Summary of the information on sighting surveys for abundance estimation in JARPN and JARPN II

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This paper responds to one of the tasks from the Preparatory Meeting following to obtain abundance estimate for RMP/IST of the NP minke whales.

- **II (1)** The figures of SC/S10/NPM5 for the JARPN and JARPN II surveys should be presented at a similar level of detail/scale to those in SC/S10/NPM6.
- **II(2)** Noting that the surveys had been conducted in differing survey modes, a summary description of the various modes and their differences should be included.
- **III(a)** The meeting requested that a table summarizing the amount of survey effort during each Beaufort state in each sub-area and year be included in the summary information provided to the First Intersessional Workshop. This should be the case for survey vessel.
- **III(b)** If the variation in sightings conditions is substantial, rather than pooling, a multi-covariate approach should be used, and desirably modify the estimates shown in SC/S10/NPM5.
- **IV(1)** Evaluate the abundance and CV (covariances could be ignored for the purpose of this exercise) for the portion of the survey area falling within the sub-area by maintaining the values of the effective search half-width and mean school size for the whole survey (block), but using only the number of primary minke sightings and the primary search effort expended within the sub-area.
- **IV(2)** Calculate the proportion of open ocean area in the sub-area that falls within the survey boundary.
- **IV(3)** Calculate the proportion of the intended trackline within the subarea which had been covered on primary search effort.

Task II (1)

Figures were revised to respond task II (1). This is to show make planned tracklines, tracklines actually surveyed, position of the primary sightings and the survey area to which estimate was applied clearly. Figs. 1-11 show planned trackline for JARPN (1994-1995) and JARPN II (2002-2007). Figs. 12-22 show order of the survey area for each surveys. Figs. 23-33 show trackline surveyed actually and primary sighting positions of the minke whales. Red lines in each figure indicate the survey area to which estimate was applied.

Task II (2)

JARPN

Sighting survey was conducted by Sampling and Sighting Vessels (SSVs) in closing mode (coded as "NSC"). Two SSVs (*Toshi-maru* No 18 (T18) and *Toshimaru* No 25 (T25)) surveyed parallel track line in 1994 and three SSVs (*Kyo-maru* No. 1, T25 and T18) did in 1995.

JARPN II

Sighting survey was conducted by dedicated sighting vessel (*Kyoshin-maru* No. 1). The sighting survey by the SV was conducted under the limited closing mode (ASP mode; same manner as "NSC" without sampling of whales) and the passing mode (NSP mode; even if sighting was made on the predetermined track line, the vessel did not approach the whale directly and searching from the top barrel was uninterrupted). Survey mode of NSP was conducted during transit survey and sighting data in this mode were not used for abundance estimation.

Task III (a)

Assuming that the just former recorded weather conditions are constant until the next record, survey effort by Beaufort state was calculated.

Task III (b)

In order to reconsider the detection functions for JARPN II data, MCDS (Multiple Covariates Distance Sampling) engine in DISTANCE was used (Thomas *et al.*, 2006). Full model of the detection function was provided by

$$f(x) = 1 - \exp\left\{-\left(x \Big/ a\exp(Beaufort + SA + year)\right)^{-b}\right\}.$$

Akaike's Information Criteria (AIC) was used to select the best model.

Task IV (1)

The number of primary sightings of the minke whales and searching distance for each sub-area were calculated. Table 2 shows abundance estimates and their CVs.

Task IV (2)

The proportions of open ocean area in the sub-area that falls within the survey boundary were calculated. The proportions are shown in Table 2.

Task IV (3)

The proportions of the intended trackline within the subarea which had been covered on primary search effort were calculated.

Table 1. Difference in survey mode conducted in JARPN and JARPN II.

	NSC	ASP	NSP
Closing?	Yes	Yes	No
Sampling whales?	Yes	No	No
Survey	JARPN	JARPN II	JARPN II (not used for estimation)

Table 2. Abundance estimates and aerial coverage by sub-area for each survey.

sub-area	year	Aerial covarage	Timing	Area size (n.miles2)	*P*	CV(P)
7CS	2003	62.6%	May	16,789	335	0.683
	2004	100.0%	May	26,826	736	0.447
	2006	100.0%	Jun - Jul	26,826	2,391	1.080
	2007	100.0%	Jun - Jul	26,826	0	-
7CN	2003	75.4%	May	18,281	270	0.705
7W	2002	30.5%	Aug	25,059	0	-
	2003	54.2%	May - Jun	44,589	551	0.374
	2004	88.8%	May - Jun	72,991	506	0.404
	2006	88.8%	Jun - Jul	72,991	0	-
	2007	88.8%	Jun - Jul	72,991	368	0.834
7E	2003	26.3%	May - Jun	22,166	303	0.842
	2004	57.1%	May - Jun	48,208	290	-
	2006	57.1%	May - Jun	48,208	438	0.917
	2007	57.1%	Jun - Jul	48,208	0	-
8	2002	65.0%	Jun - Jul	162,689	0	-
	2003	13.1%	Jul	32,857	147	0.843
	2004	40.5%	Jun	101,373	691	0.496
	2005	65.0%	May - Jul	162,789	177	0.749
	2006	65.0%	May - Jul	162,789	481	0.650
	2007	65.0%	Jun - Jul	162,789	278	0.983
9	1994 1st	42.5%	Jul. - Aug.	244,172	3,065	0.423
	1994 2nd	32.9%	Aug. - Sep.	189,012	973	0.628
	1995 1st	54.7%	Jun.	314,082	1,348	0.272
	1995 2nd	13.2%	Jul. - Aug.	75,635	994	0.396
	1995 3rd	28.5%	Aug.	163,610	399	0.636
	2002	62.4%	Jun. - Jul.	358,530	702	0.806
	2003	33.2%	Jul.-Sep.	190,676	3,670	0.282
	2004	42.6%	Jun.-Jul.	244,759	496	0.649
	2005	63.0%	May -Aug.	362,113	970	0.610
	2006	86.9%	May - Aug.	499,235	2,680	0.437
	2007	86.9%	May - Jul.	499,235	189	1.439

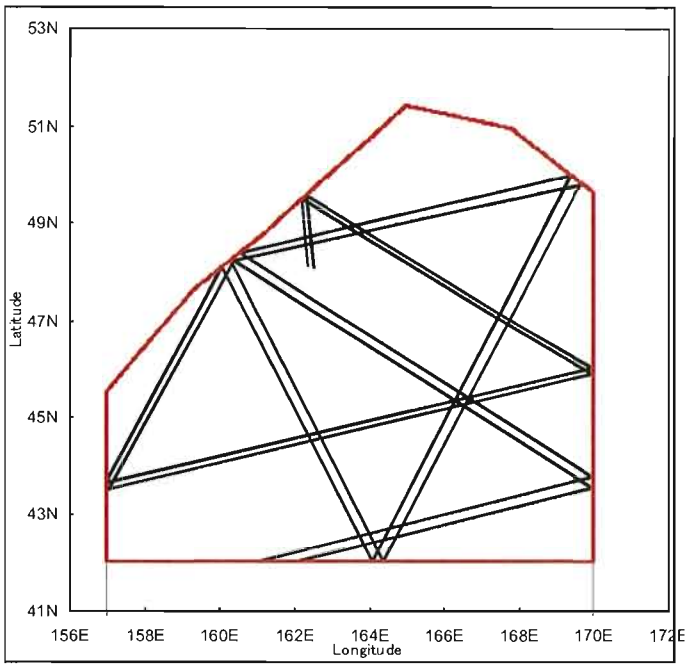

Fig 1. Pre-determined tracklines for T18 and T25 in the first half of 1994 JARPN. (5 Jul. – 8 Aug.)

