CONCEPTS FOR A RESEARCH PROGRAM ON NORTH PACIFIC BRYDE'S WHALE -RMP VARIANT 2 WITH RESEARCH-

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ABSTRACT

During the Second Intersessional Workshop on western North Pacific Bryde's whale RMP *Implementation* the conservation performance of each trial and RMP variant was examined. In reviewing trials results the Workshop agreed that Variants 1, 3 and 4 were 'acceptable without research' (conservation performance was acceptable for both 'high' and 'medium' weight trials) while Variant 2 had acceptable performance for all 'high' weight trials but it was 'unacceptable' for three 'medium' weight trials, therefore this variant could not be ranked 'accepted without research'. All these trials are related to stock structure hypothesis 4, which involve sub-stock structure within sub-area 1. This paper presents the concepts for a research program on western North Pacific Bryde's whale focused to elucidate the possibility of sub-stock structure in sub-area 1.

BACKGROUND

Figure 1, Appendix 1 and Appendix 2 shows the hypotheses on stock structure, the list of final trials and the list of RMP variants used during the RMP *Implementation* of North Pacific Bryde's whale, respectively. During the Second Intersessional Workshop (SIW) on western North Pacific Bryde's whale RMP *Implementation* (IWC, 2006a) the conservation performance of each trial and RMP variant was examined.

In reviewing trials results the Workshop agreed that Variants 1, 3 and 4 were 'acceptable without research' (conservation performance was acceptable for both 'high' and 'medium' weight trials). Variant 2 had acceptable performance for all 'high' weight trials. However, the conservation performance was 'unacceptable' for three 'medium' weight trials (BR13, BR15 and BR17 in Appendix 1), therefore this variant could not be ranked 'accepted without research'.

Allison and Punt (2007) examined the impact of using Variant 2 for ten years, e.g. they examined the conservation performance assuming that management is based on variant 2 for 10 years after which management reverts, via a five-year-out process to one of the other three variants. Results of their analyses suggested that this variant will be acceptable from the conservation point of view.

Next a research programme should be prepared by Japan, which addresses the uncertainties on the trials on which Variant 2 performed poorly. This research programme should be presented for discussion and endorsement by the Scientific Committee. For guidance purposes an Advisory Group was established during the SIW:

Members: Best, Butterworth, Donovan, Kitakado, Mate, Palsboll, Pastene (Convenor), Perrin

The Guidelines for Implementations (IWC, 2005a pp. 84-92) establishes that a 'less conservative' variant that did not perform 'acceptably' in some trials could also be recommended with research requirements. The associated research programme will be formulated such that it identifies expected progress in a manner that will allow the Committee to review annually whether the programme is being adequately followed. If, after a pre-specified period (e.g. 10 years), the research program cannot show that the trials concerned should have assigned 'low' weight, catch limits would be set using a 'more conservative' RMP variant that performed 'acceptably' on all the trials (IWC, 2005 pp78). If the research programme associated with the RMP variant has not progressed to the satisfaction of the Committee, the Committee will recommend that catch limits immediately be based on the 'more conservative' RMP variant (IWC, 2005a pp78).

This paper presents the concepts for a research program on North Pacific Bryde's whale -associated to management Variant 2- focused on stock structure.

CONCEPTS FOR A RESEARCH PROGRAM ON WESTERN NORTH PACIFIC BRYDE'S WHALE

As mentioned above the conservation performance of Variant 2 was 'unacceptable' for trials BR13, BR15 and BR17, all these trials are related to mixing across the boundary of the 1W and 1E sub-stocks for stock structure hypothesis 4 (see Fig. 1 and Appendix 1). This means that the research programme should be focused to elucidate whether or not sub-stocks occur in sub-area 1 (stock structure scenario 4) and if so, the rate of mixing.

The programme is planned for a period of ten years (2007-2017), and annual progress reports will be presented to the annual meeting of the IWC Scientific Committee. The programme would include the following research elements:

Further genetic studies and power analysis

Genetic analysis on western North Pacific Bryde's whales were conducted based on all available samples from past commercial whaling operations (coastal whaling around the Ogasawara Island in 1984 and pelagic whaling in the central western North Pacific in 1979), and samples from the JARPN II in the western North Pacific obtained between 2000 and 2003.

Two standard genetic techniques have been used: mitochondrial DNA control region sequencing and microsatellite analysis using 17 loci. Statistical comparison of haplotype and allele frequencies between whales in sub-areas 1W and 1E (divided at 155ºE) were made and no significant genetic heterogeneity was detected for sample sizes of 261/140 and 260/125 for mtDNA and microsatellites, respectively (Pastene *et al*., 2004).

