	FRA	Chitose Hatchery	Ishikari River	Ishikari River
JP12-05	ALC	2012	2013	CHUM	JAPAN	HOKKAIDO	Japan Sea coast	HOKK	Makkari Hatchery	Hamamasu River	Hamamasu River
JP12-06	ALC	2012	2013	CHUM	JAPAN	HOKKAIDO	Japan Sea coast	HOKK	Makkari Hatchery	Noduka River	Hamamasu River
JP12-07	TM	2012	2013	CHUM	JAPAN	HOKKAIDO	Japan Sea coast	FRA	Teshio Hatchery	Teshio River	Teshio River
JP12-08	TM	2012	2013	CHUM	JAPAN	HOKKAIDO	Japan Sea coast	NPH	Teshio Hatchery	Shokanbetsu	Shokanbetsu
JP12-09	TM	2012	2013	CHUM	JAPAN	HOKKAIDO	Okhotsk Sea coast	NPH	Shintonbetsu Hatchery	Tonbetsu River	Tonbetsu River
JP12-10	TM	2012	2013	CHUM	JAPAN	HOKKAIDO	Okhotsk Sea coast	FRA	Tokushibetsu Hatchery	Tokushibetsu River	Tokushibetsu River
JP12-11	TM	2012	2013	CHUM	JAPAN	HOKKAIDO	Okhotsk Sea coast	NPH	Horonai Hatchery	Horonai Hatchery	Horonai Hatchery
JP12-12	TM	2012	2013	CHUM	JAPAN	HOKKAIDO	Okhotsk Sea coast	FRA	Shari Hatchery	Shari River	Shari River
JP12-13	ALC	2012	2013	CHUM	JAPAN	HOKKAIDO	Okhotsk Sea coast	HOKK	Oketo Hatchery	Tokoro River	Tokoro River
JP12-14	ALC	2012	2013	CHUM	JAPAN	HOKKAIDO	Okhotsk Sea coast	HOKK	Aioi Hatchery	Abashiri River	Urashibetsu River
JP12-15	TM	2012	2013	CHUM	JAPAN	HOKKAIDO	Nemuro Strait coast	FRA	Ichani Hatchery	Ichani River	Ichani River
JP12-16	TM	2012	2013	CHUM	JAPAN	HOKKAIDO	Nemuro Strait coast	NPH	Shibetsu Hatchery	Shibetsu River	Shibetsu River
JP12-17	TM	2012	2013	CHUM	JAPAN	HOKKAIDO	Nemuro Strait coast	FRA	Nijibetsu Hatchery	Nishibetsu River	Nishibetsu River
JP12-18	TM	2012	2013	CHUM	JAPAN	HOKKAIDO	Nemuro Strait coast	FRA	Nijibetsu Hatchery	Nishibetsu River	Nishibetsu River
JP12-19	TM	2012	2013	CHUM	JAPAN	HOKKAIDO	Nemuro Strait coast	FRA	Nijibetsu Hatchery	Nishibetsu River	Nishibetsu River
JP12-20	ALC	2012	2013	CHUM	JAPAN	HOKKAIDO	Nemuro Strait coast	HOKK	unknown	unknown	Uebetsu River

No	Rearing Treatment	Stage	Preliminary Number of OM Released	OM ID	Hatch Code	Prehatch Graphic Image	Posthatch Graphic Image	Marking System
JP12-01	fed	fry	2,800,000	Ishikari12chum-1	2,3-2-2H			CHILLER
JP12-02	fed	fry	2,800,000	Ishikari12chum-2	2,3-2-3H			CHILLER
JP12-03	fed	fry	2,800,000	Ishikari12chum-3	2,3-5H			CHILLER
JP12-04	fed	fry	21,600,000	Ishikari12chum-4	2,3-3H			CHILLER
JP12-05	fed	fry	500,000	Hamamasu12chum-alc1	A1H			
JP12-06	fed	fry	500,000	Hamamasu12chum-alc2	A1H			
JP12-07	fed	fry	5,000,000	Teshio12chum	2n-3H			CHILLER
JP12-08	fed	fry	3,900,000	Shokanbetsu12chum	2,1-1-1-1H			CHILLER
JP12-09	fed	fry	3,900,000	Tonbetsu12chum	2-2-1-3H			CHILLER
JP12-10	fed	fry	11,100,000	Tokushibetsu12chum	2,2,2,3H			CHILLER
JP12-11	fed	fry	3,800,000	Horonai12chum	2,5nH			CHILLER
JP12-12	fed	fry	11,600,000	Shari12chum	2-2-2-2H			CHILLER
JP12-13	fed	fry	2,000,000	Tokoro12chum-alc	A2H			
JP12-14	fed	fry	1,000,000	Urashibetsu12chum-alc	A2H			
JP12-15	fed	fry	8,000,000	Ichani12chum	2-4-2H			CHILLER
JP12-16	fed	fry	3,800,000	Shibetsu12chum	2,3,4H			CHILLER
JP12-17	fed	fry	5,000,000	Nishibetsu12chum-1	2,6nH			CHILLER
JP12-18	fed	fry	10,200,000	Nishibetsu12chum-2	2-7H			CHILLER
JP12-19	fed	fry	9,800,000	Nishibetsu12chum-3	2-8H			CHILLER
JP12-20	fed	fry	3,000,000	Uebetsu12chum-alc	A1H			