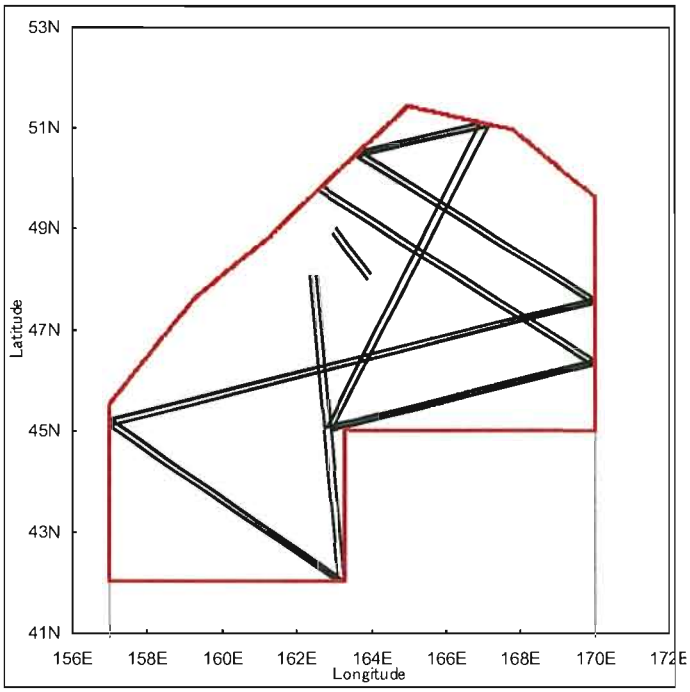

Fig 2. Pre-determined tracklines for T18 and T25 in the second half of 1994 JARPN. (7Aug. – 7Sep.)

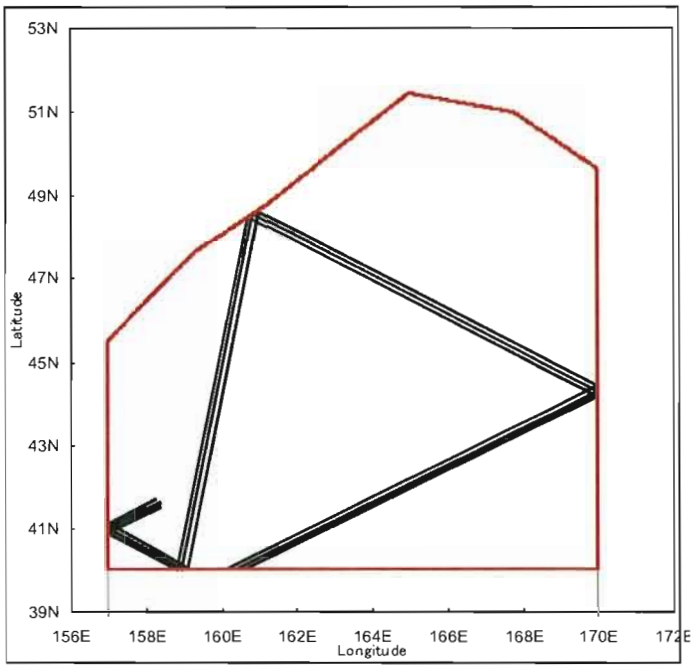

Fig 3. Pre-determined tracklines for K01, T18 and T25 in the first period of 1995 JARPN. (13 Jun.-30 Jun.)

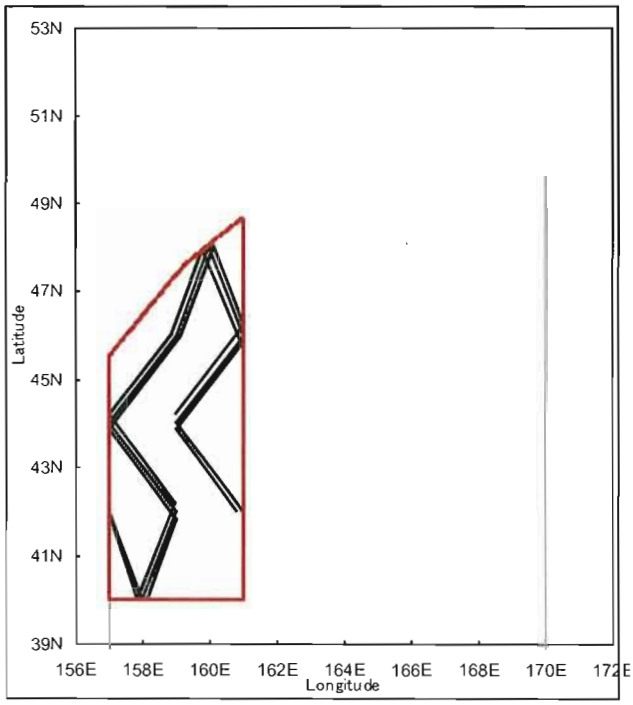

Fig 4. Pre-determined tracklines for K01, T18 and T25 in the second period of 1995 JARPN. (1 Jul.-6 Aug.)

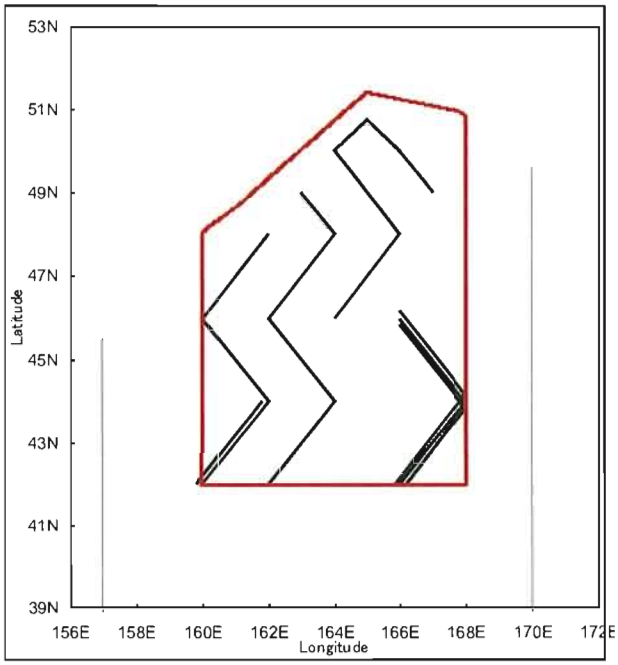

Fig 5. Pre-determined tracklines for K01, T18 and T25 in the third period of 1995 JARPN. (7Aug.-22 Aug.)

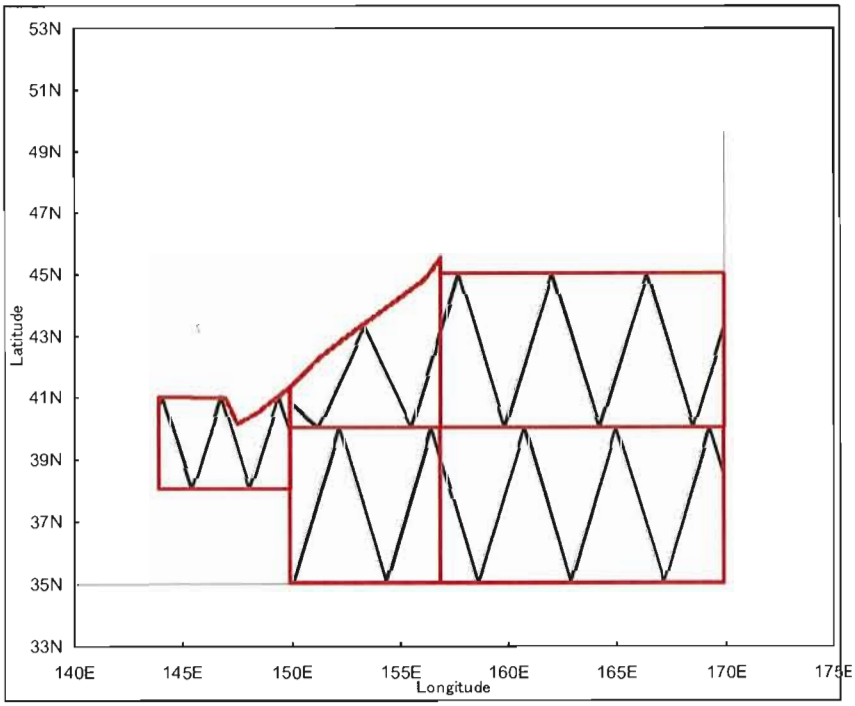

Fig 6. Pre-determined tracklines for KS2 in 2002 JARPN II.