There are two approaches that can be used to improve the resolution of the genetic analysis during the research programme:

1) Analysis using mtDNA and microsatellites of the available samples from JARPN II 2004-2006. The sample sizes for sub-areas 1W and 1E for that period are 92 and 58, respectively. Furthermore additional samples in the western North Pacific can be expected from future JARPN II surveys and these additional samples will be used for the genetic analysis as well. Increase of sample sizes will enable us to conduct further analytical approaches such as assignment tests. It will also enhance the power of the hypothesis testing analysis.
2) Examination of the power of the statistical analysis of genetic data. Kitakado *et al*. (2005) evaluated power under an island model. The use of this model makes it easy to control population differentiation in an alternative hypothesis using just a single parameter, Fst. The workshop on the *pre-implementation assessment* of western North Pacific Bryde's whale (IWC, 2006b) believed that this approach provided a defensible means of identifying the power of hypothesis tests. This workshop had recommended some additional work in this field as follows:

    i) Develop a distribution for Fst for the western North Pacific Bryde's whales to interpret the results of the power analysis;
    ii) Consider the feasibility of evaluating power using models which explicitly include changes over time in demographics and that can be tailored to the data for the resource under consideration.

In the context of the research programme, these recommendations will be considered in the analysis focused to evaluate the power of the statistical analysis of genetic data in the western North Pacific Bryde's whale.

Satellite telemetry

One of the assumptions of stock structure hypothesis 4 is that there are two breeding grounds (containing two separated sub-stocks) in low latitude waters. Whales from these breeding grounds migrate in summer to high latitude feeding grounds of sub-areas 1W and 1E. Genetic differences between sub-areas are not detected because whales from the two breeding grounds are well mixed in the feeding ground.

Satellite telemetry experiments (see methodology in Nishiwaki *et al*., 1994) will be conducted to investigate the possibility of site fidelity of whales in sub-areas 1W and 1E to particular low latitude breeding areas. Biopsy sampling will be conducted on the whales targeted for the satellite telemetry experiments. In case

of fidelity of whales from sub-areas 1W and 1E to particular breeding areas, genetic analysis between different breeding grounds will be possible.

Some experience on satellite telemetry has been accumulated during JARPA (for Antarctic minke and humpback whales) and JARPN II (western North Pacific Bryde's whale. In this latter case a Bryde's whale was marked during the 2006 JARPN II surveys and the animal was tracked for a period of two weeks (Tamura *et al*., 2007).

Satellite telemetry experiments, similar to those conducted previously in JARPA and JARPN II, will be conducted along future JARPN II surveys. Ideally whales should be marked in both sub-areas 1W and 1E at the end of the feeding season.

Ageing research

The First Intersessional Workshop (FIW) (IWC, 2005b) reported differences in age composition between whales in sub-areas 1E+2 (past commercial samples) and that in sub-area 1W (JARPN II samples), and three different hypotheses were offered to explain such results:

i) The differences are related to age reading and/or sampling issues in the commercial data. This has no implication for stock structure.
ii) The differences are real and reflect age-segregated distribution within a population.
iii) The differences are real and may indicate some degree of stock structure between sub-area 1W and 1E+2.

Hypothesis iii) above would support the sub-stock scenario (stock structure hypothesis 4). The FIW agreed that in order to investigate whether any of these possibilities can be eliminated, an inter-reader calibration experiment should be conducted (see Annex K in IWC, 2005b).

In the context of the research programme, two steps are necessary for this particular work:

1) Check the availability of earplug samples from past commercial whaling operations, and
2) Conduct the experiment as indicated in Annex K or in a modified form depending on the results of 1)

COMMENTS FROM MEMBERS OF THE ADVISORY GROUP

By 12 April 2007 comments from two members of the Advisory Group were received. Both agreed with the basic ideas in this paper. One member noted that the work on ageing is essential, and that the satellite tracking should yield useful results, if a sufficient number of whales are tracked. The other member considered all the three research items important, particularly the experiment on satellite tracking. Regarding the genetic analyses he suggested R-metasim, which can evaluate power in combination with demographic.

The authors of the present paper hope that the Scientific Committee endorses the concepts and ideas expressed here, for a research program on western North Pacific Bryde's whale associated with management variant 2.

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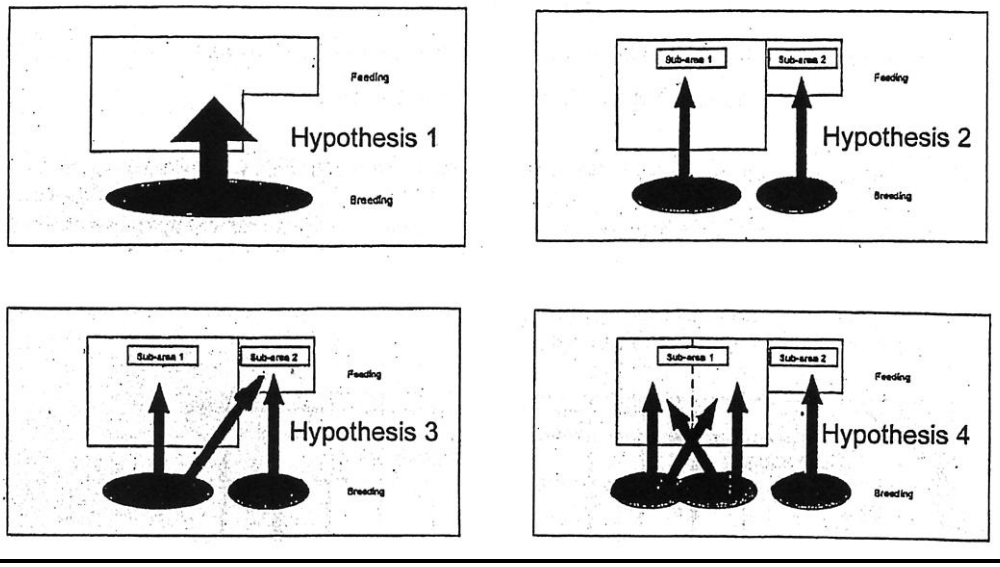