No	Otolith Mark Schedule	Temp Shift Direction	Comments
JP12-01	(1X)12C:12H,(1X)12C:24H,(2X)12C:12H,(1X)12C:36H,(1X)12C:12H,(1X)12C:36H,(2X)12C:12H	dow n(8-4°C)	
JP12-02	(1X)12C:12H,(1X)12C:24H,(2X)12C:12H,(1X)12C:36H,(1X)12C:12H,(1X)12C:36H,(3X)12C:12H	dow n(8-4°C)	
JP12-03	(1X)12C:12H,(1X)12C:24H,(2X)12C:12H,(1X)12C:36H,(5X)12C:12H	dow n(8-4°C)	
JP12-04	(1X)12C:12H,(1X)12C:24H,(2X)12C:12H,(1X)12C:36H,(3X)12C:12H	dow n(8-4°C)	
JP12-05			Small ring
JP12-06			Large ring
JP12-07	(1X)12C:12H,(1X)12C:36H,(3X)24C:24H	dow n(12-8°C)	
JP12-08	(1X)12C:12H,(1X)12C:24H,(4X)12C:36H	dow n(8-4°C)	
JP12-09	(1X)12C:12H,(1X)12C:36H,(1X)12C:12H,(1X)12C:36H,(1X)12C:36H,(3X)12C:12H	dow n(8-4°C)	
JP12-10	(1X)12C:12H,(1X)12C:24H,(1X)12C:12H,(1X)12C:24H,(1X)12C:12H,(1X)12C:24H,(3X)12C:12H	dow n(8-4°C)	
JP12-11	(1X)24C:24H,(1X)24C:48H,(5X)12C:12H	dow n(8-4°C)	
JP12-12	(1X)12C:12H,(1X)12C:36H,(1X)12C:12H,(1X)12C:36H,(1X)12C:12H,(1X)12C:36H,(2X)12C:12H	dow n(8-4°C)	
JP12-13			
JP12-14			
JP12-15	(1X)12C:12H,(1X)12C:36H,(3X)12C:12H,(1X)12C:36H,(2X)12C:12H	dow n(8-4°C)	
JP12-16	(1X)12C:12H,(1X)12C:24H,(2X)12C:12H,(1X)12C:24H,(4X)12C:12H	dow n(8-4°C)	
JP12-17	(1X)24C:24H,(1X)24C:48H,(6X)12C:12H	dow n(9-5°C)	
JP12-18	(1X)12C:12H,(1X)12C:36H,(7X)12C:12H	dow n(9-5°C)	
JP12-19	(1X)12C:12H,(1X)12C:36H,(8X)12C:12H	dow n(9-5°C)	
JP12-20			Small ring

Table 1. Continued.

No	Mark Type	Brood Year	Year of Release	Species	Country	State/Province	Region	Agency	Facility	Stock	Final Release Site
JP12-21	TM	2012	2013	CHUM	JAPAN	HOKKAIDO	East Pacific coast	FRA	Tsurui Hatchery	Kushiro River	Kushiro River
JP12-22	TM	2012	2013	CHUM	JAPAN	HOKKAIDO	East Pacific coast	FRA	Tokachi Hatchery	Tokachi River	Tokachi River
JP12-23	TM	2012	2013	CHUM	JAPAN	HOKKAIDO	East Pacific coast	NPH	Hiroo Hatchery	Hiroo River	Hiroo River
JP12-24	ALC	2012	2013	CHUM	JAPAN	HOKKAIDO	East Pacific coast	HOKK	unknown	unknown	Kushiro River
JP12-25	ALC	2012	2013	CHUM	JAPAN	HOKKAIDO	East Pacific coast	HOKK	unknown	unknown	Kushiro River
JP12-26	ALC	2012	2013	CHUM	JAPAN	HOKKAIDO	East Pacific coast	HOKK	unknown	unknown	Kushiro River
JP12-27	TM	2012	2013	CHUM	JAPAN	HOKKAIDO	West Pacific coast	NPH	Hidakahorobetsu Hatchery	Hidakahorobetsu River	Hidakahorobetsu River
JP12-28	TM	2012	2013	CHUM	JAPAN	HOKKAIDO	West Pacific coast	FRA	Shizunai Hatchery	Shizunai River	Shizunai River
JP12-29	TM	2012	2013	CHUM	JAPAN	HOKKAIDO	West Pacific coast	NPH	Shikui Hatchery	Shiraoi River	Shiraoi River
JP12-30	TM	2012	2013	CHUM	JAPAN	HOKKAIDO	West Pacific coast	NPH	Yakumo Hatchery	Shiribeshitoshibetsu River	Shiribeshitoshibetsu River
JP12-31	TM	2012	2013	CHUM	JAPAN	HOKKAIDO	West Pacific coast	FRA	Yakumo Hatchery	Yurappu River	Yurappu River
JP12-32	TM	2012	2013	CHUM	JAPAN	HOKKAIDO	West Pacific coast	NPH	Fukushima Hatchery	Fukushima River	Fukushima River
JP12-33	TM	2012	2013	CHUM	JAPAN	HONSHU	Pacific coast	NPH	Oirase Hatchery (Pacific)	Oirase River (Pacific)	Oirase River (Pacific)
JP12-34	TM	2012	2013	CHUM	JAPAN	HONSHU	Pacific coast	IFTC	Kasshi Hatchery	Katagishi River	Katagishi River
JP12-35	TM	2012	2013	CHUM	JAPAN	HONSHU	Pacific coast	IFTC	Kasshi Hatchery	Kasshi Hatchery	Kasshi Hatchery
JP12-36	TM	2012	2013	CHUM	JAPAN	HONSHU	Pacific coast	IFTC	Kasshi Hatchery	Kasshi Hatchery	Kasshi Hatchery
JP12-37	TM	2012	2013	CHUM	JAPAN	HONSHU	Pacific coast	IFTC	Kasshi Hatchery	Kasshi Hatchery	Kasshi Hatchery
JP12-38	TM	2012	2013	CHUM	JAPAN	HONSHU	Pacific coast	FRA	Orikasa Hatchery	Orikasa River	Orikasa River
JP12-39	TM	2012	2013	CHUM	JAPAN	HONSHU	Pacific coast	FRA	Orikasa Hatchery	Orikasa River	Yamada Bay
JP12-40	TM	2012	2013	CHUM	JAPAN	HONSHU	Pacific coast	FRA	Orikasa Hatchery	Orikasa River	Orikasa River