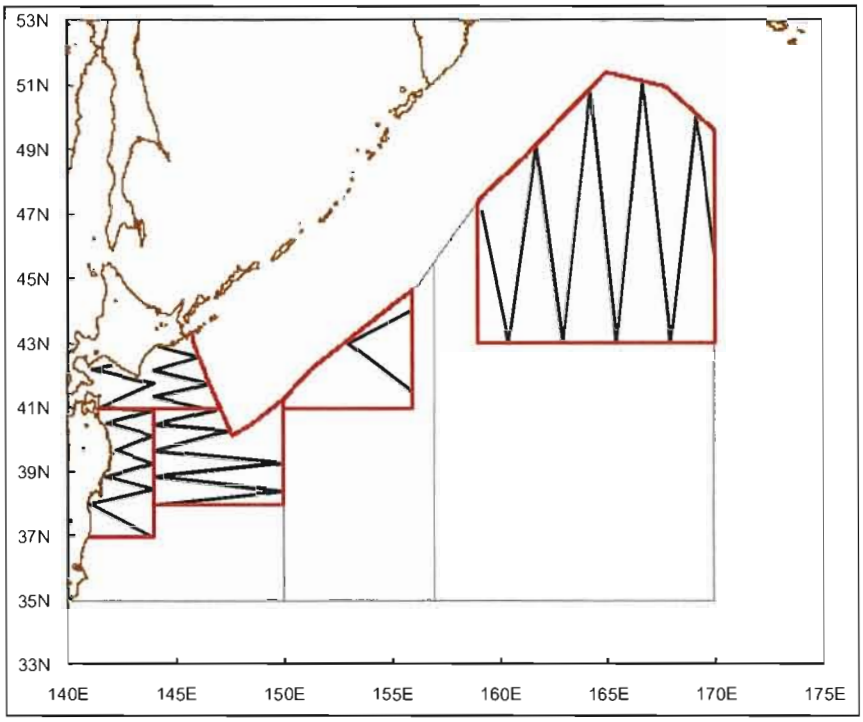

Fig 7. Pre-determined tracklines for KS2 in 2003 JARPN II.

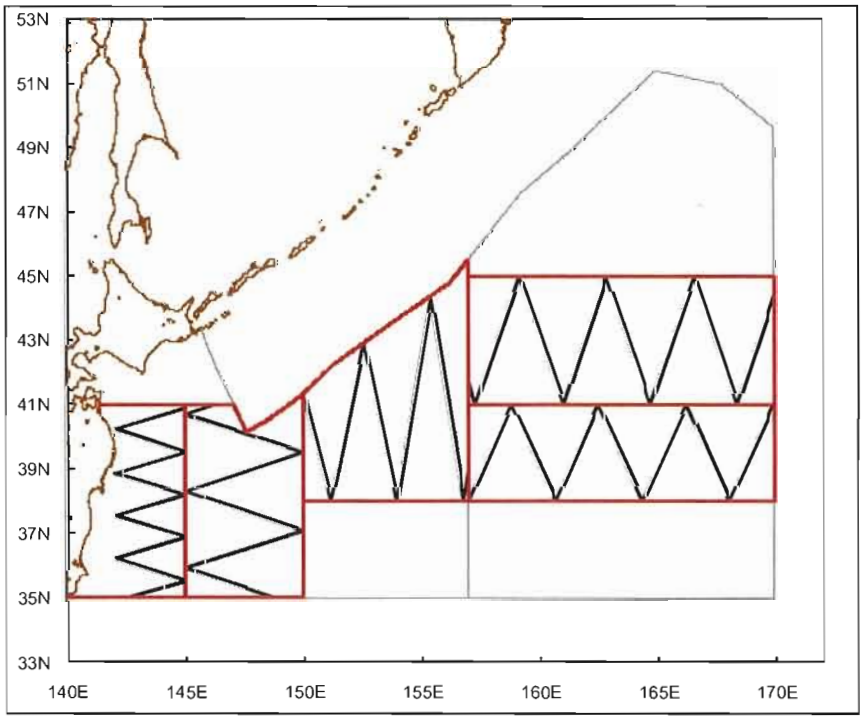

Fig 8. Pre-determined tracklines for KS2 in 2004 JARPN II.

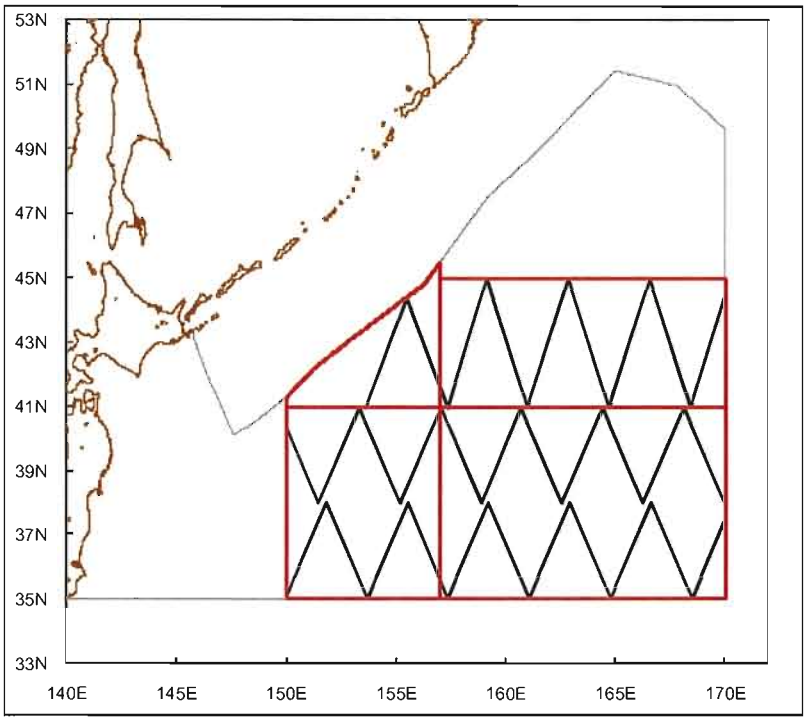

Fig 9. Pre-determined tracklines for KS2 in 2005 JARPN II.

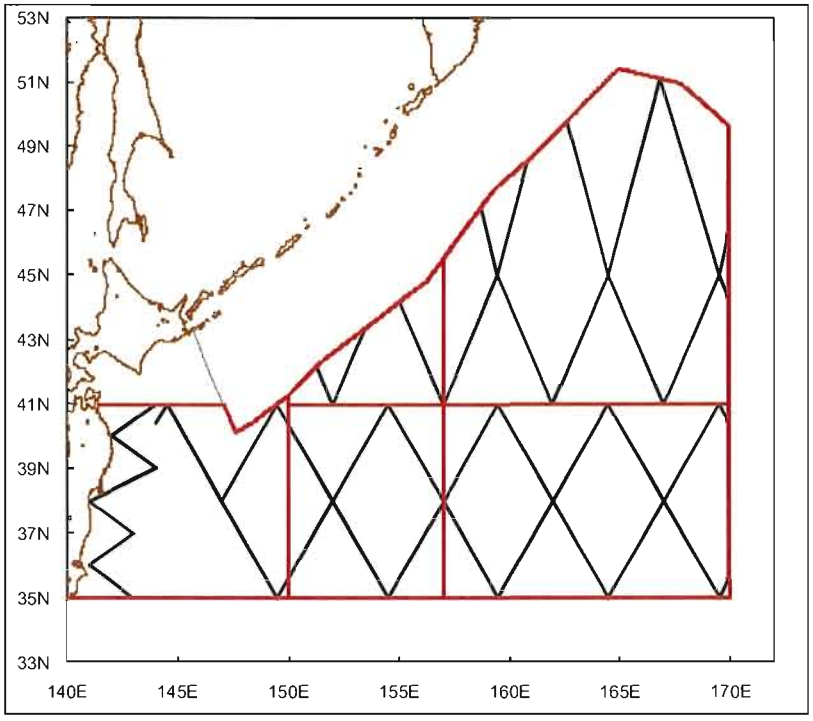

Fig 10. Pre-determined tracklines for KS2 in 2006 JARPN II.