Figure 1: Stock structure hypotheses for western North Pacific Bryde's whale

Appendix 1: List of *ISTs* (from IWC, 2006a)

Trial No.	Stocks	Sub-stocks	$MSYR_{mat}$	Mixing matrix	Process error	Stochastic mixing in 1W/1E	Catch series	Age-dependent Mixing?	1W / 1E boundary	Comment	Trial Weight
Br1	1	No	1	A	Baseline	No	Best	No	165°E	Stock structure hypothesis 1	M
Br2	1	No	4	A	Baseline	No	Best	No	165°E	Stock structure hypothesis 1	**H**
Br3	2	No	1	B	Baseline	No	Best	No	165°E	Stock structure hypothesis 2	M
Br4	2	No	4	B	Baseline	No	Best	No	165°E	Stock structure hypothesis 2	**H**
Br5	2	No	1	C	Baseline	No	Best	No	165°E	Stock structure hypothesis 3 *	M
Br6	2	No	4	C	Baseline	No	Best	No	165°E	Stock structure hypothesis 3 *	**H**
Br7	2	Yes	1	D	Baseline	No	Best	No	155°E	Stock structure hypothesis 4	M
Br8	2	Yes	4	D	Baseline	No	Best	No	155°E	Stock structure hypothesis 4	M
Br9	2	No	1	B	Baseline	No	Best	**Yes**	165°E	B + Age-dependent mixing	M
Br10	2	No	4	B	Baseline	No	Best	**Yes**	165°E	B + Age-dependent mixing	**H**
Br11	2	Yes	1	D	$\sigma_p = 0.9$	No	Best	No	155°E	D + Additional process error	M
Br12	2	Yes	4	D	$\sigma_p = 0.9$	No	Best	No	155°E	D + Additional process error	M
Br13	2	Yes	1	D	Baseline	**Yes**	Best	No	155°E	D + Stochastic mixing *	M
Br14	2	Yes	4	D	Baseline	**Yes**	Best	No	155°E	D + Stochastic mixing *	M
Br15	2	Yes	1	D	Baseline	No	Best	No	**160°E**	D + Alternative Boundary 1	M
Br16	2	Yes	4	D	Baseline	No	Best	No	**160°E**	D + Alternative Boundary 1	M
Br17	2	Yes	1	D	Baseline	No	Best	No	**165°E**	D + Alternative Boundary 2	M
Br18	2	Yes	4	D	Baseline	No	Best	No	**165°E**	D + Alternative Boundary 2	M
Br19	2	Yes	1	D	Baseline	No	**Low**	No	155°E	D + Low catch series	M
Br20	2	Yes	4	D	Baseline	No	**Low**	No	155°E	D + Low catch series	M
Br21	2	Yes	1	D	Baseline	No	**High**	No	155°E	D + High catch series	M
Br22	2	Yes	4	D	Baseline	No	**High**	No	155°E	D + High catch series	M
Br23	2	No	1	B	Baseline	No	**High**	No	165°E	B + High catch series	M
Br24	2	No	4	B	Baseline	No	**High**	No	165°E	B + High catch series	**H**
Br25	2	No	1	B	$\sigma_p = 0.9$	No	Best	No	165°E	B + Additional process error	M
Br26	2	No	4	B	$\sigma_p = 0.9$	No	Best	No	165°E	B + Additional process error	**H**
Br27	2	No	1	B	Baseline	No	**High**	**Yes**	165°E	B + Age-dep.mixing+high catch	M
Br28	2	No	4	B	Baseline	No	**High**	**Yes**	165°E	B + Age-dep.mixing+high catch	**H**

* With stochastic mixing

Appendix 2: List of management variants

Variant 1: sub-areas 1W, 1E and 2 are *Small Areas* and catch limits are set by *Small Area*.

Variant 2: sub-area 2 is taken to be a *Small Area* and the complete sub-area 1 is treated as a *Small Area*. For this management option, all of the future catches in sub-area 1 are taken from sub-area 1W.

Variant 3: Sub-area 2 is taken to be a *Small Area* and sub-area 1 is taken to be a *Combination Area*. Sub-areas 1W and 1E are *Small Areas*, with *catch-cascading* applied.

Variant 4: Sub-areas 1 and 2 (combined) are taken to be a *Combination Area*, and sub-area 2 and sub-areas 1W and 1E are *Small Areas*, with *catch-cascading* applied.