No	Rearing Treatment	Stage	Preliminary Number of OM Released	OM ID	Hatch Code	Prehatch Graphic Image	Posthatch Graphic Image	Marking System
JP12-21	fed	fry	9,100,000	Kushiro12chum	2-2-3-3H			CHILLER
JP12-22	fed	fry	15,300,000	Tokachi12chum	2-5-3H			CHILLER
JP12-23	fed	fry	3,900,000	Hiroo12chum	2n-4H			CHILLER
JP12-24	fed	fry	1,000,000	Kushiro12chum-alc-1	A1H			
JP12-25	fed	fry	2,000,000	Kushiro12chum-alc-2	A1H			
JP12-26	fed	fry	1,000,000	Kushiro12chum-alc-3	A2H			
JP12-27	fed	fry	3,900,000	Hidakahorobetsu12chum	2n-2,2nH			CHILLER
JP12-28	fed	fry	6,400,000	Shizunai12chum	2,3n-2nH			CHILLER
JP12-29	fed	fry	3,900,000	Shikui12chum	2,2n-2nH			CHILLER
JP12-30	fed	fry	3,900,000	Shiribeshitoshibetsu12chum	2-1-2-2H			CHILLER
JP12-31	fed	fry	7,500,000	Yurappu12chum	2,2n-5nH			CHILLER
JP12-32	fed	fry	3,900,000	Fukushima12chum	2-1-2-3H			CHILLER
JP12-33	fed	fry	5,300,000	Oirase-P12chum	2,2,3H			CHILLER
JP12-34	fed	fry	1,000,000	Katagishi12chum	2,4H			CHILLER
JP12-35	fed	fry	1,000,000	Kasshi12chum-1	2,2,4H			CHILLER
JP12-36	fed	fry	1,000,000	Kasshi12chum-2	2,4,3H			CHILLER
JP12-37	fed	fry	1,000,000	Kasshi12chum-3	2,2,3,2H			CHILLER
JP12-38	egg		440,000	Orikasa12chum-1	2,5H			CHILLER
JP12-39	fed	fry	425,000	Orikasa12chum-2	2,2nH			CHILLER
JP12-40	fed	fry	425,000	Orikasa12chum-3	2n-2H			CHILLER

No	Otolith Mark Schedule	Temp Shift Direction	Comments
JP12-21	(1X)12C:12H,(1X)12C:36H,(1X)12C:12H,(1X)12C:36H,(2X)12C:12H,(1X)12C:36H,(3X)12C:12H	down n(8-4°C)	
JP12-22	(1X)12C:12H,(1X)12C:36H,(4X)12C:12H,(1X)12C:36H,(3X)12C:12H	down n(8-4°C)	
JP12-23	(1X)12C:12H,(1X)12C:36H,(4X)24C:24H	down n(8-4°C)	
JP12-24			Large ring
JP12-25			Small ring
JP12-26			
JP12-27	(1X)12C:12H,(1X)12C:36H,(1X)24C:24H,(1X)24C:48H,(2X)12C:12H	down n(8-4°C)	
JP12-28	(1X)24C:24H,(1X)24C:48H,(2X)12C:12H,(1X)12C:36H,(2X)12C:12H	down n(10-6°C)	
JP12-29	(1X)24C:24H,(1X)24C:48H,(1X)12C:12H,(1X)12C:36H,(2X)12C:12H	down n(8-4°C)	
JP12-30	(1X)12C:12H,(1X)12C:36H,(1X)12C:36H,(1X)12C:12H,(1X)12C:36H,(2X)12C:12H	down n(8-4°C)	
JP12-31	(1X)24C:24H,(1X)24C:48H,(1X)12C:12H,(1X)12C:36H,(5X)12C:12H	down n(8-4°C)	
JP12-32	(1X)12C:12H,(1X)12C:36H,(1X)12C:36H,(1X)12C:12H,(1X)12C:36H,(3X)12C:12H	down n(8-4°C)	
JP12-33	(1X)12C:12H,(1X)12C:24H,(1X)12C:12H,(1X)12C:24H,(3X)12C:12H	down n(8-4°C)	
JP12-34	(1X)12C:12H,(1X)12C:24H,(4X)12C:12H	down n(10-6°C)	
JP12-35	(1X)12C:12H,(1X)12C:24H,(1X)12C:12H,(1X)12C:24H,(4X)12C:12H	down n(10-6°C)	
JP12-36	(1X)12C:12H,(1X)12C:24H,(3X)12C:12H,(1X)12C:24H,(3X)12C:12H	down n(10-6°C)	
JP12-37	(1X)12C:12H,(1X)12C:24H,(3X)12C:12H,(1X)12C:24H,(2X)12C:12H,(1X)12C:24H,(2X)12C:12H	down n(10-6°C)	
JP12-38	(1X)12C:12H,(1X)12C:24H,(5X)12C:12H	down n(14-10°C)	
JP12-39	(1X)24C:24H,(1X)24C:48H,(2X)12C:12H	down n(14-10°C)	
JP12-40	(1X)12C:12H,(1X)12C:36H,(2X)24C:24H	down n(14-10°C)	

Table 1. Continued.