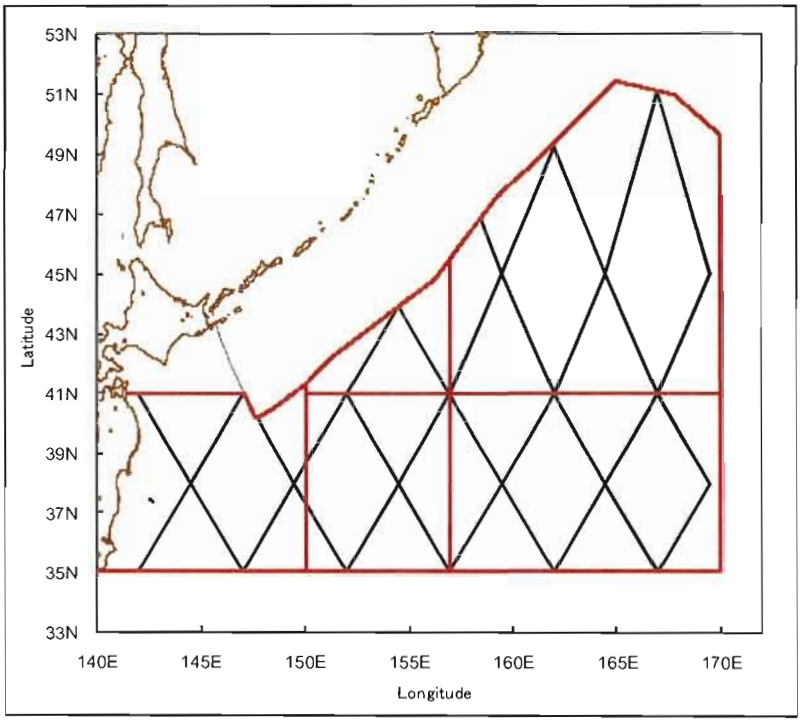

Fig 11. Pre-determined tracklines for KS2 in 2007 JARPN II.

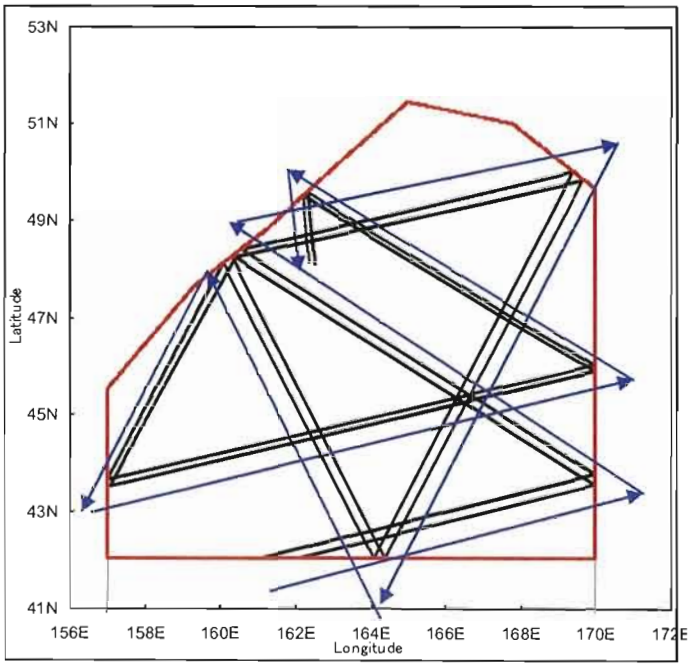

Fig 12. Survey order in the first half of 1994 JARPN.

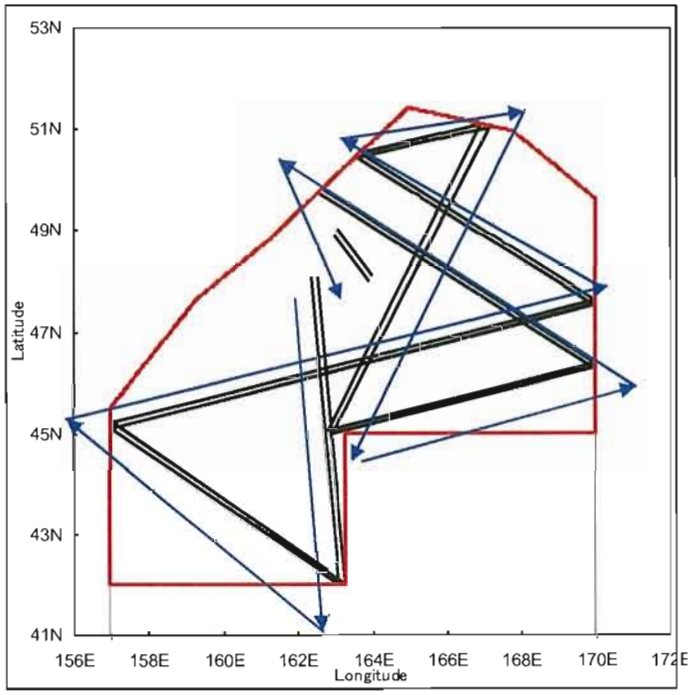

Fig 13. Survey order in the second half of 1994 JARPN.

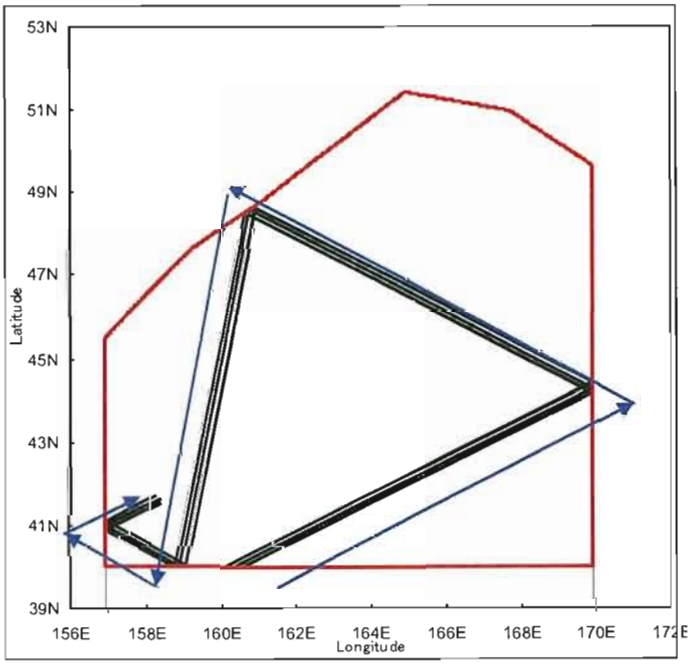

Fig 14. Survey order in the first period of 1995 JARPN.

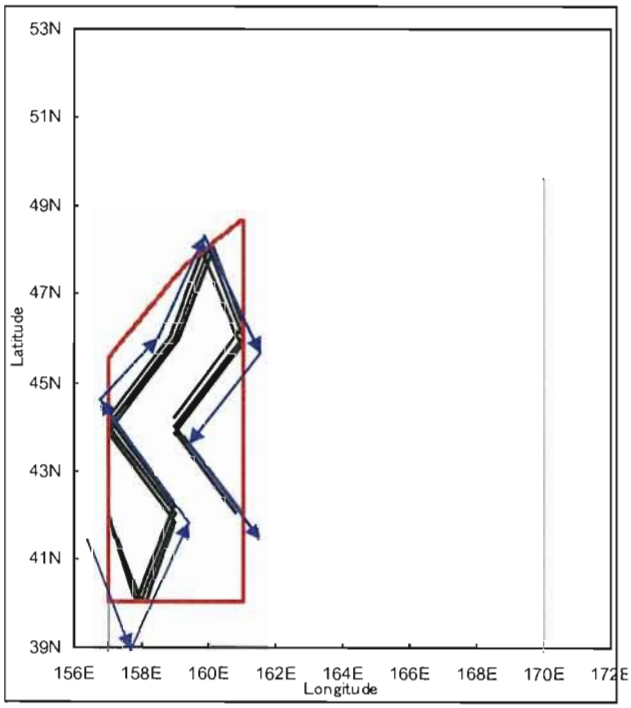

Fig 15. Survey order in the second period of 1995 JARPN.

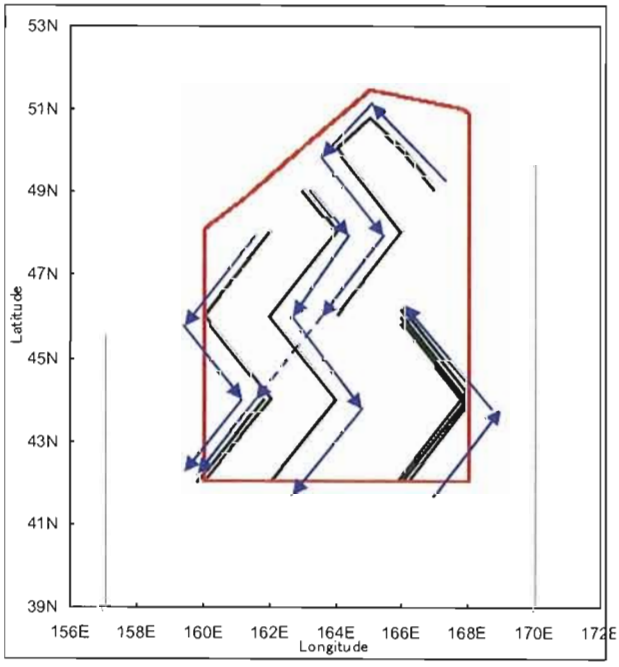

Fig 16. Survey order in the third period of 1995 JARPN.

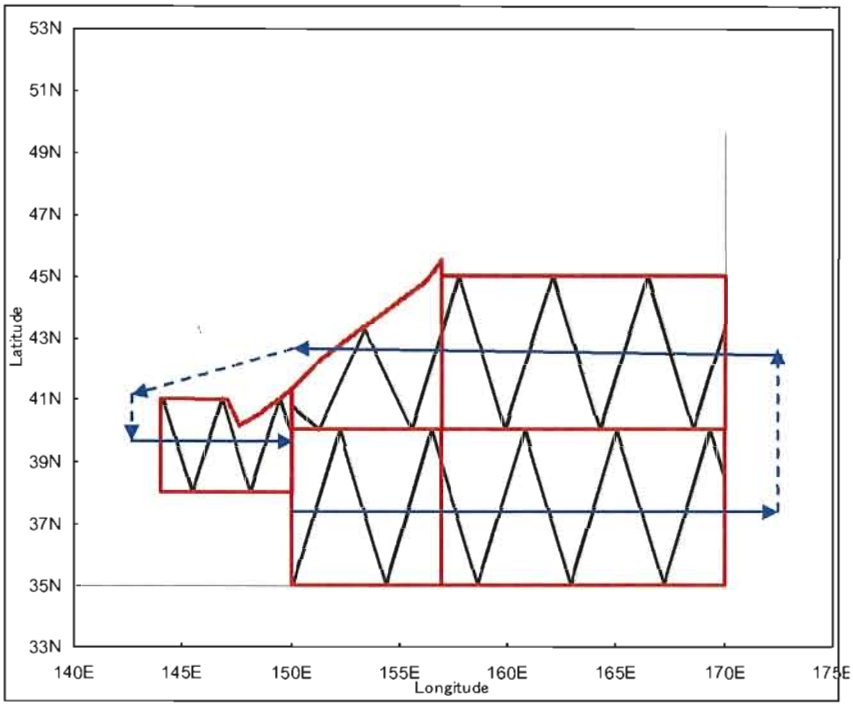

Fig 17. Survey order in 2002 JARPN II.

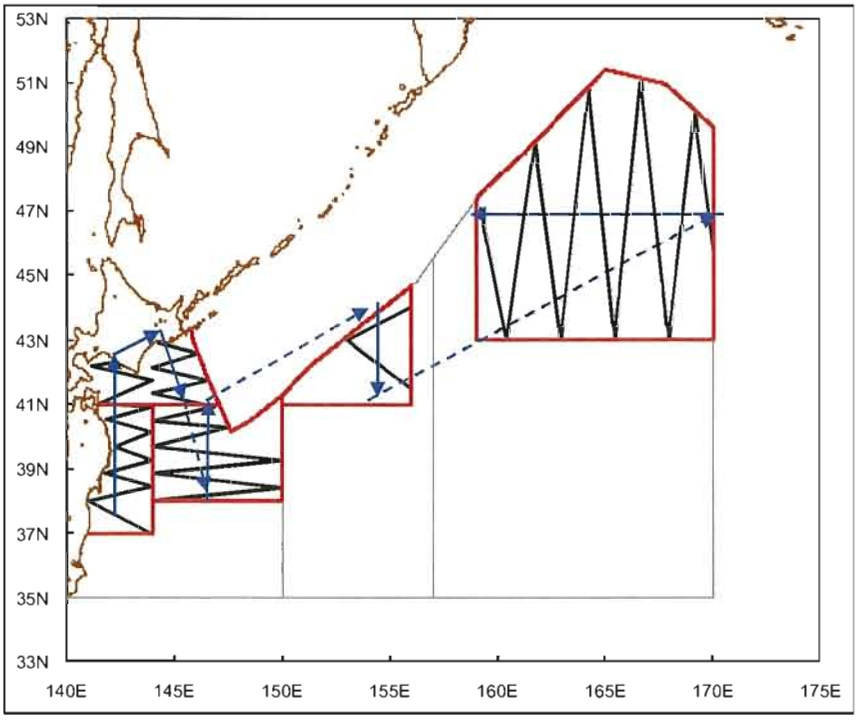

Fig 18. Survey order in 2003 JARPN II.

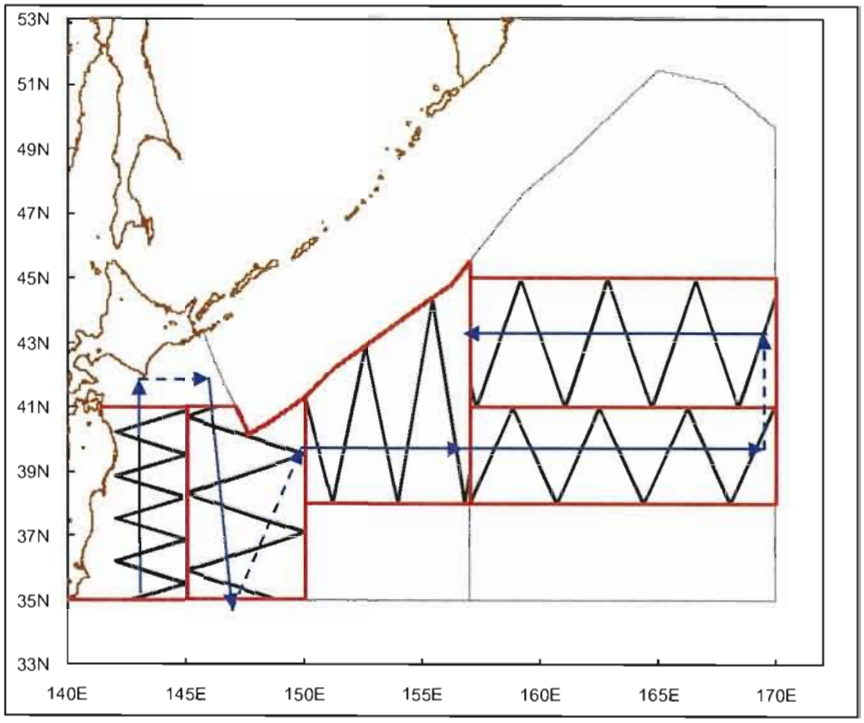

Fig 19. Survey order in 2004 JARPN II.