No	Mark Type	Brood Year	Year of Release	Species	Country	State/Province	Region	Agency	Facility	Stock	Final Release Site
JP12-41	TM	2012	2013	CHUM	JAPAN	HONSHU	Pacific coast	FRA	Orikasa Hatchery	Orikasa River	Yamada Bay
JP12-42	TM	2012	2013	CHUM	JAPAN	HONSHU	Pacific coast	NPH	Shimoakka Hatchery	Akka River	Akka River
JP12-43	TM	2012	2013	CHUM	JAPAN	HONSHU	Pacific coast	NPH	Tarou Hatchery	Tarou River	Tarou River
JP12-44	TM	2012	2013	CHUM	JAPAN	HONSHU	Pacific coast	NPH	Tsugaruishi Hatchery	Tsugaruishi River	Tsugaruishi River
JP12-45	TM	2012	2013	CHUM	JAPAN	HONSHU	Pacific coast	NPH	Orikasa Hatchery	Orikasa River	Orikasa River
JP12-46	TM	2012	2013	CHUM	JAPAN	HONSHU	Pacific coast	NPH	Ohtsuchi Hatchery	Ohtsuchi River	Ohtsuchi River
JP12-47	TM	2012	2013	CHUM	JAPAN	HONSHU	Pacific coast	NPH	Sakari Hatchery	Sakari River	Sakari River
JP12-48	TM	2012	2013	CHUM	JAPAN	HONSHU	Pacific coast	NPH	Eai Hatchery	Eai River	Eai River
JP12-49	TM	2012	2013	CHUM	JAPAN	HONSHU	Pacific coast	NPH	Eai Hatchery	Kuji River	Kuji River
JP12-50	TM	2012	2013	CHUM	JAPAN	HONSHU	Japan Sea coast	NPH	Oirase Hatchery (Japan sea	Oirase River (Japan Sea)	Oirase River (Japan Sea)
JP12-51	TM	2012	2013	CHUM	JAPAN	HONSHU	Japan Sea coast	NPH	Kawabukuro Hatchery	Kawabukuro River	Kawabukuro River
JP12-52	TM	2012	2013	CHUM	JAPAN	HONSHU	Japan Sea coast	NPH	Masukawa Hatchery	Gakkou River	Gakkou River
JP12-53	TM	2012	2013	CHUM	JAPAN	HONSHU	Japan Sea coast	YIE	YIE	Gakkou River	Gakkou River
JP12-54	TM	2012	2013	CHUM	JAPAN	HONSHU	Japan Sea coast	NPH	Momote3 Hatchery	Momote River	Momote River
JP12-55	TM	2012	2013	CHUM	JAPAN	HONSHU	Japan Sea coast	NPH	Himekawa Hatchery	Himekawa River	Himekawa River
JP12-56	TM	2012	2013	CHUM	JAPAN	HONSHU	Japan Sea coast	NPH	Shougawa Hatchery	Shougawa River	Shougawa River
JP12-57	TM	2012	2013	PINK	JAPAN	HOKKAIDO	Okhotsk Sea coast	FRA	Tokushibetsu Hatchery	Tokushibetsu River	Tokushibetsu River
JP12-58	TM	2012	2013	PINK	JAPAN	HOKKAIDO	Okhotsk Sea coast	FRA	Tokushibetsu Hatchery	Tokushibetsu River	Kitamihorobetsu River
JP12-59	TM	2012	2013	PINK	JAPAN	HOKKAIDO	Okhotsk Sea coast	FRA	Shari Hatchery	Shari River	Shari River
JP12-60	TM	2012	2013	PINK	JAPAN	HOKKAIDO	Okhotsk Sea coast	FRA	Shari Hatchery	Tokoro River	Tokoro River

No	Rearing Treatment	Stage	Preliminary Number of OM Released	OM ID	Hatch Code	Prehatch Graphic Image	Posthatch Graphic Image	Marking System
JP12-41	fed	fry	425,000	Orikasa12chum-4	2-2,2H			CHILLER
JP12-42	fed	fry	10,100,000	Akka12chum	2,6H			CHILLER
JP12-43	fed	fry	2,000,000	Tarou12chum	2,6H			CHILLER
JP12-44	fed	fry	6,000,000	Tsugaruishi12chum	2,6H			CHILLER
JP12-45	fed	fry	1,000,000	Orikasa12chum	2,6H			CHILLER
JP12-46	fed	fry	1,000,000	Ohtsuchi12chum	2,6H			CHILLER
JP12-47	fed	fry	1,000,000	Sakari12chum	2,6H			CHILLER
JP12-48	fed	fry	2,500,000	Eai12chum	2,3H			CHILLER
JP12-49	fed	fry	500,000	Kuji12chum	2,2H			CHILLER
JP12-50	fed	fry	1,400,000	Oirase-J12chum	2,3,2H			CHILLER
JP12-51	fed	fry	3,600,000	Kawabukuro12chum	2,1,4H			CHILLER
JP12-52	fed	fry	3,500,000	Gakko12chum	2,3nH			CHILLER
JP12-53	fed	fry	200,000	Gakko12chum-alc	A1H			CHILLER
JP12-54	fed	fry	2,900,000	Momote12chum	2,1,2H			CHILLER
JP12-55	fed	fry	900,000	Himekawa a12chum	2,1,2H			CHILLER
JP12-56	fed	fry	2,600,000	Shougawa a12chum	2,1,3H			CHILLER
JP12-57	fed	fry	1,700,000	Tokushibetsu12pink	2-3H			CHILLER
JP12-58	fed	fry	1,500,000	Kitamihorobetsu12pink	2n-3H			CHILLER
JP12-59	fed	fry	5,000,000	Shari12pink	2,3nH			CHILLER
JP12-60	fed	fry	1,000,000	Tokoro12pink	2,3n-2nH			CHILLER

No	Otolith Mark Schedule	Temp Shift Direction	Comments
JP12-41	(1X)12C:12H,(1X)12C:36H,(1X)12C:12H,(1X)12C:24H,(2X)12C:12H	down(14-10°C)	
JP12-42	(1X)12C:12H,(1X)12C:24H,(6X)12C:12H	down(8-4°C)	
JP12-43	(1X)12C:12H,(1X)12C:24H,(6X)12C:12H	down(8-4°C)	
JP12-44	(1X)12C:12H,(1X)12C:24H,(6X)12C:12H	down(8-4°C)	
JP12-45	(1X)12C:12H,(1X)12C:24H,(6X)12C:12H	down(8-4°C)	
JP12-46	(1X)12C:12H,(1X)12C:24H,(6X)12C:12H	down(8-4°C)	
JP12-47	(1X)12C:12H,(1X)12C:24H,(6X)12C:12H	down(8-4°C)	
JP12-48	(1X)12C:12H,(1X)12C:24H,(3X)12C:12H	down(8-4°C)	
JP12-49	(1X)12C:12H,(1X)12C:24H,(2X)12C:12H	down(8-4°C)	
JP12-50	(1X)12C:12H,(1X)12C:24H,(2X)12C:12H,(1X)12C:24H,(2X)12C:12H	down(8-4°C)	
JP12-51	(1X)12C:12H,(2X)12C:24H,(4X)12C:12H	down(8-4°C)	
JP12-52	(1X)24C:24H,(1X)24C:48H,(3X)12C:12H	down(8-4°C)	
JP12-53			
JP12-54	(1X)12C:12H,(2X)12C:24H,(2X)12C:12H	down(8-4°C)	
JP12-55	(1X)12C:12H,(2X)12C:24H,(2X)12C:12H	down(8-4°C)	
JP12-56	(1X)12C:12H,(2X)12C:24H,(3X)12C:12H	down(8-4°C)	
JP12-57	(1X)24C:24H,(1X)24C:72H,(3X)24C:24H	down(8-4°C)	
JP12-58	(1X)12C:12H,(1X)12C:36H,(3X)24C:24H	down(8-4°C)	
JP12-59	(1X)24C:24H,(1X)24C:48H,(3X)12C:12H	down(8-4°C)	
JP12-60	(1X)24C:24H,(1X)24C:48H,(2X)12C:12H,(1X)12C:36H,(2X)12C:12H	down(12-8°C)	

Table 1. Continued.