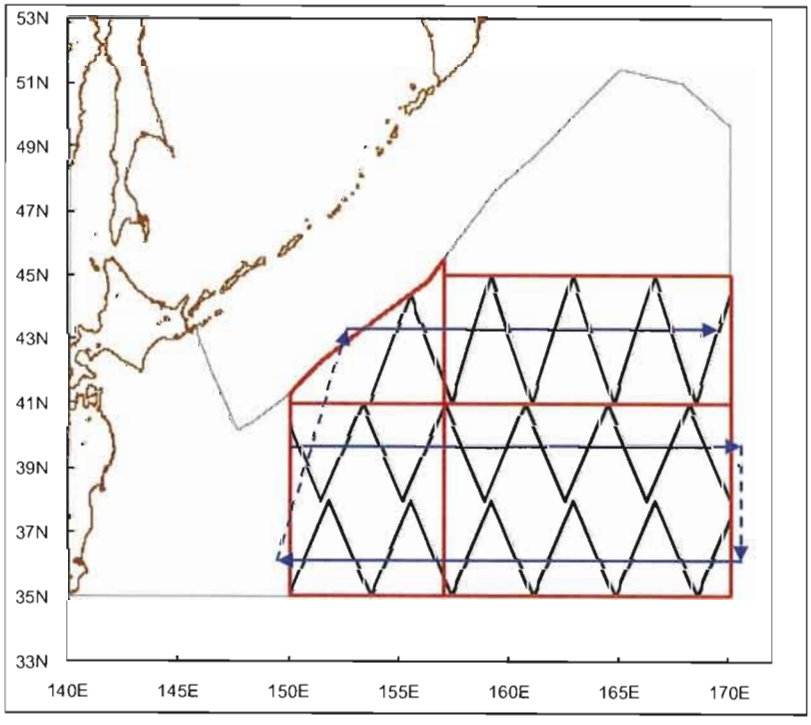

Fig 20. Survey order in 2005 JARPN II.

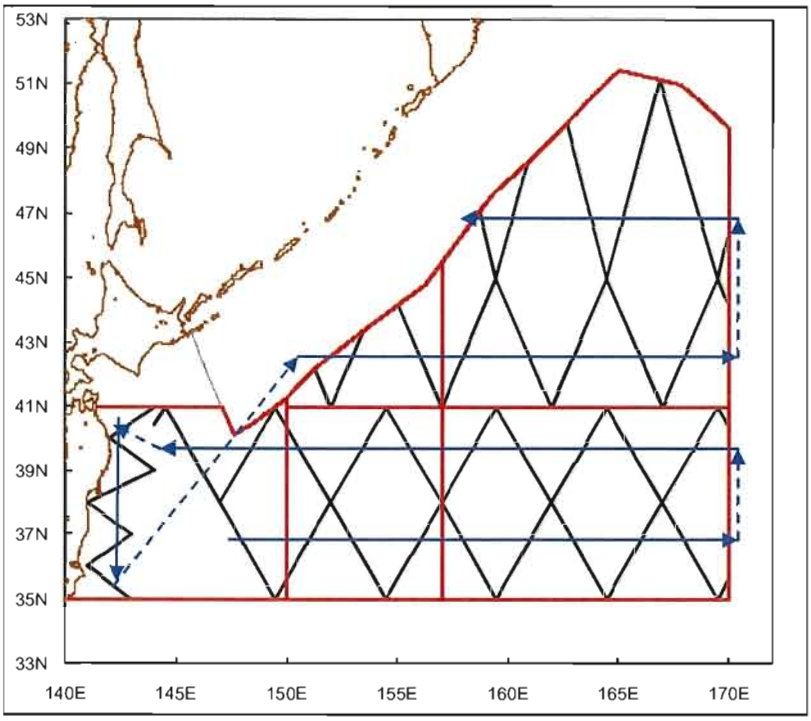

Fig 21. Survey order in 2006 JARPN II.

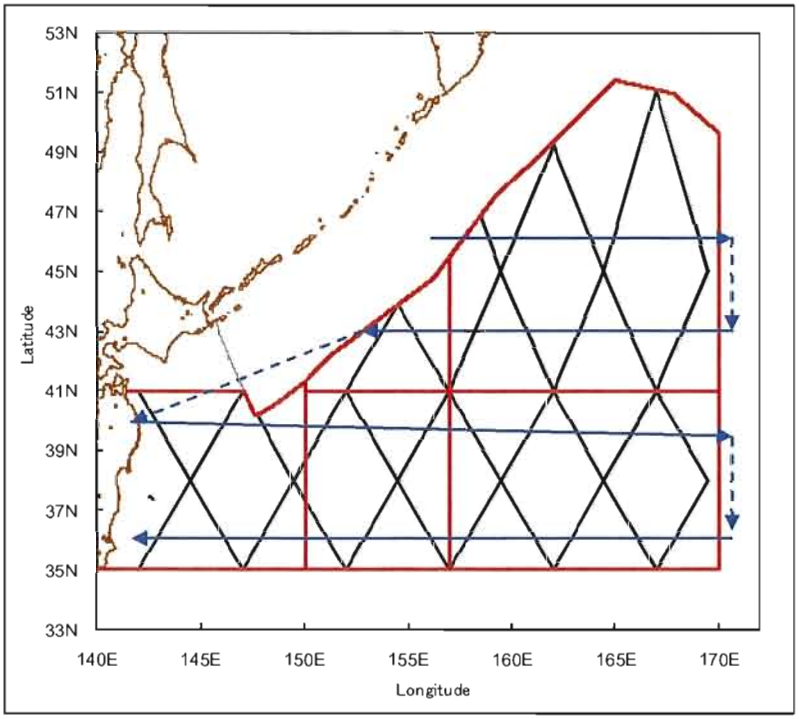

Fig 22. Survey order in 2007 JARPN II.

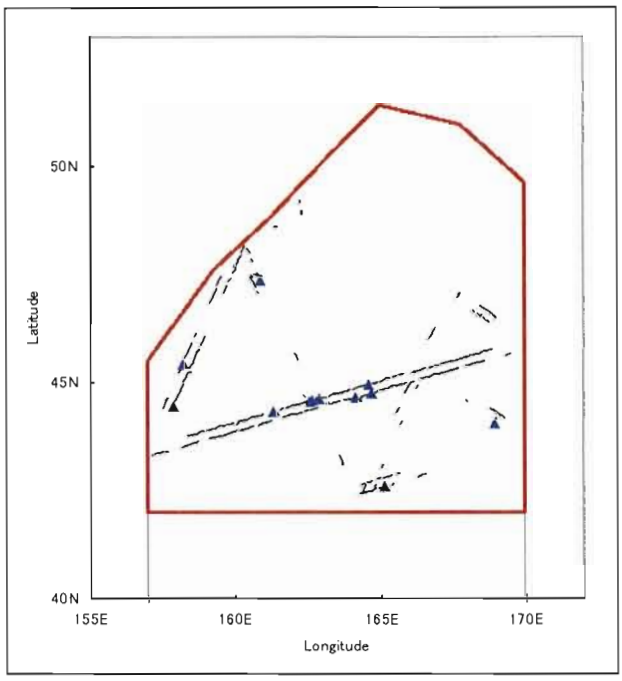

Fig 23. Track line actually surveyed and primary sighting positions of common minke whale schools in sub-area 9 in the first half of 1994 JARPN. Blue triangle indicates the position.

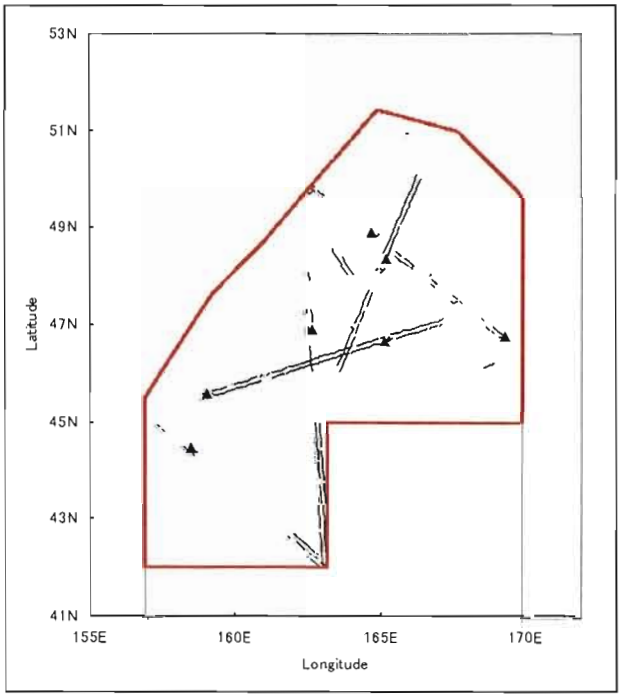

Fig 24. Track line actually surveyd and primary sighting positions of common minke whale schools in sub-area 9 in the second half of 1994 JARPN. Blue triangle indicates the position.