No	Mark Type	Brood Year	Year of Release	Species	Country	State/Province	Region	Agency	Facility	Stock	Final Release Site
JP12-61	TM	2012	2013	PINK	JAPAN	HOKKAIDO	Nemuro Strait coast	FRA	Nijibetsu Hatchery	Sashirui River	Shibetsu River
JP12-62	TM	2012	2013	PINK	JAPAN	HOKKAIDO	Nemuro Strait coast	FRA	Ichani Hatchery	Ichani River	Ichani River
JP12-63	TM	2012	2013	PINK	JAPAN	HOKKAIDO	Nemuro Strait coast	FRA	Ichani Hatchery	Ichani River	Ichani River
JP12-64	ALC	2012	2013	PINK	JAPAN	HOKKAIDO	Nemuro Strait coast	HOKK	unknow n	unknow n	Touhoro River
JP12-65	ALC	2012	2013	PINK	JAPAN	HOKKAIDO	Nemuro Strait coast	HOKK	unknow n	unknow n	Touhoro River
JP12-66	ALC	2012	2013	PINK	JAPAN	HOKKAIDO	Nemuro Strait coast	HOKK	unknow n	unknow n	Shibetsu River
JP12-67	ALC	2012	2013	PINK	JAPAN	HOKKAIDO	Nemuro Strait coast	HOKK	unknow n	unknow n	Shibetsu River
JP12-68	TM	2012	2013	MASU	JAPAN	HOKKAIDO	Japan Sea coast	FRA	Shiribetsu Hatchery	Shiribetsu River	Shubuto River
JP12-69	TM	2012	2013	MASU	JAPAN	HOKKAIDO	Japan Sea coast	FRA	Shiribetsu Hatchery	Shiribetsu River	Shiribetsu River
JP12-70	TM	2012	2013	MASU	JAPAN	HOKKAIDO	Japan Sea coast	FRA	Shiribetsu Hatchery	Shiribetsu River	Shiribetsu River
JP12-71	TM	2012	2014	MASU	JAPAN	HOKKAIDO	Japan Sea coast	FRA	Shiribetsu Hatchery	Shiribetsu River	Shiribetsu River
JP12-72	TM	2012	2013	MASU	JAPAN	HOKKAIDO	Japan Sea coast	FRA	Chitose Hatchery	Ishikari River	Ishikari River
JP12-73	TM	2012	2013	MASU	JAPAN	HOKKAIDO	Japan Sea coast	FRA	Chitose Hatchery	Ishikari River	Ishikari River
JP12-74	TM	2012	2014	MASU	JAPAN	HOKKAIDO	Japan Sea coast	FRA	Chitose Hatchery	Ishikari River	Ishikari River
JP12-75	ALC	2012	2015	MASU	JAPAN	HOKKAIDO	Japan Sea coast	HOKK	unknow n	unknow n	Kenichi River
JP12-76	TM	2012	2013	MASU	JAPAN	HOKKAIDO	Okhotsk Sea coast	FRA	Tokushibetsu Hatchery	Tokushibetsu River	Tokushibetsu River
JP12-77	TM	2012	2013	MASU	JAPAN	HOKKAIDO	Okhotsk Sea coast	FRA	Shari Hatchery	Shari River	Shari River
JP12-78	TM	2012	2013	MASU	JAPAN	HOKKAIDO	Okhotsk Sea coast	FRA	Shari Hatchery	Shari River	Shari River
JP12-79	TM	2012	2014	MASU	JAPAN	HOKKAIDO	Okhotsk Sea coast	FRA	Shari Hatchery	Shari River	Shari River
JP12-80	TM	2012	2013	MASU	JAPAN	HOKKAIDO	Nemuro Strait coast	FRA	Nemuro Hatchery	Ichani River	Ichani River

No	Rearing Treatment	Stage	Preliminary Number of OM Released	OM ID	Hatch Code	Prehatch Graphic Image	Posthatch Graphic Image	Marking System
JP12-61	fed	fry	5,500,000	Shibetsu12pink	2,4nH	II III		CHILLER
JP12-62	fed	fry	2,250,000	Ichani12pink-1	2,4H	II IIII		CHILLER
JP12-63	fed	fry	2,250,000	Ichani12pink-2	2-2-4H	II II IIII		CHILLER
JP12-64	fed	fry	1,000,000	Touhoro12pink-alc-1	A1H			
JP12-65	fed	fry	1,000,000	Touhoro12pink-alc-2	A1H			
JP12-66	fed	fry	1,000,000	Shibetsu12pink-alc-1	A1H			
JP12-67	fed	fry	1,000,000	Shibetsu12pink-alc-2	A1H			
JP12-68	fed	fry	500,000	Shubuto12masu	3H	III		CHILLER
JP12-69	fed	fry	760,000	Shiribetsu12masu-f	2,2H	II II		CHILLER
JP12-70	fed	juvenile	220,000	Shiribetsu12masu-j	2,2H	II II		CHILLER
JP12-71	fed	smolt	220,000	Shiribetsu12masu-s	2,2H	II II		CHILLER
JP12-72	fed	fry	30,000	Ishikari12masu-f	2,3H	II IIII		CHILLER
JP12-73	fed	juvenile	40,000	Ishikari12masu-j	2,3H	II IIII		CHILLER
JP12-74	fed	smolt	30,000	Ishikari12masu-s	2,3H	II IIII		CHILLER
JP12-75	fed	fry	100,000	Kenichi12masu-j-alc	A1H			
JP12-76	fed	fry	500,000	Tokushibetsu12masu	2,3nH	II III		CHILLER
JP12-77	fed	fry	500,000	Shari12masu-f	6H	IIIIII		CHILLER
JP12-78	fed	juvenile	50,000	Shari12masu-j	6H	IIIIII		CHILLER
JP12-79	fed	smolt	50,000	Shari12masu-s	6H	IIIIII		CHILLER
JP12-80	fed	fry	50,000	Ichani12masu-f	2,5H	II IIIII		CHILLER

No	Otolith Mark Schedule	Temp Shift Direction	Comments
JP12-61	(1X)24C:24H,(1X)24C:48H,(4X)12C:12H	dow n(9-5°C)	
JP12-62	(1X)24C:24H,(1X)24C:48H,(4X)24C:24H	dow n(8-4°C)	
JP12-63	(1X)12C:12H,(1X)12C:36H,(1X)12C:12H,(1X)12C:36H,(4X)12C:12H	dow n(8-4°C)	
JP12-64			
JP12-65			
JP12-66			
JP12-67			
JP12-68	(3X)24C:24H	dow n(10-6°C)	
JP12-69	(1X)24C:24H,(1X)24C:48H,(2X)24C:24H	dow n(10-6°C)	
JP12-70	(1X)24C:24H,(1X)24C:48H,(2X)24C:24H	dow n(10-6°C)	TM + Fincips
JP12-71	(1X)24C:24H,(1X)24C:48H,(2X)24C:24H	dow n(10-6°C)	TM + Fincips
JP12-72	(1X)24C:24H,(1X)24C:48H,(3X)24C:24H	dow n(8-4°C)	
JP12-73	(1X)24C:24H,(1X)24C:48H,(3X)24C:24H	dow n(8-4°C)	TM + Fincips
JP12-74	(1X)24C:24H,(1X)24C:48H,(3X)24C:24H	dow n(8-4°C)	TM + Fincips
JP12-75			
JP12-76	(1X)24C:24H,(1X)24C:48H,(3X)12C:12H	dow n(8-4°C)	
JP12-77	(6X)24C:24H	dow n(8-4°C)	
JP12-78	(6X)24C:24H	dow n(8-4°C)	TM + Fincips
JP12-79	(6X)24C:24H	dow n(8-4°C)	TM + Fincips
JP12-80	(1X)24C:24H,(1X)24C:48H,(5X)24C:24H	dow n(8-4°C)	

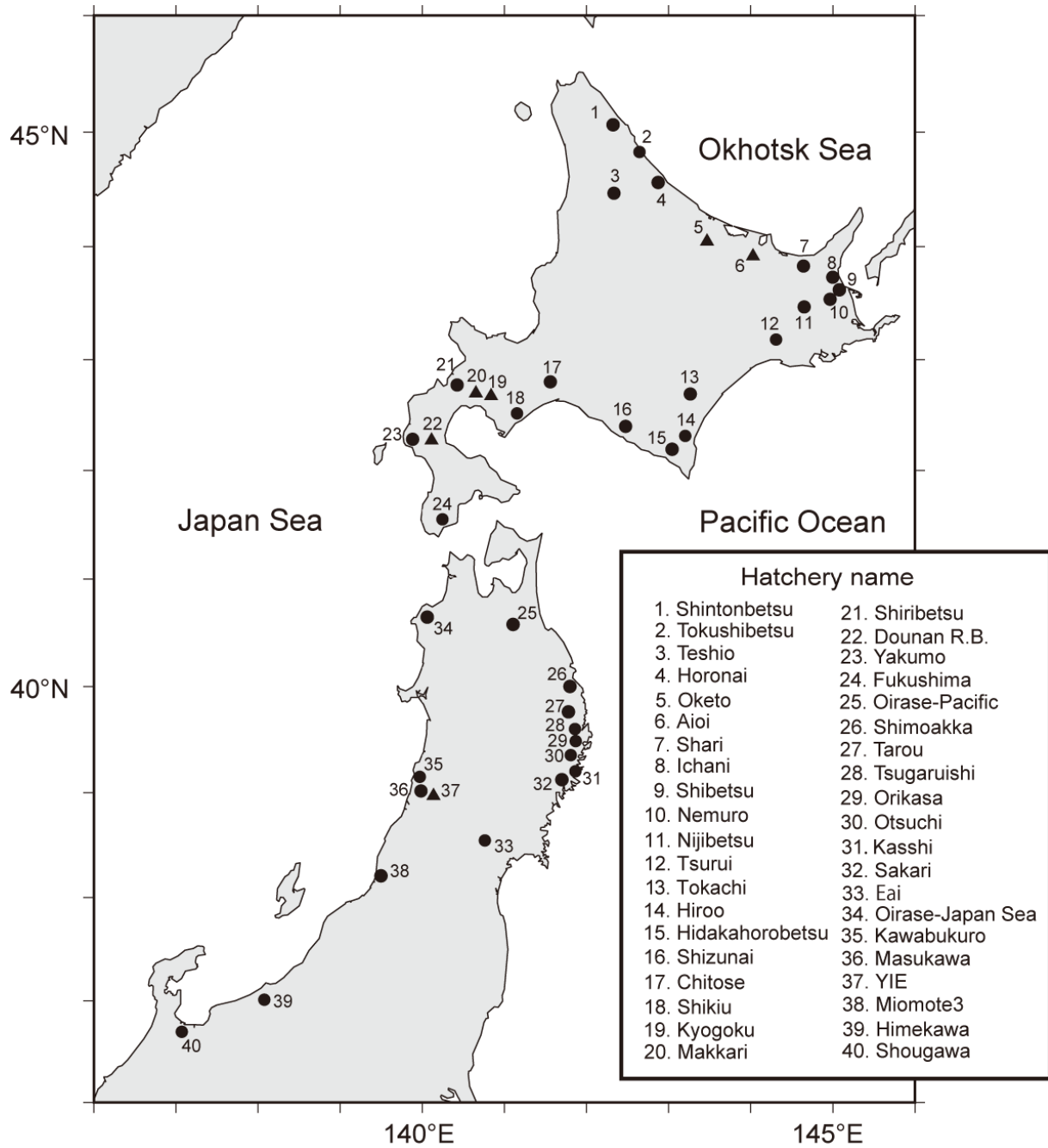
Table 1. Continued.

No	Mark Type	Brood Year	Year of Release	Species	Country	State/Province	Region	Agency	Facility	Stock	Final Release Site
JP12-81	TM	2012	2013	MASU	JAPAN	HOKKAIDO	Nemuro Strait coast	FRA	Nemuro Hatchery	Ichani River	Ichani River
JP12-82	TM	2012	2014	MASU	JAPAN	HOKKAIDO	Nemuro Strait coast	FRA	Nemuro Hatchery	Ichani River	Ichani River
JP12-83	TM	2012	2013	MASU	JAPAN	HOKKAIDO	Nemuro Strait coast	FRA	Nemuro Hatchery	Shibetsu River	Shibetsu River
JP12-84	TM	2012	2013	MASU	JAPAN	HOKKAIDO	Nemuro Strait coast	FRA	Nemuro Hatchery	Shibetsu River	Shibetsu River
JP12-85	TM	2012	2014	MASU	JAPAN	HOKKAIDO	Nemuro Strait coast	FRA	Nemuro Hatchery	Shibetsu River	Shibetsu River
JP12-86	TM	2012	2014	SOCKEYE	JAPAN	HOKKAIDO	East Pacific coast	FRA	Tsurui Hatchery	Kushiro River	Kushiro River
JP12-87	TM	2012	2014	SOCKEYE	JAPAN	HOKKAIDO	West Pacific coast	FRA	Shizunai Hatchery	Shizunai River	Shizunai River
JP12-88	TM	2012	2014	SOCKEYE	JAPAN	HOKKAIDO	West Pacific coast	FRA	Chitose Hatchery	Abira River	Abira River