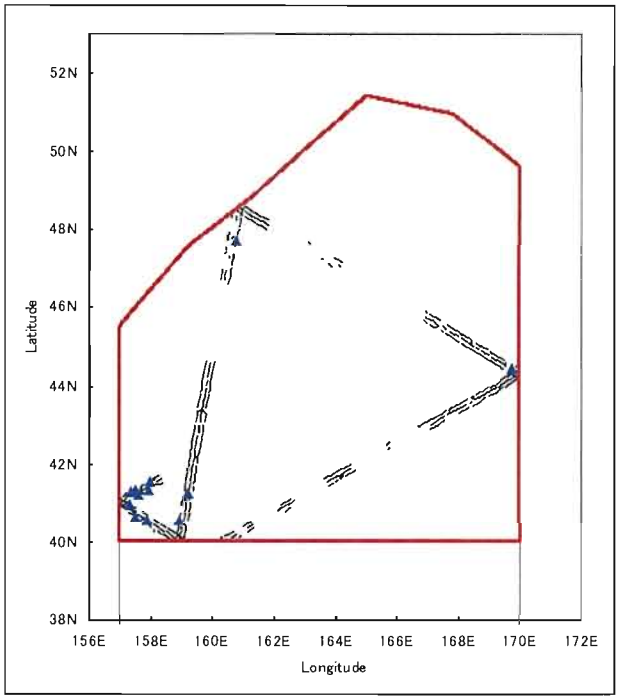

Fig 25. Track line actually surveyed and primary sighting positions of common minke whale schools in sub-area 9 in the first period of 1995 JARPN. Blue triangle indicates the position.

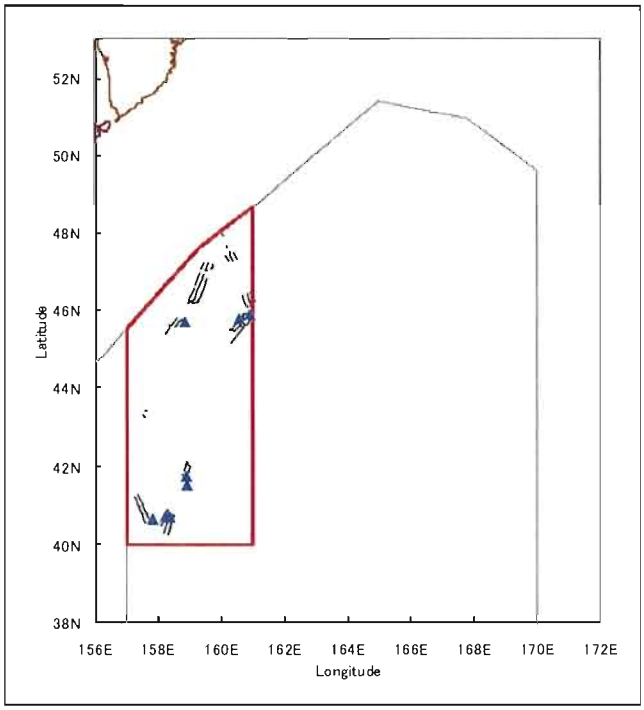

Fig 26. Track line actually surveyed and primary sighting positions of common minke whale schools in sub-area 9 in the second period of 1995 JARPN. Blue triangle indicates the position.

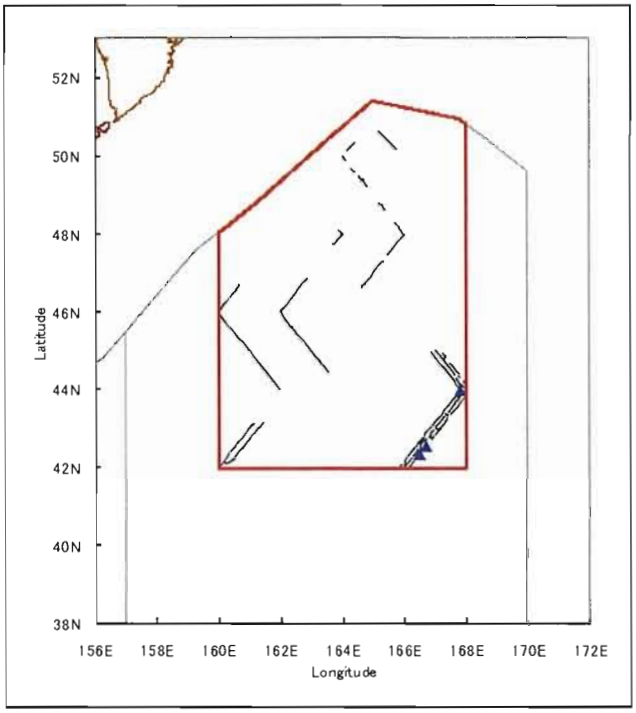

Fig 27. Track line actually surveyed and primary sighting positions of common minke whale schools in sub-area 9 in the third period of 1995 JARPN.

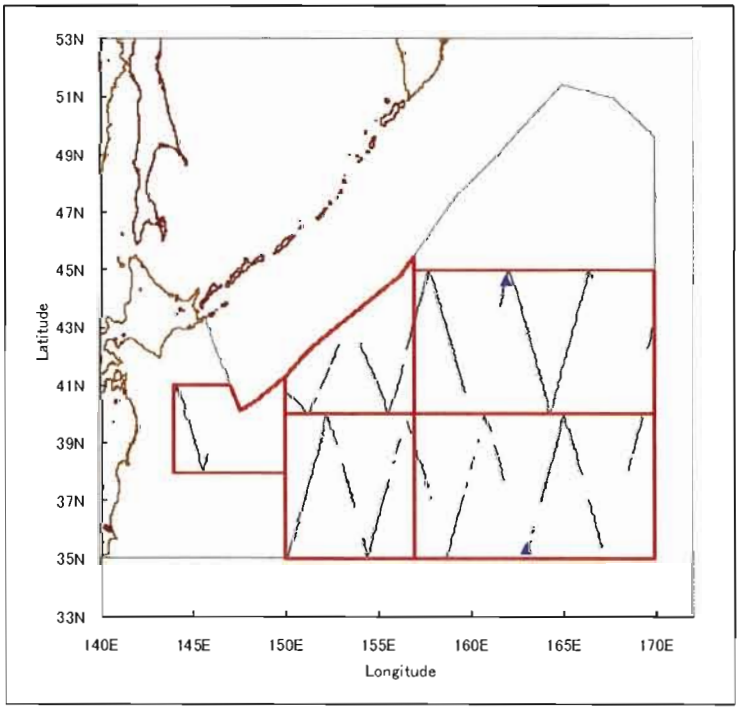

Fig. 28. Track line actually surveyed and primary sighting positions of common minke whale schools in the 2002 JARPN II.

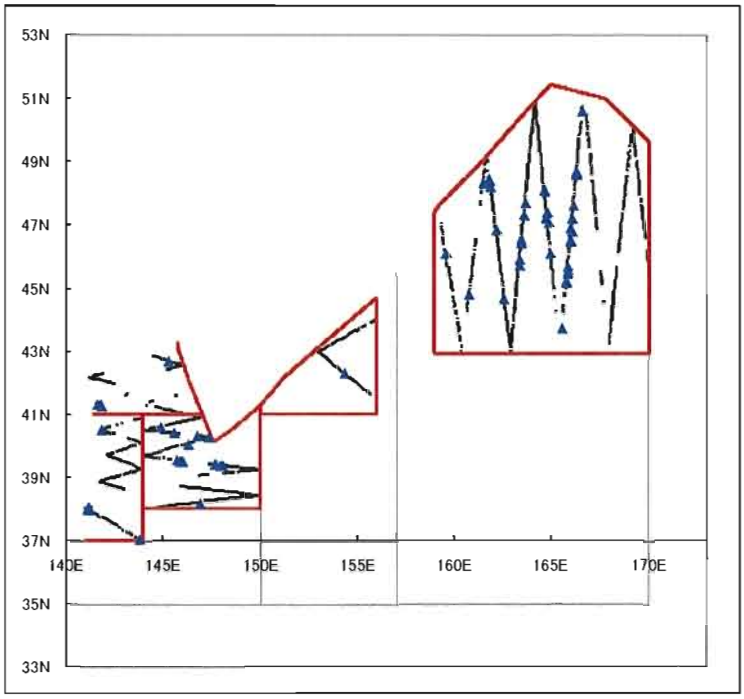

Fig. 29. Track line actually surveyed and primary sighting positions of common minke whale schools in the 2003 JARPN II.