No	Rearing Treatment	Stage	Preliminary Number of OM Released	OM ID	Hatch Code	Prehatch Graphic Image	Posthatch Graphic Image	Marking System
JP12-81	fed	juvenile	30,000	Ichani12masu-j	2,5H	II IIIII		CHILLER
JP12-82	fed	smolt	20,000	Ichani12masu-s	2,5H	II IIIII		CHILLER
JP12-83	fed	fry	120,000	Shibetsu12masu-f	2,4H	II IIIII		CHILLER
JP12-84	fed	juvenile	60,000	Shibetsu12masu-j	2,4H	II IIIII		CHILLER
JP12-85	fed	smolt	20,000	Shibetsu12masu-s	2,4H	II IIIII		CHILLER
JP12-86	fed	smolt	50,000	Kushiro12sockeye	2,3H	II IIII		CHILLER
JP12-87	fed	smolt	50,000	Shizunai12sockeye	2,7H	II IIIIIII		CHILLER
JP12-88	fed	smolt	50,000	Abira12sockeye	2,7H	II IIIIIII		CHILLER

No	Otolith Mark Schedule	Temp Shift Direction	Comments
JP12-81	(1X)24C:24H,(1X)24C:48H,(5X)24C:24H	dow n(8-4°C)	
JP12-82	(1X)24C:24H,(1X)24C:48H,(5X)24C:24H	dow n(8-4°C)	
JP12-83	(1X)24C:24H,(1X)24C:48H,(4X)24C:24H	dow n(8-4°C)	
JP12-84	(1X)24C:24H,(1X)24C:48H,(4X)24C:24H	dow n(8-4°C)	
JP12-85	(1X)24C:24H,(1X)24C:48H,(4X)24C:24H	dow n(8-4°C)	
JP12-86	(1X)24C:24H,(1X)24C:48H,(3X)24C:24H	dow n(8-4°C)	
JP12-87	(1X)24C:24H,(1X)24C:48H,(7X)24C:24H	dow n(10-6°C)	
JP12-88	(1X)24C:24H,(1X)24C:48H,(7X)24C:24H	dow n(8-4°C)	





**Fig. 1.** Locations of hatcheries where brood year 2012 salmon will be otolith-marked. Thirty-four (closed circles) and six (closed triangles) hatcheries continue otolith thermal marking and ALC marking, respectively.

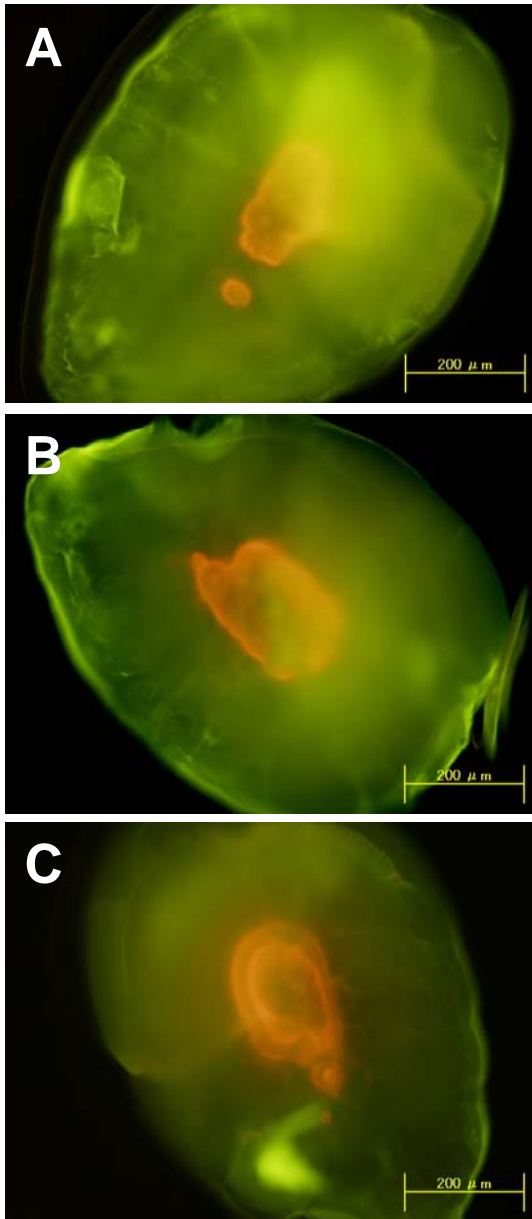


Fig. 2. ALC (alizarin complexone) marks in the otolith of chum salmon. A, A1H (small ring); B, A1H (large ring), C, A2H (double rings). Images were provided by Hokkaido Salmon and Freshwater Fisheries Research Institute.