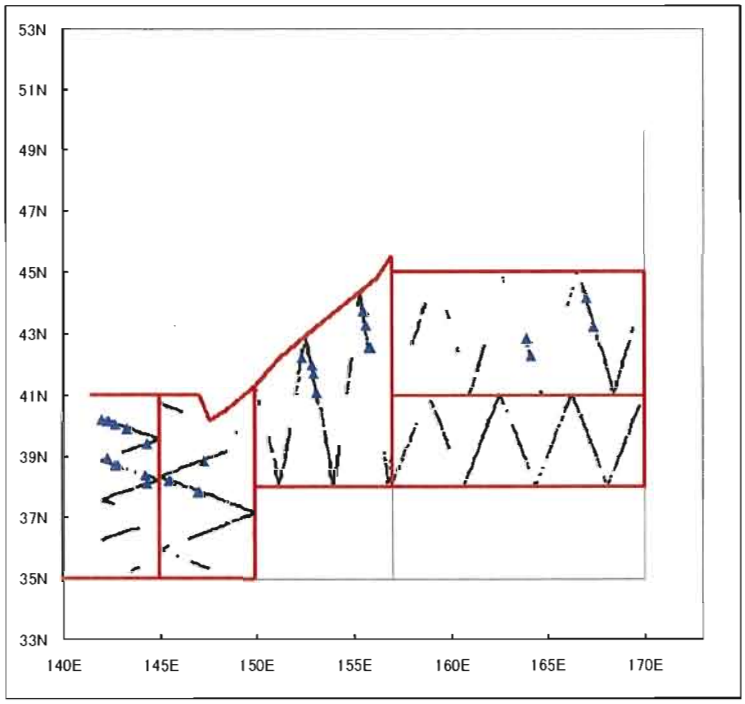

Fig. 30. Track line actually surveyed and primary sighting positions of common minke whale schools in the 2004 JARPN II.

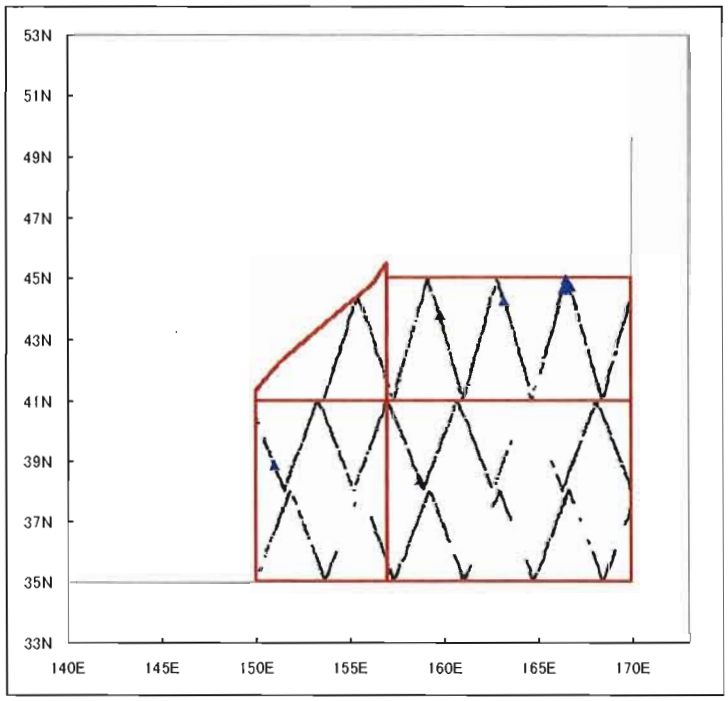

Fig. 31. Track line actually surveyed and primary sighting positions of common minke whale schools in the 2005 JARPN II.

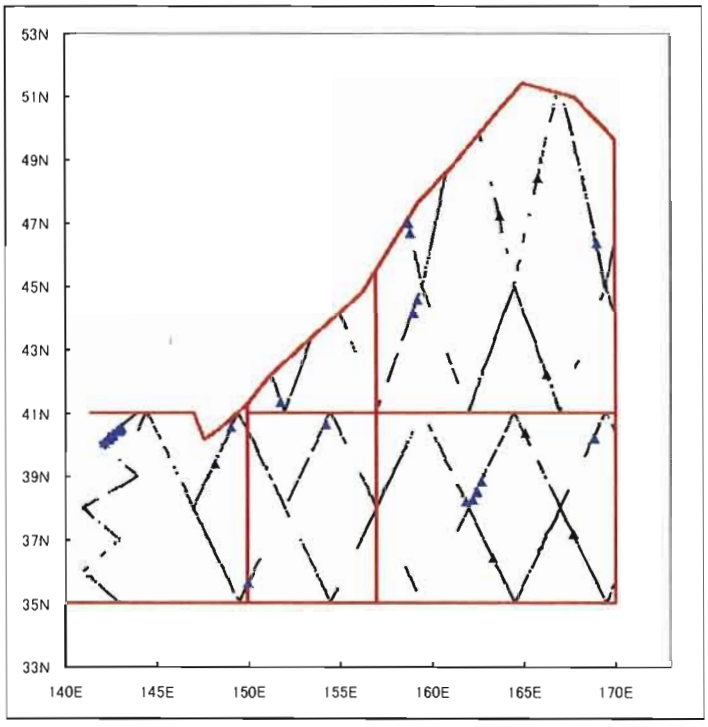

Fig. 32. Track line actually surveyed and primary sighting positions of common minke whale schools in the 2006 JARPN II.

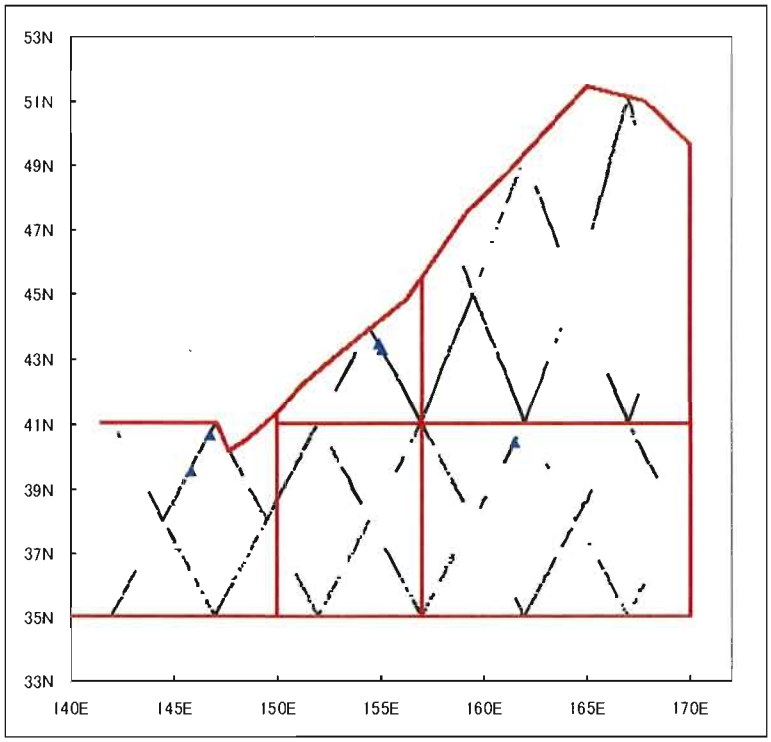

Fig. 33. Track line actually surveyed and primary sighting positions of common minke whale schools in the 2007 JARPN II.